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Beyond Scaring Them Straight: Assessing Alternative Measures of Persuasion in Road Safety Campaigns

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Beyond Scaring Them Straight: Assessing Alternative Measures of Persuasion in Road Safety Campaigns

by

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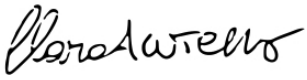
Signed: 

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Abstract

WORLDWIDE, young drivers are involved in more road traffic collisions than any other age group. 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, qualified drivers. 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 personality characteristics, such as willingness to take risks and optimism bias, that motivate young males' to ignore long-term negative consequences, which forms the basis of traditional RSIs.

The subsequent study was conducted to acquire further knowledge on young male risk-takers' opinion of fear appeal RSIs as well as to ascertain whether optimism bias underpins greater risky driving behaviours. We found that optimism bias and willingness to take risks were more prominent in young males aged 18-25 compared to older males, and that optimism bias and willingness to take risks diminish after 25 years old. We also found that young males did not change their attitudes towards risky driving, suggesting that RSIs may not be effective because young people tend to rate themselves as more skilled and less-accident prone than their peers, and are more inclined to believe that the risks associated with dangerous driving do not apply to them.

The findings from the third study provided insight into how two brief interventions, one based on an unambiguous definition of "good" driving and the other on a hazard perception test, might reduce young drivers' optimism bias, as well as furthering our knowledge

on how individual factors such as sensation seeking and risky driving may impact on the effectiveness of interventions aimed at improving optimism bias. In particular, we found that both brief interventions reduced optimism bias levels, but hazard perception had the strongest effect. The effectiveness of the two interventions also differed across individuals depending on their sensation-seeking and past risky driving tendencies. Hence, the results provide evidence for the effectiveness of brief interventions to reduce optimism bias.

Finally, the last study investigated the impact of fear vs positively-framed road safety films and traditional technologies (2D) vs emerging technologies (VR) on young drivers' self-reported risky driving behaviours and message acceptance. The findings indicate that the positively-framed films significantly decreased self-reported risky driving behaviours in both modalities, but especially when viewed in VR format. In contrast, the fear appeal film, when shown in VR, failed to reduce risky driving behaviours, and in fact, increased young drivers' self-reported risky driving behaviours.

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

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Chapter 1

Introduction

GLOBALLY each year nearly 1.35 million drivers between the ages of 16-25 die on the road, an average of 1,000 a day (Department of Transport, 2018). In Europe, approximately 10,000 fatalities occur in road traffic collisions every year. The number of additional non-fatal crashes is much higher, standing at 50,000 (Racioppi et al., 2004). Hence, road traffic collisions are a long-standing challenge for public health and safety worldwide. Amongst road-users, young drivers aged 16-19 are more than twice as likely to die in a collision as drivers aged 40-49 (Fylan & Strandling, 2014; World Health Organization, 2018). In addition, young male drivers, in particular, account for 80% of young driver fatalities compared to 76% of fatalities for all car drivers in 2017 (Department of Transport, 2017).

Despite their prevalence, and high financial cost, the majority of road collisions are preventable (Abbas et al., 2011; Goonewardene, Baloch, Porter, Sargeant, & Punchihewa, 2010), and can be attributed to human factors (Borowsky & Oron-Gilad, 2013; Cestac et al., 2011). According to the literature, up to 90% of young drivers' road traffic collisions involve mistakes, or risky driving (Gicquel et al., 2017; Rolison et al., 2018). For example Clarke et al. (2015) examined police reports of collisions in the UK involving one or more fatalities. They found that drivers below the age of 25 were 12 times more likely to have caused a fatal collision than drivers of any other age. For these reasons, young drivers represent a major cause for concern among road safety practitioners.

There are multiple proposed risk factors that contribute to young drivers' high collision risk. We can cluster them into three broad categories:

i) Personality factors (e.g. sensation-seeking, optimism bias and overconfidence);

ii) Risk-taking behaviours (e.g. speeding, driving under the influence, peer influence etc.);

iii) Skill-based deficits due to inexperience, such as an underdeveloped hazard perception.

In the driving literature, there has been an increasingly growing interest in investigating these clusters, in order to better understand the risk factors associated to young drivers. Nevertheless, it still remains unclear why novice drivers are more inclined to risk compared to older drivers, and, most importantly, how can these risks can be effectively reduced (Horvath et al., 2012). The literature review detailed below provides an overview of the evidence to date regarding the risk factors associated with young drivers' high collision rates, and considers possible gaps in the literature that still might need to be filled.

1.1 Personality Factors

The role of personality characteristics has been frequently assessed in relation to driving collisions, in order to better understand why young drivers often engage in risky driving (Scott-Parker et al., 2016). Even if personality does not predict car crashes directly (Ulleberg, 2004), there is evidence to show that it influences collision involvement indirectly through driving behaviour (Constantinou et al., 2011; Heck & Carlos, 2008). For example, 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 (i.e. sensation seeking and optimism bias) were associated with risk-taking, negative attitudes toward road safety and, in turn, higher self-reported risky driving behaviour (Rolison et al., 2018). Therefore, a growing body of evidence has reported a strong link between personality characteristics, crash involvement and dangerous driving (Atombo et al., 2017; Gulliver & Begg, 2007; Iversen & Rundmo, 2004) and more research is now being conducted to investigate how personality factors are related to young drivers' heightened sense of risk.

1.1.1 Sensation Seeking

Sensation seeking is a personality trait described as the tendency to seek new, different, and intense sensations and experiences (Zuckerman et al., 1964). Specifically, a high sensation seeker is a person who *"feels a heightened need for different experience, actively seeks thrill and adventure, is disinhibited, and easily bored"* (Zuckerman 1964, p. 312). A strong connection has been found in the literature between adolescence and sensation seeking. More precisely, research has shown a decline in sensation seeking with age, where it ascends between ages 9 and 14, reaches its peak at around age 20 and declines steadily afterwards (Giambra et al., 1992). Sensation seeking has also been shown to predict a number of risky driving behaviours (Scott-Parker et al., 2013). In a study done by Cestac et al. (2011), who investigated which factors, between past driving behaviours, sensation seeking and comparative judgment of risks, were more likely to influence young drivers' intention to speed, highlighted that sensation seeking had the greatest impact on young drivers in general, and specifically on young males' intentions to speed. Moreover, in a review of 40 studies examining the relationship between sensation seeking and risky driving, Jonah, Thiessen and Au-Yeung (2001) concluded that self-reported high sensation seekers were more likely than low sensation seekers to speed, not wear seatbelts, drive after drinking, and be aggressive whilst driving (see also Dahlen et al., 2005, Iversen & Rundmo, 2004). Hence, young people that score high on sensation seeking scales were found to be more likely to engage in high risk driving behaviours (Delhomme et al., 2012); and in turn, risky, aggressive driving is considered to be a prominent factor implicated in young drivers' high collision rate (Hatfield et al., 2014).

However strong the connection, it is unclear if sensation seekers fail to perceive the risks, or instead acknowledge that the risk is there but choose to engage in the behaviour anyway. As a consequence, it raises the question as to why young sensation seekers report more risk-taking behaviours while driving. A possible explanation might be that, on one hand, sensation seekers may not perceive some driving situations as

risky because of their exaggerated confidence with their driving skills (Kim & Kim 2012); on the other hand, sensation seekers may acknowledge some driving situations as risky but accept the risk nonetheless (Jonah, 1997). Hatfield et al. (2014) provide support for this second explanation. The authors examined whether aspects of sensation seeking modify the relationship between perceived risk and risky driving. They found that high sensation seekers are aware of the potential risks but accept these risks in order to gratify their need for thrilling experiences. They also found that low thrill seekers were less likely to drive under the influence of alcohol, or were more likely to wear a seat belt because they perceived these behaviours as highly risky and unsafe. These findings suggest that sensation seeking not only affects risky driving for high sensation seekers, but it also has an effect on low sensation seekers, who instead wish to avoid risky scenarios.

The research outlined above suggests that not only are young adults likely to score high on measures of sensation seeking, compared to the general population (Zuckerman et al., 1964), but also that young people scoring high on sensation seeking tend to report engaging in risky driving behaviour more frequently (Delhomme et al., 2012; Wang et al., 2019). However, sensation seeking is not the only personality factor implicated in young drivers' overreppresentation in road traffic collisions.

1.1.2 Optimism Bias

Another age-related personality factor associated with young drivers', and in particular young male drivers', increased risk is optimism bias (Fernandes et al., 2007; Harré et al., 2004; Horswill et al., 2004). Optimism bias refers to the belief that one is more skilled and less likely to experience negative events compared to one's peers (Weinstein & Klein, 1996). This biased evaluation of risk and skills leads individuals to incorrectly assess the likelihood of an event taking place and to overestimate their ability to control the outcome (Causse et al., 2004; Delhomme et al., 2010). As a result, one perceives oneself at a reduced risk in comparison to others. Building on this idea, Johnson, McCaul, and Klein (2002) examined adolescents beliefs about their likelihood to contract-

ing sexually transmitted disease following unprotected sex as well as lung cancer if they smoked. The authors found that adolescents who were daily smokers and engaged in unprotected sex estimated their probability of developing lung cancer or contracting a sexually transmitted disease as equal, if not lower, compare to adolescents who were not engaging in those behaviours.

Similar results were reported in regard to driving. Several studies have suggested that while the majority of drivers acknowledge the possible risks associated with driving, novice drivers are more inclined to believe that these risks do not apply to them but do apply to their peer group, whilst simultaneously overestimating their driving skills (Delhomme et al., 2010, White et al., 2011). Combined, these form the notion of having a driving optimism bias: an inaccurate perception of risk on the road, and increased chance of collision (Deery, 2013). In support of this, Finn and Bragg (1986) asked young drivers to answer questions about their prior involvement in collisions, and to rate the riskiness of specific driving situations illustrated in both still images and short video clips. The authors found that young drivers, especially male drivers, consistently rated specific driving situations, illustrated in both static images and video clips, as less 'risky' than more experienced drivers. Further to this, young drivers tended to perceive their risk of being involved in a collision as substantially lower than older drivers, and they also perceived that they were less likely to have a collision than their own peers (Finn & Bragg, 1986). In support of the latter, White et al. (2011) have also shown that young male drivers perceived themselves to be more skilled and less likely to be involved in a car crash compared to their cohort and hence foster a sense of invulnerability.

Myntinnen et al. (2009) employed a similar methodological procedure to Finn and Bragg (1986); the authors' compared novice male drivers' self-assessed competence with the assessment made by their examiners and found that between 40% and 50% of novice males tended to overestimate their driving skills. Further support comes from Kinnear et al. (2013), who suggested that young drivers' higher propensity for losing control of the vehicle is correlated with an overestimation of their safety margins as well as an

overestimation of their capability to react in time to prevent collisions from happening. Similarly, young male drivers were also reported to portray more negative and less compliant attitude towards traffic rules and traffic safety compared to other drivers (Bergdahl, 2005; Laapotti & Keskinen, 2004; Kweon & Kockelman, 2006).

Hence, the evidence highlighted in the literature reveals that novice drivers, and in particular male novice drivers, overestimate their driving abilities while underestimating the level of risk they face on the road (Gosselin et al., 2010; Renner et al., 2008). In addition to young drivers' high self-confidence, they also lack experience. Experience, however, can be rather easily improved through time and practice. In particular, one of the key concepts that novice drivers need to learn is the relationship between an antecedent, the behaviour targeted and its consequence. For example, novice drivers need to learn that certain antecedent events are associated with potential risk, that there is a probability of those risks occurring and, if appropriate avoidance action is not taken, a punishing consequence may result (Cestac et al., 2011). Speed reduction, for instance, is often an important response to reduce the probability of collision. However, speed is intrinsically gratifying because it is thrilling, it saves time, and it is correlated with feelings of freedom and pleasure (Fylan & Stradling, 2014). Since not all cases of speeding lead to a crash, young drivers often "gamble" that their speeding would not result in a collision. In addition, Corbett (2006) has noted that one of the reasons young drivers attach less importance to the risk of speeding is their overconfident in their vehicle control and recovery skills (Brown, 1986). Furthermore, White et al., (2011) found that young drivers generally overestimate the speed of others and they report driving slower than the average driver.

Taken together it is therefore logical to assume that young drivers' risk is elevated by a combination of overconfidence, lack of driving experience and underestimation of potential risks, leading not only to optimism bias whilst driving but also collision involvement (Măirean & Havârneanu, 2018).

1.2 Risk-Taking Behaviours

Risky driving behaviour has been identified as one of the most critical elements involved in collision occurrence (Harré et al., 2005) 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 (Cassarino & Murphy, 2018). Specifically, behaviours such as speeding, alcohol use, the tendency not to wear a seatbelt, and driving with peers have all been implicated in the over-representation of young drivers' collision and injury rates (Begg & Langley, 2004; Clarke et al,. 2015; Vassallo et al., 2007).

1.2.1 Speeding

While there are many behaviours that may influence the increased fatalities for novice drivers, one of the major contributors is speeding (Horvath et al., 2012). In fact, speeding not only increases the likelihood of having a crash, but also the severity of injuries sustained when a crash occurs (Fleiter et al., 2010). In support of this, Bedard et al. (2002) found that travelling at a speed greater than 70 kilometers per hour was independently associated with a 164% increase in the odds of a fatality compared with speeds of less than 35 kilometers per hour.

Machin and Sankey (2006) reported that, while speeding is one of the most common risky behaviours performed by drivers of all ages, speed was the most common factor involved in driving offences among young drivers. This is because they: a) 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, such as speeding while also being distracted (Moller & Siguroardóttir, 2009).

As a consequence, there are a few suggestions as to why young drivers engage in high-risk speeding behaviour. For instance, one line of explanation concerns the freedom, pleasure and feelings of self-enhancement that comes from driving fast (Lewis et al.,

2008); or that speed could represent both a mean of competing with others and of expressing one's own superiority and power while driving (Cestac et al., 2011), as well as a mean to test their driving skills (Lucidi et al., 2010). Roy and Liersch (2013) have also suggested that one of the reasons young drivers attach less importance to the risks of speeding is their overconfident in their vehicle control and recovery skills. Finally, most simply, that driving fast saves time and gets the driver to their destination quicker (Fylan et al., 2006).

In order to overcome this issue, pre-license driver training provides learner drivers with comprehensive information regarding the risks of excessive speed (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 (Fernandes et al., 2010). However, despite being aware of the risks, Simon-Morton et al. (2005) found, using observation methods, 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.

These results are similar to those reported by Knight, Iverson and Harris (2013), who 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.

1.2.2 Driving under the influence

Within the driving literature, ample evidence provides support for the notion that driving whilst intoxicated by alcohol produces severe impairments in driving abilities (Bates et al., 2014; Hingson et al., 2011). There is also strong evidence that younger drivers constitute a higher percentage of alcohol-related crashes than any other age group. Drivers under the age of 20 have a five-fold higher risk of being involved in an alcohol-related collision compared to drivers over the age of 30 (Keall et al., 2004).

The common explanation for this is that young people are, on one hand, inexperienced at driving, and on the other inexperienced at drinking and inexperienced at combining both these two activities (McKenna, 2010; Williams et al., 2007). 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 (Department of Transport, 2017). However, despite the high collision risk, a survey done by Curry et al., (2015) revealed that 29% of young drivers between the ages of 17 and 24 said that they would be willing to risk driving after drinking.

Bingham et al. (2016) explored the social and behavioural characteristics of young drink drivers and found 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 drink driving, but also perceived rewards for doing so.

Hence, to summarise, when young people drink drive they are at a much greater risk of a collision (Begg & Langley, 2004), and these collisions are more likely to result in injury (Department of Transport, 2017). However, the biggest risk factors for young adults is to be surrounded by peers who not only support risk-taking behaviours but actively encourage them (Silva et al., 2016).

1.2.3 Peer influence

In studies of young adults and driving, two consistent facts stand out: a) road traffic collisions constitute the leading cause of death among 18-25 years old (Ozer et al., 2008); and b) contrary to adults, collision rates rise dramatically when young adults are accompanied by peer passengers (Buckley et al., 2014; Chen et al. 2000; Williams et al., 2007).

Allen et al. (2009) defined young drivers with same-age passengers as the ‘perfect storm’. This ‘perfect storm’ is a combination of young drivers’ propensity to engage in risky behaviours, inexperience, their desire to please their peers, as well as in-group

pressures. In support of this claim, Heck and Carlos (2008) suggested that just the mere presence of teen passengers altered young drivers behaviours. Furthermore, because teen-passengers have been found to be an important source of social influence, Simons-Morton et al. (2005) stated that they may cause actual distraction through their actions in the vehicle, such as talking, changing music, moving about, or touching the driver.

Peer influence may include direct and intentional encouragement of risky driving behaviour, for example by urging the driver to drive faster, catch up with, or pass another vehicle. Pileggi et al. (2006) reported that crashes and risky driving were more common among Italian adolescents when they encounter distraction from peers playing music too loudly, engaging in conversations that heighten emotions, or doing other things that more directly drawn the young driver's attention away from the task of navigating the car (Pileggi et al., 2006).

However, peer influences may also be indirect and unintended, for example when the driver decides to drive in a more risky or careless way because s/he perceives that the teen passenger would view such driving behaviour as desirable or expected (Smorti et al., 2014). Another example of indirect peer influence has been reported by Scott-Parker et al. (2014). The authors found that young drivers who perceived their friends to be risky drivers, reported modelling their own driving behaviour on their friends' style of driving and engaged in more risky driving themselves.

There is inconclusive evidence on whether direct and intentional, or indirect and unintended 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 or the drivers' own perception on how they 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 danger-

ously, 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) discussed that direct, active verbal encouragement by peer passengers had just as much effect on young drivers' intentions to commit driving violations.

Moreover, Arnett et al. (2002) suggested that young drivers are affected differently depending on the passengers' age. The authors stated that young drivers tend to drive faster and take more risk in traffic when they were accompanied by a peer than when their parents were present. Additionally, a number of studies have found that novice drivers engage in fewer risky decisions in the mere presence of their mothers, compared to when they are accompanied by their peers (Baxter et al., 1990; Moreira Guassi & Telzer, 2016; Silva et al., 2016; Telzer et al., 2013).

Also gender differences have been highlighted to be relevant in young drivers' susceptibility to peer influence and involvement in risky driving behaviours. It has been noted that male drivers appear to be more susceptible to peer influence than female drivers (Moller et al., 2014; Horvath et al., 2012; Moller & Siguroardóttir, 2009). A possible explanation for this difference may be found in gender specific differences in peer group relationships with male relationships being more competitive and involving a higher level of risk compared to female relationships (Cestac et al., 2011). In particular, the effects of passengers' age and gender seem to be reflected in accident statistics. Chen et al. (2000) analysed traffic collision data dated from 1994 to 2000, focusing on drivers aged 18-25 who were carrying passengers at the time of the collisions. The authors concluded that drivers aged 16-20 were more likely to die in traffic accidents when accompanied by passengers aged 16-26 than when carrying passengers 30 years of age or older.

Even if peer passengers can influence risk-driving behaviour, the social influence of peers can also motivate safe driving practices. This can occur through *modeling* of positive behaviours, such as, for example, when a driver in the lead car maintains a safe

driving distance from other vehicles, setting an example for the other cars behind him (Allen & Brown, 2009). *Positive reinforcement* is another example of positive peer influence, and it refers to when, for example, adolescents make positive comments about a young driver's safe driving, which then becomes more consistent (Allen & Brown, 2009). Supporting this, further studies have inferred that drivers who believed that their friends would disapprove of drinking and driving were less likely to drive under the influence of alcohol (Moller et al., 2014; Ulleberg, 2004). Furthermore, Ulleberg et al., (2004) reported that drivers who believed that their significant others would disapprove of them committing violations and, at the same time, felt motivated to comply to safe driving behaviours, reported less intentions to commit violations while driving.

Some traffic safety campaigns like the "Peer Intervention Program" (McKnight & McKnight, 2003) or the Norwegian "Speak Out!" (Elvik, 2000) campaigns have focused their approach primarily on positive peer pressure through empowering peers and passengers to intervene against unsafe driving. In particular, in an evaluation of the "Speak Out!" campaign, Elvik (2000) concluded that, even though the teenagers found the positive peer pressure techniques useful, the number of car drivers injured or killed was not reduced. An explanation to why this might be is that the campaign did not help the teenage passengers to prevent unsafe driving by voicing their opinion in a way that could help the driver.

However, it still unclear why peer-passengers would decide not to speak up when they consider the situation in the car to be too dangerous. According to Näätänen and Summala (2016) an explanation could be that a passenger will be more likely to address unsafe driving when experiencing risk and fear. In addition, it is likely that some passengers may refrain from confronting an unsafe driver due to the perceived cost of such an action. Such cost can be understood as the expectation of negative social sanctions from the driver or other passengers in the car. Thus, the passenger may fear that his or her attempts to address unsafe driving may result in personal rejection, such as becoming unpopular or being regarded as a coward. As a consequence, the need for the

passenger to say when enough is enough is a primary need in road safety interventions today.

Thus it appears that engagement in both risky (Guggenheim & Taubman-Ben-Ari, 2015) and safe (Buckley & Davidson, 2013) driving is shaped not only by how young drivers perceive how their peer passengers want them to drive but also through clear cut influence exerted directly from the passengers (Moller et al., 2014; Horvath et al., 2012; Moller & Siguroardóttir, 2009). Whilst research on negative peer influence suggests that indirect peer influence plays a greater role in their risky behaviour (Simons-Morton & Farhat, 2012), it is still relatively unclear how young drivers are influenced by their peers to drive in a dangerous way.

1.3 Skill Deficits

The US Department of Transportation Federal Highway Administration has identified several driving skill characteristics considered to be fundamental for safe driving that young drivers are proposed to be deficient in (Husband, 2010). The most important of which seems to be hazard perception.

1.3.1 Hazard Perception

Why do novice drivers have difficulties in reading the road and overcoming complex cognitive demands that the traffic environment presents?

Safe driving not only involves being engaged in many tasks simultaneously but it also demands that we quickly and reliably respond to hazards in the driving environment. Thus, hazard avoidance is a critical component to safe driving and, conversely, failures to respond appropriately to hazards increases driver's risk. In order to be prepared, drivers must search the environment for potential hazards, often over prolonged periods of time while engaged in multiple distracting tasks (Mckenna & Crick, 1994). Furthermore, they must have accurate expectations regarding when and where hazards are likely to occur, in order to anticipate them and adjust their behaviour accordingly (Falkmer & Gregersen, 2005; Pradhan et al., 2009; Scialfa et al., 2011). McKnight and

McKnight (2003) found that, among young drivers, more than 40% of crashes involved a failure to scan the roadway, presumably because scanning enables detection of hazards. Awareness of hazards protects against collision in the early stages of driving (Wells et al., 2008), yet inexperienced drivers are less able to identify and respond to hazards than more experienced drivers (McKenna & Myers, 1997; Pollatsek et al., 2006; Wallis & Horswill, 2007; Wetton et al., 2010) .

According to Endsley's (1995) three-level model of situation awareness, the highest level of awareness corresponds to the drivers' ability to predict the behaviour of other road users, anticipating how the current situation might develop as other vehicles maneuver around them, or what a group of children on the footpath ahead might do. In support of the latter, Pradhan et al. (2005) presented young drivers and experienced drivers with simulated scenes in which there were potential hazards with no obvious cues. The authors found that, compared to more experienced drivers, young drivers were much less likely to fixate critical areas in the scenes. An explanation for these results might be that young drivers have an impoverished mental model of hazards within the environment. Consistent with this view, Underwood et al. (2003) found that inexperienced drivers scanned the scenes more narrowly along the horizontal axis and dependent less reliably on their peripheral vision compared to the more experienced drivers. Additionally, inexperienced young drivers were particularly inaccurate in predicting where an experienced drivers would look in the search for hazards, they tend look closer to the front of the vehicle, check the mirrors less frequently, glance at objects less frequently and fixate on fewer objects (Isler et al., 2009). Young drivers also fixate more on stationary objects, whereas experienced drivers fixate more on moving objects (Deery, 2013). Such findings suggest that young drivers with limited experience do not have an accurate internal representation of the context-dependent nature of driving hazards.

If young drivers have a harder time identifying and responding to hazards, then experience and practice are critical elements that can mitigate young drivers' deficits in

hazard perception (McKenna et al., 2006). There have been numerous attempts to improve the hazard perception skills of inexperienced and learner drivers. Mckenna and Farrand (1999) designed a risk perception training program that included watching video segments of potential traffic hazards. The video was paused as the traffic hazards were unfolding and participants were asked to make predictions about what might happen next. McKenna and Crick (1997) showed that novice drivers' risk perception skills were enhanced by this "prediction training". Therefore, hazard perception is to be consider the most reliable skill that correlated with crash risk and, if improved, it can reliably diminish the probability of collisions (Wetton et al., 2010).

Thus, typical hazard perception tests involve movies filmed from a driver's perspective in a car that travels along a range of roadways. Events occur that would require braking or steering changes, such as the car in front of the camera car slowing sharply, or another road user moving into the path of the car. The participant is required to press a response button whenever one of these events would require a driving response, or in some cases a continuous recording is taken by the participant moving a lever between settings marked "safe" to "dangerous" (Crundall et al., 2010; Underwood et al., 2003). Results show that drivers with fewer accidents tended to be more cautious overall and to respond faster to the onset of a hazard.

Over the past few years, other approaches to hazard perception training have been based on findings that show inexperienced drivers to have poorer visual skills than more experienced drivers in relation to hazards, such as narrower scanning, longer processing times and less flexible search strategies (Crundall et al., 2010; Pradhan et al., 2009; Underwood et al., 2011). The assumption is that by making drivers aware of the locations that they should frequently inspect in anticipation of hazards, it will improve their responses if hazards should actually occur. Such training interventions have had inexperienced drivers watch markers on a video to show them where experienced drivers look while watching hazard clips.

Yet, the effectiveness of hazard perception training and whether it does in fact improve

novice drivers' skills on the road is still under assessment especially in light of the fact that McKenna & Farrand, (1999) suggested that skill-based training can actually increase young novice drivers' risk-taking behaviour. In support of their claim, a number of authors have pointed to the associated increase in crashes following advanced skill training, such as skid control (Helman, Kinnear, McKenna, Allsop, & Horswill, 2013; Williams, 2006, 2007). The authors' have also suggested that advance skill training can feed optimism bias, due to the fact that novice drivers who have undergone hazard perception training, feel safer after the training period and, therefore, tend to underestimate the risks on the road (Helman, Kinnear, McKenna, Allsop, & Horswill, 2013; Williams, 2006, 2007).

Nevertheless, it is worth mentioning that driving a car is a complex skill requiring coordinated movements, knowledge, and an integration of numerous types of perceptual information (Eby, 2004). And, like any skilled behaviour, practice is necessary to improve, and mistakes are made more frequently in the early phases of learning than in latter phases (Eby, 2004). Therefore, it is not surprising to find that higher collision rates are linked to novice young drivers when compared with drivers who have more experience (O'Neal & Plumert, 2018). An illustrative study by Borowsky et al., (2010) on crashes rates and number of years of driving experience, has found that, between the ages of 15 and 55, those drivers with one year of experience tended to have higher crash rates than same age drivers with two or three years of experience when at-fault crashes were considered. This study highlights the important role experience plays in crash likelihood, at least in at-fault crashes. Further, since no difference was found between drivers with four or more years of driving experience, the study showed that the most important driving skills are probably acquired during the first three years of driving (Borowsky et al., 2010; Borowsky & Oron-Gilad, 2013). Furthermore, Borowsky et al (2010) also showed that higher crashes rates were reported especially for young male drivers compared to young female drivers and compared to older drivers.

In conclusion, there appears to be a wealth of evidence supporting the idea that a lack of

experience and underdeveloped driving skills, are contributing factors to young drivers' over-involvement in collisions. However, whilst skill-based deficits may explain young drivers' collision involvement to a certain extent, their heightened risk when compared to older drivers suggests that there are other risk factors that require consideration as well.

To summarise, 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), drink driving (Bates et al., 2014), and negative peer influence (Buckley & Watson, 2014). 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 (Scott-Parker et al., 2013), and an optimistic bias comprised of reduced risk perception and overestimation of skill ability (Fernandes et al., 2007).

The diagram below summarises what has been explained so far and how the factors described in this review may underpin young drivers' risky driving and provides a framework for understanding the linkages between these contributory factors.

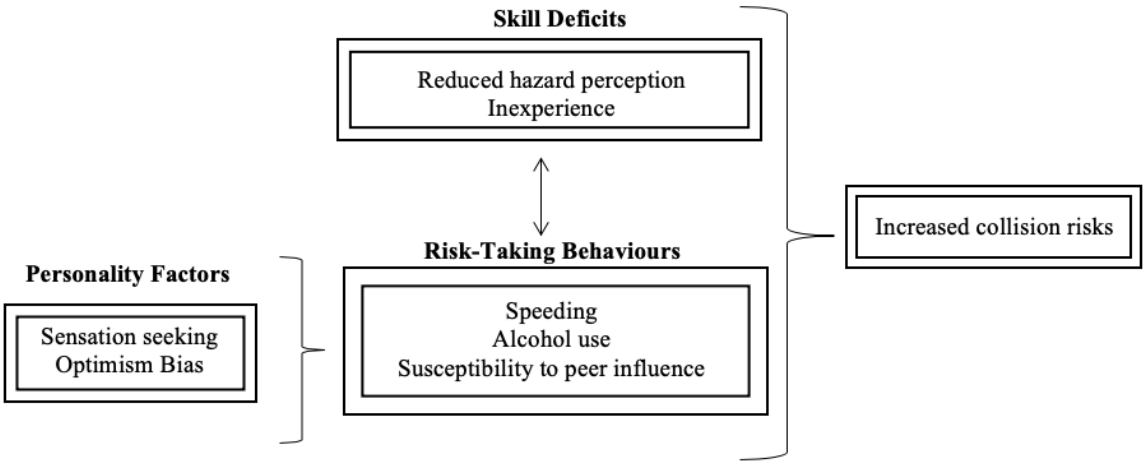

Figure 1.1: Factors thought to underpin young drivers' increased collision risk

Nevertheless, it has also been shown that these factors cannot explain young drivers' risk on their own. Therefore, understanding the specific reasons behind young drivers' risky tendencies is of critical importance in order to try and address the problem. Thus the next part of this review details some of the most common theories of risk-taking to try and explain young drivers risk-taking behaviours. Further to this, the final sections of this review will examine the most common decision and behaviour theories and the role that educational road safety interventions have at reducing young drivers' in-car behaviours and the pros and cons of the most traditional manner to try and reduce young drivers' risky driving behaviours: fear appeals.

1.4 Theories of Risk-Taking

The apparent increase in risk taking observed through late adolescence and early adulthood has been address by several theories. Current neurophysiological evidence has suggested that the brain, and particularly the prefrontal cortex regions associated with executive functions such as inhibition, reasoning and decision making, do not fully develop until the age of 25 (Constantinou et al., 2011). The prefrontal cortex is crucial in the ability to function under challenging circumstances with the ability to manage risk (Reyna et al., 2015). The development of the prefrontal cortex allows for integrative functioning, in which adolescents can accomplish a task despite major distractions, such as driving with passengers in the car. Furthermore, brain functions guiding the ability to maintain attention, shift in attention, planning, and executing strategies all are controlled in the prefrontal cortex of the brain (Heck & Carlos, 2008; Millstein & Halpernfelsher, 2002). Therefore, young drivers may not be entirely suitable to manage the risks of such a complex task as driving, particularly under sub-optimal conditions, such as under the influence of alcohol or fatigue, to both of which novice drivers are more susceptible (Constantinou et al., 2011).

Steinberg et al. (2008) provide an alternative theoretical model, one in which they proposed a dual neurobiological model to explain adolescent's risk taking, which consist of two distinct systems: socio-emotional and cognitive-control. The authors ar-

gued 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 (2007) stipulate 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. In support of the latter, there is evidence which suggests that around 26 years of age, young people start to “mature out" of the desire to engage in risky behaviours (Begg & Langley, 2001).

Additionally, Begg and Langley, (2004) found that deliberate risky driving behaviour, such as driving fast for the “thrill of it" or taking deliberate risks to make the driving more fun was less common at 26 than at 21. Also, in a review of adolescent driving and development, Harré (2000) describes factors influencing the judgments of young drivers. He suggests that more experienced drivers will tend to keep risk low at all times. Instead young male drivers consistently have a reduced crash-risk perception compared to older drivers, underestimating their risk of a crash both for themselves and peers.

Moreover, The Behaviour Decision Theory (Beyth-Marom et al., 1993) maintains that, when individuals make decisions, they tend to consider all the possible consequences for each outcome, and then integrate the costs, benefits and likelihood of each consequence, when making their final decision. If we apply this theoretical framework to adolescent’s decision making process, adolescents tend to focus more on the benefits associated with an action rather than the risks (Reyna & Farley, 2006). That is, perceived benefits often carry more weight than perceived risks do . Thus, despite overestimation of risks, perceived benefits may drive adolescents’ reactive behaviours and behavioural intentions (Reyna & Unlversllyofarlzona, 1995). Therefore, even if speeding is considered to be risky and might increase the probability of a collision, if the driver

does not think they will personally be involved in a collision they are unlikely to change their behaviour.

Taken together, these theories suggest that adolescents differ from older adults in how they assess and perceive risk and hence might make different decisions. This is in line with the literature review above showing that certain personality characteristics are associated with adolescence that may help to explain why young drivers engage in heightened risk-taking.

1.5 Decision and Behaviour Theories

There are several psychological theories aimed to predict behaviour and to model the way in which individuals make decisions about their health. These theories have often been used in the design and implementation of interventions to change risky behaviours.

a) 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".

b) Prospect Theory (Kahneman & Tversky, 1979). 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. 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, 2016). 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.

c) The Theory of Planned Behaviour (TPB; Ajzen, 1985) has been used extensively to better understand and explain behaviour change. It asserts that an individual's behaviours is ultimately determined by their intention to carry out that behaviour (Elliott & Armitage, 2009; Forward, 2009; Lewis et al., 2013; Poulter & McKenna, 2010). Intentions are assumed to *"capture the motivational factors that influence a behaviour. They are indicators of how hard people are willing to try and of how*

much effort they are planning to exert, in order to perform the behaviour" (Ajzen, 1985, p. 181). In turn, intentions are affected by three key variables: a) attitudes (i.e. positive or negative evaluations of the behaviour), b) subjective norms (i.e. how the behaviour is viewed by significant individuals in our life) and c) perceived behavioural control (i.e. how easy it would be to carry out the targeted behaviour).

The TPB has been applied to a wide spectrum of health risk behaviours, including risky driving (Conner et al., 2003; Elliott & Thomson, 2010; Forward, 2009). The elements of the TPB have frequently been applied when studying the determining factors of risky driving behaviour (e.g. Prat et al., 2015); and they have been shown to reliably predict future behaviour in a range of studies. For example, attitudes towards risky driving have been found to be associated with speeding and self-reported collision involvement (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, 2013). Therefore interventions that effectively improve young peoples' attitudes and intentions to drive safely may be crucial to reducing their risk on the road. For these reasons, the TPB is held to be a complete theory of behaviour and it is one of the most used theories to assess behavioural change (Hardeman et al., 2002; Markl, 2016).

1.6 Educational Road Safety Interventions (RSIs)

The ultimate aim of a road safety campaigns is to improve safety and reduce the number of road traffic collisions and the number of people killed or injured on the roads, by influencing road users' behaviour (Adamos & Nathanail, 2016; Hoekstra & Wegman, 2011). In order to influence road user behaviour and motive them to follow the driving regulations, road safety campaigns are required.

Originally it was thought that young drivers were more at risk primarily because their driving skills were underdeveloped. Therefore the first types of young driver interven-

tion aimed to further develop these skills (Crundall et al., 2010). However evaluations of advanced driver training have found that there is a lack of scientific evidence that they do in fact reduce young drivers' collisions (De Craen et al., 2011; Lonero & Mayhew, 2010; Raftery & Wundersitz, 2011). These findings were justified by Helman et al., (2013), who suggested that skill-based training tends to over-inflate young drivers' already heightened optimism bias, with no actual improvement to their driving abilities (Helman et al., 2013).

As a consequence, more recent interventions have focused less on improving young drivers' skills (which have the potential to increase risk-taking due to increased confidence) and focused more on reducing specific risky driving behaviours associated most with young drivers. Specifically, these interventions tried to address the aspects that could motivate users to adopt safe behaviours, and encourage the audience to quit from any unsafe acts, either unintended (i.e., slips, lapses, mistakes) or intended (i.e., violations, intentional mistakes; Adamos & Nathanail, 2016). These new forms of educational interventions vary in form and delivery style, and there is little consensus on which interventions are the most effective in achieving lasting changes in road-users' behaviours (Yannis et al., 2012) and relatively few interventions are evidence-based (Helman et al., 2013). Any safety campaign that seeks to effect a change in people's behaviour must be persuasive. However, there is also little consensus about what types of safety messages are the most persuasive (Phillips et al., 2011a). For example, persuasion is often attempted rationally, through the presentation of facts or figures (i.e. showing young people being involved in a road traffic collision, or how many young drivers are severely injured in a year), but Ullberg and Rundmo, (2003) suggested that the effect can be larger if an emotional message is conveyed.

The emotional approach is therefore the most used in educational road safety intervention. The emotion invoked in the target audience can be negative, e.g. shock or fear appeals (Lewis, Watson, & White, 2008), or positive, e.g. humour appeals (Hu et al., 2013). However, research on the role of emotions in road safety campaigns is ongo-

ing and there is little consensus on which strategies work more efficiently in changing risk-taking in-car behaviour.

1.7 The Pros and Cons of Fear Appeals

Traditionally, most of the road safety interventions across the UK and around the world have heavily relied upon the use of fear-based approaches to reduce the prevalence of risky driving amongst young adults. They usually tend to arouse a sense of fear in the audience by depicting an aversive consequence (e.g. a road crash, resulting from the driver's engagement in an illegal and/or unsafe behaviour such as drink driving or speeding), and, once this fear is aroused, the assumption is that this heightened state of fear will lead to behaviour change (Lewis et al., 2008). Fear appeals are also common in other persuasive campaigns (i.e. anti-tobacco campaigns, anti-drug campaigns, unprotected sex campaigns, promoting more physical activity etc).

Empirical results in relation to fear appeal effectiveness are mixed (Ruiter et al., 2014; Tannenbaum et al., 2015). Some researchers stipulate that fear elicitation is necessary to motivate individuals to accept and carry out protective activities (Morales et al., 2012; Munoz et al., 2010). Consistent with this notion, studies of drivers' perceptions of the role (and effectiveness) of different types of road safety advertisements found that fear-based appeals were regarded by the audience as more 'attention-grabbing' and 'attention-retaining' than other approaches (Lewis, Watson, White, & Tay, 2007; Tay, Watson, Radbourne, & De Young, 2001). Witte and Allen (2000) have also identified a reliable correlation between fear arousal and persuasion to adhere to safer in-car behaviours, which supports the finding of a previous meta-analysis (Boster & Mongeau, 1984).

One of the prominent theories that justifies the usage of fear appeal techniques is Protection Motivation Theory (PMT; Rogers, 1975). According to PMT, the cognitive appraisal of the threat can trigger negative emotions (such as fear), leading people to think about the negative consequence of their present behaviour. Several meta-analysis of research on PTM suggest that increases in threat is associated with stopping risky

behaviour, as well as starting or maintaining protective behaviour (Munoz et al., 2010; Taubman – Ben-Ari et al., 2016). Furthermore, numerous researchers (Leventhal, 1967; Shen & Shen, 2011; Witte, 1996) have proposed that two parallel processes occur when an individual is exposed to fear appeals messages: (1) perceived self-efficacy; and (2) perceived threat and susceptibility.

Perceived self-efficacy refers to the extent to which people think they are able to do something to prevent whatever the fear appeal is portraying. Thus, when self-efficacy is low (i.e., one does not believe there is anything one can do to stop the fearful image from happening), people are more likely to show defensive reactions to fear appeals, which renders them ineffective (Levental, 1967). Perceived threat instead refers to the extent to which people believe themselves to be in any danger of the consequences shown. Even when people are sympathetic to the plight shown by the fear appeal and feel that the recommended precautions are both sensible and doable, the fear-appeal will not have the intended effect if people do not believe that the consequences shown will ever happen to them (Ruiter et al., 2014). Only if people feel that the portrayed consequences are relevant to themselves and feel they are able to take the preventive measures the campaign proposes, does the fear-appeal have a chance to work.

However, even though fear can motivate people, it can also have the opposite effect. It may in fact lead people to employ defensive responses. Such responses may take many forms, for example with people discounting the veracity of the claims in the campaign (deHoog, Stroebe, & de Wit, 2005), by them saying that the campaign bears no personal relevance to oneself (Carey, McDermott, & Sarma, 2013), or even by avoiding exposure to the campaign altogether (Hastings, Stead, & Webb, 2004). Specifically to young people, they recognise that fear appeals are trying to scare them, find the messages irrelevant and they doubt the consequences will happen to them (i.e. optimism bias; Glock, Unz, & Kovacs, 2012). In addition, Hastings and MacFadyen (2002) reported that young drivers, who attended a fear appeal road safety intervention, perceive the intervention to be effective for others but not themselves. There is also reason to believe

that young people have become desensitised and tired of fear appeals, rending them therefore ineffective (Hoekstra & Wegman, 2011).

These diverging results may also have something to do with the gender of the group the campaigns are aimed at. Women tend to respond more favourably to fear appeals than men, as evidenced by women's greater recall, increased behavioural intentions and more positive attitudes towards safety message compared to men (Hoekstra & Wegman, 2011). Young males, especially, seem to have little susceptibility to fear appeals. Lewis, Tay and Watson (2007), for example, posited that the reason why fear appeals have less effect on young males is because they tend to discount the recommendations and avoid them. Similar results were found by Tay et al. (2001), who found that a fear-evoking drink driving campaign resulted in a reduction in fatal crashes in the group of women of all ages and in older men (35–54 years old), but not in the target group of young men ages 18 to 24.

In summary, the review presented highlights the areas in which young, novice drivers appear to be the most inexperienced and vulnerable in. Research has shown, for example, that young drivers display poorly developed hazard perception skills (Pollatsek et al, 2006), are more susceptible to negative peer influence (Buckley & Watson, 2014), have a desire to engage in sensation-seeking activities (Scott-Parker et al., 2013), and exhibit high levels of optimism bias (Fernandes et al., 2007).

In addition, apart from laboratory studies, simulation experiments, and analysis of 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.

The following research work will be divided in two parts. In the first part, we will evaluate the effectiveness of already existing fear appeal road safety educational interventions created in the UK by the Devon and Somerset Fire and Rescue Service and the Ministry of Defence (Chapter 2 and 3). In the second part, we will compare the effectiveness of

different behavioural change techniques to decrease novice drivers' risk-taking tendencies, compared to traditional fear appeal (Chapter 4 and 5). By reviewing the findings from evaluations of previous interventions, and exploring what does and does not work, we will be able to better understand why young people engage in risk-taking behaviours.

Part I

Investigating existing road safety campaigns

Chapter 2

Study 1. Evaluating the Effectiveness of a Young Driver-Education Intervention: Learn2Live

2.1 Chapter Introduction

As previously discussed in the literature review, road traffic collisions are the leading cause of death among young adults, and behaviour change interventions play a key role in battling this public health concern. Specifically to road safety, these behavioural change interventions are often educational and have traditionally relied on fear appeals to alter risky driving behaviour - yet there is a paucity of data regarding their effectiveness. However, peer-education has been championed as an additional route to promoting safe driving behaviour.

Hence, the study reported below evaluated the effectiveness of a fear appeal intervention in improving young drivers' attitudes towards risky driving behaviour. In addition, two different types of follow-up interventions were compared: a peer-led and an expert-led road safety educational event.

2.2 Introduction

Every year, road traffic collisions are responsible for approximately 1.3 million deaths worldwide and young drivers aged 16-25 are significantly overrepresented amongst those killed and seriously injured (World Health Organization, 2018). Novice drivers are twice as likely to have a collision compared to drivers aged 40-49 (Department of Transport, 2017) and road deaths account for 25% of deaths amongst 16-25-years old, compared to 0.5% of deaths in a wider population. Young male drivers, in particular, account for 80% of young driver fatalities compared to 76% of fatalities for all car drivers

in 2017 (Department of Transport, 2017). These statistics highlight the need to address road traffic collisions among young drivers, especially among males.

A variety of factors have been proposed to explain the disproportionate representation of young, particularly male, drivers in road traffic collisions (Borowsky & Oron-Gilad, 2013; Cestac et al., 2011; Delhomme et al., 2012). Insufficient skills and a lack of driving experience have frequently been regarded as the main causes of collisions in this age group (Fisher et al., 2004; Underwood et al., 2003). In addition, novice drivers, and in particular young male drivers, tend to overestimate their own driving capability and underestimate the probability of being involved in a crash (i.e. optimism bias; Gosselin et al., 2010; Myntinnen et al., 2009; Pedruzzi & Swinbourne 2009). Gender has also been found to predict unsafe driving behaviours (Harré, 2000; Turner & McClure, 2004), with young males being more willing to take risks than females (Bina et al., 2006; Fergusson et al., 2003; Harré, 2000; McEvoy et al., 2006; Oltedal & Rundmo, 2006; Vassallo et al., 2007).

To address the high rate of collision among this age group, researchers have suggested a range of interventions to improve young drivers safe driving and attitudes, specifically through skill-based training (Horswill et al., 2004; Lenné et al., 2011), public initiatives and mass media campaigns (Wundersitz & Hutchinson, 2012), in-vehicle telematics (Stevenson et al., 2018) and educational interventions (Adamos & Nathanail, 2016; Lawrence & Lonero, 2008; Poulter & McKenna, 2010). However, despite the abundance of schemes, and the increased emphasis on evaluation (Hauer, 2007; Mckenna, 2010), there is little consensus on which approach(es), if any, are effective in affecting road-user behaviour.

To address this gap in the literature, we evaluated whether a specific road safety intervention was effective in improving young drivers' risky driving behaviour. We also created a peer-led follow-up intervention and compared it to a traditional professional-led follow-up intervention.

2.2.1 Educational Road Safety Interventions

Educational road safety interventions (RSIs) are the most commonly used approach to attempt to change young drivers' driving behaviours and to promote road safety. Yet, despite their popularity, the effectiveness of educational RSIs is still under debate (Phillips et al., 2011b). Educational RISs have been shown to reduce young drivers' collision involvement by approximately 9% (Lonero & Mayhew, 2010; Phillips et al., 2011b) and reduce young drivers' engagement in risky driving behaviours on a short-term time scale (King et al., 2008; Nelson et al., 2005). A review on the effectiveness of 13 educational interventions reported that approximately half of them resulted in a positive, albeit small, changes in intentions towards risky driving (Hardeman et al., 2002; Poulter & McKenna, 2010). However, Carcary, Power and Murray (2001) investigated the effects of classroom-based interventions and found little evidence to support their efficacy. Educational RSIs have been demonstrated to not only have little effect on the risk of traffic collision involvement, but in some cases they could even increase risky driving by encouraging pre-drivers to obtain their driving license earlier (Williams, 2006). In support of this claim, some studies have found that young drivers reported riskier attitudes following an educational intervention (Glendon et al., 2014) and thus suggested that educational RSIs may only serve to enhance young drivers' overestimation of their own driving ability (Brijs et al., 2014). Moreover, some have suggested that educational RSIs lack the anticipated effect because they are of too short a duration to offer much prospect of having a long-term impact on young drivers' risky driving behaviours (Williams, 2007).

One reason why educational RSIs may have limited or mixed effects is because they are oriented towards negatively-framed messages (Job, 1988), specifically focusing young people on the negative consequences of risky driving (i.e. fear appeals). Fear appeals have been widely adopted by health-promotion professional, in a wide a number of contexts, including risky driving (Carey et al., 2013; Jessop et al., 2008). However, there has been a growing concern over the effectiveness of fear appeals. Tannenbaum

et al. (2015; see also, Lewis, Watson, Tay, & White, 2008), for example, have argued that fear appeals may be less effective for young males. Specifically, for young thrill-seeking males, the rewarding sensation they anticipate from risky-taking may outweigh the risks, and fear appeal campaigns focusing on risks may therefore have little impact on reducing their risky behaviours (Tannenbaum et al., 2015). Furthermore, fear appeal campaigns have been shown to lead young people to employ defence mechanisms, such as discounting the veracity of the claims, concluding that the campaign bears no personal relevance, or avoiding exposure to the campaign altogether (Ruiter et al., 2001). Yet, two meta-analytic examinations have reported positive results of fear appeal campaigns in terms of emotional reactions and conformity to the message's recommendations, even if for a short time (Witte & Allen, 2000; Xu et al., 2015).

Another possible explanation for the diverging results in the success of educational RSIs is that their effect may be dependent on other factors, such as peer influence (Bingham et al., 2016; Simons-Morton et al., 2012). A number of studies have demonstrated 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 allowing their peers' to influence their driving (Allen & Brown, 2009; Shope, 2006; Silva et al., 2016). If peers play such a prominent role in influencing young drivers' behaviours, they also provide an opportunity to reduce risky driving. If peers discourage risk-taking behaviours and encourage safer behaviours, this might lessen young drivers' engagement in risky driving. The idea of positive peer influence gives rise to peer-led education, which has been defined as *"the teaching or sharing of health information, values and behaviours by members of similar age or status group"* (Sciacca, 1987, p.2). Peer-led education has been found to increase knowledge, attitudes, and beliefs, and to promote health behaviours compared to adult-led education (Colby & Haldeman, 2007; Mellanby et al., 2000). Peers play a critical role in the lives of adolescents by serving as formal and informal models of behaviours, and as trusted sources of information (Whitaker & Miller, 2000). Research suggests that peer education draws on the credibility that peers have, and leverages the

power of role modelling, compared to teachers, older adults, or “experts”, whom they have no affiliation with, and are less therefore influenced by (Beshers, 2007). Despite these findings, very few studies have examined the effectiveness of peer-led education in educational RSIs.

In summary, there is limited evidence to date regarding the efficacy of educational RSIs and the evaluations that have been carried out provide mixed and inconclusive results. Evaluations are therefore vital to enhance our knowledge of the benefits of these interventions. In response, the current study adds to the literature by evaluating the extent to which a British educational RSI called Learn 2 Live (L2L) might improve young drivers' risky driving behaviours, and by creating and assessing the effectiveness of a peer-led follow-up educational event (Peer2Peer) compared to an adult-led follow-up event (Question Time).

2.2.2 The Present Study

The current study reports an evaluation of a 1-day educational RSI targeting 16-20-year olds, focusing on their attitudes towards risks driving. Additionally, we compared the effectiveness of the P2P and QT follow-up events. The study sought to evaluate the intervention program using valid and reliable self-report measures with a comparison control sample. Table 2.1 illustrates the study design diagram.

	Pre-Intervention	**L2L**	**Post-Intervention**	**Follow-Up**
Intervention Group	Attitudes towards risky driving (1)	Attended L2L	Attitudes towards risky driving (2)	Peer2Peer, Attitudes towards risky driving (3), Evaluation of Follow-up Session
				Question Time, Attitudes towards risky driving (3), Evaluation of Follow-Up Session
Control Group	Attitudes towards risky driving (1)	X	X	Attitudes towards risky driving (2)

Table 2.1: The data collection schedule for each group at each time point. X means data was not collected.

2.2.3 Learn 2 Live

Learn 2 Live (L2L) is a traditional fear appeal, interactive and multi-agency (firefighters, police, paramedics, victims of road traffic collisions and their families) British educational RSI. It aims to personalise the consequences of risky driving in order to reduce

risk-taking behaviour in young drivers and passengers, aged 16 to 20. This intervention has been running continuously since 2008 and is delivered to approximately 12,000 students per annum in the South West of the UK (Devon & Cornwall).

The intervention is structured in the following manner: after a spoken introduction by a firefighter, 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 have 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 of delivery and involve places or road names the participants will be familiar with, further personalising the experience.

Three months after the initial presentation the firefighters and the police return to deliver a follow-up session, Question Time (QT), in which they describe their experiences aiding in road traffic collisions and give a presentation on the biggest dangers on the road for young drivers: drink driving, peer pressure, texting and speeding. The aim of the follow-up is to reinforce the messages given during the L2L event and to provide the students with additional evidence regarding the negative consequences of risky driving behaviours.

2.2.4 Peer2Peer

The peer-led educational event (P2P) was developed on the basis of best practice evidence relating to peer education (Buckley & Watson, 2014; Mellanby et al., 2000). Four undergraduate students were recruited as peer leaders, to design and deliver the intervention. The aim of the P2P event, like QT, was to describe the four biggest dangers for young novice drivers on the road (i.e. drink driving, negative peer influence, distractions and speeding). The peer leaders designed tasks to communicate these themes. They were given road safety educational material and factual content to furnish the ac-

tivities they designed. The peer leaders created four activities. A road safety quiz with multiple-choice answers was presented at the beginning of the event. The aim of the quiz was to engage participants with the idea of safety on the road, using a relaxed but informative approach. Example questions included: *"Imagine yourself in the pub with your mates. If you drank 4 pints of 5% strength beer, 3 Large glasses of wine or 4 doubles of regular strength spirits and went to bed at midnight, what time would you be legally allowed to drive the next day?"*. After the road safety quiz, the peer leaders divided the participants into 3 groups, each group performing three further activities (beer goggles, a speeding game and an off-the-shelf road safety video game). At the end of the event, the peer leaders discussed the main themes of the event and recalled personal experiences related to driving. The experiences related by the peer leaders were negative but did not have tragic consequences. As an example, they recalled being arrested while driving under the influence, falling asleep at the wheel with their sibling in the car and driving while texting.

Based on the reviewed literature it was hypothesized that:

(a) Participants who attended the L2L intervention would exhibit a decrease in their attitudes towards risky driving, compared to the control group;

(b) Females would show a greater attitudinal change compare to males who attended the L2L intervention program;

(c) Participants who attended the peer-led follow-up would report a bigger decrease in their attitudes towards risky driving compared to the participants who attended the adult-led follow-up.

2.3 Methods

The intervention group was made up of students attending the Learn2Live event. 1,465 Year 12 students attended the L2L presentation evaluated in this study. Of those, a total of 800 students from Further Education Colleges (i.e. education in addition to that received at secondary school) aged 16-20 (M= 16.64; SD= 1.01) completed the pre-

intervention. Of the 800 responses from pre-intervention, 145 provided complete date sets at follow-up.

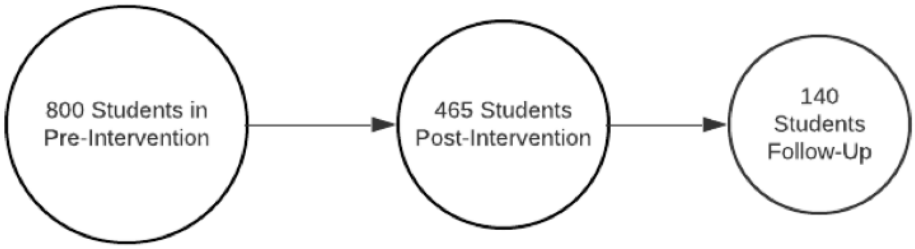

Figure 2.1: Flow chart of the number of participants in the Intervention Group.

Participants were fairly distributed across gender (M= 349; F=451). In addition, there were no age differences between the groups for either females (intervention n=451: M= 16.7, SD = 1.04; control n=45: M= 16.9, SD=0.62) or for males (intervention n= 349: M= 16.7, SD = 0.99; control n= 21, M= 16.7, SD = 0.66).

The control group was made up of students from Further Education Colleges that did not attend the L2L presentation or any other RSI during the time period of the study. For these schools, an educational RSI was scheduled for later in the academic year. 66 students completed the pre-intervention questionnaire (M= 21; F=45) and 66 completed the follow-up (M=21; F=45).

The colleges that agreed to participate in the study were all located in the South-West of the UK and the colleges' population had similar demographic and socioeconomic backgrounds.

2.3.1 Materials

Attitudes towards risky driving and future intentions to drive safely. At each time point attitudes towards risky driving behaviour were assessed using 12 statements, based on the Theory of Planned Behaviour (TPB; Ajzen, 1980), adapted from Burgess et al. (2011). Participants were asked 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"*. Subsequently eight road traffic scenarios, each detailing a specific risky driving situation (drink driving, speeding, seat belt use, overtaking, distraction, peer-influence, texting while driving and night-time driving) were presented. For each scenario, participants were presented with a list of 6 six statements based on the TPB (Ajzen, 1985). The 6 six statements measured behavioural intentions, perceived behavioural control, behavioural beliefs, social norms of friends, social norms of family and regret. 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 Table 2.2 for an example (See Appendix A 1.1).

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:
1. I would ask my friend not to answer their phone while driving
2. My family would approve of me asking my friend not to answer their phone while driving
3. I would regret not asking my friend to ignore their mobile phone whilst driving
4. It would be difficult for me to ask my friend not to answer their phone whilst driving
5. If I asked my friend not to answer their phone, he/she would listen to me and do what I asked
6. My close friends would approve of me asking my friend not to answer their phone while driving

Table 2.2: Example of a road traffic scenario and the list of six statements based on the TPB.

Cronbach's alphas for each of the TPB subscales [behavioural intentions, perceived behavioural control, behavioural beliefs, social norms of friends, social norms of family, and regret] ranged from .61 to .97, across the data collection points, indicating good and very good reliability for all measures.

Evaluation of Follow-Up Sessions 7 statements regarding the effectiveness of the follow-up were presented. Participants were asked to indicate how much they agreed/

disagreed with the statements on a 5-point Likert scale where 1 =*strongly agree* and 5 =*strongly disagree*. Example statements were: *"Today's session will make you a safer driver" or " I would tell a friend about what I have learned today"* (See Appendix A 1.2).

2.3.2 Procedure

Prior to its commencement, the study was approved by the first authors' University Human Research Ethics Committee and the required ethical guidelines were adhered to throughout.

Pre-intervention Local schools/colleges that had already consented to participate in the L2L intervention run by the Devon County Council (UK) were contacted, informed of the research and invited to participate. In order to maximise response rates each school/college was given the opportunity to receive paper-based copies of the questionnaire and/or access to a web link containing an online version. The Head of Year informed the students' parents of the nature and the design of study, asked the parents' approval and to provide signed consent of their acknowledgement. Three weeks prior to the L2L event, the researcher provided each Head of Year with either an online link or the paper-based pre-intervention (T1) questionnaire to distribute to the students. Before the students were allowed to complete the pre-intervention, they were asked to read information regarding the design of the study.

Post-intervention Immediately after attending the L2L event, the students were invited to remain seated and complete a paper-based post- intervention (T2) questionnaire.

Follow-Up 3 month after the L2L event, the participants were invited to complete the paper-based follow-up (T3) questionnaire. Next, the participants were randomly allocated to either the P2P or the QT follow-up. At the end of the follow-ups the participants were also asked to complete the Evaluation of the follow-up session questionnaire.

The control groups were contacted and invited to participate in a research on young drivers' 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. Participants completed

the questionnaires only in two occasions (T1; T3) separated by a period of three months, with no road safety intervention nor follow-up sessions occurring between the two data collection points.

2.3.3 Statistical Analysis

The internal consistency of the Attitudes towards risky driving and future intentions to drive safely questionnaire was determined by calculating the Cronbach's α scores for the items of each domain. To test the effectiveness of the intervention, we conducted a Friedman's analysis of variance (ANOVA) on participants' attitudes towards risky driving, with gender and groups as between-subject variables and time of the intervention as within-subject variable. Tukey HSD post hoc comparison was then used to gain further insight on the differences between gender, groups and time of the intervention on participants' attitudes towards risky driving. To test the effectiveness of the follow-up sessions, we conducted a Friedman's analysis of variance (ANOVA) on participants' evaluation of the follow-up sessions. We used an α level of .05 for all our analyses. Furthermore, all analyses were performed in R version 2.15.3.

2.4 Results

2.4.1 The effectiveness of the L2L event

Firstly, we examined the effectiveness of the L2L intervention program by considering the impact of the event on attitudes and behavioural intentions. The mean of the summed scores of the attitudes towards risky driving questionnaire was used in the analysis. Higher scores represent riskier attitudes towards risky driving.

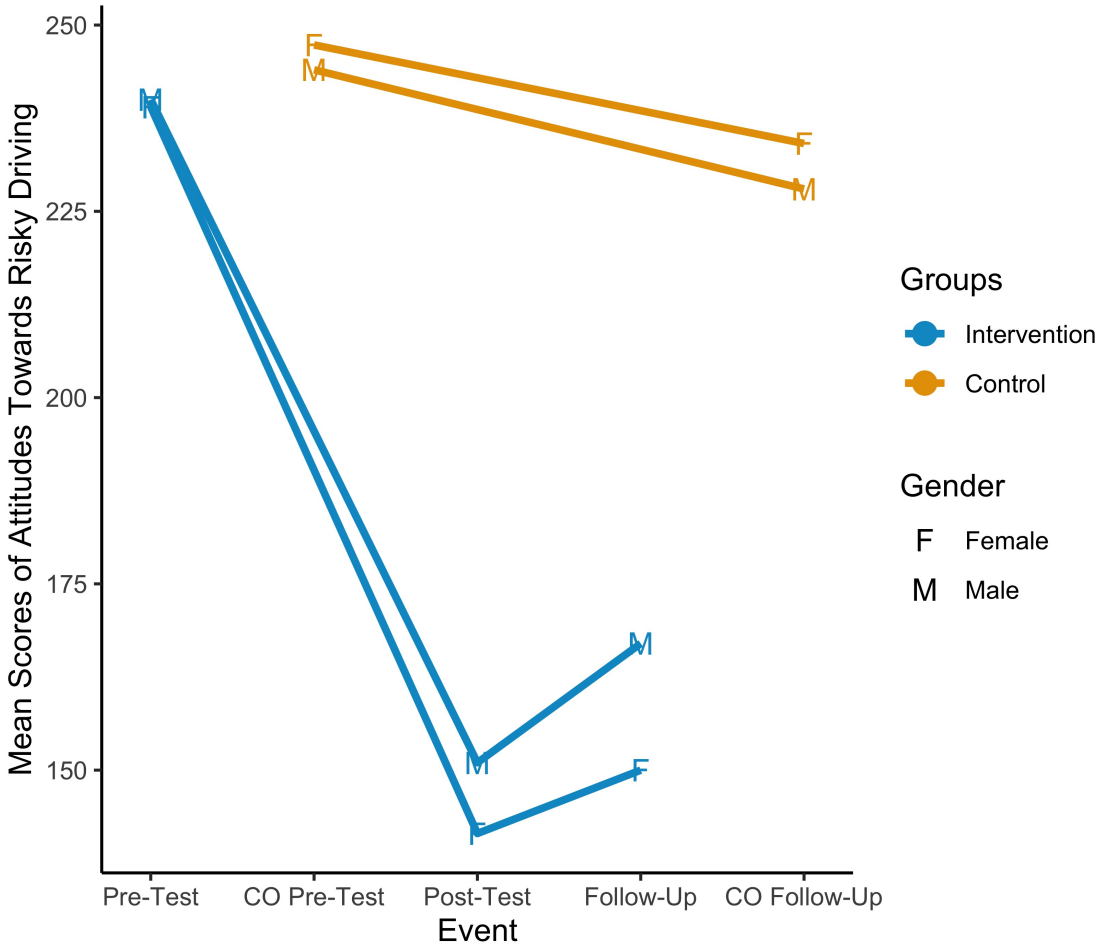

Figure 2.2: Significant main effects of Time and Gender on overall attitudes towards risky driving (intervention group).

A 2x2x3 mixed model ANOVA was used to investigate the effect of the intervention, gender and time of testing on changes to the sum attitudes towards risky driving questionnaire scores. The between-subject variables were 'Group' (Interventions vs control) and 'Gender' (male vs female). The within-group variable 'Time' had 3 levels (pre-test, post-test, and follow-up). A significant three way interaction was found between Time, Gender and Groups $F(1, 1512) = 7.009$, $p < .001$. There was also a significant interaction between Time and Gender $F(2, 1512) = 10.662$, $p < .001$; Time and Groups $F(1, 1512) = 373.696$, $p < .001$; and finally between Gender and Groups $F(1,1512) = 5.256$, $p < .001$. Tukey HSD post-hoc comparison revealed a significant pre-to-post intervention improvement in participants' attitudes towards risky driving ($p < .001$). Moreover,

the improvement was maintained over time at follow-up (p <.001), even if the participants reported a deterioration in their attitudes towards risky driving compared to the post-intervention. Nevertheless, there was a significant difference between the Control group and the Intervention group at follow-up (p <.001).

	Intervention			Control	
Variables	Pre-Intervention mean (SD)	Post-Intervention mean (SD)	Follow-Up mean (SD)	Pre-Intervention mean (SD)	Follow-Up mean (SD)
Attitudes towards risky driving- Mean Total	238.7 (14)	147.6 (23.2)	156.7 (26.3)	244.8 (13.8)	231.6 (11.6)
Behavioural Intentions	34.2 (3.4)	23.7 (2.8)	24.6 (2.9)	33.8 (3.1)	28.4 (2.2)
Perceived Behavioural Control	30.6 (3.7)	20.9 (4.4)	22.4 (4.4)	33.3 (2.5)	33.3 (3.3)
Behavioural Beliefs	37.1 (3.8)	21.9 (4)	22.7 (4)	36 (3.3)	31 (2.3)
Social Norms of Friends	31 (3)	24.5 (3.5)	25.6 (3.9)	31.4 (2.4)	35.9 (3.3)
Social Norms of Family	39.2 (5.8)	15.8 (5)	17.4 (5.5)	40.7 (5.4)	33.4 (3.9)
Regret	35.3 (4.6)	18.3 (5.7)	20.1 (6.2)	37.3 (5)	37.3 (3)

Table 2.3. Descriptive statistics for participants' scores on the sum of attitudes towards risky driving, and on each of the TPB component scores. The scores are split by groups.

Next, we examined whether there were gender differences. Tukey HSD post hoc comparison revealed that there was only a significant gender difference in the intervention group at post-intervention (p <.001), with females reporting a greater improvement in attitudes towards risky driving compared to males. Moreover, there was a significant difference between male students at post-intervention and at follow-up (p <.001), where the males reported a worsening in their attitudes towards risky driving over the course of the 3 months.

	Intervention						Control			
Variable	Pre-Intervention mean (SD)		Post-Intervention mean (SD)		Follow- Up mean (SD)		Pre-Intervention mean (SD)		Follow-Up mean (SD)	
	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males
Attitudes towards risky driving – Mean Total	238.2 (13.7)	239.5 (14.4)	143.1 (20.6)	152 (24.7)	150.6 (25.7)	164.2 (25.4)	243.8 (13.6)	245.2 (14)	239.7 (11)	240.1 (11.8)
Behavioural Intentions	34.3 (3.4)	34 (3.4)	23.4 (2.5)	23.9 (3.1)	24.2 (3)	25.1 (2.8)	34.1 (3)	33.7 (3.2)	28.5 (2.2)	28.1 (2.3)
Perceived Behavioural Control	30.5 (3.7)	30.7 (3.7)	20.3 (4.2)	21.5 (4.6)	21.5 (4)	23.4 (4.3)	32.9 (2)	33.6 (2.5)	33.7 (3.4)	32.4 (3.1)
Behavioural Beliefs	37.2 (3.7)	37 (3.8)	21.5 (3.9)	22.3 (4.1)	21.9 (3.7)	23.6 (4.2)	35.3 (3)	36.4 (3.2)	31.1 (2.4)	30.9 (2.1)
Social Norms of Friends	30.8 (2.9)	31.2 (3)	24 (3.4)	25 (3.6)	24.9 (4.2)	26.4 (3.3)	31.5 (1.8)	31.3 (2.6)	36.4 (3.2)	35.0 (3.4)
Social Norms of Family	39.8 (5.8)	38.3 (5.6)	14.9 (4.5)	16.6 (5.2)	16.2 (5.1)	18.9 (5.6)	40.9 (5.1)	40.7 (5.6)	33.6 (3.8)	32.9 (4.2)
Regret	35.1 (4.6)	35.5 (4.6)	17.3 (5.3)	19.4 (5.9)	18.7 (5.6)	21.9 (6.4)	36.7 (5)	37.5 (5.1)	37.4 (2.9)	37.1 (3.1)

Table 2.4. Descriptive statistics for participants' scores on the sum of attitudes towards risky driving, and on each of the TPB component scores. The scores are split by gender.

2.4.2 The effectiveness of the follow-ups

A 2x2 ANOVA was conducted to investigate the effect of follow-ups and gender on students' attitudes towards risky driving. The between-subject variable was 'Gender' (male vs females). The within-subject variable was 'Session Attended' (P2P vs QT). The mixed ANOVA did not show any interaction between gender and session attended $F(1,136) = 0.1460$, $p = 0.7$. The ANOVA also showed a non-significant difference of session attended $F(1,136) = 1.1138$, $p = 0.2$. However, there was a significant effect of gender $F(1,136) = 8.9565$, $p < .01$, where male students reported riskier attitudes towards risky driving in both follow-ups compared to the female students.

Furthermore, a 2x2 ANOVA was performed to assess how the students evaluated the follow-up sessions, by using the mean summed scores of the evaluation of the follow-up questionnaires. The ANOVA reported a significant difference only of the Session Attended $F(1,136) = 11.9203$, $p < .01$. Specifically, the participants evaluated the Peer2Peer as preferred when compared to the Question Time follow-up.

2.5 Discussion

With a considerate amount of young adults being killed or injured in road traffic collisions, identifying interventions that are effective is of paramount importance. Yet, despite the prevalence of young driver road safety interventions worldwide, there are very few evaluations of which interventions work, with L2L representing such an example. The aim of the present study was to evaluate the effectiveness of the L2L road safety intervention and evaluate the success of two different follow-ups, on young drivers' self-reported attitudes towards risky driving. The prediction that participants who attended the L2L intervention would report a decrease in their risk attitudes at post- intervention was corroborated by the data: both males and females reported safer attitudes after attending the intervention, specifically with females reporting much safer attitudes compared to males. Furthermore, the attendees maintained safer attitudes over time, reporting safer attitudes after 3 months compared to the control group.

Furthermore, our data showed that males who attended the L2L intervention reported less improvement in their attitude to risk, in accordance with our prediction. In fact, females showed safer attitudes not only immediately after attending L2L but also 3 months later. In contrast, males reported riskier attitudes 3 months later compared to immediately after the L2L event. Thus, while females retained the benefits of the L2L educational intervention over time, males only exhibited an immediate impact. These findings are important for at least two reasons. First, it reveals that intervention programs do not affect participants equally. That is, focusing on the overall data would have suggested that the intervention program was successful in changing attitudes among all participants. Yet, a closer look at the results reveal that the promising results were driven predominantly by the female participants. More importantly, it illustrates that the high risk group—namely, males—are less susceptible to this particular intervention program. This highlights the need to develop bespoke programs to address the high risk drivers.

The results presented are in line with previous research (Hoekstra & Wegman, 2011;

Tannenbaum et al., 2015; Wauters & Brengman, 2013), which found that fear appeal campaigns are successful at influencing attitudes, intentions, and behaviours. Moreover, as with research by Laapotti and Keskinen (2004; see also, Mynttinen et al. 2009) we found that the intervention appeared to be more successful in improving females' attitudes and intentions. Given that young males tend to be higher sensation seekers (Cross et al., 2013), highly optimistic about their driving skills (Delhomme et al., 2012) and less likely to respond to fear- appeal-style persuasion (Lewis et al., 2008), this may explain why they were less likely to report improved attitudes after the intervention. Alonso et al. (2019) also found that males are more directed/permissive towards aggressive behaviours compared to women, which provides further evidence on the differences in young people's risk perception. Furthermore, 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 (Goldenbeld, 2008; Tay & De Barros, 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 present findings nicely match 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 the Extended Parallel Process Model (EPPM; Witte, 1992) it might be that the females perceived the threat of risky driving to be high following the L2L intervention but also perceived themselves able to behave in line with the messages conveyed. Further to this, although we found some safer intentions amongst the males who attended the L2L intervention, it can be debated that young male drivers recognise that fear appeal style interventions are trying to scare them (Cohn, 1998) and this might lead them 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 et al., 2014; Nestler & Egloff, 2010).

The results of this study did not support the hypothesis that participants who attended the Peer2Peer follow-up would report a bigger decrease in their attitudes towards risky driving compared to the Question Time follow-up. There were slight differences between the two follow-ups, where the students in the Question Time follow-up reported safer attitudes compared to those attending the Peer-led educational follow-up. However, their scores were not significantly different, so this study cannot provide conclusive support for the use of such peer-led education interventions in deterring risky driving behaviour. Nevertheless, the peer-led educational event was globally preferred by the students compared to the adult-led event. This result could help give more insight on what students overall prefer and, therefore, what could potentially influence them to perform safer in-car behaviours.

The results should be understood within the limitations of the study. All the measures were self-reported, thus raising concern that the possibility of social desirability influences could not be accounted for. Even so, this study has road safety practice implications. The evaluation reported that participation in the educational RSI was associated with safer attitudes and intentions to behave safely in a car both short-term and long-term. The students of the same age that did not attend L2L or any other RSI showed no such improvement in attitudes or intentions to behave safely over the same time frame.

To summarise, the findings from the first study suggest that whilst the intervention may be effective in improving young females' attitudes towards risky driving, an alternative approach may be necessary to better engage young males. The young males in this study were less affected by, and showed less engagement to, the fear-inducing threats of the L2L road safety intervention. 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 because they are able to convince themselves that the consequences are not applicable or unlikely to happen to them (i.e. optimism bias). Therefore, to better investigate young males' risky in-car behaviours the

next chapter presents a study that was conducted predominantly on young males risk-takers to investigate whether they report high levels of optimism bias about their own driving behaviours. Also, because road collisions have been a growing safety concern for the military, and military personnel have been shown to be high risk-takers and highly optimistic about their ability to deal with dangerous situations, the target of the second experiment were military personnel. The aim was to gain further knowledge not only on their opinion of fear appeal RSI but also to better understand whether optimism bias underpins greater risk taking in young males.

Chapter 3

Study 2. Measuring Optimism Bias among Military Personnel

3.1 Chapter Introduction

As previously said, young drivers' high collision risk is due to skill deficits, risky behaviours and personality factors. The evaluation conducted in chapter two indicated that the intervention was very effective at improving females' attitudes and intentions to behave safely, but was less so for males. This may be because interventions tend not to consider 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 have higher optimism bias are more likely to incorrectly assess the likelihood of negative events taking place and overestimate their ability to control the outcomes (Delhomme et al., 2010, Weinstein, 1984, White et al., 2011). This is particularly true of young males, who were those less likely to respond to the intervention evaluated in chapter two. Therefore assessing optimism bias in young males, specifically those with high risk-taking tendencies, might provide insight into what underpins this risky behaviour, and will enable the development of more effective ways of targeting this high risk group.

3.2 Introduction

Deaths from road traffic collisions (RTCs) have been a growing safety concern for the Armed Forces around the world (DASA, 2007). In Europe, data from the UK armed forces research has revealed that RTCs are the leading cause of death in peacetime (Powell et al., 2000), and the loss of lives and injuries contribute to readiness and training costs (Thandi et al., 2015). Quite similarly, data from the US present a similar trend, where RTCs account for 20 to 40 % of all young military fatalities, which constitute the primary cause of unintentional injury hospitalizations within the US Armed Forces (Leland & Oboroceanu, 2011). Although RCTs among military personnel are significant financial, health and safety concern, there is a paucity of research on the contributing factors associated with RTCs. To address this gap, the following study examined one specific road safety educational intervention tailored for the UK military personnel and investigated their attitudes towards the program, their optimism bias and willingness to take driving risks.

3.2.1 Risk Factors

Previous research with military personnel has reported that the chief risk factor associated with risky driving among this population is alcohol abuse. Indeed, ample evidence exists for the link between excessive alcohol use and reckless driving in the Armed Forces (Fear, Iversen, Meltzer, et al., 2007; Williams, Bells & Amoroso, 2002). Studies reveal that US military personal consume more alcohol compared to their civilian counterparts and they are more likely to experience illnesses and hospitalizations (Bray et al., 1991) and road traffic collisions (Bell, Amoroso, Yore, Smith, Jones, 2000; Williams, Bells & Amoroso, 2002). Other investigations have focused on the relationship between military personnel and the propensity to engage in risky behaviours (see Breivik, Sand & Sookermany, 2019; Fijałkowska, 2012; Garyn-Tal, & Shahrabani, 2015). The findings showed that military personnel are more inclined to yell, shout, drive recklessly, and consume alcohol and illegal drugs compared to the civilian population (Breivik et al., 2019; Fijałkowska, 2012; Garyn-Tal & Shahrabani, 2015). Research by Adler, Britt,

Castro, McGurk and Bliese (2011) also shows that military training may increase risk-taking behaviours. The authors identified that, after military training, army personnel were three times more likely to report getting into a fight, and drinking excessively compare to their behaviour prior to undergoing the military training (see also Kelley et al. 2012). Another line of research has identified deployment as a risk factor for risky driving (Fear et al., 2008; Hoggatt et al., 2015).

Despite the findings mentioned above, there is a paucity of research documenting the predicting factors of risky driving behaviours amongst the military personnel. In comparison, there is a large body of research among young adults. As the two populations— young adults and military personnel— might share several characteristics (e.g., age [1]), drawing on research with young adults could prove useful. Indeed, young adult are especially at high risk of being involved in car crash and dying in a vehicle crashes (Fear et al., 2008; Sheriff et al., 2015). Data suggests that young adults are twice as likely to engage in risk-taking behaviours, such as drinking, reckless driving, high-level speeding, or consuming illegal substances, compared to older adults (Hatfield et al., 2014) Moreover, insufficient skills and a lack of driving experience have frequently been regarded as the main causes of collisions in this age group (Fisher et al., 2002; Underwood, 2007). Gender has also been found to predict unsafe driving behaviours (Harré, 2000; Turner & McClure, 2003), with young males being more willing to take risks than females (Bina et al., 2006; Fergusson et al., 2003; Harré et al., 1996; McEvoy et al., 2006; Oltedal & Rundmo, 2006; Vassallo et al., 2007).

3.2.2 Optimism Bias

In addition to the work on risk taking and risky driving, researchers have also found a clear and consistent association between optimism bias and risky driving behaviours. Optimism bias refers to people's belief that they are more capable, competent, and talented and less prone to errors than others on a number of personal traits and skills (Heck & Carlos, 2006), one of which is driving (Pronin, Gilovich, & Ross, 2004). Previ-

[1] The average age of those who join the UK armed forces is 20 years and 8 months

ous studies have found that compared to more experienced adults, young adults tend to focus more on the perceived benefits than the perceived costs of engaging in risky behaviours (e.g., Parsons, Siegel, & Cousins, 1997; Reyna & Farley, 2006) and have a greater tendency to assume that they will experience more favourable outcomes and fewer negative outcomes than their peers. Moreover, optimism bias has been associated with overconfidence (Mynttinen et al., 2009), feelings of invulnerability and illusion of control (Millstein & Halpern-Felsher 2002; Weinstein 1980). Most notability, optimism bias has been associated with risky driving behaviours (Weinstein & Lyon, 1996). The belief that one is less likely to be involved in car crash is often translated into a reduced probability of engaging in self-protective behaviours (Gosselin, Gagnon, Stinchcombe, & Joanisse, 2010; McKenna, 1993; Mynttinen, Sundström, Koivukoski, Hakuli, Keskinen, & Henriksson, 2009; Pedruzzi Swinbourne, 2009) or paying attention to road safety campaigns. Furthermore, young drivers tend to assume that these campaigns are to be directed at other drivers who are less skillful, competent, or safe than them (Horswill, Waylen & Tofield, 2004; Pedruzzi, Swinbourne & Quirk, 2016). Thus, young drivers' overestimation of their own abilities combined with limited driving experience are considered to be critical factors in road safety (Măirean & Havârneanu, 2018; Taubman-Ben-Ari & Katz-Ben-Ami, 2012).

It comes, therefore, natural to ask ourselves, what about optimism bias among military personnel? To the best of our knowledge, little is known about military personnels' optimism bias tendencies (Montes & Weatherly, 2014). The limited data that does exists was carried out on military pilots and showed that they were more danger-prone and had higher levels of optimism bias compared to commercial pilots (Sicard, Taillemite, Jouve, & Blin, 2003). Is it possible that other types of military personal (non-pilots) would also exhibit heightened levels of optimism bias? This idea is not without foundation, as increased feelings of "invincibility" and "invulnerability" have been commonly reported among soldiers returning from military training (Killgore et al., 2008). It is possible, therefore, that soldiers who are exposed to risky situations, experiences and training will show elevated risk of engaging in a range of domains, such as driving. Whether military

personal exhibit optimism bias and whether it can help explain risky driving behaviour among this population remains, however, an open empirical question. Furthermore, we know very little about any tailored programmes designed to reduce risky driving behaviour among military personal. Hence, in this paper, we examined military personal optimism bias and willingness to take risks as well as their change in attitudes after attending a tailored road safety educational programme aimed at reducing their risky driving behaviours.

3.2.3 Educational road safety interventions

Educational road safety interventions (RSIs) are designed to change young drivers' risky behaviours and to promote road safety. To achieve these aims, RSIs are designed to raise awareness and improve insight into the risk factors that contribute to road traffic collisions, through theoretical or classroom-based lessons, and to strengthen skills of anticipatory risk in order to avoiding potentially dangerous in-car situation (Bates et al., 2014; Brijs et al., 2014). However, despite having high face validity, there is mixed evidence regarding their effectiveness (Phillips, Ullberg, & Vaa, 2011b). Some studies suggest that RSIs can have short-term benefits, by making young drivers more aware of safe driving (King et al, 2008; Nelson et al, 2005) and by reducing their collisions (Lonero & Mayhew, 2010; Phillipsa et al., 2011a). Other research however has found that RSIs have limited or no impact in changing young drivers' risky behaviours (Farmer & Wells, 2015; Glendon, McNally, Jarvis, Chalmers & Salisbury, 2014). For example, an evaluation of one RSIs done by Cutello et al. (2020) has reported that young male drivers exhibited riskier attitudes following the educational intervention compared to young female drivers. In addition, Glendon et al. (2014) suggested that educational RSIs may only serve to enhance young drivers' overestimation of their own driving ability (see also Brijs et al., 2014).

However, to our knowledge, there is a scarcity of research related risky driving within the military personnel. The present study was designed to evaluate some of the above questions. Based on the reviewed literature it was hypothesized that:

(a) Young military personnel should report higher levels of optimism bias compared to older military personnel;

(b) The participants who scored higher levels of optimism bias would also report more willingness to take risks and would rate the educational road safety intervention worst.

3.2.4 The present study

The current study reports a 1-day educational driver intervention targeting military personnel, specifically focusing on measuring their optimism bias, willingness to take risks and their attitudes to change. The study sought to investigate the role of optimism bias and willingness to take risks in military personnel using valid and reliable self-report measures.

3.2.5 Educational Intervention- Survive the Drive

Survive the Drive is a traditional fear appeal and interactive driver-education intervention. It aims to personalise the consequences of risky driving in order to reduce risky driving behaviour in the Armed Forces.

The intervention was structured in the following manner: after a spoken introduction by a male firefighter, a film is presented showing a group of military personnel, a woman and two men, in the moments leading up to and including a collision. As the emergency services begin to arrive the film is paused, and a member of each agency (i.e. firefighters, police, family liaisons and paramedics) comes on stage to recount a personal experience of a collision they have 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 of delivery and involve places or road names the military personnel will be familiar with, in order to further personalise the experience.

3.3 Method

3.3.1 Participants

A total of 118 British military personnel (M= 98, F= 20) took part in the study. They were all navy military personnel. Their length of service ranged from 1 to 48 years (Myears= 10.91; SDyears= 9.74). The age of the military personnel ranged from 18 to 60+ (52%= 18-25; 5%=26-34; 20%= 35-44; 18%= 45-54; 3%=55-60 and 2%= 60+). The criteria to participate in the study was a valid driver's license and being enrolled in the military.

3.3.2 Procedure

Prior to its commencement, the study was approved by the authors' University Human Research Ethics Committee (ref. 18/19-1012) and the required ethical guidelines were adhered to throughout. Furthermore, the researchers sent emails of permission directly to the commanders of the military base. The emails outlined the nature and purpose of the study. The driving preventive programme —Survive the Drive—was conducted in one military based in the south west of the UK. The programmewas delivered (as it usually does) by the Devon Somerset Fire and Rescue Service and prior to the road safety event the military personnel were contacted, informed of the research and invited to participate. After attending the driver-education intervention, participants were asked to complete the optimism bias questionnaire (Gosselin, 2010; Mckenna, & Myers, 1997), the willingness to take risk questionnaire (Dohmen et al., 2011) and the perception of the driving-education intervention.

3.3.3 Measures

Optimism Bias Questionnaire (OB) Participants were asked to complete questions on Comparative Optimism (CO; Gosselin, 2010), by reading nine driving related events (i.e. yielding the right-of-way, changing lanes, crossing an intersection, merging onto the highway, driving on winding roads, driving at night, reacting quickly to unexpected events, driving when tired, and driving in poor weather conditions) and were asked to estimate their individual probability of getting into a collision compared to an average

driver of their same sex and age on a 5-point Likert scale (1= *much higher than average*; 5= *much lower than average*; see Appendix B 1.1).

Furthermore, participants were asked to complete the Driving Skill Questionnaire (DSQ; Mckenna, & Myers, 1997), concerning participants' perceptions of their driving. They were asked to rate how good they are on a variety of driving skills, compared to the average driver of their same sex and age on a 5-point Likert scale (1= *much higher than average*; 5= *much lower than average*). (α= .92). See Appendix B 1.2.

Willingness to take risks (Dohmen et al., 2011) One question that directly asked the participants to make a global assessment of their willingness to take risks: *"How willing are you to take risks, in general?"* Respondents rated their willingness on a scale from 1 to 5 (1= *Not at all willing to take risks*; 5= *Very willing to take risks*).

Attitudes to change Participants were presented with 6 driving behaviours and were asked whether their attitude to engaging in the behaviour had changed following the RSI. Specifically, they were asked *"The Survive the Drive presentation has changed my attitude to (1) driving whilst tired, (2) using the mobile phone when driving, (3) distractions within the vehicle, (4) driving under the influence of alcohol, (5) wearing a seat-belt and (6) driving at inappropriate speed".* Participants were asked to tick all that applied.

3.4 Results

3.4.1 Statistical Analysis

The internal consistency of the OB questionnaire and the attitudes to change questionnaire were determined by calculating the Cronbach's α scores for the items of each domain. To improve clarity, we transformed the individual scores into a percentage of maximum score values for OB sub-scales (i.e. the comparative optimisms and driving skills) and attitudes to change questionnaires. This was achieved by subtracting the minimum score possible of the given questionnaire, multiplying this value by 100 then dividing it by the maximum score possible. Such transformations allowed to compare the scores from the comparative optimisms and driving skills questionnaires. Furthermore,

ANOVAs were performed on the scores of the questionnaires, taking into account age, military rank, road traffic collision and deployment. These analyses were performed in R version 2.15.3.

3.4.2 Optimism bias

Our first goal was to determine whether military personnel reported optimistic bias and, specifically, whether they were differences between young military personnel and older military personnel. A one-sample t-test with a central value of 50% (i.e., neither optimistic nor pessimistic) was used to test whether our sample showed significant levels of optimism bias when comparing themselves to an average driver ($t(117) = 30.75$, $p < .0001$, Mean OB score = 61.3 %).

The young military personnel, aged 18-25, represented the vast majority of the low-ranking officers (93.5%), and were under-represented in higher ranks (7.1%). An ANOVA revealed that low-ranking military personnel displayed more optimistic bias (M = 75.4%; SD = 11.1%) than high-ranking military personnel (M = 45.8%; SD = 17.3%; $F(1,116) = 124.9$, $p < .0001$). Corroborating this result, higher levels of optimism bias were reported by young military officers (18-25 years old; M = 76.9%; SD = 9.18%) compared to older military (>25 years old; M = 44.1%; SD = 15.2%; $F(1,116) = 205.6$, $p < .0001$. see Fig. 3.1A). Tukey HSD post-hoc comparison revealed that 18-25 years old military were more biased that all the other age groups (all $p < .001$; see Fig. 3.1B).

We analysed the two OB scales separately to see if the military personnel were more optimistic in one questionnaire rather than the other. Once again, an ANOVA revealed a significant effect of age group ($F(1,232) = 318.1$, $p < .0001$). However, no effect was shown in the type of questionnaire ($F(1,232) = 0.25$, $p = .61$) nor in their interaction ($F(1,232) = 0.15$, $p = .69$). Thus, military personnel aged 18-25 reported more optimistic bias in both the comparative optimisms ($F(1,116) = 161.9$, $p < .0001$) and the driving skills questionnaire ($F(1,116) = 156.1$, $p < .0001$), but the responses to these two questionnaires did not appear to differ in both the young ($p = .99$) nor in the older military personnel ($p = .92$).

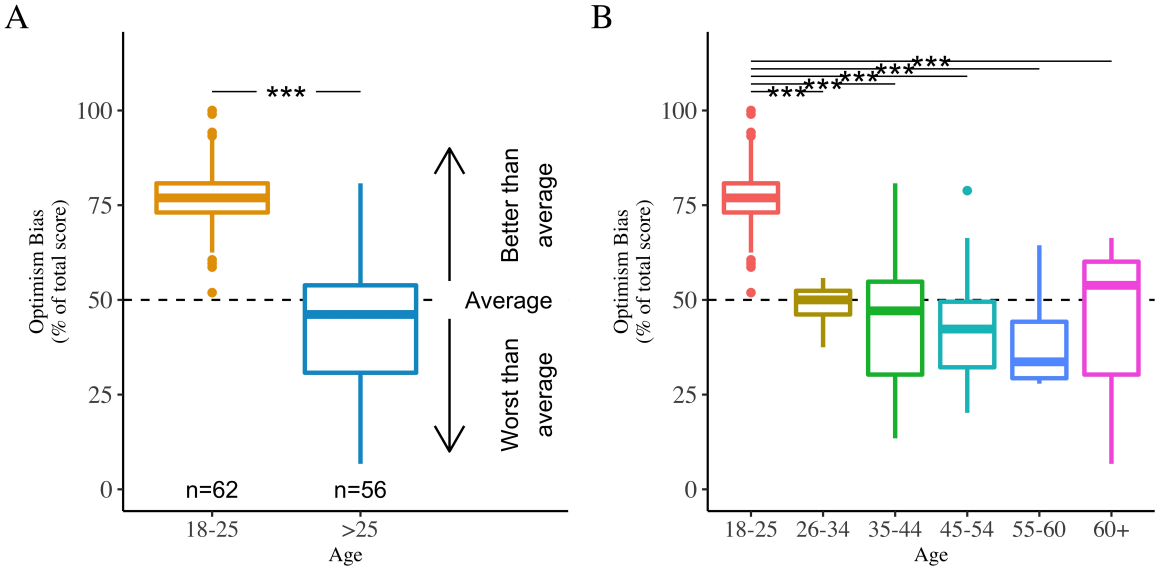

Figure 3.1: A: Participants OB scores, split into two equivalent age groups (18-25; >25). B: Participants OB scores, split by all the age groups. Error bars represent 95% of confidence intervals.

3.4.3 Willingness to take risks

Secondly, an ANOVA was performed to evaluate the effect of age on the willingness to take risks. The ANOVA revealed that young military personnel reported more willingness to take risks (M = 1.52; SD = 0.92) than older military personnel (M = 2.79; SD = 1.06; F(1,116) = 48.7, $p < .0001$. See 3.2). A Pearson correlation showed that optimism bias was correlated with the reported willingness to take risks (r = -0.379, $p < .0001$), such as the military personal that reported higher willing to take risks had the highest scores to the optimism bias questionnaire. Additionally, a One-way ANCOVA was conducted between optimism bias and willingness to take risks controlling for age. No significant effect of willingness to take risks on participants' optimism bias was found after controlling for the participants' age, F(2,115) = 103.9, p =0.2. The results suggest that younger adults are both more likely to show an optimism bias and be willing to take risks but these two factors are not related to one another once we control for age.

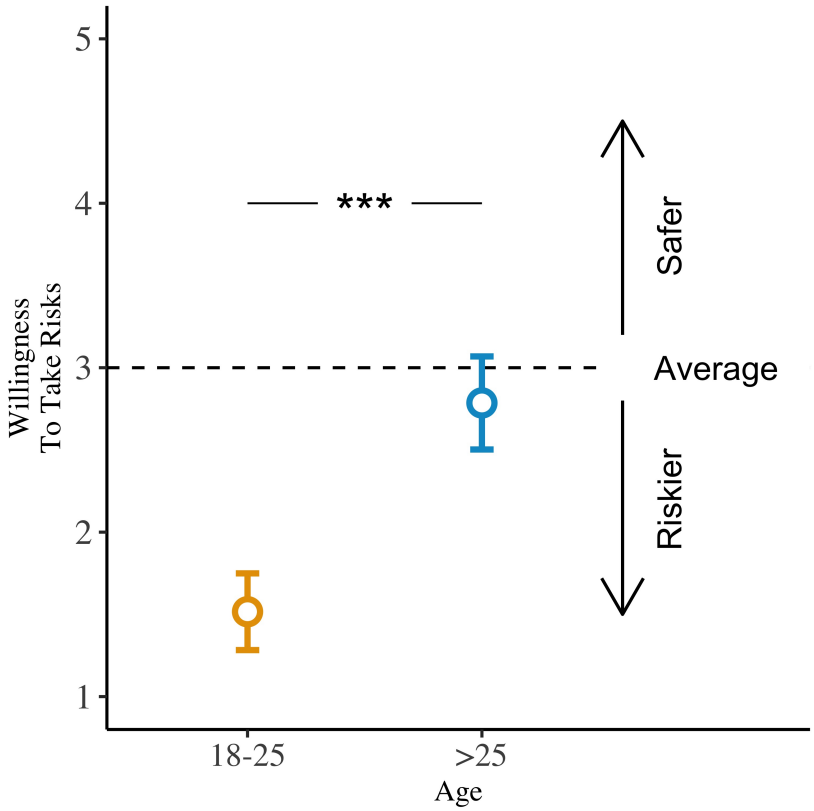

Figure 3.2: Participants willingness to take risks scores, split into two age groups (18-25; >25). Error bars represent 95% of confidence intervals

3.4.4 Attitudes to change

Regarding the attitude to change, regression analyses were computed to explore the interrelations between participants' age, OB scores, willingness to take risks scores, and attitudes to change. The regression analysis indicated that optimism bias, willingness to take risks and age were not associated with attitudes to change (r = -.21, all p = 0.7). Furthermore, logistical regression analysis on the attitudes to change subscales, did not revealed any differences (all $p > .09$).

3.4.5 Road traffic collisions and deployment

We then performed analyses to evaluate the link between road traffic collisions and deployment on participants' optimism bias, willingness to take risks and attitude to change. We asked participants to indicate whether they had been in a road traffic collision either

while on duty (1), while off duty (2) or not at all (3). As there were very few accidents while on duty, we then merged the categories for on and off duty to identify if they had been in a collision in general or not.

Three ANOVAs were computed to look at the effect of age and road traffic collision on participants' optimism bias, willingness to take risks and attitudes to change. In all cases, the findings did not reveal any significant effect of road traffic collisions on participants' OB scores (p = 0.4), nor on willingness to take risks (p = 0.2), and attitudes to change (p = 0.3). Nevertheless, age had a major effect on optimism bias F(1,114) = 203.6, $p < .0001$ and willingness to take risks F(1,114) = 48.13, $p < .0001$. In addition, no interaction effects were found.

Finally, we conducted an ANOVA to evaluate the impact of deployment on OB scores. We asked participants to indicate whether they had returned from active service in the last year (1), from training in the last year (2) or none of the above (3). We then merged the answers into two categories to identify if the participants had been deployed or not. The findings revealed that deployment influenced the participants' optimism bias, independently of age. Specifically, the findings showed lower optimism bias in military personnel who had returned from deployment (M = 56.7%; D = 22.4%) compared to those that hadn't been deployed (M = 63.4%; SD = 19.6%; F(1,114) = 7.18, $p < .001$. See Fig. 4A). We also performed an ANOVA to evaluate the impact of the deployment and age on the participants' willingness to take risks. There was a main effect of deployment F(1,114) = 4.15, $p < .05$, age (F(1,114) = 48.5, $p < .0001$) and an interaction between age and deployment F(1,114) = 9.6, $p < .01$. Tukey HSD post-hoc comparison indicated that young military personnel who had been deployed the year before reported less willingness to take risks (M = 2.14; SD = 1.09) than young military personnel who hadn't been deployed (M = 1.33; SD = 0.78, p = .031; Fig. 4B), whereas no significant difference was reported in the older military (p = .43). A last ANOVA evaluating the effect of deployment and age on military's attitude towards change, which revealed a main effect of deployment F(1,114) = 26.3, $p < .0001$ and age (F(1,114) = 869.9, $p <$

.0001), but no interaction between the variables F(1,114) = 1.87, p = 0.17.

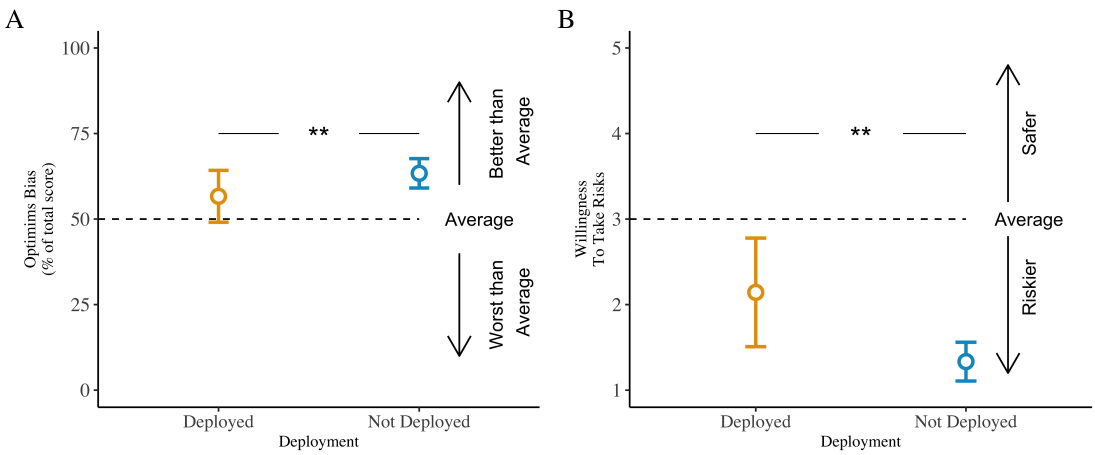

Figure 3.3: Results from the exploratory analysis. Military personnel that had been deployed to combat training the year before the intervention appeared less incline to the optimism bias (A), self-reported being less risky (B). Error bars represent 95% of confidence intervals.

3.5 Discussion

According to DASA (2007), military personnel's deaths from road traffic collisions have been a growing safety concern worldwide. In Europe alone, military personnel's RTCs are the leading cause of death in peacetime (Powell et al., 2000). Despite the high numbers of young military fatalities due to RTCs, research related to the contributing factors (i.e. optimism bias and willingness to take risks) associated with RTCs and the examination of road safety education programme tailored at reducing young military fatalities are few and far between. In order to address this gap in the literature, we examined one specific road safety educational intervention tailored for the UK military personnel and investigated their attitudes towards the program, their optimism bias and willingness to take risks.

Firstly, we hypothesised that young military personnel would report higher levels of optimism bias compared to older military personnel. The results corroborate our hypothesis, revealing that optimism bias was predicted by age. Specifically, young military personnel, aged 18-25, considered their own driving skills as better than their average peer and underestimated the probability of negative events (e.g., car crashes) occur-

ring. Consequently, our findings are consistent with previous work on young drivers and optimism bias. In particular, they mirror those of previous work which found that young drivers aged 18-25 report higher tendency to perceive themselves as better than their same-age peers and underestimate their personal risk compared to others (Fernandes et al., 2010; Gosselin, 2010; Harré & Sibley, 2005; White et al., 2011). Furthermore, when examining the results for each age cohort it appears that optimism bias diminishes with age, which is also aligned with previous findings showing that drivers' levels of optimism bias vary by age (Finn & Bragg, 1986; Matthew & Moran, 1986).

Secondly, we predicted that those who would report higher levels of optimism bias would also display higher willingness to take risks and would rate the educational road safety event worst. Our data revealed, in support of our hypothesis, that willingness to take risks was not only predicted by age, with young military personnel showing that they were more willing to take risks, but by optimism bias as well. Indeed, those who were more willing to take risks also reported the highest levels of optimism bias. These findings are in accordance with previous work, in which young drivers were found to be more willing to take risks because of their persistent bias in their perception of risks (Chraif, Anitei & Alex, 2013; Mairean & Havarneanu, 2018), as well as a general propensity towards deliberately engaging in high-risk behaviors (Ullberg, 2004).

Furthermore, optimism bias and higher willingness to take risks have been linked with inexperience (Bingham et al., 2016; Williams, 2006). Specifically, it has been argued that young people's lack of experience fuels their overestimation of their skills and underestimation of the dangers, believing that they they are at lower risk to become involved in a collision compared to older adults and peers (Constantinou et al., 2011). At the same time, while underestimating the risks, young inexperienced drivers have been found to act more recklessly and aggressively compared to more experienced drivers (Chen et al., 2000; Heck & Carlos, 2008). These findings were corroborated by our post-hoc results, in which experience military personnel who had return from military deployment were less optimistic about their driving skills compared to those who had not. Simi-

larly, young military personnel who had been deployed the year before reported less willingness to take risks than young military personnel who hadn't been deployed.

However, our results did not support our hypothesis that those who rated themselves as more skilled and less-accident prone than their peers would also be less inclined to change their attitudes after attending the road safety intervention. Thus, our results cannot provide conclusive evidence that military personnel who report higher levels of optimism bias would be less inclined to change their behaviours through a road safety educational intervention.

Taken together our data not only provides, to our knowledge, the first empirical evidence of military's personnel tendency to exhibit optimism bias, but also illustrates how young people perceive their own driving skills as better than their average peer and underestimated the probability of negative events occurring, which can be detrimental when trying to persuade them to change their risky behaviours.

This study has several limitations. First, this was not a longitudinal study aimed to evaluate whether the RSI could have been effective in reducing military personnel's optimism bias and willingness to take risks. Future research would need to evaluate whether similar interventions have a long-lasting effect among military personnel. At this point, we are unable to indicate if the RSI would have an impact on the military's optimism bias and willingness to take risks. Second, our sample is not necessarily representative of the entire military personnel, and we cannot conclude whether military personnel from other branches would exhibit similar tendencies. Finally, only one type of RSI was employed, and it is possible that other education programs might achieve better results. Needless to say, further research is urgently needed to examine these important factors.

In summary, military personnel's RTCs are the leading cause of death in peacetime and the research related to the contributing factors (i.e. optimism bias and willingness to take risks) associated with RTCs are few and far between. This research not only provides the first empirical evidence of military's optimism bias, but also illustrates how

young people perceive their own driving skills as better than their average peer, underestimated the probability of negative events occurring, and are more willing to take risks compared to older military personnel. It is important to acknowledge these factors when creating tailored RSIs, because they can be detrimental when trying to persuade young people to change their risky behaviors. Taken them into account can help decrease young drivers' over-represented in road traffic collisions.

In conclusion, the findings from the second study reinforce the notion that traditional 'fear appeal' style RSIs may be ineffective at reducing risky young drivers' behaviour, because young people are more inclined to believe in their illusory sense of vehicle control and overestimation of their driving abilities. This then poses the question, can optimism bias be reduced? The next section, will consider two different behavioural change manipulations to see whether young drivers' optimism bias levels can be diminished.

Part II

Manipulations to increase the effectiveness of road safety campaigns

Chapter 4

Study 3. Reducing optimism bias in the driver's seat: comparing two interventions

4.1 Chapter Introduction

The results from the studies conducted so far add to the driving literature by showing that: a) a fear appeal road safety intervention was least effective for those most at risk (young males); b) this may be due to the fact that their behaviour is influenced by their positive bias of their risks and driving skills.

Results such as these suggest that optimism bias is a contributing factor to young drivers' involvement in risky in-car behaviours. Furthermore, as previously discussed in the literature review, not only do young drivers have a bias evaluation of risk and their driving skills, but they also display a heightened desire to engage in sensation-seeking behaviours (Zuckerman et al., 1964), which increases their reluctance to listen to fear-appeal-style RSIs. Therefore, it is critical to investigate how to reduce optimism bias and whether sensation-seeking may impact on the effectiveness of RSIs.

To that end, the present study aimed to evaluate how two brief manipulations, one based on an unambiguous definition of "good" driving and the other on a hazard perception test, might reduce young drivers' optimism bias, as well as investigate whether sensation-seeking impacts on the effectiveness of two manipulations. The assessment of two brief manipulation focused on decreasing optimism bias might provide evidence for tailored interventions aimed at tackling specific age-related personality factors, that put young drivers at risk of being involved in RTCs.

4.2 Introduction

Worldwide, road traffic collisions are the leading cause of death and serious injuries among young adults – aged 18 to 25 years—with 48% of road deaths each year worldwide (World Health Organization, 2018). De facto, novice drivers are twice as likely to have a collision compared to drivers aged 40-49 (Department of Transport, 2017) and road deaths account for 25% of deaths amongst 16-25-year old, compared to 0.5% of deaths in a wider population. These alarming statistics raise two important and related questions. First, what are the factors that contribute to young drivers' high involvement in (fatal) collision(s). And, second, what can be done to tackle this grave problem. In this paper, we examine whether we can alter one important variable—namely optimism bias—that has been shown to contribute to young drivers' risky driving.

4.2.1 Factors contributing to road crashes

Researchers have proposed several factors to explain the vulnerability of young drivers in road traffic collisions (Borowsky & Oron-Gilad, 2013; Cestac et al., 2011). For instance, risk-taking, insufficient skills and a lack of driving experience have frequently been regarded as contributors of collisions in this age group (Fisher et al., 2002; Underwood, 2007). Young drivers are more likely to drive too fast, follow too closely and overtake too dangerously, compared to older and more experienced drivers (Ulleberg, 2001). Research also suggests that compared to more experienced drivers, young drivers' cognitive skills in handling complex traffic situations are still developing due to maturational constraints (O'Neal & Plumert, 2018).

Ample evidence links the propensity to engage in risky-taking behaviours to sensation seeking. Sensation-seeking refers to "*the seeking of varied, novel, complex, and intense sensations and experiences, and the willingness to take physical, social, legal, and financial risks for the sake of such experiences*" (Zuckerman 1964, p. 27). Several studies have reported a relationship between sensation-seeking and risky driving, which includes excessive speeding, frequent overtaking, reckless lane-changing, and driving under the influence of alcohol or drugs (Arnett, 1996; Jonah, 1997; Schwebel

et al., 2006; Wagner, 2001). Moreover, base on a review of 40 studies examining the relationship between sensation seeking and risky driving, Jonah, Thiessen and Au-Yeung (2001) concluded that self-reported high sensation seekers are more likely than low sensation seekers to speed, not wear seatbelts, drive under the influence of alcohol and be aggressive whilst driving (see also Dahlen et al., 2005, Iversen & Rundmo, 2004).

Importantly, previous research has also revealed an association between young drivers' risky driving behaviours and optimism bias (Fernandes et al., 2007; Harré & Sibley, 2005; Horswill et al., 2004). Optimism bias refers to the belief that one is more skilled and less likely to experience negative events compared to one's peers (Weinstein & Klein, 1996). This biased evaluation of risk and skills leads individuals to incorrectly assess the likelihood of an event taking place and to overestimate their ability to control the outcome (Causse et al., 2004; Delhomme et al., 2010). As a result, young drivers perceive themselves at a reduced risk in comparison to others. This phenomenon has been shown to be present in a multitude of situations that may threaten well-being, including the risk of being involved in a road traffic collision (Weinstein,1980, 1984). Several studies have suggested that while the majority of drivers acknowledge the possible risks associated with driving, novice drivers are more inclined to believe that these risks do not apply to them but do apply to their peer group (DeJoy, 1989; Delhomme et al., 2010; White et al., 2011).

Drivers' optimism bias has commonly been measured by asking participants to rate their perceived risk of being involved in or being responsible for a car crash and their perception of their driving skills and capabilities compared to others (see Delhomme et al., 2012; Gosselin et al., 2010; McKenna, 1997; McKenna, 1993). For instance, White et al. (2011) have shown that young drivers perceived themselves to be more skilled and less likely to be involved in a car crash compared to their cohort and hence fostering a sense of invulnerability. Thus, novice drivers' overestimation of their own abilities combined with their lack of driving experience and heighten risk-taking tendencies are

considered to be the chief factors contributing to lack of road safety behaviour and involvement in collisions (Măirean & Havârneanu, 2018).

4.2.2 Optimism Bias: The bias blind spot

Optimism bias might be motivated by the fact that people hold more positive opinions about themselves than about others, and the belief that they are above average generates an illusion of superiority (Garrett & Sharot, 2016). With regards to driving behaviours, young drivers may believe that others would likely agree with their higher self-assessments due to a "bias blind spot" where they recognize bias in others but not in themselves (Dunning et al., 2003). This bias blind spot might be due to egocentrism, where people have extensive knowledge about their own beliefs and thoughts but possess limited knowledge and insights into that of others' (Kruger & Dunning, 1999). This gap, therefore, could lead people to think that others view them as they view themselves (i.e., good drivers) because, at least in their own minds, they are above average drivers.

A second possibility is that the bias blind spot emerges because of people's idiosyncratic definitions of what it means to be a "good" driver (Roy & Liersch, 2013). The use of idiosyncratic definitions can elevate the sense of optimism bias, and this is particularly poignant when tasks or traits are ambiguous, enabling people to generate and then evaluate their performance against definitions that best highlight their strengths (Dunning et al., 1995). For example, there is no universally agreed upon definition for "good" driving abilities, suggesting that people might be using individual (subjective) definitions to judge their own driving skills (Chambers, 2010). Indeed, one person may believe that it is more important to be a safe and law-abiding driver, while another might believe it is more important to be a fast but efficient driver. Also, people may shape or construe the definition of good driving abilities to best fit their skills and think that these skills make them superior drivers (Chambers & Windschitl, 2004). Thus, if people are unaware that their high self-assessment is due to their use of idiosyncratic definitions of driving ability, this opens the possibility that a common definition of "good driving"

abilities might lower their optimism bias. In fact, a study by Dunning et al. (1989) has found that when the skill being assessed is unambiguous, presumably making it more difficult to maintain idiosyncratic definitions of good performance, the optimism bias effect can be attenuated. However, there is still partial support for the effectiveness of unambiguous definitions interventions in reducing optimism bias.

4.2.3 Driving intervention programmes

To address the high rate of collision among young drivers, researchers have offered a range of interventions to improve young drivers' attitudes towards driving. However, despite the abundance of schemes, and the increased emphasis on evaluation (Hauer et al., 2007; McKenna, 2010), there is little consensus on which approach(es), if any, are effective in affecting road-user behaviour. Nevertheless, the few evaluations that have been carried out reported that educational interventions aimed at reducing risky-driving behaviours reduce young drivers' engagement in risky driving behaviours in the short-term time (see Cutello et al., 2020; King et al, 2008; Nelson et al, 2005). Furthermore, a review on the effectiveness of 13 different educational interventions reported that approximately half of them resulted in a positive, albeit small, change in intentions towards risky driving (Hardeman et al., 2002; Poulter & McKenna, 2010) Although evaluations of road safety interventions have demonstrated a small change in young drivers' risky driving behaviours, there are no evaluations on the efficiency of safety interventions on drivers' optimism bias (see Kreuter & Strecher, 1995; McKenna & Myers, 1997, for two exceptions).

One of the few interventions that has been carried out to reduce optimism bias is hazard perception training. Hazard perception training aims to make participants more aware of their own limitations in critical situations (i.e., increasing their insight into their own skill deficits in demanding driving situations) by providing them with a difficult task to reflect on, hence reducing optimism bias in later estimates (Gregersen, 1996). In one study, Perrissol et al. (2011) examined the effect of a two-day, hazard perception training programme with the aim of fostering safer driving behaviour through the study of

hazards in specific driving situations. Before and after the participants attended the two-day training programme, they were asked to complete questions regarding their perceived probability of having a car crash and their optimism bias. The researchers found that the hazard training programme increased personal accident risk perceptions among a group of 25–44-year olds. There is, however, a pressing need to examine whether hazard perception training could be used to reduce young drivers' optimism bias about their skills and driving abilities, and whether this can be done using a briefer, cheaper form that could be utilized routinely in licensing programmes.

In summary, risky-driving behaviours, sensation-seeking, and optimism bias are important risk factors in young drivers' involvement in road traffic collisions. Yet, there are limited evaluations on the effectiveness of interventions aimed at decreasing young drivers' risky-driving behaviours. Specifically, there is a paucity of evidence to date regarding ways to reduce young adults' optimism bias about their driving ability and skills. In response, the current study adds to literature by comparing the extent to which two different manipulations, one based on an unambiguous definition of "good" driving and the other based on a hazard perception test, might improve young drivers' optimism bias. Furthermore, this study also examines how individual factors such as sensation seeking, and risky driving behaviour may impact on the effectiveness of the two interventions. Based on the reviewed literature it was hypothesized that participants in the two manipulation conditions would display lower levels of optimism bias after the interventions than before the manipulations and compared to the control group.

4.3 Methods

4.3.1 Participants

One hundred and twenty-eight participants (F= 103; M= 25) took part in the study. They were all University students, aged 18-25 (M = 20.97; SD = 2.14). The only inclusion criterion was a valid full driver's license for less than 5 years (M = 3.50; SD = 1.39) - participants could therefore be classified as young novice drivers. Participants were allocated randomly to one of the three experimental conditions: a) Standardised Defi-

nition Group (n= 42; F= 34, M= 8), b) Hazard Perception Group (n = 40; F= 32, M=8) and c) Control Group (n= 46; F= 37, M= 9). The groups did not differ in age: Standard Definition Group (M=19.87; SD= 1.90), Hazard Perception Group (M= 20.20; SD= 2.20), Control Group (M= 19.15; SD=2.10). An a priori power analysis showed that 30 participants per condition should have 80% power to detect an effect size (f) of 0.50.

4.3.2 Measures

Hazard Perception Test In the Hazard Perception condition, the participants were asked to complete the 'Official UK government Driving and Vehicle Standard Agency (DVSA) Hazard Perception Test' on a computer screen. The hazard perception was a 20-minute test where participants had to click whenever they detected a hazard. Specifically, the participants viewed 20 video clips which depicted traffic situations filmed from the driver's perspective and included potentially dangerous situations (i.e. accidents). The test's instructions directed participants to use the mouse to click on road users (such as other vehicles, pedestrians, motorcyclists, or cyclists) as soon as they predicted that their car was likely to be involved in a dangerous situation. A response latency was calculated by measuring the time between the first moment that the dangerous conflict could be detected and the first time that the participants clicked on the relevant road user. At the end, the test would provide a score based on how many correct hazards the participants had detected.

Unambiguous Definition of "Good Driving" In the Standardised Definition condition, the participants were supplied with an unambiguous definition of good driving. This definition was taken from the Royal Society of Prevention and Accidents (ROSPA), and presented the 7 most important qualities to be considered a good driver.

Optimism Bias Questionnaire (OB) Participants were asked to complete questions on Comparative Optimism (CO; Gosselin et al., 2010), by reading nine driving related events (i.e. yielding the right-of-way, changing lanes, crossing an intersection, merging onto the highway, driving on winding roads, driving at night, reacting quickly to unexpected events, driving when tired, and driving in poor weather conditions) and were

asked to compare themselves to an average driver of their same sex and age on a 5-point Likert scale (1= *much higher than average*; 5= *much lower than average*). See Appendix B.1.1. Furthermore, participants were asked to complete the Driving Skill Questionnaire (DSQ; Mckenna & Myers, 1997), concerning participants' perceptions of their driving. They were asked to rate how good they are on a variety of driving skills, compared to the average driver of their same sex and age on a 5-point Likert scale (1= *much higher than average*; 5= *much lower than average*). See Appendix B 1.2.

Brief Sensation Seeking Scale (BSSS; Hoyle at al., 2002). The 8-item questionnaire was used to measure participants' self-reported levels of sensation seeking. Participants were asked to indicate how much they (dis)agreed with 8 statements (e.g. "I get restless when I spend too much time at home", "I prefer friends who are excitingly unpredictable") on a five-point scale (1= *Strongly Disagree*, 5= *Strongly Agree*), where higher scores indicate higher levels of sensation seeking. See Appendix C 1.1.

Driver Behaviour Questionnaire (DBQ; Reason et al, 1990). For studies investigating the relationship between personality factors and risky driving, a common measure of self-reported risky driving behaviour is the DBQ. The 50-item version of the DBQ was used to measure participants' self-reported engagement in risky driving behaviours. Each item belongs to one of three subscales: "violations", "errors", or "lapses". Violations are defined as behaviours that deliberately break 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*), where higher score indicate higher risk-taking tendencies. See Appendix C 1.2.

4.3.3 Procedure

The study received ethical approval from the Human Ethics Committee of the first author's institution (ref. 18/19-1078), and participants provided informed consent before participating. At the start of the study, all the participates first completed the OB questionnaire. Next, participants were assigned randomly to one of the three experimental conditions. In the Standardised Definition conditions the participants were supplied with a standard 'by the book' definition of what it means to be a good driver, and the main characteristics of a good driver. After they read the definition carefully, they were asked to complete again the OB questionnaire and to complete the BSSS and the DBQ. In the Hazard Perception conditions the participants were asked to complete the 'Official DVSA Hazard Perception Test' on a computer screen. After the Hazard Perception test, the participants completed again the OB questionnaire and completed the BSSS, and the DBQ. Finally, in the Control condition, the participants were asked to complete the questionnaires without any manipulation. Table 1 illustrates the study design diagram.

	Pre-Intervention	**Manipulation**	**Post-Intervention**
Standarsided Definition	OB	"By the book" definition of good driving	OB, BSSS, DBQ
Hazard Perception	OB	Hazard Perception test with a score at the end	OB, BSSS, DBQ
Control Group		OB, BSSS, DBQ	

Table 4.1: The data collection schedule for each group at each time point.

4.4 Results

4.4.1 The effect of the manipulations on Optimism Bias

All analyses were performed in R version 2.15.3. A one-sample T-Test with a central value of 3 (i.e., neither optimistic nor pessimistic) demonstrated that our sample showed significant levels of OB when comparing themselves to an average driver ($t(209) = 80.35$, $p < .01$). A One-way ANOVA demonstrated that there were no differences in OB scores and its subscales between the three conditions (Standardised Definition, Hazard Perception or Control) at pre-test $F(1,26) = 129.108$ $p > .08$ (see Table 2). The

internal consistency of the OB questionnaire, BSSS scale and DBQ was determined by calculating the Cronbach's α scores for the items of each domain (OB α= .92; BSSS α= .78; DBQ α= .93).

	Pre-Intervention Mean (SD)	**Post-Intervention Mean (SD)**
Standardised Definition	OB Total 110 (3.3) OB-CO 38 (1.8) OB-DSQ 71.9 (2.9)	OB-Total 81.4 (3.7) OB-CO 29.8 (3.3) OB-DSQ 51.5 (1.6)
Hazard Perception	OB Total 118.3 (5.9) OB-CO 40.2 (3.6) OB-DSQ 78 (3.5)	OB-Total 76.1 (4.8) OB-CO 25. 9 (4.2) OB-DSQ 50.2 (5.4)
Control Group	OB Total 106.7 (7.1) OB-CO 32.9 (4.4) OB-DSQ 73.8 (6.5)	X

Table 4.2: Mean scores for Optimism Bias (OB) and its subscales for each condition before and after the intervention

	Post-Intervention Mean (SD)	
Standardised Definition	BSSS	25.9 (4.8)
	DBQ-Total	213.7 (22.7)
	DBQ-Slips	87.4 (10.4)
	DBQ-Violations	88.1 (9.8)
	DBQ-Errors	37.8 (4)
Hazard Perception	BSSS	24.8 (5.9)
	DBQ-Total	220 (13.6)
	DBQ-Slips	90.1 (6.3)
	DBQ-Violations	90.8 (7.1)
	DBQ-Errors	38.3 (3.6)
Control Group	BSSS	34.6 (1.6)
	DBQ-Total	221.7 (12.8)
	DBQ-Slips	90.3 (5.4)
	DBQ-Violations	92.1 (6.3)
	DBQ-Errors	39.1 (3.1)

Table 4.3: Mean scores for Sensation Seeking (BSSS), the Driving Behaviour Questionnaire (DBQ) and its subscales for each condition after the intervention

Preliminary analyses showed no gender differences in initial optimism bias or in the effect of the intervention. Hence, analyses reported here are collapsed across gen-

der. We examined changes in OB using a 3x2 ANOVA with the between-subject factor of Intervention (Standardised Definition, Hazard Perception or Control) and the within-subject factor Time of testing (pre-test, follow-up). There was a main effect of Time $F(2, 205) = 1863.752$ $p < .001$, with lower OB scores after the intervention than before. Furthermore, there was also a main effect of Intervention $F(2, 205) = 71.761$, $p < .001$. Tukey HSD post-hoc comparison revealed higher overall OB scores in the Control Perception condition (mean= 106.7, $p < .001$) than in the Standardised Definition condition (mean = 81.4, $p < .001$) and the Hazard Perception condition (mean = 76.1, $p < .001$). There were also higher OB scores in the Standardised definition condition than in the Hazard perception condition (mean = 81.4) Most importantly, there was a significant interaction of Time x Intervention, $F(1, 205) = 68.939$, $p < .001$. Tukey HSD post-hoc comparison displayed a pre-to-post decrease in participants' optimism bias in both the Standardised Condition (mean change = -28.61, $p < .001$) and in the Hazard Perception Condition (mean change = -42.17, $p < .001$) compared to the control condition. Moreover, the decrease in OB scores was greater in the Hazard Perception condition than in the Standardised Definition Condition (See Figure 1).

We analysed the two OB scales separately to see if the interventions were effective in changing both. Concerning the Comparative Optimism Scale (CO scores), a 3x2 ANOVA revealed a significant main effect of Time $F(2, 205) = 383.0835$, $p < .001$, with lower scores after the intervention than before. However, there was no main effect of intervention ($p = .19$). Again, most importantly, there was a significant interaction of Time x Intervention $F(1, 205) = 29.0896$ $p < .001$. Tukey HSD post-hoc comparison displayed a decrease in both the Hazard Perception condition (mean change in CO = -16.96) and the Standardised Definition Condition (mean change in CO = -13.03) at follow-up compared to control ($p < .001$ and $p < .001$ respectively). Furthermore, there was a greater decrease in CO scores in the Hazard Perception condition than in the Standardised Definition Condition.

Similarly, a 3x2 ANOVA on the Driver Skills Questionnaire (DSQ scores) revealed a

significant main effect of Time F(2, 205) = 383.0835, p <.001, with lower scores after the intervention compared to before. Furthermore, there was a significant interaction of Time x Intervention F(1, 205) = 29.0896, p <.001. Tukey HSD post-hoc comparison displayed a decrease in both the Hazard Perception condition (mean change in CO = -23.6) and the Standardised Definition Condition (mean change in CO = -22.3) at follow-up compared to control (p < .001 and p < .001 respectively). However, the two intervention groups did not differ at follow-up (p =.07).

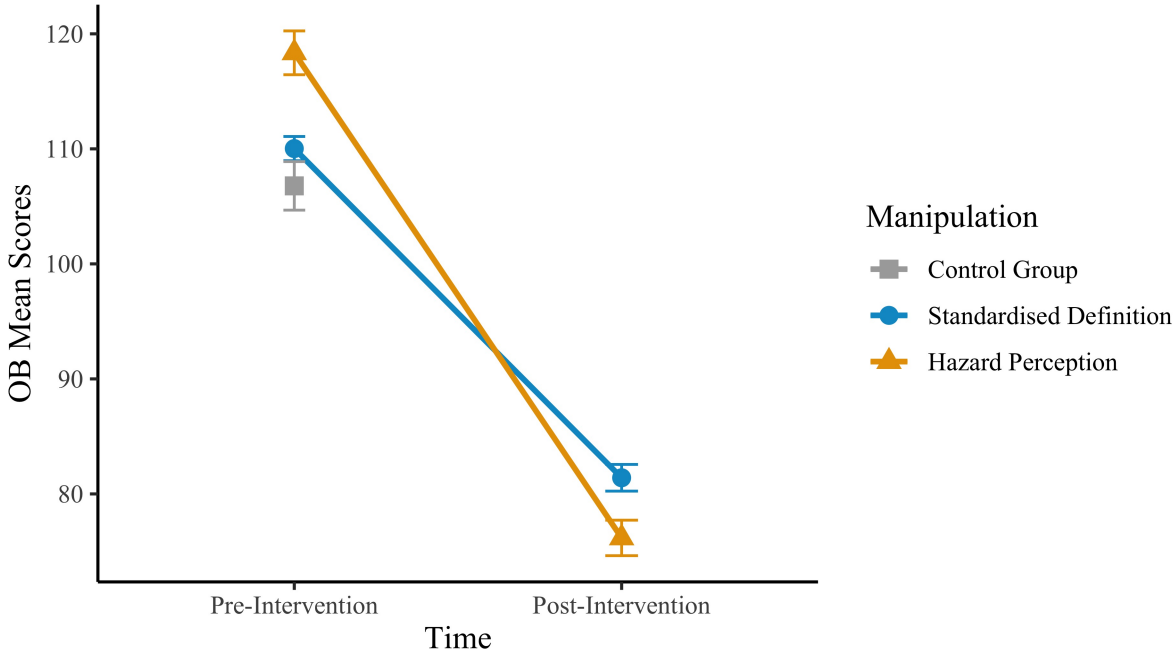

Figure 4.1: Participants' mean OB scores over time, split by Manipulation. Bars represent standard deviations.

4.4.2 Correlations

Pearson correlations were computed to explore the interrelations between past risky driving behaviours (DBQ scores) and the change in OB scores in both intervention conditions. These revealed that providing a Standard Definition produced a greater reduction in OB scores for those with lower DBQ scores (r(38)= .39, p <.01) whereas the effectiveness of the Hazard Perception training was unrelated to participants' DBQ scores (r =(37) = -.23, p =.15; see Figure 2).

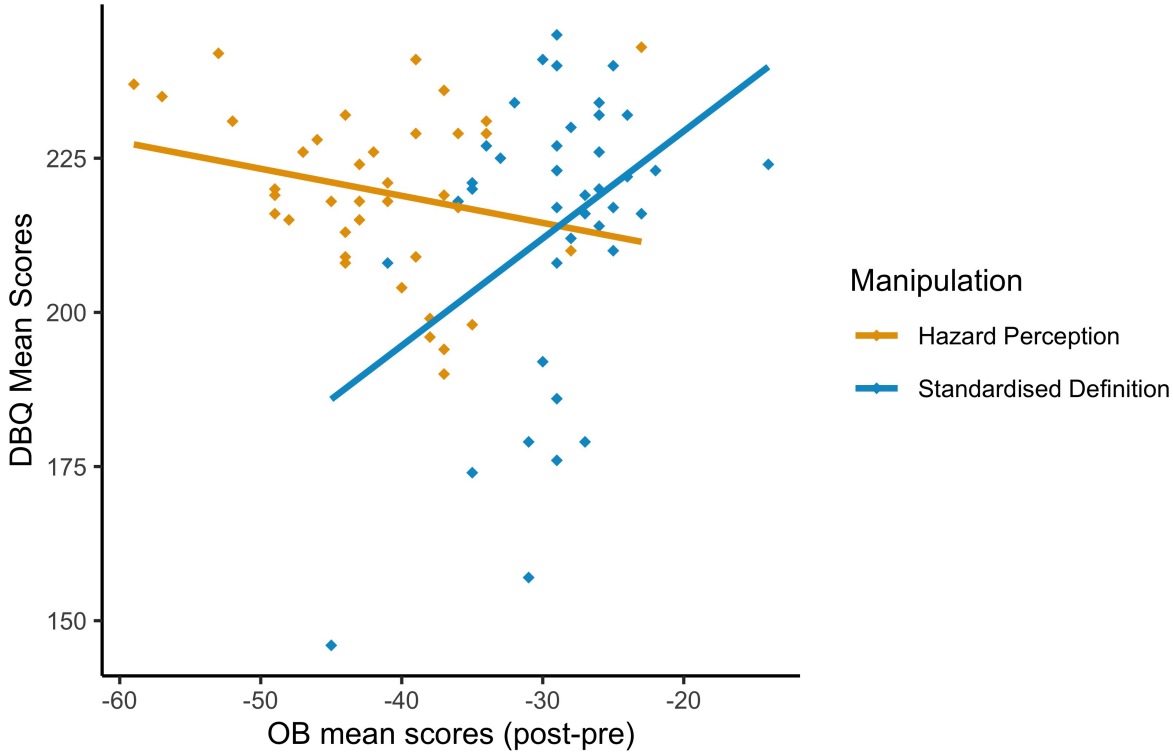

Figure 4.2: Scatterplot interrelations between past risky driving behaviours (DBQ scores) and the change in OB scores (post – pre-intervention), split by manipulation.

Finally, Pearson correlations examined the relationship between sensation-seeking behaviours (BSSS scores) and the change in OB scores (post – pre-intervention). These revealed that Hazard Perception training produced a greater reduction in OB scores for those with higher sensation-seeking scores (r(39)= .30, p <.05), whereas the effectiveness of the Standard Definition was unrelated to participants' sensation-seeking scores (r(39) = -.08, p= 0.5; see Figure 3).

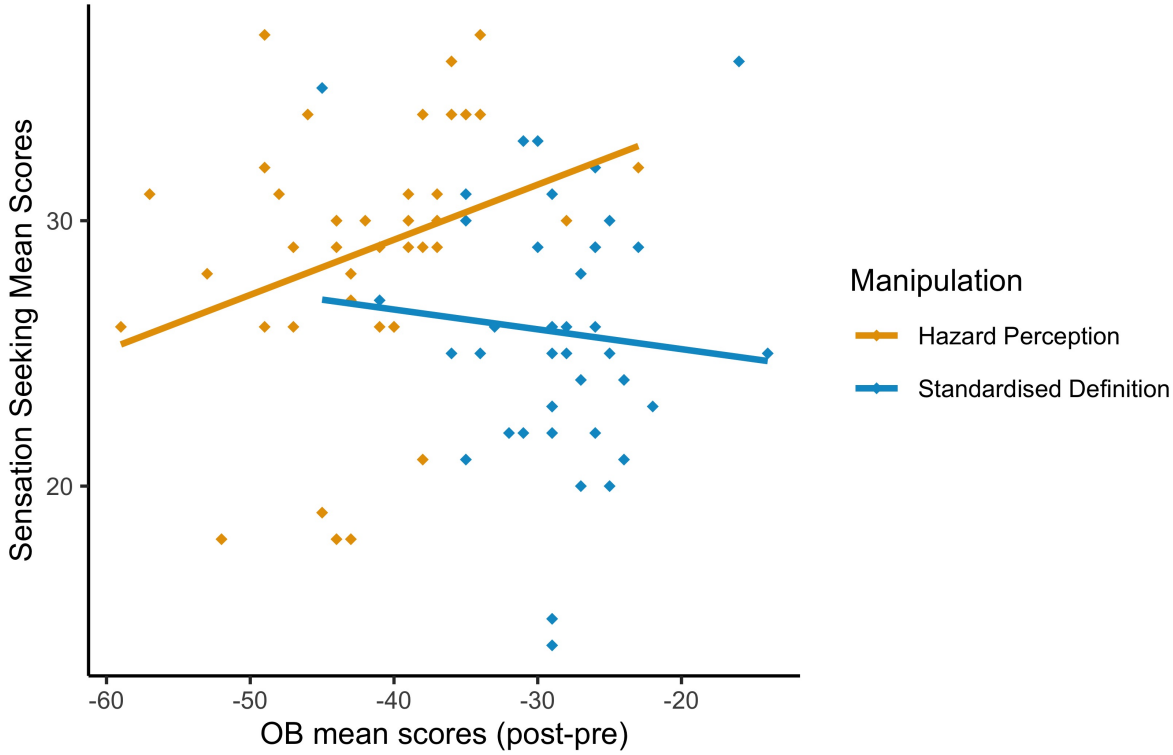

Figure 4.3: Scatterplot of interrelations between sensation-seeking (BSSS scores) and the change in OB scores (post – pre-intervention), split by manipulation.

4.5 Discussion

Previous literature has identified risky-driving behaviour, sensation-seeking, and optimism bias as the key risk factors in explaining young drivers' over-representation in road traffic collisions. Yet, there is limited evidence on interventions aimed at addressing and tackling these risk factors. Indeed, while there are driving intervention programmes that have directly addressed young drivers' risk-taking tendencies, there is a paucity of evidence regarding ways to reduce young drivers' optimism bias. The current study was specifically designed to focus on this matter, by directly comparing the extent to which two different manipulations—an unambiguous definition of "good" driving and a hazard perception test—could improve young drivers' optimism bias.

First, we expected that the participants, in both conditions, would display lower levels of optimism bias after the manipulation compared to before; we also predicted that in both

conditions they would exhibit lower optimism bias compared to the control group. Our findings reveal that both the Standard Definition and the Hazard Perception test were effective in lowering participants' levels of optimism bias. Indeed, both manipulations led to a decrease in optimism bias tendencies. Moreover, our data shows that participants who attended the Hazard Perception test training displayed the biggest decrease in their levels of optimism bias. These results are in accordance with McKenna's (1993) and Perrissol et al.'s (2011) findings, who found that optimism bias can be reduced by a hazard perception test training in highly controlled situations. Correspondingly, our results are in line with previous findings which showed that unambiguous definitions make it more difficult to maintain idiosyncratic ideas and thus attenuate the levels of optimism bias (Chambers, 2010; Dunning et al., 1989; Gregersen, 1996; Sedikides et al., 2002).

Our data not only provide further evidence for the effectiveness of using a brief intervention technique to address young drivers' optimism bias, but also illustrate that even a simple intervention (i.e. reminding young drivers what the definition of good driving is or administering a hazard perception test) is sufficient to impact participants optimism bias. This has one practical implication. As novice drivers around the world often need to display a sign indicating that they are new drivers, they might also be required to post a definition of what it means to be a good driver inside the car. This can serve as a constant 'nudge' or a reminder. Needless to say, this possibility would require further empirical support. In addition, Sheppard et al. (2013) have suggested that just a few studies have linked optimism bias to actual behaviour, and whether optimism bias can have different behavioural consequences. Our results, therefore, increase knowledge in that direction testing whether optimism bias can be manipulated and can influence potential behaviours (or intention).

Together, our data seem to pose a challenge to Delhomme's assertion that optimism bias is quite challenging to modify when it is associated with risk perceptions in traffic collisions (2000). Instead, our results suggest that both manipulations led young drivers

to become increasingly aware of their limited ability to drive safely compared to the average driver of the same sex and age, providing promising results regarding our ability to reduce optimism bias among this important age group.

Second, our findings indicated a positive relationship between changes in optimism bias and past risky driving behaviours and sensation-seeking. That is, a decrease in optimism bias was greater for those with high risky driving behaviours in the standardise definition condition. In addition, the results also revealed that a decrease in optimism bias was greater for those with high sensation-seeking tendencies in the hazard perception condition. These findings contradict several previous studies which suggested that sensation seeking-seeking and past risky driving behaviours may be a barrier to effective educational interventions, as they are conceptualised as stable personality traits (Cross et al., 2013; Gianfranchi et al., 2017; Pizam et al., 2004; Zuckerman, 2007). Our findings suggest that these interventions may be best effective if tailored to these personalities. DBQ is likely to reflect risk taking specifically in the driving domain. Individual with high scores seem more resistant to the Standard Definition approach perhaps because the definition is most different from their current behaviour. Individuals with lower sensation-seeking scores gained most from more experiential training. One possible explanation is that these individuals are most sensitive to and ready to learn from potential hazards. More work needs to be done to understand the mechanisms underlying these findings. In fact, as this was an exploratory study on how sensation-seeking and risky driving behaviour might influence optimism bias, future research should investigate more in depth how these personality factors influence tailored road safety interventions. Nevertheless, our finding that an unambiguous definition of “good” driving can be particularly successful in decreasing optimism bias with groups who are less risky, and that hazard perception training can be particularly successful in decreasing optimism bias in groups who are less thrill-seekers, offers promise for the success of tailored behavioural intervention. In addition, it also provides insight into how different interventions could target specific population (or individuals with certain personality characteristics) to decrease young drivers’ involvement in road traffic collisions, and decrease young drivers’

levels of optimism bias.

This study has several limitations. First, the use of immediate post-intervention data could have created a response bias. To mitigate this limitation, the study used pre-validated scales to enhance the reliability of the data obtained from the participants. Nevertheless, future research would need to evaluate whether similar interventions have a long-lasting effect. At this point, we are unable to indicate how long our manipulation would last. Second, our sample was not balanced according to gender. Previous research has found that females are safer drivers and more likely to accept the recommendation of educational interventions compared to males (Cutello et al., 2020; Goldenbeld et al., 2008; Tay & Ozanne, 2002). Consequently, future work should focus on gender differences in the implementation of unambiguous definition of "good" driving and the other based on a hazard perception test in mitigating optimism bias. And third, the present investigation only measured intention and not actual driving behaviour. However, several papers have reported that a linkage between intentions and driving behaviour (Ba et al., 2016; Gianfranchi et al., 2017), thus it possible to predict that the implications of the of both optimism bias and sensation seeking in driving behaviours as revealed in this work might be replicable also when considering real-on road context.

In summary, reducing risky driving behaviour, and thus collisions, offers not only the opportunity to save lives, but also to reduce injuries and financial cost. This research not only found direct effects of two different interventions in improving young drivers' optimism bias, of tailored interventions that could be more effective towards high risk-takers and high sensation-seekers, but also provided promising results for easy and cheap interventions that could help decrease young drivers' overrepresented in road traffic collisions. As an example, one suggestion might be that all new drivers who have would need to post in their car a sign that includes the definition of a good driver. A second possibility is that all novice drivers undergo a hazard perception training test twice a year for the first 2 years of driving.

In conclusion, the findings provide evidence on the effectiveness of small behavioural change techniques to decrease optimism bias tendencies. Nevertheless, additional manipulations are needed to gain more knowledge on which elements could be more effective in reducing young drivers risky-driving behaviours. For these reasons, in the next chapter we will manipulate the framing of road safety messages, as well as the mode of delivery to assess whether these elements can increase young drivers' message acceptance.

Chapter 5

Study 4. Taking the fear out of Virtual Reality: An experiment

5.1 Chapter Abstract

The results from study three suggested that two brief behavioural change manipulations can help decrease young drivers' optimism bias. Nevertheless, as previously discussed, traditional RSIs rely on scare tactics, fear appeals, to motivate young drivers to change their future driving behaviour. Despite being challenged, fear appeals continue to be used both in mass media campaigns and local young driver interventions. As described earlier, a parallel line of research has championed the use of positively-framed road safety interventions, which have been found to be effective in reducing young drivers' risky driving compared to traditional fear appeals. Additionally, new modes of delivery are starting to be used more frequently to increase young drivers' interest towards educational RSIs. Virtual Reality (VR) is a prime example.

In the present chapter, we examined the impact of fear vs positively-framed road safety films and traditional technologies (2D screen) vs emerging technologies (e.g. VR) on young drivers' self-reported risky driving behaviours. Theoretical frameworks regarding the strengths and weaknesses of fear appeals and positively-framed appeals are discussed to aid future research. Practical implications on the future usage of VR are also considered.

5.2 Introduction

With over 1 million people dying in road traffic collisions globally, and young novice drivers (aged 15–25) accounting for 48% of road deaths worldwide (WHO, 2018), finding a means of improving young driver safety is of vital importance. While there are

plethora of safe driving interventions targeted at reducing young drivers' risky driving behaviours, their success has varied (Peck, 2011; Raftery & Wundersitz, 2011). Here, we examined the impact of fear vs positively-framed appeals as well as traditional technologies (2D) vs emerging technologies (VR) on young drivers' self-reported risky driving behaviours. Ultimately, examining the impact of these variables on the effectiveness of safe driving interventions could impact their development and implementation across the globe.

Most safe driving interventions have utilised fear-based materials and films, which portray a crash scene in a graphically explicit manner (Tay & Ozanne, 2002; Tannenbaum et al., 2015). The assumption governing this approach is that arousing a sense of fear (by depicting an extremely aversive consequence, such as death) will persuade drivers to alter their attitudes, intentions, and behaviours and drive more safely (Lewis et al., 2008; Witte & Allen, 2000). Indeed, when placed in the right context, fear appeals lead to behavioural change and reduced risky driving (see Tannenbaum et al., 2015; Witte & Allen, 2000; Xu et al., 2015). Fear appeals might work because they raise viewers' awareness of potential risks, attract and hold attention to protective information, and provide enough motivation to avoid engaging in unsafe behaviours (R. Tay & Ozanne, 2002; Thompson et al., 2009). Consistent with this notion, drivers perceived road safety messages formulated as fear appeals as relatively more 'attention-grabbing' and 'attention-retaining' than other approaches, making them more memorable (Lewis, Watson, White & Tay, 2007; Tay & De Barros, 2008).

While fear-based programmes are the most common educational interventions used in road safety, mixed findings have led researchers to suggest that fear appeals could generate counterproductive results, increasing rather than decreasing risky behaviours (see Blondé & Girandola, 2019; Carey, McDermott, & Sarma, 2013; Jessop et al., 2008; Kok, Peters, Kessels, Hoor & Ruiter, 2018). For example, fear appeals have been shown to enhance defensive reactions, which are characterized by avoidance of relevant threatening information and message rejection (Brown & Locker, 2009; Hastings

& MacFadyen, 2002; Kempf & Harmon, 2006).

A parallel line of research has championed the use of positive appeals (e.g., humor, empathy, role-modeling, compassion) in road safety interventions (Monahan, 1995; Nabi, 2002). Lewis et al. (2007) showed that positive, rather than fear, appeals were more effective in reducing risky driving behaviours (see also Zhao, Roditis & Alexander, 2019) and that positive appeals might have a particular advantage for individuals at high risk of collisions, namely, young drivers. Santa and Cochran (2008) examined the effectiveness of empathy, fear and informational appeals used in anti-drink driving interventions in a sample of young drivers. They found that the empathy approach (i.e., highlighting the consequences of one's behaviour for others) was perceived to be the most effective and elicited the most positive affect. Hope has also been found to be a suitable substitution to fear appeals in the promotion of safer behaviours (Nabi, 2016). Positive appeals may help draw new attention to an overly familiar issue (Nabi, 2002), and reframe and reconsider issues that individuals may feel as not being particularly relevant to them (Monahan, 1995). Overall, these results provide evidence that positive appeals might serve as more effective alternatives to fear ones.

Road safety interventions have varied not only the content of messages but have also capitalized on emerging technologies to vary the mode of presentation. Since 2016, the Fire and Rescue service in the United Kingdom (UK) - the main organisation providing driver safety interventions - has used Virtual Reality (VR) to give thousands of young drivers a realistic experience of a road traffic collision. Likewise, Ford Motor Company has implemented VR technologies to help European cyclists and drivers learn to detect road hazards from another's perspective – in the hope of reducing collisions in the process (e.g. WheelSwap, Forbes 2018). As VR technology offers a sense of "being there" (Slater, 2009), and provides the illusion that the events occurring are authentic (Kim & Rizzo, 2005), its usage has grown dramatically in the entertainment industries (Morris, 2015), and in clinical applications (e.g., Anderson et al., 2013; Shiban et al., 2013; Smith et al., 2015).

While VR has shown some success with clinical trials, it does have limitations. Firstly, there can be a lack of transfer of learning from VR to real life environments, perhaps because people treat VR as if it were entertainment (Lin, 2017). Secondly, some studies report a high number of dropout rates, partially due to cyber-sickness, nausea, and dizziness induced by using VR headsets (Valmaggia et al., 2016). Thirdly, there is little to no data on the impact of VR usage in extreme fear appeals, as currently used by the Fire and Rescue Service in the UK. In addition, there is concern that VR's ability to provide realism might backfire. That is, experiencing fear appeals (such as car crashes) via VR might aggravate already existing defensive mechanics, such as disengagement, "not-real" strategies, avoidance (Lin, 2017), message rejection and consequent risk-taking (Harré et al., 2005). Finally, to our knowledge, VR's effectiveness in road safety programmes has simply not been tested.

To address these gaps in the literature, the present study investigated the effect of Film Content (fear versus positive) and Delivery Mode (2D versus VR) on the effectiveness of a road safety educational film.

We measured participants' risky driving behaviours in two ways. First, a self-report measure of risky driving, the Driver Behaviour Questionnaire (DBQ; Reason et al., 1990) was administered pre-intervention and at the two-week follow-up. Self-reported risky driving measured by the DBQ has been shown to correlate with collision liability (Parker, Reason, Manstead, Stradling, 1995) and self-reported crashes (Wåhlberg, Dorn, & Kline, 2009). Second, at follow-up participants completed the Vienna Risk-Taking Test-Traffic (Hergovich, Bognar, Arendasy, & Sommer, 2007), a standardized and widely accepted behavioural measure of risky driving. The Vienna Risk-Taking Test-Traffic is based from Wilde's (1994) theory of risk homeostasis in risky driving. This model argues that people accept a certain degree of risk (target risk value) if they achieve an expected gain (e.g., arriving at a location earlier) in exchange. The target risk value is subjective and differs between individuals. If in a specific traffic situation, the perceived danger exceeds this subjective risk target value, the person will reduce risky driving behaviours.

If the perceived danger is seen as less risky than the risk target value, drivers continue to carry out risky activities. In the Vienna Risk-Taking Test, participants are presented with video clips of driving situations that require a situation-contingent reaction (e.g., considering whether to overtake another car in icy conditions) and are asked to indicate if and when they regard the situation as too risky to carry out the behaviour. Thus, the Vienna Risk-Taking Test-Traffic uses a person's reaction time as the prime indicator of their willingness to engage in risky driving activity—the longer they take to abort the situation-contingent behaviour, the more willing they are to take risks.

Several studies have previously used the Vienna Risk-Taking Test to directly measure risk taking behaviour in various traffic situations (Fisher, Kastenmüller & Asal, 2012), have linked risky driving measured by the Vienna Risk-Taking Test to variables that are known to increase risky road traffic behaviour (e.g., voluntary sleep loss; Rusnac, Spitzenstetter, & Tassi, 2016), and have used it to evaluate the effectiveness of road traffic intervention programmes (Chraif, Anitai, & Alex, 2013). Indeed, the German Federal Highway Research Institute recommends dynamic reaction-time exercises, such as the Vienna Risk-Taking Test, as a possible measure to improve the theoretical driving test that all German drivers needs to pass to obtain a driving licence (Malone, Biermann, Brünken, & Buch, 2012). This is because reaction-time measures for risky driving allow for assessing drivers' hazard perception and in how far they can anticipate and react to risky driving situations.

Based on the literature reviewed above, the present investigation had several guiding hypotheses. First, as fear appeals tend to lead to reduced engagement with the risky information and its related outcome, we hypothesised that viewing fear appeals would increase self-reported risky driving and reaction times to risky driving situations in the Vienna Risk-Taking Test. Conversely, viewing positive appeals should reduce risk taking intentions and reaction times, since positive appeals have been shown to increase the relevance of and engagement with risky information. The effect of positive and fear appeals on risky driving should be more pronounced in the VR than 2D conditions,

because of the hyper-reality in the depiction of events in VR compared to 2D formats.

5.3 Methods

5.3.1 Participants

One hundred and forty-six participants (F= 102; M= 44) took part in the study. They were all University students from the School of Psychology, aged 18-25 (M = 20.97; SD = 2.14). The only inclusion criterion was a valid driver's license for less than 5 years (M = 3.25, SD = 1.23) – participants could therefore be classified as young novice drivers. Participants were allocated randomly to one of the four experimental conditions: a) Fear VR (n= 39); b) Positive VR (n= 36); c) Fear 2D (n= 37) and d) Positive 2D (n= 34). An a priori power analysis showed that 32 participants per condition should have 80% power to detect an effect size (f) of 0.50.

5.3.2 Measures

Road Safety Films The road safety films, both negative and positive, were developed for,and used by, the Fire and Rescue Service across the UK. Both films were 6 minutes long, with the same three professional actors playing the parts of young adults driving in a car. A male actor was the driver, and two female actors were the backseat passengers. The participants saw the film from the point of view of the front passenger and were able to see the other passengers interact with the driver. In the fear-based film, one back seat passenger was not wearing a seat-belt and both passengers were disturbing the driver, while he was speeding along a narrow road. As a result of the driver's speeding and distracted driving the car was involved in a road traffic collision. The crash and its aftermath are shocking, and the participant witness the backseat passenger's death, the other passenger's severe injuries, and how the Fire and Rescue Service and the paramedics deal with the situations and the bodies.

In the positively-framed film, the same three friends are driving, and again a backseat passenger is not wearing a seat-belt. The driver immediately slows down and encourages her to wear the seat-belt. The backseat passengers are also asked to stop dis-

tracting the driver and the passengers caution the driver to be more careful while driving on a narrow road. Unlike the fear-based film, at the end of the positively-framed film, the driver and his passengers arrived safely at a house party, and the film ends with the three friends being welcomed by other guests at the party.

Driver Behaviour Questionnaire (DBQ; Reason at al., 1990) The 50-item version of the DBQ was used to measure participants' self-reported engagement in risky driving behaviours. Each item belongs to one of three subscales: "violations", "errors", or "lapses". Violations are defined as behaviours that deliberately break 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)*, where higher score indicated higher risk-taking tendencies (See Appendix C 1.2.). Cronbach's alphas for each of the DBQ subscales [violations, errors and lapses] ranged from .61 to .93, across the data collection points, indicating good and very good reliability for all measures.

Emotional Arousal (Keller & Block, 1996) The 21-item Emotional Arousal Scale measured the level of emotional arousal that participants experienced while watching the films. Participants were asked to rate their emotional arousal on a five-point scale (1= strongly disagree, 5= strongly agree), where higher scores indicated higher emotional arousal response (e.g. "The safety message makes me feel very afraid"; See Appendix D.1.1). Cronbach's alphas for the Emotional Arousal was .90, indicating very good reliability.

The Vienna Risk-Taking Test Traffic (Hergovich, Bognar, Arendasy, & Sommer, 2007; Hergovich et al., 2005) The Vienna Risk-Taking Test Traffic was used to assess the participants' willingness to take risks in potentially dangerous driving situations. The

test consisted of 24 videotaped dangerous traffic situations presented from the driver's perspective on a computer screen. The videos were filmed from the inside of the car, enabling participants to easily picture themselves as the driver of the car. The traffic situations can be categorised into (1) speed choice and overtaking situations and (2) decisions at intersections. Participants view each 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. Weather conditions also varied between scenes. Participants viewed one practice trial and then completed 23 experimental trials. Response latency (in seconds) was recorded as a measure of the participant's propensity for risky driving. The time that elapsed between the start of the sequence and the participant's decision to abandon it was employed as a dependent measure of risk-taking inclination in critical road traffic situations (i.e. the longer participants wait to press the button in order to abandon the critical situation, the higher the risk-taking). We checked for outliers, and three participants' scores were 3SD above or below the mean, hence were removed from the main analysis.

Figure 5.1: Screenshot from the Vienna Risk-Taking Test- Traffic (Hergovich, Bognar, Arendasy, & Sommer, 2005)

5.3.3 Procedure

The study received ethical approval from the Human Ethics Committee of the first author's institution (ref. 18/19-999), and participants provided informed consent before participating. The participants were recruited through the University's point system, according to which they were allowed to receive credit points for their participation in the study. After completing an online version of the DBQ (Reason et al., 1990), participants were assigned randomly to one of the four experimental conditions. In the VR conditions the film was presented using a HTC VIVE Virtual Reality headset. In the 2D conditions the film was presented on a computer screen. After watching the films, the participants were asked to complete an online version of the Emotional Arousal Scale (Wauters & Bregman, 2013). At follow-up, 2 weeks later, participants completed an online version the DBQ (Reason et al., 1990) again as well as the Vienna Risk-Taking

Test-Traffic on the computer (Hergovich, Bognar, Arendasy, Sommer, 2005).

5.4 Results

Preliminary analyses checked gender differences, but no significant main or interaction effects of gender emerged. Hence, analyses reported here collapsed across gender.

5.4.1 Manipulation Check

We performed a manipulation check by examining participants' scores in the DBQ at pre-test to assess whether there were any differences between conditions at the start of the experiment. We performed a 2x2 ANOVA to investigate the effect of Delivery Mode (VR or 2D) and Film Content (positive vs fear) on the mean DBQ scores at pre-test. There were no significant differences between conditions at pre-test (all $ps > .09$; see Figure 1).

To ensure that the films content did not impact arousal differently, we also examined participants' emotional arousal after viewing the road safety films. A 2x2 ANOVA with the independent variables Delivery Mode (VR or 2D) and Film Content (positive or fear) showed a main effect of Delivery Mode $F(1,137) = 102.571$, $p < .01$. Participants' in both the positive and fear VR conditions displayed a higher emotional arousal response compared to the positive and fear 2D conditions.

5.4.2 The effect of Film Content and Delivery Mode on the effectiveness of the road safety film

Concerning self-reported engagement in risky driving (DBQ scores), a 2x2x2 mixed ANOVA with the between-subject factors Delivery Mode (VR or 2D) and Film Content (positive versus fear) and the within-subject factor Time of testing (pre-test, follow-up) revealed a significant three-way interaction of Time x Delivery Mode x Film Content, $F(1, 276) = 4.303$, $p<.001$. There were also significant two-way interactions of Time x Film Content, $F(1, 276) = 41.949$, $p < .001$, and Film Content x Delivery Mode $F(1, 276) = 3.703$, $p < .01$). Tukey HSD post-hoc comparison revealed a significant pre-to-post decrease in participants' self-reported engagement in risky driving behaviours in the

positive VR condition (p <.001) and in the positive 2D condition (p <.05). Moreover, there was a significant pre-to-post increase of participants' engagement in risky driving behaviours in the fear VR condition (p <.05). No difference was found pre-to-post in the fear 2D condition (p =.09). Tukey HSD post-hoc comparison also revealed that the fear VR follow-up condition significantly differed from the fear 2D follow-up (p <.001), the fear 2D follow-up significantly differed from the positive 2D follow-up (p <.001), and the positive 2D follow-up significantly differed from the positive VR follow-up (p <.001; see Figure 1).

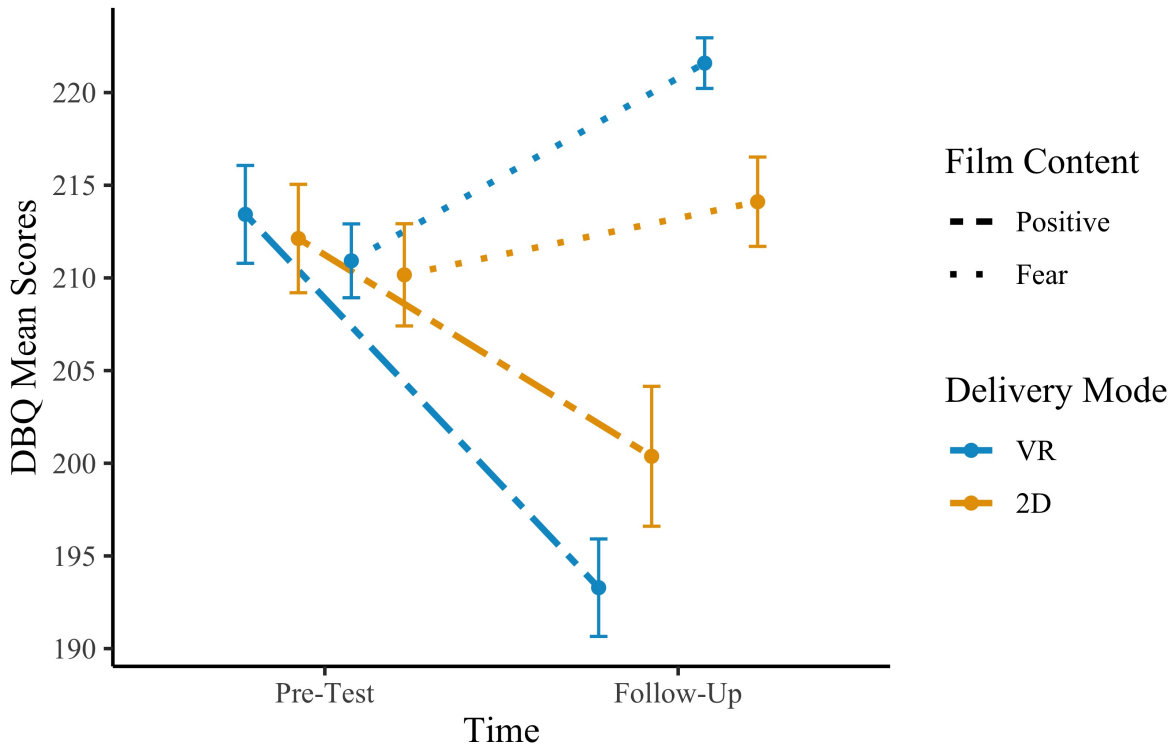

Figure 5.2: Participants' mean DBQ scores, by Film Content and Delivery Mode. The bars represent Standard Errors.

5.4.3 Vienna Risk-Taking Test

A 2x2 ANOVA with the between-subject factors Delivery Mode (VR or 2D) and Film Content (positive versus fear) and the dependent variable Mean Reaction Time revealed a significant main effect of Film Content, F(1, 134) = 3.958, p <.05. Participants in the fear conditions showed higher RTs, thus indicating more risky driving behaviours,

than participants in the positive conditions (see Figure 2). No differences were found between the VR and 2D delivery mode (p = 0.9).

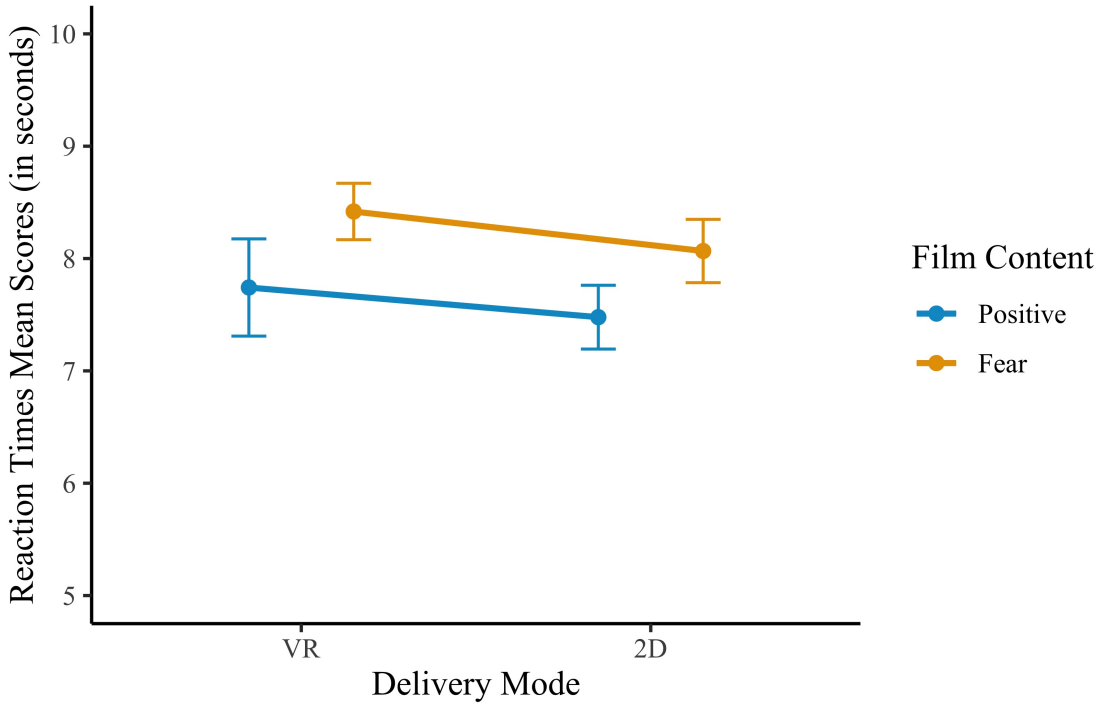

Figure 5.3: Participants' Reaction Time mean scores, by Film Content and Delivery Mode. The bars represent the Standard Errors

5.5 Discussion

According to the World Health Organization (2018), road traffic collisions are the leading cause of death among young adults. Finding the best means to tackle this issue, is thus of paramount importance. Studying currently-used driver safety interventions employed by the Fire and Rescue service across the UK, this research provides the first examination of the effects of both message content (fear versus positive) and mode of delivery (2D versus VR) on risky driving behaviour among young drivers.

Results showed that fear appeals failed to decrease young drivers' risky driving behaviours, as measured by both self-reported and objective measures of risky driving. Specifically, participants who viewed the fear VR film reported riskier driving behaviours at follow-up and exhibited heightened risky driving behaviour. Our results, thus, lend

further support to a growing body of evidence showing that fear appeals are not effective in reducing risky driving behaviours. In fact, fear appeals seem to have the opposite effect increasing risky driving behaviours over time (de Hoog et al., 2008; Jessop et al., 2008). Exposing participants to an extreme and graphic collision tends to activate defensive mechanisms, such as paying attention to threatening messages for a shorter time (S. Brown & Locker, 2009), disengagement, message rejection (Hastings & MacFadyen, 2002) and an increase in risky behaviours (Harré et al., 2005). Using fear appeals in driver safety interventions might, paradoxically, lead to increase in risky behaviour rather than a decrease. Our results, coupled with others, cast serious doubt on the effectiveness and extensive utilisation of fear appeals.

As the first study to examine the usage of VR in driver safety programmes, our results caution against the usage of VR in driver safety programmes, when combined with fear appeals. As VR is designed to provide a more realistic experience of driving collisions (Lin, 2017; Parsons & Rizzo, 2008), it is likely that participants' experience of the collision in the fear condition was more vivid than those viewing it in 2D. Indeed, in the 2D films the participants experienced the events as spectators, creating a distance between themselves and the avatars (Christoph et al., 2009; Lin, 2013). Arguably, VR's capacity to deliver a more realistic experience, might heighten participants' emotional arousal and exacerbate participants' tendency to disregard and dismiss the message, rendering the fear appeal even less effective (Witte, 1992, 1996).

Conversely, our study reveals that positively-framed messages led to a reduction in risky behaviour. In contrast to the fear appeals condition, using VR in combination with a positive message further reduced participants' risky behaviour compared to the positive 2D condition. Hence, while participants who viewed the positive messages showed a decrease in self-reported and objectively-measured risky driving, participants who viewed the positive VR film exhibited the biggest decrease in risky driving behaviours. Consequently, using VR in intervention strategies can be useful, but only when coupled with positive appeals.

Our results, thus, provide key insights about the role of positive vs fear framed messages in tackling risky driving behaviour among young drivers. On the one hand, they extend previous work regarding the effectiveness of positively framed messages in promoting road safety (Delhomme et al., 2012; Lewis et al., 2008), through the portrayal and modelling of "safe" driving behaviours and the positive consequences of adhering to that behaviour (Hoekstra & Wegman, 2011; Lewis, Watson, White, & Tay, 2007). In addition, they contend that allowing the participants to experience what proactive behaviours can lead to and giving them the illusions that the events occurring are authentic through VR (Kim & Rizzo, 2012) can encourage the creation of positive role models and strategies to be safer on the roads, which in turn decreased risky driving behaviours (Zhao et al., 2019). Taken together, our data question the usage of fear appeals and promote the employment of positively-framed messages. Importantly, it shows that the effectiveness of novel technologies, such as VR, depends on the type of messages employed.

While this study is the first to examine the impact of VR vs 2D and fear vs positively-framed appeals in driver safety programmes, it does have several limitations. First, our sample was not balanced according to gender. Previous research has found that females are more likely to accept the recommendation of fear appeal messages compared to males (Goldenbeld et al., 2008; Tay et al., 2001). Consequently, the results of our study might actually underestimate the effects of fear- and positive appeals on risky driving. Future work should focus on gender differences in the implementation of fear vs positively-framed appeals and VR technologies. Secondly, we did not measure actual driving behaviour.

In summary, safe driving interventions are largely focused on and targeted towards young drivers. Reducing risky driving behaviour, and thus collisions, offers not only the opportunity to save lives, but also to reduce injuries and financial cost. With millions of young adults being exposed to different driving interventions, it is vital that these programmes are designed in the best possible way. This research provides the first exami-

nation of the effects of both message content (fear versus positive) and mode of delivery (2D versus VR) on risky driving behaviour among young drivers. The present results caution against further use of fear appeals, especially when delivered via VR technologies. Rather, using positively-framed messages, regardless of the delivery mode (2D or VR), seem to alter driving behaviour in the intended direction.

Chapter 6

General Discussion

According to the World Health Organization (2018), in Europe approximately 40,000 fatalities occur in road traffic collisions every year. The number of additional non-fatal accidents is much higher, standing at 50,000 (Department of Transport, 2017). Amongst road-users, young drivers aged 16-19 are more than twic eas likely to die in a collision as drivers aged 40-49 (Fylan & Strandling, 2014). Hence, road traffic collisions are a long-standing challenge for public health and safety worldwide. It is, therefore, of paramount importance to find the best means to tackle this issue.

There were two overarching aims of the present research: a) to assess already existing road safety intervention targeted to improve the safety of young novice drivers; b) to better understand young drivers' personality factors, which underpin their higher collision risks. The goal was to identify which techniques do and do not work and to use this information to improve the design of future interventions that are more likely to yield success in reducing the number of people killed or injured on the roads.

An overview of the four studies conducted and their main findings can be found 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 mentioned above. Finally, practical implications will be discussed.

Study	Measures	Main findings	Conclusions
1. Longitudinal Evaluation of L2L	- Attitudes and Intentions based on components of the Theory of Planned Behaviour. - Evaluation of Follow-up Sessions	- Females reported much safer attitudes after attending the intervention - Males reported smaller improvements on their attitudes and intentions. - Peer-led educational event was compared to the adult-led	- The intervention was effective in improving young females' intentions to be safe - Young males were less affected by fear appeal threats. - Young males' over-ride consideration of negative outcomes, and this may be driven by their optimism bias
2. Survive the drive: optimism and a driver-education program among military personnel	- Optimism Bias Questionnaire - Willingness to Take Risks Questionnaire - Attitudes to Change	- Young military personnel aged 18-25 and low-ranking officers reported higher levels of optimism bias - Young military personnel aged 18-25 reported lower attitude to change	- Optimism bias was found to be the most prominent in young military personnel aged 18-25 - Optimism bias was related to young military personnel's willingness to take risks
3. Reducing optimism bias in the driving seat: comparing two interventions	- Hazard Perception Test - Unambigous Definition - Optimism Bias Questionnaire - Brief Sensation Seeking Scale - Driver Behaviour Questionnaire	- Both brief interventions reduced optimism bias levels - Hazard perception had the strongest effect - The effectiveness of the two interventions differed across individuals depending on their sensation-seeking and past risky driving tendencies.	- Both interventions were effective in improving young drivers' optimism bias. - Standardized definition was more effective in reducing optimism bias for those with lower risky driving tendencies. - Hazard perception produced the greatest reduction in optimism bias in individuals with lower sensation-seeking tendencies.
4. Taking the fear out of Virtual Reality: An experiment	- Road Safety Films - Driver Behaviour Questionnaire - Emotional Arousal Scale - The Vienna Risk-Taking Test Traffic	- Positively-framed films significantly decreased self-reported risky driving behaviours in both modalities, but especially when viewed in VR format. - Fear appeal film, when shown in VR increased young drivers' self-reported risky driving behaviours	- Using positively-framed messages, regardless of the delivery mode (2D or VR), seem to alter driving behaviour in the intended direction

Table 6.1: Summary of findings from all the studies

6.1 Research aim one: investigating already existing road safety intervention

The findings from each study provide insight into why young people may engage in risk-taking behaviours and thus be at higher risk of a collision. Based on the present findings, we can draw a number of conclusions. The first study presented in this research work aimed at evaluating the extent to which a British educational RSIs called Learn2Live could improve young drivers' risky driving behaviours, and assessing the effectiveness of a peer-led follow-up educational event compared to an adult-led follow-up event. The first study found that whilst young females reported much safer attitudes towards risky driving after attending L2L, young males showed only a modest improvement. In

fact, males reported riskier attitudes three months after L2L, indicating 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 behaviours than females (e.g. Lonczak et al, 2007), and so more effective ways to reduce their risk is critical.

In addition, the findings are consistent with existing evidence, which reveal that males are less likely to respond to fear-appeal-style- persuasion (Alonso et al., 2019; Lewis, Watson, White, & Tay, 2007), recognise that fear appeals are trying to scare them (Crohn, 1998) and find their messages irrelevant (Hastings & MacFadyen, 2002). Coupled with previous research, these findings suggest that RSIs need to be sensitive to the audience they are presented to and the speakers delivering them need to better consider how differential approaches may increase message acceptance. For instance, even though the results from study one did not support differences between the peer-led educational intervention and the adult-led educational intervention, the former was globally preferred by the participants compared to the adult-led follow-up event. This finding could help give more insight on what young people overall prefer and, therefore, what could potentially help reduce risky driving behaviours in this cohort. In fact, the findings are in line with the existing, though limited, evidence concerning the efficacy of peer-to-peer education (Colby & Haldeman, 2007; Whitaker & Miller, 2000). Because young people are naturally more inclined to try and enhance their in-group similarity by conforming to the norms of their social group, peer leaders have the potential to effectively alter a social norm amongst young people to reduce risky driving (Beshers, 2007). Thus, future research should consider how we can use young drivers' social groups to modify the perception that risky driving is a means to attain social prestige (Geedipally et al., 2008; White et al., 2009).

However, despite the potential of peer-to-peer education, the number of interventions promoted or evaluated remains limited. One interesting and crucial idea that emerged from the first study is that there is not a 'one-size-fits-all' approach in targeting young

drivers' risky behaviour. RSIs need to consider the role that the audience, the age and the surrounding context in which young drivers resides, specifically young males, have; as well as the individual personality characteristics that motivate young people to behave in the way they do, and the opinions that young people have in regards to RSIs, in order to more effectively reduce young drivers' collision rates.

Hence, the results from study one, which suggest that the fear-appeal-style intervention was particularly ineffective for young males, may be due to personality characteristics that motivate them to ignore long-term negative consequences, such as willingness to take risks and optimism bias. For these reasons, the second study of this research was conducted predominantly on males risk-takers. Specifically, because road traffic collisions have been a growing safety concern for the military, and military personnel have been shown to be high risk-takers and highly optimistic about their ability to deal with dangerous situations, the target of the second experiment was military personnel. The aim was to gain further knowledge not only on males', especially young males', opinion of fear appeal RSIs but also to better understand whether optimism bias underpins greater risky driving behaviours.

In the second study it was found that optimism bias and willingness to take risks were in fact more prominent in young, low ranking, military personnel aged 18-25 compared to older, higher ranking, military personnel. These results are consistent with previous work on young drivers and optimism bias, which found that young drivers aged 18-25 report higher tendency to perceive themselves as better than their same-age peers and underestimate their personal risk compared to others (Fernandes et al., 2007; Gosselin et al., 2010; Harré et al., 2005; White et al., 2011). Furthermore, when examining the results for each age cohort it appears that optimism bias diminishes after 25 years old, which mirrors previous research that indicated that individuals' levels of optimism bias vary depending on the age (Finn & Bragg, 1986; Matthews & Moran, 1986).

The findings also reported that young military personnel did not change their attitudes towards risky driving. It could be argued that the reason why the RSIs may not have had

the expect outcome could be because young people might not identify with the story or the speakers of the event, which in turn may encourage them to ignore the message altogether (Pedruzzi & Swinbourne, 2009). Furthermore, as previously discussed, because young people tend to rate themselves as more skilled and less accident-prone than their peers, they are more inclined to believe that the risks associated with dangerous driving do not apply to them (Clarke et al., 2015; Lawrence & Lonero, 2008). Moreover, they are less likely to respond to fear-appeal-style persuasion (Cestac et al., 2011; Santa & Cochran, 2008), which may explain why they did not report an improvement in their attitudes after the RSI.

Taken together, the findings from the first two studies not only suggest that RSIs based on fear appeals are not as effective for young males as they are for females; but are congruent with the notion that young people may be more inclined to ignore fear appeal messages because of their illusory sense of vehicle control and overestimation of their driving abilities (Măirean & Havârneanu, 2018). Based on this, the next section will consider different behavioural change techniques with the aim of: a) reducing the levels of optimism bias in young novice drivers; b) manipulating message framing and mode of delivering to see whether positively-framed messages might have a stronger effect compared to fear appeals in reducing young drivers' risky-driving behaviours.

6.2 Research aim two: assess young drivers' personality factors that are correlated to their higher collision risks

Based on the results from study two, it is possible to posit that young people might not respond to fear-appeal-style RSIs because of their biased evaluation of risk and their driving skills (Weinstein & Klein, 1996). In turn, this biased evaluation leads young drivers to underestimate the likelihood of a negative event taking place and overestimate their ability to control negative outcomes (Causse et al., 2004; Delhomme et al., 2010). As a result, young drivers perceive themselves at a reduced risk of a collision in comparison to others. Furthermore, young people may be especially reluctant to listen to fear-appeal-style RSIs because they may have a heightened desire to engage in

sensation-seeking behaviour in general (Zuckerman et al., 1964). Therefore, it is critical to investigate how to reduce optimism bias and whether sensation-seeking may impact the effectiveness of RSIs.

To that end, the first aim of the third study was to directly compare the extent to which two different manipulations could improve young drivers' optimism bias. The second aim was to investigate how individual factors such as sensation seeking, and risky driving behaviour may impact on the effectiveness of the two manipulations.

The first manipulation was based on an unambiguous definition of "good" driving. Previous research has revealed that optimism bias might emerge because of people's idiosyncratic definitions of what it means to be a "good" driver (Roy & Liersch, 2013). Because there is no universally agreed upon definition for "good" driving abilities, which leads people to use subjective definitions to judge their own driving skills (Chambers & Windschitl, 2004), the usage of a common definition of "good driving" abilities might lower their optimism bias. The second manipulation was a hazard perception test. Hazard perception training aims to make participants more aware of their own limitations in critical situations (i.e., increasing their insight into their own skill deficits in demanding driving situations) by providing them with a difficult task to reflect on. Hence, by showing them the limits of their driving skills this could reduce optimism bias in later estimates (Gregersen, 1996).

The results from the study revealed that both manipulations led to a decrease in optimism bias tendencies. These results are in accordance with McKenna's (1993) and Perrissol et al.'s (2011) findings, who found that hazard perception test training could moderate participants' levels of optimism bias in highly controlled situations. Correspondingly, our results are in line with previous work which showed that unambiguous definitions make it more difficult to maintain idiosyncratic ideas and thus attenuate the levels of optimism bias (Chambers, 2010; Dunning et al., 1989; Gregersen, 1996; Sedikides et al., 2002).

The practical implications of these findings are twofold: not only do they provide ev-

idence for the effectiveness of using brief intervention techniques to address young drivers' optimism bias; but they also illustrate that even a simple intervention (i.e. reminding young drivers what the definition of good driving is or administering a hazard perception test) is sufficient to impact young drivers' overestimation of their driving ability. These manipulations could be used as 'nudges', to increase young drivers' awareness of their limited ability to drive safely compared to the average driver of the same sex and age.

The findings from the third study also demonstrated a variations in the effectiveness of the two interventions depending on individual differences in past risky driving tendencies and sensation-seeking. In other words, the present findings showed that an unambiguous definition of "good" driving can be particularly successful in decreasing optimism bias with groups who are less risky, and that hazard perception training can be particularly successful in decreasing optimism bias in groups who are less thrill-seekers, which offers promise for the success of tailored behavioural intervention. Hence, the third study also provides insight into how different interventions could target specific population (or individuals with certain personality characteristics). Results such as these indicate that small behavioural change techniques appear to be effective in manipulating optimism bias associated with risky driving behaviours. Also, the results of study three further highlight the need to create a bespoke program to different populations.

Nevertheless, traditional RSIs keep utilising fear techniques, based on "scary" materials and films. The limited efficacy of young driver RSIs to date suggests that young drivers cannot be persuaded to change through fear appeal techniques, because highly optimistic young drivers may be prepared to take risks because they underestimate the dangerous and overestimate their ability to overcome high risk situations such as speeding, or driving under the influence of alcohol/ drugs (Glendon & Walker, 2013; Lewis, Watson White & Tay, 2007; Phillips et al., 2011b).

An alternative avenue for interventions that target risky driving might be to replace fear appeal messages with positively-framed messages. In fact, a parallel line of research

has championed the use of positive appeals in road safety interventions, which have been found to be more effective in reducing risky driving behaviours compared to fear appeals (Monahan, 1995; Nabi, 2002; Zhao, Roditis & Alexander 2019). The main strength of these new approaches is that positive appeals may help draw new attention to an overly familiar issue (Nabi, 2016), and help to reframe and reconsider issues that young drivers may feel as not being particularly relevant to them (Monahan, 1995). Furthermore, as previously discussed, presenting information in terms of positive gain can enhance the appraisal of the issue being advertised and aid persuasion when compared with negatively-loss-framed information or information bestowed in a neutral form (i.e. Prospect Theory; Dillard & Anderson, 2004; Dillard, Weber, & Vail, 2007; Wansink & Pope, 2014).

Additionally, new modes of delivery are starting to be used more frequently to increase young drivers' interest towards educational RSIs. For example, VR has been implemented more and more frequently to give thousand of young drivers a realistic experience of road traffic collisions, because it allows them to experience the illusion that the events occurring are authentic (Kim & Rizzo, 2005; Lin 2017).

Hence, study four investigated the effect of message framing (positively vs negatively-framed messages) and delivery mode (VR vs 2D) on the effectiveness of road safety educational messages. The findings from study four strengthen the idea that the way in which RSIs are framed may be crucial to their efficacy. Our results suggests that fear appeals fail to decrease young drivers' risky driving behaviours, specifically for who viewed the fear appeal messages in VR. In fact, fear appeals in VR appear to increase risky driving behaviours over time. These results are in accordance with De Hoog et al's findings (2008), who found that the exposure to extreme negatively-framed messages tend to activate defensive mechanics that, paradoxically, lead to an increase in risky driving behaviours (see also Apollonio et al., 2009; Avineri 2014; Pedruzzi & Swinbourne 2016; Ruiter, Abraham & Kok, 2001).

Conversely, our findings revealed that positively-framed messages led to a reduction

in risky behaviour. In contrast to the fear appeals condition, using VR in combination with a positive message reduced participants' risky behaviour. These results are in line the framing hypothesis of Prospect Theory (Kahneman & Tversky, 1979), which posits that the framing of the message in terms of gains has an impact on the efficiency of the message and on the adoption rate of the behaviour. The results from study four extend previous work regarding the effectiveness of positively-framed messages in promoting road safety, through the portrayal and modelling of "safe" driving behaviours and the positive consequences of adhering to that behaviour (Hoekstra & Wegman, 2011; Lewis, Watson, White, & Tay, 2007). Hence, the findings from study four support the framing hypothesis of Prospect Theory (Kahneman & Tversky, 1979), because our results have shown that positively-framed messages that focus on the benefits of adopting a safe behaviour were more successful than negatively- framed messages. And, finally, as the first study to examine the usage of VR in driver safety programs, our findings suggest that allowing young drivers to experience what proactive behaviours can lead to and giving them the illusions that the events occurring are authentic through VR, can encourage the creation of positive role models and strategies to be safer on the roads, which in turn decreased risky driving behaviours (see also Zhao et al., 2019).

6.3 Practical Implications

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 risky driving in the 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.

The implications of this work are important to consider when discussing future RSIs development. For instance, it's clear that there is not a 'one-size-fits-all' approach when discussing how to protect young drivers. However, based on our findings, it appears that young drivers overall preferred a peer-led educational interventions compared to an adult-led event. Thus, peer leaders could be used to alter social norm amongst young

people to reduce risky driving.

Interventions also need to consider the personality factors that motivate young people to behave in a riskier fashion. Optimism bias was found to be an obstacle to young drivers' message acceptance. Our results have shown that simple interventions (i.e. reminding young drivers what the definition of good driving is or administering a hazard perception test during the first year of driving) are sufficient to impact young drivers' overestimation of their driving ability. These manipulations could be used as 'nudges', or positive influences, to increase young drivers' awareness of their limited ability to drive safely and encourage safe driving.

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, and the findings from this research work, suggest that this is not an effective way of changing young drivers' behaviour, not least because despite their longstanding and widespread use young drivers' collision rates remain high. Instead, rather than trying to force a notion of fear onto young drivers, it would perhaps be more intuitive to portray "safe" driving behaviours and the positive consequences of adhering to that law-abiding behaviours, as positively-framed messages have shown to be more likely to have a significant impact on self-enhancement bias (i.e. the desire to maintain good feeling about oneself). In addition, novel technologies, such as VR, can be employed to allow young people to experience what proactive behaviours can lead to and give them the illusion that the events occurring are authentic.

6.4 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.

6.4.1 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 (Assailly, 2017; Brijs et al., 2014). Future interventions need to be grounded in sound theoretical evidence 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. Furthermore, if we want to effectively target this high-risk group we need to understand 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.

6.4.2 Self-reported 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, 2015). 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 response bias.

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. Goldenbeld et al., 2008) 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 one and four attempted to overcome this issue by providing a gap between the delivery of the manipulation and then subsequent reporting of driving intentions. It was hoped that, by providing this space between data collection points, 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. So, one suggestion for future research is to apply some of the behavioural techniques used in this research and apply them to assess driving behaviour through driving simulators instead of just relying on self-reported data.

6.4.3 Gender Differences

There was an under-representation of males in some of 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. 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.

6.5 Conclusion

In conclusion, 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, optimistic male drivers may engage in the most high-risk driving behaviour because they perceive themselves at a reduced risk of a collision in comparison to others. Furthermore, 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 negatively-framed fear appeal techniques may not be the most effective way to target them (e.g. Lewis et al, 2007). Instead, it would perhaps be better to portray "safe" driving behaviours and the positive consequences of adhering to that law-abiding behaviours. And, finally, 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 optimism bias. In this way young peoples' natural inclination to overestimate their driving abilities may be tamed to improve their driving behaviour.

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Appendix A

Appendix

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

Chapter 2 Appendix

Attitudes towards risky driving and future intentions to drive safely

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

1. It's okay if you don't wear a seatbelt on short journeys
2. It's alright if a passenger fails to wear a seatbelt
3. 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
4. I think speed limits are often set too low
5. I feel it is safer if the speed limits on 30mph roads are strictly enforced
6. I think distracting the driver in any way could result in a serious crash
7. It is acceptable to distract the driver whilst he/she is driving
8. It is acceptable for people to use a mobile phone while driving
9. I think mobile phone usage is one of the leading causes of road accidents
10. Some drivers can be perfectly safe overtaking in situations which would be risky for others
11. People stopped by the police for dangerous overtaking are unlucky because lots of people do it

The Eight Road Traffic Scenarios

1. 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:

1. I would ask my friend not to answer their phone while driving
2. My family would approve of me asking my friend not to answer their phone while driving
3. I would regret not asking my friend to ignore their mobile phone whilst driving
4. It would be difficult for me to ask my friend not to answer their phone whilst driving
5. If I asked my friend not to answer their phone, he/she would listen to me and do what I asked
6. My close friends would approve of me asking my friend not to answer their phone while driving

2. 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:

1. I would try to discourage my friend from overtaking the car in front on a bend
2. I would find it difficult asking my friend not to overtake on a bend
3. My close friends would think I was stupid asking my friend not to overtake on a bend

4. If I asked my friend not to overtake on a bend, he/she would listen to me and do what I asked
5. My family would approve of me asking my friends not to overtake on a bend
6. I would regret it if I didn't ask my friend not to overtake on a bend

3. 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:

1. I would lean forward to change the track myself, even if it meant distracting the driver
2. My family would disapprove of me distracting the driver to change the track
3. It would be easy for me to leave the track playing
4. If I were to reach over my friend's shoulder whilst they were driving then we are more likely to have an accident
5. I would regret distracting my friend by leaning over their shoulder to change the track
6. My close friend would disapprove of me distracting the driver to change the track

4. 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:

1. I would ask my friend to slow down

2. It would be easy for me to ask my friend to slow down
3. My family would approve of me asking my friend to slow down
4. If I asked my friend to slow down, then he/she would listen to me and do as I asked
5. My close friends would think I was wrong to ask my friend to slow down
6. I would regret not asking my friend to slow down

5. 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:

1. I would get into the car with my friend, even though he/she had been drinking
2. I would find it hard not to get into the car
3. My close friends would think I was stupid to get into the car
4. I would regret getting into the car
5. If my friend is over the legal drink driving limit we are more likely to have an accident
6. My family would approve of me if I refused to get in the car

6. 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:

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

2. It would be easy for me to ask my friend not to drive home
3. My family would disapprove if I let my friend drive home without trying to talk him/her out of it
4. If I asked my friend not to drive home he/she would listen to me and do what I asked
5. I would regret not asking my friend to leave the car and walk home
6. My close friends would think I was stupid if I asked my friend not to drive home

7. 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:

1. I would not bother to put my seatbelt on
2. I would regret not putting my seatbelt on
3. It would be easy for me to put my seatbelt on
4. My close friends would disapprove if I did not wear my seatbelt
5. 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
6. My family would disapprove if I did not wear my seatbelt

8. 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:

1. I would ask my friend to put his/her seatbelt on
2. I would find it difficult to ask my friend to put their seatbelt on
3. My family would approve of me asking mt friend to put his/her seatbelt on
4. If I asked my friend to wear a seatbelt, he/she would listen to me and do as I asked
5. My close friends would approve of me asking my friend to put his/her seatbelt on
6. I would regret not asking my friend to wear his/her seatbelt

9. 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:

1. I would get into the car, even though my friend is complaining of being tired
2. I would find it hard not to get into the car with my friend
3. I would regret it if I didn't get in the car with my friend
4. My family would approve of me if I did not get in the car
5. If my friend is tired we are more likely to have an accident
6. My other close friends would think I was stupid if I did get into the car

10. 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:

1. I would ask my friend not to drive home

2. It would be easy for me to ask my friend not to drive home
3. My close friends would think I was stupid to ask my friend not to drive home
4. If I asked my friend not to drive home he/she would listen to me and do what I asked
5. I would regret not asking my friend to drive home the next day
6. My family would approve of me if I tried to talk my friend out of driving home

Evaluation of Follow-Up Sessions

1. Today's session will make me a safer driver
2. I would tell a friend about what I have learned today
3. I have a better understanding of driving and the risks involved in driving after attending the session
4. The presenters were engaging
5. The presenters were approachable
6. Today's session has giving me the tools to face difficult decisions or situations
7. I enjoyed today's session

Chapter 3 Appendix

Optimism Bias Questionnaire: Comparative Optimism

Compare yourself to the average driver of the same age and gender as you

1. My risk of getting into an accident while I drive at night is
2. My risk of getting into an accident when I drive in bad weather is
3. My risk of getting into an accident when I am in a busy junction is
4. My risk of getting into an accident when I have to change lanes on a dual carriageway is
5. My risk of getting into an accident when I have to give way is
6. My risk of getting into an accident when I have to quickly react to other drivers' unexpected maneuvers is
7. My risk of getting into an accident when I drive on a winding road is
8. My risk of getting into an accident when I drive and I feel tired is
9. My risk of getting into an accident onto a dual carriageway from a side road is

Optimism Bias Questionnaire: Driving Skill Questionnaire

Compare yourself to the average driver of the same age and gender as you, how would **YOU** rate **YOURSELF** on each of these driving skills?

1. Navigating while driving in unfamiliar areas
2. Leaving motorways

3. Driving at an appropriate speed for conditions
4. Overtaking
5. Attention to other road users
6. Reversing
7. Parking
8. Changing traffic lanes
9. Three-point turns
10. Hill starts
11. Judging stopping distances
12. Attention to road signs
13. Moving onto motorways
14. Adjusting driving to suit weather conditions
15. Changing lanes on motorways
16. Judging correct approach speed for bends
17. Driving in busy town traffic

Chapter 4 Appendix

Brief Sensation Seeking Scale

For each item, indicate how much you (dis)agree with each statement

1. I would like to explore strange places
2. I get restless when I speed too much time at home
3. I like to do frightening things
4. I like wild parties
5. I would like to take off on a trip with no pre-planned routes or timetables
6. I prefer friends who are excitingly unpredictable
7. I would like to bungee jumping
8. I would love to have new and exciting experiences, even if they are illegal

Driver Behaviour Questionnaire

Whilst you have been driving on your Provisional driver's license, how often have you done the following behaviours?

1. You drove over the speed limit in areas where it was unlikely there was a radar or speed camera
2. You went 10-20 mph over the speed limit
3. You deliberately sped when overtaking
4. You sped at night on roads that were not well lit

5. You went up to 10 mph over the speed limit
6. You went more than 20 mph over the speed limit
7. You raced out of an intersection when the light went green
8. You traveled in the right lane on multi-lane carriageways
9. You sped when the lights went yellow
10. You went too fast around a corner
11. You did an illegal u-turn
12. You overtook a car on the left
13. You spoke on a mobile that you held in your hands
14. Your passengers didn't wear seatbealts
15. You drove after taking an illicit drug such as marijuana or ecstasy
16. You carried more passengers than could legally fit in your car
17. You didn't always wear your seatbelt
18. You drove without a valid license you hadn't applied for one yet or it had been suspended
19. You didn't wear a seatbelt if it was only for a short trip
20. If there was no red light camera, you drove through intersections on a red light
21. You carried more passengers than there were seatbelts for your car
22. You drove when you thought you may have been over the legal alcohol limit
23. You drove a high-powered vehicle
24. You misjudged the speed of an oncoming vehicle

25. You misjudged the gap when you were turning right
26. You misjudged the stopping distance you needed
27. You turned into the path of another vehicle
28. You misjudged the gap when you were overtaking another vehicle
29. You missed your exit or turn
30. You entered the road in front of another vehicle
31. You didn't always indicate when you were changing lanes
32. You drove on the weekend
33. You drove in the rain
34. You drove at peak times in the morning and afternoon
35. You drove at night
36. You drove at dusk or dawn
37. You carried your friends as passengers at night
38. You drove when you knew you were tired
39. Your car was full of your friends as passengers
40. You went for a drive your mates giving directions to where they wanted to go
41. Your driving was affected by negative emotions like anger or frustration
42. You allowed your driving style to be influenced by what mood you were in
43. You drove faster if you were in a bad mood

Chapter 5 Appendix

Emotional Arousal Scale

1. The safety message made me feel very afraid
2. The safety message made me feel very tense
3. The safety message made me feel very agitated
4. The safety message was convincing
5. the safety message was informative
6. The safety message was too strong