The development of messages and experiences to reduce road-related illusory invulnerability and risky driving, for young drivers

Final Report for the Motor Accidents Authority of NSW

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Executive summary

Background and aims

In developed countries road crashes are a leading cause of accidental death and injury, especially amongst young people. The paradoxical belief that “It’ll never happen to me” is partly to blame. The common belief that we are less likely to suffer negative events than are our peers (“illusory invulnerability”), allows us to take risks. Risky driving is a prominent cause of road trauma. For example, thinking that one is less likely than average to have a serious car crash increases the chances of speeding or running red lights, ironically increasing the chances of having a serious car crash.

Our primary aim was to develop and evaluate 1) messages to be available in educational institutions, community youth centres and learner driver programs; and 2) controlled error experiences to be used in learner driver programs (or by parents teaching driving); in order to reduce illusory invulnerability regarding road trauma, risky driving and road-trauma-involvement, amongst young people.

Study 1

In a previous study from this research program (not reported here) we assessed the cross-sectional relationship of illusory invulnerability with self-reported risky driving and road-trauma involvement, and evaluated messages designed to reduce illusory invulnerability in terms of their effect on self-reported risky driving and road-trauma involvement, in a corporate driver training sample. Results appeared promising.

Study 2

In Study 2 (the first Study reported here) we aimed to replicate the cross-sectional component of Study 1, adding measures of risky driving on a driving simulator, in a tertiary student sample (n=45).

Overall, observed relationships between illusory invulnerability between intended and actual (simulated) behaviour were weak and inconsistent, as could be expected on the basis of theory and previous research. The claim that illusory invulnerability promotes risky driving was consistent with general pattern of relationships between relative future risk estimates and simulated behaviour (measured immediately after relative future risk), and between relative experience and intended behaviours.

The endeavour of reducing future-related illusory invulnerability in order to promote safer driving is supported by earlier experimental evidence relating judgements of relative risk with behavioural intentions (Klein, 1997), which is partly corroborated by the present results. Further, results suggested the approach of encouraging consideration of past unsafe behaviour and negative experience.

Study 3

In Study 3 we evaluated messages that were slightly modified from those employed in Study 1 (and based on supported theories of illusory invulnerability), in terms of their impact on illusory invulnerability, self-reported risky driving and road trauma involvement, as well as risky driving, and trauma involvement, on a driving simulator. We employed a tertiary student sample (n=59).

Prior to completion of the questionnaires and driving simulator task employed in Study 2, Participants in the treatment group were given the messages, whereas Participants in the control group were given messages that are unrelated to illusory invulnerability. Participants returned after approximately 2 months for follow-up testing.

Although evidence for a positive impact of the messages on future-related illusory invulnerability was minimal, the messages appeared to reduce past-related illusory invulnerability (peoples' perception that they have had a better

past than their peers). With relevant personal characteristics statistically controlled, compared to the control group, relative experience estimates were significantly lower in the treatment for road-related negative events (and, separately, injury as a driver at fault, or not at fault), road-related positive events, and road-unrelated negative events, at the immediate post-test, and for road-related negative events (and, separately, injury as a driver not at fault, or as a passenger) and road-unrelated negative events, at the 2-month follow-up. Illusory invulnerability regarding negative experiences on the simulator was significantly lower in the treatment (relative to the control) group at follow up (with statistical control for personal characteristics).

The messages also appeared to have some positive effects on risky simulated driving. With statistical control for personal characteristics, compared to the control group, the treatment group approached hazards significantly more slowly at immediate post-test and at follow-up; drove significantly more slowly in a 40km/hr zone and *nonsignificantly* more slowly in a 50km/hr zone (p=0.080) at follow-up; demonstrated significantly lower speed while following a lead vehicle at immediate post-test; had significantly fewer drives that were marred by a red light ticket, and had significantly fewer red light tickets at immediate post-test.

While several effects in the direction opposite to prediction would have been significant had a 2-tailed test been employed, these undesirable effects were far outnumbered by the observed significant beneficial effects, and the messages appear to provide a promising basis for an intervention.

Study 4

In Study 4 we evaluated “active error” training on the driving simulator in terms of its impact on illusory invulnerability, and risky driving, and trauma involvement, on a driving simulator. We employed a tertiary student sample (n=32).

Before testing, Participants completed a “training” drive in which “active error” Participants were exposed to hazards and given feedback regarding their errors, whereas the “minimised error” group were exposed to fewer hazards and given no error feedback.

Although no significant reduction in illusory invulnerability regarding the future was observed, means were in the predicted direction for road-related negative and positive events.

The evidence for a positive effect of active error training on risky simulated driving is more compelling. The “active error” group approached one of 7 hazards significantly more slowly than the “minimised error” group, and for 5 of the remaining hazards the group difference became significant when relevant covariates were included in analysis. Compared to the “minimized error” group, the “active error” group travelled significantly more slowly in both speed zones (40km/hr and 50km/hr), and maintained a significantly greater minimum distance from the lead vehicle (regardless of whether relevant covariates were employed). Significantly more “active error” Participants than “minimised error” Participants waited for a safe time to turn across oncoming traffic, whereas significantly fewer “active error” Participants received a speeding ticket for 2 of the 4 tasks in which speed exceedence was considered (and the p-value was low for a further task). The “active error” group demonstrated significantly fewer tasks that were marred by a speeding ticket, or by a crash, than did the “minimised error” group (regardless of whether covariates were employed).

While several effects in the direction opposite to prediction would have been significant had a 2-tailed test been employed, these undesirable effects were far outnumbered by the observed significant beneficial effects, and the messages appear to provide a promising basis for an intervention.

Study 5

To develop the integrated messages that were evaluated in Study 5, the messages employed in Study 3 were modified to integrate aspects of active error training (Study 4), to increase motivation to read the entire pamphlet (by stressing the importance of illusory invulnerability earlier, by simplifying language, and by improving the graphical presentation of the information), and to strengthen recommendations for techniques to attack illusory invulnerability.

The integrated messages were evaluated in a sample of young learner drivers (n=39) in terms of hazard perception and on-road driving.

Trent driving students who were judged to be at least 3 weeks from their RTA driving test were invited to participate and given envelopes containing study materials. Participants read the study messages that they were given (either relevant to improving risk perception, or not relevant) and returned a Consent Form and Materials Evaluation Form. After at least 3 weeks, Participants had a driving lesson during which a practice test was conducted (and driving performance evaluated and recorded) and questionnaires completed.

The large majority of the sample agreed that the materials were readable, comprehensible and in a format that made sense, and 28% of the sample even agreed that the materials were interesting.

Nonetheless, only one significant effect of the materials was observed and this could be a Type I error. The failure to detect substantial impacts of the messages does not appear to reflect inadequate statistical power.

Several plausible explanations may be offered for the failure of the messages to fulfil the promise of Study 2 and 3 results. The present study involved a general population sample whereas the earlier studies involved tertiary student samples, and higher education may allow for better understanding of the written materials. Probably more importantly, though, in the present study

Participants were given the materials to read at their leisure, whereas in Study 3 they read through the materials with an experimenter present. The materials may be more effective if provided in a setting that ensures young drivers engage with the messages. Finally, the behavioural measure employed in the present study may have been somewhat insensitive. Driving behaviour may have been strongly determined by students being on their “best behaviour” in front of their driving trainer in a “mock test” situation. Thus, Participants may all have been driving so carefully that there was no “room for improvement” due to the messages.

Conclusions

The messages evaluated in Study 3 and the active error experiences evaluated in Study 4, both appear promising as techniques for reducing illusory invulnerability, risky driving, and trauma-involvement amongst young people.

Whilst the written materials that were based on Study 3 messages and incorporated elements of “active error” training appeared to have minimal impact in a general population sample, the materials may be more effective in settings where they could be delivered in a manner to promote their being read more thoroughly by young drivers. Future evaluation of the materials should involve sensitive behavioural measures (such as simulated driving, unobtrusive observations by parents, or driving records).

Chapter 1: Background

Road trauma is a significant public health problem, in Australia and overseas. Road traffic injuries are the leading cause of injury-related deaths worldwide (Krug, Sharma, and Lozano, 2000; Peden, McGee, and Sharma, 2002) [see Figure 1.1]. In 1999/2000, in NSW alone, road casualties cost the community an estimated $600million, in direct costs of treating and managing injuries, as well as in indirect costs associated with lost or degraded life-years. The indirect costs of road trauma are particularly high because of the well-recognised over-representation of young people in crash statistics (Krug, Sharma, and Lozano, 2000; Peden et al., 2002; see also Williamson, 2000, 2003) [see Figures 1.2 and 1.3]. Thus, there is a pressing need for the development of effective interventions to reduce young drivers' involvement in road trauma. The present research aims to develop messages and experiences to improve hazard perception and reduce risky driving.

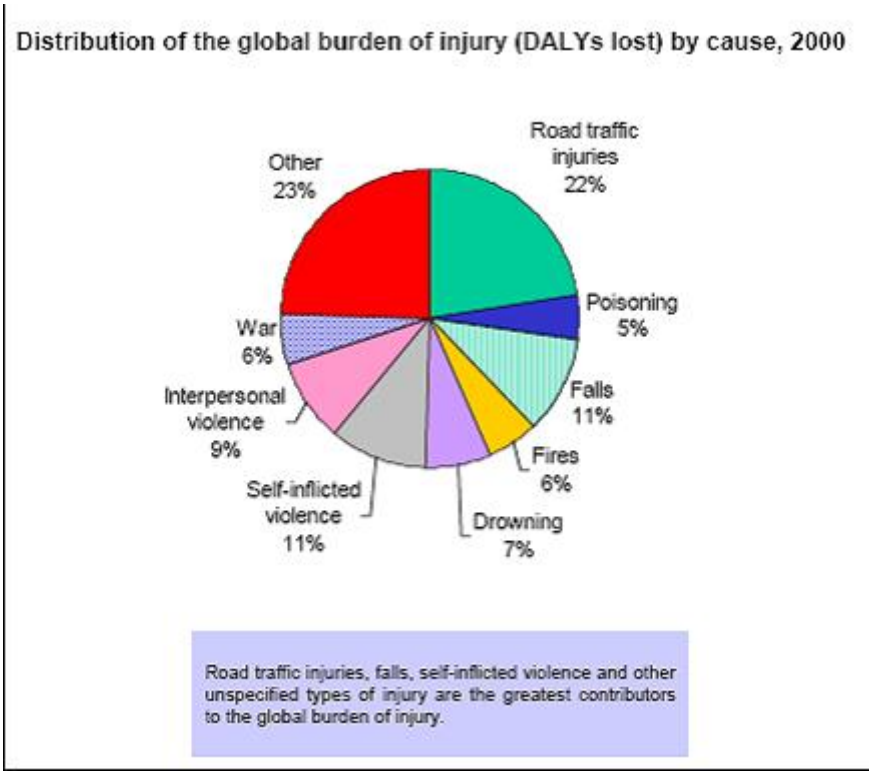


Figure 1.1: Distribution of global burden of injury by cause, 2000 [from Peden, McGee, and Sharma, 2002, p.18]

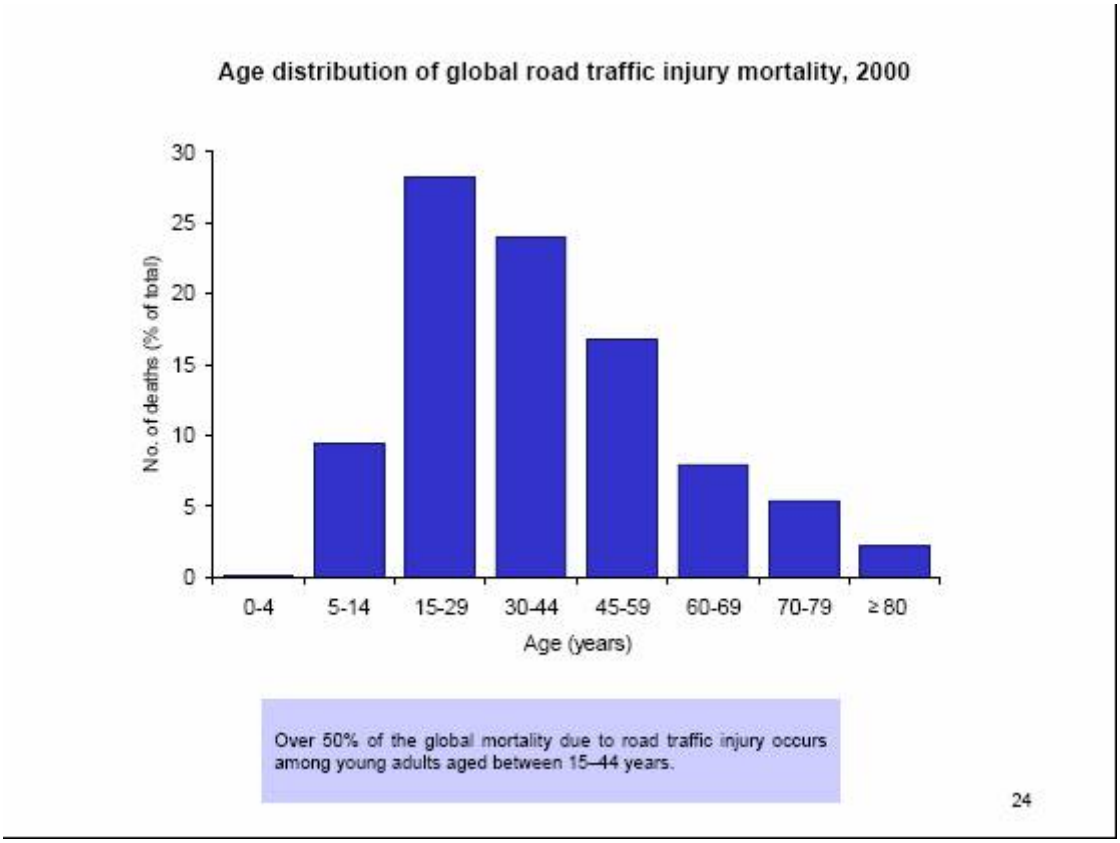


Figure 1.2: Age distribution of global traffic injury mortality, 2000 [from Peden, McGee, and Sharma, 2002, p.24]

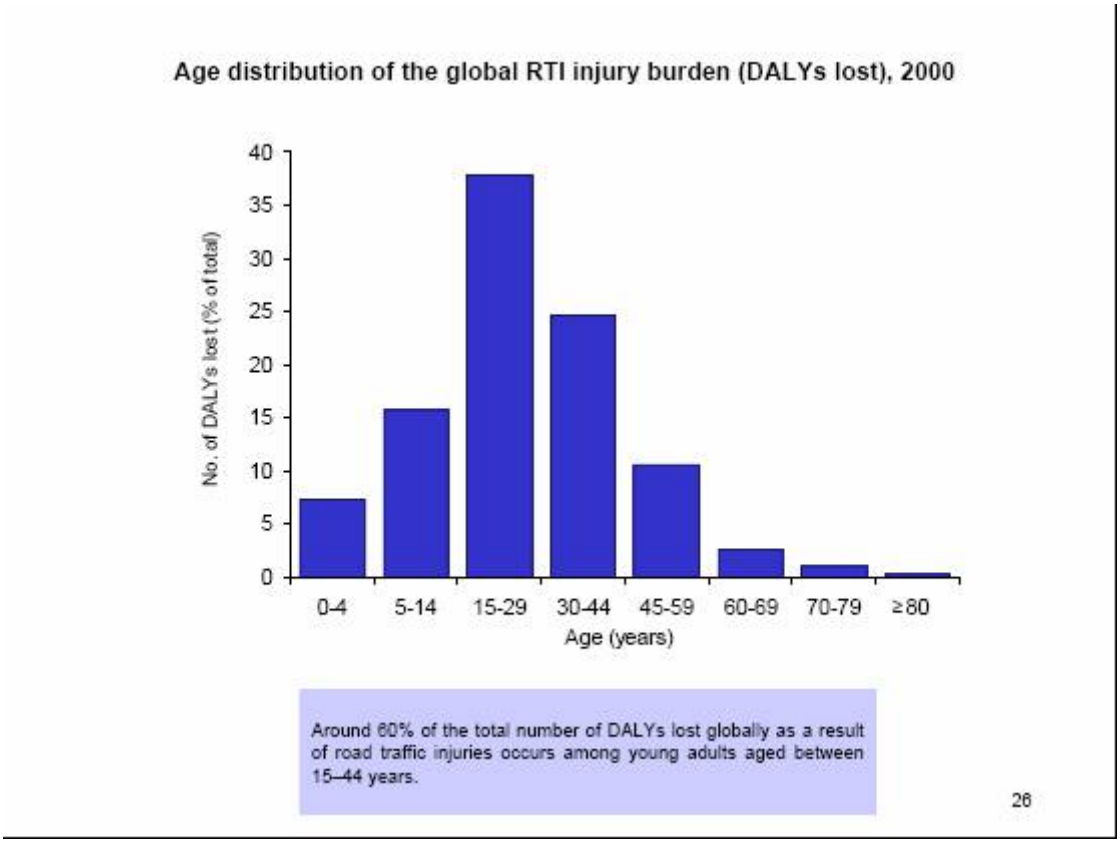


Figure 1.3: Age distribution of global road traffic injury (RTI) burden, 2000 [from Peden, McGee, and Sharma, 2002, p.28]

The over-involvement of young people in road trauma may occur for a variety of reasons (for reviews see Jonah, 1986; Jonah and Dawson, 1987; Williamson, 2000, 2003). For example, because young drivers tend to be inexperienced drivers they may lack the skills to deal with difficult situations on the road. They may also have greater exposure to risk due to driving at dangerous times, such as late at night after going out (especially on Friday or Saturday nights). However, these factors appear to be less relevant than young drivers' tendency to engage in risky driving (Jonah, 1986). Thus, interventions which effectively reduce risky driving would improve road safety for young drivers.

Young drivers, like all drivers, may *choose* to adopt risky driving behaviours when the balance between the perceived (possible) costs and the perceived (possible) benefits of the behaviour is judged to be favourable (Job, 1995). The possible benefits depend on the specific behaviour involved, but for

example in the case of speeding might include getting to an appointment on time, or the pleasing sensation of driving fast. The possible costs of risky driving behaviours include getting a penalty, or having a crash (and resulting injuries). Thus, if the probability of such costs is underestimated, the likelihood of risky driving is increased. In extreme cases, when the possibility of costs is not recognised at all, drivers may engage in risky driving without risk-taking *per se*.

Amongst young drivers, failure to recognise risk accurately may result partly from lack of driving experience. However, experience does not account for all of the variance in their risky driving behaviour (Jonah, 1986). It has also been suggested that young people may be particularly likely to regard themselves as invulnerable, in part because they overestimate their own skill and competence. The present research focuses on the role of "illusory invulnerability" and overconfidence in road-trauma-involvement.

Illusory invulnerability refers to individuals' common belief that unpleasant events are less likely to happen to them than to their peers (for reviews see Weinstein, 1980, 1989a). For example, people believe they are less likely than the average person of their age and gender to have a heart attack. Illusory invulnerability has been demonstrated in relation to many aspects of road use. For example, people believe that, compared to their average peer, they are less likely to be involved in a car crash (Finn and Bragg, 1986; Matthews and Moran, 1986; McKenna and Albery, 2001), less likely to be injured or killed as a driver in a car crash, and less likely to be or booked for speeding (and other offences) (Job, Hamer, and Walker, 1995; see also DeJoy, 1989). People also believe that they are better and safer drivers than their peers (Job, 1990; Job et al., 1995; Svenson, Fishhoff and MacGregor, 1985), and that they run red lights less frequently (Morgan and Job, 1995).

Illusory invulnerability regarding road safety may be exaggerated in young people. For example, younger people are more likely to demonstrate illusory invulnerability regarding the likelihood of crash involvement (Finn and Bragg, 1986; Matthews and Moran, 1986), overall driving ability, vehicle handling

skills and driving judgement (Matthews and Moran, 1986). Young drivers recognise that they may be more likely to be in a car crash than older drivers (Berger and Persinger, 1980; Jonah and Dawson, 1982; Matthews and Moran, 1986), but this is not illusory invulnerability, which requires comparison to a peer.

Illusory invulnerability to road trauma may promote risky driving on the road. Illusory invulnerability is hypothesised to promote risky behaviour and inhibit precaution-taking (Weinstein, 1988, 1989a, 1989b, 1993). According to a number of leading models of health behaviour (see: Janz and Becker, 1984; Weinstein, 1988), perceived absolute personal risk is a primary determinant of risky behaviour. Various researchers have suggested that perceived *relative* risk may also be important, and perceived relative risk has been shown in experimental studies to influence behaviour to at least as great an extent as perceived absolute personal risk (Klein, 1997). In non-experimental (prospective and cross-sectional) studies the relationship between illusory invulnerability and risky behaviour has been inconsistent [see Table 1.1].

This inconsistency might be expected partly because the “egocentrism account” of illusory invulnerability predicts a positive between precautionary behaviour and risk illusory invulnerability, whereas health behaviour models predict a negative relationship. The “egocentrism account” posits that individuals consider their own precautionary behaviours, but not those of others, when estimating relative risk (and so judge themselves as safer than average). Thus, illusory invulnerability is promoted by performing, or intending to perform, precautions; by not performing, or intending not to perform, risky behaviours. In contrast, it has been proposed and shown experimentally that judging oneself to be safer than others promotes risky behaviour (e.g. Klein, 1997). The relationship between illusory invulnerability and risky behaviour may be cyclical, and results of non-experimental studies may depend on the time characteristics of measurements (for a detailed discussion see Weinstein and Nicolich, 1993).

Table 1.1: An overview of non-experimental (prospective and cross-sectional) studies which have demonstrated a negative relationship, no relationship, or a positive relationship between illusory invulnerability and either safe behaviour (precaution-taking or lack of risk-taking) (b) or safe behavioural intention (i).

Negative relationship	***No relationship***	***Positive relationship***
Prospective studies	*Prospective studies*	*Prospective studies*
Weinstein et al., 1990 (b) Blalock et al., 1990 (b) Klein, 1997 (i) Davidson and Prkachin, 1997 (b)	Joseph et al., 1987 (b) Aspinwall et al., 1991 (b)	van der Velde and van der Pligt, 1991 (b, i) van der Velde et al., 1992 (b, i) van der Velde et al., 1994 (b, i)
Cross-sectional studies	*Cross-sectional studies*	*Cross-sectional studies*
Larwood, 1978 (i) Svenson, 1981 (i) Weinstein, 1982 (i) Spolander, 1983[a] (b) Svenson et al., 1985, Study 1 (b) Dolinksi et al., 1986 (b) Hoorens and Buunk, 1993 (b)	Robertson, 1977 (i) Svenson et al., 1985, Study 2 (b) Gladis et al., 1992 (i) Langley and Williams, 1992 (b)	Svenson et al., 1985, Studies 1 and 2 (b) Weinstein et al., 1986 (b) Hoorens and Buunk, 1991 (b) Renner, 1993[b] (b)

a Cited in Svenson et al. (1985)
b Cited in Schwarzer (1994)

Because of the superiority of experimental research in establishing causal relations, it could be predicted that reduction of illusory invulnerability may be

of substantial benefit in reducing risky driving on the roads and involvement in road trauma.

Approaches to reducing illusory invulnerability may be based on several supported relevant theories of the phenomenon, which are outlined here briefly (see also Chua and Job, 1999; Weinstein, 1980). *The* "egocentrism account" posits that individuals consider their own precautionary behaviours, but not those of others, when estimating risk. The "absent/exempt error" occurs when it is reasoned that an event that has not occurred in the past will not occur in future. The absent/exempt error focuses on the absence of experience, however perceived relative lack of experience (illusory invulnerability regarding the past) may also contribute to illusory invulnerability regarding the future The "downward comparison" account of illusory invulnerability suggests that people estimate their risks relative to a stereotypical victim for the posited hazard (e.g. an intravenous drug user in the case of AIDS) rather than "average". According to the defensive denial account, individuals deny perceived risk in order to avoid the anxiety provoked by it. The self-esteem enhancement account posits that individuals seek to promote their self-esteem or subjective well-being by overestimating the quality of their futures.

Although illusory invulnerability has proven difficult to reduce (for example: Griffeth and Rogers, 1976; Hoorens and Buunk, 1992; Mahatane and Johnson, 1989; Regan, Snyder, and Kassin, 1995; Schoenbach, 1987; Siero, Kok, and Pruyn, 1984; Sutton and Eiser, 1990; Weinstein and Klein, 1995; Weinstein et al., 1991; Wurtele and Maddux, 1987), several effective interventions have been based on the egocentrism account (e.g. Weinstein, 1980, 1983; Weinstein and Lachendro, 1982). Further, several recent studies suggest the importance of egocentrism in producing illusory invulnerability (Aucote and Gold, 2005; Covey and Davies, 2004; Kruger and Burrus, 2004).

Experience of negative events has also been found to reduce illusory invulnerability (e.g. Dolinski, Gromski, and Zawisza, 1986), including road-

related illusory invulnerability (McKenna and Albery, 2001). Further, several avenues of research identify the importance of experience in judgements about the future. For example, prediction of the future derives more from past experience than a range of other factors including circumstances, personal dispositions, and population base rates (Osberg and Shrauger, 1986). People distort their memory of past behaviour patterns in order to maintain a perceived superiority over their peers (Klein and Kunda, 1993; see also Klein, 1996), and illusory invulnerability regarding the past correlates positively with illusory invulnerability regarding the future (Hatfield and Job, unpublished).

The possible causal role of past-related illusory invulnerability appears to be particularly relevant to road safety. Unlike many other risks (cancer, heart attack, stroke, etc.) there is no apparent genetic basis, but people have substantial experience as drivers and passengers. Thus, perceptions relating to experience are likely to contribute strongly to judgements of risk. For example, a young driver may reason that although s/he has done a substantial amount of driving s/he is yet to have had a serious crash, even though s/he hears about such crashes in the media all the time, and so s/he may conclude that s/he must be a particularly safe driver who is thus relatively unlikely to have a crash in future. Similarly, a young driver may seldom notice when s/he forgets to turn on the indicator light, but notice whenever another driver forgets, so that s/he believes him/herself to be a safer than average driver.

Active exposure to driving errors (with feedback) reduces confidence, and may facilitate transfer of skills required to deal with different driving situations (see Ivancic and Hesketh, 2000). However, few young people have the opportunity to “experience” their own driving errors in a manner which allows them to generate transfer heuristics. Similarly, young drivers may be particularly poor at judging their ability to handle particular driving situations, because they have little experience in judging riskiness (Brown and Groeger, 1988).

Considering the importance of egocentrism and experience in producing illusory invulnerability, and the success of relevant interventions, the intervention evaluated here was designed to encourage consideration of other people, and of negative outcomes. Nonetheless, illusory invulnerability may be produced by different causes for different events (Chua and Job, 1999), and so an intervention which draws on many accounts of illusory invulnerability may be the most efficient means of reducing it. Our preliminary data suggests that an information-based intervention, derived from a range of theories of illusory invulnerability, may be effective.

Although illusory invulnerability may contribute substantially to road trauma in general, and in young drivers in particular, few road safety interventions have targeted it specifically. Interventions which expose young drivers to their own errors are similarly rare. Thus, messages which reduce illusory invulnerability and controlled error experience each have the potential to make a large impact on road safety.

We aimed to develop messages that could be made available in learner driver programs, educational institutions, and community youth centres because of the possibility of reaching a large number of potential drivers whilst their attitudes to driving are still forming. Further, given the over-representation of young drivers in road-trauma statistics, and their tendency to take risks, young drivers appear to be a particularly important audience to target.

Objectives[1]

1. To identify illusory invulnerability regarding various aspects of future road use, amongst young drivers or potential drivers.
2. To identify illusory invulnerability regarding various aspects of past road use, amongst young drivers or potential drivers.
3. To evaluate the hypothesis that illusory invulnerability regarding the past contributes to illusory invulnerability regarding the future, in the context of road use, amongst young drivers or potential drivers.
4. To evaluate the extent to which illusory invulnerability regarding the future versus the past promotes risky driving on the road (and thus road trauma):

a) using performance in a driving simulator.

b) using self-report of current and intended behaviours.

5. To develop and evaluate techniques for reducing illusory invulnerability regarding aspects of road use amongst tertiary students (including evaluation of risky driving in terms of performance in a driving simulator and self-report of current and intended behaviours immediately after the intervention and at follow-up).
6. To develop and evaluate techniques for reducing illusory invulnerability regarding aspects of road use amongst secondary students (including evaluation of risky driving in terms of performance in a driving simulator and self-report of current and intended behaviours immediately after the intervention and at follow-up).
8. To develop and evaluate messages and experiences to be available in educational institutions, community youth centres and learner driver programs, designed to reduce illusory invulnerability regarding aspects of past and future road use, risky driving on the road and involvement in road trauma.

[1] The phrasing of these aims is slightly different from that in our proposal. However, only one change is substantive. Specifically, whilst we had proposed to conduct a follow-up evaluation of "active error training", only immediate post-testing was conducted by the researchers responsible for Study 4.

Project overview

The research program reported here followed from earlier research (Hatfield and Job, 2000) involving:

1. a correlational study of the relationship between road-related illusory invulnerability, self-reported risky driving on the road, and experience of road trauma, in a tertiary student sample.
2. the development of an intervention to reduce illusory invulnerability, and evaluation in a driver training program.

Thus, the first study reported here is referred to as Study 2. The full sequence of studies reported here, and the "stages" in which they were carried out are detailed in Table 1.2.

Table 1.2: The sequence of studies reported here, and the "stages" in which they were carried out"

Stage	***Study***	***Stage objectives***
STAGE1	STUDY 2	Assessment of illusory invulnerability regarding future road use, illusory invulnerability regarding past road use, risky driving on the road (self-reported and driving simulator behaviour), and road trauma, and the interrelationships of these variables, employing Psychology I students at the University of Sydney.
STAGE 2		Entry, analysis and reporting of data from Stage 1.
STAGE 3	STUDY 3	Evaluation of techniques to reduce illusory invulnerability, employing Psychology I students at the University of Sydney. a) Administration of techniques to reduce past-related illusory invulnerability versus filler task versus administration of filler task. b) Immediate post-treatment assessment of illusory invulnerability regarding future road use, illusory invulnerability regarding past road use, risky driving on the road (self-reported only), and the interrelationships of these variables.
WAIT		Required prior to follow-up post-treatment assessment. Entry, analysis and reporting of data from Stage 3.

Stage	*Study*	*Stage objectives*
STAGE 4		Follow-up post-treatment assessment of illusory invulnerability regarding future road use, illusory invulnerability regarding past road use, risky driving on the road (self-reported and driving simulator behaviour), and road trauma involvement, and the interrelationships of these variables, employing Psychology I students at the University of Sydney.
STAGE 5		Entry, analysis and reporting of data from Stage 4.
STAGE 6	STUDY 4	Repetition of Stages 3, WAIT, 4, and 5 with active error training instead of informational techniques.
STAGE 7[2]	PILOT	Pilot refined and modified techniques in a tertiary sample
STAGE 8	STUDY 5	Evaluation of refined and modified techniques, employing learner driver samples.
STAGE 9	FUTURE WORK	Development of final messages to be available in educational institutions, community youth centres and learner programs.
STAGE 10		Media release of results and messages. Interview and promotion of messages with media.
STAGE 11		Implement and evaluate final messages in educational institutions, community youth centres and learner programs (employing procedures similar to above).

[2] Our proposal identified that "studies similar to Studies 3 and 4 are conducted as needs be to refine interventions to reduce road-related illusory invulnerability". In fact, we felt that the results of Studies 3 and 4 were sufficiently clear for similar studies with refined materials not to be necessary, especially because of other project delays. We agreed with the MAA to replace Stage 7 with an informal pilot of the materials to be employed in Study 5, as identified in the covering letter to our progress report in March 2004.

Chapter 2: Study 2- Investigation of hazard perception and risky driving in a tertiary student sample

Design

Study 2 represents a cross-sectional study of the relationship between road-related illusory invulnerability, risky driving, and experience of trauma, on the road (self-reported), *and in a driving simulator*, in a tertiary student sample. Thus, the present study aimed to replicate and extend earlier research (Hatfield and Job, 2000), with the addition of more ecologically valid assessment of risky behaviour employing a driving simulator.

Methods

Participants and sampling

45 University of Sydney students (40% female, mean age= 20.29 years)[3] volunteered to participate in a study on "attitudes and behaviours involved in driving" for up to $20 compensation. The study was publicised via advertisements that were posted around the university. The advertisement explicitly limited volunteers to licensed drivers aged between 18 and 24, and briefly stated that the study involved driving in a driving simulator and completing some questionnaires. The advertisement also clearly stated that volunteers had the chance to earn up to $20, depending on their driving performance, and the experimenter's contact details were provided.

Materials and apparatus

Advertisement

A poster was designed to call for "licensed drivers between 18 and 24 years of age" to participate in a study on "attitudes and behaviours involved in driving"

[3] Although data was initially collected for 30 Participants (50% female, mean age= 20.37 years), in accordance with our research proposal, data from 15 additional Participants was collected some months later to increase the power of statistical analyses.

[see Appendix A]. The poster identified that Participants would have the opportunity to drive in a simulator, earn up to $20, and complete some questionnaires, at the University of Sydney Psychology Department. Potential Participants were informed that the study would take approximately 45 minutes, and were assured of confidentiality and the right to withdraw. The poster provided contact details for the researcher, to allow interested people to volunteer.

Participant Information Statement

A Participant Information Statement (PIS) [see Appendix B] described the study of "decision making while driving" as involving completion of questionnaires, followed by driving on the simulator. The PIS instructed Participants to drive "as you would a normal car" when "you need to get to work on time" while following "normal road rules" (with examples of not overtaking on double lines, stopping at red traffic lights, and adhering to posted speed limits). The PIS then explained the remuneration procedure of Participants beginning with a kitty of $20 ($5 per drive) and losing $4 for every infringement or crash, until $0 would be owed to them[4]. Participants were told that they should stop driving if they began to experience simulator sickness. Finally, Participants were informed that the study would take approximately 45 minutes, and assured of confidentiality and the right to withdraw. Completion of questionnaires and drives was taken as an indication of consent.

Main questionnaire

The main questionnaire comprised of several questionnaires in the following order [see Appendix C].

[4] In fact, all Participants were given a minimum of $5 at the end of the session.

Future-related Illusory Invulnerability Questionnaire

Participants estimated the likelihood that each of a list of 17 road-related and 7 road-unrelated positive events [see Table 2.1] would affect them, as well as the likelihood that the same events would affect "the average person" of their age and gender. The order of making self versus average peer ratings was not counterbalanced, because this factor has been found to have no effect in our previous research with university students.

Both road-related (eg. injured in a crash as a driver, be booked for speeding) and road-unrelated (e.g. flu, smoking-related illness) events were included in the list in order to allow comparison illusory invulnerability regarding different types of events. Twelve road-related events were negative (and 5 positive). Three road-unrelated events were negative (and 4 positive). Positive events (eg. travel to Europe) were included to control for response biases. That is, in order to demonstrate illusory invulnerability regarding negative and positive events, Participants must employ both sides of the response scale.

Participants responded on a well-validated, fully verbally labelled 7-point Likert scale (e.g. 1= "extremely likely", 2= "very likely", 3= "likely", 4= "neither likely nor unlikely", 5= "unlikely", 6= "very unlikely", 7= "extremely unlikely").

Table 2.1: Road-related negative, road-related positive, road-unrelated negative, and road-unrelated positive included in the Future-related Illusory Invulnerability Questionnaire.

Event type	***Item***	***Event wording***
Road-related	*1*	Be booked for speeding
negative	*4*	Have a car crash, as a driver at fault
	7	Be injured in a crash, as a driver at fault
	8	Be killed in a car crash, as a driver at fault
	11	Be booked for doing an illegal U-turn
	13	Be injured in a car crash, as a driver not at fault
	14	Be killed in a car crash, as a driver not at fault
	15	Have the car you are driving stolen
	18	Be booked for running a red light
	21	Be injured in a car crash, as a passenger
	22	Be killed in a car crash, as a passenger
	24	Be booked for driving with a blood alcohol content over the legal limit
Road-related	*6*	Just avoid a car crash because you are able to stop quickly
positive	*9*	Have 3 consecutive years without having a car crash as a driver
	10	Have 3 consecutive years without being booked
	16	Avoid a car crash nearly caused by another driver
	17	Drive safely if driving while tired
Road-unrelated	*5*	Have pneumonia
negative	*19*	Have gastrointestinal illness
	20	Have your wallet stolen
Road-unrelated	*2*	Not be hospitalised in the next 5 years for illness or injury
positive	*3*	Travel overseas in the next 5 years
	12	Get very good marks at university
	23	Own your own home

Past-related Illusory Invulnerability Questionnaire

Participants then estimated how often each of a second, similar list of events [see Table 2.2] had happened to themselves and "the average person" of their age and gender (again, in this order only). For road-related events, Participants were asked to consider only the time they had been driving, or the past year (whichever is smallest). For road-unrelated events, Participants were asked to consider their whole life. All of the events in the past-related illusory invulnerability questionnaire paralleled events employed in the future-related illusory invulnerability questionnaire, but were rephrased in the past tense. Four of the events from the future-related illusory invulnerability questionnaire were inappropriate for use in relation to the past (e.g. “be killed in a car crash”), and were thus omitted from the past-related illusory invulnerability questionnaire. Thus, the past-related illusory invulnerability questionnaire included; 9 road-related negative events, 5 road-related positive events, 3 road-unrelated negative events, and 3 road-unrelated positive events. Participants’ responses were open-ended, except for the item “Got very good overall marks in end-of-year exams at school”, for which Participants provided an answer between 1 and 6 (corresponding to the 6 years of high school). In addition to measuring past-related illusory invulnerability, this questionnaire provides information regarding Participants’ previous involvement in road trauma, as well as other events.

Table 2.2: Road-related negative, road-related positive, road-unrelated negative, and road-unrelated positive included in the Past-related Illusory Invulnerability Questionnaire.

Event type	***Item***	***Event wording***
Road-related	*1*	Booked for speeding
negative	*4*	Had a car crash, as a driver at fault
	7	Injured in a car crash, as a driver at fault
	10	Booked for doing an illegal U-turn
	12	Injured in a car crash, as a driver not at fault
	13	Had the car you have been driving stolen
	16	Booked for running a red light
	19	Injured in a car crash, as a passenger
	20	Booked for driving with a blood alcohol content over the legal limit
Road-related positive	*6*	Just avoided a car crash because of being able to stop quickly
	8	Had 3 consecutive years without having a car crash, as a driver
	9	Had 3 consecutive years without being booked
	14	Avoided a crash nearly caused by another driver
	15	Drove safely while tired
Road-unrelated	*5*	Had pneumonia
negative	*17*	Had gastrointestinal illness
	18	Had your wallet stolen
Road-unrelated	*2*	Had 5 years without being hospitalised for illness or injury
positive	*3*	Travelled overseas
	11	Got very good overall marks in end-of year exams at school

On-road Risky Driving Intentions Questionnaire:

Participants identified the frequency with which they would engage in each of 10 risk-increasing and 3 risk-decreasing driving behaviours [see Table 2.3] “as a proportion of the time spent driving” over the next year. Responses were made on a fully labelled 7-point Likert scale (0= “never”, 1= "hardly ever", 2= "occasionally", 3= "quite often", 4= "frequently", 5= "nearly all the time", 6= "always").

Table 2.3: Risk-increasing and risk-decreasing behaviours included in the On-road Risky driving Intentions Questionnaire.

Behaviour type	***Item***	***Behaviour***
Risk-increasing	*1*	Run a red light
	2	Keep driving even though you are very tired
	3	Do an illegal U-turn
	5	Change lanes without checking properly for vehicles in other lanes
	6	Drive with a blood alcohol content above the legal limit
	7	Drive while under the influence of illegal drugs that may impair your driving
	8	Drive while under the influence of legal drugs (besides alcohol) that may impair your driving
	9	Travel as a passenger of a driver with a blood alcohol content above the legal limit
	12	Turn right across a busy road even when there is a small chance of a collision
	13	Exceed the speed limit by no more than 15km/hr
Risk-decreasing	*4*	Stop driving if you want to talk on a hand-held mobile phone
	10	Wear a seatbelt
	11	Reduce your usual speed when it is raining

Demographic and control variables questionnaire:

A final questionnaire assessed several personal characteristics that may influence the critical risk-perception and on-road risky driving variables. Participants were asked for how long they had been licensed, how many hours they spent driving as a driver and as a passenger in the average week, and whether they owned a car (or had permanent access to a car). They were asked how many crashes they had been in as a driver, and to provide further details of any crash involvement (whether anyone was injured, whether any vehicles were towed, whether anyone was booked, etc.). Participants also responded to several questions assessing demographic variables (including age, gender, main language spoken at home, and socioeconomic status). The questionnaire also incorporated the Marlowe-Crowne Social Desirability Scale, short form C (Reynolds, 1982).

Simulator-related questionnaires

Simulator-related Illusory Invulnerability Questionnaire.

Before each simulator drive, Participants estimated the likelihood that each of 3 negative events and 2 positive events would happen to them in the following drive on the driving simulator [see Table 2.4], and the likelihood that the same events would happen to "the average person" of their age and gender. Participants responded on the same ratings scale as for the Future-related Illusory Invulnerability Questionnaire. [see Appendix D].

Table 2.4: Negative and positive simulator-related events included in the Simulator-Related Illusory Invulnerability Questionnaire.

Event type	***Item***	***Event wording***
Negative	*1*	Be booked for speeding
	3	Be booked for going through a red light
	4	Have a car crash on a blind corner
Positive	*2*	Have less than 2 car crashes
	5	Get less than 2 fines

Simulator-related Risky Driving Intentions Questionnaire.

Participants also estimated how often they would “not use rear-vision mirror”, “travel across double lines”, “disobey speed signs”, and “drive off the roadway” in the following drive on the driving simulator. Participants responded to each item on a fully labelled 7-point Likert scale (0= “never”, 1= "hardly ever", 2= "occasionally", 3= "quite often", 4= "frequently", 5= "nearly all the time", 6= "always") [see Appendix C].

Simulator Driving Record Sheet.

A standard record sheet was employed to record several simulator measures (as a back-up) [see Appendix E].

STISIM Driving simulator, and drives

The driving simulator, situated in a room in the School of Psychology, University of Sydney, provides an interactive driving experience, with immediate visual and auditory feedback. It consists of the cab of a Hyundai Excel with automatic transmission, including a modular steering unit with 360 degree, speed sensitive steering capability, an accelerator and a brake pedal unit. Vehicle speed is displayed on the speedometer in the instrument panel. The simulated visual scene is projected from three projectors onto three screens (each 1.42m x 1.14m in size), giving the driver a 135-degree field of view.

Driving scenarios are programmed on software developed by Systems Technology Inc (STI) and runs on a multiprocessor computer with three 133 MHz Pentium processors. The programs describe the position, orientation, and speed of road segments, on-road objects (e.g. cars, traffic signals, pedestrians barriers), and roadside objects (e.g. speed limit signs, pedestrians, trees, buildings). A graphics accelerator, providing a visual update of 20 Hz, with texturing, shading and lighting, produces reasonable scene resolution (1024 by 768 pixels). The simulator also provides immediate auditory feedback including tire screeching, and collision sounds.

Figure 2.1 shows the car body in relation to the screens, and an example of the simulated graphics.

Figure 2.1: Simulator car body, screens, and example graphics

The STISIM software also recording of a wide range of driver performance variables.

A practice drive provided Participants with an opportunity to familiarise themselves with driving the simulator, and particularly with accelerating, braking, handling curves and turns, and lane changing (e.g. to avoid road blocks and pedestrians crossing the road). The practice drive had a duration of approximately 8-10 minutes.

The four test drives were based on tasks employed by Ivancic and Hesketh (2000), although some tasks were designed specifically for the present study. For each task a second, similar, task was included in one of the four drives, and measures were averaged across the paired tasks (in order to increase

Table 2.5: Driving tasks included in the four test drives employed in Study 2

Test drive	***Task***	***Task Description***
1	*1.1*	Left lane is blocked by pedestrians and there are oncoming cars in the other lane.
	2.1	Traffic lights at an intersection which turn amber 5 secs before being reached by the driver.
	3.1	Road sign with curved arrow, road curves sharply to right, cars emerge suddenly from the right at an intersection.
	4.2	Left lane is blocked by pedestrians, cars appear in the rear–vision mirror coming from behind at high speed.
2	*5.2*	Left turn across pedestrians to test gap acceptance.
	5.1	Right turn across traffic to test gap acceptance.
	3.2	There is a crest in the road, cars emerge suddenly from the left at an intersection.
	4.1	Left lane is blocked by cones, cars appear in the rear-vision mirror coming from behind at high speed.
3	*7*	Driving speed on 4 different types of road a) Driving on a straight road; speed limit = 100 km/hr. b) Driving past a curve; no specified speed limit, last speed sign = 100 km/hr. c) Driving near a school; speed limit = 40 km/hr. d) Driving near a shopping district and through a village; speed limit = 50 km/hr.
	6.1	Headway task: car ahead is travelling slowly at 70km/hr, there are double centre lines.
4	*2.2*	Traffic lights at an intersection which turn amber 5 secs before being reached by the driver.
	1.2	Left lane is blocked by cones and there are oncoming cars in the other lane.
	6.2	Headway task: car ahead is travelling slowly at 50km/hr, there are double centre lines.

reliability). The tasks assessed driving behaviour in response to road-blockages with vehicles approaching from in front or behind, to traffic signals, and to blind curves or crests. Other tasks assessed right turning behaviour (with oncoming traffic) and following behaviour, as well as speed maintenance in a variety of speed limit zones. The tasks included in each drive are presented in Table 2.5. Drives were kept relatively short in order to minimise the likelihood of simulator sickness. The order of test drives was counterbalanced across Participants to minimise practice effects.

Speed was recorded every 10m for 200m preceding the hazard in Tasks 1.1 and 1.2 (road blocked, vehicles approaching in front), 2.1 and 2.2 (traffic lights), and 4.1 and 4.2 (road blocked, vehicles approaching behind), and every 10m for 300m preceding the hazard in Tasks 3.1 and 3.2 (curve or rise followed by intersection). These distances from the hazard correspond roughly to the distance at which the hazard first appears on the horizon. Speed was recorded every 50m throughout the different speed zones in Task 7. Due to problems with recording data for other vehicles, the data required for planned calculations of gap acceptance and headway (in tasks 5.1, 5.2, 6.1, and 6.2, respectively) were not obtained. Nonetheless speed data were obtained every 50m for Tasks 6.1 and 6.2. Lane position data were recorded for Tasks 1.2, 4.2, 6.1 and 6.2. Data were also collected for the number of collisions, the number of pedestrians hit, the number of speed exceedences, the number of traffic light tickets issued, the total run time, and the number of off-road accidents within each of the four drives.

Procedure

When potential Participants responded to the advertisement by contacting the researcher (by telephone) they were informed of the basic research procedures (i.e. use of questionnaires and driving simulator tasks, and deduction of $4 from the maximum $20 compensation for each error). Appointments were made with consenting Participants.

All Participants were tested individually. In a quiet room next to the room housing the driving simulator Participants read the PIS. According to a standard script, all Participants were assured of their anonymity and asked to complete some questionnaires as accurately and honestly as they could. All Participants completed the Future-related Illusory Invulnerability Questionnaire, the Past-related Illusory Invulnerability questionnaire, the Simulator-related Illusory Invulnerability Questionnaire, the On-road Risky Driving Intentions Questionnaire, the Simulator-related Risky Driving Questionnaire, and finally the Demographic and Control Variables Questionnaire (in a single questionnaire booklet).

Participants were then directed into the driving simulation room and told:

> "The simulator is basically an automatic car with a rear view mirror on the left screen. Start out driving slowly because you might feel odd as the usual G forces are not operating. However, during the practice run, try travelling at different speeds to help you judge speeds later, as we are not penalising you for any errors during this drive. During the test drives, you will need to drive as if you need to get to work on time. However, it is important that you obey the road rules because you will lose $4 of the $20 we give you for every rule you break or crash you have. The rules are just like on the real road: double lines mean you can't overtake and there are speed signs to tell you what speed you are meant to be travelling at. You are required to drive straight down the road unless there is a detour sign advising you which way to turn in the following intersection."

Participants then completed the practice drive before completing the four test drives. In the 1-2 minute interval before each test drive (incorporated partly to minimise simulator sickness), Participants completed the Simulator-related Illusory Invulnerability Questionnaire. The mean total driving time was 383.74s (s.d.=52.66) for Drive 1, 427.29s (s.d.=79.22) for Drive 2, 579.46s (s.d.=99.91) for Drive 3, and 377.17s (s.d.=47.45) for Drive 4.

After completing the drives, the experimenter informed Participants of any driving errors they had made, and gave them their appropriate monetary

compensation. Specifically, Participants were given whatever remained of the initial $20 or $5 (whichever was greater).

This experimental session lasted approximately 45 minutes.

Variable computation and statistical analysis

Data were analysed with SPSS (Statistical Package for the Social Sciences). The Type I error rate for all analyses was set at .05. All tests were 2-tailed unless otherwise stated. Significant p values are marked with asterisks in all tables (* $p<.05$; ** $p<.001$).

Analysis of questionnaire data

Descriptive statistics were employed to investigate the characteristics of the sample, in terms of age, gender, driving exposure, and the tendency to conform to social expectations.

Relative “risk” estimates were calculated for each item of the Future-related Illusory Invulnerability Questionnaire, by subtracting self from average peer estimates for negative events, and average peer from self estimates for positive events. Thus, a higher score for each item reflects a belief that one is better off than one’s peers. A road-related negative relative future risk index was computed by averaging relative estimates across all road-related negative events. A road-related positive relative future risk index was computed by averaging relative estimates across all road-related positive events. Further indices were computed separately by averaging relative estimates across items considering casualty as a driver at fault, casualty as a driver not at fault, and casualty as a passenger. Two road-unrelated relative future risk indices were also computed, for negative and positive events respectively.

Road-related and road-unrelated positive and negative indices were similarly computed for relative past experience estimates. Because there were no items regarding death as a driver at fault, as a driver not at fault, or as a passenger, the three items regarding injury in each of these three cases were considered in the analyses.

Relative scores were calculated for each item of the Simulator-Related Illusory Invulnerability Questionnaire, by subtracting self from average peer estimates for negative events and average peer from self estimates for positive events. Thus, a higher score for each item reflects a belief that one is better off than one's peers. Two indices were computed by averaging across negative and positive events, respectively.

Illusory invulnerability was assessed by comparing relative index and event scores to the score representing no difference between self and peers (0) using a 1-tailed single sample t-test. Means significantly greater than 0 reflect illusory invulnerability.

The possibility that past-related illusory invulnerability influences future-related illusory invulnerability was assessed by computing correlations between corresponding indices and events. Because positive correlations were expected, 1-tailed tests were employed.

A general on-road risky driving intentions index was computed by reverse-scoring scores for all risk-decreasing items On-road Risky Driving Intentions Questionnaire, and then adding scores for all items. Thus, a higher score reflects the intention to engage in more risky driving behaviour.

The hypothesis that illusory invulnerability regarding future and past road use promotes risky driving was evaluated by assessing the correlation of relative future risk estimates and relative past experience estimates with the general on-road risky driving intentions index. Due to the inconsistency of previous cross-sectional findings, the hypotheses were tested two-tailed. The relationship of illusory invulnerability regarding specific road-related events (e.g. being booked for speeding) with corresponding on-road risky driving intentions (e.g. speeding) was also assessed.

The hypothesis that illusory invulnerability regarding future and past road use contributes to involvement in road trauma was evaluated by assessing the correlation of relative future risk estimates with estimates of personal

experience of road trauma from the Past-related Illusory Invulnerability Questionnaire, as well as the crash involvement item from the Demographic and Control Variables Questionnaire. For relative past experience scores, only the relationship with crash involvement was assessed (due to the mathematical dependence of personal and relative experience scores on one another). Again, two-tailed tests were employed.

Analysis of simulator-related data

We calculated a self-reported risky simulator driving index by averaging Participants' estimates of how often they would fail to use the rear-vision mirror, travel across double lines, disobey speed signs, and drive off the roadway.

Several simulated driving performance measures were derived from the simulator driving data. Based on plots of speed approaching each hazard [see Figures 2.2 to 2.9] means were computed separately for each task employing all available data for Tasks 1.1, 1.2, 2.1, and 2.2 (from 200m to 10m from hazard), and for Tasks 3.1 and 3.2 (300m to 10m from hazard). For Tasks 4.1 and 4.2 data from 110-200m, and from 70-130m, respectively, were included in the mean speed calculations. We then computed mean speed approaching hazard indices for Task 1 (averaged across Tasks 1.1 and 1.2), Task 2 (averaged across Tasks 2.1 and 2.2), Task 3 (averaged across Tasks 3.1 and 3.2), and Task 4 (averaged across Tasks 4.1 and 4.2). In addition, an overall mean speed approaching hazards index was calculated by averaging the four individual indices for each Task.

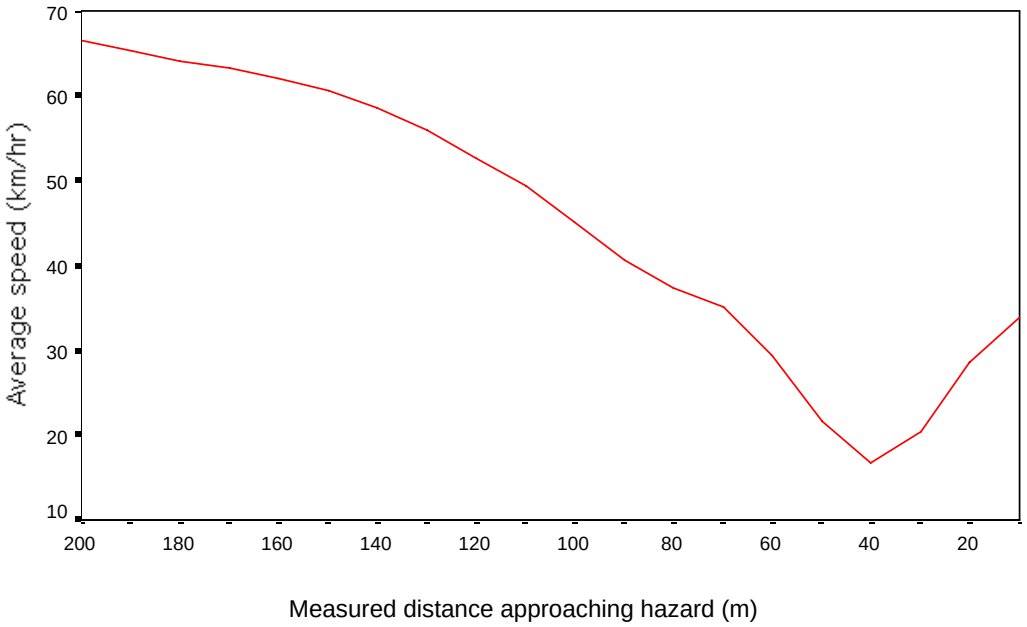


Figure 2.2: Average speed approaching the pedestrians in Task 1.1.

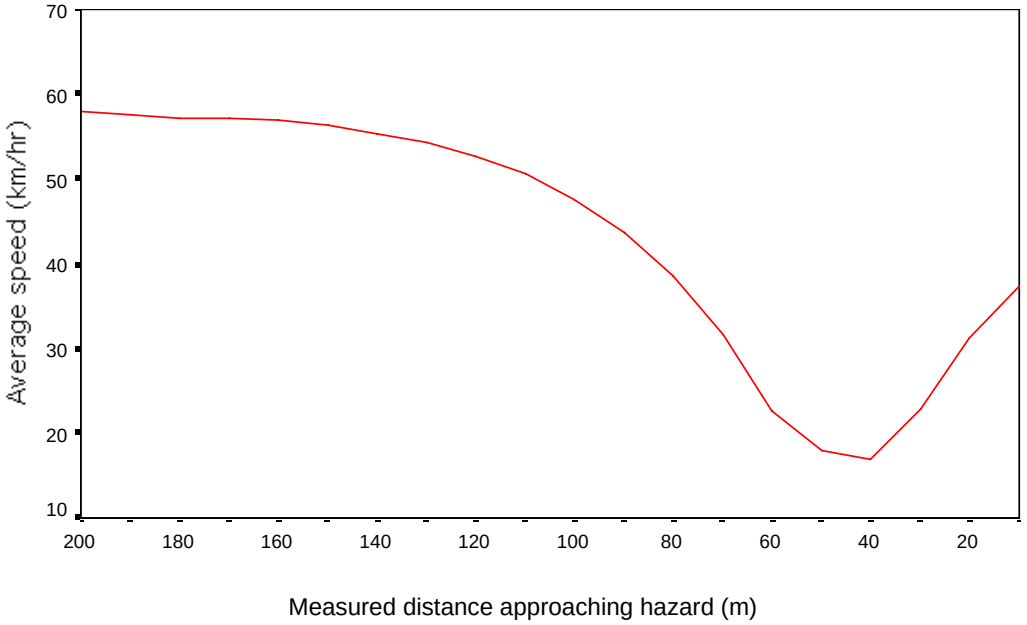


Figure 2.3: Average speed approaching the hazard in Task 1.2.

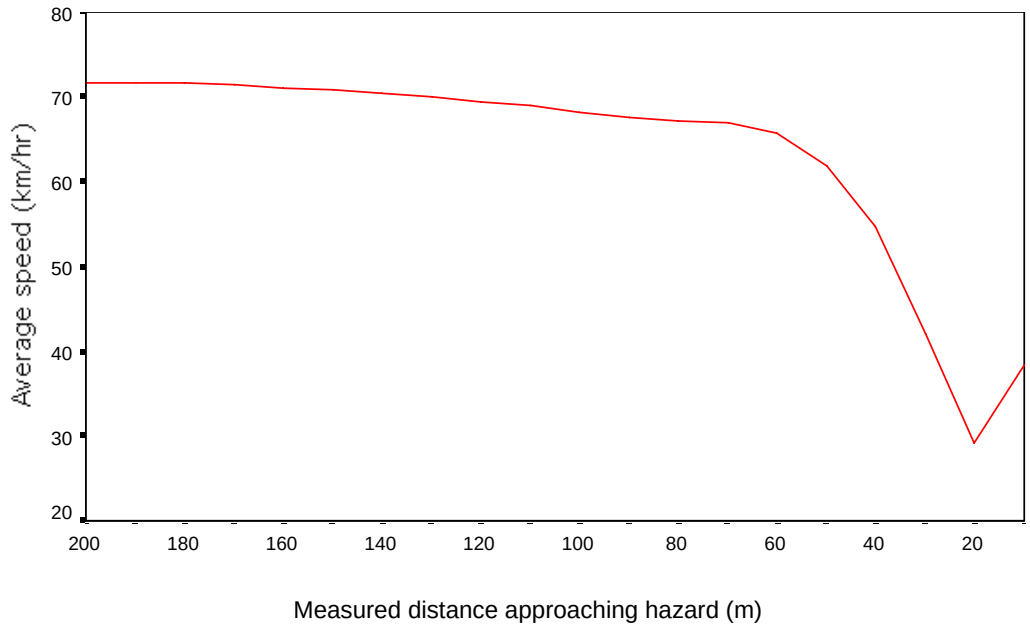


Figure 2.4: Average speed approaching the hazard in Task 2.1.

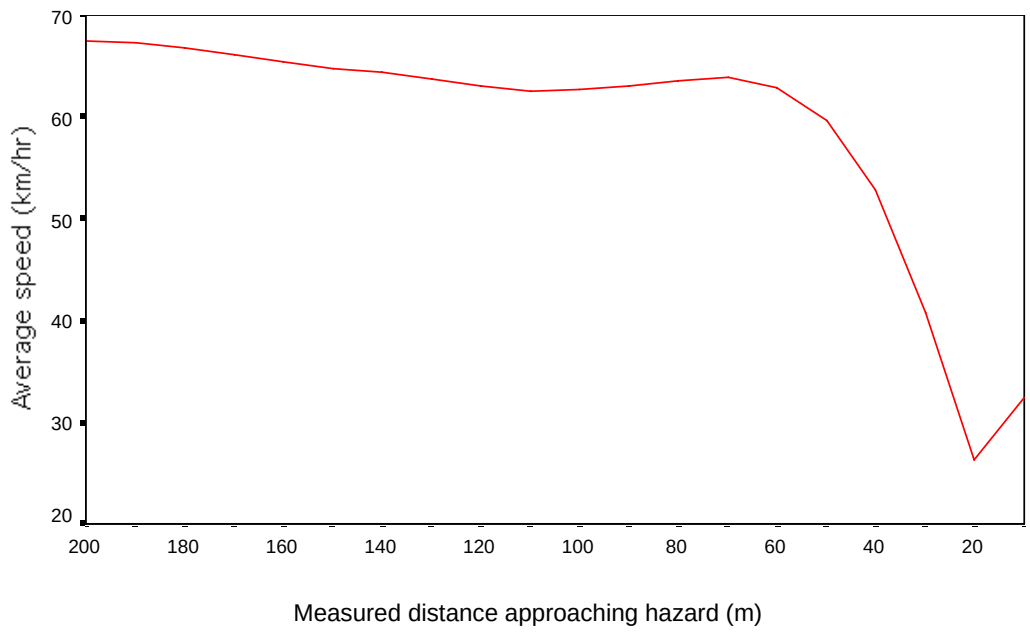


Figure 2.5: Average speed approaching the hazard in Task 2.2.

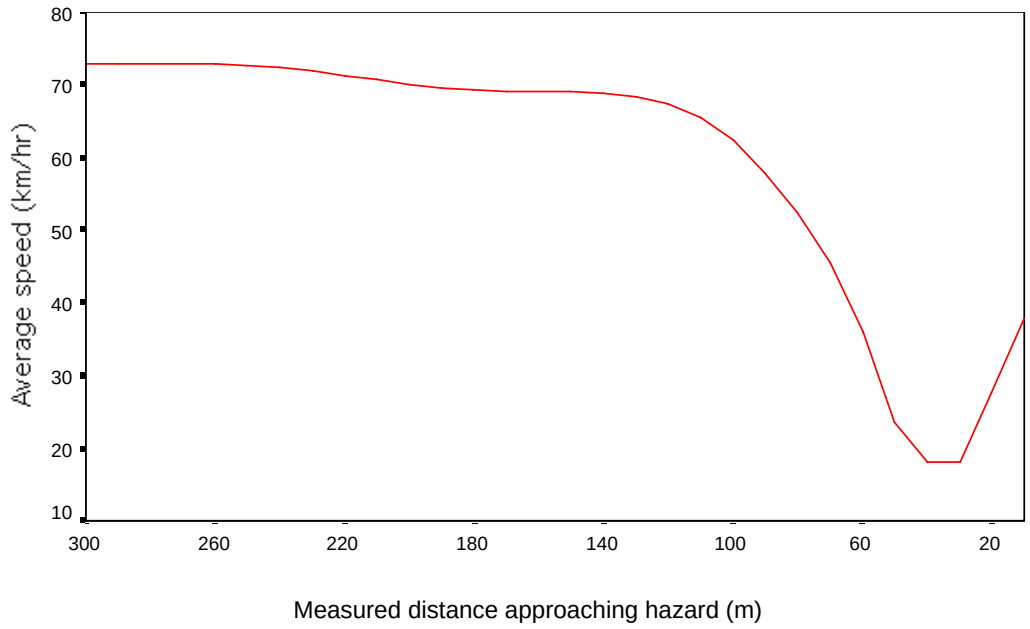


Figure 2.6: Average speed approaching the hazard in Task 3.1.

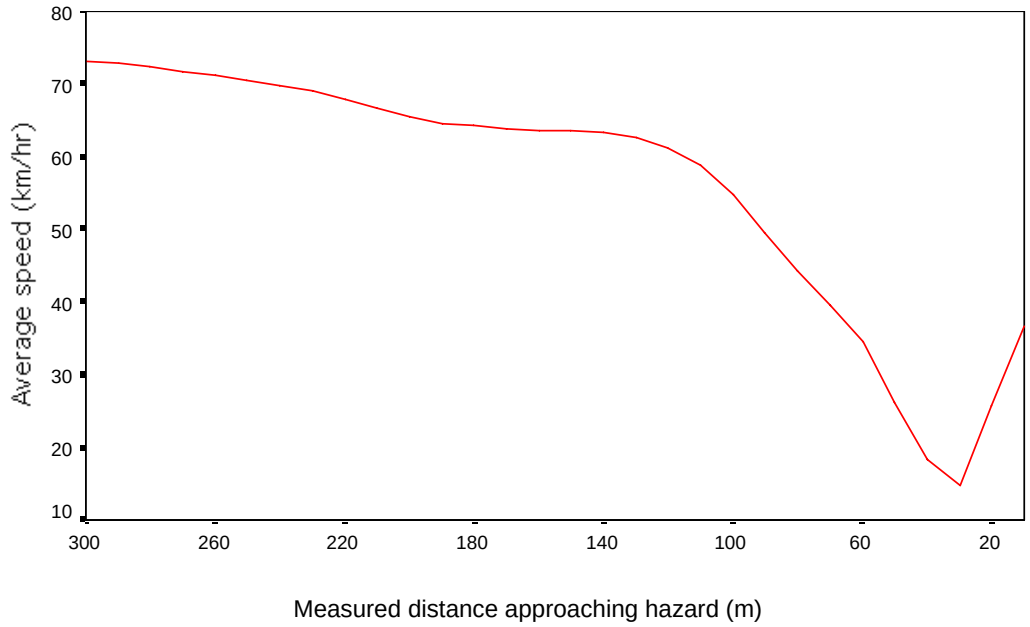


Figure 2.7: Average speed approaching the hazard in Task 3.2.

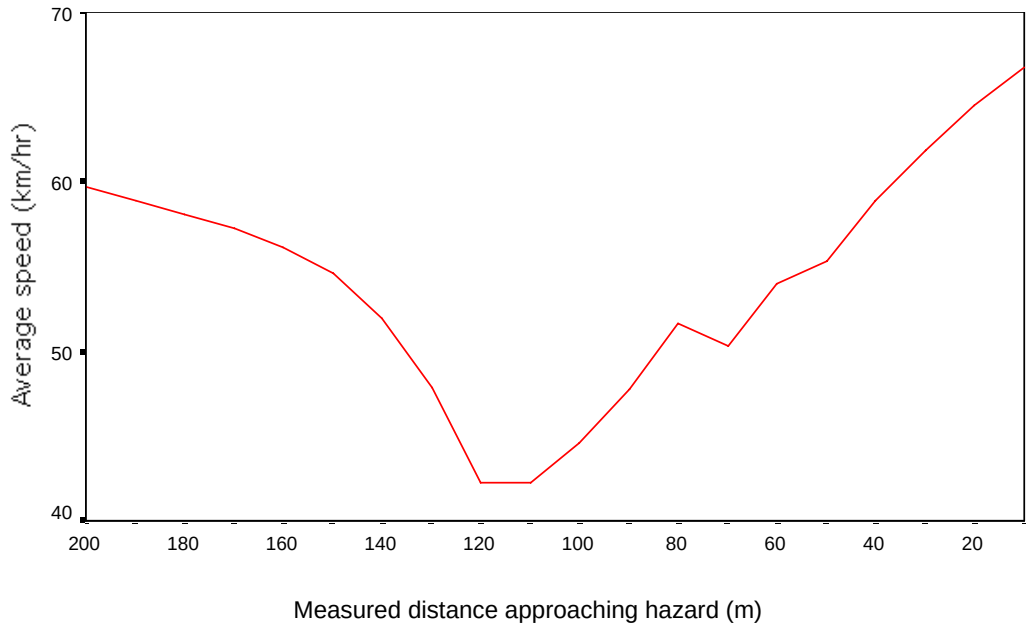


Figure 2.8: Average speed approaching the hazard in Task 4.1.

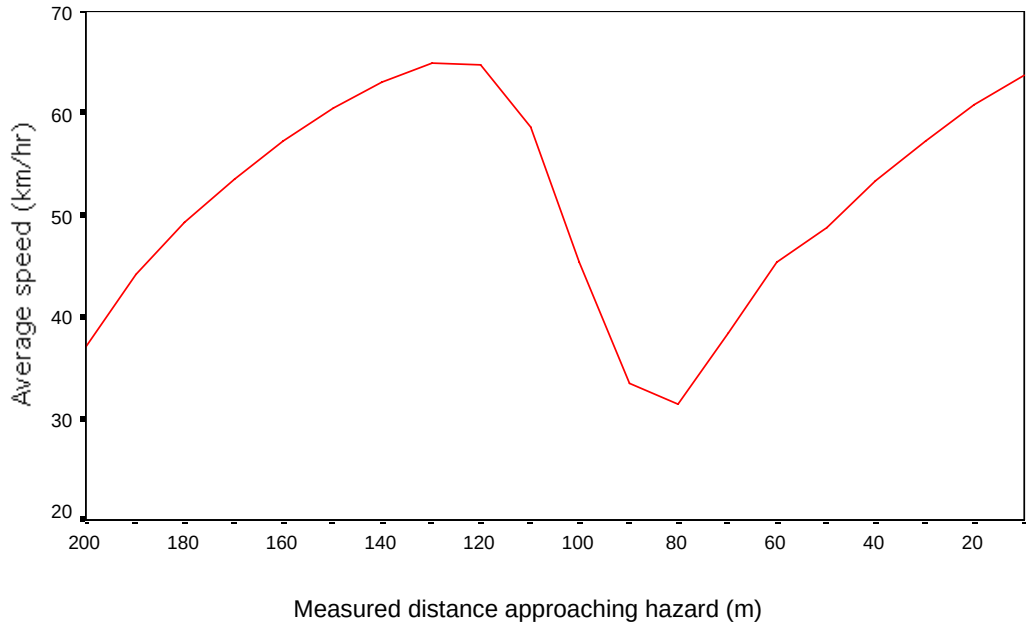


Figure 2.9: Average speed approaching the hazard in Task 4.2.

As intended, for Task 1.2 all Participants waited for all cars to pass before going around the obstruction (cones). For task 4.2, most Participants did not cross the centreline to pass the pedestrians. We assume a similar pattern in Tasks 1.1 and 4.1 (although the position of cars and pedestrians was not recorded) in these drives. Thus, no indices reflecting gap acceptance were considered for Tasks 1 and 4.

Data for other objects successfully recorded for task 5.1 but not task 5.2. Thus, we were able to consider the distance or time to the nearest car when the driver started and finished turning. Participants who waited for all cars to pass before turning were not included in the analyses.

For Tasks 6.1 and 6.2, STISIM failed to record data regarding the lead vehicle. Thus, for both tasks, we analysed only mean speed and maximum speed variability. As intended, no Participants overtook the lead vehicle.

Mean speed indices were also calculated for each of the four speed zone tasks that constituted Task 7 (see Table 2.5).

Indices were calculated for the total number of drives (0-4) in which speed was exceeded and the total number of drives (0-3) in which traffic light tickets were issued. In addition, we computed the total number of traffic light tickets (0-3).

A series of analyses were conducted to assess the relationship between risk perception and risky driving on the driving simulator. Thus, we assessed the correlation of each of the seven relative future risk indices (road-related negative, road-related positive, road-unrelated negative, road-unrelated positive, crash as a driver at fault, crash as a driver not at fault, crash as a passenger) with intended risky simulator driving, average speed approaching each type of hazard, distance to nearest car when starting and finishing the right-hand turn Task 5.1 (for Participants who did not wait for all cars to pass), average speed and speed variability during the following task (Task 6), average speed on each of the four speed zone tasks, number of drives in

which speed was exceeded, number of drives in which traffic light tickets were issued, and total number of traffic light tickets. Some more targeted analyses were also conducted (for example, correlation of relative risk of being booked for speeding with number of drives in which speed was exceeded).

Parallel analysis was conducted for relative past experience indices and events.

The relationship between simulator-related illusory invulnerability and risky driving on the simulator was assessed. First, we correlated the intended risky simulator driving index the simulator-related negative and positive relative risk indices and the relative likelihood of having “have less than 2 crashes”. In more targeted analyses we assessed the correlation of relative estimates for “be booked speeding” and “get less than 2 fines” with intention to “disobey speed signs” on the simulator. We then assessed the correlations between the simulator-related negative and positive relative risk indices with each of the driving performance measures. We then correlated relative risk estimates for “be booked for speeding” on the simulator prior to Drive 1 with the average speed approaching hazards in Drive 1 (i.e. averaged across Tasks 1.1, 2.1, 3.1, and 4.2; see Table 2.5). Similarly, relative risk estimates for “be booked for speeding” on the simulator prior to Drive 2 were correlated with the average speed approaching hazards in Drive 2, and relative risk estimates for “be booked for speeding” on the simulator prior to Drive 4 were correlated with the average speed approaching hazards in Drive 4 (see Table 2.5 for a listing of tasks). We correlated relative risk estimates for “be booked for speeding” on the simulator prior to Drive 3 with the average speed in each of the four speed zone tasks in Task 7. Finally, relative risk estimates for “be booked for speeding” on the simulator (averaged across all four drives) was correlated with number of drives in which the speed limit was exceeded, relative risk estimates for “be booked for going through a red light” on the simulator (averaged across all four drives) was correlated with the total number of drives in which traffic light tickets were issues, and with the total number of traffic light tickets issued. Relative risk estimates for “have less than 2 fines” on the simulator was correlated with each of these infringement measures.

To assess the relationship between risk perception and trauma involvement on the driving simulator, each of the seven relative future risk indices was correlated with the total number of crashes on the driving simulator. Parallel analyses were conducted for relative past experience indices. The relationship of simulator-related negative and positive relative risk indices, and of relative risk for “have less than 2 car crashes” on the simulator (averaged across all four drives), and “have a car crash on a blind corner” on the simulator (averaged across all four drives), with the total number of crashes on the simulator, was assessed.

In order to validate the on-road risky driving intentions questionnaire to be employed in later studies not involving the simulator (Study 5), the relationship between intended on-road risky driving and risky driving on the simulator was assessed. The on-road risky driving intentions index was correlated with each of the simulated driving performance measures (e.g. speed approaching hazards). The intention of running a red light was correlated with the two traffic light infringement measures. The intention of exceeding the speed limit was correlated with the simulator speed infringement measure.

Associations with personal characteristics

We computed correlations of age, average number of hours spent driving each week (as a driver and as a passenger), number of years licensed, and social desirability, with the relative future risk indices, the relative past experience indices, the relative simulator-related risk indices, the on-road risky driving intentions index, the personal past experience indices, self-reported crash involvement (from the Demographic and Control Variables Questionnaire), the risky simulator driving intentions index, and each of the simulated driving performance measures. The relationships of gender with illusory invulnerability, risky driving intentions, self-reported involvement in road (and other) trauma, and simulated driving performance measures were assessed by employing separate independent samples t-tests with gender as the grouping variable. As relevant evidence in the literature is inconsistent, all

tests were 2-tailed. Where significant associations with personal characteristics were observed we repeated relevant analyses using the personal characteristic as a covariate.

Results

Sample characteristics

The 45 subjects (27 males; 18 females) had a mean age of 20.29 years (s.d.=1.91), had held their licenses for a mean of 4.08 years (s.d.=1.85), and spent on average 6.80 hours per week (s.d.=7.25) driving as a driver, and 4.09 hours per week (s.d.=4.72) as a passenger. 49% of the sample reported never having had a crash. The remainder reported having had 1 (31%), 2 (11%), 3 (7%) or 4 (2%) crashes. The mean score on the Marlowe-Crowne Social Desirability Scale (with a maximum possible score of 13) was 7.66 (s.d.=2.09).

Internal consistency of self-report indices

Internal consistency was evaluated for each self-reported index employed in analyses employing either Cronbach's alpha (for indices involving more than 2 items), or Pearson correlations (for indices involving only 2 items)[see Table 2.6]. Internal consistency was not computed for indices of personal experience, since these are not expected to demonstrate it (determined primarily by past experience rather than perceptual tendencies.) Internal consistency was acceptable for all indices except the relative future risk road-related positive index (moderate), road-unrelated negative index (moderate), and road-unrelated positive index (low), and for the relative experience road unrelated negative and positive indices (both low). Low internal consistencies should be born in mind when interpreting associations with these scales.

Table 2.6: Internal consistency of self-reported indices (with n and number of items).

Index	***n***	***Cronbach's alpha or r(where indicated)***	***Number of items***
Relative future risk			
Road-related negative	44	.796	12
Road-related positive	44	.571	5
Casualty as driver at fault	45	r=.645**	2
Casualty as driver not at fault	45	r=.375*	2
Casualty as passenger	45	r=.631**	2
Road-unrelated negative	45	.532	3
Road-unrelated positive	45	.346	4
Relative past experience			
Road-related negative	44	.842	9
Road-related positive	42	.605	5
Road-unrelated negative	44	.204	3
Road-unrelated positive	41	.046	3
Simulator-related relative risk			
Negative	44	.801	3
Positive	44	r=.697**	2
On-road risky driving intentions	45	.763	13
Simulator-related risky driving intentions	45	.692	4
Social desirability	44	.628	13

Illusory invulnerability regarding various aspects of future road use

Figure 2.10 presents mean relative future risk estimates for each index.

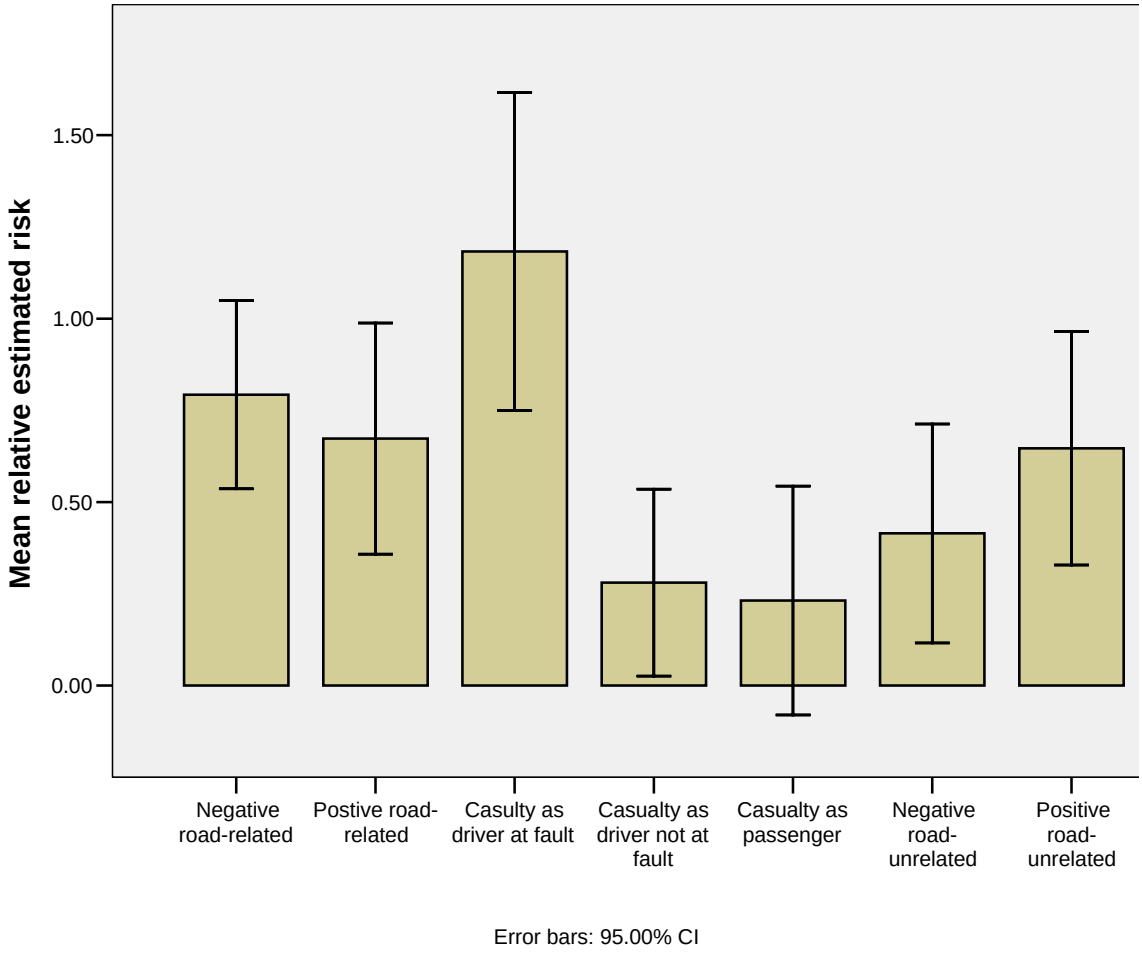


Figure 2.10: Mean relative estimated future risk for the road-related negative, road-related positive, injury/death as a driver at fault, injury/death as a driver not at fault, injury/death as a passenger, road-unrelated negative and road-unrelated positive indices

Relative future risk estimates were significantly greater than zero for the road-related negative and positive indices (t_{42}=6.56, $p_{1\text{-tailed}}$<.001, t_{43}=4.68, $p_{1\text{-tailed}}$ <.001, respectively), and for the road-unrelated negative and positive indices (t_{44}=3.28, $p_{1\text{-tailed}}$ =.001, t_{43}=4.37, $p_{1\text{-tailed}}$ <.001, respectively). Future-related illusory invulnerability was also demonstrated for injury/death as a driver at

fault (t_{43}=5.78, $p_{1\text{-tailed}}$ <.001), as a driver not at fault (t_{44}=2.52, $p_{1\text{-tailed}}$ =.008), and as a passenger (t_{44}=1.90, $p_{1\text{-tailed}}$ =.032).

Thus, there is convincing evidence of future-related illusory invulnerability regarding road-related, as well as road-unrelated, events in the present sample.

Illusory invulnerability regarding various aspects of past road use

Figure 2.11 presents mean relative past experience estimates for each index.

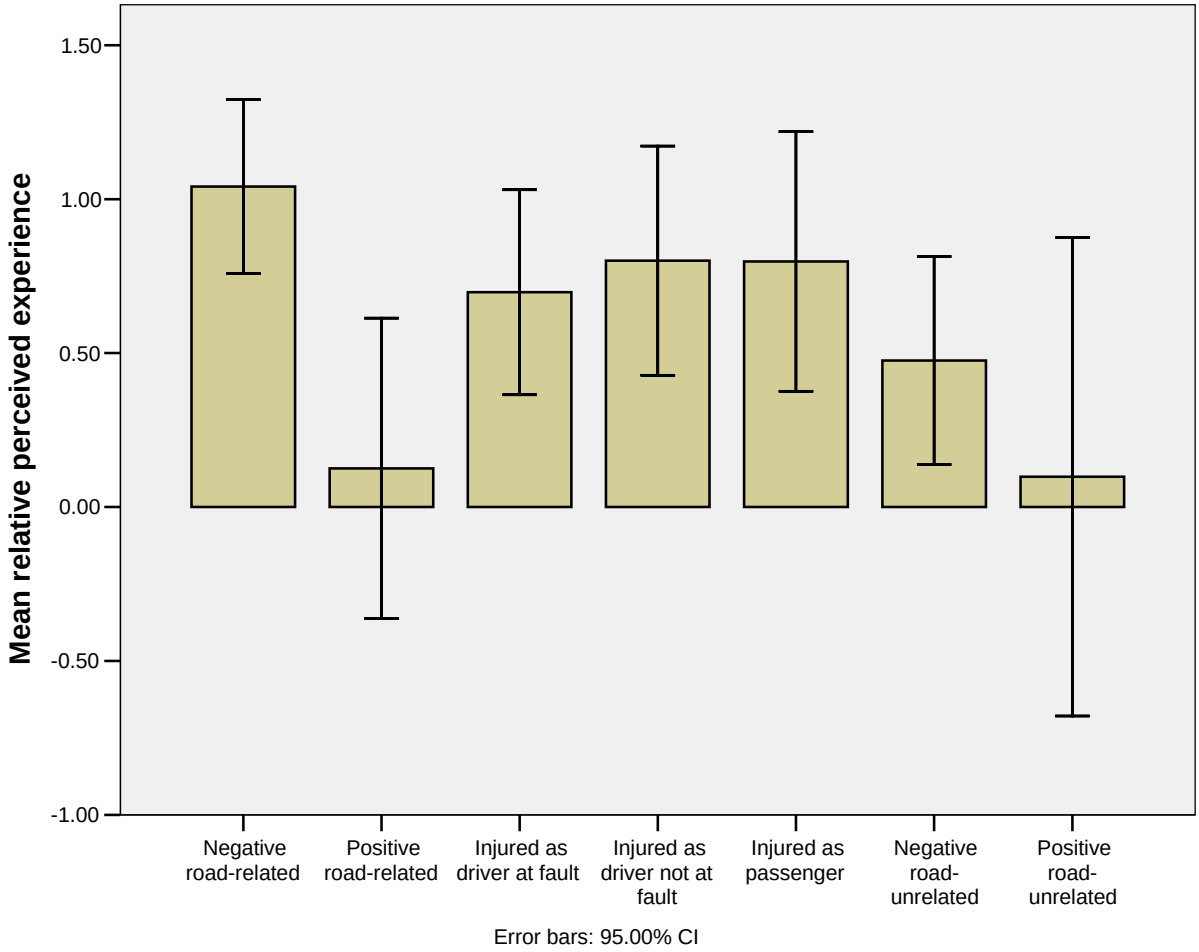


Figure 2.11: Mean relative perceived experience for the road-related negative, road-related positive, injury as a driver at fault, injury as a driver not at fault, injury as a passenger, road-unrelated negative and road-unrelated positive indices.

Relative past experience estimates were significantly greater than zero for the road-related and road-unrelated negative indices (t_{43}=6.78, $p_{1\text{-tailed}}$ <.001, t_{43}=3.24, $p_{1\text{-tailed}}$ =.001, respectively). Past-related illusory invulnerability was also demonstrated for injury as a driver at fault (t_{43}=4.61, $p_{1\text{-tailed}}$ <.001), as a driver not at fault (t_{43}=4.61, $p_{1\text{-tailed}}$ <.001), and as a passenger (t_{43}=4.25, $p_{1\text{-tailed}}$ <.001). For the road-related and road-unrelated positive indices relative past experience estimates were *nonsignificantly* greater than zero (t_{41}=0.38, $p_{1\text{-tailed}}$ =.354, t_{40}=0.03, $p_{1\text{-tailed}}$ =.462, respectively).

Thus, there is convincing evidence of past-related illusory invulnerability regarding negative road-related and road-unrelated events in the present sample.

Correlations between past-related and future-related illusory invulnerability

Table 2.7 presents correlations between corresponding relative future risk and relative past experience indices and events. Positive correlations were expected, and so tests are 1-tailed.

All but one correlation (for casualty as a driver not at fault) were positive but only one (for casualty as a driver at fault) reached conventional significance. Thus, there appears to be only a weak relationship between past- and future-related illusory invulnerability in the present sample.

Table 2.7: Correlations between corresponding relative estimated future risk and relative perceived past experience indices (with n- and p-values).

Index	***r***	***n***	$p_{1\text{-tailed}}$
Road-related negative	.140	42	.188
Road-related positive[a]	.253	41	.055
Casualty as driver at fault	.323	43	.018*
Casualty as driver not at fault	-.041	44	Direction opposite to prediction
Casualty as passenger	.071	44	.325
Road-unrelated negative[a]	.172	44	.132
Road-unrelated positive[a]	.178	40	.136

[a] Scale has low internal consistency

Illusory invulnerability regarding driving on the simulator

Simulator-related relative risk scores were significantly greater than zero for both the negative and positive indices (t_{43}=5.98, $p_{1\text{-tailed}}$ <.001, t_{43}=1.79, $p_{1\text{-tailed}}$ =.041, respectively). Thus, illusory invulnerability was observed in Participants' expectations of their simulated driving performance.

The relationship of future-related illusory invulnerability with risky driving intentions, and with self-reported road trauma involvement

Table 2.8 presents correlations of the relative future risk indices with the on-road risky driving intentions index, with corresponding personal experience indices, and with self-reported crash involvement (from the Demographic and Control Variables Questionnaire).

Table 2.8: Correlations of relative future risk indices with the on-road risky driving index, corresponding personal past experience indices, and self-reported crash involvement (with n- and p-values).

Index		***On-road risky driving intentions index***	***Corresponding personal experience index***	***Self-reported crash involvement***
Road-related negative	*r*	-.336	.007	-.156
	n	(43)	(43)	(43)
	p	.028*	.960	.317
Road-related positive[a]	*r*	-.015	-.234	.232
	n	(44)	(42)	(44)
	p	.925	.136	.129
Casualty as driver at fault	*r*	.007	.074	.089
	n	(44)	(44)	(44)
	p	.965	.632	.564
Casualty as driver not at fault	*r*	.111	-.087	-.107
	n	(45)	(45)	(45)
	p	.469	.570	.484
Casualty as passenger	*r*	.071	.155	-.130
	n	(45)	(45)	(45)
	p	.642	.309	.394
Road-unrelated negative[a]	*r*	.001	-.289	.109
	n	(45)	(45)	(45)
	p	.997	.054	.477
Road-unrelated positive[a]	*r*	.055	.342	.163
	n	(44)	(42)	(44)
	p	.724	.026*	.291

[a] Scale has low internal consistency

Only the road-related negative relative future risk index correlated significantly with on-road risky driving intentions, in a direction consistent with the claim

that the intention to engage in risky driving undermines illusory invulnerability regarding the future.

Only the road-unrelated positive relative future risk index correlated significantly with self-reported experience of corresponding events, in a direction consistent with the claim that personal experience of positive events increases illusory invulnerability (related to the absent/exempt account of illusory invulnerability). A *near-significant* (p=0.054) negative correlation between the road-unrelated negative relative future risk index and self-reported experience of corresponding events was also observed, and may have been significant in a larger sample (also supporting the absent/exempt account).

No significant correlations between relative estimated future risk indices and self-reported crash involvement were observed.

Because 1 correlation between perceived relative risk and trauma involvement (last 2 columns) could have been expected by chance, the observed effects may be spurious.

In order to conduct more targeted analyses, two further on-road risky driving intentions indices were computed by averaging scores for behaviours which are likely to contribute to having a crash as a driver (behaviours numbered 1, 2, 3, 4, 5, 6, 7, 8, 11, 12, and 13 in Table 2.3) and by averaging scores for behaviours which contribute to being booked (behaviours numbered 1, 3, 6, 10, and 13 in Table 2.3).

Correlations were computed between the intention to perform behaviours which contribute to having a crash index and the relative future risk of casualty as a driver at fault index, as well as the relative future likelihood of having 3 consecutive years without having a crash. We also computed correlations between the intention to perform behaviours which contribute to being booked index and the relative future likelihood of having 3 consecutive years without being booked. Correlations of the relative future risk scores for being booked

for speeding, for doing an illegal U-turn, for running a red light, and for driving with a BAC over the legal limit, with the intention to perform the corresponding behaviours, were computed. The correlation of intention to travel with an alcohol impaired driver with the relative future risk of crash involvement as a passenger was also computed. These “targeted” correlations are presented in Table 2.9.

Table 2.9: Correlations of specific road-related relative future risk indices and events, with self-reported frequency of performing corresponding on-road risky driving behaviours (with n- and p-values).

Paired indices or items	***r***	***n***	***p***
Behaviours which contribute to crash with Casualty as driver at fault	-.006	44	.970
Behaviours which contribute to crash with 3 crash-free years	.064	45	.675
Behaviours which contribute to being booked with 3 booked-free years	-.170	45	.264
Speeding with Booked for speeding	-.354	45	.017*
U-turn with Booked for U-turn	-.387	45	.009*
Run red light with Booked for run a red light	-.354	45	.017*
Drive with BAC over limit with Booked for drive with BAC over limit	-.512	45	<.001 **
Crash involvement as a passenger	.019	45	.903

The significant correlations that were observed suggested that the more often individuals intend to perform illegal behaviours, the less illusory invulnerability they demonstrate regarding the risk of being booked for speeding, for doing an illegal U-turn, for running a red light and for running a red light and for driving with a BAC over the legal limit. The observed rate of correlation was well above that which could be expected by chance.

Finally, we computed correlations of self-reported involvement in road trauma with the relative future risk of casualty as a driver at fault and as a driver not at fault indices, as well as the relative future likelihood of having 3 consecutive years without having a crash. No significant correlations were observed (highest nonsignificant r=-0.107, n=45, p=.484).

In summary, correlations of matching variables were most likely to be significant, and in a direction supporting the claim that the intention to engage in risky driving reduces future-related illusory invulnerability (consistent with the egocentrism account of illusory invulnerability). There was weak evidence for the claim that experience influences illusory invulnerability.

The relationship of past-related illusory invulnerability with self-reported risky driving on the road, and with self-reported road trauma involvement

Table 2.10 presents correlations of the relative past experience indices with the self-reported on-road risky driving index, and with self-reported crash involvement (from the Demographic and Control Variables Questionnaire). Correlations between relative past experience indices and corresponding personal experience indices were not considered because of the mathematical dependence of these scales.

Two significant positive correlations were observed between relative past experience indices (for “Injury as driver not at fault” and “injury as a passenger”) and on-road risky driving intentions. This rate of correlation with driving intention is above that which could be expected by chance, and, furthermore, all remaining correlations were positive but nonsignificant. Positive correlations are consistent with the claim that higher past-related illusory invulnerability promotes intentions to engage in risky driving.

No significant correlations were observed between past-related illusory invulnerability indices and self-reported road trauma involvement.

Table 2.10: Correlations of relative past experience indices with the on-road risky driving index and self-reported crash involvement (with n- and p-values).

Index		***On road Risk-taking index***	***Crash involvement***
Road-related negative	*r*	.269	-.145
	n	(44)	(44)
	p	.078	.347
Road-related positive	*r*	.163	.114
	n	(42)	(42)
	p	.302	.473
Casualty as driver at fault	*r*	.176	-.188
	n	(44)	(44)
	p	.254	.222
Casualty as driver not at fault	*r*	.338	-.227
	n	(44)	(44)
	p	.025*	.138
Casualty as passenger	*r*	.481	.082
	n	(44)	(44)
	p	.001**	.598
Road-unrelated negative[a]	*r*	.104	.018
	n	(44)	(44)
	p	.500	.905
Road-unrelated positive[a]	*r*	.142	.142
	n	(41)	(41)
	p	.375	.376

[a] Scale has low internal consistency

In more targeted analyses, correlations were computed between the intention to perform behaviours which contribute to having a crash index and the relative experience of casualty as a driver at fault index, as well as the relative experience of having 3 consecutive years without having a crash. The

intention to perform behaviours which contribute to being booked index was correlated with the relative past experience of having 3 consecutive years without being booked. We also computed correlations of the relative past experience scores for being booked for speeding, for doing an illegal U-turn, for running a red light, and for driving with a BAC over the legal limit, with the intention to perform the corresponding behaviours on the road. The correlation of intention to travel with an alcohol impaired driver with the relative past experience of crash involvement as a passenger was also computed. These "targeted" correlations are presented in Table 2.11.

Table 2.11: Correlations of specific road-related relative past experience indices and events, with self-reported frequency of performing related on-road risky driving behaviours (with n- and p-values).

Paired indices or items	***r***	***n***	***p***
Behaviours which contribute to crash with Injury as driver at fault	.176	44	.254
Behaviours which contribute to crash with 3 crash-free years	-.078	45	.609
Behaviours which contribute to being booked with 3 booked-free years	.012	43	.942
Speeding with Booked for speeding	-.175	44	.256
U-turn with Booked for U-turn	.033	44	.833
Run red light with Booked for run a red light	-.036	44	.814
Drive with BAC over limit with Booked for drive with BAC over limit	.066	44	.669
Crash involvement as a passenger	.207	44	.177

No significant correlations were found between specific road-related relative past experience indices and events, and intention to perform corresponding on-road risky driving behaviours.

Finally, we computed correlations of self-reported involvement in road trauma with the relative past experience of injury as a driver at fault and as a driver not at fault indices, as well as the relative past experience of having 3 consecutive years without having a crash. No significant correlations were observed (highest nonsignificant r=-0.227, n=44, p=.138).

In summary, the only clear correlations with relative past experience indices and events are consistent with the claim that higher past-related illusory invulnerability promotes intentions to engage in risky driving.

The relationship of future-related illusory invulnerability with risky driving, and with trauma involvement, on the driving simulator

The correlations between each of the seven relative future risk indices and self-reported intended risky simulator driving are presented in Table 2.12.

Table 2.12: Correlations of each relative future risk index with self-reported intended risky simulator driving (with n- and p-values).

Index	***r***	***n***	***p***
Road-related negative	.469	43	.002*
Road-related positive[a]	-.098	44	.528
Casualty as driver at fault	-.172	44	.264
Casualty as driver not at fault	-.097	45	.528
Casualty as passenger	-.143	45	.349
Road-unrelated negative[a]	-.225	45	.138
Road-unrelated positive[a]	.034	44	.828

[a] Scale has low internal consistency

The road-related negative relative future risk index correlated significantly and positively with intention to engage in risky driving on the simulator, consistent with the claim that illusory invulnerability promotes risk taking.

The correlations between each of the seven relative future risk indices and mean speed approaching hazards in Tasks 1, 2, 3, and 4 are presented in Table 2.13.

Table 2.13: Correlations of each relative future risk index with mean speed approaching hazards in Tasks 1, 2, 3, and 4 (with n- and p-values).

Index		***Task 1***	***Task 2***	***Task 3***	***Task 4***	***Overall***
Road-related negative	*r*	.131	.077	.196	.150	.162
	n	41	41	42	42	41
	p	.413	.631	.215	.342	.312
Road-related positive[a]	*r*	.173	.203	.121	.246	.231
	n	42	42	43	43	42
	p	.272	.197	.441	.112	.141
Casualty as driver at fault	*r*	.089	.115	.305	.288	.268
	n	42	42	43	43	42
	p	.574	.468	.047*	.061	.087
Casualty as driver not at fault	*r*	.261	-.100	-.013	-.017	.021
	n	43	43	44	44	43
	p	.090	.524	.932	.911	.891
Casualty as passenger	*r*	.039	-.125	-.075	.141	.013
	n	43	43	44	44	43
	p	.804	.425	.627	.361	.933
Road-unrelated negative[a]	*r*	.025	-.162	.016	.195	.036
	n	43	43	44	44	43
	p	.873	.301	.919	.205	.817
Road-unrelated positive[a]	*r*	-.093	.103	.088	-.030	.021
	n	42	42	43	43	42
	p	.557	.516	.574	.850	.896

[a] Scale has low internal consistency

Only one significant correlation was observed; a positive correlation between relative future risk of being a casualty as a driver at fault and mean speed approaching an intersection. Although 1-2 significant correlations with speed

approaching hazards could be expected by chance, the majority of nonsignificant correlations were positive and 3 had low p-values (.061<p>.090). Thus results appear consistent with the claim that illusory invulnerability is associated with greater speed approaching hazards (and so with lower caution).

The correlations of each of the seven relative future risk indices with average distance to the closest oncoming vehicle when the right turn was commenced in Task 5.1 are presented in Table 2.14. The relative future risk indices were also correlated with the time from when drivers completed their right turn to the arrival of the next oncoming vehicle at the location of the turn [see Table 2.14]. These correlations were only conducted for drivers that turned before all oncoming vehicles had passed (71.1% of drivers)[5]. Relevant data from Task 5.2 were not successfully recorded. No significant correlations were observed. The majority were negative and nonsignificant. Negative correlations would suggest that illusory invulnerability is associated with lower accepted gap-distances and –times (and so with lower caution).

[5] Relative risk indices were not significantly associated with whether or not the driver waited for all oncoming cars to pass.

Table 2.14: Correlations of each relative future risk index with measures of gap acceptance from Task 5.1 (with n- and p-values).

Index		***Distance to closest car at start***	***Time to arrival of closest car at finish***
Road-related negative	*r*	-.190	-.243
	n	31	31
	p	.307	.188
Road-related positive[a]	*r*	-.029	-.136
	n	31	31
	p	.875	.464
Casualty as driver at fault	*r*	-.188	-.244
	n	31	31
	p	.312	.286
Casualty as driver not at fault	*r*	.055	.082
	n	32	32
	p	.767	.654
Casualty as passenger	*r*	-.102	-.013
	n	32	32
	p	.579	.943
Road-unrelated negative[a]	*r*	.005	-.001
	n	32	32
	p	.977	.996
Road-unrelated positive[a]	*r*	-.195	-.129
	n	31	31
	p	.293	.490

[a] Scale has low internal consistency

In headway Task 6.1 (lead vehicle travelling at 70km/hr) the average mean speed was 76.03km/hr (s.d.=3.92), and the average speed variation (standard deviation) was 5.28 (s.d.=3.02). In Task 6.2 (lead vehicle travelling at 50km/hr) the average mean speed was 53.95km/hr (s.d.=9.30), and the average speed variation was 3.41 (s.d.=1.84). Thus, there is some evidence

for encroachment on the lead vehicle. The correlations between each of the seven relative future risk indices and mean speed and maximum speed during the headway tasks are presented in Table 2.15.

Table 2.15: Correlations of each relative future risk index with mean speed and maximum speed during the headway Tasks 6.1 (lead vehicle travelling at 70km/hr) and 6.2 (lead vehicle travelling at 50km/hr) (with n- and p-values).

Index		***Mean speed for Task 6.1***	***Maximum speed for Task 6.1***	***Mean speed for Task 6.2***	***Maximum speed for Task 6.2***
Road-related negative	*r*	-.096	-.045	-.473	-.241
	n	43	42	42	43
	p	.540	.776	.002*	.119
Road-related positive[a]	*r*	-.019	.053	-.138	-.036
	n	44	43	43	44
	p	.903	.734	.376	.814
Casualty as driver at fault	*r*	.161	.112	-.495	-.206
	n	44	43	43	44
	p	.298	.474	.001*	.180
Casualty as driver not at fault	*r*	.118	-.014	-.037	.052
	n	45	44	44	45
	p	.441	.928	.811	.735
Casualty as passenger	*r*	.203	-.043	-.033	-.120
	n	45	44	44	45
	p	.180	.781	.832	.431
Road-unrelated negative[a]	*r*	.229	-.065	-.244	-.210
	n	45	44	44	45
	p	.131	.676	.110	.165
Road-unrelated positive[a]	*r*	-.169	.105	.100	.182
	n	44	43	43	44
	p	.271	.501	.523	.238

[a] Scale has low internal consistency

Significant negative correlations were observed between mean speed during Task 6.2 (lead vehicle travelling at 50km/hr) and the relative future risk negative road-related index, as well as the relative future risk of casualty as a driver at fault index. These correlations would suggest that lower mean speeds are associated with greater illusory invulnerability. However, 1-2 significant correlations could be expected by chance.

The correlations between each of the seven relative future risk indices and mean speed on each of the 4 speed zone tasks (i.e. straight road, approaching a curve, school bus area, shopping district/village) can be seen in Table 2.16.

Mean speed in the school zone was significantly positively correlated with estimated relative future risk of casualty as a passenger, as well as the road-unrelated relative future risk. No further significant correlations were observed. 1-2 correlations could be expected by chance. Positive correlations would suggest that illusory invulnerability is associated with faster driving.

Table 2.16: Correlations of each relative future risk index with mean speed on each of the four speed zone tasks (with n- and p-values).

Index		*Straight 100km/hr*	*Curve 100km/hr*	*School 40km/hr*	*Village 50km/hr*
Road-related negative	*r*	.211	.179	.099	-.005
	n	43	43	43	43
	p	.175	.250	.972	.972
Road-related positive[a]	*r*	.048	.068	.037	-.019
	n	44	44	44	44
	p	.758	.662	.813	.904
Casualty as driver at fault	*r*	.199	.156	.154	.086
	n	44	44	44	44
	p	.196	.312	.318	.580
Casualty as driver not at fault	*r*	-.068	-.002	.183	-.223
	n	45	45	45	45
	p	.656	.988	.229	.141
Casualty as passenger	*r*	.084	-.072	.387	-.008
	n	45	45	45	45
	p	.582	.638	.009*	.958
Road-unrelated negative[a]	*r*	-.057	-.026	.336	.056
	n	45	45	45	45
	p	.711	.865	.024*	.714
Road-unrelated positive[a]	*r*	.041	-.045	-.163	-.049
	n	44	44	44	44
	p	.791	.774	.290	.753

[a] Scale has low internal consistency

Table 2.17 presents correlations of each of the seven relative future risk indices with the number of drives on the simulator in which the speed limit was exceeded, with the number of drives in which a traffic light ticket was issued, and with the total number of traffic light tickets.

Table 2.17: Correlations of each relative future risk index with number of drives in which the speed limit was exceeded, and total number of traffic light tickets issued, on the driving simulator (with n- and p-values).

Index		***Number of drives in which speed limit exceeded***	***Number of drives in which traffic light tickets were issued***	***Total number of traffic light tickets***
Road-related negative	*r*	.365	.286	.171
	n	43	43	41
	p	.016*	.063	.284
Road-related positive[a]	*r*	.026	.199	.195
	n	44	44	42
	p	.866	.195	.216
Casualty as driver at fault	*r*	.360	.200	.017
	n	44	44	42
	p	.016*	.192	.913
Casualty as driver not at fault	*r*	.100	.110	.166
	n	45	45	43
	p	.512	.473	.287
Casualty as passenger	*r*	.173	.210	.205
	n	45	45	43
	p	.257	.166	.187
Road-unrelated negative[a]	*r*	.203	.117	.040
	n	45	45	43
	p	.182	.444	.801
Road-unrelated positive[a]	*r*	-.027	-.048	.049
	n	44	44	42
	p	.860	.759	.756

[a] Scale has low internal consistency

For number of drives on the simulator in which the speed limit was exceeded, all values between 0 (11%) and 4 (16%) were represented, with 3 the modal

value (33%), and 1 the least common (9%). For number of drives on the simulator in which a traffic light ticket was issued, all values between 0 (47%, modal) and 3 (2%, least common) were represented, with 1 being the second most common value (36%). The distribution of values was very similar for number of traffic light tickets. Correlations are thus an appropriate statistic for all of these measures.

Significant positive correlations of the number of drives in which the speed limit was exceeded with the relative negative road-related index and the relative “crash as a driver at fault” index. No further significant correlations were observed. Although one significant correlation could be expected by chance, all but one of the remaining correlations was positive (and nonsignificant). Positive correlations would be consistent with the view that illusory invulnerability promotes more risky driving.

In more targeted analyses, estimated relative future risk of being booked for speeding did not correlate significantly with the number of drives in which speed was exceeded (r=.159, n=45, p=.297). Estimated relative future risk of being booked for running a red light did not correlate significantly with the number of drives on which a traffic light ticket was issued (r=.187, n=45, p=.218) or the total number of traffic light tickets issued (r=.116, n=43, p=.458). Estimated relative future likelihood of driving for 3 years without being booked did not correlate significantly with any of these performance indices (highest nonsignificant r=-.022, n=43, p=.887).

Correlations between each of the seven relative future risk indices and total number of crashes on the simulator are presented in Table 2.18.

No significant correlations were observed. Because 40% of Participants had no crashes, 51% had 1 crash, and only 9% had 2 crashes, crashes on the simulator was re-analysed as a dichotomous variable. Still, no significant association was observed.

Table 2.18: Correlations between each relative future risk index and total number of crashes on the driving simulator (with n- and p-values).

Index	*r*	*n*	*p*
Road-related negative	-.075	41	.641
Road-related positive[a]	-.024	42	.882
Casualty as driver at fault	-.167	42	.291
Casualty as driver not at fault	-.012	43	.940
Casualty as passenger	.161	43	.301
Road-unrelated negative[a]	.227	43	.143
Road-unrelated positive[a]	.073	42	.646

[a] Scale has low internal consistency

The relationship of past-related illusory invulnerability with risky driving intentions, and with trauma involvement, on the driving simulator

The correlations between each of the seven relative past experience indices and self-reported intended risky simulator driving are presented in Table 2.19.

Table 2.19: Correlations of each relative past experience index with self-reported intended risky simulator driving (with n- and p-values).

Index	*r*	*n*	*p*
Road-related negative	.128	44	.407
Road-related positive	-.130	42	.412
Injury as driver at fault	.071	44	.647
Injury as driver not at fault	.262	44	.086
Injury as passenger	.385	44	.010*
Road-unrelated negative[a]	.054	44	.727
Road-unrelated positive[a]	.228	41	.151

[a] Scale has low internal consistency

The road-related relative perceived experience of injury as a passenger correlated significantly and positively with intention to engage in risky driving on the simulator. A positive correlation is consistent with the view that illusory invulnerability promotes risky driving (although it is slightly odd that the association is with relative risk of injury *as a passenger*).

The correlations between each of the seven relative past experience indices and mean speed approaching hazards in Tasks 1, 2, 3 and 4 are presented in Table 2.20.

Only one significant correlation was observed; between relative perceived experience of being injured as a passenger and average speed approaching an intersection. This correlation was negative. 1-2 significant correlations could be expected by chance and so it is likely that the observed correlation is spurious.

Table 2.20: Correlations of each relative past experience index with mean speed approaching hazards in Tasks 1, 2, 3, and 4 (with n- and p-values).

Index		*Task 1*	*Task 2*	*Task 3*	*Task 4*	*Overall*
Road-related negative	*r*	.059	-.100	-.270	.118	-.033
	n	42	42	43	43	42
	p	.708	.529	.080	.451	.837
Road-related positive	*r*	.019	-.163	.082	.058	.001
	n	40	40	41	41	40
	p	.905	.315	.608	.719	.996
Injury as driver at fault	*r*	.171	.033	.018	.175	.131
	n	42	42	43	43	42
	p	.279	.837	.910	.262	.407
Injury as driver not at fault	*r*	.108	.002	-.219	.127	.032
	n	42	42	43	43	42
	p	.495	.989	.157	.417	.843
Injury as passenger	*r*	-.080	-.126	-.305	.011	-.121
	n	42	42	43	43	42
	p	.616	.427	.046*	.944	.445
Road-unrelated negative[a]	*r*	.005	.017	-.044	.152	.063
	n	42	42	43	43	42
	p	.973	.916	.781	.329	.694
Road-unrelated positive[a]	*r*	-.012	-.070	-.062	.048	.012
	n	39	39	40	40	39
	p	.942	.672	.706	.771	.943

[a] Scale has low internal consistency

The correlations of each of the seven relative past experience indices with average distance to the closest oncoming vehicle when the right turn was commenced in Task 5.1 are presented in Table 2.21. The relative past experience indices were also correlated with the time from when drivers completed their right turn to the arrival of the next oncoming vehicle at the location of the turn [see Table 2.21]. These correlations were only conducted

for drivers that turned before all oncoming vehicles had passed. Relevant data from Task 5.2 were not successfully recorded.

Table 2.21: Correlations of each relative past experience index with measures of gap acceptance from Task 5.1 (with n- and p-values).

Index		***Distance to closest car at start***	***Time to arrival of closest car at finish***
Road-related negative	*r*	.031	.377
	n	31	31
	p	.870	.036*
Road-related positive	*r*	.055	-.061
	n	31	31
	p	.770	.745
Injury as driver at fault	*r*	-.066	.079
	n	31	31
	p	.724	.674
Injury as driver not at fault	*r*	-.092	.231
	n	31	31
	p	.624	.212
Injury as passenger	*r*	-.088	.234
	n	31	31
	p	.638	.206
Road-unrelated negative[a]	*r*	.225	.359
	n	31	31
	p	.223	.047*
Road-unrelated positive[a]	*r*	-.199	-.159
	n	29	29
	p	.301	.411

[a] Scale has low internal consistency

Time from the end of turn to the arrival of the closest oncoming car at the location of the turn correlated positively and significantly with the negative road-related and road-unrelated indices. No further significant correlations were observed. The observed rate of correlation is above that which could be expected by chance, and suggests that more cautious driving is associated with greater illusory invulnerability

The correlations between each of the seven relative past experience indices and mean speed and maximum speed during the headway tasks (lead vehicle travelling at either 70km/hr or 50km/hr) are presented in Table 2.22.

A significant positive correlation was observed between the relative past experience of injury as a driver at fault and mean speed during task 6.1 (lead vehicle travelling at 70km/hr), and a significant positive correlation was observed between relative past experience of injury as a passenger and mean speed during Task 6.2 (lead vehicle travelling at 50km/hr). Maximum speed correlated significantly and negatively with the road-related negative past experience index in both Task 6.1 and 6.2, and with relative past experience of injury as a passenger and mean speed during Task 6.1. A significant positive correlation with maximum speed during Task 6.2 was observed for the road-unrelated positive relative past experience index. No further significant correlations were observed. Thus, the positive correlations with mean speed are counter to those observed for relative future risk, and consistent with the claim that illusory invulnerability promotes risk taking. The negative correlations with maximum speed are consistent with the claim that more cautious driving promotes illusory invulnerability.

Table 2.22: Correlations of each relative past experience index with mean speed and maximum speed during the headway Tasks 6.1 (lead vehicle travelling at 70km/hr) and 6.2 (lead vehicle travelling at 50km/hr) (with n- and p-values).

Index		***Mean speed for Task 6.1***	***Maximum for Task 6.1***	***Mean speed for Task 6.2***	***Maximum for Task 6.2***
Road-related negative	*r*	.166	-.488	-.194	-.317
	n	44	43	43	44
	p	.283	.001*	.214	.036*
Road-related positive	*r*	.127	.093	.156	.271
	n	42	42	41	42
	p	.421	.556	.331	.083
Injury as driver at fault	*r*	.298	-.230	.050	-.020
	n	44	43	43	44
	p	.049*	.138	.750	.899
Injury as driver not at fault	*r*	.108	-.253	.011	-.064
	n	44	43	43	44
	p	.486	.102	.946	.682
Injury as passenger	*r*	.149	-.424	.047	-.040
	n	44	43	43	44
	p	.335	.005*	.763	.797
Road-unrelated negative[a]	*r*	-.002	-.153	.062	-.078
	n	44	43	43	44
	p	.989	.328	.692	.614
Road-unrelated positive[a]	*r*	-.031	.070	.612	.577
	n	41	40	40	41
	p	.848	.669	<.001**	<.001**

[a] Scale has low internal consistency

The correlations between each of the seven relative past experience indices and mean speed on each of the 4 speed zone tasks (i.e. straight road, approaching a curve, school bus area, shopping district/village) can be seen in Table 2.23.

Table 2.23: Correlations of each relative past experience index with mean speed on each of the four speed zone tasks (with n- and p-values).

Index		***Straight 100km/hr***	***Curve 100km/hr***	***School 40km/hr***	***Village 50km/hr***
Road-related negative	*r*	-.435	-.301	.373	-.106
	n	44	44	44	44
	p	.003*	.047*	.013*	.494
Road-related positive	*r*	.101	.103	-.006	-.151
	n	42	42	42	42
	p	.524	.515	.970	.340
Injury as driver at fault	*r*	-.090	.047	.388	-.044
	n	44	44	44	44
	p	.561	.763	.009*	.776
Injury as driver not at fault	*r*	-.265	-.128	.292	-.105
	n	44	44	44	44
	p	.082	.406	.054	.496
Injury as passenger	*r*	-.444	-.313	.147	-.093
	n	44	44	44	44
	p	.003*	.038*	.342	.548
Road-unrelated negative[a]	*r*	-.207	-.153	.106	.068
	n	44	44	44	44
	p	.178	.321	.493	.660
Road-unrelated positive[a]	*r*	.099	.153	-.072	.040
	n	41	41	41	41
	p	.536	.341	.653	.805

[a] Scale has low internal consistency

The road-related negative relative experience index correlated significantly and negatively with mean speed in the two 100km/hr zones, and significantly and positively with mean speed in the school zone. Mean speed in the school zone was also significantly positively correlated with perceived relative past experience of injury as a driver at fault. Mean speed in the straight 100km/hr zone was significantly negatively correlated with perceived relative past experience of injury as a passenger. No further significant correlations were observed. These results are again complicated. Considering only “driver” indices correlations in the 100km/hr zones are negative, suggesting that more cautious driving promotes illusory invulnerability, whereas in the 40km/hr zone the positive correlation suggests that illusory invulnerability promotes risky driving. Arguably, the 40km/hr zone represents a more stringent test of preparedness to slow down, and the results here accord with the 40km/hr zone results for relative future risk.

Table 2.24 presents correlations of each of the seven relative past experience indices with the number of drives on the simulator in which the speed limit was exceeded, with the number of drives in which a traffic light ticket was issued, and with the total number of traffic light tickets.

Table 2.24: Correlations of each relative past experience index with number of drives in which the speed limit was exceeded, and total number of traffic light tickets issued, on the driving simulator (with n- and p-values).

Index		***Number of drives in which speed limit exceeded***	***Number of drives in which traffic light tickets were issued***	***Total number of traffic light tickets***
Road-related negative	*r*	-.005	.194	.185
	n	44	44	42
	p	.972	.207	.240
Road-related positive	*r*	-.003	-.229	-.109
	n	42	42	40
	p	.983	.144	.504
Injury as driver at fault	*r*	.125	-.010	.067
	n	44	44	42
	p	.420	.949	.675
Injury as driver not at fault	*r*	-.044	.065	.170
	n	44	44	42
	p	.778	.676	.282
Injury as passenger	*r*	-.123	.021	.045
	n	44	44	42
	p	.427	.894	.778
Road-unrelated negative[a]	*r*	-.139	.167	.174
	n	44	44	42
	p	.367	.280	.271
Road-unrelated positive[a]	*r*	-.136	-.434	-.194
	n	41	41	39
	p	.397	.005*	.237

[a] Scale has low internal consistency

Only one significant correlation was observed: between the number of drives in which traffic light tickets were issued and the road-unrelated positive relative experience index. One significant correlation could be expected by chance.

In more targeted analyses, estimated relative past experience of being booked for speeding did not correlate significantly with the number of drives in which speed was exceeded (r=.159, n=44, p=.301). Estimated relative past experience of being booked for running a red light did not correlate significantly with the number of drives on which a traffic light ticket was issued (r=-.044, n=44, p=.776) or the total number of traffic light tickets issued (r=.034, n=42, p=.830). Estimated relative past experience of driving for 3 years without being booked did not correlate significantly with any of these performance indices (highest nonsignificant r=-.250, n=43, p=.106).

Correlations between each of the seven relative past experience indices and total number of crashes on the simulator are presented in Table 2.25.

Table 2.25: Correlations between each relative past experience index and total number of crashes on the driving simulator (with n- and p-values).

Index	***r***	***n***	***p***
Road-related negative	.015	42	.923
Road-related positive	-.205	40	.204
Injury as driver at fault	-.214	42	.173
Injury as driver not at fault	.012	42	.937
Injury as passenger	.168	42	.289
Road-unrelated negative[a]	.108	42	.497
Road-unrelated positive[a]	.239	39	.143

[a] Scale has low internal consistency

No significant correlations were observed. Again, the pattern of results did not change when simulator crashes was treated as a dichotomous variable.

The relationship of simulator-related illusory invulnerability with risky driving, and with trauma involvement, on the driving simulator

The simulator-related illusory invulnerability questionnaire was included to allow more targeted analyses of the relationship between risk perception and simulated driving.

First, significant negative correlations of self-reported intention to engage in risky driving on the simulator with the simulator-related positive index (r=-.371, n=44, p=.013), and with relative risk for “have less than 2 crashes” on the simulator (r=-.345, n=44, p=.022), were observed. Negative correlations suggest that intended risky behaviour reduces illusory invulnerability. No significant correlation was observed between self-reported intention to engage in risky driving on the simulator and the simulator-related negative relative risk index. Intention to disobey speed signs did not correlate significantly with either relative risk estimates for “be booked for speeding” on the simulator (r=-.282, n=44, p=.064), or “have less than 2 fines” on the simulator (r=.240, n=44, p=.117). However the p-value of .064 for “be booked for speeding” is low, and both of the correlations are again negative.

Next we computed correlations of the simulator-related negative and positive indices with mean speed approaching hazards in Tasks 1, 2, 3 and 4, with measures of gap acceptance in Task 5, with mean speed and speed variability during Tasks 6.1 and 6.2, with speed in each of the speed zones in Task 7, and with infringements were computed [see Table 2.26].

Table 2.26: Correlations of the simulator-related positive and negative indices relative indices with each of the simulated driving performance measures (with n- and p-values).

Index		***Negative index***	***Positive index***
Mean speed approaching Task 1 hazards	*r*	.061	-.057
	n	43	43
	p	.700	.718
Mean speed approaching Task 2 hazards	*r*	.111	.036
	n	43	43
	p	.477	.820
Mean speed approaching Task 3 hazards	*r*	.033	.098
	n	44	44
	p	.830	.527
Mean speed approaching Task 4 hazards	*r*	.299	-.019
	n	44	44
	p	.048*	.903
Mean speed approaching hazards	*r*	.178	.005
	n	43	43
	p	.253	.974
Distance to closest car at start of turn in Task 5.1	*r*	-.075	.125
	n	44	44
	p	.630	.417
Time to arrival of closest car at finish of turn in Task 5.1	*r*	-.042	.158
	n	44	44
	p	.788	.305
Mean speed for Task 6.1	*r*	.072	-.434
	n	44	44
	p	.643	.003*
Maximum speed for Task 6.1	*r*	-.256	-.243
	n	44	44
	p	.093	.112

Index		***Negative index***	***Positive index***
Mean speed for Task 6.2	*r*	-.081	.145
	n	44	44
	p	.600	.349
Maximum speed for Task 6.2	*r*	-.048	.082
	n	44	44
	p	.756	.596
Mean speed for straight 100km/hr in Task 7	*r*	-.102	.109
	n	44	44
	p	.508	.482
Mean speed for Curve 100km/hr in Task 7	*r*	-.077	-.003
	n	44	44
	p	.621	.984
Mean speed for School 40km/hr in Task 7	*r*	.264	-.250
	n	44	44
	p	.083	.102
Mean speed for Village 50km/hr in Task 7	*r*	-.026	-.179
	n	44	44
	p	.867	.246
Number of drives in which speed limit exceeded	*r*	.239	.082
	n	44	44
	p	.118	.596
Number of drives in which traffic light tickets were issued	*r*	.249	.170
	n	44	44
	p	.104	.271
Total number of traffic light tickets	*r*	.246	.182
	n	43	43
	p	.112	.242

The two significant correlations observed could have been expected by chance.

In more targeted analyses, the relative risk for “be booked for speeding” before each drive was correlated with mean speed approaching hazards for that drive (for Drives 1, 2, and 4). For Drive 3, this question was correlated with the mean speed in each of the 4 speed zones [see Table 2.27].

Table 2.27: Correlations of relative risk estimates for “be booked speeding” before each simulator drive with speed performance measures from the corresponding drive (with n- and p-values).

Index	***r***	***n***	***p***
Speed approaching hazards in Drive 1	.042	44	.785
Speed approaching hazards in Drive 2	.021	45	.892
Speed approaching hazards in Drive 4	.122	43	.434
Speed in straight 100km/hr zone in Drive 3	-.118	45	.441
Speed in curved 100km/hr zone in Drive 3	-.143	45	.347
Speed in 40km/hr school zone in Drive 3	.027	45	.861
Speed in 50km/hr village zone in Drive 3	-.094	45	.541

None of these correlations was significant.

Simulator-related illusory invulnerability for “be booked for speeding” (averaged across all four drives) did not correlate significantly with the number of drives in which the speed limit was exceeded (r=.072, n=29, p=.642). Simulator-related illusory invulnerability for “be booked for going through a red light” (averaged across all four drives) did not correlate significantly with the number of drives in which a traffic light ticket was issued (r=.201, n=44, p=.191) or with the total number of traffic light tickets issued (r=.257, n=43,

p=.096). Simulator-related illusory invulnerability for “get less than 2 fines” did not correlate significantly with the number of drives in which the speed limit was exceeded, the number of drives in which a traffic light ticket was issued, or the total number of traffic light tickets issued (highest nonsignificant r=.216, n=44, p=.158)

Finally, the relationship between simulator-related illusory invulnerability and crash involvement on the simulator was assessed. Total number of crashes on the simulator correlated significantly and negatively with the simulator-related positive index (r=-.315, n=43, p=.040) and with simulator-related illusory invulnerability for the “have less than 2 car crashes” (r=-.318, n=43, p=.038). These correlations suggest an association of illusory invulnerability with safer driving. Correlations of the total number of car crashes on the simulator with the simulator-related negative index, and simulator-related illusory invulnerability for “have a car crash on a blind corner” were not significant (r=.188, n=43, p=.228 and r=.211, n=43, p=.175, respectively).

Relationships between on-road risky driving intentions and risky driving on the driving simulator

The relationship of on-road risky driving intentions with simulator driving performance was assessed.

First, the on-road risky driving intentions index was correlated with the main indices of simulated driving [see Table 2.28].

Only one significant correlation was observed: with the mean speed during the headway Task 6.1 (in which the lead vehicle travels at 70km/hr). The p-value for the correlation with maximum speed during Task 6.2 was low (.055).

Table 2.28: Correlations of the on-road risky driving intentions index with simulated driving performance measures (with n- and p-values).

Index	***r***	***n***	***p***
Mean speed approaching Task 1 hazards	.110	43	.483
Mean speed approaching Task 2 hazards	-.043	43	.785
Mean speed approaching Task 3 hazards	-.152	44	.325
Mean speed approaching Task 4 hazards	.140	44	.366
Mean speed approaching hazards	.047	43	.764
Distance to closest car at start of turn in Task 5.1	-.036	45	.814
Time to arrival of closest car at finish of turn in Task 5.1	-.027	45	.862
Mean speed for Task 6.1	.365	45	.014*
Maximum speed for Task 6.1	.295	44	.052
Mean speed for Task 6.2	-.121	45	.427
Maximum speed for Task 6.2	.084	44	.588
Mean speed for straight 100km/hr in Task 7	-.260	45	.085
Mean speed for Curve 100km/hr in Task 7	-.111	45	.467
Mean speed for School 40km/hr in Task 7	.252	45	.095
Mean speed for Village 50km/hr in Task 7	-.139	45	.364
Number of drives in which speed limit exceeded	-.081	45	.597
Number of drives in which traffic light tickets were issued	-.134	45	.380
Total number of traffic light tickets	-.041	43	.796

The intention of running a red light on the road did not correlate significantly with number of drives on which traffic light tickets were issued (r=-.017, n=45, p=.914) or with number of traffic light tickets issued (r=.055, n=43, p=.725). The intention of exceeding the speed limit did not did not correlate significantly with number of drives on which speed was exceeded (r=-.101, n=45, p=.509).

The relationship of demographic variables, driving experience, and social desirability with future-related, past-related, and simulator-related illusory invulnerability, self-reported risky driving and involvement in road (and other) trauma, and simulator performance

Age correlated positively and significantly with the road-related positive future risk index (r=.485, n=42, p=.001), but demonstrated no further significant correlations with any future- or past-related illusory invulnerability indices (highest nonsignificant r=.198, n=45, p=.191). Gender was significantly associated with the road-related positive past experience index (t_{40}=2.08, p=.044), but demonstrated no further significant correlations with any future- or past-related illusory invulnerability indices (highest nonsignificant t_{42}=1.90, p=.065). Number of hours per week as a passenger correlated positively and significantly with the relative future risk of being injured or killed in a crash as a driver at fault (r=.390, n=44, p=.009). No further significant correlations were observed between driving experience (years licensed, hours per week as a driver, hours per week as a passenger) and future-related illusory invulnerability (highest nonsignificant r=-.292, n=45, p=.052) or past-related illusory invulnerability (highest nonsignificant r=.174, n=41, p=.276). Neither future- nor past-related illusory invulnerability was significantly associated with social desirability scores (highest nonsignificant r=-.301, n=43, p=.050).

The simulator-related illusory invulnerability negative index was significantly correlated with hours per week as a passenger (r=.324, n=44, p=.032), but no other driving experience measure or age (highest nonsignificant r=.201, n=44, p=.190). Neither simulator-related illusory invulnerability index was significantly associated with gender (highest nonsignificant t_{42}=1.51, p=.140) or social desirability scores (highest nonsignificant r=-.141, n=43, p=.369).

The on-road risky driving intentions index was significantly positively correlated with age (r=.318, n=45, p=.034) and number of hours spent as a driver (r=.399, n=45, p=.007). The on-road risky driving intentions index was not significantly associated with gender (t_{43}=1.32, p=.194), number of hours

spent driving as a passenger (r=.043, n=45, p=.779), years licensed (r=.266, n=45, p=.077), or social desirability scores (r=-.144, n=44, p=.351).

Personal past experience indices and self-reported crash involvement were regarded as indicators of involvement in road (and other) trauma. Self-reported crash involvement correlated significantly with age (r=.338, n=45, p=.023) and the number of years Participants have held a license (r=.318, n=45, p=.033). No further significant correlations of involvement in road (and other) trauma with age or driving experience were observed (highest nonsignificant r=.209, n=45, p=.168). Gender demonstrated no significant associations with indicators of trauma involvement (highest nonsignificant t_{43}=1.53, p=.133). Social desirability scores correlated significantly with the personal past experience negative road-unrelated index (r=-.373, n=44, p=.013), but with no other indicator of trauma involvement (highest nonsignificant r=-.264, n=42, p=.091).

Self-reported intention to take risks on the simulator (index) was not significantly associated with age or driving experience (highest nonsignificant r=-.170, n=45, p=.264), gender (t_{43}=1.15, p=.256), or social desirability scores (r=-.065, n=44, p=.674).

No significant associations were observed between mean speed approaching each hazard with age or driving experience (highest nonsignificant r=-.265, n=43, p=.086), gender (highest nonsignificant t_{42}=1.82, p=.076), or social desirability scores (highest nonsignificant r=.285, n=43, p=.064).

Hours driving per week as a passenger correlated significantly with both measures of gap acceptance in Task 5.1 (lowest significant r=-.351, n=32, p=.049). No further significant associations were observed between measures of gap acceptance and age or driving experience (highest nonsignificant r=.264, n=32, p=.145), gender (highest nonsignificant t_{30}=-.77, p=.447), or social desirability scores (highest nonsignificant r=-.138, n=32, p=.451).

Mean speed during the headway task 6.1 correlated significantly with age (r=.325, n=45, p=.029) and years licensed (r=.305, n=45, p=.042). No further significant associations were observed of mean speed and maximum speed during the headway tasks with age or driving experience (highest nonsignificant r=.246, n=44, p=.107), gender (highest nonsignificant t_{43}=1.37, p=.178), or social desirability scores (highest nonsignificant r=-.229, n=44, p=.135).

No significant associations were observed between mean speed in each speed zone of Task 7 and age or driving experience (highest nonsignificant r=-.286, n=45, p=.056), gender (highest nonsignificant t_{43}=1.58, p=.122), or social desirability scores (highest nonsignificant r=.145, n=44, p=.347).

No significant associations were observed between any of the 3 infringement measures age or driving experience (highest nonsignificant r=.267, n=45, p=.077), gender (highest nonsignificant t_{41}=-.83, p=.412), or social desirability scores (highest nonsignificant r=.209, n=44, p=.173).

No significant associations were observed between number of crashes on the simulator and age or driving experience (highest nonsignificant r=.125, n=43, p=.423), gender (t_{41}=.42, p=.679), or social desirability scores (r=-.145, n=42, p=.361).

Analyses involving particular variables were thus repeated employing personal characteristics with which these variables were related [see Table 2.29] as covariates.

Table 2.29: Summary of relationships between outcome variables and personal characteristics, to inform covariate analyses

Index	***Covariate***
Relative future risk Road-related positive	Age
Relative future risk Casualty as driver at fault	Hours per week as a passenger
Relative past experience Road-related positive	Gender
Simulator-related relative risk Negative	Hours per week as a passenger
On-road risky driving intentions	Age Hours per week as a driver
Crash involvement	Age Years licensed
Personal past experience Road-unrelated negative	Social desirability
Distance to closest car at start of turn in Task 5.1	Hours per week as a passenger
Time to arrival of closest car at finish of turn in Task 5.1	Hours per week as a passenger
Mean speed for Task 6.1	Age Years licensed

The pattern of results was largely unchanged. The only changes were:

The relative future risk of casualty as a driver at fault was no longer significantly related to mean speed approaching Task 3 hazards, mean speed during Task 6.2, or number of drives in which speed was exceeded. However the relationship of relative future risk of casualty as a driver at fault with average speed in the 40km/hr zone became significant (r=.322, n=39, p=.040).

The relationship of simulator-related negative relative risk index with mean speed approaching Task 4 hazards was no longer significant, but its relationship with mean speed in the 40km/hr zone became significant (r=.330,

n=40, p=.033). The relationship of the simulator-related positive relative risk index with distance to the closest oncoming vehicle at the start of turning in Task 5.1 also became significant (r=.693, n=28, p<.001).

Discussion

Study 2 demonstrated the typical illusory invulnerability for a range of events, particularly road-related events. Illusory invulnerability was demonstrated in relation to the future, the past, and simulated driving.

Only a weak relationship was observed between future- and past-related illusory invulnerability, and dissociations could be expected between the relationships they each demonstrate with other variables.

Overall, observed relationships of illusory invulnerability with intended and actual (simulated) behaviour were weak and inconsistent [see Tables 2.30 to 2.32]. This is not uncommon for cross-sectional studies in the literature. Theoretically, it is to be expected. The hypothesis that illusory invulnerability promotes risk-taking (supported in experimental studies; e.g. Klein, 1997) predicts a positive relationship, whereas a negative relationship is predicted by egocentrism account of illusory invulnerability, according to which people consider their own risk-relevant behaviour to the exclusion of others' when making relative risk estimates. Thus, according to the egocentrism account, high levels of risky behaviour, or intended risky behaviour, should reduce illusory invulnerability. It is likely that each of these processes operate, possibly at different times (in a cyclical fashion) for different people in relation to different events. Consideration of past-related illusory invulnerability makes matters yet more complicated. Thus, in a cross-sectional study, like the present one, weak and inconsistent relationships could be expected. Ultimately, resolution of causal issues requires experimentation in which illusory invulnerability is manipulated and any changes in behaviour observed. Nonetheless, there appear to be some patterns that are worthy of discussion. Only road-related negative events are considered because these are likely to offer the most relevant and reliable indication of road-relevant illusory invulnerability.

Table 2.30: Summary of significant relationships of relative future risk road-related negative (NRo), road-related positive (Pro), casualty as a driver at fault (Fault), casualty as a driver not at fault (NoFault), casualty as a passenger (Pass.), road-unrelated negative (N), and road-unrelated positive (P) with intended and simulated behaviour.

Index	*NRo*	*PRo*	*Fault*	*NoFault*	*Pass.*	*N*	*P*
Intended on-road risky driving	R,IV(5)						
Personal experience							Exp,IV
On-road crash							
Intended simulator risky driving	IV,R						
Mean speed approaching Task 1 hazards							
Mean speed approaching Task 2 hazards							
Mean speed approaching Task 3 hazards			(IV,R)				
Mean speed approaching Task 4 hazards							
Mean speed approaching hazards							
Distance to closest car at start of turn in Task 5.1							
Time to arrival of closest car at finish of turn in Task 5.1							
Mean speed for Task 6.1							
Maximum speed for Task 6.1							

Index	*NRo*	*PRo*	*Fault*	*NoFault*	*Pass.*	*N*	*P*
Mean speed for Task 6.2	R,IV		(R,IV)				
Maximum speed for Task 6.2							
Mean speed for straight 100km/hr in Task 7							
Mean speed for Curve 100km/hr in Task 7							
Mean speed for School 40km/hr in Task 7			[IV,R]		IV,R	IV,R	
Mean speed for Village 50km/hr in Task 7							
Number of drives in which speed limit exceeded	IV,R		(IV,R)				
Number of drives in which traffic light tickets were issued							
Total number of traffic light tickets							
Total number of crashes							

IV,R: relationship in a direction suggesting that illusory invulnerability promotes risk

R,IV: relationship in a direction suggesting that risky driving undermined illusory invulnerability

( ) relationship not observed with covariate(s)

[ ] relationship only observed with covariate(s)

Table 2.31: Summary of significant relationships of relative past experience road-related negative (NRo), road-related positive (Pro), casualty as a driver at fault (Fault), casualty as a driver not at fault (NoFault), casualty as a passenger (Pass.), road-unrelated negative (N), and road-unrelated positive (P) indices with intended and simulated behaviour.

Index	***NRo***	***PRo***	***Fault***	***NoFault***	***Pass.***	***N***	***P***
Intended on-road risky driving				IV,R	IV,R		
Personal experience							
On-road crash							
Intended simulator risky driving					IV,R		
Mean speed approaching Task 1 hazards							
Mean speed approaching Task 2 hazards							
Mean speed approaching Task 3 hazards							
Mean speed approaching Task 4 hazards							
Mean speed approaching hazards							
Distance to closest car at start of turn in Task 5.1							
Time to arrival of closest car at finish of turn in Task 5.1	R,IV					R,IV	
Mean speed for Task 6.1			IV,R				
Maximum speed for Task 6.1	R,IV				R,IV		

Index	***NRo***	***PRo***	***Fault***	***NoFault***	***Pass.***	***N***	***P***
Mean speed for Task 6.2							IV,R
Maximum speed for Task 6.2	R,IV						IV,R
Mean speed for straight 100km/hr in Task 7	R,IV				R,IV		
Mean speed for Curve 100km/hr in Task 7	R,IV				R,IV		
Mean speed for School 40km/hr in Task 7	IV,R		IV,R				
Mean speed for Village 50km/hr in Task 7							
Number of drives in which speed limit exceeded							
Number of drives in which traffic light tickets were issued							R,IV
Total number of traffic light tickets							
Total number of crashes							

IV,R: relationship in a direction suggesting that illusory invulnerability promotes risk

R,IV: relationship in a direction suggesting that risky driving undermined illusory invulnerability

( ) relationship not observed with covariate(s)

[ ] relationship only observed with covariate(s)

Relative future risk estimates tended to demonstrate relationships with intended behaviours that are consistent with the egocentrism account. That is findings were consistent with the notion that people considered their future behaviour when making relative risk estimates. In contrast, relative future risk estimates tended to demonstrate relationships with simulated behaviour (measured immediately after relative future risk) in a direction consistent with the claim that illusory invulnerability promotes risky driving.

Relative experience estimates tended to demonstrate relationships with intended behaviours that are consistent with the claim that relative past experience estimates influenced future behaviour. However, relationships with risky driving on the simulator (measured *after* relative experience estimates) were more consistent with the view (associated with the egocentrism account) that risky driving influenced the experience estimates. Perhaps risky driving on the simulator partially reflected earlier on-road driving, which influenced experience estimates.

Table 2.32: Summary of significant relationships of simulator-related negative (NRo), and positive (Pro) relative risk indices with intended and simulated behaviour.

Index	***NRo***	***PRo***	***Less than 2 crashes***	***Disobey signs***
Intended simulator risky driving		*R,IV*	*R,IV*	
Mean speed approaching Task 1 hazards				
Mean speed approaching Task 2 hazards				
Mean speed approaching Task 3 hazards				
Mean speed approaching Task 4 hazards	*(IV,R)*			
Mean speed approaching hazards				
Distance to closest car at start of turn in Task 5.1		*[R,IV]*		
Time to arrival of closest car at finish of turn in Task 5.1				

Index	***NRo***	***PRo***	***Less than 2 crashes***	***Disobey signs***
Mean speed for Task 6.1		*R,IV*		
Maximum speed for Task 6.1				
Mean speed for Task 6.2				
Maximum speed for Task 6.2				
Mean speed for straight 100km/hr in Task 7				
Mean speed for Curve 100km/hr in Task 7				
Mean speed for School 40km/hr in Task 7	*[IV,R]*			
Mean speed for Village 50km/hr in Task 7				
Number of drives in which speed limit exceeded				
Number of drives in which traffic light tickets were issued				
Total number of traffic light tickets				
Total number of crashes				

IV,R: relationship in a direction suggesting that illusory invulnerability promotes risk

R,IV: relationship in a direction suggesting that risky driving undermined illusory invulnerability

( ) relationship not observed with covariate(s)

[ ] relationship only observed with covariate(s)

Thus, simulator-related illusory invulnerability appeared more likely to influence simulated driving.

One shortcoming of the present study is the use of a tertiary student sample, which may not be representative of the target population. Whilst the present sample is likely to be similar to the target population in terms of age (because we aim to target younger drivers), it may not be similar in terms of education and socioeconomic status.

The endeavour of reducing future-related illusory invulnerability in order to promote safer driving is supported by earlier experimental evidence relating judgements of relative risk with behavioural intentions (Klein, 1997), which is partly corroborated by the present results. Given evidence for the influence of behavioural considerations on illusory invulnerability, encouraging consideration of past unsafe behaviour may be one approach to doing this. (Clearly, there can be no consideration of future unsafe behaviour when aiming to promote safe future behaviour). The value of considering past negative experience is also suggested by the negative correlation between relative and personal experience of road-related positive events. Experimental studies in which illusory invulnerability is manipulated and changes in behaviour observed offer clarification of causal direction, as well as practical benefits.

Chapter 3: Study 3- Evaluation of messages designed to reduce illusory invulnerability in a tertiary student sample

Design

Study 3 represents an experimental evaluation of the effectiveness of messages designed to reduce road-related illusory invulnerability, which appeared promising in previous research. Prior to completion of the questionnaires and driving simulator task employed in Study 2, Participants in the treatment group were given the messages, whereas Participants in the control group were given materials that are unrelated to illusory invulnerability. Participants returned after approximately 2 months for follow-up testing.

Methods

Participants and sampling

59 University of Sydney students volunteered to participate in a study on "attitudes and behaviours involved in driving" for up to $20 compensation. Recruitment procedures were the same as for Study 2. One participant was 29 years old, so was excluded from the sample. The remaining 58 Participants (48% female) were randomly allocated to the treatment or control group by assigning each volunteer to a different group from the previous volunteer. Participant characteristics are reported in "Results" Section.

After approximately 2 months, 36 Participants (44% female) returned for follow-up testing.

Materials and apparatus

Advertisement

The poster employed to advertise the study and recruit volunteers was essentially the same as that employed in Study 2 [see Appendix A].

Participant Information Statement and Consent Form

The Participant Information Statement (PIS) was similar to that employed in Study 2. In addition, Participants were told that they would have to read an information booklet before completing questionnaires and driving on the simulator. The PIS also identified that Participants would be contacted after approximately 2 months to come back and repeat the procedures, with a guaranteed remuneration of $10 in addition to the usual $20 less $4/error. Participants were informed that the research session would take approximately 1.25 hours [see Appendix E].

Messages to reduce illusory invulnerability, and control messages

All messages were presented as a printed brochure.

Messages designed to reduce illusory are reproduced on the following pages (as Figure 3.1) and also in Appendix G. The messages incorporated material that was found to be effective in reducing faulty risk perceptions in our earlier research (Study 1). The messages described illusory invulnerability and sought to address the possibility that Participants would not modify their thinking because of a biased belief that they do not experience illusory invulnerability. They emphasised the dangers of illusory invulnerability (in order to strengthen motivation to avoid it) and offered strategies for reducing illusory invulnerability. Strategies were based on several well-supported theories of illusory invulnerability.

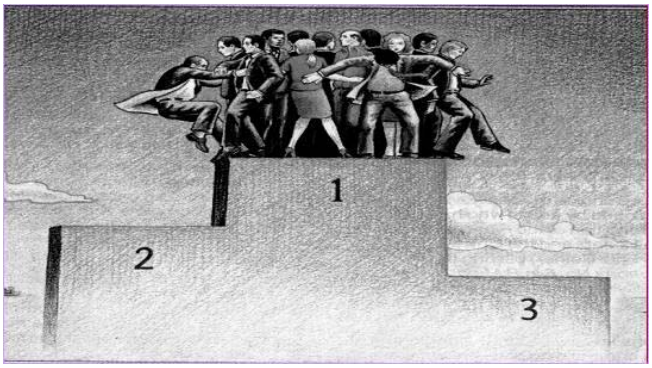
Figure 3.1: Message employed to reduce illusory invulnerability in the treatment group.

In a while you will be having a drive in the driving simulator, but before you do I would like to talk to you about recognising risks. When you are out driving on the road, it is very important that you are able to recognise risky situations, so that you can avoid them. Recognising risks is not always easy, and one thing that might stop you from recognising risks accurately is a phenomenon called “illusory invulnerability”. So I am going to tell you a bit about “illusory invulnerability”, and offer you some techniques for avoiding it.

Illusory invulnerability

People often think that they are better off than their peers.

a) They estimate that they are MORE likely than their average peer to experience positive events (like having a healthy, happy life after 80 years of age).



b) They estimate that they are LESS likely than their average peer to experience negative events (like being injured in a car crash, having an early heart attack, or being mugged).

In other words, illusory invulnerability translates into the common belief: “It won’t happen to me… I know it happens, but it won’t happen to me”.

Illusory invulnerability about driving

People have particularly strong illusory invulnerability when it comes to their driving. For example, many drivers think that they are less likely to crash than is the average driver of their age and gender. They think that they are better and safer drivers, compared to their average peer.

You probably experience illusory invulnerability

You might have been thinking “I don’t have illusory invulnerability…. Other people might, but I don’t”.

But this thought would be an example of illusory invulnerability... other people probably think that they don’t have illusory invulnerability either!

Think about the risks you take on the road. Don’t you often take them because you don’t really believe that you will have a crash, be injured or killed, or even get booked?

The dangers of illusory invulnerability

Illusory invulnerability can be a problem. Believing that bad things are less likely than average to happen to you makes you behave dangerously.

For example, you may drive faster than you should because you think you won't crash (or be booked) anyway. Or you might not leave a large enough gap between you and the car in front of you in a line of moving traffic because you think you will be able to brake fast enough not to crash into the car in front.

One of the most important things you can do to reduce the chances of bad things, like crashing, from happening to you is to believe that they ARE JUST AS LIKELY TO HAPPEN TO YOU AS TO YOUR PEERS.

Fighting illusory invulnerability

It is very important that you learn not to think you are invulnerable when you are not. I will now outline some of the reasons you may have for thinking you are better off than your peers, and ask you to analyse them carefully.

1) You might think that "crashes happen fairly often" because you "read about them and see them on TV", that you have had very little crash experience. Similarly, you may see people getting booked quite frequently on the road, without being booked very often yourself. So you may reason that you are a safer and better driver than average, and that you are less likely than your average peer to have a crash or be booked in the future.

BUT REMEMBER:
There are a lot of other drivers, & only one of you. Even though car crashes seem to happen a lot, the chance of any one "average driver" having a crash is relatively low. Many drivers never have a serious crash.
Even if you have not yet had a crash, you could have one in future.

Even if you have had better driving past than your peers, this does not mean you will have a better driving future than your peers.

To illustrate this point: All of the drivers on the road today have never been killed in a car crash… just like you. Some of today's drivers will be killed in a car crash in future. You could be one of them.

2) You may think that there is a particular kind of driver who drives dangerously or has crashes… and that you are not this kind of driver. For example, you might think that “taxi drivers are crazy drivers and crash considerably more than other drivers”.

BUT REMEMBER:
Do not stereotype “unsafe drivers”. All kinds of people take risks and have crashes.

People who are generally safe drivers sometimes drive unsafely... just like you. So, if you see a driver perform an unsafe act, don’t immediately stereotype them as an unsafe driver.

3) You may think that other drivers take more risks, and make more mistakes, than you.

BUT REMEMBER:
You make mistakes too.

You probably notice other people's mistakes more often than you notice your own. For example, if the driver in front of you forgets to indicate before turning, you notice (perhaps in colourful language!), whereas if you forget to indicate you probably don't notice.

You might dismiss your mistakes because you know the reasons for them (e.g. your blinker is broken, you were tuning the radio, you were looking for a street sign), whereas you don't know the reasons for other drivers' mistakes.

Other drivers may seem to make worse mistakes than you, because it is the big ones you notice.

4) You may simply want (or need) to think that you are unlikely have a crash, be injured or killed, or even be booked.

BUT REMEMBER:
Do not deny your risk; face it and do something about it.

Driving is a dangerous activity and crashes happen.

You can influence your chances of having a crash, being injured or killed, or being booked.

One of the most important things you can do to reduce your chances of experiencing these bad events is to judge risks accurately…

by remembering what illusory invulnerability is and fighting the irrational thoughts which cause it

Not having illusory invulnerability and being a low risk driver is critical to your health and safety

Naturally, you would prefer not to have crash, be injure or killed, or even be booked.

You can influence your chances of experiencing these bad events

You need to avoid taking risks.

To do this you need to recognise risks accurately, and one way of this is to fight illusory invulnerability.

Now you know what illusory invulnerability is, and you know some ways to avoid it. Please use your skills.

Were you *really* a safer than average driver this morning?
Will you be from now on?

Thus, under the heading "Fighting illusory invulnerability", Technique 1 derives from experience-based accounts of illusory invulnerability such as contingency error, absent/exempt, and better-past-better-future. Technique 2 derives from the downward comparison account. Technique 3 derives from behaviour-based accounts of illusory invulnerability such as the egocentrism account, and Technique 4 derives from "motivation" accounts such as defensive denial or self-esteem enhancement.

The control messages were designed to be of similar length to the "active" messages, but not to influence illusory invulnerability [see Appendix H]. They essentially described the simulator.

Future-related and Past-related Illusory Invulnerability Questionnaires

These questionnaires were identical to those employed in Study 2 [see Appendix C], with the exception that for Study 3 (which involved longer session times) the order of making self versus average peer ratings was counterbalanced to minimise fatigue effects. In addition, a second version of

the Past-related illusory invulnerability was developed for the follow-up. It asked Participants to consider their experience in the “last 2 months” rather than the past year.

On-road Risky Driving Intentions Questionnaire

This questionnaire was identical to that employed in Study 2 [see Appendix C].

Demographic and Control Variables Questionnaire

Again, this questionnaire was identical to that employed in Study 2 [see Appendix C].

Simulator-related Illusory Invulnerability Questionnaire

This questionnaire was again identical to that employed in Study 2 [see Appendix D], with the exception that the second item (“have less than 2 car crashes” was omitted). Further, the order of self versus average peer ratings was counterbalanced across Participants (to match the counterbalance in the Illusory Invulnerability Questionnaire).

Simulator-related Risky Driving Intentions Questionnaire

This questionnaire was identical to that employed in Study 2 [see Appendix C].

Simulator-related Risky Driving Intentions Questionnaire

This questionnaire was identical to that employed in Study 2 [see Appendix C].

Simulator Driving Record Sheet

This record sheet was identical to that employed in Study 2 [see Appendix E].

STISIM Driving simulator, and drives

Study 3 again employed the driving simulator situated in a room in the School of Psychology, University of Sydney. The practice drive was identical to that employed in Study 2. Some minor refinements were made to the Study 2 test drives for use in Study 3. Specifically,

1. In Tasks 1.1, 1.2, 4.1, 4.2, 5.1 and 5.2, data was recorded every .05sec, rather than every 10m, for 25sec before the hazard.
2. In Tasks 2.1 and 2.2 data was recorded for 300m rather than 200m before the hazard
3. Other vehicles were spaced more realistically in the overtaking and turning tasks (1, 4, and 5)
4. Task 6.2 was removed

Procedure

Procedures parallelled those employed in Study 2, with the exception that the intervention materials were administered before Participants completed their questionnaires and drives. The mean total driving time was 401.12s (s.d.=49.27) for Drive 1, 413.91s (s.d.=69.29) for Drive 2, 557.05s (s.d.=38.88) for Drive 3, and 392.69s (s.d.=34.79) for Drive 4.

Approximately 2 months later, 36 Participants returned to complete the illusory invulnerability questionnaires and simulator drives once again. The mean total driving time was 419.75s (s.d.=5.56) for Drive 1, 449.27s (s.d.=89.88) for Drive 2, 581.16s (s.d.=43.31) for Drive 3, and 408.33s (s.d.=37.47) for Drive 4.

Table 3.1 presents total drive run times for the treatment and control groups, at Sessions 1 and 2. No significant group differences were observed (highest nonsignificant t_{36}=1.69, $p_{2\text{-tailed}}$ =0.097).

Table 3.1: Drive total run times (s.d) (seconds) for treatment and control group Participants, at Sessions 1 and 2.

	Treatment group	***Control group***
Session 1		
Drive 1 total run time	398.47 (47.82)	403.79 (51.38)
Drive 2 total run time	405.71 (62.05)	422.72 (76.52)
Drive 3 total run time	548.42 (35.98)	565.99 (40.37)
Drive 4 total run time	394.16 (33.22)	391.11 (36.98)
Session 2		
Drive 1 total run time	419.00 (41.73)	420.79 (62.45)
Drive 2 total run time	463.56 (92.52)	429.26 (85.06)
Drive 3 total run time	582.07 (30.56)	579.88 (57.90)
Drive 4 total run time	406.69 (41.36)	410.63 (32.51)

Variable computation and statistical analysis

Data were analysed with SPSS (Statistical Package for the Social Sciences). The Type I error rate for all analyses was set at .05. Significant p values are marked with asterisks in all tables (* p<.05; ** p<.001).

Computation of main questionnaire indices

Descriptive statistics were employed to investigate the characteristics of the sample, in terms of age, gender, driving exposure, and the tendency to conform to social expectations.

The following indices were computed in the same manner as for Study 2:

- Relative future risk estimates:
    - Road-related negative index
    - Road-related positive index
    - Casualty as a driver at fault index
    - Casualty as a driver not at fault index
    - Casualty as a passenger index
    - Road-unrelated negative index
    - Road-unrelated positive index
- Relative past experience estimates:
    - Road-related negative index
    - Road-related positive index
    - Injury as a driver at fault index (1 item)
    - Injury as a driver not at fault index (1 item)
    - Injury as a passenger index (1 item)
    - Road-unrelated negative index
    - Road-unrelated positive index
- Simulator-related relative risk estimates:
    - Negative index
    - Positive index (here, 1 item)
- On-road risky driving intentions index
- Simulator-related risky driving intentions index

Computation of simulator-related indices

Several simulated driving performance measures were derived from the simulator driving data.

The average speed approaching hazards in Tasks 1, 2, 3, and 4 was computed employing all available data-points. An overall speed when approaching hazards index was calculated by averaging the four individual task speed averages.

Average speed indices were also calculated for each of the four speed zone tasks that constituted Task 7 [see Table 2.5].

The number of drives (0-4) in which speed was exceeded, the number of drives (0-4) in which traffic light tickets were issued, as well as total number of traffic light tickets issued, were employed as dependent variables. Finally, number of crashes on the driving simulator was employed as a dependent variable.

Analyses

For both immediate post-test and 2-month follow-up, the Treatment group was compared to the Control group in terms of continuous dependent variables employing one-way ANOVAs. Continuous dependent variables were item and index scores for future-related illusory invulnerability (general and simulator-related), past-related illusory invulnerability, and self-reported intended risky driving (on-road and simulator-related), as well as simulator-related speed indices, number of drives in which speed was exceeded, the number of drives in which traffic light tickets were issued, total number of traffic light tickets, and total number of crashes. The impact of treatment on categorical variables was assessed employing Chi-squares. We examined what numbers of Participants were involved in any kind of real road trauma between immediate post-test and 2-month follow-up (based on self-reports), and conducted analysis accordingly. Treatment Participants were expected to

demonstrate improvements (relative to controls) in terms of risk perception and risky driving, and crashing, and thus 1-tailed tests were employed. Nonetheless, when means were in a direction opposite to prediction, p-values <0.05 are reported because of its practical importance.

We assessed the association of demographic variables (e.g. age, gender), driving experience (e.g. number of years licensed, average hours spent driving per week), and social desirability with each dependent variable, and where significant associations were observed we repeated the comparisons described above using the personal characteristic variable as a covariate[6].

[6] Our proposal identifies that statistical analysis of Study 3 data would include assessment of the association between illusory invulnerability and driving outcomes. However, we felt that this would be excessive in view of extensive such analyses in Studies 1 and 2, and in view of the already considerable length of the report.

Results

Sample characteristics

Table 3.2 and 3.3 present personal characteristics of treatment and control group Participants, at Sessions 1 and 2, respectively.

Table 3.2: Characteristics of Participants in Session 1, for Treatment and Control groups separately

	Treatment group (n=29)	***Control group (n=29)***
Gender	45% female	52% female
Age	20.45 years (s.d. = 1.86)	20.97 years (s.d. = 1.82)
Language spoken at home	83% English	79% English
Area of residence	14% city 10% eastern Sydney 17% northern Sydney 10% southern Sydney 17% inner west 24% western Sydney 0% south west 7% north west	24% city 7% eastern Sydney 17% northern Sydney 3% southern Sydney 28% inner west 10% western Sydney 7% south west 3% north west
Years of licensure	3.85 years (s.d. = 1.59)	4.36 years (s.d. = 2.01)
Hrs/week driving as driver	6.09 hours (s.d. = 5.29)	5.05 hours (s.d. = 4.77)
Hrs/week driving as passenger	4.10 hours (s.d. = 8.01)	2.69 hours (s.d. = 3.65)
Permanent access to car	79% “Yes”	76% “Yes”
Crash history	52% at least one mean= 0.93, mode= 0, range: 0 - 3	41% at least one mean= 0.55, mode= 0, range: 0 - 3
Social Desirability score	4.83 (s.d. = 2.42)	4.75 (s.d. = 3.15)

Table 3.3: Characteristics of Participants remaining by Session 2, for Treatment and Control groups separately

	Treatment group (n=21)	***Control group (n=15)***
Gender	43% female	47% female
Age	20.71 years (s.d. = 2.05)	21.00 years (s.d. = 1.85)
Language spoken at home	76% English	87% English
Area of residence	14% city 10% eastern Sydney 19% northern Sydney 14% southern Sydney 24% inner west 14% western Sydney 14% south west 5% north west	13% city 0% eastern Sydney 13% northern Sydney 7% southern Sydney 33% inner west 13% western Sydney 0% south west 7% north west
Years of licensure	3.93 years (s.d. = 1.79)	4.49 years (s.d. = 2.23)
Hrs/week driving as driver	6.57 hours (s.d. = 5.87)	4.90 hours (s.d. = 3.97)
Hrs/week driving as passenger	3.95 hours (s.d. = 8.97)	3.77 hours (s.d. = 4.71)
Permanent access to car	76% "Yes"	80% "Yes"
Crash history	57% at least one mean= 1.00, mode= 0, range: 0 - 3	47% at least one mean= 0.73, mode= 0, range: 0 - 3
Social Desirability score	4.76 (s.d. = 2.30)	4.07 (s.d. = 2.87)

Unexpected group differences were assessed by comparing treatment and control groups in terms of personal characteristics, at each session. Again, one-way ANOVAs were employed for continuous variables, and chi-squared tests for categorical variables. No significant group difference was observed at session 1 (lowest p=0.136) or session 2 (lowest p=0.346).

In order to check for selective attrition, Participants who continued to session 2 were compared to those who did not, within each group, in terms of personal characteristics. One-way ANOVAs were employed for continuous

variables, and chi-squared for categorical variables. No significant difference was observed in the treatment group (lowest p=0.129) or the control group (lowest p=0.101).

Illusory invulnerability regarding various aspects of future road use

For both immediate post-test and 2-month follow-up, treatment and control groups were compared in terms of relative perceived future likelihood indices.

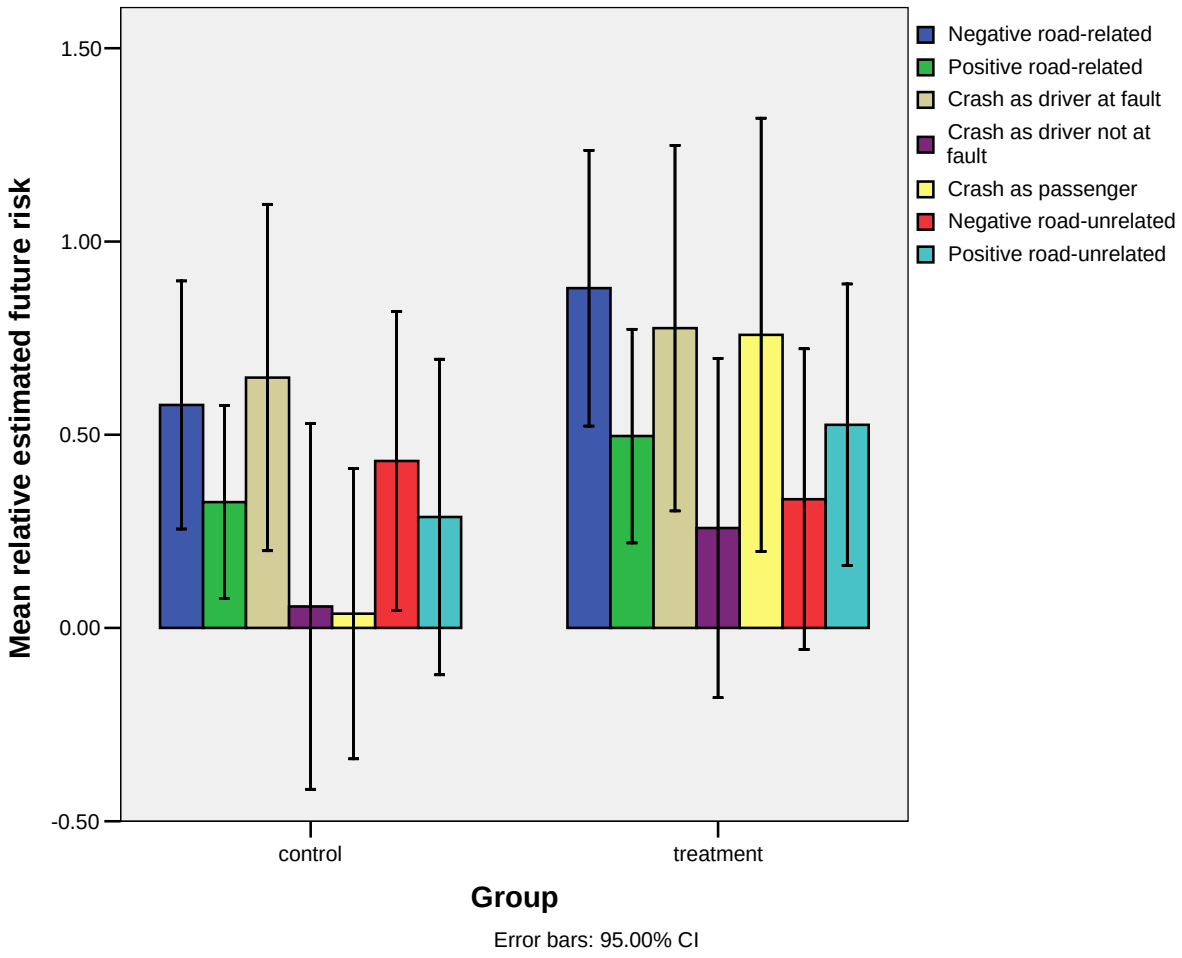


Figure 3.2: Mean relative estimated future risk for the road-related negative, road-related positive, road-unrelated negative, and road-unrelated positive indices, and the indices regarding injury/death as a driver at fault, for Treatment and Control groups separately, at Session 1.

At the immediate post-test [see Figure 3.2], no significant differences were observed. For the road-unrelated negative index means were in the predicted direction ($F_{1,56}$=0.19, $p_{1\text{-tailed}}$ =0.332). All other means were in the direction opposite to prediction, and thus nonsignificant according to the one-tailed test employed. For one of these, the crash as a passenger index, $F_{1,56}$=4.05, $p_{2\text{-tailed}}$ =0.049.

Considering the control group only, relative scores were significantly greater than zero for all indices (lowest significant t_{28}=1.86, $p_{1\text{-tailed}}$ =0.037), except the "crash as a driver not at fault" index (t_{28}=0.32, $p_{1\text{-tailed}}$ =0.377) and the "crash as a passenger" index (t_{28}=0.59, $p_{1\text{-tailed}}$ =0.281). Thus, illusory invulnerability was observed in the sample.

At follow-up [see Figure 3.3], no significant differences were observed between the treatment and control groups. For 5 out of 7 indices relative estimated risk was *nonsignificantly* lower in the treatment than the control group (highest nonsignificant $F_{1,34}$=1.38, $p_{1\text{-tailed}}$ =0.125). For the remaining 2 indices (the road-related negative index, and the road-unrelated positive index) means were in the direction opposite to prediction, and thus the group difference was nonsignificant according to the one-tailed test employed.

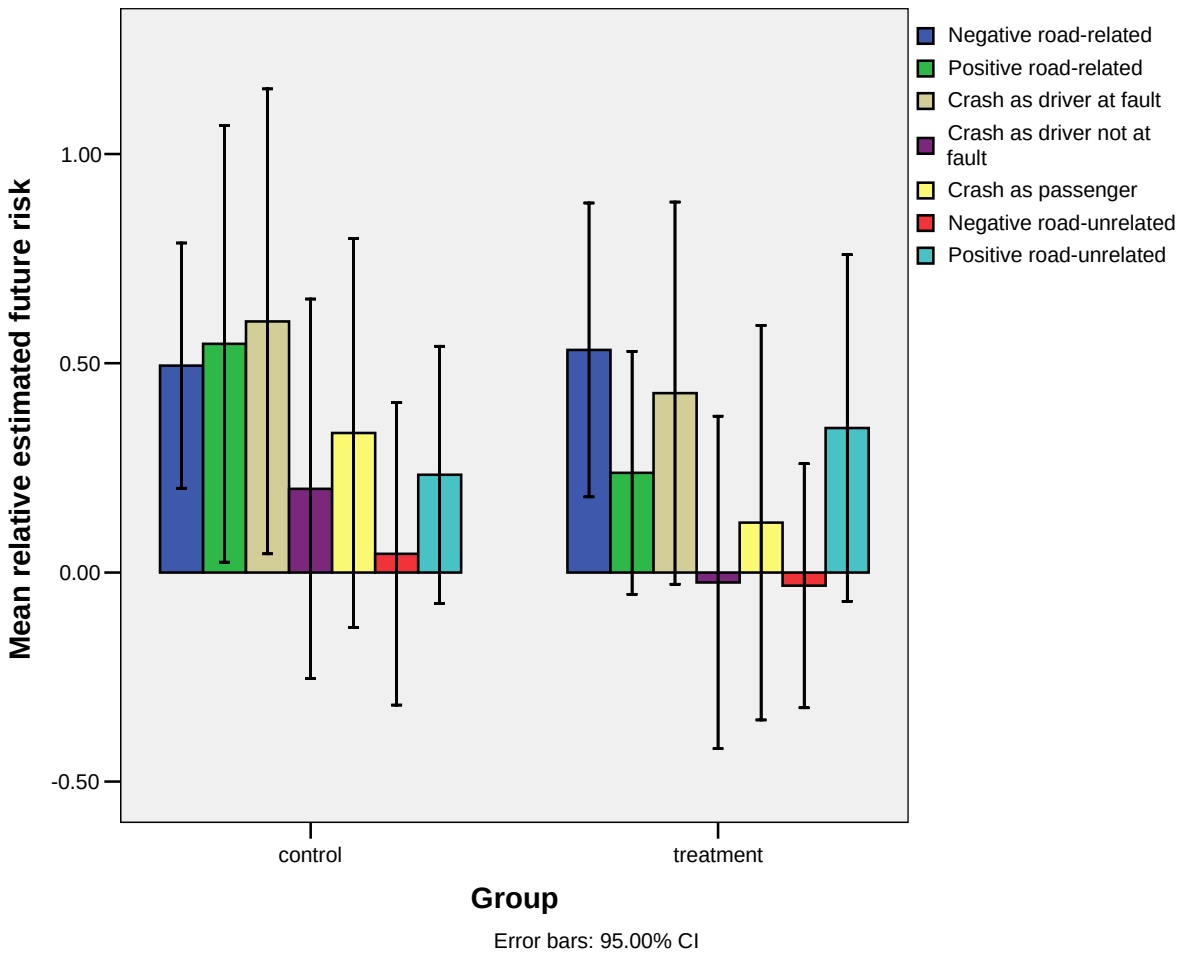


Figure 3.3: Mean relative estimated future risk for the road-related negative, road-related positive, road-unrelated negative, and road-unrelated positive indices, and the indices regarding injury/death as a driver at fault, for Treatment and Control groups separately, at Session 2.

These results are more consistent with a real effect than a demand characteristic, because the follow-up data are more consistent with expectation than are the immediate post-test data.

Considering the control group only, relative scores were significantly greater than zero for the negative road-related index, the positive road-related index, and the "crash as a driver at fault" index (lowest significant t_{14}=2.25, $p_{1\text{-tailed}}$ =0.021). Scores for all other indices were *nonsignificantly* greater than zero (highest nonsignificant t_{14}=1.63, $p_{1\text{-tailed}}$ =0.063). Thus, illusory invulnerability was observed in the sample.

Illusory invulnerability regarding various aspects of past road use

For both immediate post-test and 2-month follow-up, treatment and control groups were compared in terms of relative perceived experience indices.

At the immediate post-test [see Figure 3.4], no significant difference was observed between the treatment and control group. Perceived relative experience was *nonsignificantly* lower in the treatment compared to the control group for 5 of 7 indices (highest nonsignificant $F_{1,53}$=1.89, $p_{1\text{-tailed}}$ =0.088). For the other two indices means were in a direction opposite to prediction and thus not significantly different (although for the positive road-unrelated index $F_{1,54}$=6.18, $p_{2\text{-tailed}}$ =0.016).

Considering the control group only, relative scores were significantly greater than zero for all indices (lowest significant t_{27}=2.39, $p_{1\text{-tailed}}$ =0.012), except the positive road-related index (t_{25}=0.33, $p_{1\text{-tailed}}$ =0.372) and the positive road-unrelated index (mean in a direction opposite to prediction and thus nonsignificant according to the 1-tailed test employed). Thus, illusory invulnerability was observed in the sample.

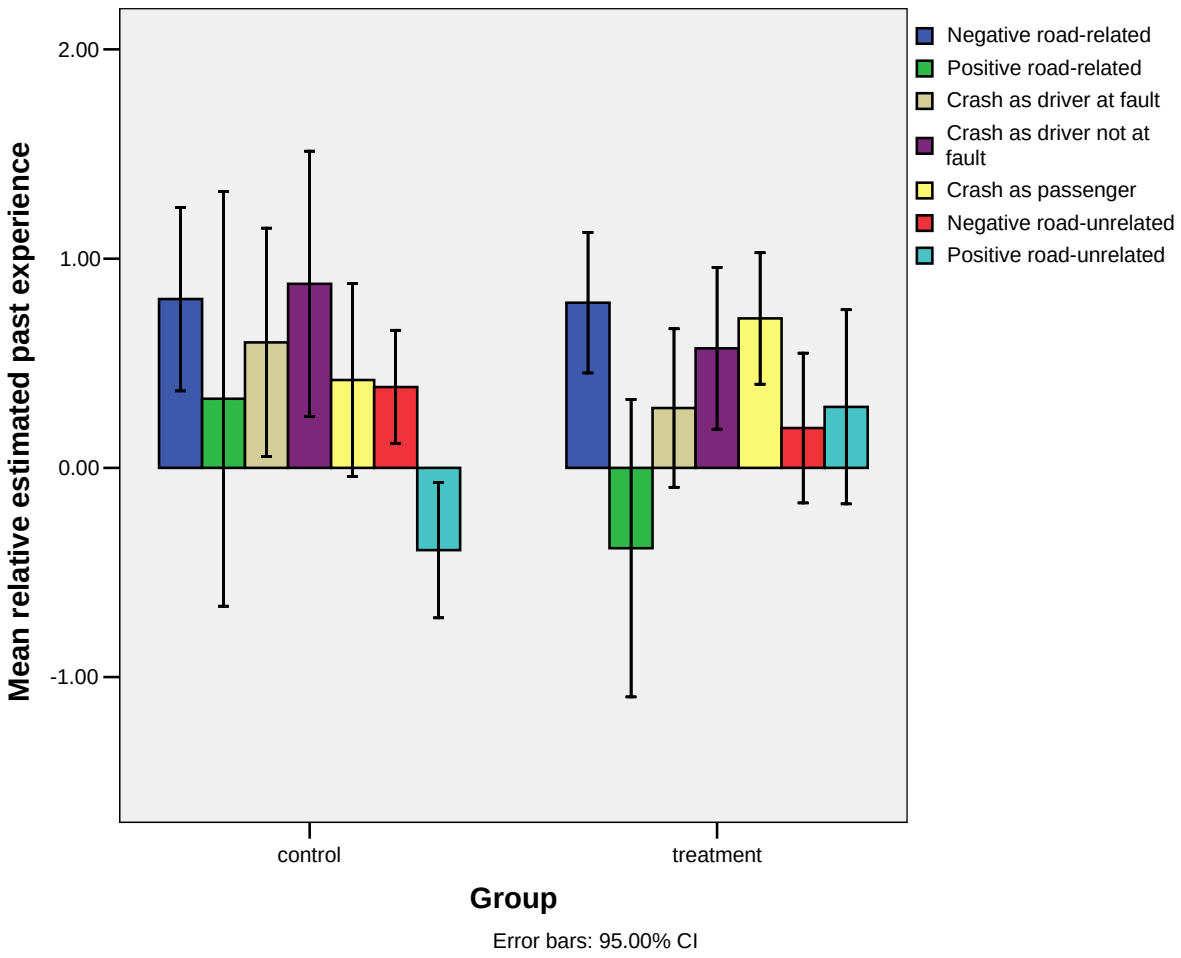


Figure 3.4: Mean relative estimated past experience for the road-related negative, road-related positive, road-unrelated negative, road-unrelated positive indices, and the events regarding injury as a driver at fault, for Treatment and Control groups separately, at Session 1.

At follow-up [see Figure 3.5], no significant difference was observed between the treatment and control group. Perceived relative experience was *nonsignificantly* lower in the treatment compared to the control group for 4 of 7 indices (highest nonsignificant $F_{1,32}$=1.52, $p_{1\text{-tailed}}$ =0.114).

The remaining means (for the road-related positive index, the road-unrelated positive index, and crash as a driver at fault) were in the direction opposite to prediction, and thus nonsignificant according to the one-tailed test employed.

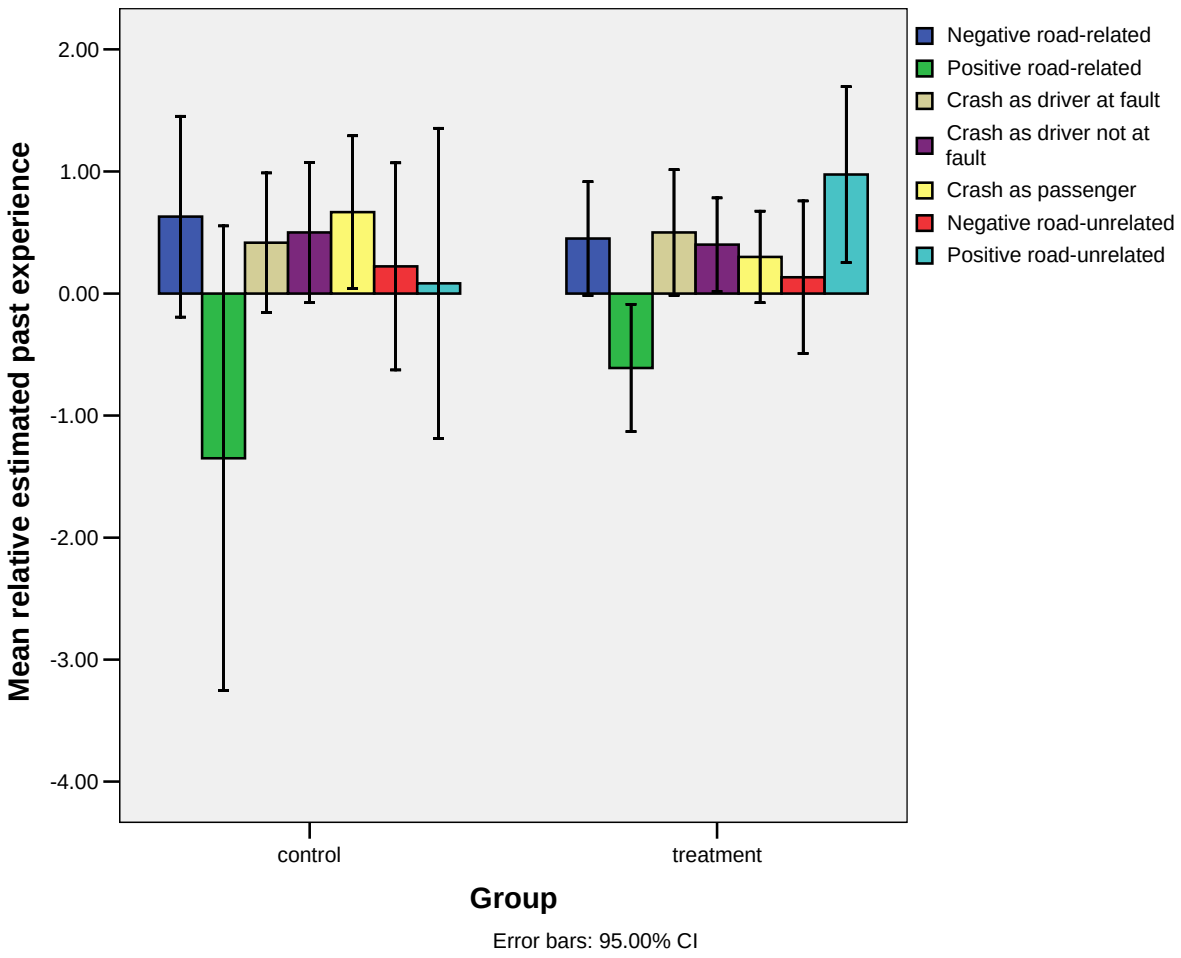


Figure 3.5: Mean relative estimated past experience for the road-related negative, road-related positive, road-unrelated negative, road-unrelated positive indices, and the events regarding injury as a driver at fault, for Treatment and Control groups separately, at Session 2.

Considering the control group only, relative scores were significantly greater than zero for the indices relating to crashing as a driver not at fault (t_{12}=1.90, $p_{1\text{-tailed}}$ =0.041) and as a passenger t_{12}=2.50, $p_{1\text{-tailed}}$ =0.014). Scores were nonsignificantly greater than zero for all other indices (t_{12}=1.77, $p_{1\text{-tailed}}$ =0.051) except the positive road related index (mean in the direction opposite to prediction and thus nonsignificant according to the 1-tailed test employed). Thus, illusory invulnerability was observed in the sample.

In summary, the observed pattern of results was similar to that observed for relative future risk estimates

Illusory invulnerability regarding driving on the simulator

For both immediate post-test and 2-month follow-up, treatment and control groups were compared in terms of the simulator-related relative estimated future likelihood negative and positive indices.

At the immediate post-test [see Figure 3.6], scores were *nonsignificantly* lower in the treatment compared to the control group for both the negative index ($F_{1,54}$=1.66, $p_{1\text{-tailed}}$ =0.102) and the positive index (“get less than 2 fines”; $F_{1,54}$=0.03, $p_{1\text{-tailed}}$ =0.434).

Considering the control group only, the relative score for negative events was significantly greater than zero (t_{26}=3.19, $p_{1\text{-tailed}}$ =0.002), indicating illusory invulnerability in the sample. For positive events the score was nonsignificantly greater than zero (t_{26}=0.17, $p_{1\text{-tailed}}$ =0.433).

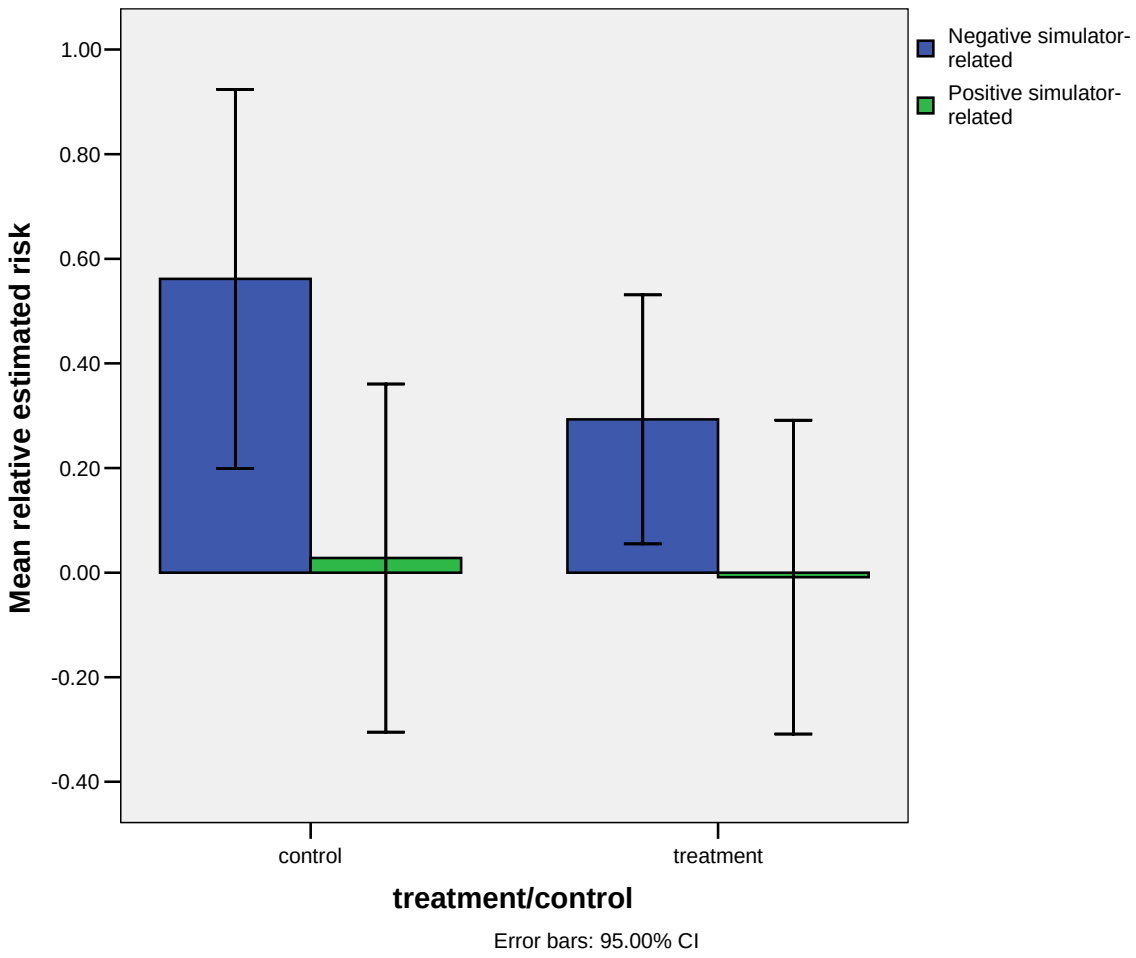


Figure 3.6: Mean relative estimated future risk, for Treatment and Control groups separately, at Session 1.

At follow-up [see Figure 3.7], the treatment group demonstrated *nonsignificantly* lower simulator-related relative risk scores than the control group for both negative index ($F_{1,34}$=0.01, $p_{1\text{-tailed}}$ =0.463) and the positive index ($F_{1,34}$=0.01, $p_{1\text{-tailed}}$ =0.428).

Considering the control group only, the relative score for negative events was significantly greater than zero (t_{14}=2.63, $p_{1\text{-tailed}}$ =0.010), indicating illusory invulnerability in the sample. For positive events the score was nonsignificantly greater than zero (t_{14}=0.39, $p_{1\text{-tailed}}$ =0.350).

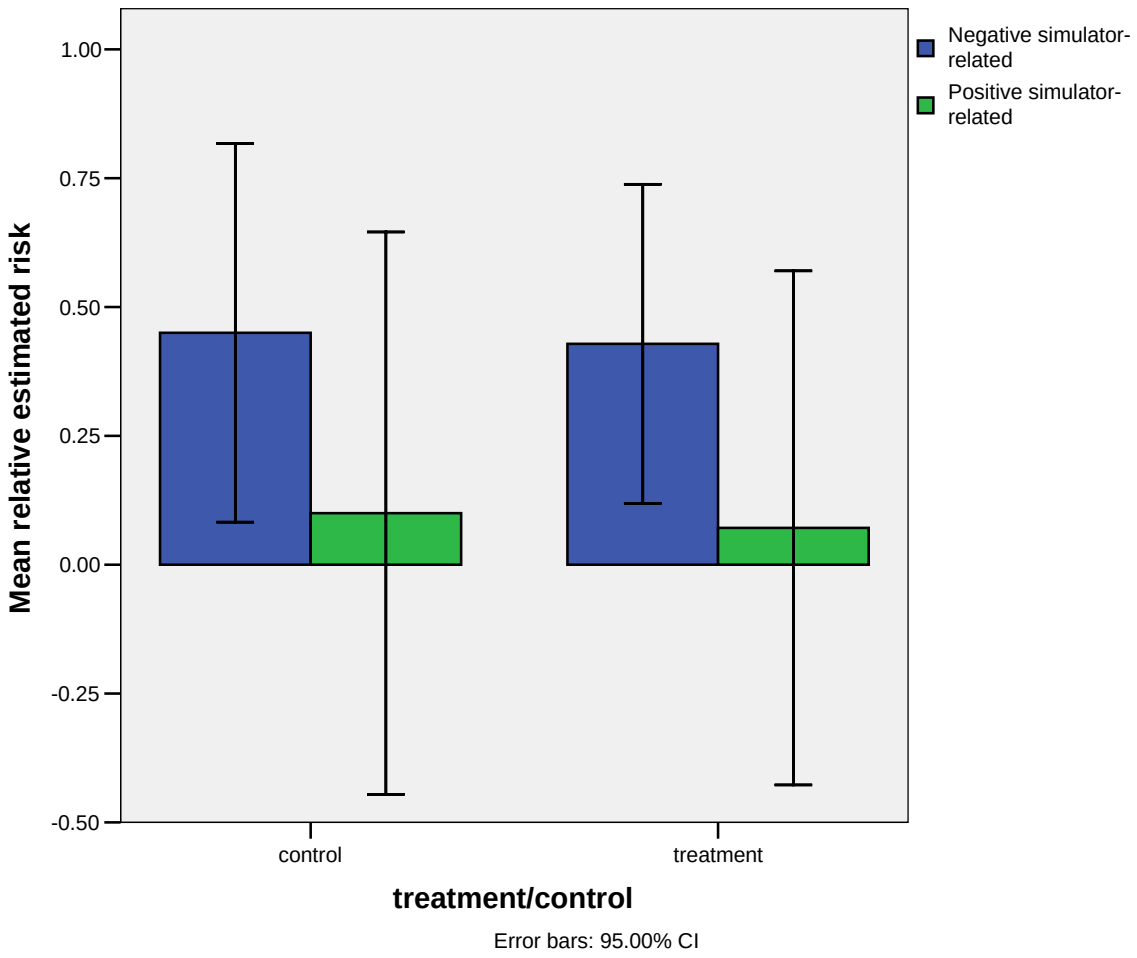


Figure 3.7: Mean relative estimated future risk, for Treatment and Control groups separately, at Session 2.

Self-reported risky driving on the road

For the immediate post-test only, treatment and control groups were compared in terms of self-reported intention to engage in risky driving on the road.

At the immediate post-test [see Figure 3.8], self-reported intention of engaging in risk driving was *nonsignificantly* lower in the treatment compared to the control group ($F_{1,56}$=0.093, $p_{1\text{-tailed}}$ =0.381).

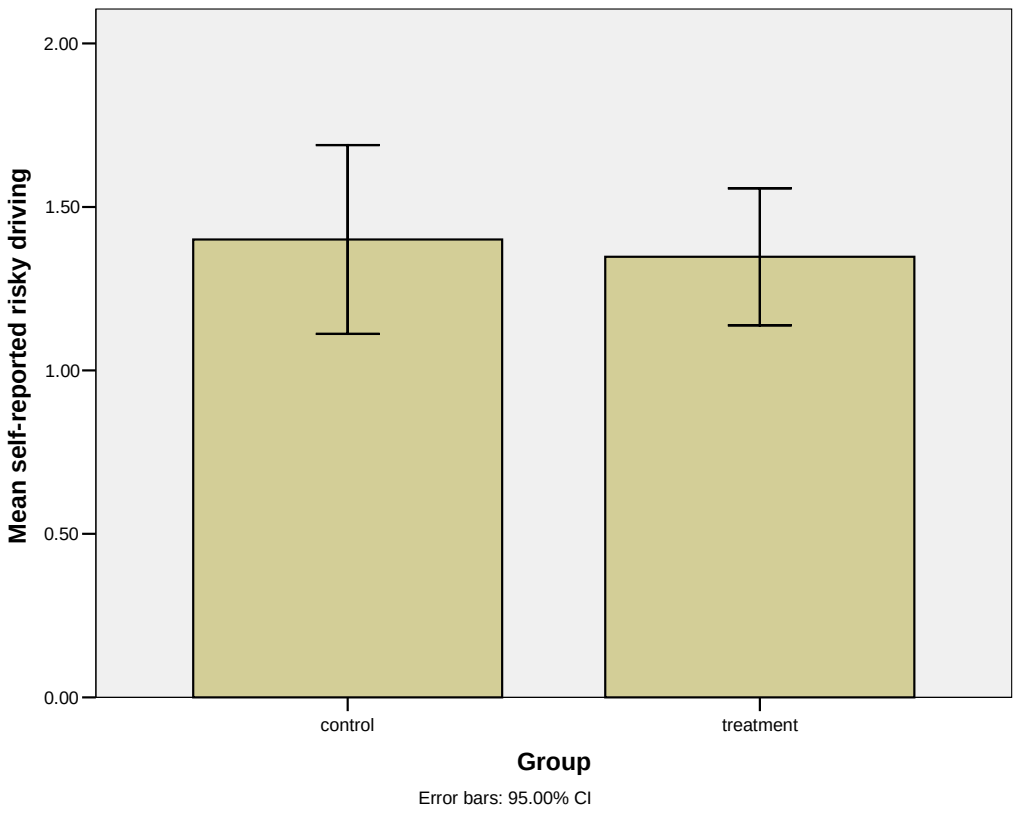


Figure 3.8: Mean scores on risky driving index, for Treatment and Control groups separately, at Session 1.

Self-reported experience of real road trauma between immediate post-test and 2-month follow-up

Based on the estimates of personal crash experience from the past-related illusory invulnerability questionnaire at the second session, between the immediate post-test and the 2-month follow-up, 87% of Participants in the control group had no crashes, compared to 82% in the treatment group. Other Participants in the control group reported having had 3 crashes or 5 crashes (1 participant each). Other Participants in the treatment group reported having 1 crash or 2 crashes (2 Participants each). This measure was recoded as a dichotomous variable (0=no crash, 1=at least one crash). The groups did not differ significantly on this recoded measure (proportions in the direction opposite to prediction according to the 1-tailed test employed).

Self-reported risky driving on the simulator

For the immediate post-test only, treatment and control groups were compared in terms of self-reported intention to engage in risky driving on the simulator.

At the immediate post-test [see Figure 3.9], self-reported intention of engaging in risky driving also was *nonsignificantly* lower in the treatment compared to the control group ($F_{1,56}$=1.12, $p_{1\text{-tailed}}$ =0.147).

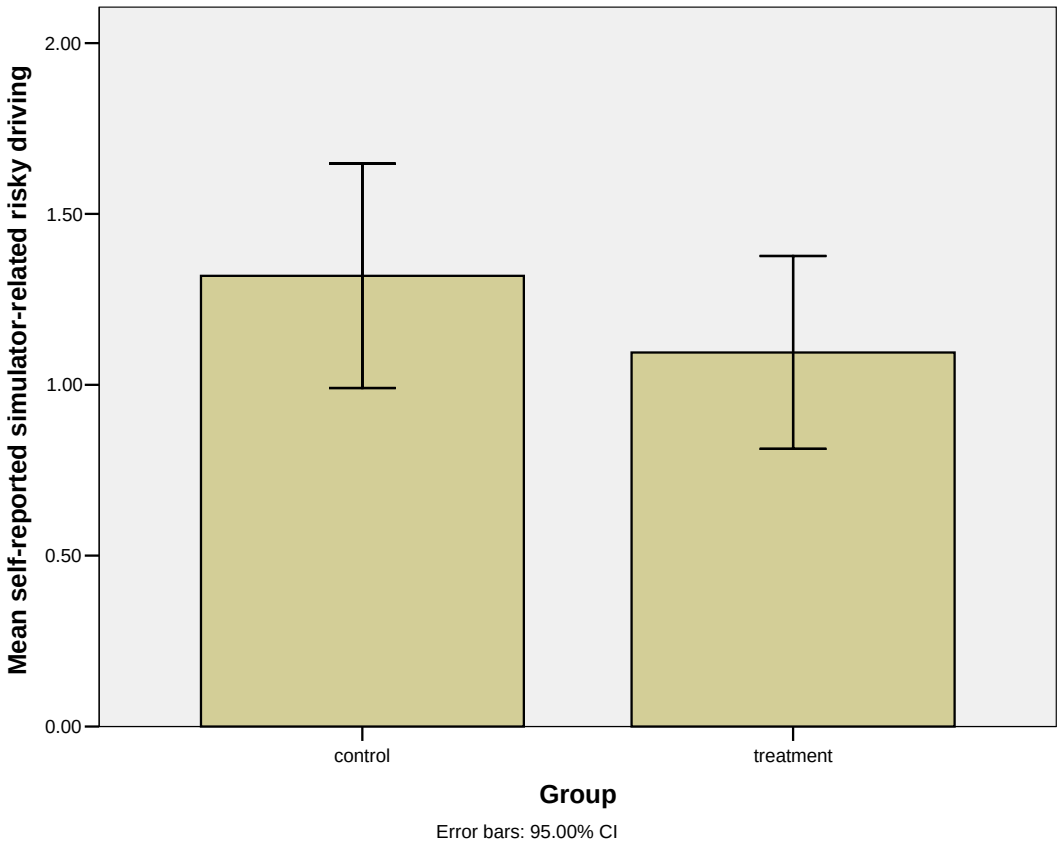


Figure 3.9: Mean scores on simulator-related risky driving index, for Treatment and Control groups separately, at Session 1.

Risky driving on the simulator

Speed approaching hazards

For both immediate post-test and 2-month follow-up, treatment and control groups were compared in terms of speed approaching hazards in simulator task.

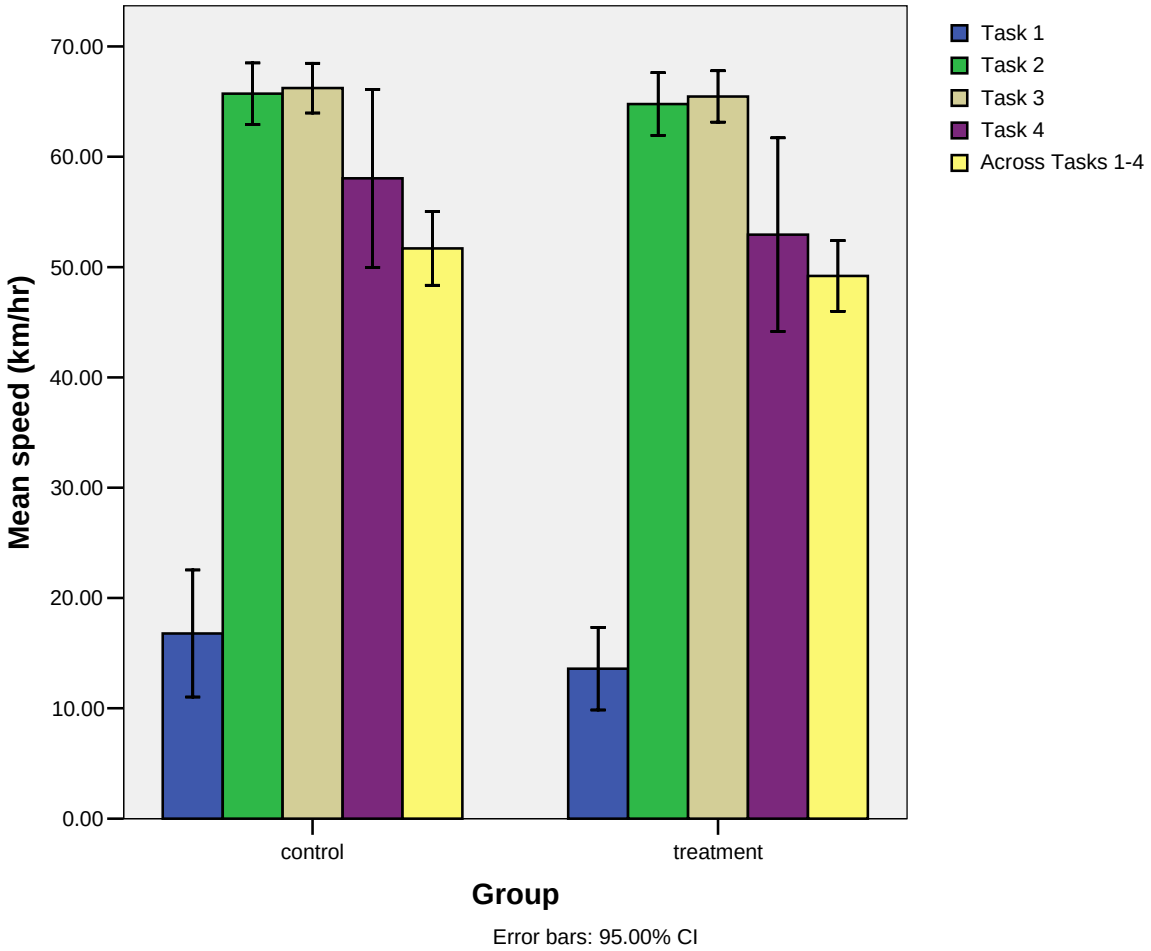


Figure 3.10: Mean speed (km/hr) approaching road blockage with oncoming cars (average of Tasks 1.1 and 1.2) , approaching traffic lights (average of Tasks 2.1 and 2.2) , approaching a curve/crest (average of Tasks 3.1 and 3.2) , approaching road blockage with cars coming from behind (average of Tasks 4.1 and 4.2) , or the treatment and control groups separately, at Session 1.

At the immediate post-test [see Figure 3.10], hazards were approached *nonsignificantly* slower by the treatment than the control group for Task 1 ($F_{1,54}$=0.870, $p_{1\text{-tailed}}$ =0.178), Task 2 ($F_{1,54}$=0.273, $p_{1\text{-tailed}}$ =0.302), Task 3 ($F_{1,553}$=0.24, $p_{1\text{-tailed}}$ =0.312), and Task 4 ($F_{1,53}$=0.50, $p_{1\text{-tailed}}$ =0.241). The average across hazards displayed the same pattern ($F_{1,52}$=1.23, $p_{1\text{-tailed}}$ =0.068).

At follow-up [see Figure 3.11], hazards were approached *nonsignificantly* slower by the treatment than the control group for Task 2 ($F_{1,33}$=0.002, $p_{1\text{-tailed}}$ =0.482), Task 3 ($F_{1,29}$=0.07, $p_{1\text{-tailed}}$ =0.397), and Task 4 ($F_{1,28}$=1.99, $p_{1\text{-tailed}}$ =0.085). For Task 1 means were in the direction opposite to prediction and thus the group difference was nonsignificant according to the 1-tailed test employed. The average across hazards displayed the same pattern as Tasks 2, 3, and 4 ($F_{1,28}$=1.32, $p_{1\text{-tailed}}$ =0.131).

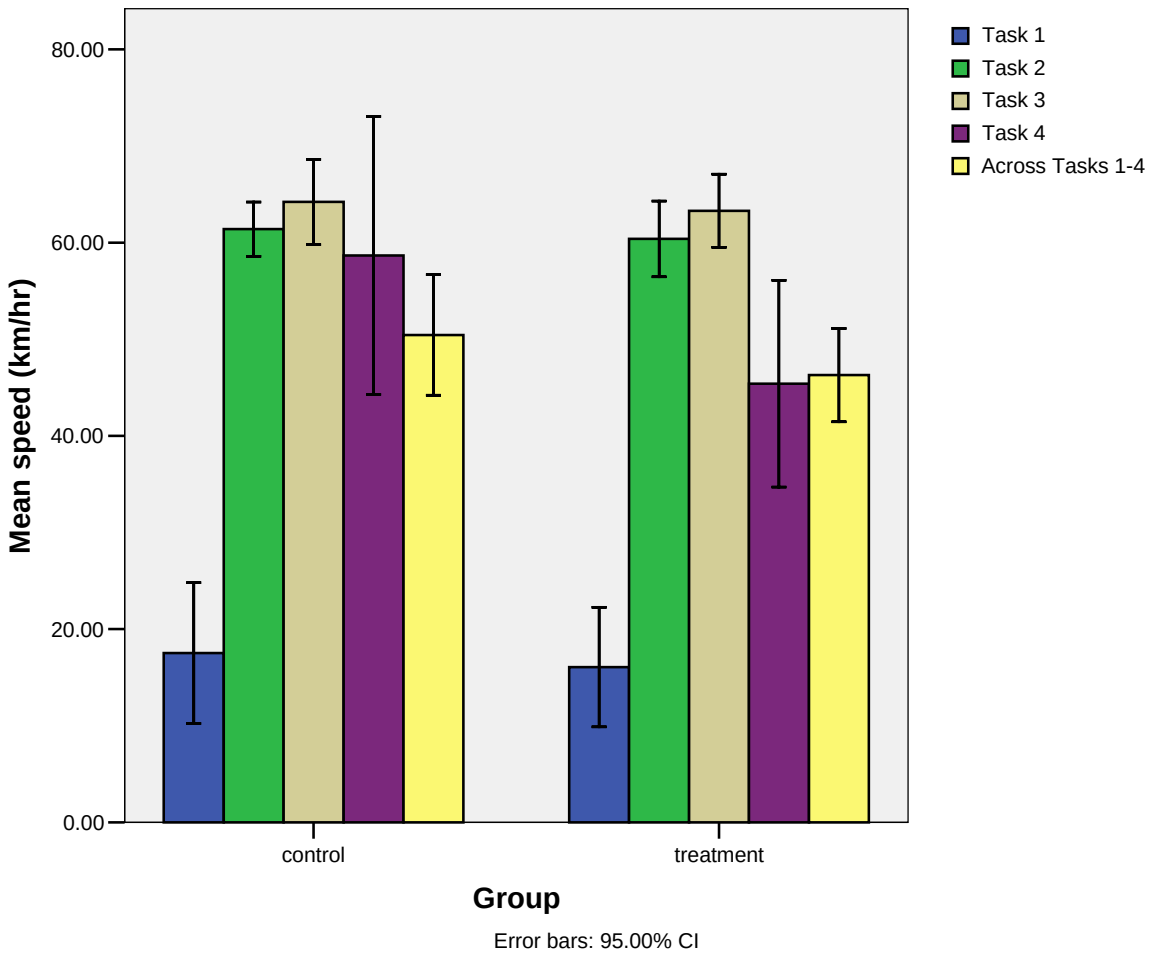


Figure 3.11: Mean speed (km/hr) approaching road blockage with oncoming cars (average of Tasks 1.1 and 1.2) , approaching traffic lights (average of Tasks 2.1 and 2.2) , approaching a curve/crest (average of Tasks 3.1 and 3.2) , approaching road blockage with cars coming from behind (average of Tasks 4.1 and 4.2) , or the treatment and control groups separately, at Session 2.

Speed in designated speed zones

For both immediate post-test and 2-month follow-up, treatment and control groups were compared in terms of speed in the designated speed zones in Task 7 (Drive 3) on the simulator.

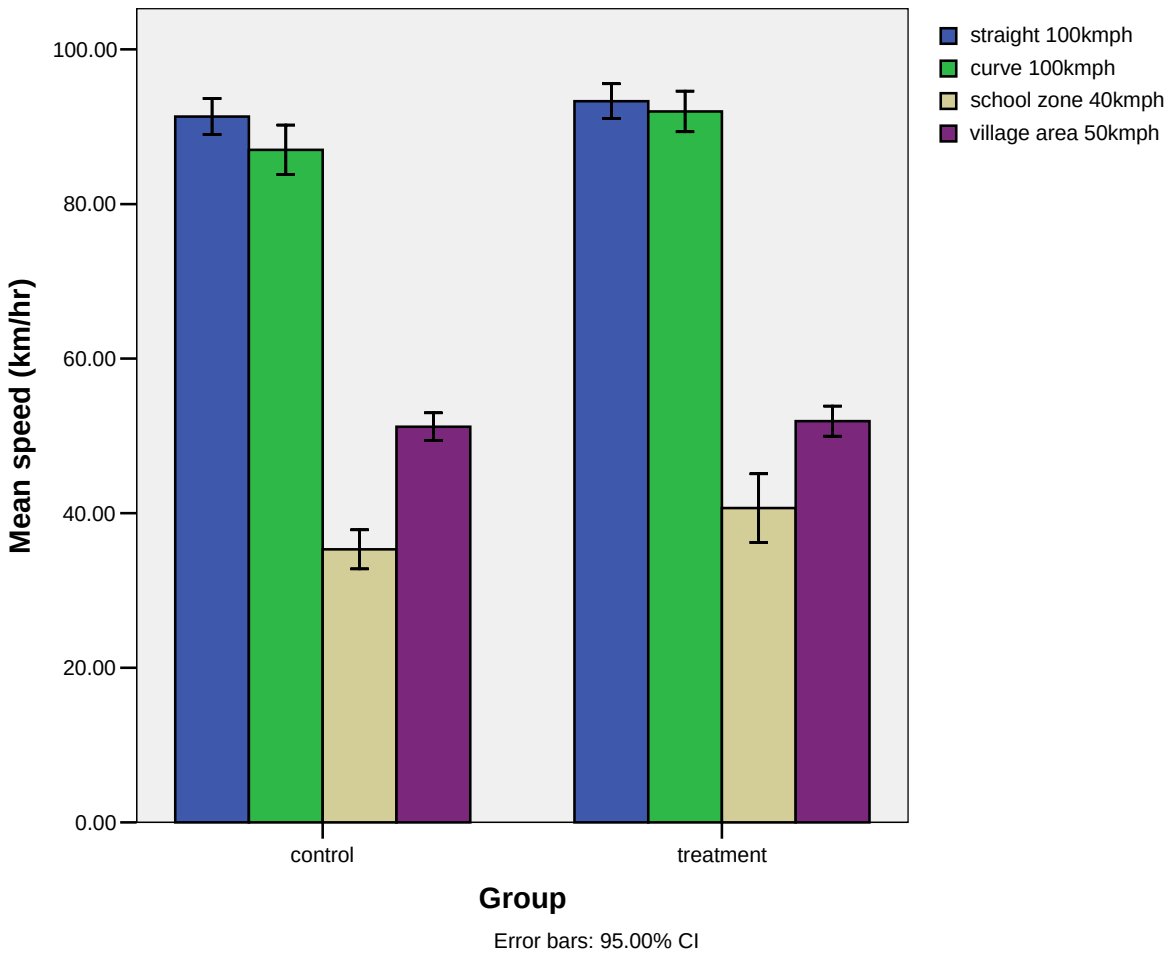


Figure 3.12: Mean speed (km/hr) in the 100km/hr straight section, the 100km/hr curve section, the 40km/hr school zone, and the 50km/hr shopping area, for the treatment and control groups separately, at Session 1.

At the immediate post-test [see Figure 3.12], the treatment group did not differ significantly from the control group in any of the speed zones (means in a direction opposite to prediction and thus not significant according to the 1-tailed test employed).

At follow-up [see Figure 3.13], the treatment group did not differ significantly from the control group in either of the 100km/hr zones (means in a direction opposite to prediction and thus not significant according to the 1-tailed test employed). However, the treatment group drove significantly more slowly than the control group in the 40km/hr school zone ($F_{1,33}$=3.80, $p_{1\text{-tailed}}$ =0.030). The treatment group drove *nonsignificantly* more slowly than the control group in the 50km/hr shopping area ($F_{1,33}$=2.61, $p_{1\text{-tailed}}$ =0.053).

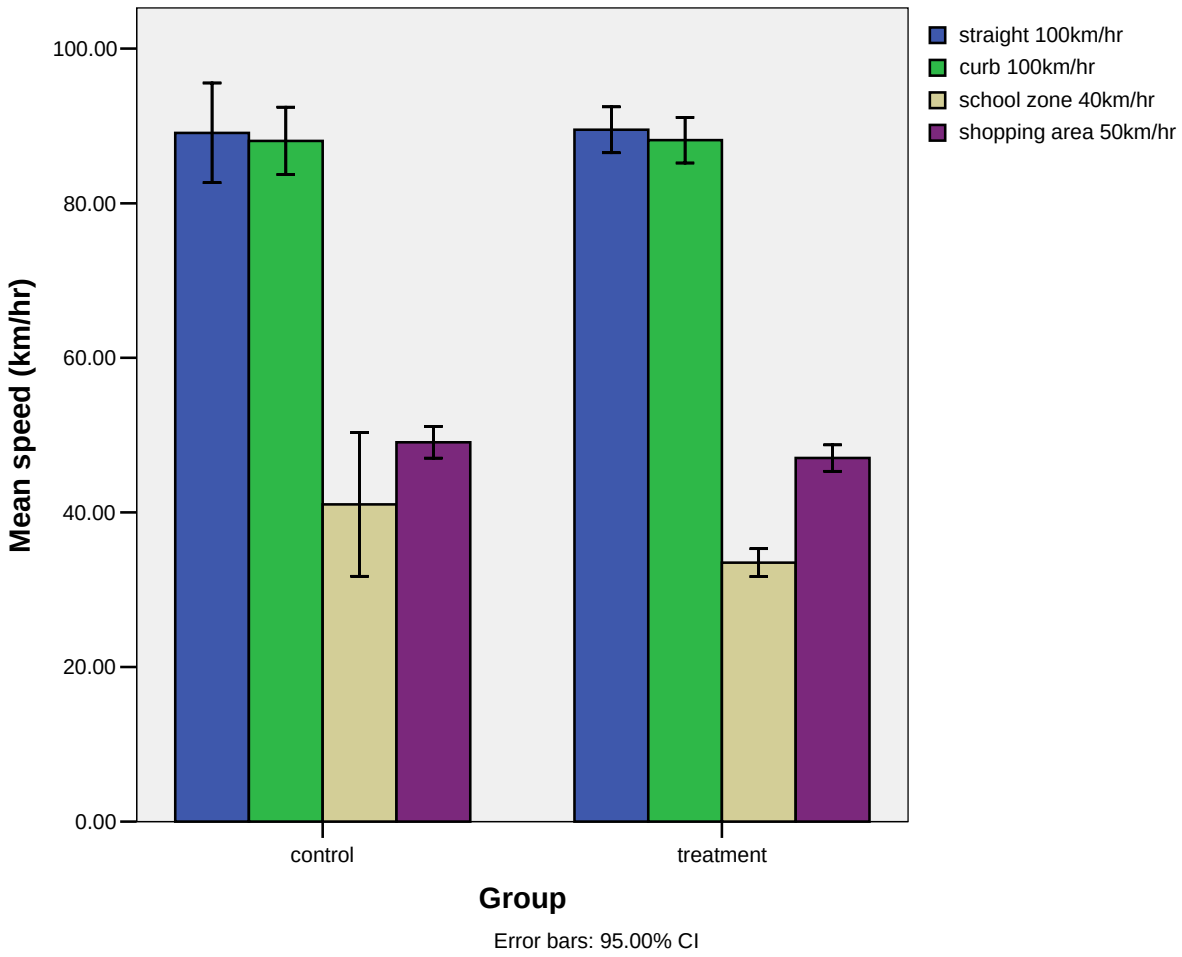


Figure 3.13: Mean speed (km/hr) in the 100km/hr straight section, the 100km/hr curve section, the 40km/hr school zone, and the 50km/hr shopping area, for the treatment and control groups separately, at Session 2.

Tailgating

For both immediate post-test and 2-month follow-up, treatment and control groups were compared in terms of speed and speed variability during the following task.

At the immediate post-test [see Figure 3.14], compared to the control group the treatment group demonstrated *nonsignificantly* slower mean speed ($F_{1,55}$=1.98, $p_{1\text{-tailed}}$ =0.083), and *nonsignificantly* lower maximum speed

($F_{1,55}$=0.44, $p_{1\text{-tailed}}$ =0.255). On average, speeds were faster than that of the lead vehicle.

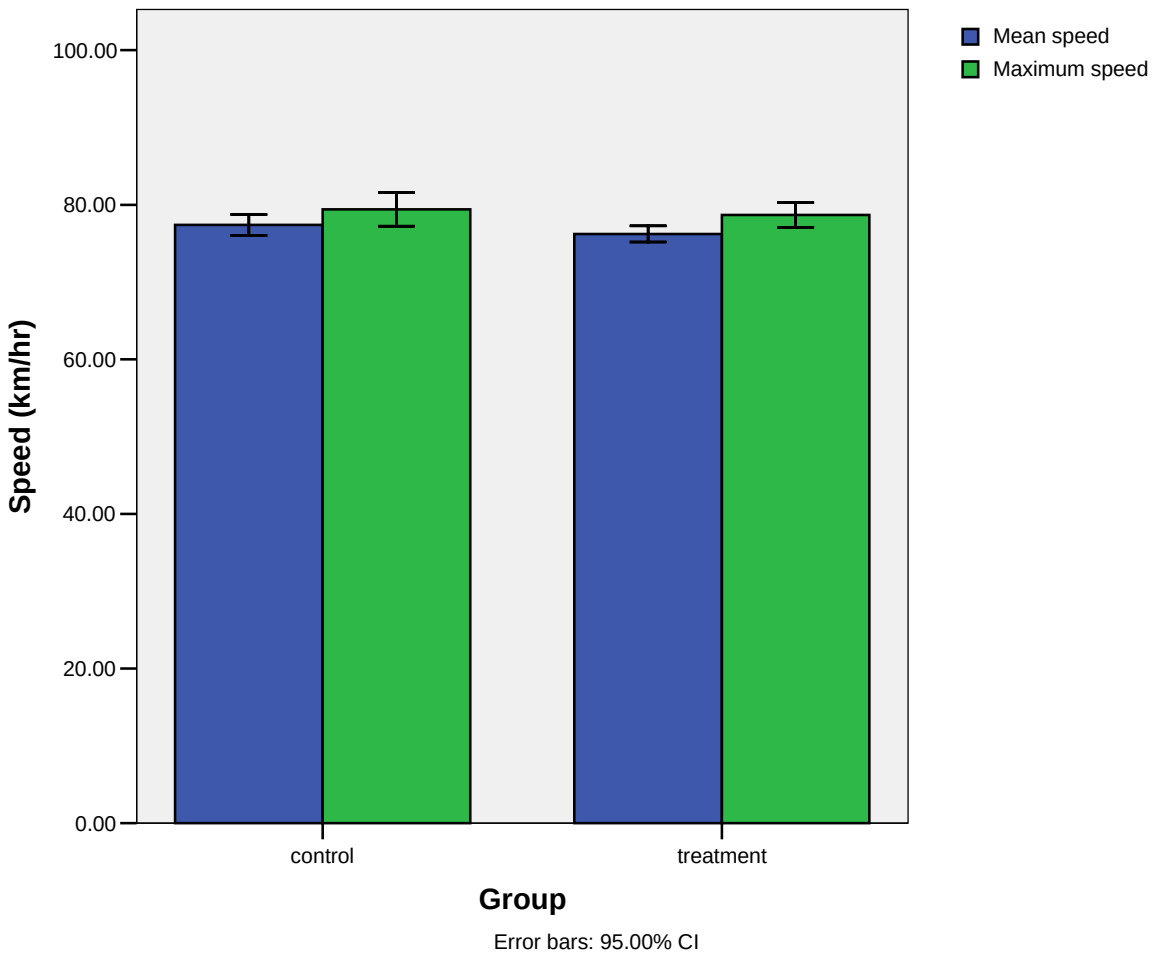


Figure 3.14: Mean speed (km/hr) and maximum speed while following the truck at average 70km/hr (Task 6.1), for the treatment and control groups separately, at Session 1.

At follow-up means were in the direction opposite to prediction and thus the group difference was not significant according to the 1-tailed test employed [see Figure 3.15]. On average, speeds were faster than that of the lead vehicle.

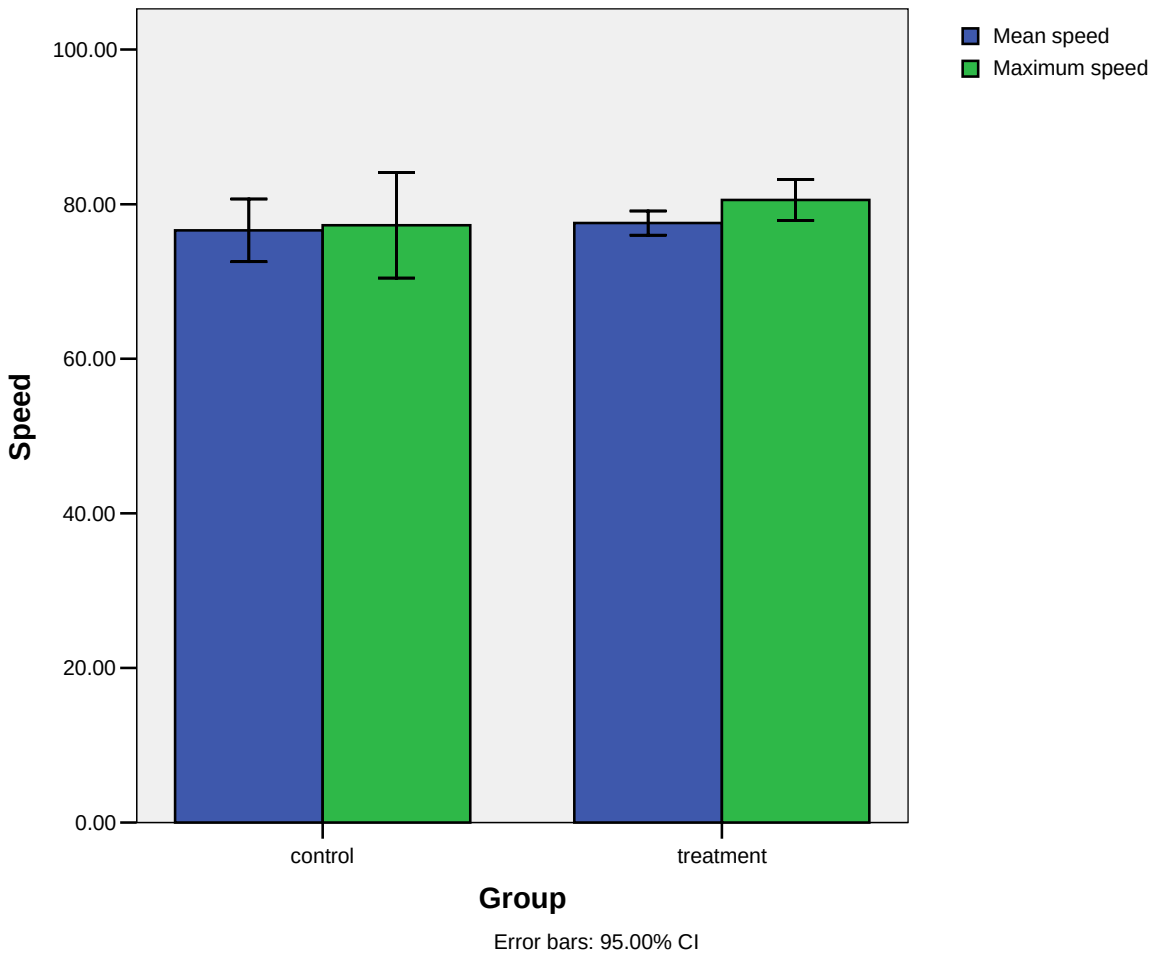


Figure 3.15: Mean speed (km/hr) and maximum speed while following the truck at average 70 km/hr (Task 6.1), for the treatment and control groups separately, at Session 2.

Infringements

For both immediate post-test and 2-month follow-up, treatment and control groups were compared in terms of infringements during the simulator drives.

At the immediate post-test [see Figure 3.16], compared to the control group, the treatment group completed *nonsignificantly* fewer drives that were marred by a speeding ticket ($F_{1,53}$=0.99, $p_{1\text{-tailed}}$ =0.163), or by a traffic light ticket ($F_{1,53}$=0.68, $p_{1\text{-tailed}}$ =0.207). The treatment group also received *nonsignificantly* fewer traffic light tickets across the four drives ($F_{1,53}$=0.65, $p_{1\text{-tailed}}$ =0.212).

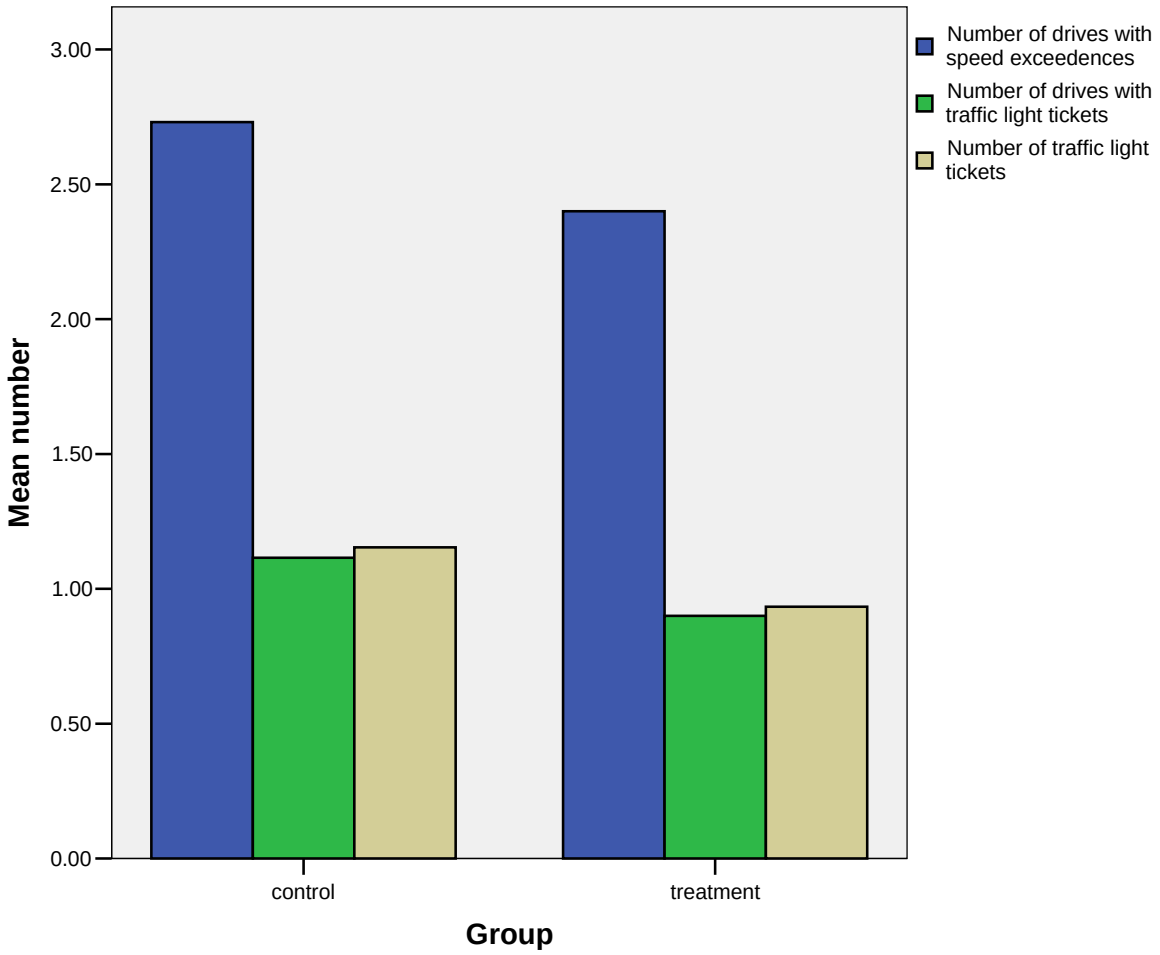


Figure 3.16: Number of drives with speed exceedences, number of drives with traffic tickets and total number of traffic tickets, for the treatment and control groups separately, at Session 1.

At follow-up [see Figure 3.17], there were no significant differences between the groups (all means in a direction opposite to prediction and thus nonsignificant according to the 1-tailed test employed).

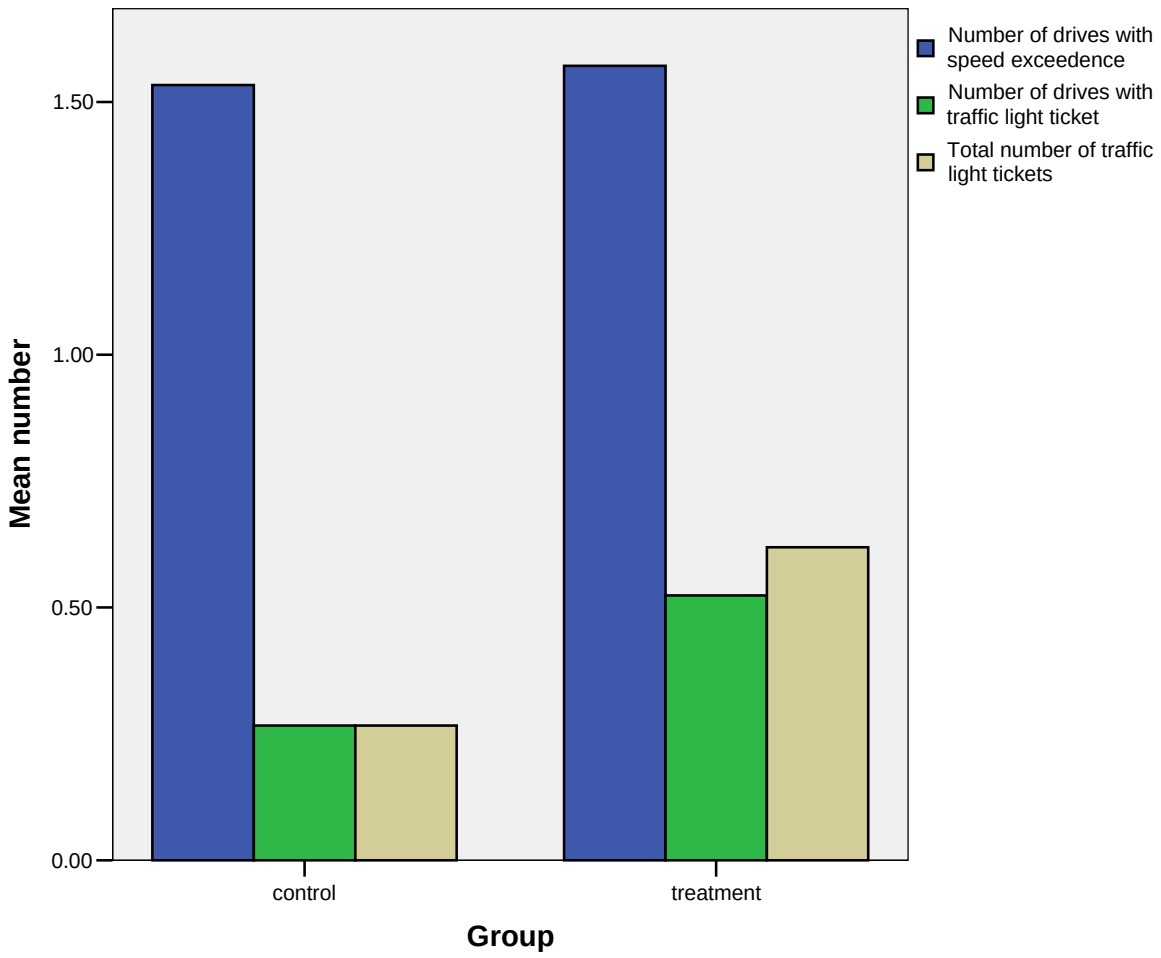


Figure 3.17: Number of drives with speed exceedences, number of drives with traffic tickets and total number of traffic tickets, for the treatment and control groups separately, at Session 2.

Experience of trauma on the simulator

For both immediate post-test and 2-month follow-up, treatment and control groups were compared in terms of crashes during the simulator drives.

At the immediate post-test [see Figure 3.18] and at follow-up [see Figure 3.19], the groups did not differ in terms of crash-likelihood (means in a direction opposite to prediction, and thus not significant according to the 1-tailed test employed). At the immediate post-test, 12 Participants in the control group had at least 1 crash, compared to 13 in the treatment group (one of whom had 8 crashes). At follow-up, 4 Participants in the control group had at

least 1 crash, compared to 7 in the treatment group (one of whom had 8 crashes).

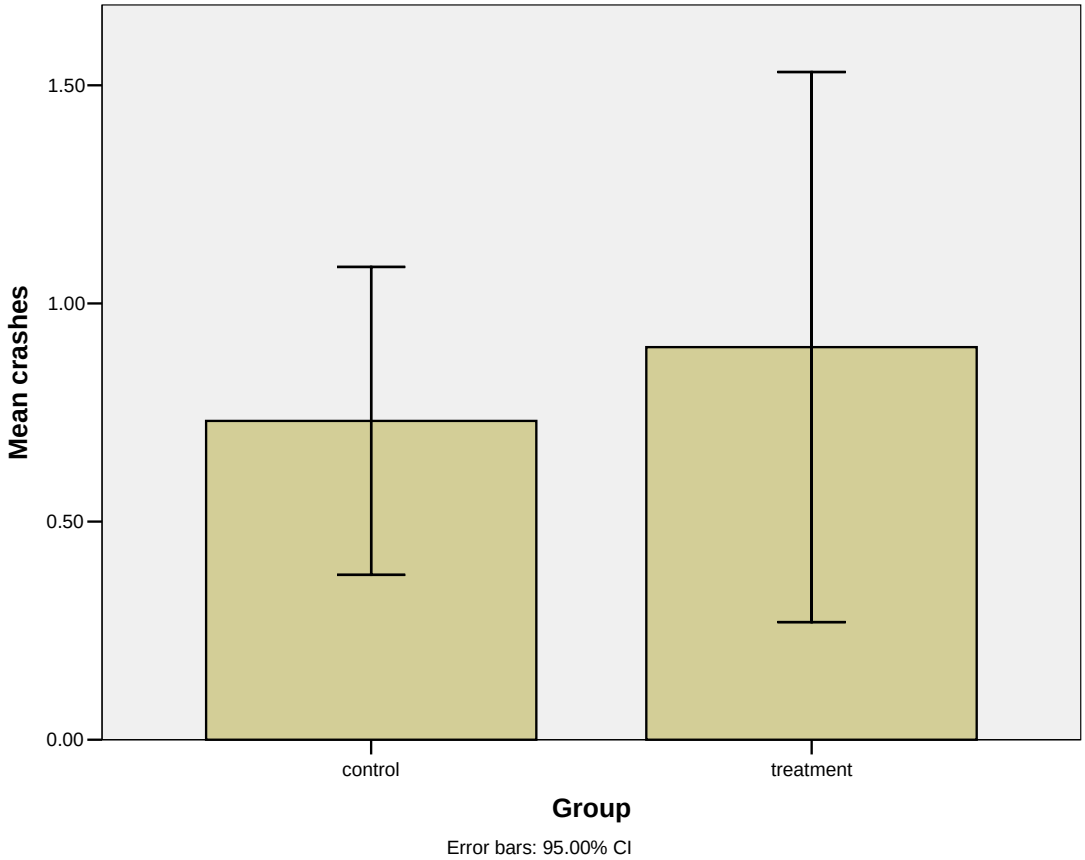


Figure 3.18: Total number of crashes, for the treatment and control groups separately, at Session 1.

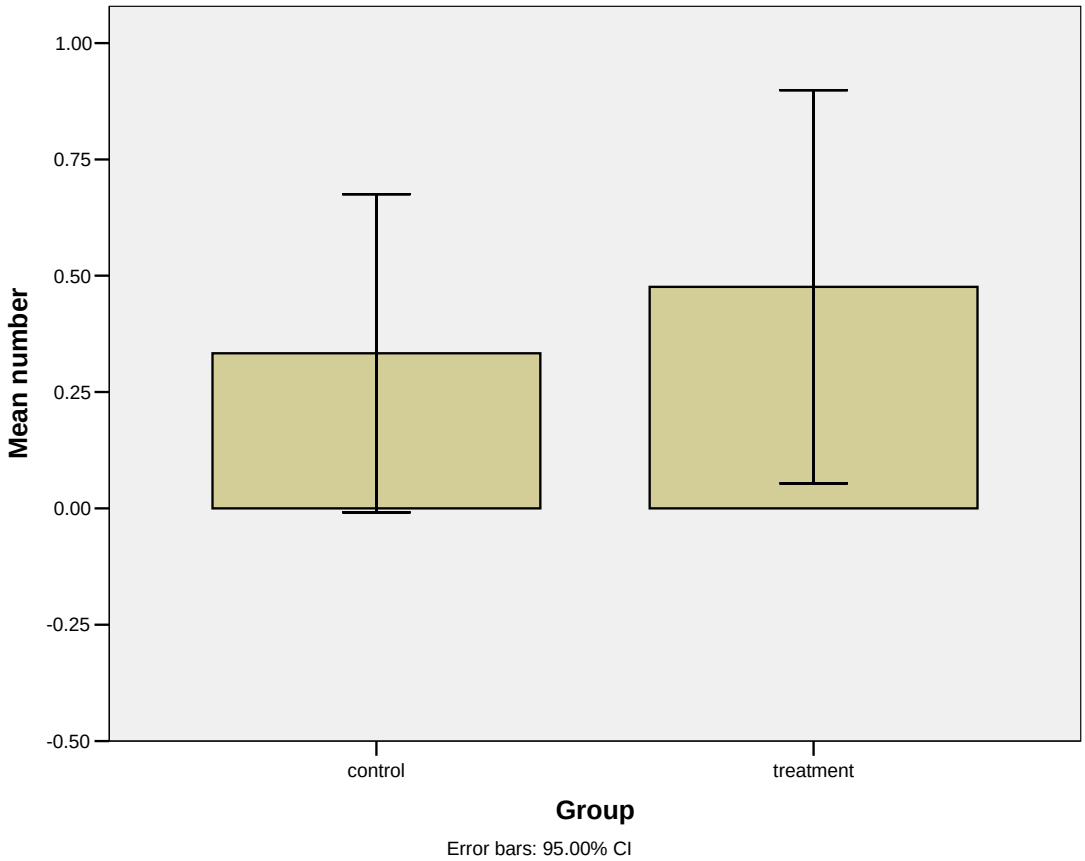


Figure 3.19: Total number of crashes, for the treatment and control groups separately, at Session 2.

The relationship of demographic variables, driving experience, and social desirability with illusory invulnerability regarding the past and future, on-road risky driving, and involvement in road (and other) trauma.

We assessed relationships of gender, age, average number of hours spent driving each week (as a driver and as a passenger), number of years licensed, and social desirability, with all dependent variables (with analyses selected appropriately for each combination of continuous and categorical variables). Significant relationships are presented in Table 3.4. All hypotheses were tested 2-tailed.

Table 3.4: Significant relationships between each dependent variable and personal characteristics, at Session 1 and Session 2 separately

Dependent variable	***Session 1***	***Session 2***
	Significantly related	***personal characteristics***
Road-related negative relative risk	SES Social Desirability score	-
Road-related positive relative risk	-	-
Road-unrelated negative relative risk	Language Social Desirability score	-
Road-unrelated positive relative risk	Years of licensure	Hours/week driving Car ownership
Crash as a driver at fault relative risk	Language	Social Desirability score
Crash as a driver not at fault relative risk	-	-
Crash as a passenger relative risk	Hours/week as a passenger	-
Road-related negative relative experience	Gender Years of licensure Hours/week as a passenger Social Desirability score	Gender Language Years of licensure Hours/week as a passenger
Road-related positive relative experience	Years of licensure	-
Road-unrelated negative relative experience	Hours/week as a driver Social Desirability score	Years of licensure Hours/week driving

Dependent variable	***Session 1***	***Session 2***
	Significantly related	***personal characteristics***
Road-unrelated positive relative experience	-	-
Crash as a driver at fault relative experience	Language	Gender Language Years of licensure Hours/week as a passenger
Crash as a driver not at fault relative experience	Gender	Gender Years of licensure Hours/week as a passenger
Crash as a passenger relative experience	Years of licensure	Gender Years of licensure Hours/week as a passenger
Simulator-related negative relative risk	Language Hours/week as a passenger	Age Years of licensure
Simulator-related positive relative risk	-	-
Self-reported risk taking	-	N/A
Self-reported crashing	N/A	Years of licensure Language Hours per week as a driver Car ownership
Simulator-related self-reported risk taking	-	-
Total traffic tickets on simulator	Car ownership	-
Total number of drives with speed exceedence	-	-

Dependent variable	***Session 1***	***Session 2***
	Significantly related	***personal characteristics***
Total number of drives with traffic ticket	Car ownership	-
Booked index	-	-
Total crashes on simulator	SES	-
Speed approaching hazard in Task 1	Hours/week driving	-
Speed approaching hazard in Task 2	Years of licensure	-
Speed approaching hazard in Task 3	Gender	-
Speed approaching hazard in Task 4	Gender	SES
Average speed approaching hazards	Gender	SES
Speed in Task 7 100km/hr straight section	Age Years of licensure Gender	SES Car ownership
Speed in Task 7 100km/hr curved section	Age	Car ownership
Speed in Task 7 40km/hr school zone	-	SES
Speed in Task 7 50km/hr shopping area	-	SES
Mean speed in Task 6.1	SES	-
Maximum speed in Task 6.1	Years	-

Covariate analyses

The previous analyses were repeated for dependent variables that evidenced significant relationships with personal characteristics [see Table 3.4]. For each

such continuous dependent variable the univariate linear model was tested, with group as a fixed factor, and the related personal characteristics as covariates. For the dichotomous self-reported crashing measure a binary logistic regression was employed.

With the covariates from Table 3.4, at immediate post-test the treatment group demonstrated significantly lower relative future risk scores than the control group for the road-unrelated negative index ($F_{3,53}$=4.06, $p_{1\text{-tailed}}$ =0.006), and lower relative experience scores than the control group for the road-related negative index ($F_{5,48}$=6.15, $p_{1\text{-tailed}}$ <0.001), the road-related positive index ($F_{2,52}$=2.55, $p_{1\text{-tailed}}$ =0.044), the road-unrelated negative index ($F_{3,51}$=7.17, $p_{1\text{-tailed}}$ < 0.001), the crash as a driver at fault index ($F_{3,54}$=3.99, $p_{1\text{-tailed}}$ =0.012), and the crash as a driver not at fault index ($F_{3,57}$=4.55, $p_{1\text{-tailed}}$ =0.008). The treatment group also demonstrated lower scores for the simulator-related negative relative risk index ($F_{3,52}$=8.46, $p_{1\text{-tailed}}$ <.001), total traffic light tickets on the simulator ($F_{2,52}$=2.67, $p_{1\text{-tailed}}$ =0.040) and total number of drives with traffic light tickets ($F_{2,52}$=3.39, $p_{1\text{-tailed}}$ =0.021). The treatment group drove significantly slower approaching hazards in Task 1 ($F_{2,53}$=3.41, $p_{1\text{-tailed}}$ =0.020), Task 2 ($F_{2,53}$=3.21, $p_{1\text{-tailed}}$ =0.024), Task 3 ($F_{2,55}$=2.44, $p_{1\text{-tailed}}$ =0.049), and Task 4 ($F_{2,52}$=2.65, $p_{1\text{-tailed}}$ =0.040). Naturally, this was reflected in the average speed approaching hazards ($F_{2,51}$=3.31, $p_{1\text{-tailed}}$ =0.023). The treatment group also drove significantly slower during the following task ($F_{2,54}$=5.61, $p_{1\text{-tailed}}$ =0.005). No further comparisons were significant.

At follow-up, the treatment group demonstrated significantly lower relative future risk scores than the control group for the crash as a driver at fault index ($F_{2,33}$=2.55, $p_{1\text{-tailed}}$ =0.047), and significantly lower relative experience scores than the control group for the road-related negative index ($F_{5,28}$=6.30, $p_{1\text{-tailed}}$ <.001), the road-unrelated negative index ($F_{3,30}$=3.57, $p_{1\text{-tailed}}$ =0.013), the crash as a driver not at fault index ($F_{4,29}$=13.59, $p_{1\text{-tailed}}$ <.001), and the crash as a passenger index ($F_{4,29}$=5.84, $p_{1\text{-tailed}}$ =.001). The treatment group also demonstrated lower scores for the simulator-related negative relative risk index ($F_{3,32}$=2.35, $p_{1\text{-tailed}}$ =0.046). The treatment group drove significantly

slower approaching hazards in Task 4 ($F_{2,28}$=3.80, $p_{1\text{-tailed}}$ =0.018) and across hazards ($F_{2,27}$=2.91, $p_{1\text{-tailed}}$ =0.036). No further comparisons were significant.

Discussion

Results, summarised in Table 3.5 suggest some positive impacts of the messages.

The intervention did not appear to reduce illusory invulnerability regarding the future. At the immediate post-test, means were in the direction opposite to prediction for all indices except the road-unrelated negative index (for which p>.05). With relevant personal characteristics statistically controlled, relative future likelihood estimates were significantly lower in the treatment than in the control group for the road-unrelated negative index. At follow-up, the relative future likelihood estimates were *nonsignificantly* lower in the treatment than in the control group for 5 of 7 indices (lowest p=0.125). However for the road-related negative index and the road-unrelated positive index means were in the direction opposite to prediction. With relevant personal characteristics statistically controlled, relative future likelihood estimates were significantly lower in the treatment than in the control group for the crash as a driver at fault index. The road-related indices are arguably the most likely to be impacted by the intervention.

Illusory invulnerability regarding the past appears to have been more successfully impacted by the intervention. At the immediate post-test the relative past experience estimates were *nonsignificantly* lower in the treatment than in the control group for 5 of 7 indices (lowest p=0.088; with the exceptions being the “crash as a passenger” and positive road-unrelated indices). With relevant personal characteristics statistically controlled, relative experience estimates were significantly lower in the treatment than in the control group for the road-related negative index, the road-related positive index, the road-unrelated negative index, the crash as a driver at fault index, and the crash as a driver not at fault index. At follow-up, for 4 of 7 indices relative past experience estimates were *nonsignificantly* lower in the treatment group (lowest p=0.114; with the exceptions being the “crash as a driver at fault” and the positive road-related and road-unrelated indices). With relevant personal characteristics statistically controlled, relative experience estimates

Table 3.5: Summary of comparisons between treatment (T) and control (C) groups in Study 3

Dependent variable	***Session 1***	***Session 1 (with covariate)***	***Session 2***	***Session 2 (with covariates)***
Road-related negative relative risk	Opposite to prediction	Opposite to prediction	Opposite to prediction	N/A
Road-related positive relative risk	Opposite to prediction	N/A	T nonsig. < C	N/A
Road-unrelated negative relative risk	T nonsig. < C	T < C*	T nonsig. < C	N/A
Road-unrelated positive relative risk	Opposite to prediction	Opposite to prediction	Opposite to prediction	Opposite to prediction ($p_{2\text{-tailed}}$ =0.034)
Crash as a driver at fault relative risk	Opposite to prediction	Opposite to prediction	T nonsig. < C	T < C*
Crash as a driver not at fault relative risk	Opposite to prediction	N/A	T nonsig. < C	N/A
Crash as a passenger relative risk	Opposite to prediction ($p_{2\text{-tailed}}$ =0.049)	Opposite to prediction ($p_{2\text{-tailed}}$ =0.003)	T nonsig. < C	N/A
Road-related negative relative experience	T nonsig. < C	T < C**	T nonsig. < C	T < C**

Dependent variable	**Session 1**	**Session 1 (with covariate)**	**Session 2**	**Session 2 (with covariates)**
Road-related positive relative experience	T nonsig. < C	T < C*	Opposite to prediction	N/A
Road-unrelated negative relative experience	T nonsig. < C	T < C**	T nonsig. < C	T < C*
Road-unrelated positive relative experience	Opposite to prediction ($p_{2\text{-tailed}}$ =0.016)	N/A	Opposite to prediction	N/A
Crash as a driver at fault relative experience	T nonsig. < C	T < C*	Opposite to prediction	Opposite to prediction ($p_{2\text{-tailed}}$ =0.002)
Crash as a driver not at fault relative experience	T nonsig. < C	T < C*	T nonsig. < C	T < C**
Crash as a passenger relative experience	Opposite to prediction	Opposite to prediction ($p_{2\text{-tailed}}$ = 0.030)	T nonsig. < C	T < C*
Simulator-related negative relative risk	T nonsig. < C	T < C**	T nonsig. < C	T < C*
Simulator-related positive relative risk	T nonsig. < C	N/A	T nonsig. < C	N/A
Self-reported risk taking	T nonsig. < C	N/A	N/A	N/A

Dependent variable	**Session 1**	**Session 1 (with covariate)**	**Session 2**	**Session 2 (with covariates)**
Simulator-related self-reported risk taking	T nonsig. < C	N/A	N/A	N/A
Speed approaching hazard in Task 1	T nonsig. < C	T < C*	Opposite to prediction	N/A
Speed approaching hazard in Task 2	T nonsig. < C	T < C*	T nonsig. < C	N/A
Speed approaching hazard in Task 3	T nonsig. < C	T < C*	T nonsig. < C	N/A
Speed approaching hazard in Task 4	T nonsig. < C	T < C*	T nonsig. < C	T < C*
Average speed approaching hazards	T nonsig. < C	T < C*	T nonsig. < C	T < C*
Speed in Task 7 100km/hr straight section	Opposite to prediction	Opposite to prediction ($p_{2\text{-tailed}} = 0.011$)	Opposite to prediction	Opposite to prediction
Speed in Task 7 100km/hr curved section	Opposite to prediction	Opposite to prediction ($p_{2\text{-tailed}} = 0.002$)	Opposite to prediction	Opposite to prediction ($p_{2\text{-tailed}} = 0.019$)
Speed in Task 7 40km/hr school zone	Opposite to prediction	N/A	T < C*	T nonsig. < C

Dependent variable	**Session 1**	**Session 1 (with covariate)**	**Session 2**	**Session 2 (with covariates)**
Speed in Task 7 50km/hr shopping area	Opposite to prediction	N/A	T nonsig. < C	T nonsig. < C
Mean speed in Task 6.1	T nonsig. < C	T < C*	Opposite to prediction	N/A
Maximum speed in Task 6.1	T nonsig. < C	Opposite to prediction	Opposite to prediction	N/A
Total traffic tickets on simulator	T nonsig. < C	T < C*	Opposite to prediction	N/A
Total number of drives with speed exceedence	T nonsig. < C	N/A	Opposite to prediction	N/A
Total number of drives with traffic ticket	T nonsig. < C	T < C*	Opposite to prediction	N/A
Booked index	T nonsig. < C	N/A	Opposite to prediction	N/A
Total crashes on simulator	Opposite to prediction	Opposite to prediction	Opposite to prediction	N/A

N/A= No potential covariates significantly associated with dependent variable, and so group comparison not repeated with covaria

were significantly lower in the treatment than in the control group for the road-related negative index, the road unrelated negative index, the crash as a driver not at fault index, and the crash as a passenger index.

At post-test, illusory invulnerability regarding performance on the simulator was *nonsignificantly* lower in the treatment group for negative outcomes (p=0.107) and positive outcomes. The same pattern was observed at follow-up. With relevant personal characteristics statistically controlled, the difference for the negative index became significant for both sessions.

Illusory invulnerability regarding the future and the past was evident in the sample. Measured in the control group only (to avoid the impacts of the intervention), at post-test, relative future likelihood estimates were significantly greater than zero for the road-related positive and negative indices, the “crash as a driver at fault” index, and the road-unrelated positive and negative indices. Estimates for the “crash as a driver not at fault” and the “crash as a passenger” indices were *nonsignificantly* greater than zero. At follow-up the road-unrelated indices became *nonsignificantly* greater than zero. At post-test, relative past experience estimates were significantly greater than zero for five of seven indices, and *nonsignificantly* greater than zero for the positive road related index, though less than zero (and thus nonsignificant) for the positive road-unrelated index. At follow-up, relative experience estimates were less than zero for the positive road-related index, significantly greater than zero for “crash as a driver at fault” and “crash as a passenger” and *nonsignificantly* greater than zero for all remaining indices. Relative estimates regarding the likelihood of experiencing negative outcomes while driving the simulator were significantly greater than zero at both post-test and follow-up (although less than zero for positive outcomes at both sessions).

There is some suggestion of a positive effect of the intervention on risky driving.

1. When driving in the simulator, the treatment group approached hazards *nonsignificantly* slower than the control group for Task 2, 3, and 4, at both immediate post-test, and at follow-up. Task 1 demonstrated the same pattern at immediate post-test only. With relevant personal characteristics statistically controlled, effects became significant for all tasks at immediate post-test, and for Task 4 at follow-up.
2. At follow-up, the treatment group drove significantly slower than the control group in the 40km/hr zone (33.5km/hr vs. 41.0km/hr) and *nonsignificantly* slower in the 50km/hr zone (47.0 vs. 49.0 km/hr; p=0.080) at follow-up.
3. The treatment demonstrated *nonsignificantly* lower mean speed and maximum speed than the control group during the following task at immediate post-test (but not at follow up). When relevant personal characteristics were statistically controlled the effect was significant for mean speed.
4. At immediate post-test, the treatment group also had *nonsignificantly* fewer drives that were marred by a speeding ticket, or a red light ticket, and *nonsignificantly* fewer red light tickets. With relevant personal characteristics controlled the effects relating to red light tickets became significant.

Compared to the control group, the treatment group demonstrated *non-significantly* lower self-reported intention of engaging in risky driving on the roads and in the simulator (both at immediate post-test).

Aside from their practical significance, these results support earlier experimental support for the claim that illusory invulnerability influences risk-taking (Klein, 1997). An intervention that was designed to reduce illusory invulnerability, and that appeared to have some success in the context of past-related illusory invulnerability, also appeared to reduce risky simulated driving.

There was no effect of the intervention on crashes in the simulator, which were fairly infrequent.

It must be recognised that several effects in the direction opposite to prediction would have been significant had a 2-tailed test been employed. At immediate post-test these effects were observed for: the crash as a passenger relative future risk index and the road-unrelated positive relative experience indices without covariates, and crash as a passenger relative future risk index, the crash as a passenger relative experience indices, speed in the 100km/hr straight zone, speed in the 100km/hr curved zone with covariates. At follow-up, the effects in the direction opposite to prediction that would have been significant had a 2-tailed test been employed were for: the road-unrelated positive relative future risk index, the crash as a driver at fault relative experience index, and speed in the 100km/hr curved zone with covariates only. Arguably, in the context of an intervention designed to reduce road-related illusory invulnerability (and its sequelae) amongst young drivers the most concerning of these are the crash as a driver at fault relative experience index and the speed measures. The undesirable effects that would have been significant had 2-tailed tests been employed were far outnumbered by the observed significant beneficial effects.

Again, an important shortcoming of the present study is the use of a tertiary student sample, which may not be representative of the target population. In Study 5 refined messages will be evaluated in a general population sample.

In summary, the messages appear to provide a promising basis for an intervention, that may be further refined via integration with the active error training technique that was investigated in Study 4.

Chapter 4: Study 4- - Evaluation of active error training in a tertiary student sample

Design

Study 4 represents an experimental evaluation of the effectiveness of active error experience in reducing road-related illusory invulnerability, risky driving and road-trauma involvement. Prior to completing test drives similar to those employed in Studies 2 and 3, Participants completed a “training” drive. “Active error” Participants were exposed to hazards, and given feedback regarding their errors, whereas the “minimised error” group were exposed to fewer hazards and given no feedback regarding errors.

Methods

Participants and sampling

32 University of Sydney First Year Psychology students (50% female, mean age=19.56 years) volunteered to participate via the School of Psychology “Experimetrix” on-line-system. The sign-up information identified the experiment as being about “driving” and involving driving on a simulator and completing questionnaires on “driving attitudes and experience”. Volunteers were explicitly limited to licensed drivers between 18 and 24 years of age. Participants received course credit. Male and female Participants (separately) were randomly allocated to the “active error” or “minimised error” group.

Materials and apparatus

Participant Information Statement and Consent Form

A Participant Information Statement (PIS) [see Appendix I] described the study as an investigation of “risk taking while driving” in which error training would be

compared to other types of intervention such as verbal persuasion. Participants were told that they would be asked to complete questionnaires, followed by driving on the simulator. The PIS instructed Participants to drive “as you would a normal car” when “you need to get to work on time” while following “normal road rules” (with examples of not overtaking on double lines, stopping at red traffic lights, and adhering to posted speed limits). Participants were told that they should stop driving if they began to experience simulator sickness. Finally, Participants were informed that the study would take approximately 1.5 hours, and assured of confidentiality and the right to withdraw. A form was provided for formal consent to these procedures [see Appendix J].

Future-related Illusory Invulnerability Questionnaires

This questionnaire was identical to that employed in Study 2 [see Appendix C], with the exception that for Study 4 (as for Study 3) the order of making self versus average peer ratings was counterbalanced to minimise fatigue effects.

Demographic and Control Variables Questionnaire

Again, this questionnaire was identical to that employed in Study 2 [see Appendix C].

STISIM Driving simulator, and drives

Study 4 again employed the University of Sydney driving simulator.

A practice drive was designed to give Participants practise in accelerating, braking, handling a right turn and changing lanes. It had a mean duration of 2.62 minutes (s.d. = 0.46 mins).

Participants completed four training drives involving 6 training tasks (Drive 1: Task 3; Drive 2: Tasks 5 and 4; Drive 3: Task 6; Drive 4 Tasks 2 and 1). They

then completed six drives involving nine test tasks (Drive 1: Tasks 1, 2, and 3; Drive 2: Tasks 4 and 5; Drive 3: Task 6; No Drive 4; Drive 5; Transfer task 1; Drive 6: Transfer task 2; Drive 7: Transfer task 3). Six of the test tasks were similar to the 6 training tasks, requiring the same strategy to negotiate an obstacle, but with different surface features (eg. lane blocked by cones instead of a parked car). The final 3 test tasks were designed to test adaptive transfer- that is the extent to which the "error training" impacted tasks which were quite different from the training tasks. All tasks were based on those used by Ivancic and Hesketh (2000) and are summarised in Table 4.1.

Table 4.1: Driving tasks included in the training and test drives employed in Study 4

Task	***Training***	***Test***	***Strategy description***
1	Left lane is blocked by a double parked car. Police and pedestrians are standing nearby. There are oncoming cars in the other lane; the first set fast, and the second set slower.	Same as training except left lane is blocked by cones.	Allow (fast) oncoming cars to pass before overtaking obstacle blocking road
2	Approaching traffic lights at intersection which turn amber	Same as training except the scenery is changed	Slow down, stop if lights are red
3	Road sign with curved arrow, road curves sharply to left, cars come suddenly from right at intersection.	Same as training except road curves sharply to right.	Slow down when approaching sharp bend where view is occluded

Task	***Training***	***Test***	***Strategy description***
4	Left lane is blocked by a double parked car. Police and pedestrians are standing nearby. Vehicles appear in rear mirror coming up from behind at rapid speed; the first set fast, and the second set slower.	Same as training except left lane is blocked by cones.	Check rear mirror, allow (fast) oncoming cars to pass before overtaking obstacle blocking road
5	Right turn across oncoming traffic at lights to test gap acceptance	Same as training except the scenery is changed	Leave a safe gap between oncoming cars before turning right
6a and 6b	Driving speed on 2 different speed zones: 1. school, speed limit=40 km/hr 2. shopping area/village, speed limit=50 km/hr	Driving speed on 2 different speed zones: 1. university grounds, speed limit = 40km/hr 2. kangaroo area, speed limit = 50 km/hr	Stay within the speed limits
Transfer 1		Approaching school, a stationary bus is blocking left lane. Behind the bus, there are school children crossing	Drive slowly in school zone, esp. when view is occluded
Transfer 2		A car ahead is travelling slowly at 50km/hr, and there are double centrelines.	Do not tailgate or overtake when there are double centrelines

Task	***Training***	***Test***	***Strategy description***
Transfer 3		Driving on a 4 lane road, 2 lanes in each direction. Cars in the other lane and behind driver are all travelling above speed limit, so there is pressure to keep up with traffic. There is a sharp hill. As driver comes over hill, an obstruction in the driver's lane suddenly appears.	Slow down when approaching sharp hill where view is occluded

Thus, each training-test pair of tasks in Study 4 roughly comprised the two versions of each Study 2 task[7].

Training drives differed for the "active error" and "mimimised error" groups. "Active error" Participants were given immediate feedback if they exceeded the speed limit or drove through a red light (in the form of a police siren), or crashed (in the form of crash sounds and a broken windscreen). For "minimised error" Participants no error feedback was given. Further, for "minimised error" Participants risky elements were removed from each task to eliminate the possibility of errors. Specifically, in Task 1 and 4 there are no oncoming cars until the driver overtakes the obstacle, in Task 3 there are no cars approaching from the right at the intersection, and in Task 5 there are fewer cars approaching, and travelling at slower speeds (rather than accelerating when they approach the intersection).

[7] The main differences were that in Study 2 Task 5.2 involved turning left across pedestrians, rather than right across traffic, whereas in Study 4 both the training and test tasks involve turning right across traffic (albeit in different surrounds). Further, the tasks involving a double-parked car in Study 4 involved only pedestrians crossing the road in Study 2. Rather than including a second 40km/hr and 50km/hr zones (as in Study 4) Study 2 included some 100km/hr zones.

For each test task, summary data was collected on total number of off-road and on-road crashes, pedestrians hit, speeding tickets, and traffic light tickets. Speed, lateral position, crashes, elapsed time and total distance travelled was collected every metre (for Tasks 1, 4, 5, 7, 8, 9) or every 10 metres (for Tasks 2, 3, 6) depending on the precision in data collection required. In addition, data about other vehicles on the road (for Tasks 1, 4, 5, 8, 9) and traffic light position (for Tasks 2, 4) were collected to assist with analyses. Data collection usually began 300 m before the hazard (the distance at which the hazard first appears on the horizon), and stopped 20 m beyond the hazard. The exceptions were Task 6 (speed zone), for which data was collected for 300m in the middle of each speed zone, and Task 8 (overtaking), for which data was collected at 2000m.

Training Summary Form

Two versions of the Training Summary Form were employed to give feedback to the “active error” and “minimised error” groups [see Appendix K and Appendix L, respectively]. For the active error group, the form listed “common mistakes people make”, and noted any errors in driving performance drive by drive, task by task. For the minimised error group strengths of driving performance were identified. For example, minimised error group Participants were told that they

- Followed the road rules
- Followed the road signs
- Kept within your lanes
- Drove at a good speed
- Didn’t have or had few red light violations
- Didn’t have or had few collisions.

Test Summary Form

A form similar to the Training Summary Form was also provided to Participants after they completed their test drives [see Appendix M].

Procedure

All Participants were tested individually. They read the PIS and signed the consent form before completing the questionnaires.

They were then introduced to the simulator and instructed to drive as they normally would to get to work on time obeying road rules. Participants completed the practice drive, before entering the “training stage”. Each participant completed 4 training drives (involving 6 training tasks; drive order counterbalanced). “Active error” Participants completed tasks that included hazards and error-feedback, whereas “minimised error” Participants completed tasks with minimal hazards and no feedback.

After the “training stage”, the experimenter talked to “active error” Participants about their own errors as well as the common mistakes that Participants make (speeding, red light violations, accidents). The experimenter talked to “minimised error” Participants about their driving performance in a neutral and non-specific manner, telling them that they followed the road rules and signs, kept inside their lanes, and drove at a “good” speed. Participants then completed the illusory invulnerability questionnaires again.

Participants then completed six test drives involving nine test tasks. Drives 1-3 were completed (order counterbalanced) before a break, and then Drives 5-7 (order counterbalanced). Participants then completed the illusory invulnerability questionnaires for a last time. Participants were then debriefed [see Appendix N]. The experimental session lasted approximately 1.25 hours.

Variable computation and statistical analysis

Data were analysed with SPSS (Statistical Package for the Social Sciences). The Type I error rate for all analyses was set at .05. Significant p values are marked with asterisks in all tables (* p<.05; ** p<.001).

The negative and positive road-related relative likelihood indices were computed as in Study 2. A 2x(3) ANOVA (between groups: active error vs. minimised error training; and within-Participants, repeated-measures: before training, after training, vs. after test) was conducted to test the interactions of training group with the comparison of relative risk estimates before and after training (t1 vs. t2) and before and after test (t2 vs. t3), respectively.

Computation of simulator variables is comparable to Study 3, with the main difference that there was only one version of each task. Again, the “active error” group was compared to the “mimimised error” group employing one-way ANOVAs for continuous variables (e.g. mean speed approaching each hazard) and chi-squared analysis for categorical variables (e.g. “errors” in relation to each hazard). “Active error” Participants were expected to demonstrate improvements relative to “minimised error” Participants in terms of risk perception, risky driving, and trauma-involvement. Thus, relevant tests were conducted 1-tailed.

Results

Sample characteristics

Descriptive statistics describing the sample characteristics are presented in Table 4.2.

Table 4.2: Characteristics of "active error" and "minimised error" groups in Study 4.

	"Active error" group	***Minimised error group***
Gender	50% female	50% female
Age	19.56 years (s.d. = 1.03)	19.56 (s.d. = 1.55)
Years of licensure	3.26 years (s.d. = 0.87)	3.14 years (s.d. = 1.08)
Hrs/week driving as driver	9.41 hours (s.d. = 7.68)	9.55 hours (s.d. = 6.48)
Hrs/week driving as passenger	4.06 hours (s.d. = 4.91)	3.95 hours (s.d. = 3.60)
Permanent access to car	94%	94%
Crash history	56% at least one mean= 1.19, mode= 0, range: 0 - 4	50% at least one mean= 0.56, mode= 0, range: 0 - 2

The groups did not differ significantly in terms of any of these personal characteristics (lowest nonsignificant p=0.717).

Analysis to characterise training and test drives

Table 4.3 shows average run time for each training and test drive in each group.

Table 4.3: Drive total run times (s.d.)(seconds) for treatment and control group Participants, at Sessions 1 and 2.

	"Active error" group	***Minimised error group***
Training		
Drive 1 total run time	93.20 (11.08)	90.04 (12.91)
Drive 2 total run time	171.02 (27.42)	169.62 (30.96)
Drive 3 total run time	232.92 (27.49)	218.05 (15.37)
Drive 4 total run time	170.48 (29.91)	163.88 (37.63)
Mean Training	497.14 (56.03)	477.72 (48.41)
Test		
Drive 1 total run time	295.40 (58.51)	269.71 (32.72)
Drive 2 total run time	173.94 (15.29)	160.74 (14.90)
Drive 3 total run time	239.29 (26.45)	216.36 (16.36)
Mean Test	708.63 (77.20)	646.80 (42.27)
Transfer		
Drive 5 total run time	81.56 (15.78)	73.38 (7.20)
Drive 6 total run time	154.55 (6.71)	152.34 (9.41)
Drive 7 total run time	128.26 (12.95)	119.26 (9.69)
Mean Transfer	364.36 (28.23)	344.98 (16.22)

The "active error" group did not differ significantly from the "minimised error" group in terms of total training drive time ($F_{1,30} = 1.10$, $p_{2\text{-tailed}} = 0.302$), but did take longer to complete the test drives ($F_{1,30} = 7.90$, $p_{2\text{-tailed}} = 0.009$) and transfer drives ($F_{1,30} = 5.67$, $p_{2\text{-tailed}} = 0.024$).

Table 4.4 summarises the number of Participants in the "active error" group who committed an error in each training task by type of error.

Table 4.4: Number of Participants in the "active error" group who committed an error in each training task by type of error in Study 4.

	Type of error		
Task	*Speeding at least once*	*Red light*	*Collision*
1	7	n/a	0
2	7	16	n/a
3	4	n/a	1
4	5	n/a	14
5	0	0	4
6a	15	n/a	n/a
6b	16	n/a	n/a

Thus, there were sufficient errors in relation to each task to provide the "active error" group with substantial error feedback.

Analysis of questionnaire-based variables: Illusory Invulnerability

Figure 4.1 shows mean relative risk estimates for the road-related negative index before training (T1), after training (T2) and after test (T3) for the “active error” and “minimised error” groups.

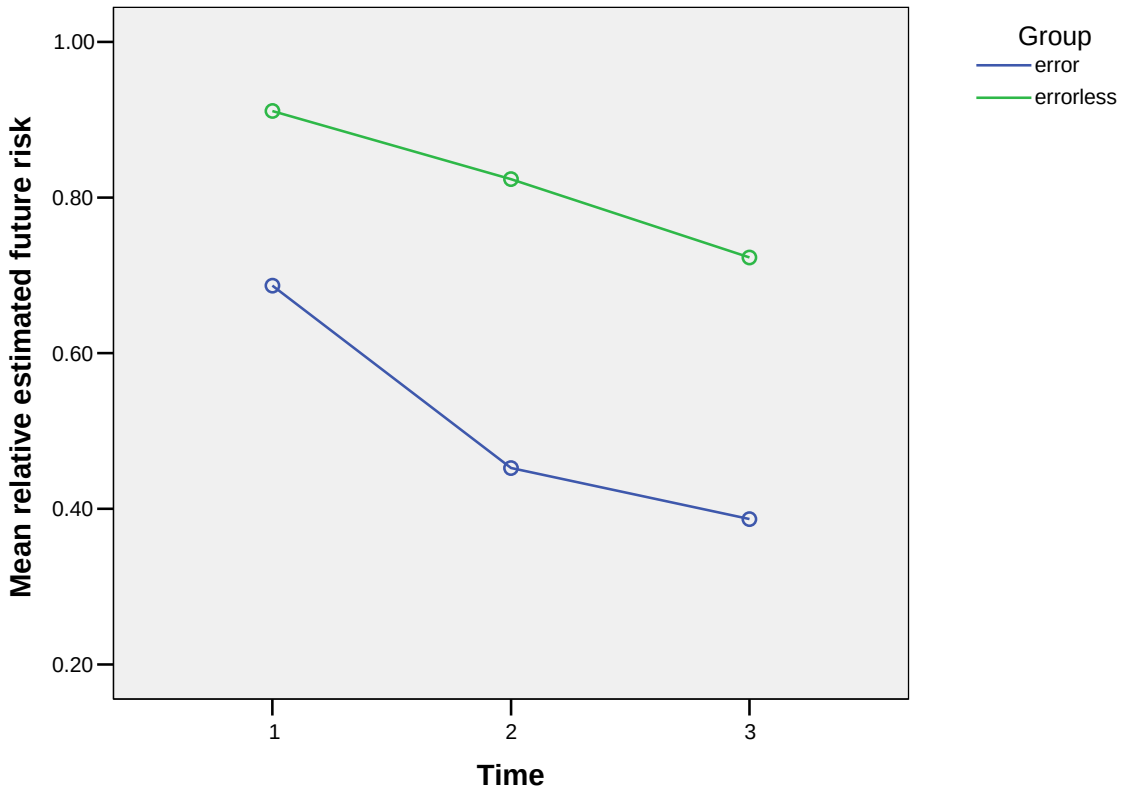


Figure 4.1: Mean relative risk estimates (road-related negative events index) at pre-training (T1), and post-training (T2) and post-test (T3) for the “active error” and “minimised error” groups

Contrary to predictions, the interaction of training group with the comparison of relative risk before and after training was non-significant ($F_{1,30}$ = 0.91, $p_{2\text{-tailed}}$ = 0.348), suggesting that the drop in OB from before to after training ($F_{1,30}$ = 4.36,

$p_{2\text{-tailed}}$ = 0.045) was no different between the “active error” group and the “minimised error” group [see Figure 4.1]. The interaction of training group with the comparison of relative risk before and after test was also not significant ($F_{1,30}$= 0.07, $p_{2\text{-tailed}}$ = 0.793), and there was no significant reduction in relative risk estimates from before to after test ($F_{1,30}$ = 1.57, $p_{2\text{-tailed}}$ = 0.219). The groups did not differ significantly in terms of relative risk estimates ($F_{1,30}$ = 2.43, $p_{2\text{-tailed}}$ = 0.129).

Illusory invulnerability was assessed across all Participants before and immediately after training by comparing the relative indices to the score representing no difference between self and peers (0) using a 1-tailed single sample t-test. Illusory invulnerability was present in the sample (T1: t_{31} = 6.85, $p_{1\text{-tailed}}$ < 0.001; T2: t_{31} = 6.12, $p_{1\text{-tailed}}$ < 0.001).

Figure 4.2 shows mean relative risk estimates for the road-related positive index before training (T1), after training (T2) and after test (T3) for the “active error” and “minimised error” groups.

Again contrary to predictions, the interaction of training group with the comparison of relative risk before and after training was non-significant ($F_{1,30}$ = 0.10, $p_{2\text{-tailed}}$ = 0.750), and there was no significant reduction in relative risk estimates from before to after training ($F_{1,30}$ = 0.50, $p_{2\text{-tailed}}$ = 0.485). The interaction of training group with the comparison of relative risk before and after test was also not significant ($F_{1,30}$= 0.13, $p_{2\text{-tailed}}$ = 0.723), and there was no significant reduction in relative risk estimates from before to after test ($F_{1,30}$ = 0.41, $p_{2\text{-tailed}}$ = 0.525).

Illusory invulnerability was present in the sample at T1 (t_{31} = 3.61, $p_{1\text{-tailed}}$ = 0.001) and at T2 (t_{31} = 2.71, $p_{1\text{-tailed}}$ = 0.006).

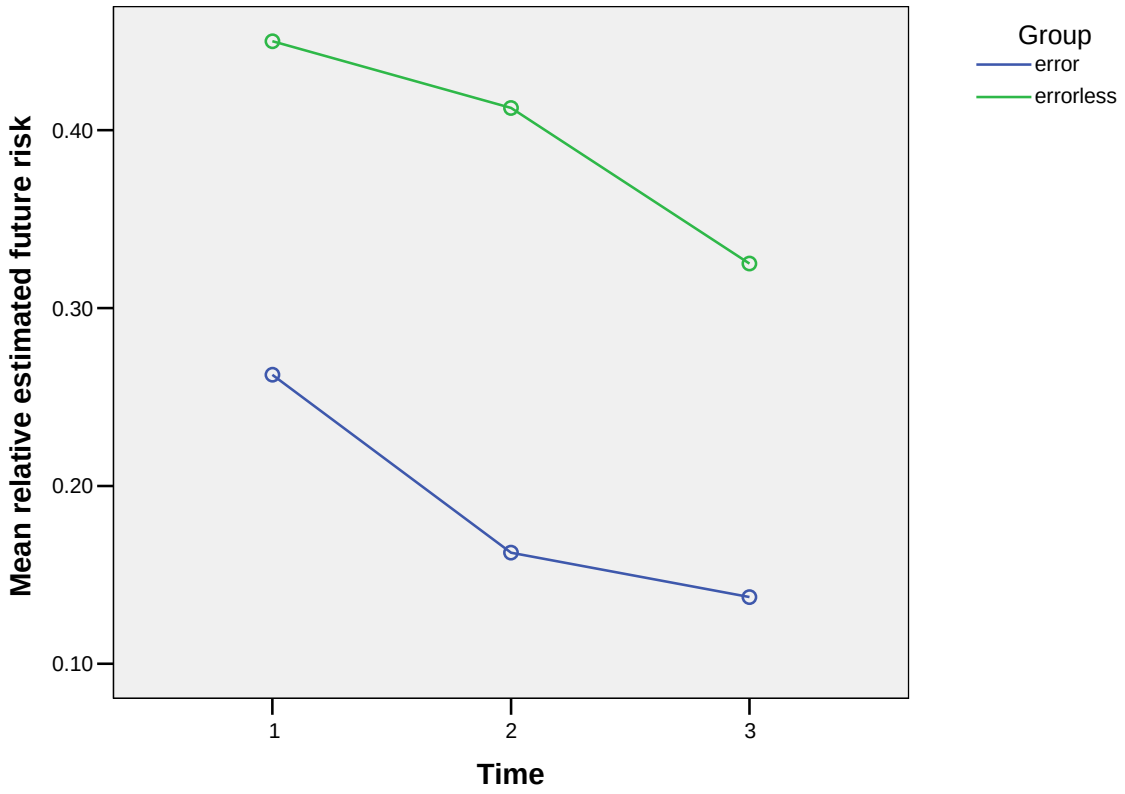


Figure 4.2: Mean relative risk estimates (road-related positive events index) at pre-training (T1), and post-training (T2) and post-test (T3) for the "active error" and "minimised error" groups

Analysis of simulator-related variables

Task 1: Left lane is blocked by cones. There are oncoming cars in the other lane. Driver should allow oncoming cars to pass before overtaking cones.

Speed

A one-way between groups ANOVA compared the average speeds for the two groups 300 to 0m before the obstacle [see Figure 4.3]. The "active error" group

drove *nonsignificantly* more slowly than the "minimised error" group when approaching the obstacle ($F_{1,30}$= 1.19, $p_{1\text{-tailed}}$ = 0.142).

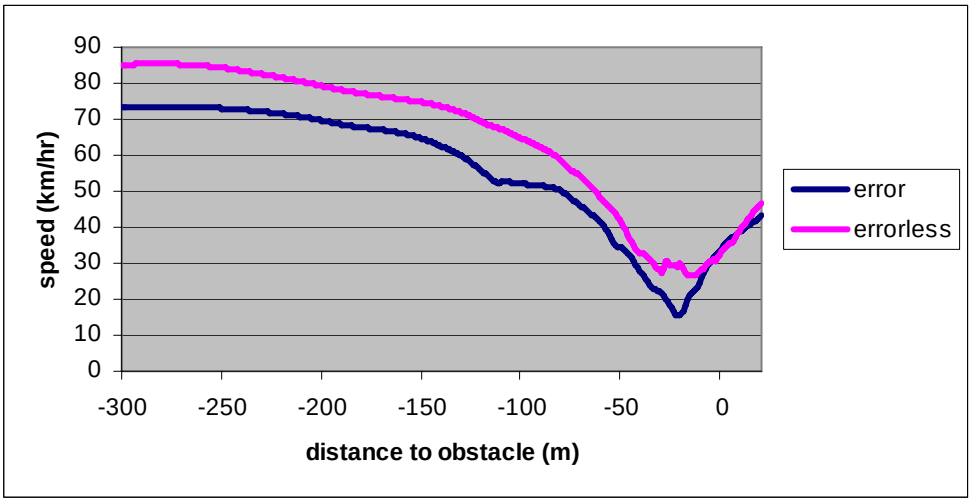


Figure 4.3: Speed for 300m approaching cones in test task 1, in Study 4

Crashes

There were 2 crashes in the "active error" group and 5 in the "minimised error" group, but this difference was not statistically significant (X^2 (1, N = 31) = 1.42, $p_{1\text{-tailed}}$ = 0.12). In each group, one of the crashes involved the driver smashing through the barrier (with the remainder colliding with it while overtaking), and these drivers were excluded from the analysis of overtaking.

Overtaking an obstacle facing oncoming cars

Safety in overtaking was assessed in two ways. The first related to whether the driver waited for the first set of faster oncoming cars to pass before overtaking the obstacle (with later cars approaching at a slower speed). In both the "active error" and "minimised error" groups, 12 Participants waited until after the faster cars had passed (and 2 waited until *all* cars had passed). The second approach was based on the average time between when drivers stopped before the obstacle and when the overtaking manoeuvre was made. There was no significant difference between groups (means in the direction opposite to

prediction and thus not significant according to the 1-tailed test employed; “active error” group: M=8.57, s.d.=10.87; “minimised error” group M=13.13, s.d.=22.53).

Task 2: approaching traffic lights at intersection which turn amber 5 secs before lights. Driver should slow down, stop if lights are red.

Speed

A one-way between groups ANOVA compared the average speeds for the two groups 300 to 0m before the obstacle [see Figure 4.4]. The “active error” group drove *nonsignificantly* more slowly when approaching traffic lights than the “minimised error” group ($F_{1,30}$= 1.14, $p_{1\text{-tailed}}$ = 0.147).

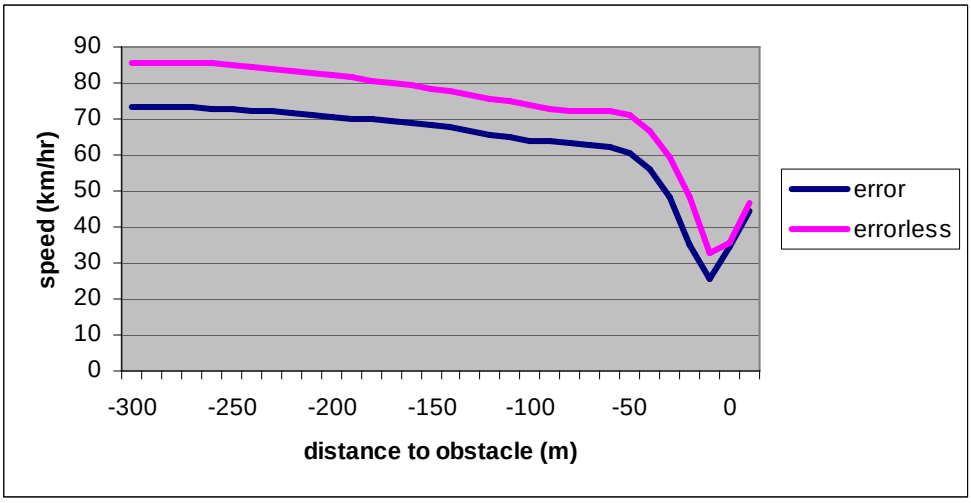


Figure 4.4: Speed for 300m approaching traffic lights in test task 2, in Study 4

Red light violations

In the “active error” group 3 Participants received a ticket for running the red light, compared to 7 in the “minimised error” group. This difference was not statistically significant (X^2 (1, N = 32) = 2.33, $p_{1\text{-tailed}}$ = 0.07).

Task 3: Road sign with curved arrow, road curves sharply to right, cars come suddenly from right at intersection. Driver should slow down when approaching sharp bend where view is occluded.

Speed

A one-way between groups ANOVA compared the average speeds for the two groups 300 to 0m before the obstacle [see Figure 4.5]. No difference was observed between the "active error" and the "minimised error" group (means in a direction opposite to prediction and thus non-significant according to the 1-tailed test employed).

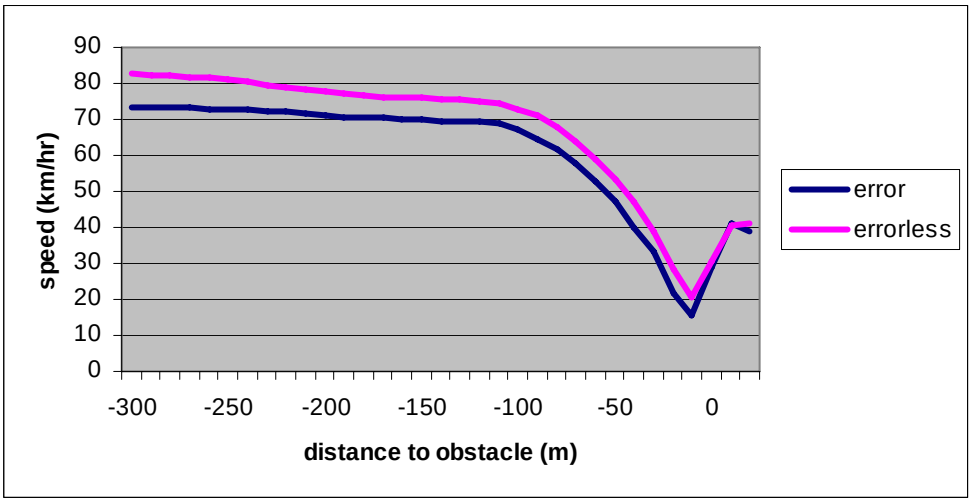


Figure 4.5: Speed for 300m approaching intersection in test task 3, in Study 4

Crashes

There was no crash in the "active error" group and 2 crashes (both with other vehicles) in the "minimised error" group, and this difference was not statistically significant (X^2 (1, N = 32) = 2.13, $p_{1\text{-tailed}}$ = 0.07).

Task 4: left lane is blocked by cones, vehicles appear in rear vision mirror coming up from behind. Driver should check rear mirror, allow oncoming cars to pass before overtaking obstacle blocking road.

Speed

A one-way between groups ANOVA compared the average speeds for the two groups 300 to 0m before the obstacle [see Figure 4.6]. The "active error" group drove *nonsignificantly* more slowly when approaching the cones than the "minimised error" group ($F_{1,30}$= 0.55, $p_{1\text{-tailed}}$ = 0.233). Eight Participants in the "minimised error" group did not reduce speed at all and overtook the cones at an excessive speed before the cars from rear appeared. In contrast, only four Participants in the "active error" group failed to reduce speed.

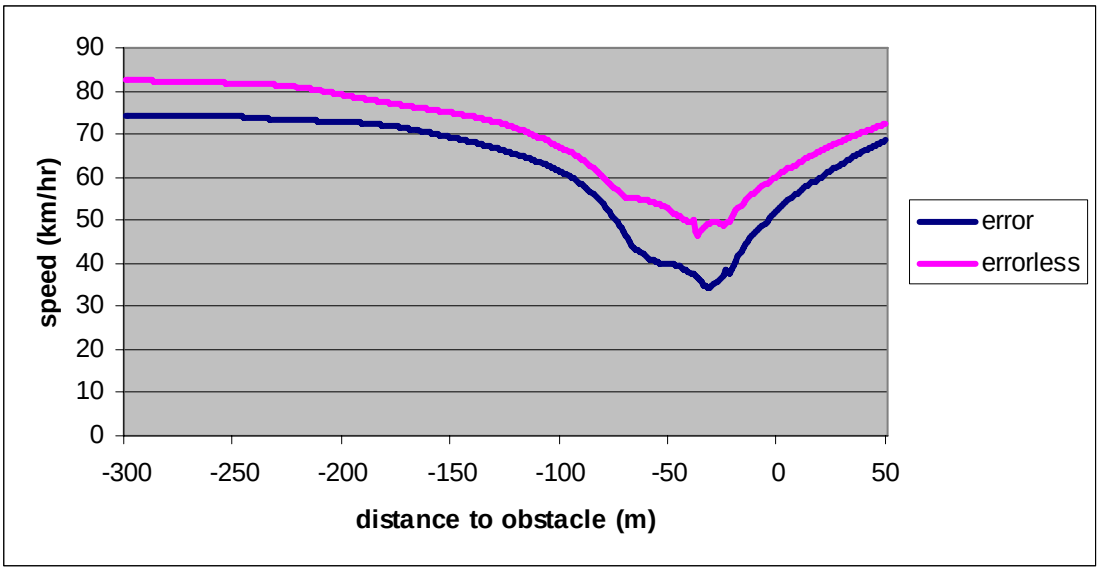


Figure 4.6: Speed for 300m approaching cones in test task 4, in Study 4

Crashes

There was 1 crash in the "active error" group (with a vehicle from the rear) and 2 in the "minimised error" group (one with a vehicle from the rear and 1 with the obstacle), and this difference was not statistically significant (X^2 (1, N = 32) = 0.37, $p_{1\text{-tailed}}$ = 0.27).

Overtaking an obstacle facing oncoming cars

Safety in overtaking was assessed in two ways. The first related to whether the driver waited for the first set of faster oncoming cars to pass before overtaking the obstacle (with later cars approaching at a slower speed). In the “active error” group 4 Participants overtook before any cars arrived from the rear and 12 overtook between cars. In the “minimised error” group, 8 Participants overtook before any cars arrived and 8 overtook between cars (but one crashed). Of those that overtook between cars and did not crash (“active error” group n=12; “minimised error” group n=7), no significant difference was observed in terms of time to overtake (“active error” group M = 7.77s, s.d.=4.40s; “minimised error” M =5.24s, s.d.=2.45s; $F_{1, 17} = 1.94$, $p_{1\text{-tailed}}$ 0.091).

Task 5: Right turn across oncoming traffic at lights. Driver should leave a safe gap between oncoming cars before turning right.

Speed

A one-way between groups ANOVA compared the average speeds for the two groups 300 to 0m before the obstacle [see Figure 4.7]. The “active error” group drove significantly more slowly when approaching the traffic lights than the “minimised error” group ($F_{1,30}= 5.54$, $p_{1\text{-tailed}} = 0.013$).

Crashes

No collisions occurred in either training group.

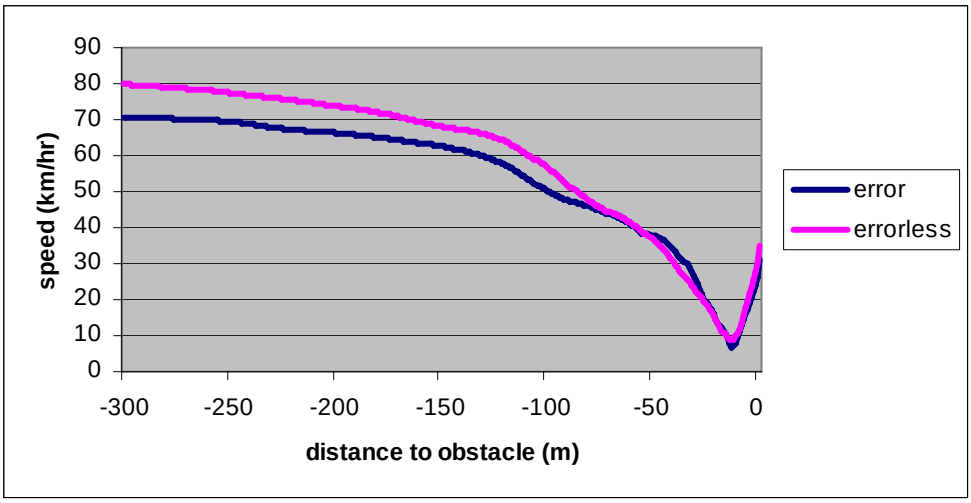


Figure 4.7: Speed for 300m approaching traffic lights in test task 5, in Study 4

Turning right across oncoming cars

In the "active error" group 10 Participants waited until *all* oncoming cars had passed before turning right, compared to 5 in the "minimised error" group. This difference was statistically significant (X^2 (1, N = 32) = 3.14, $p_{1\text{-tailed}}$ = 0.04). Although the "active error" group waited slightly longer than "minimised error" group, this difference was not statistically significant ("active error" group M = 7.06s, s.d.=4.43s; "minimised error" group M = 6.85s, s.d.=3.56s; $F_{1,31}$ = 0.02, $p_{1\text{-tailed}}$ = 0.44).

Tasks 6a and 6b: Driving speed on 2 different speed zones, university grounds (speed limit = 40km/hr) and a kangaroo area (speed limit = 50km/hr).

Speed

Figure 4.8 presents the average speed for the 300m 40km/hr zone for the "active error" and "minimised error" groups. Both groups travelled at a mean speed that exceeded the speed limit. On average, the "active error" group drove more slowly than the "minimised error" group ($F_{1,30}$= 4.19, $1_{2\text{-tailed}}$ = 0.025). Further, fewer Participants in the "active error" group exceeded the speed limit at least once

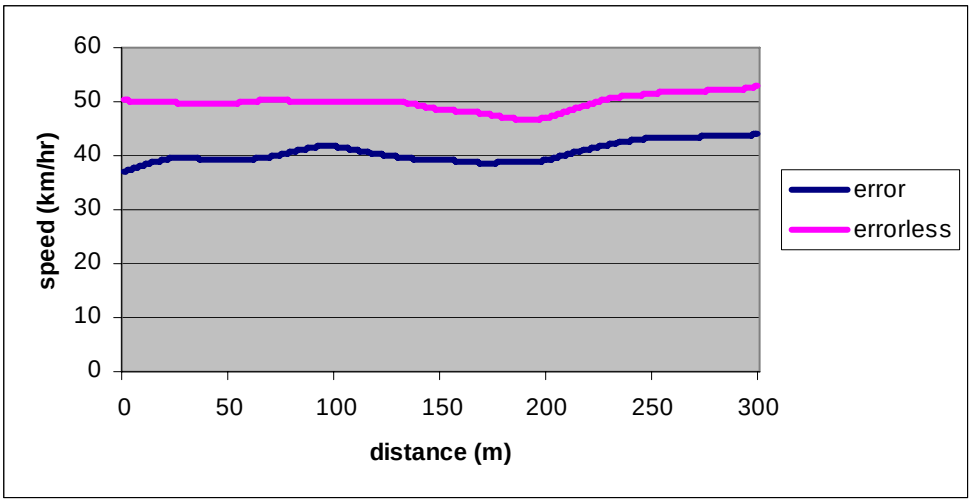


Figure 4.8: Average speed for the 300m 40km/hr zone for the "active error" and "minimised error" groups, in Study 4.

("active error" group: 10; "minimised error" group: 15; X^2 (1, N = 32) = 4.57, $p_{1\text{-tailed}}$ = .02).

Figure 4.9 presents the average speed for the 300m 50km/hr zone for the "active error" and "minimised error" groups. Both groups travelled at a mean speed that exceeded the speed limit. On average, the "active error" group drove significantly more slowly than the "minimised error" group ($F_{1,30}$= 4.62, $p_{2\text{-tailed}}$ = 0.020). The groups did not differ significantly in terms of the number of Participants who exceeded speed limit at least once ("active error" group: 14; "minimised error" group: 16; X^2 (1, N = 32) = 2.13, $p_{1\text{-tailed}}$ = 0.07).

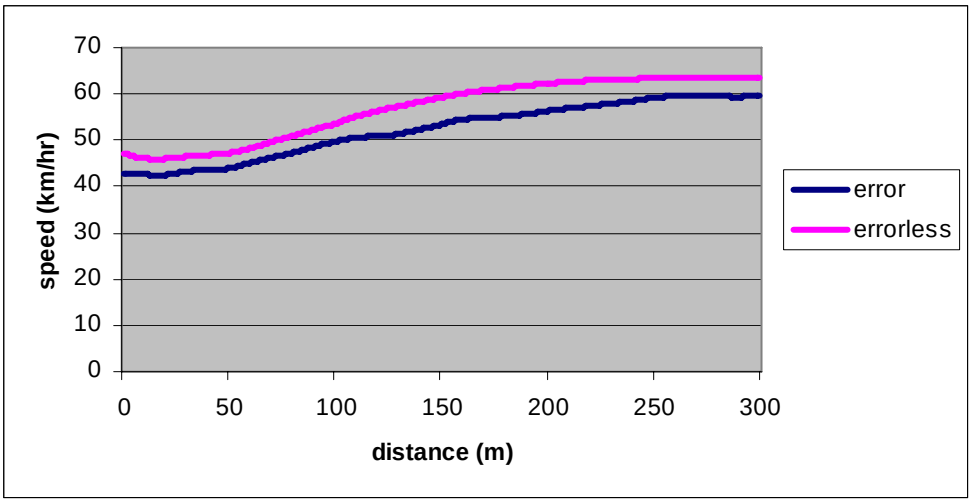


Figure 4.9: Average speed for the 300m 50km/hr zone for the "active error" and "minimised error" groups, in Study 4.

Transfer task 1: Approaching school, view occluded by a stationary bus, there are school children crossing in front of bus. Driver should drive slowly in school zone, especially when view is occluded as there could be school children crossing.

Speed

A one-way between groups ANOVA compared the average speeds for the two groups 300 to 0m before the obstacle [see Figure 4.10]. The "active error" group drove *nonsignificantly* more slowly when approaching the school bus than the "minimised error" group ($F_{1,30}$= 0.13, $p_{1\text{-tailed}}$ = 0.360).

Crashes

In the "active error" group, 6 Participants collided with children crossing the road, compared to 8 in the "minimised error" group. This difference was not statistically significant (X^2 (1, N = 32) = 0.51, $p_{1\text{-tailed}}$ = 0.24). One further participant in the "minimised error" group narrowly avoided a collision.

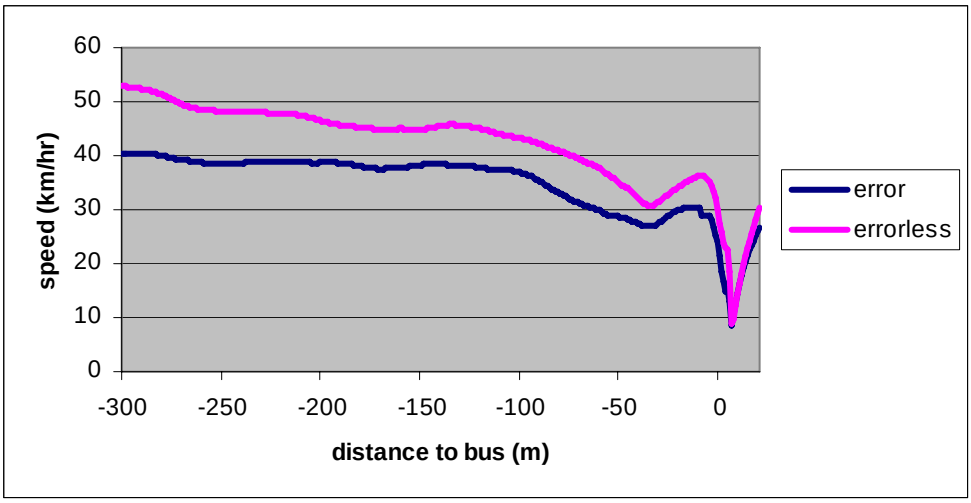


Figure 4.10: Speed for 300m approaching school bus in transfer task 1, in Study 4

Transfer task 2: Headway car is travelling slowly at constant speed of 50km/hr, and there are double centrelines. Driver should not overtake when there are double centrelines and not tailgate.

Speed

Interpretation of speed in this situation is complex. If Participants do not overtake, speed is restricted to some extent by the speed of the lead vehicle, such that the average speed should be around 50km/hr for all Participants. Speeding is required to overtake, and so Participants who overtook were excluded for this analysis. Thus, groups were compared in terms of the number of Participants who exceeded the speed limit at least once during the 2km recording period. In the "active error" group 5 Participants exceeded the speed limit at least once, compared to 9 in the "minimised error" group. This difference was not significant (X^2 (1, N = 32) = 1.64, $p_{1\text{-tailed}}$ = 0.10).

Crashes

There was 1 crash in the "active error" group and 2 in the "minimised error" group, and this difference was not statistically significant (X^2 (1, 32) = 0.37, $p_{1\text{-tailed}}$ = 0.27).

Tailgating

Participants who overtook were also excluded from these analyses. Tailgating was considered to have occurred if the Participants' car was less than 12m away from the headway car at least once during the 2km recording period. At 50km/hr, a car travels 12m in .86 seconds. 2 Participants in the "active error" group tailgated, compared 6 in the "minimised error" group. This difference was not significant (X^2 (1, N = 32) = 2.27, $p_{1\text{-tailed}}$ = 0.05). The active error group maintained a larger distance to the headway car (smallest distance: "active error" group M = 66.80m, s.d.=37.51m; "minimised error" group M = 42.31m, s.d.=17.72m; $F_{1,23}$ = 4.47, $p_{1\text{-tailed}}$ = 0.022).

Transfer task 3: 4 lane road, 2 lanes in each direction. Speed limit is 60km/hr. Cars in the left lane and behind driver are travelling above speed limit, so there is pressure to keep up with traffic. There is a sharp hill, as driver comes over hill, an obstruction in driver's lane suddenly appears. If driver is travelling <60km/hr, there is time to stop before obstacle. Driver should slow down when approaching sharp hill where view is occluded.

Speed

A one-way between groups ANOVA compared the average speeds for the two groups 300 to 0m before the obstacle [see Figure 4.11]. The "active error" group drove *nonsignificantly* more slowly when approaching the school bus than the "minimised error" group ($F_{1,30}$= 0.51, $p_{1\text{-tailed}}$ = 0.241).

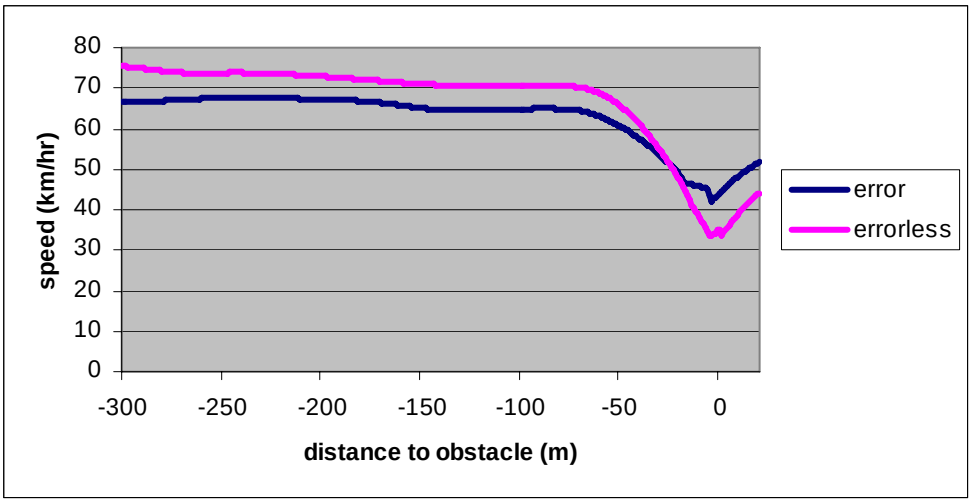


Figure 4.11: Speed for 300m approaching the hill in transfer task 3, in Study 4

12 Participants in the "active error" group exceeded the speed limit at least once, compared to 16 in the "minimised error" group, and this difference was statistically significant (X^2 (1, N = 32) = 4.57, $p_{1\text{-tailed}}$ = .02).

Crashes

1 participant in each group collided with the obstacle or with cars in the other lane.

Experience of speed exceedence and crashes across drives

When all relevant tasks were considered together, compared to the "minimised error" group, the "active error" group demonstrated significantly fewer tasks in which at least one speed exceedence was committed ("active error" group M = 2.73, s.d.=1.10; "minimised error" group M = 3.50, s.d.=0.63; $F_{1,29}$= 5.75, $p_{1\text{-tailed}}$ = 0.017), or at least one crash was experienced ("active error" group M = 0.67, s.d.=0.90; "minimised error" group M = 1.25, s.d.=0.86; $F_{1,29}$= 3.42, $p_{1\text{-tailed}}$ = 0.038).

The relationship of personality characteristics with relevant dependent variables, and subsequent covariate analysis.

We assessed relationships of gender, age, average number of hours spent driving each week (as a driver and as a passenger), number of years licensed, and training time with all dependent variables (with analyses selected appropriately for each combination of continuous and categorical variables). Because of the group differences in the total run time for test and transfer drives, and the implications for the collisions and crashes, the relevant associations were also assessed. Significant relationships are presented in Table 4.5. All hypotheses were tested 2-tailed.

Table 4.5: Significant relationships between each dependent variable and personal and drive characteristics, with statistic for group comparison with covariates.

Dependent variable	***Significantly related characteristics***	***Statistic for group comparison with covariates***
Road-related negative relative risk		N/A
Road-related positive relative risk		N/A
Speed approaching hazard in Task 1	Total training time	$F_{2,29}$= 4.68, $p_{1\text{-tailed}}$ = 0.017*
Crash in Task 1		N/A
Waiting for cars to pass in Task 1		N/A
Time to overtake in Task 1	Total training time Hours as a passenger	Direction opposite to prediction ($p_{2\text{-tailed}}$ = 0.006)
Speed approaching hazard in Task 2	Total training time	$F_{2,29}$= 13.22, $p_{1\text{-tailed}}$ < 0.001**
Traffic light ticket in Task 2		N/A

Dependent variable	***Significantly related characteristics***	***Statistic for group comparison with covariates***
Speed approaching hazard in Task 3	Total training time	Direction opposite to prediction ($p_{2\text{-tailed}} = 0.002$)
Crash in Task 3		N/A
Speed approaching hazard in Task 4	Total training time	$F_{2,29} = 3.57$, $p_{1\text{-tailed}} = 0.021$*
Time to overtake in Task 4		N/A
Crash in Task 4	Age Years of licensure	$p_{1\text{-tailed}} = 0.453$
Speed approaching hazard in Task 5		N/A
Crash in Task 5		N/A
Waiting for cars to pass in Task 5		N/A
Time to turn in Task 5		N/A
Speed in Task 6a	Total training time	$F_{2,29} = 11.70$, $p_{1\text{-tailed}} < 0.001$**
Speed exceedence in Task 6a		N/A
Speed in Task 6b	Total training time	$F_{2,29} = 6.26$, $p_{1\text{-tailed}} = 0.003$*
Speed exceedence in Task 6b	Total test time Total transfer time	$p_{1\text{-tailed}} = 0.499$
Speed approaching hazard in Transfer Task 1	Total training time	$F_{2,29} = 5.99$, $p_{1\text{-tailed}} = 0.004$*
Crash in Transfer task 1		N/A
Speed exceedence in Transfer task 2	Gender Total transfer time	$p_{1\text{-tailed}} = 0.372$
Crash in Transfer task 2		N/A
Tailgate in Transfer task 2	Age	$p_{1\text{-tailed}} = 0.054$
Smallest distance to lead vehicle in Transfer Task 2	Years licensed Total training time	$F_{3,21} = 6.41$, $p_{1\text{-tailed}} = 0.002$*

Dependent variable	***Significantly related characteristics***	***Statistic for group comparison with covariates***
Speed approaching hazard in Transfer Task 3	Total training time	$F_{2,29}$= 3.97, $p_{1\text{-tailed}}$ = 0.015*
Speed exceedence in Transfer task 3	Total test time Total transfer time	$p_{1\text{-tailed}}$ = 0.499
Crash in Transfer task 3		N/A
Total number of tasks with speed exceedence	Total test time Total transfer time	$F_{3,27}$= 5.45, $p_{1\text{-tailed}}$ = 0.003*
Total number of tasks with crash		N/A

The previous analyses were repeated for dependent variables that evidenced significant relationships with personal or drive characteristics [see Table 4.5]. For each such continuous dependent variable the univariate linear model was tested, with group as a fixed factor, and the related characteristics as covariates. For dichotomous variables binary logistic regressions were employed. The group comparison became significant for speed approaching the hazard in task 1, 2, 4, transfer1, and transfer3, as well as speed during tasks 6a and 6b and smallest distance to lead vehicle in Transfer task 2.

Discussion

The results of Study 4 are summarised in Table 4.5.

Table 4.5: Summary of comparisons between active error and minimised error groups in Study 4

Dependent variable	***Without covariate***	***With covariate***
Road-related negative relative risk	Active error nonsig < Minimal error	N/A
Road-related positive relative risk	Active error nonsig < Minimal error	N/A
Speed approaching hazard in Task 1	Active error nonsig < Minimal error	Active error < Minimal error*
Speed approaching hazard in Task 2	Active error nonsig < Minimal error	Active error < Minimal error*
Speed approaching hazard in Task 3	Opposite to prediction	Opposite to prediction ($p_{2\text{-tailed}} = 0.002$)
Speed approaching hazard in Task 4	Active error nonsig < Minimal error	Active error < Minimal error*
Speed approaching hazard in Task 5	Active error < Minimal error*	N/A
Speed approaching hazard in Transfer Task 1	Active error nonsig < Minimal error	Active error < Minimal error*
Speed approaching hazard in Transfer Task 3	Active error nonsig < Minimal error	Active error < Minimal error*
Mean speed in Task 6a	Active error < Minimal error*	Active error < Minimal error*
Mean speed in Task 6b	Active error < Minimal error*	Active error < Minimal error*

Dependent variable	***Without covariate***	***With covariate***
Waiting for cars to pass in Task 1	=	N/A
Waiting for cars to pass in Task 5	Active error safer than Minimal error*	N/A
Time to overtake in Task 1	Opposite to prediction ($p_{2\text{-tailed}} = 0.050$)	Opposite to prediction ($p_{2\text{-tailed}} = 0.006$)
Time to overtake in Task 4	Active error nonsig > Minimal error	N/A
Time to turn in Task 5	Active error nonsig > Minimal error	N/A
Traffic light ticket in Task 2	Active error nonsig < Minimal error ($p_{1\text{-tailed}} = 0.07$)	N/A
Speed exceedence in Task 6a	Active error < Minimal error*	N/A
Speed exceedence in Task 6b	Active error nonsig < Minimal error ($p_{1\text{-tailed}} = 0.07$)	Active error nonsig < Minimal error
Speed exceedence in Transfer task 2	Active error nonsig < Minimal error	Active error nonsig < Minimal error
Speed exceedence in Transfer task 3	Active error < Minimal error*	Active error nonsig < Minimal error
Tailgate in Transfer Task 2	Active error nonsig < Minimal error ($p_{1\text{-tailed}} = 0.050$)	Active error nonsig < Minimal error ($p_{1\text{-tailed}} = 0.054$)
Smallest distance to lead vehicle in Transfer Task 2	Active error > Minimal error*	Active error > Minimal error*

Dependent variable	***Without covariate***	***With covariate***
Total number of tasks with speed exceedence	Active error < Minimal error*	Active error < Minimal error*
Crash in Task 1	Active error nonsig < Minimal error	N/A
Crash in Task 3	Active error nonsig < Minimal error ($p_{1\text{-tailed}} = 0.07$)	N/A
Crash in Task 4	Active error nonsig < Minimal error	Active error nonsig < Minimal error
Crash in Task 5	=	N/A
Crash in Transfer task 1	Active error nonsig < Minimal error	N/A
Crash in Transfer task2	Active error nonsig < Minimal error	N/A
Crash in transfer task 3	=	N/A
Total number of tasks with crash	Active error < Minimal error*	N/A

N/A= No potential covariates significantly associated with dependent variable, and so group comparison not repeated with covariates

Results suggest a positive impact of active error training on hazard perception and risky driving.

Although no significant reduction in illusory invulnerability regarding the future was observed, means were in the predicted direction for both the road-related negative and positive relative risk indices. Interestingly, the scores for the road-related negative index demonstrated a main effect of training. Nonetheless, illusory invulnerability was present in the sample both before and after training.

Evidence for a positive effect of active error training on risky simulated driving is more compelling.

The “active error” group performed better than the “minimised error” group in terms of speed approaching hazards, an indicator of hazard awareness. The “active error” group approached one of the 7 hazards (Task 5) significantly more slowly than the “minimised error” group. For 5 of the remaining comparisons, means were in the predicted direction, and all 5 became significant when relevant covariates were included in analysis.

The “active error” group performed better than the “minimised error” group in terms of mean speed in 2 speed zones (40km/hr and 50km/hr), an indicator of general speed awareness. In both zones, both groups travelled at a speed above the speed limit. In both zones, the “active error” group travelled significantly more slowly than the “minimised error” group (regardless of whether relevant covariates were employed).

The “active error” group also performed better than the “minimised error” group in terms of negotiating other vehicles when turning or getting around obstacles. In Task 5, more “active error” group Participants than “minimised error” group Participants waited for a safe time to turn across oncoming traffic. In Task 1, the groups were identical in terms of waiting for oncoming traffic to pass before driving around an obstacle. This variable could not be considered for Task 4 because so many drivers arrived at the obstacle long before cars coming from the rear were in sight. For both Tasks 4 and 5, the “active error” group waited nonsignificantly longer before making a turning manoeuvre than did the “minimised error” group.

The “active error” group also performed better than the “minimised error” group in terms of following other vehicles. The smallest distance left by “active error” group Participants was significantly greater than that left by minimised error

Participants (regardless of whether relevant covariates were employed). When 12m was applied as a criterion for tailgating the groups no longer differed significantly although the p-value was low (without covariates: $p_{1\text{-tailed}} = 0.050$; with covariates: $p_{1\text{-tailed}} = 0.054$).

There was also evidence in a reduction in infringement rate as a result of active error training. Significantly less “active error” Participants than “minimised error” Participants received a speeding ticket for 2 of the 4 tasks in which speed exceedence was considered (Task 6a and Transfer task 3). For the remaining tasks means were in the expected direction, and for Task 6b the p-value was low ($p_{1\text{-tailed}} = 0.07$). Unsurprisingly, the “active error” group demonstrated significantly fewer tasks that were marred by a speeding ticket than did the “minimised error” group (regardless of whether covariates were employed).

Also in terms of crashes the “active error” group appeared to perform somewhat better than the “minimised error” group. The “active error” group demonstrated significantly fewer tasks that were marred by a crash than did the “minimised error” group. Of 7 tasks for which crashes were considered, means were in the predicted direction for 5 tasks (and equal for the remaining 2). No significant difference was observed. However, for Task 3 the p-value was low ($p_{1\text{-tailed}} = 0.07$).

It must be recognised that a couple of effects in the direction opposite to prediction would have been significant had a 2-tailed test been employed (including relevant covariates). Specifically, these effects were for speed approaching the hazard in Task 3, and time taken to overtake in Task 1). These undesirable effects are far outnumbered by the observed beneficial effects.

Again, an important shortcoming of the present study is the use of a tertiary student sample, which may not be representative of the target population. In Study 5 refined messages will be evaluated in a general population sample.

In summary, active error training appears to hold great promise as a means of reducing risky driving amongst young drivers. In the present study active error training was provided and evaluated on a simulator. This leaves two key questions for future research:

1) Do the benefits of active error training on a driving simulator generalise to real-world driving? If so, such training may be a valuable component of driver training on simulators like those recently purchases by NRMA.
2) Can elements of active error training be provided in the context of real-world driving? Clearly, it would not be appropriate to encourage young drivers to make errors in the real world, but techniques for ensuring that young drivers notice and learn from their errors may be beneficial.

The remainder of the present research program focuses on developing printed materials for learner drivers that would be appropriate for dissemination in educational institutions, community youth centres and learner driver programs. Thus, we addressed the second question outlined above by modifying the messages that were evaluated in Study 3, and incorporating in them messages designed to provide learner drivers with “error experiences” on the road. We evaluated the refined messages in Study 5 in a sample of learner drivers in terms of hazard perception and on-road driving.

Chapter 5: Integration of materials

To develop the messages that were evaluated in Study 5, the messages employed in Study 3 were modified to integrate aspects of active error training (Study 4), to increase motivation to read the entire pamphlet (by stressing the importance of illusory invulnerability earlier, by simplifying language, and by improving the graphical presentation of the information), and to strengthen recommendations for techniques to attack illusory invulnerability.

Changes to integrate aspects of active error training

The messages employed in Study 3 were modified to further emphasise the importance of noticing errors (in keeping with active error training). In Study 3 the messages urged Participants to remember:

3) You may think that other drivers take more risks, and make more mistakes, than you. BUT REMEMBER: You make mistakes too. You probably notice other people's mistakes more often than you notice your own. For example, if the driver in front of you forgets to indicate before turning, you notice (perhaps in colourful language!), whereas if you forget to indicate you probably don't notice. You might dismiss your mistakes because you know the reasons for them (e.g. your blinker is broken, you were tuning the radio, you were looking for a street sign), whereas you don't know the reasons for other drivers' mistakes. Other drivers may seem to make worse mistakes than you, because it is the big ones you notice.

This was enhanced in the materials that were employed in Study 5, to incorporate further explanation and as well as experiences to mimic active error training. Thus, in place of the message shown above, Participants received the message:

a) Remember that you make mistakes too. Try to notice them when they happen. At the end of each drive you do, make a list of all of the mistakes you made. You can find a checklist to use for this at www.irmrc.edu.au/Feedback.survey.asp. Keeping track of your mistakes will help you not to make them in future.
b) Ask the people who travel with you when you are driving (like your parents) to point out your mistakes, to help you to learn to be a safe driver.
c) You probably notice other people's mistakes more often that you notice your own. For example, if the driver in front of you forgets to indicate before turning you notice (perhaps in colourful language!) whereas if you forget to indicate you probably don't notice. When you notice another driver make a mistake, try to remember a time when you have made the same mistake.
d) You might dismiss your mistakes because you know the reasons for them (e.g. your blinker is broken, you were tuning the radio, you were looking for a street sign), whereas you don't know the reasons for other drivers' mistakes. When you make a mistake, remember that a mistake is a mistake even if you know why you made it.
e) Remember that, just like you, other drivers try to drive safely.

The advice to make lists of mistakes, to ask passengers to identify errors, and to try to remember making the same mistake as others, was designed to mimic active error training. A checklist was provided with the brochure to facilitate the listing of errors, and further copies were available at the website given in the pamphlet. Further, this error was discussed as the first error in the materials, rather than the third error (as it had been in Study 3).

Changes to increase motivation to read the entire pamphlet

We changed the position of the information about the behavioural significance of illusory invulnerability to immediately following the description of the phenomenon (and before the section headed "You probably experience

illusory invulnerability”). This was designed to motivate Participants to read on.

We created a new section, “You should fight illusory invulnerability”, from the last paragraph of the section, “You probably experience illusory invulnerability “, to set a tone of action, that was continued in the following section. In the section “How to fight illusory invulnerability” , rather than urging Participants to “remember” particular facts that might undermine illusory invulnerability, the pamphlet urged Participants to “Attack this error”, and used action words to begin each recommendation for doing so. For example, one recommendation was “ask people who travel with you… to point out your mistakes to help you to learn to be a safe driver.”

In addition, some minor changes were made to simplify wording. Most dramatically:
We removed examples of illusory invulnerability regarding positive outcomes, because of their limited relevance
We simplified the wording that served to introduce the thinking errors and the ways of attacking them.
We simplified the wording describing thinking error # 1 (in Study 3 materials; #2 in Study 5 materials)

Finally, a graphic designer was contracted to develop a brochure that would appeal to a younger audience.

Changes to strengthen recommendations for techniques to attack illusory invulnerability

We

1. added the sentence “When you make a mistake remember that a mistake is a mistake even if you know why you made it”
2. added the recommendation: “Remember that, just like you, other drivers try to drive safely”

3. used more salient examples in the stereotype section. For example, rather than describing the stereotype of taxi drivers, we used the stereotypes of “young males” and “middle-aged women, or even “unskilled or very risky drivers”.

The resulting brochure is found in Appendix Q.

Chapter 6: Study 5- Evaluation of final messages in a learner driver sample

The objective of Study 5 was to evaluate the messages that were developed employing university student samples in a learner driver sample from the general population.

Design

Trent driving students[8] who were judged to be at least 3 weeks from their RTA driving test were invited to participate and given envelopes containing study materials (participant information and consent forms, study messages). Learner drivers who consented to participating in the study read the study messages that they were given (either relevant to improving risk perception, or not relevant i.e. the control group). After at least 3 weeks, Participants had a driving lesson during which a practice test was conducted (and driving performance evaluated and recorded). At the end of this lesson Participants completed questionnaires.

Methods

Participants

45 Trent driving students consented to participate in the study. Of these, 39 returned completed Message Evaluation forms with their consent forms. 29 students reached the second stage of the study (post-testing). In the final second stage sample, 63% were female, 93% spoke English at home (with the remainder unknown), and the average age was 18.46 (s.d.=1.98, min=17, max=24).

[8] According to our original proposal, secondary student or learner driver samples were to be recruited, possibly through driver training schools, to come in for testing on the driving simulator. However, in discussions with Trent we recognized an opportunity for replacing the simulated driving test with the more ecologically valid on-road test. We had also expected that the on-road test conducted as part of Trent's normal activities would allow for more efficient data acquisition, although this turned out not to be the case. We sought and received approval from the MAA for this methodological change.

Materials

Participant Recruitment Log

Participating driver trainers were given a form on which to log the names of students who were invited to participate, the date on which they were invited and whether they accepted the materials [see Appendix O].

Participant Information Statement and Consent Forms

A Participant Information Statement (PIS) [see Appendix P] invited students to participate in a study of "Strategies for improving risk perception in learner drivers" because of their being "a learner driver, enrolled in driving lessons, … soon [to] attempt a driving test". Participants were informed that if they decided to participate they would be required to read the provided messages, complete an evaluation form about these messages, and send the completed evaluation form and a consent form to the researchers (in the addressed envelope provided). Then, at their final driving lesson they would be required to complete a brief questionnaire. Researchers would obtain this questionnaire, a copy of their Trent Student Enrolment Form, as well as a copy of the Trent On-Road Test Driving Evaluation Form completed by their driver trainer at the final lesson, Potential Participants were informed that it would take about 10 minutes to read the materials, and that by participating in the study they would enter a draw for 1 of 10 CD vouchers. They were assured that the study would not involve any additional risk beyond that involved in a normal driving lesson. They were also assured of confidentiality, and the right to decline or withdraw from involvement in the study without prejudice. Attached to the PIS was a Consent Form for Participants to sign and return, as well as a Revocation of Consent Form for them to sign and return at a later date should they decide no longer to be involved.

Messages to reduce illusory invulnerability, and control messages

All messages were presented as a printed brochure.

Messages designed to reduce illusory invulnerability are reproduced in Appendix Q. The messages were based on those employed in Study 3, incorporating advice to promote “active error training” on the basis of Study 4.

The control messages essentially described auto maintenance [see Appendix S] and were designed to be roughly the same length as the messages that were designed to reduce illusory invulnerability. Auto maintenance was chosen to be plausible in the setting, but be of limited direct relevance to risky driving behaviour.

Driving Practice Checklist

A Driving Practice Checklist [see Appendix R] was designed for Participants to use as a tool in monitoring their errors when driving. The instructions asked Participants to indicate which of 15 behaviours they did in the drive they just completed. The behaviours included in the checklist corresponded to those that were included in the On-road Risky Driving Questionnaire (see Table 6.1), except that driving as the passenger of an alcohol-affected driver was omitted, and phrasing was in the past tense, for the Driving Practice Checklist. For most behaviours, response options were “Yes”, “No”, or “Not applicable in that the relevant circumstance did not arise”. For some behaviours, “Not applicable” was not allowed as a response because circumstances are always relevant (e.g. “Exceeded the speed limit by no more than 15km/hr). Several behaviours that were included in the checklist also corresponded to several that were assessed in the Trent On-Road Test.

Message Evaluation Form

A Message Evaluation Form [see Appendix T] asked Participants to rate their agreement with the 4 statements that the material was “easy to read”, “easy to understand” “interesting”, and in a format that made sense, on a fully-labelled 5-point Scale ranging from “Strongly disagree” (-1) to “Strongly Agree” (1) with the midpoint of “Neutral” (0). A statement at the bottom of the form reminded

Participants to return it with their signed consent form in the reply paid envelope provided.

Future-related Illusory Invulnerability Questionnaires

The Future-related Illusory Invulnerability Questionnaire that was employed in Study 2 was abbreviated for use in the more time-restricted driver training context [see Appendix U]. The items that were removed were items 11, 12, 13, 14, 15, and 23. Most substantially, items relating to being injured/killed as a driver not at fault (items 13 and 14) were removed, and reference to fault was removed from the remaining items 4, 7, and 8.

On-road Risky Driving Questionnaire

This questionnaire was also modified slightly from that employed in Study 2 [see Appendix U]. The items now included are shown in Table 6.1.

“Give way appropriately at intersections” replaced “Do an illegal U-turn” due to its greater correspondence to the on-road driving test. Items 13-16 were added for a similar reason. “Reduce your speed appropriate to conditions” replaced “reduce your speed when it is raining” due to its broader applicability.

In addition, respondents estimated the frequency which the average driver of their age and gender would do those actions as a proportion of the time they spend driving over the next year.

Table 6.1: Risk-increasing and risk-decreasing behaviours included in the On-road Risky driving Questionnaire.

Behaviour type	***Item***	***Behaviour***
Risk-increasing	*1*	Run a red light
	2	Keep driving even though you are very tired
	3	Give way appropriately at intersections
	5	Move into a lane without checking properly for vehicles in other lanes
	6	Drive with a blood alcohol content above the legal limit
	7	Drive while under the influence of illegal drugs that may impair your driving
	8	Travel as a passenger of a driver with a blood alcohol content above the legal limit
	11	Turn right across a busy road even when there is a small chance of a collision
	12	Exceed the speed limit by no more than 15km/hr
	13	Accidentally cause a dangerous situation
	15	Not indicate when turning
	16	Not give way to pedestrians when appropriate
Risk-decreasing	*4*	Stop driving if you want to talk on a hand-held mobile phone
	9	Wear a seatbelt
	10	Reduce your usual speed appropriate to conditions
	13	Keep a safe distance between your vehicle and the vehicle in front of you

Marlow-Crowne Social Desirability Questionnaire

The Social Desirability Questionnaire that was employed in Study 2 was employed again here [see Appendix U].

Demographic and Control Variables Questionnaire

Again, this questionnaire was abbreviated from that employed in Study 2 [see Appendix U]. Specifically questions regarding place of residence, length of licensure, hours per week spent driving, and hours per week spent as a passenger, were omitted. Further, fewer questions were asked regarding the details of any previous crashes.

Trent On-Road Test (TORT) Form

The Trent On-Road Test (TORT) Form [see Appendix V] is used by Trent driver trainers to record students' driving performance in the practice test drive that is completed in a driving lesson soon before the NSW Roads and Traffic Authority licensing test. On the form, trainers identify whether students commit various "automatic fail" behaviours, and whether students fail to perform various standard "Manoeuvres and procedures", or "Performance checks", correctly. We selected for analysis items that appear to reflect risk perception and behaviour. These items are identified in Table 6.2.

The Fail items were only marked if they were performed (coded as 1= poor performance). Otherwise they are coded as missing; because non-performance may reflect appropriate behaviour, or lack of opportunity for appropriate (or inappropriate) behaviour. Manoeuvres and procedures were often only marked if performed incorrectly, so they are coded as "No" (1= poor performance). Otherwise they are coded "Yes" because these manoeuvres and procedures are invariably assessed (0= good performance). Similarly, performance checks were often only marked if performed incorrectly, so they are then coded as "No" (1= poor performance). Otherwise they are coded "Yes" (0= good performance), because the relevant circumstances are likely to have arisen, except for "mastery of unexpected situation, which was coded as missing if unmarked.

Table 6.2: Fail items, standard "Manoeuvres and procedures", and "Performance checks" from the Trent On-Road Test (TORT) that were included in analyses.

Fail behaviours	***Manoeuvres and Procedures***	***Performance checks***
Not give way	*Reverse park*	Adjust speed-curve
Disobey lights	Traffic checks	Adjust speed-general
Disobey traffic signs	Speed control	Intersection safety procedure
Disobey road markings	Signals intention	Observe traffic behind
Exceed speed limit	*Three point turn*	Observe when diverging
Cause a dangerous situation	Traffic checks	Select adequate gap
Not signal intention	Speed control	Stop behind line
Not give way to pedestrians	Signals intention	Signal when necessary
Dangerous procedure/lane change	*Kerbside stop*	Show mastery of unexpected situation
Unsafe at point of decision	Traffic checks	
Too fast for situation	Speed control	
Following distance too short	Signals intention	

Trent Enrolment Form

Further information regarding personal characteristics was obtained from the Trent Enrolment Form that students complete at their first lesson with Trent [see Appendix W]. The details we employed were postcode, occupation (school, tertiary, P/T work, F/T work, shift work, other), previous hours of driving, time of last tuition (recent, within 1 month, over 6 months), experience of traffic (yes/no), planned home practice (yes/no), date for completion of tuition.

Procedures

Initially 12 Trent driver trainers were selected to recruit Participants. Selection of trainers was targeted to ensure that Participants were recruited from Northern, Southern, Western and Eastern geographical areas of metropolitan Sydney, and from a wide range of socioeconomic backgrounds. Each trainer was given detailed instructions about the study [see Appendix X] and asked to recruit 10 Participants, of whom we estimated 50% would reach stage 2 of the study. However, when recruitment took longer than we anticipated we selected several further driver trainers to recruit Participants, with less scope to target their selection. Further, driver trainers who had been successful in recruiting Participants in the first phase of data collection were asked to recruit a further 10 Participants. We identified to the MAA that these changes would be likely to result in overrepresentation of Participants from the North Shore, but agreed that the changes should be made in the interests of speeding data collection. At around the same time, we posted an invitation to participate on the Trent website, but no Participants volunteered via this avenue.

In the first phase of data collection Trent driver trainers identified students who were likely to complete their RTA driving test in “no less than 3 weeks” as “potential Participants”. During the second phase of data collection this criterion was loosened to “no less than 2 weeks” in order to speed up data collection. We judged that any less than 2 weeks would be insufficient time for Participants to read the messages, and have subsequent driving practice. In “potential Participants’” next driving lesson, they were invited by driver trainers to participate in a study on “risky driving”. Driver trainers gave “potential Participants” an envelope containing study materials and told them: “You will just need to read some materials and fill in questionnaires, which should take a total of 20 minutes. All of the results are anonymous. If you choose to participate it might help improve your danger perception. All the information and materials you need to be involved is in the envelope.” Specifically, the “information envelope” contained information forms, consent forms (marked with an ID number that identified which message the student received), reply paid envelopes, the messages, and questions relating to the characteristics of

the message (e.g. readability). Half of the envelopes contained the trial messages (about illusory invulnerability), and the other half contained control messages (about auto maintenance)[9]. Each driver trainer received a pile of intermingled envelopes, and was not aware of the type of messages contained in any given envelope. Thus, random allocation to treatment and control group was achieved by random distribution of envelopes. Driver trainers completed a record form showing the data on which they invited students to participate in the study, and whether the student accepted the information package.

Participants who returned the signed consent form to the researchers (in reply paid envelopes) became “consenting Participants”. Participants were also asked to return a completed “evaluation of messages” form with their consent form (marked with an ID number matching the consent form). For each consenting participant, researchers allowed a delay of 3 weeks (in phase 1) or 2 weeks (in phase 2) before sending the participant’s driver trainer the “questionnaire envelope”, and advice to go ahead with a practice driving test. Questionnaires were marked with the participant’s ID number (from their consent form), to allow later matching (and identification of group). After the driving lesson in which the practice test was conducted, the driver trainer gave the student the “questionnaire envelope”. The student completed questionnaires and handed them back to the driver trainer in the envelope (to achieve a perception of anonymity), to which the driver trainer added copies of the TORT from, and of the student’s Trent Enrolment Form).

[9] The control group were provided with the trial messages after the conclusion of the study (direct contact by researchers), so they ultimately received equal benefit for their participation

Variable computation and statistical analysis

Data were analysed with SPSS (Statistical Package for the Social Sciences). The Type I error rate for all analyses was set at .05. Significant p-values are marked with asterisks in all tables (* p<.05; ** p<.001).

Computation of main questionnaire indices

The following indices were computed in a similar manner as for Study 2:

- Relative future risk estimates (all with slightly different events to Study 2):
    - Road-related negative index
    - Road-related positive index
    - Casualty as a driver at fault index
    - Casualty as a driver not at fault index
    - Casualty as a passenger index
    - Road-unrelated negative index
    - Road-unrelated positive index
- On-road risky driving intentions index (with slightly different behaviours to Study 2)

Computation of driving behaviour indices

Three indices were computed for the total number of errors made on fail items, manoeuvres and procedures items, and performance check items. Total number of errors was also computed by totalling these three indices.

Analyses

Descriptive statistics were employed to investigate the characteristics of the sample at each stage of recruitment, in terms of age, gender, driving exposure, and the tendency to conform to social expectations.

For both immediate post-test and 2-month follow-up, the Treatment group was compared to the Control group in terms of continuous dependent variables employing one-way ANOVAs. The impact of treatment on categorical variables was assessed employing Chi-squares. Treatment Participants were expected to demonstrate improvements (relative to controls) in terms of risk perception and risky driving, and crashing, and thus 1-tailed tests were employed. Nonetheless, when means were in a direction opposite to prediction, p-values <0.05 are reported because of its practical importance.

We assessed the association age, gender and social desirability with each dependent variable, and where significant associations were observed we repeated the comparisons described above using the personal characteristic variable as a covariate.

Results

Sample characteristics

Not all driver trainers returned records of the material packages that they handed out. From the 8 record sheets that were returned, 72 material packages were handed out. From these, 34 identifiable consent forms were received (29 with completed Message Evaluation Form), and 26 Participants reached the second stage of the study. Only two record sheets were completed properly to demonstrate what proportion of approached students accepted materials. These two forms suggested an acceptance rate of 1 in 3.

In total we received consent forms from 45 students (39 with a completed Message Evaluation Form). These included 6 that did not provide a name. Four of these we could match with an instructor, and so they were given unique identifiers and included in the study (being given a question to identify their group allocation). The remaining 2 we could not match with an instructor. Another 2 consent forms provided the name of a student who we could not trace with Trent. Thus, these 4 consenting students for whom no instructor could be identified were not sent follow-up materials, leaving 41 consenting Participants eligible for Stage 2. From these, 3 completed their driving test earlier than anticipated, and so before receiving Stage 2 materials. Twenty-nine consenting Participants reached the final stage of the study. However, one of these was 28 years old, and one 46 years old, and so these Participants were excluded from the “Evaluation Stage” sample and the “Stage 2” sample. A 38 year old who did not progress beyond the evaluation stage was also not included. In the final Stage 2 sample [see Table 6.3] only the TORT was returned for 2 Participants, only the questionnaire was returned for a further 2, and for the remaining 23 both questionnaires and TORT was received.

Table 6.3: Sample characteristics at each stage of data collection

	Consented	***Evaluation***	***Stage 2 sample***
N	45	36	27
% treatment group	47% (7% unknown)	50% (8% unknown)	48%
% female	58% (4% unknown)	53% (6% unknown)	63%
Age	Min= 17 Max= 46 Mode= 17 (38% unknown)	Min= 17 Max= 22 Mode= 17 Mean= 18.09 s.d.= 1.50 (43% unknown)	Min= 17 Max= 24 Mode= 17 Mean= 18.46 s.d.= 1.98 (4% unknown)

In the stage 2 sample, the groups did not differ in terms of gender (Chi-squared=0.89, $p_{2\text{-tailed}}$=0.345) or age ($F_{1,24}$=1.43, $p_{2\text{-tailed}}$=0.243).

Evaluation of Messages

In the “final Evaluation stage sample”, we computed the percentage of treatment group Participants (n=19) agreeing or disagreeing with statements that the materials were readable, comprehensible, in a sensible format, and interesting, or rating these statements as neutral [see Table 6.4].

Table 6.4: Sample characteristics at each stage of data collection

	Readable	***Comprehensible***	***Format made sense***	***Interesting***
% Agree or Strongly agree	83.4%	72.2%	83.9%	27.8%
% Neutral	11.1%	11.1%	11.1%	55.6%
% Disagree or Strongly disagree	5.6%	16.7%	5.6%	16.7%

Illusory invulnerability regarding various aspects of future road use

In the “final Stage 2 sample”, treatment and control groups were compared in terms of indices for road-related negative events, road-related positive events, crashing as a driver at fault, and crashing as a passenger, as well as for road-unrelated negative and positive events, using one-way ANOVAs. Means were in the predicted direction but not significant for road-related negative events ($F_{1,20}$=0.29, $p_{1\text{-tailed}}$=0.298) and crashing as a passenger ($F_{1,20}$=1.38, $p_{1\text{-tailed}}$=0.127). For all remaining indices means were in a direction opposite to prediction and thus not significant according to the 1-tailed test employed (lowest $p_{2\text{-tailed}}$=0.220).

Considering events separately, the treatment group had significantly lower relative risk scores than the control group for the event “be booked running a red light” ($F_{1,20}$=3.19, $p_{1\text{-tailed}}$=0.045). For a further 7 (of 18) events means were in the predicted direction but not significant (lowest $p_{1\text{-tailed}}$=0.125). For all remaining events means were in a direction opposite to prediction or equal, and thus not significant according to the 1-tailed test employed (lowest $p_{2\text{-tailed}}$=0.211).

Self-reported risky driving on the road

Again in the “final Stage 2 sample”, treatment and control groups were compared in terms of the total self-reported risky driving index using a one-way ANOVA. Means were in the direction opposite to prediction and thus not significant according the 1-tailed test employed ($p_{2\text{-tailed}}$=0.497).

Considering behaviour separately, means were in the predicted direction but not significant for “stop driving if you want to talk on handheld mobile” ($F_{1,23}$=0.50, $p_{1\text{-tailed}}$=0.243) and “reduce your usual speed appropriate to conditions” ($F_{1,23}$=1.43, $p_{1\text{-tailed}}$=0.122). For all remaining behaviours means were in a direction opposite to prediction or equal and thus not significant according to the 1-tailed test employed (lowest $p_{2\text{-tailed}}$=0.102 for “accidentally cause a dangerous situation” which may reflect risk awareness rather than intention to drive in a risky manner).

Risky driving during the practice test

All errors

Treatment and control groups were compared in terms of the total driving errors index using a one-way ANOVA. Means were in a direction opposite to prediction and thus not significant according to the 1-tailed test employed ($p_{2\text{-}tailed}$=0.721).

Fail items

In the “final Stage 2 sample” treatment and control groups were compared in terms of the total fail items index using a one-way ANOVA. Means were identical.

When individual items were considered, the data were low count, as shown in Table 6.5, which also shows the results of the (thus somewhat unreliable) statistical comparison of the treatment and control groups (Chi-squared).

Table 6.5: Number of each group performing errors on each fail item, and comparison of treatment and control groups

Fail behaviours	***Treatment (n=13)***	***Control (n=13)***	***Statistic***
Not give way	0	0	N/A
Disobey lights	1	0	Opposite to prediction ($p_{2\text{-tailed}}$=0.308)
Disobey traffic signs	2	0	Opposite to prediction ($p_{2\text{-tailed}}$=0.141)
Disobey road markings	2	3	Chi-squared=0.25 $p_{1\text{-tailed}}$=0.310
Exceed speed limit	1	3	Chi-squared=1.18 $p_{1\text{-tailed}}$=0.139
Cause a dangerous situation	0	0	N/A
Not signal intention	0	1	Chi-squared=1.04 $p_{1\text{-tailed}}$=0.154
Not give way to pedestrians	0	0	N/A
Dangerous procedure/lane change	0	0	N/A
Unsafe at point of decision	0	0	N/A
Too fast for situation	0	0	N/A
Following distance too short	0	0	N/A

Manoeuvres and procedures items

Treatment and control groups were compared in terms of the total manoeuvres and procedures items index using a one-way ANOVA. Means were in a direction opposite to prediction and thus not significant according to the 1-tailed test employed ($p_{2\text{-tailed}}=0.399$).

When individual items were considered, the data were low count, as shown in Table 6.6, which also shows the results of the (thus somewhat unreliable) statistical comparison of the treatment and control groups (Chi-squared).

Table 6.6: Number of each group performing errors on each manoeuvres and procedures item, and comparison of treatment and control groups

Manoeuvres and Procedures	***Treatment (n=13)***	***Control (n=13)***	***Statistic***
Reverse park			
Traffic checks	7	7	N/A
Speed control	0	0	N/A
Signals intention	1	3	Chi-squared=1.18 $p_{1\text{-tailed}}=0.139$
Three point turn			
Traffic checks	4	1	Opposite to prediction ($p_{2\text{-tailed}}=0.135$)
Speed control	2	0	Opposite to prediction ($p_{2\text{-tailed}}=0.099$)
Signals intention	0	1	Chi-squared=1.04 $p_{1\text{-tailed}}=0.154$
Kerbside stop			
Traffic checks	2	1	Opposite to prediction ($p_{2\text{-tailed}}=0.539$)
Speed control	2	1	Opposite to prediction ($p_{2\text{-tailed}}=0.539$)
Signals intention	0	0	N/A

Performance check items

Treatment and control groups were compared in terms of the total performance check items index using a one-way ANOVA. Means were identical.

Although performance check items were scored continuously, most Participants made each error once or not at all. Thus, these scores for these items were dichotomised. Table 6.7 shows the number of Participants who made each error (at least once) as well as the results of the statistical comparison of the treatment and control groups (Chi-squared).

Table 6.7: Number of each group performing errors on each performance check item, and comparison of treatment and control groups

Performance checks	***Treatment (n=13)***	***Control (n=13)***	***Statistic***
Adjust speed-curve	1	0	Opposite to prediction ($p_{2\text{-tailed}}$=0.308)
Adjust speed-general	2	2	N/A
Intersection safety procedure	6	4	Opposite to prediction ($p_{2\text{-tailed}}$=0.420)
Observe traffic behind	4	4	N/A
Observe when diverging	5	5	N/A
Select adequate gap	1	0	Opposite to prediction ($p_{2\text{-tailed}}$=0.308)
Stop behind line	2	1	Opposite to prediction ($p_{2\text{-tailed}}$=0.539)
Signal when necessary	5	9	Chi-squared=2.48 $p_{1\text{-tailed}}$=0.058
Show mastery of unexpected situation	Missing for all Participants	Missing for all Participants	N/A

The relationship of personal characteristics with dependent variables.

In the final Stage 2 sample, we computed correlations of age and social desirability scores, with all continuous dependent variables. The relationships of gender with the continuous dependent variables were assessed by employing separate one-way ANOVAs with gender as the grouping variable. Relationships of categorical dependent variables with age and social desirability scores were tested employing one-way ANOVAs (with the dependent variable as the grouping variable), and with gender employing Chi-squared. All hypotheses were tested 2-tailed. Significant relationships are presented in Table 6.8.

Table 6.8: Significant relationships of gender, age and social desirability scores with dependent variables

Gender	***Age***	***Social desirability score***
Self-reported "Drive with a BAC above the legal limit"		Self-reported "keep safe distance from vehicle in front"
Performance check: not observe traffic when diverging		Self-reported "accidentally cause a dangerous situation"
Performance check: not signal intention		Fail item: Disobey traffic signs
		Fail item index

Follow-up analyses

Continuous dependent variables that demonstrated significant relationships with personal characteristics were re-analysed using univariate general linear model, and employing the relevant personal characteristic as a covariate. Logistic regression was employed for categorical variables.

No significant effects were observed (lowest nonsignificant $p_{1\text{-tailed}}=0.020$ for “accidentally cause a dangerous situation”, in keeping with the revised prediction).

Discussion

Although the materials were well-received, they appear to provide little positive impact on risk perception and risky driving.

The large majority of the sample agreed that the materials were readable, comprehensible and in a format that made sense, and only a very small proportion of the sample disagreed. Whilst only 28% of the sample agreed that the materials were interesting, 56% were neutral with regard to this issue. This can be regarded as a positive outcome given that road safety issues are not typically uppermost amongst young peoples' interests.

Only one significant effect of the materials was observed. Specifically, the treatment group had significantly lower relative risk scores than the control group for the event "be booked by a red light". Given the number of tests conducted, this could be a Type I error.

Although the final sample was small[10], the failure to detect substantial impacts of the messages does not appear to reflect inadequate statistical power. There were no near-significant effects in the expected direction (improvement of treatment relative to control group) and group means more often lay in the direction opposite to that predicted. Thankfully, we observed no significant differences that suggested a worsening of treatment relative to control group.

It is disappointing that the materials did not appear to be effective, despite incorporating two interventions that had appeared promising in earlier studies of this research program. Several explanations are plausible.

[10] Although we initially proposed to recruit 60 Participants data collection was slower than we had envisaged, partly because of the requirement that Participants be at least 3 weeks from taking their driving test, but likely to remain involved with Trent for the duration of the study. We relaxed this criterion to 2 weeks, and involved additional driver trainers, to increase the rate of recruitment. We attempted to further increase the rate of recruitment by employing the Trent website, and by offering increased incentives to trainers and Participants. Neither of these approaches was effective. When 45 Participants had consented we conducted preliminary analysis that suggested that further data collection would not change the results. The MAA agreed for data collection to cease at this stage.

First, the present study involved a general population sample whereas the earlier studies involved tertiary student samples. Higher education may allow for better understanding of the written materials (also required for “active error” experiences in the present context), and so enhanced efficacy of the messages. However, this sample difference is unlikely to completely account for differences from the earlier results. The sample in the present study are likely to have an above average socioeconomic status, given that they are enrolled in paid driving lessons, and given the over-sampling from the northern suburbs. Thus, the present sample is also likely to be fairly highly educated. In Study 1 (not reported here), “illusory invulnerability” messages similar to those employed in Study 3 appeared to be somewhat effective in a general population sample, again with relatively high education (and including older drivers). There may be other relevant differences between the present sample and the tertiary student samples employed in Studies 3 and 4.

Second, in the present study Participants were given the materials to read at their leisure, whereas in Study 3 they read through the materials with an experimenter present. Thus, the messages may not have been read as carefully in the present study. We did not assess compliance with reading the materials directly, although we did ask Participants to rate the materials on several dimensions. Thirty-nine of 45 consenting Participants completed and returned this Materials Evaluation Form. However, this form could have been completed with a fairly superficial reading of the materials. Although we incorporated “motivational” statements in the messages (e.g. “One of the most important things you can do to avoid crashing, or being booked, is to believe that it is just as likely to happen to you as to your peers”), this may not have been sufficient to encourage thorough reading. The materials may be more effective if they could be provided in a setting that ensures young drivers engage with the messages, which seems feasible. However, in the current study we did not want driver trainers to read through the materials with students in the present study because of the need for trainers (who made the behavioural observations) to be “blind” to the group Participants were in.

Third, the behavioural measure employed in the present study may have been insensitive. Whereas in the earlier studies driving behaviour was measured on a driving simulator, the present study involved on-road behavioural observations. Whilst on-road measures have apparent advantages in terms of ecological validity[11], they clearly also have disadvantages. For example, the driving situation is more difficult to control and thus situational factors can "over-determine" observed behaviours, leaving experimental effects more difficult to detect. Especially in the present circumstance, driving behaviour may have been strongly determined by students being on their "best behaviour" in front of their driving trainer in a "mock test" situation. Indeed, relatively few driving errors were observed, perhaps producing a ceiling effect (i.e. Participants were all driving so carefully that there was no room for message-induced improvement). In a more casual situation effects of the messages might emerge. However, naturalistic on-road driving observations are, of course, extremely difficult. Perhaps the effects of the integrated messages could be assessed on a driving simulator, by arranging for parents to make unobtrusive observations during normal practice or driving, or by tracking Participants' driving records (although this typically involves low-count data).

Given the apparent promise of the interventions upon which the integrated messages were based, it may be worth further evaluating them in a setting which encourages their being thoroughly read, and employing more sensitive behavioural measures.

[11] This was one of the reasons that we changed, with approval from the MAA to an on-road methodology. We had also thought it would improve the efficiency of data collection; obviating the need for testing sessions and extraction of data from the simulator, by harnessing procedures already in place with Trent. Unfortunately, the Trent data collection was not as efficient as we had hoped.

Chapter 7: Conclusions and recommendations

The present research program supported the role of illusory invulnerability in risky driving and road trauma. The relationships that were observed between illusory invulnerability and risky driving in Study 2 were inconsistent, in keeping with the literature, and probably due their cyclical nature. In Study 3, there was some evidence that messages that reduced illusory invulnerability (about the past) also reduced risky driving, although results were not entirely unequivocal.

Thus, the messages evaluated in Study 3 appeared promising as a means of improving risk perception, risky driving, and so road trauma amongst young drivers. The “active error” experiences evaluated in Study 4 also improved simulated driving (though not risk perception).

We developed written materials that aimed to combine active error experiences with the messages from Study 3, while also strengthening aspects of these messages.

These materials were evaluated in a sample of young drivers undergoing driver training. They appeared to be of limited benefit, perhaps because they were not read thoroughly, or because the on-road behaviour measures employed were insensitive.

In appropriate settings the materials could be delivered in a manner to promote their being read more thoroughly by young drivers. However, they should first be evaluated employing more sensitive behavioural measures.

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References

Aspinwall, L.G., Kemeny, M.E., Taylor, S.E., and Schneider, S.G. (1991). Psychosocial predictors of gay men's AIDS risk-reduction behavior. *Health Psychology, 10,* 432-444.

Aucote, H.M. and Gold, R.S. (2005). Non-equivalence of direct and indirect measures of unrealistic optimism. *Psychology, Health and Medicine, 10*, 376-383.

Berger, R.J. and Persinger, G.S. (1980). *Survey of Public Perceptions on Highway Safety*. National Highway Traffic Safety Administrations, U.S., DOT Automated Services, Inc., McLean, VA.

Blalock, S.J., De Vellis, B.M., Afifi, and Sander, R.A. (1990). Risk perceptions and participation in colorectoral cancer screening. *Health Psychology, 9,* 792-806.

Brown, I.D. and Groeger, J.A. (1988). Risk perception and decision taking during the transition between novice and experienced driver status. *Ergonomics, 31,* 585-597.

Covey, J.A. and Davies, A.D.M. (2004). Are people unrealistically optimistic? It depends how you ask them. *British Journal of Health Psychology, 9,* 39-49.

Chua, F.J and Job, R.F.S. (1999). Event-specific versus unitary causal accounts of optimism bias. *Journal of Behavioural Medicine, 22*, 457-491.

Davidson, K. and Prkachin, K. (1997). Optimism and unrealistic optimism have an interacting impact on health-promoting behavior and knowledge changes. *Personality and Social Psychology Bulletin, 23*, 617-625.

DeJoy, D.M. (1989). The optimism bias and traffic accident risk perception. *Accident Analysis and Prevention, 21*, 333-340.

Dolinski, D., Gromski, W., and Zawisza, E. (1986). Unrealistic pessimism. *The Journal of Social Psychology, 127*, 511-516.

Finn, P. and Bragg, B. (1986). Perception of the risk of an accident by young and older drivers. *Accident Analysis and Prevention, 18*, 289-298.

Gladis, M.M., Michela, J.L, Walter, H.J., and Vaughan, R.D. (1992). High school students' perceptions of AIDS risk: Realistic appraisal or motivated denial? *Health Psychology, 11*, 307-316.

Griffeth, R.W. and Rogers, R.W. (1976). Effects of fear arousing components of driver education on students' safety attitudes and simulator performance. *Journal of Educational Psychology, 68*, 501-506.

Hatfield J, Job R.F.S. (2000). *Reduction of road related illusory invulnerability and risk taking: Final report*. Report to the Federal Office of Road Safety.

Hoorens, V. and Buunk, B.P. (1991). *Social comparison of health risks*. Paper presented at the European Association of Experimental Social Psychology Small Group Meeting: Social Psychological Models in Health and Safety Research, Canterbury, September, 1991.

Hoorens, V. and Buunk, B.P. (1992). Self-serving biases in social comparison: Illusory superiority and unrealistic optimism. *Psychologica Belgica, 32*, 169-194.

Hoorens, V. and Buunk, B.P. (1993). Social comparison of health risks: Locus of control, the person-positivity bias, and unrealistic optimism. *Journal of Applied Social Psychology, 23*, 291-302.

Ivancic, K. and Hesketh, B. (2000). Learning from errors in driving simulation: Effects on driving skill and self-confidence. *Ergonomics, 43,* 1966-1984.

Janz, N.K. and Becker, M.H. (1984). The Health Belief Model: A decade later. *Health Education Quarterly, 11,* 1-47.

Job, R.F.S. (1990). The application of learning theory to driving confidence: The effect of age and the impact of random breath testing. *Accident Analysis and Prevention, 22,* 97-107.

Job, R.F.S. (1995). The future of driver education. *Roadwise (Official Journal of the College of Road Safety), 7,* 5-7.

Job, R.F.S., Hamer, V. and Walker, M. (1995). The effects of illusory invulnerability and fear on protective behaviour. In D. Kenny and R.F.S. Job (Eds.). *Australia's Adolescents: A Health Psychology Perspective*. (pp. 151-156) Armidale, NSW: New England University Press.

Jonah, B.A. (1986). Accident risk and risk taking behavior among young drivers. *Accident Analysis and Prevention, 18,* 255-271.

Jonah, B.A. and Dawson, N.E. (1982). *The National Vehicle Occupant Restraint Survey: Attitudes Toward the Use of Restraints by Canadians*. Road Safety Directorate, Transport: Canada.

Jonah, B.A. and Dawson, N.E. (1987). Young and risky: Age differences in risky driving, risk perception, and risk utility. *Alcohol, Drugs, and Driving, 3,* 13-29.

Joseph, J.G., Montgomery, S.B., Emmons, C., Kirscht, J.P., Kessler, R.C., Ostrow, D.G., Wortman, C.G., O'Brien, K., Eller, M., and Eshleman, S. (1987). Perceived risk of AIDS: Assessing the behavioral consequences in a cohort of gay men. *Journal of Applied Social Psychology, 17*, 231-250.

Klein, W.M. (1996). Maintaining self-serving social comparisons: Attenuating the perceived significance of risk-increasing behaviours. *Journal of Social and Clinical Psychology, 15,* 120-142.

Klein, W.M. (1997). Objective standards are not enough: Affective, self-evaluative, and behavioral responses to social comparison information. *Journal of Personality and Social Psychology, 72,* 763-774.

Klein, W.M. and Kunda, Z. (1993). Maintaining self-serving social comparisons: Biased reconstruction of one's past behaviours. *Personality and Social Psychology Bulletin, 19,* 732-739.

Krug, E.G., Sharma, G.K., and Lozano, R. (2000). The global burden of injuries. *American Journal of Public Health, 90,* 523-526.

Kruger, J. and Burrus, J. (2004). Egocentrism and focalism in unrealistic optimism (and pessimism). *Journal of Experimental Social Psychology, 40,* 332-340.

Langley, J.D. and Williams, S.M. (1992). Cycling beliefs, crash experiences and night cycling behaviour of 13 year olds. *Journal of Pediatrics and Child Health, 28*, 231-235.

Larwood, L. (1978). Swine flu: a field study of self-serving bias. *Journal of Applied Social Psychology, 8*, 283-289.

Mahatane, J., and Johnson, M. (1989). Unrealistic optimism and attitudes towards health. *British Journal of Clinical Psychology, 28*, 181-182.

Matthews, M.L. and Moran, A.R. (1986). Age differences in male drivers' perception of accident risk: The role of perceived driving ability. *Accident Analysis and Prevention, 18*, 205-208.

McKenna, F.P. and Albery, I.P. (2001). Does unrealistic optimism change following a negative experience? *Journal of Applied Social Psychology, 31*, 1146-1157.

Morgan, G.A. and Job, R.F.S. (1995). Red light cameras: drivers knowledge, attitudes and behaviours. In: D. Kenny and R.F.S. Job (Eds.). *Australia's Adolescents: A Health Psychology Perspective*. (pp 144-150) Armidale, NSW: New England University Press.

Osberg, T.M. and Schrauger, J.S. (1986). Self-prediction: Exploring the parameters of accuracy. *Journal of Personality and Social Psychology, 51,* 1044-1057.

Peden, M., McGee, K., and Sharma, G. (2002). *The Injury Chart Book: A Graphical Overview of the Global Burden of Injuries.* Geneva: World Health Organization.

Regan, P.C., Snyder, M., and Kassin, S.M. (1995). Unrealistic optimism: Self-enhancement or person positivity? *Personality and Social Psychology Bulletin, 10*, 1073-1082.

Reynolds, W.M. (1982). Development of reliable and valid short forms of the Marlowe-Crowne Social Desirability Scale. *Journal of Clinical Psychology, 38,* 119-125.

Robertson, L.S. (1977). Car crashes: perceived vulnerability to victimization. *Journal of Personality and Social Psychology, 50*, 502-510.

Schoenbach, V.J. (1987). Appraising the health risk appraisal. *American Journal of Public Health, 77*, 409-410.

Schwarzer, R. (1994). Optimism, vulnerability, and self-beliefs as health-related cognitions: A systematic overview. *Psychology and Health, 9*, 161-180.

Siero, S., Kok, G., and Pruyn, J. (1984). Effects of public education about breast cancer and breast self-examination. *Social Science and Medicine, 18*, 881-888.

Spolander, K. (1982). *Inexperienced Drivers' Behaviour, Abilities and Attitudes*. Swedish National Road and Traffic Research Institute, Linkoping

Sutton, S.R. and Eiser, J.R. (1990). The decision to wear a seatbelt: The role of cognitive factors, fear and prior behavior. *Psychology and Health, 4*, 111-123.

Svenson, O. (1981). Are we less risky and more skillful than our fellow drivers? *Acta Psychologica, 47*, 143-148.

Svenson, O., Fishhoff, B. and MacGregor, D. (1985). Perceived driving safety and seatbelt usage. *Accident Analysis and Prevention, 17*, 119-133.

Van der Velde, F.W. and Van der Pligt, J. (1991). AIDS-related health behavior: Coping, protection motivation, and previous behavior. *Journal of Behavioral Medicine, 14*, 429-451.

van der Velde, F.W., Hooykaas, C., and van der Pligt, J. (1992). Risk perception and behavior: Pessimism, realism, and optimism about AIDS-related health behavior. *Psychology and Health, 6*, 23-38.

van der Velde, F.W., van der Pligt, J., and Hooykaas, C. (1994). Perceiving AIDS-related risk: Accuracy as a function of differences in actual risk. *Health Psychology, 13*, 25-33.

Weinstein, N.D. (1980). Unrealistic optimism about future life events. *Journal of Personality and Social Psychology, 39,* 806-820.

Weinstein, N.D. (1982). Unrealistic optimism about susceptibility to health problems. *Journal of Behavioral Medicine, 5*, 441-460.

Weinstein, N.D. (1983). Reducing unrealistic optimism about illness susceptibility. *Health Psychology, 2,* 11-20.

Weinstein, N.D. (1988). The precaution adoption process. *Health Psychology, 7,* 355-386.

Weinstein, N.D. (1989a). Effects of personal experience on self-protective behaviour. *Psychological Bulletin, 105,* 31-50.

Weinstein, N.D. (1989b). Perceptions of personal harm. In V.M. Mays, G.W. Albee, and S.F. Schneider (Eds.). *Primary Prevention of AIDS: Psychological Approaches.* Newberry Park, CA: Sage Publications.

Weinstein, N.D. (1993). Testing four competing theories of health protective behavior. *Health Psychology, 12,* 234-333.

Weinstein, N.D. and Klein, W.M. (1995). Resistance of personal risk perceptions to debiasing interventions. *Health Psychology, 14*, 132-140.

Weinstein, N.D., & Lachendro, E. (1982). Egocentrism as a source of unrealistic optimism. *Personality and Social Psychology Bulletin, 8,* 195-200.

Weinstein, N.D. and Nicolich, M. (1993). Correct and incorrect interpretations of correlations between risk perceptions and risk behaviours. *Health Psychology, 12,* 235-245.

Weinstein, N.D., Grubb, P.D, and Vautier, J. (1986). Increasing automobile seatbelt use: an intervention emphasising risk susceptibility. *Journal of Applied Social Psychology, 71* 285-290.

Weinstein, N.D., Sandman, P.M., and Roberts, N. (1990). Determinants of self-protective behavior: Home radon testing. *Journal of Applied Social Psychology, 20*, 783-801.

Weinstein, N.D., Sandman, P.M., and Roberts, N. (1991). Perceived susceptibility and self-protective behaviour: A field experiment to encourage home radon testing. *Health Psychology, 10*, 25-33.

Williamson, A. (2000). *Why are young drivers over-represented in crashes?* Report to the NSW Motor Accidents Authority.

Williamson, A. (2003). *Why are young drivers over-represented in crashes? Summary of the issues. Update of literature reviews: Literature from 2000 to 2003*. Report to the NSW Motor Accidents Authority.

Wurtele, S.K. and Maddux, J.E. (1987). Relative contributions of protective motivation theory components in predicting exercise intentions and behaviour. *Health Psychology, 6*, 453-466.

Appendices

Appendix A- Advertisement

If you are a licensed driver between 18 and 24 years of age....

We are offering you the opportunity to participate in a study in which you will:

1. Drive in a driving simulator
2. Be able to earn up to $20 (depending on how well you drive)
3. Complete some questionnaires

We are conducting an experiment on attitudes and behaviours involved in driving, and we would appreciate your help.

The study will be conducted in the Department of Psychology at the University of Sydney, and should take around 45 minutes of your time. All of our results are confidential, and you would be free to withdraw at any time.

If you are interested, please contact Justine Gatt to make an appointment on
ph:9351 2788 or
email: justineg@psych.usyd.edu.au (please provide a contact phone number)

Appendix B: Participant Information Statement Employed in Study 2

The University of Sydney

Psychology Department

NSW 2006 AUSTRALIA

Attitudes And Driving Behaviours In The STISIM Research Driving Simulator

Participant Information Sheet

Chief Investigators: A/Prof. Soames Job (ph: 9351 2859)
Dr. Julie Hatfield (ph: 9351 8930)
Secondary Investigator: Ms. Justine Gatt (ph: 9351 2788)

You are invited to take part in an experiment investigating decision-making while driving. Your task in this experiment is to complete several attitude questionnaires, and then to drive a simulator as you would a real car. The driving simulator includes a full car cabin and provides you with full steering and motion control via a steering wheel, accelerator and brake pedals. The visual stimuli are provided by computer graphics projected onto screens in front of the car.

You will be asked to drive as though you need to get to work on time, however it is important that you obey normal road rules. Therefore, you shouldn't overtake when there are double lines on the road, means you must stop at red traffic lights, and your speed must remain under the limit designated on speed limit signs.

You will be given $20 at the beginning of the experiment. However, every time you break a normal road rule, or crash, you will lose $4. You cannot lose any more than the $20 you are originally given. For example, if you break a rule twice and crash once, you will only be given $8 at the end of the experiment. If you break a rule three times and crash three times, you will not receive any money at the end of the experiment (but you will not owe us anything!).

As with all devices of this type, a few people may experience feelings of discomfort or sickness during their drives in the simulator. These effects are usually not serious and last only a short time. If this happens, you should stop immediately and the session will be concluded. There will be no penalty or consequence if this occurs. You will be given the amount of money available for the time you spent driving, minus the cost of any "errors" you make. For example, if you quit after 1 drive only $5 is available to you (because there are 4 drives), so if you have made 1 error you will only receive $1.

All aspects of this study including the results will be strictly confidential and only the investigators named above will have access to the information. You will not be identified in any publication arising from the study. Participation in this study is entirely voluntary. You are not obliged to participate and if you do participate, you can withdraw at any time. This study will take approximately 45 minutes of your time.

Any person with concerns or complaints about the conduct of a study can contact the Manager of the Human Ethics Committee, University of Sydney, on (02) 9351 4811.

Appendix C: Main Questionnaire

In this questionnaire you are asked about your beliefs regarding your future, and about your beliefs regarding the future for an average person of your age and gender. You are also asked about some personal details.

Please answer as accurately and honestly as you can. There are no right or wrong answers- we are interested in what you think, even if you are not sure it is correct. All your answers are anonymous, so please do not write your name on the questionnaire.

Thank you for your participation and co-operation.

Please estimate the likelihood that the following events will happen to you in the future, by circling a number from 1 to 7, where the numbers mean:

1= Extremely unlikely to happen to you

2= Very unlikely to happen to you

3= Unlikely to happen to you

4= Neither likely nor unlikely to happen to you

5= Likely to happen to you

6= Very likely to happen to you

7= Extremely likely to happen to you

1. Be booked for speeding	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. Not be hospitalised in the next 5 years for illness or injury	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. Travel overseas in the next 5 years	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4. Have a car crash, as a driver at fault	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. Have pneumonia	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6. Just avoid a car crash because you are able to stop quickly	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7. Be injured in a car crash, as a driver at fault	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8. Be killed in a car crash, as a driver at fault	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9. Have 3 consecutive years of without having a car crash as a driver	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. Have 3 consecutive years without being booked	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. Be booked for doing an illegal U-turn	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12. Get very good marks at university	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13. Be injured in a car crash, as a driver not at fault	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14. Be killed in a car crash, as a driver not at fault	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15. Have the car you are driving stolen	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16. Avoid a car crash nearly caused by another driver	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17. Drive safely if driving while tired	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18. Be booked for running a red light	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19. Have gastrointestinal illness	**1**	**2**	**3**	**4**	**5**	**6**	**7**
20. Have your wallet stolen	**1**	**2**	**3**	**4**	**5**	**6**	**7**
21. Be injured in a car crash, as a passenger	**1**	**2**	**3**	**4**	**5**	**6**	**7**
22. Be killed in a car crash, as a passenger	**1**	**2**	**3**	**4**	**5**	**6**	**7**
23. Own your own home	**1**	**2**	**3**	**4**	**5**	**6**	**7**
24. Be booked for driving with a blood alcohol content over the legal limit	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Please estimate the likelihood that the following events will happen to the average person of your age and gender, by circling a number from 1 to 7, where the numbers mean:

1= Extremely unlikely to happen to the average person

2= Very unlikely to happen to the average person

3= Unlikely to happen to the average person

4= Neither likely nor unlikely to happen to the average person

5= Likely to happen to the average person

6= Very likely to happen to the average person

7= Extremely likely to happen to the average person

1. Be booked for speeding	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. Not be hospitalised in the next 5 years for illness or injury	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. Travel overseas in the next 5 years	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4. Have a car crash, as a driver at fault	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. Have pneumonia	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6. Just avoid a car crash because you are able to stop quickly	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7. Be injured in a car crash, as a driver at fault	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8. Be killed in a car crash, as a driver at fault	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9. Have 3 consecutive years of without having a car crash as a driver	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. Have 3 consecutive years without being booked	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. Be booked for doing an illegal U-turn	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12. Get very good marks at university	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13. Be injured in a car crash, as a driver not at fault	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14. Be killed in a car crash, as a driver not at fault	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15. Have the car you are driving stolen	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16. Avoid a car crash nearly caused by another driver	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17. Drive safely if driving while tired	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18. Be booked for running a red light	**1**	**2**	**3**	**4**	**5**	**6**	**7**
19. Have gastrointestinal illness	**1**	**2**	**3**	**4**	**5**	**6**	**7**
20. Have your wallet stolen	**1**	**2**	**3**	**4**	**5**	**6**	**7**
21. Be injured in a car crash, as a passenger	**1**	**2**	**3**	**4**	**5**	**6**	**7**
22. Be killed in a car crash, as a passenger	**1**	**2**	**3**	**4**	**5**	**6**	**7**
23. Own your own home	**1**	**2**	**3**	**4**	**5**	**6**	**7**
24. Be booked for driving with a blood alcohol content over the legal limit	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Please estimate how often the following events ***have happened to*** *you in the past, by writing a number in the space provided. When you are asked how often a driving-related event has happened, please consider only the past year. If you have been driving for less than one year, please indicate how often the event has happened in the time you have been driving. For events which are not driving-related, please consider your whole life so far.*

1. Booked for speeding	_____
2. Had 5 years without being hospitalised for illness or injury	_____
3. Traveled overseas	_____
4. Had a car crash, as a driver at fault	_____
5. Had pneumonia	_____
6. Just avoided a car crash because of being able to stop quickly	_____
7. Injured in a car crash, as a driver at fault	_____
8. Had 3 consecutive years without having a car crash, as a driver	_____
9. Had 3 consecutive years without being booked	_____
10. Booked for doing an illegal U-turn	_____
11. Got very good overall marks in end-of year exams at school *(answer between 1 and 6)*	_____
12. Injured in a car crash, as a driver not at fault	_____
13. Had car you have been driving stolen	_____
14. Avoided a crash nearly caused by another driver	_____
15. Drove safely while tired	_____
16. Booked for running a red light	_____
17. Had gastrointestinal illness	_____
18. Had your wallet stolen	_____
19. Injured in a car crash, as a passenger	_____
20. Booked for driving with a blood alcohol content over the legal limit	_____

Please estimate how often the following events ***have happened to*** *the average person of your age and gender in the past, by writing a number in the space provided. When you are asked how often a driving-related event has happened, please consider only the past year. If you think the average person has been driving for less than one year, please indicate how often the event has happened in the time you think they have been driving. For events which are not driving-related, please consider their whole life so far.*

1. Booked for speeding	_____
2. Had 5 years without being hospitalised for illness or injury	_____
3. Traveled overseas	_____
4. Had a car crash, as a driver at fault	_____
5. Had pneumonia	_____
6. Just avoided a car crash because of being able to stop quickly	_____
7. Injured in a car crash, as a driver at fault	_____
8. Had 3 consecutive years without having a car crash, as a driver	_____
9. Had 3 consecutive years without being booked	_____
10. Booked for doing an illegal U-turn	_____
11. Got very good overall marks in end-of year exams at school *(answer between 1 and 6)*	_____
12. Injured in a car crash, as a driver not at fault	_____
13. Had car they had been driving stolen	_____
14. Avoided a crash nearly caused by another driver	_____
15. Drove safely while tired	_____
16. Booked for running a red light	_____
17. Had gastrointestinal illness	_____
18. Had their wallet stolen	_____
19. Injured in a car crash, as a passenger	_____
20. Booked for driving with a blood alcohol content over the legal limit	_____

Please estimate the likelihood that the following events will happen to you in your first drive in the driving simulator, by circling a number from 1 to 7, where the numbers mean:

1= Extremely unlikely to happen to you

2= Very unlikely to happen to you

3= Unlikely to happen to you

4= Neither likely nor unlikely to happen to you

5= Likely to happen to you

6= Very likely to happen to you

7= Extremely likely to happen to you

1. Be booked for speeding	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. Have less than 2 car crashes	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. Be booked for going through a red light	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4. Have a car crash on a blind corner	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. Get less than 2 fines	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Please estimate the likelihood that the following events would happen to the average person in their first drive in the driving simulator, by circling a number from 1 to 7, where the numbers mean:

1= Extremely unlikely to happen to the average person

2= Very unlikely to happen to the average person

3= Unlikely to happen to the average person

4= Neither likely nor unlikely to happen to the average person

5= Likely to happen to the average person

6= Very likely to happen to the average person

7= Extremely likely to happen to the average person

1. Be booked for speeding	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. Have less than 2 car crashes	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. Be booked for going through a red light	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4. Have a car crash on a blind corner	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. Get less than 2 fines	**1**	**2**	**3**	**4**	**5**	**6**	**7**

The next set of questions ask you how often you will do certain actions as a proportion of the time you spend driving. When choosing your answer, think about your driving over the next year, and circle the number that best represents how often you will do the following:

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

1. Run a red light	**0**	**1**	**2**	**3**	**4**	**5**	**6**
2. Keep driving even though you are very tired	**0**	**1**	**2**	**3**	**4**	**5**	**6**
3. Do an illegal U-turn	**0**	**1**	**2**	**3**	**4**	**5**	**6**
4. Stop driving if you want to talk on a hand-held mobile phone	**0**	**1**	**2**	**3**	**4**	**5**	**6**
5. Change lanes without checking properly for vehicles in other lanes	**0**	**1**	**2**	**3**	**4**	**5**	**6**
6. Drive with a blood alcohol content above the legal limit	**0**	**1**	**2**	**3**	**4**	**5**	**6**
7. Drive while under the influence of illegal drugs that may impair your driving	**0**	**1**	**2**	**3**	**4**	**5**	**6**
8. Drive while under the influence of legal drugs (besides alcohol) that may impair your driving	**0**	**1**	**2**	**3**	**4**	**5**	**6**
9. Travel as a passenger of a driver with a blood alcohol content above the legal limit	**0**	**1**	**2**	**3**	**4**	**5**	**6**
10. Wear a seatbelt	**0**	**1**	**2**	**3**	**4**	**5**	**6**
11. Reduce your usual speed when it is raining	**0**	**1**	**2**	**3**	**4**	**5**	**6**
12. Turn right across a busy road even when there is a small chance of a collision	**0**	**1**	**2**	**3**	**4**	**5**	**6**
13. Exceed the speed limit by no more than 15km/hr	**0**	**1**	**2**	**3**	**4**	**5**	**6**

The next set of questions ask you how often you will do certain actions while driving the driving simulator. Please circle the number that best represents how often you will do the following:

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

1. Not use rear-vision mirror	**0**	**1**	**2**	**3**	**4**	**5**	**6**
2. Travel across double lines	**0**	**1**	**2**	**3**	**4**	**5**	**6**
3. Disobey speed signs	**0**	**1**	**2**	**3**	**4**	**5**	**6**
4. Drive off the roadway	**0**	**1**	**2**	**3**	**4**	**5**	**6**

Please indicate which of the following statements apply to you by circling Yes (Y) or N (N).

1. It is sometimes hard for me to go on with my work if I am not encouraged	**Y**	**N**
2. I sometimes feel resentful when I don't get my way	**Y**	**N**
3. On a few occasions, I have given up doing something because I thought too little of my ability	**Y**	**N**
4. There have been times when I felt like rebelling against people in authority even though I knew they were right	**Y**	**N**
5. No matter who I'm talking to I am always a good listener	**Y**	**N**
6. There have been occasions when I took advantage of someone	**Y**	**N**
7. I'm always willing to admit it when I make a mistake	**Y**	**N**
8. I sometimes try to get even rather than forgive and forget	**Y**	**N**
9. I am always courteous, even to people who are disagreeable	**Y**	**N**
10. I have never been bothered when people have expressed ideas very different from mine	**Y**	**N**
11. There have been times when I was quite jealous of the good fortune of others	**Y**	**N**
12. I am sometimes irritated by people who ask favours of me	**Y**	**N**
13. I have never deliberately said something that hurt someone's feelings	**Y**	**N**

Please answer to the following questions about yourself.

1. How old were you at your last birthday?_____
2. Are you male or female?_____
3. What is the main language spoken at your home?_____
4. Which suburb do you live in? _____
5. How long have you had your license (*Including L-plates)*?_____ years _____ months
6. How many hours do you spend driving (as a driver) in an average week?_____
7. How many hours do you spend driving (as a passenger) in an average week?_____
8. Do you own your own car or have permanent access to a car owned by someone else?_____
9. How many car crashes have you been in as a driver?_____

If you have ever had a car crash as a driver, think of the most severe, and answer the following questions by circling "Yes" or "No":

b) Was anyone injured and hospitalised? Yes No

c) Was anyone injured and treated at the scene? Yes No

d) Was any vehicle towed away? Yes No

e) Were you at fault? Yes No

f) Was someone else at fault? Yes No

g) Were you booked? Yes No

h) Was another driver booked? Yes No

i) If you were booked, what was the charge?_____

Appendix D: Simulator-related Illusory Invulnerability Questionnaire

Please estimate the likelihood that the following events will happen to you in the next drive in the driving simulator, by circling a number from 1 to 7, where the numbers mean:

1= Extremely unlikely to happen to you

2= Very unlikely to happen to you

3= Unlikely to happen to you

4= Neither likely nor unlikely to happen to you

5= Likely to happen to you

6= Very likely to happen to you

7= Extremely likely to happen to you

1. Be booked for speeding	**1 2 3 4 5 6 7**
2. Have less than 2 car crashes	**1 2 3 4 5 6 7**
3. Be booked for going through a red light	**1 2 3 4 5 6 7**
4. Have a car crash on a blind corner	**1 2 3 4 5 6 7**
5. Get less than 2 fines	**1 2 3 4 5 6 7**

Please estimate the likelihood that the following events would happen to the average person driving the driving simulator for the second time, by circling a number from 1 to 7, where the numbers mean:

1= Extremely unlikely to happen to the average person

2= Very unlikely to happen to the average person

3= Unlikely to happen to the average person

4= Neither likely nor unlikely to happen to the average person

5= Likely to happen to the average person

6= Very likely to happen to the average person

7= Extremely likely to happen to the average person

1. Be booked for speeding	**1 2 3 4 5 6 7**
2. Have less than 2 car crashes	**1 2 3 4 5 6 7**
3. Be booked for going through a red light	**1 2 3 4 5 6 7**
4. Have a car crash on a blind corner	**1 2 3 4 5 6 7**
5. Get less than 2 fines	**1 2 3 4 5 6 7**

Appendix E: Simulator Data Record Sheet

*Date & Time:*_____
*Subject no:*_____ *Condition:*_____

1. Seatbelt worn? **Yes** **No**

2. Practice Run: Complaints of extreme dizziness? **Yes** **No**
   Complaints of nausea? **Yes** **No**
   Ceased driving experiment? **Yes** **No**

3. Test Drives: **Test Drive Order - ___ ___ ___ ___**

Drive 1

Event	*Computer Score #*
Off road accidents	
Collisions (with approaching object)	
Pedestrians hit	
Speed exceedances (exceed speed limit)	
Speeding tickets (police watching)	
Traffic light tickets	
Total run length (sec to complete run)	

Appendix F: Participant Information Statement Employed in Study 3

The University of Sydney

Psychology Department

NSW 2006 AUSTRALIA

Attitudes And Driving Behaviours In The STISIM Research Driving Simulator

Participant Information Sheet

Chief Investigators: Prof. Beryl Hesketh (ph: 9351 2685)
A/Prof. Soames Job (ph: 9351 2859)
Dr. Julie Hatfield (ph: 9351 8930)
Secondary Investigator: Ms. Justine Gatt (ph: 9351 2788)

You are invited to take part in an experiment investigating decision-making while driving. Your task in this experiment is to read an information booklet, complete several attitude questionnaires, and then drive a simulator as you would a real car. The driving simulator includes a full car cabin and provides you with full steering and motion control via a steering wheel, accelerator and brake pedals. The visual stimuli are provided by computer graphics projected onto screens in front of the car.

You will be asked to drive as though you need to get to work on time, however it is important that you obey normal road rules. Therefore, you shouldn't overtake when there are double lines on the road, you must stop at red traffic lights, and your speed must remain under the limit designated on speed limit signs.

You will be given $20 at the beginning of the experiment. However, every time you break a normal road rule, or crash, you will lose $4. You cannot lose any more than the $20 you are originally given. For example, if you break a rule twice and crash once, you will only be given $8 at the end of the experiment. If you break a rule three times and crash three times, you will not receive any money at the end of the experiment (but you will not owe us anything!).

In approximately 2 months time, you will be contacted to come back and repeat the same experiment as you complete today. However, when you return in 2 months time, you will be given $10 guaranteed, PLUS $20 minus the cost of any driving errors you make ($4 per error).

As with all devices of this type, a few people may experience feelings of discomfort or sickness during their drives in the simulator. These effects are usually not serious and last only a short time. If this happens, you should stop immediately and the session will be concluded. There will be no penalty or consequence if this occurs. You will be given the amount of money available for the time you spent driving, minus the cost of any "errors" you make. For example, if you quit after 1 drive only $5 is available to you (because there are 4 drives), so if you have made 1 error you will only receive $1.

All aspects of this study including the results will be strictly confidential and only the investigators named above will have access to the information. You will not be identified in any publication arising from the study. Participation in this study is entirely voluntary. You are not obliged to participate and if you do participate, you can withdraw at any time. This study will take approximately 1.25 minutes of your time.

Any person with concerns or complaints about the conduct of a study can contact the Manager of the Human Ethics Committee, University of Sydney, on (02) 9351 4811.

Appendix G: Intervention Message Employed in Study 3

In a while you will be having a drive in the driving simulator, but before you do I would like to talk to you about recognising risks.

When you are out driving on the road, it is very important that you are able to recognise risky situations, so that you can avoid them.

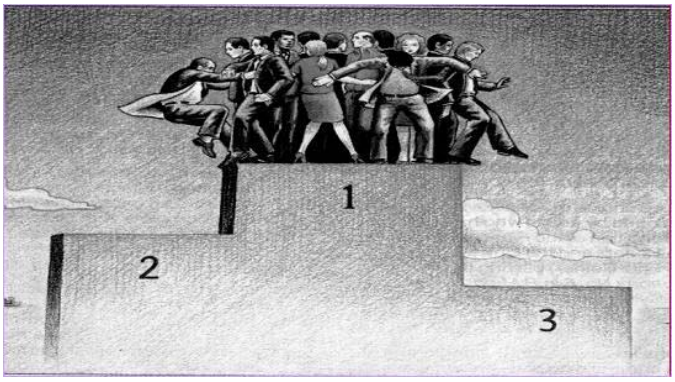
Recognising risks is not always easy, and one thing that might stop you from recognising risks accurately is a phenomenon called “illusory invulnerability”.

So I am going to tell you a bit about “illusory invulnerability”, and offer you some techniques for avoiding it.

Illusory invulnerability

People often think that they are better off than their peers.

a) They estimate that they are MORE likely than their average peer to experience positive events (like having a healthy, happy life after 80 years of age).



b) They estimate that they are LESS likely than their average peer to experience negative events (like being injured in a car crash, having an early heart attack, or being mugged).

In other words, illusory invulnerability translates into the common belief: “It won’t happen to me… I know it happens, but it won’t happen to me”.

Illusory invulnerability about driving

People have particularly strong illusory invulnerability when it comes to their driving. For example, many drivers think that they are less likely to crash than is the average driver of their age and gender. They think that they are better and safer drivers, compared to their average peer.

You probably experience illusory invulnerability

You might have been thinking “I don’t have illusory invulnerability…. Other people might, but I don’t”.

But this thought would be an example of illusory invulnerability... other people probably think that they don’t have illusory invulnerability either!

Think about the risks you take on the road. Don’t you often take them because you don’t really believe that you will have a crash, be injured or killed, or even get booked?

The dangers of illusory invulnerability

Illusory invulnerability can be a problem. Believing that bad things are less likely than average to happen to you makes you behave dangerously.

For example, you may drive faster than you should because you think you won't crash (or be booked) anyway. Or you might not leave a large enough gap between you and the car in front of you in a line of moving traffic because you think you will be able to brake fast enough not to crash into the car in front.

One of the most important things you can do to reduce the chances of bad things, like crashing, from happening to you is to believe that they ARE JUST AS LIKELY TO HAPPEN TO YOU AS TO YOUR PEERS.

Fighting illusory invulnerability

It is very important that you learn not to think you are invulnerable when you are not. I will now outline some of the reasons you may have for thinking you are better off than your peers, and ask you to analyse them carefully.

1) You might think that “crashes happen fairly often” because you “read about them and see them on TV”, that you have had very little crash experience. Similarly, you may see people getting booked quite frequently on the road, without being booked very often yourself. So you may reason that you are a safer and better driver than average, and that you are less likely than your average peer to have a crash or be booked in the future.

BUT REMEMBER:
There are a lot of other drivers, & only one of you. Even though car crashes seem to happen a lot, the chance of any one “average driver” having a crash is relatively low. Many drivers never have a serious crash.
Even if you have not yet had a crash, you could have one in future.

Even if you have had better driving past than your peers, this does not mean you will have a better driving future than your peers.

To illustrate this point: All of the drivers on the road today have never been killed in a car crash… just like you. Some of today’s drivers will be killed in a car crash in future. You could be one of them.

2) You may think that there is a particular kind of driver who drives dangerously or has crashes… and that you are not this kind of driver. For example, you might think that “taxi drivers are crazy drivers and crash considerably more than other drivers”.

BUT REMEMBER:
Do not stereotype “unsafe drivers”. All kinds of people take risks and have crashes.

People who are generally safe drivers sometimes drive unsafely... just like you. So, if you see a driver perform an unsafe act, don’t immediately stereotype them as an unsafe driver.

3) You may think that other drivers take more risks, and make more mistakes, than you.

BUT REMEMBER:
You make mistakes too.

You probably notice other people's mistakes more often than you notice your own. For example, if the driver in front of you forgets to indicate before turning, you notice (perhaps in colourful language!), whereas if you forget to indicate you probably don't notice.

You might dismiss your mistakes because you know the reasons for them (e.g. your blinker is broken, you were tuning the radio, you were looking for a street sign), whereas you don't know the reasons for other drivers' mistakes.

Other drivers may seem to make worse mistakes than you, because it is the big ones you notice.

4) You may simply want (or need) to think that you are unlikely have a crash, be injured or killed, or even be booked.

BUT REMEMBER:
Do not deny your risk; face it and do something about it.

Driving is a dangerous activity and crashes happen.

You can influence your chances of having a crash, being injured or killed, or being booked.

One of the most important things you can do to reduce your chances of experiencing these bad events is to judge risks accurately…

by remembering what illusory invulnerability is and fighting the irrational thoughts which cause it

Not having illusory invulnerability and being a low risk driver is critical to your health and safety

Naturally, you would prefer not to have crash, be injure or killed, or even be booked.

You can influence your chances of experiencing these bad events

You need to avoid taking risks.

To do this you need to recognise risks accurately, and one way of this is to fight illusory invulnerability.

Now you know what illusory invulnerability is, and you know some ways to avoid it. Please use your skills.

Were you *really* a safer than average driver this morning?
Will you be from now on?

Appendix H: Control Message Employed in Study 3

You will shortly be having a drive in the driving simulator. The driving simulator was constructed to allow researchers at the University of Sydney to conduct research into factors that affect driving behaviour. We first used the simulator in 1999, and since then, we and other researchers have conducted various research studies involving the driving simulator. Further studies are either currently in progress or still in the planning stage.

Now we'd like to tell you a bit about how the University of Sydney driving simulator was built and how it works. Please take the time to read the information in this booklet.

Location
The driving simulator is located in room 405 of the North Badham building at the University of Sydney. This room used to be an administrative office, and the driving simulator was installed in this room when the Clinical Psychology Unit moved to the Transient Building in 1999. A number of researchers share the facilities in this room to conduct their research.

Construction of the driving simulator
The driving simulator is made up of a full car body, three computers loaded with STISIM software, three projectors, and three large projection screens.

The motor and other components were removed from under the bonnet, and replaced by a number of mechanical and electrical devices that operate the driving simulator. You drive the simulator as if it is a real car. The steering wheel, accelerator, and brake are connected up under the bonnet so that it feels like driving a real car.

Under the bonnet there are also mechanical and electrical devices which allow the steering, accelerating, and braking mechanisms to function and which record their movements. The steering wheel, accelerator, and brake are connected up under the bonnet so that what you see on the projection screen is consistent with what you do. For example, if you brake, the image you see on the screen appears to “move toward” you as the car slows down and comes to a stop. You may also notice a gear stick in the car, but this is not used by the driver when driving on the simulator. The driver only needs to use the accelerator, brake, and steering wheel to manoeuvre the car. The car is also equipped with an accurate and fully functioning speedometer.

The computers which run the visual displays
The three computers that run the simulator displays are located at the rear of the driving simulator room. Each computer controls a separate part of the visual display. These computers work together to present the wide-angle image of a road environment that you will see when you have a drive on the simulator. The program that generates the images specifies the road characteristics, using a scenario definition language. For example, the computer program whether the road veers right, left, or remains straight. The program also specifies the number of lanes on the road at different stages of each drive, and where the intersections are located (and whether the intersections have traffic lights, require you to turn right or left, etc.). Finally, the computers have also been programmed to specify whether or not there are objects on the screen (e.g. pedestrians, other vehicles), the features of objects that are on the screen (e.g. the colour of the cars, etc.), and how long these objects remain on the screen.

The projectors
There are three projectors on the roof of the car. These projectors are positioned to transmit images onto the three white screens in front of the car. The images are computer generated and the projectors are linked to three computers that transmit the images to them. As mentioned earlier, the three computers have been programmed to run specific stimulus displays that are projected onto the screens in front of the car. The middle projector transmits the images seen on the central screen, the left projector transmits images seen on the left screen and the right projector transmits images seen on the right screen. The image transmitted onto the left screen also includes a rear view mirror image to allow drivers to see behind them (as they would do when driving a real car). Together these projectors give you a wide-angle image of the road environment.

Data collection
In addition to generating visual displays to be presented during the drives, the computers have been programmed to collect data in real time. This is obviously important to the researchers using the driving simulator. The computer program allows us to specify the start and end points for data collection. These points can be specified in terms of distance (e.g. starting at 200m before the intersection and finishing at 100m after the intersection), or in terms of time (e.g. starting at 10 secs from the time at which the car passes through the intersection and finishing at 50 secs from the time at which the car passes through the intersection). This feature is extremely useful in pinpointing data from particular manoeuvres within each drive.

The driving simulator room
The room which houses the driving simulator has been painted black (and covered with black plastic in some parts) to avoid light entering the room. This is important for the quality of the images and it also helps the driver to focus on the screens (there's not much else to look at!). There is a large black partition behind the car so that the driver is not distracted by the computer screens, or the experimenter, while they are driving. It is very important that drivers pay attention to the visual displays on the screens in front of them and not on anything else that is going on in the environment.

Driving simulators throughout Australia

The driving simulator is currently being utilised by a number of staff members and postgraduate students at the University of Sydney to conduct research into factors affecting driving behaviour. The University of Sydney driving simulator is one of four in Australia. These other driving simulators at located at the University of New South Wales, Macquarie University, and Monash University. It is hoped that the data gained from the research being conducted in these centres will help us to achieve a greater understanding of driver behaviour.

Appendix I: Participant Information Statement Employed in Study 4

ATTITUDES AND DRIVING BEHAVIOURS ON THE DRIVING SIMULATOR.

Participant Information Statement

Chief Investigator: Prof. Beryl Hesketh (ph: 9351 2685)
Secondary Investigator: Dr. Wendy Joung (ph: 9351 5679)

You are invited to take part in an experiment investigating risk-taking while driving. The aim of this experiment is to examine whether active exposure to driving errors reduces road related "illusory invulnerability", and consequently, the incidence of risky driving on the driving simulator. We will be assessing the effectiveness of the error training intervention (compared to other types of intervention such as verbal persuasion in the form of a lecture) in reducing the incidence of risky driving.

Your task in this experiment is to complete several attitude questionnaires, and then drive a simulator as you would a real car. The driving simulator includes a full car cabin and provides you with full steering and motion control via a steering wheel, accelerator and brake pedals. The visual stimuli are provided by computer graphics projected onto screens in front of the car. This experiment will take approximately 1.5 hours of your time.

You will be asked to drive as though you need to get to work on time, however it is important that you obey normal road rules. For example, you should stop at red traffic lights, and your speed should remain under the limit as indicated by speed limit signs.

As with all devices of this type, some people may experience feelings of discomfort or sickness during their drives in the simulator. These effects are usually not serious and last only a short time. If this happens, you should stop immediately and the session will be concluded. There will be no penalty or consequence if this occurs.

All aspects of the study including the results will be strictly confidential and only the investigators named above will have access to the information. You will not be identified in any publication arising from the study. Participation in this study is entirely voluntary. You are not obliged to participate and if you do participate you can withdraw at any time.

Any person with concerns or complaints about the conduct of a study can contact the Manager of the Human Ethics Committee, University of Sydney, on (02) 9351 4811.

Appendix J: Consent Form Employed in Study 4

ATTITUDES AND DRIVING BEHAVIOURS ON THE DRIVING SIMULATOR.

Informed Consent Form

Chief Investigator: Prof. Beryl Hesketh (ph: 9351 2685)
Secondary Investigator: Dr. Wendy Joung (ph: 9351 5679)

I, the undersigned, hereby declare that tasks related to the above-named research project which I have elected to commence have been fully and adequately explained to me. I understand that data collected from me during my participation cannot reveal my identity, and will never be related to any other information about me.

I acknowledge that I volunteered to participate in this specific project, and my consent was provided without additional incentive or risk of sanction. I understand that I am free to withdraw from this experiment at any stage of the proceedings.

Participant's		Investigator's	
Name:	_____	Name:	_____
Signature:	_____	Signature:	_____
Date:	_____	Date:	_____

Any person with concerns or complaints about the conduct of a study can contact the Manager of the Human Ethics Committee, University of Sydney, on (02) 9351 4811.

Appendix K: Training Summary Form Employed for the "Active Error" Group in Study 4

Order of drives:

Common mistakes people make are:

- Speeding
- Going through red lights
- Accidents

Your driving performance:

DRIVE 1

Task 3 (view is occluded by curve, cross traffic)

Did cross traffic arrive before or after driver arrived at intersection?

Collisions?

Speeding?

DRIVE 2

Task 5 (right turn across traffic)

Did driver make right turn in a safe way?

Did driver wait until all cars had passed or overtake in between?

Red light violation?

Collisions?

Task 4 (obstacle on road, cars from rear)

Did driver overtake obstacle in a safe way?

Did driver wait until all cars had passed or overtake in between?

Collisions?

Any speeding?

DRIVE 3

Task 7 (speed zones)

Speeding? How many times?

DRIVE 4

Task 2 (red lights)

Red light violation?

Task 1 (obstacle on road, 3 oncoming cars)

Did driver overtake obstacle in a safe way?

Did driver wait until all cars had passed or overtake in between?

Collisions?

Any speeding?

Appendix L: Training Summary Form Employed for the "Minimised Error" Group in Study 4

Participant no. _____

Training Summary (Errorless)

Order of drives:

Driving Performance:

- Followed the road rules
- Followed the road signs
- Kept within your lanes
- Drove at a good speed
- Didn't or had few red light violations
- Didn't or had few collisions

DRIVE 1

Task 3 (view is occluded by curve, cross traffic)

DRIVE 2

Task 5 (right turn across traffic)
Did driver wait until all cars had passed or overtake in between?

Task 4 (obstacle on road, cars from rear)

DRIVE 3

Task 7 (speed zones)

DRIVE 4

Task 2 (red lights)
Task 1 (obstacle on road, 3 oncoming cars)

Appendix M: Test Summary Form Employed Study 4

Test Summary

Order of drives:

DRIVE 1

Task 1 (obstacle on road, 3 oncoming cars)
Did driver overtake obstacle in a safe way?
Did driver wait until all cars had passed or overtake in between?
Collisions?

Task 2 (red lights)
Red light violation?

Task 3 (view is occluded by curve, cross traffic)
Did cross traffic arrive before or after driver arrived at intersection?
Collisions?

DRIVE 2

Task 5 (right turn across traffic)
Did driver make right turn in a safe way?
Did driver wait until all cars had passed or overtake in between?
Red light violation?
Collisions?

Task 4 (obstacle on road, cars from rear)
Did driver overtake obstacle in a safe way?
Did driver wait until all cars had passed or overtake in between?
Collisions?

DRIVE 3

Task 7 (speed zones)
Speeding?

DRIVE 5

Transfer (school children crossing)
Collisions?

DRIVE 6

Transfer (headway task)
Overtaking
Tailgating

DRIVE 7 ***[Remember to ask subjects to drive in the right lane!]***
Did driver have collision with obstacle (cones or police car) on road? If yes, which?
Did driver have collision with cars in the other lane?

Appendix N: Participant Debrief Employed in Study 4

ATTITUDES AND DRIVING BEHAVIOURS ON THE DRIVING SIMULATOR.

Participant Debrief

Chief Investigator: Prof. Beryl Hesketh (ph: 9351 2685)
Secondary Investigator: Dr. Wendy Joung (ph: 9351 5679)

The aim of this experiment is to examine whether active exposure to driving errors (with feedback) reduces road related "illusory invulnerability" and overconfidence, and consequently, the incidence of risky driving on the driving simulator. We will be assessing the effectiveness of the error training intervention (compared to other types of intervention such as verbal persuasion) in reducing the incidence of risky driving. The findings of this experiment will be used to develop key safety messages and experiences to be distributed at educational institutions, community youth centres and learner driver programs.

All aspects of the study including the results will be strictly confidential and only the investigators named above will have access to the information. You will not be identified in any publication arising from the study.

THANK YOU FOR YOUR PARTICIPATION

This information sheet is for you to keep.

Any person with concerns or complaints about the conduct of a study can contact the Manager of the Human Ethics Committee, University of Sydney, on (02) 9351 4811.

Appendix O: Participant Recruitment Log Employed by Driver Trainers

Driving Instructor Checklist

Instructor name:_____

Location:_____

Student name	I estimate that this student will take their driving test in no less than 2 weeks time	Date on which initial information package was offered (DD/MM/YY)
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /
	Yes/No (if Yes give information package)	/ /

Appendix P: Participant Information Statement Employed in Study 5

NSW
NJURY RISK
ANAGEMENT
EARCH CENTRE
BN 57 195 873 17

IRMRC

THE UNIVERSITY OF
NEW SOUTH WALES

Dr Julie Hatfield

Senior Research Fellow
Level 8, Applied Science Building
The University of NSW, 2052
Phone:+61 2 9385 7949
Facsimile: +61 +2 9385 6040
email: j.hatfield@unsw.edu.au

Approval No HREC 04161

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM

Strategies for improving risk perception in learner drivers

You are invited to participate in a study of factors relating to risky driving. We hope to learn whether particular strategies are effective in making risk perception more accurate and driving less risky. You were selected as a possible participant in this study because you are a learner driver, enrolled in driving lessons, and will soon attempt your driving test.

If you decide to participate, we will ask you to

(1) Sign and return the attached consent form in the envelope provided, and
(2) Read the enclosed reading material carefully in the next day or two. We may call to remind you
(3) Complete the enclosed evaluation of the reading material, and return it in the same envelope as the consent form

At your final driving lesson, you will be asked to fill out a short questionnaire. Also, a copy of the evaluation that your Instructor makes of your driving during this lesson will be provided to us, along with the student information that you out filled out when you enrolled with Trent.

We expect that it will take no more than 10 minutes to read the short pamphlet. Some participants will receive information relevant to the aims of this study, and others will receive irrelevant information. We have given you all the information you need, but you can get additional copies

The study is not expected to involve any additional risk beyond that involved in a normal driving lesson. The driving lesson from which we will obtain records will be conducted just like any driving lesson that you would ordinarily be given at this stage in your driving experience.

If you participate, you will go into the draw for one of 10 CD vouchers.

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission, except as required by law. If you give us your permission by signing this document, we plan to publish the results in reports to the Motor Accidents Authority and in journal articles and conference presentations. In any publication, information will be provided in such a way that you cannot be identified.

Complaints may be directed to the Ethics Secretariat, The University of New South Wales, SYDNEY 2052 AUSTRALIA (phone 9385 4234, fax 9385 6648, email ethics.sec@unsw.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

Your decision whether or not to participate will not prejudice your future relations with Trent Driving School or with The University of New South Wales. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without prejudice.

If you have any questions, please feel free to ask us. If you have any additional questions later, Carlo Caponecchia *(Ph. 93856142; email carloc@ unsw.edu.au)* will be happy to answer them.

You may keep this form.

PARTICIPANT INFORMATION STATEMENT AND CONSENT FORM (continued)

Strategies for improving risk perception in learner drivers

You are making a decision whether or not to participate. Your signature indicates that, having read the Participant Information Statement, you have decided to take part in the study.

……
Signature of Research Participant

……
(Please PRINT name)

……
Date

……
Signature(s) of Investigator(s)

…….
Please PRINT Name

We may also wish to contact you by telephone to remind you about reading the pamphlet. If you consent to us having your contact details for this purpose, please provide your telephone number below

Ph. ……..

Please return this page and the evaluation of the reading material to us in the reply paid envelope provided.

REVOCATION OF CONSENT

Strategies for improving risk perception in learner drivers

I hereby wish to **WITHDRAW** my consent to participate in the research proposal described above and understand that such withdrawal **WILL NOT** jeopardise my relationship with The University of New South Wales.

……
…….
Signature Date

……
Please PRINT Name

The section for Revocation of Consent should be forwarded to
Dr Julie Hatfield
Senior Research Fellow
NSW Injury Risk Management Research Centre
Level 8, Applied Science Building
The University of NSW, 2052

Please only return this page to us if you want to revoke your consent

Appendix Q: Intervention Message Employed in Study 5

DRIVER THINKING ERROR #3

You may think that there is a particular kind of driver who has crashes, or gets booked... and that you are not this kind of driver. For example, you might think that only young males have crashes (unless you are a young male!). You might think that only middle-aged women have crashes. You may simply think that people who have crashes are those who are unskilled or very risky drivers.

Attack this error:

a) Do not stereotype "unsafe drivers". All kinds of people take risks and have crashes.

b) People who are generally safe drivers sometimes drive unsafely... just like you. So, if you see a driver perform an unsafe act, don't immediately stereotype them as an unsafe driver.

DRIVER THINKING ERROR #4

You may simply want (or need) to think that you are unlikely have a crash, be injured or killed, or even be booked.

Attack this error:

a) Do not deny your risk; face it and do something about it.

b) Remember that driving is a dangerous activity and crashes happen.

c) You can influence your chances of having a crash, being injured or killed, or being booked.

d) One of the most important things you can do to reduce your chances of experiencing these bad events is to judge risks accurately... by remembering what illusory invulnerability is and fighting the irrational thoughts which cause it

Not having illusory invulnerability and being a low risk driver is critical to your health and safety

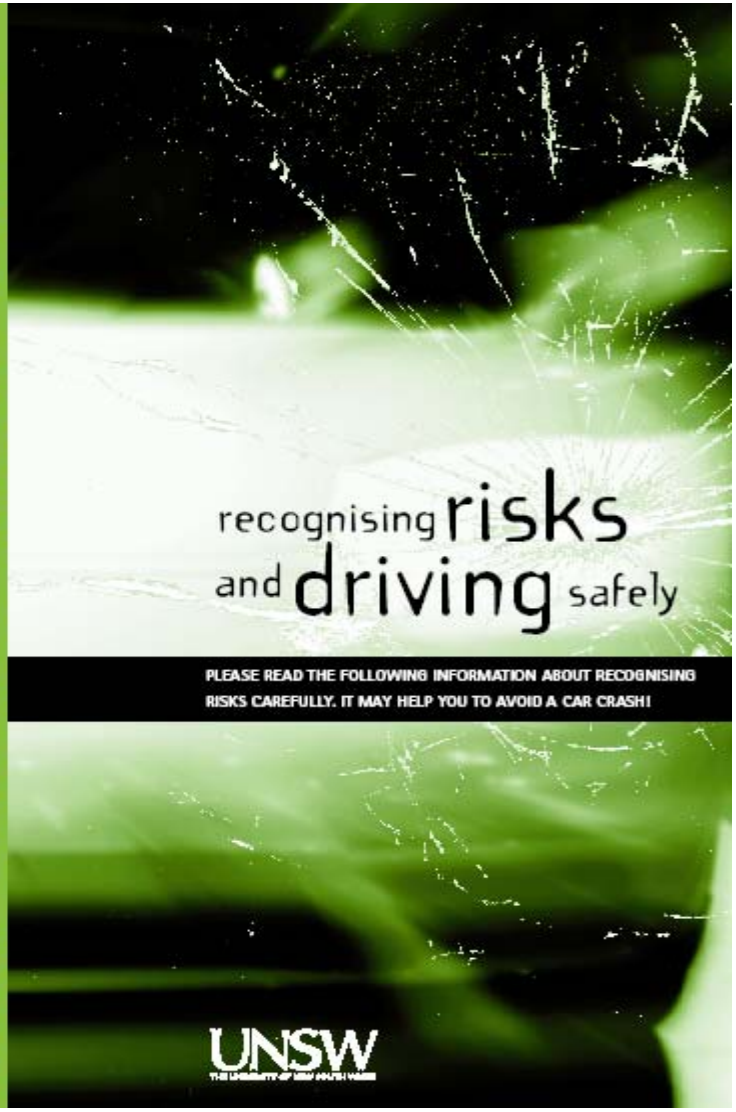
Naturally, you would prefer not to have a crash, or be injured, killed, or even booked. You can influence your chances of experiencing these bad events, by avoiding risks. To do this you need to recognise risks accurately, and one way of doing this is to fight illusory invulnerability.

Now you know what illusory invulnerability is, and you know some ways to avoid it. Please use your skills.

WERE YOU *REALLY* A SAFER THAN AVERAGE DRIVER THIS MORNING?

WILL YOU BE FROM NOW ON?

RECOGNISING RISKS AND DRIVING SAFELY



WHEN YOU ARE OUT DRIVING ON THE ROAD, IT IS VERY IMPORTANT THAT YOU ARE ABLE TO RECOGNISE RISKY SITUATIONS, SO THAT YOU CAN AVOID THEM.

RECOGNISING RISKS IS NOT ALWAYS EASY AND ONE THING THAT MIGHT STOP YOU FROM RECOGNISING RISKS ACCURATELY IS "ILLUSORY INVULNERABILITY".

What is "illusory invulnerability"?

People often think that they are better off than their peers. For example, they think that they are less likely than their peers to experience negative events like being mugged or having a heart attack.

In other words, illusory invulnerability translates into the common belief: "It won't happen to me...".

People have particularly strong illusory invulnerability when it comes to their driving. For example, most drivers think that they are less likely to crash than the average driver of their age and gender. They think that they are better and safer drivers.

Is illusory invulnerability a problem?

Yes- illusory invulnerability can be a problem. When you think that bad things won't to happen to you, you are likely to behave dangerously.

For example, if you can't imagine having a car crash, then you might not bother to stick to the speed limit, or you might not leave a large enough gap between you and the car in front of you.

You probably experience illusory invulnerability

You might be thinking "I don't have illusory invulnerability.... Other people might, but I don't".

But this thought would be an example of illusory invulnerability.. other people probably think that they don't have illusory invulnerability either!

Think about the risks you take on the road. Don't you often take them because you don't really believe that you will have a crash, or even get booked?

You should fight illusory invulnerability

It is very important that to recognise your vulnerability on the road. One of the most important things you can do to avoid crashing, or being booked, is to believe that it is *just as likely to happen to you as to your peers.*

How to fight illusory invulnerability

You need to be aware of the faulty thinking that might cause illusory invulnerability, so that you can fight this faulty thinking.

Several kinds of faulty thinking might be involved. They are outlined below, with ways to fight them.

DRIVER THINKING ERROR #1

You may think that other drivers make more mistakes, and take more risks, than you.

Attack this error:

a) Remember that you make mistakes too. Try to notice them when they happen. At the end of each drive you do, make a list of all of the mistakes you made. You can find a checklist to use for this at **www.irmrc.edu.au/Feedback.survey.asp** Keeping track of your mistakes will help you not to make them in future.

b) Ask the people who travel with you when you are driving (like your parents) to point out your mistakes, to help you to learn to be a safe driver.

c) You probably notice other people's mistakes more often than you notice your own. For example, if the driver in front of you forgets to indicate before turning, you notice (perhaps in colourful language!), whereas if you forget to indicate you probably don't notice. When you notice another driver make a mistake, try to remember a time when you have made the same mistake.

d) You might dismiss your mistakes because you know the reasons for them (e.g. your blinker is broken, you were tuning the radio, you were looking for a street sign), whereas you don't know the reasons for other drivers' mistakes. When you make a mistake, remember that a mistake is a mistake even if you know why you made it.

e) Remember that, just like you, other drivers try to drive safely.

DRIVER THINKING ERROR #2

You might think that crashes happen fairly often because you see them or hear about them (from people you know, or in the media). Also, you may see people getting booked quite frequently on the road. In contrast, you probably have very little experience of crashing, or being booked. So you may reason that you are a safer and better driver than average, and that you are less likely than your peers to have a crash or be booked in the future.

Attack this error:

a) Remember that there are a lot of other drivers and only one of you. Even though car crashes seem to happen a lot, the chance of any one driver having a crash is fairly low. In fact, many drivers never have a serious crash.

b) Remember that even if you have not yet had a crash, you could have one in future.

c) Remember that even if you have had better driving history than your peers, this does not mean you will have a better driving future than your peers.

d) To illustrate this point: All of the drivers on the road today have never been killed in a car crash... just like you. Some of today's drivers will be killed in a car crash in future. You could be one of them.

Appendix R: Driving Checklist accompanying Intervention Message Employed in Study 5

Driving Checklist

Indicate whether you did any of the following in this drive

(N/A = “not applicable” in that the relevant circumstance did not arise)

1. Kept driving even though you were very tired	**Yes**	**No**	**N/A**
2. Gave way appropriately at intersections	**Yes**	**No**	**N/A**
3. Stopped driving if you wanted to talk on a hand-held mobile phone	**Yes**	**No**	**N/A**
4. Exceeded the speed limit by no more than 15km/hr	**Yes**	**No**	
5. Drove with a blood alcohol content above the legal limit	**Yes**	**No**	
6. Drove while under the influence of illegal drugs that may impair your driving	**Yes**	**No**	
7. Moved into a lane without checking properly for Vehicles in that lane	**Yes**	**No**	**N/A**
8. Did not indicate when turning	**Yes**	**No**	**N/A**
9. Reduced your usual speed appropriate to conditions	**Yes**	**No**	
10. Turned right across a busy road even though there was a small chance of a collision	**Yes**	**No**	**N/A**
11. Wore your seatbelt	**Yes**	**No**	**N/A**
12. Kept a safe distance between your vehicle and the vehicle in front of you	**Yes**	**No**	**N/A**
13. Accidentally caused a dangerous situation	**Yes**	**No**	
14. Ran a red light	**Yes**	**No**	**N/A**
15. Did not give way to pedestrians when appropriate	**Yes**	**No**	**N/A**

Appendix S: Control Message Employed in Study 5

The following contains information about changing a tyre and inspecting your tyres for signs of wear. Please carefully read this information as it may assist you when your vehicle breaks down.

Changing a flat tyre

Modern, steel-belted radial tyres provide many kilometres of trouble-free driving. The possibility still exists, however, that a tyre may be punctured by debris, blow out, or otherwise go flat. The following guidelines present steps and precautions to help you change a tyre easily and safely if the need should arise.

Before you try to change a flat tyre, be sure the car is on a firm level surface. It's OK to move the vehicle a short distance very slowly on a flat tyre to get it onto a surface where it is safe to jack it up for tyre changing. Place the transmission in park (or reverse gear for a manual transmission) and apply the parking brake firmly.

There are a variety of jack styles. One type fits into a sill locator bracket on the side of the car. Some vehicles use a bumper jack that fits into a slot on the bottom of the bumper. Still others have a screw-type scissors jack that is placed under the vehicle axle or suspension. The jack handle usually has a wheel nut socket at one end and a prybar point at the other for removing wheel covers.

Your owner's manual contains instructions for operating the jack. Most vehicles also have a placard on the spare tyre cover or near the jack that contains the same instructions. If you can't find the jack instructions and are unsure about its operation, it is advisable to have the tyre changed by Emergency Road Service.

The following instructions are general, and your vehicle may require special procedures. Pay particular attention to the safety precautions in these instructions. All passengers should be out of the vehicle except small children secured in child car seats.

1. Remove the spare tyre, jack, and tool kit from the boot or other storage location. Place the spare tyre next to the flat tyre.

2. Install the jack in the appropriate body location as specified in the instructions for your vehicle. Operate the jack to put slight pressure on the vehicle but do not raise the vehicle yet.

Do not get under any part of the vehicle while it is raised on the jack.

3. If they are available, place wheel chocks to block the wheel diagonally opposite the one you are changing as further insurance against vehicle movement. If wheel chocks are not available use a large rock, brick, or piece of wood.

4. If necessary, remove the wheel cover from the flat tyre to expose the wheel nuts.

5. Loosen the wheel nuts one turn while the wheel is still on the ground but do not remove them yet.

6. Raise the vehicle with the jack until the tyre just clears the ground.

7. Remove the wheel nuts and the flat tyre. Lay the flat tyre under the side of the car so that if the jack falls, the car will still be supported by the wheel and tyre.

8. Install the spare tyre. (You may need to raise the jack slightly higher for clearance to install the inflated spare tyre.)

9. Install and tighten the wheel nuts as much as possible with the wheel raised off the ground.

10. Remove the damaged tyre from under the car and slowly lower the jack until the spare tyre just touches the ground.

11. Finish tightening the wheel nuts completely. Tighten them in a star-shaped or crisscross pattern and in three or four stages to be sure they are secure.

12. Lower the jack completely and remove it from the vehicle. Reinstall the wheel cover.

13. Remove the wheel chocks and store the damaged tyre, the jack, and other tools in the vehicle.

If you must leave the spare tyre on the vehicle for more than a day or two, have the tightness of the wheel nuts checked at a repair facility.

Inspecting Tyre Tread Condition

Although modern tyres may get exceptional mileage before needing replacement, the tread will eventually wear down. All modern tyres have tread wear indicators (tread bars) that appear as continuous bars across the entyre tread width when the tyres wear out. Tread wear indicators become visible when the tread wears to its last 1/16 inch or to the minimum tread depth permitted by law.

Replace any tyre when the indicators become exposed in two adjacent tread grooves across the tread width or in two locations around the tyre circumference. Ideally, the tread wear should be even from right to left across the width of the tread. This indicates a tyre that was operated at the proper inflation pressure with no wheel alignment or wheel balance problems.

Besides checking your tyres for normal wear, you should look for abnormal wear conditions. Two common-but easily correctable-causes of abnormal tread wear are overinflation and under inflation.

Underinflation: An underinflated tyre has been operated at lower pressure than recommended by the tyre maker/vehicle manufacturer. Low pressure causes the tyre to collapse slightly, and more vehicle weight is carried on the tyre sidewalls than on the center of the tread. Consequently, tread wear will be greater toward the sides than in the center. It shortens tyre life and can make steering seem slow and sluggish. Under inflation is a far more common problem than overinflation.

Overinflation: An overinflated tyre has been operated at higher pressure than recommended by the tyre maker or the vehicle manufacturer. High pressure causes the tyre to expand more, and wear will be greater in the center of the tread than toward the sides. The inside and outside edges wear less because they contact the road with less force than does the center of the tread. Overinflation shortens tyre life and can make vehicle handling seem "light" or "skittish," particularly on wet roads.

Abnormal tyre wear due to overinflation and underinflation is not the only thing to look for when you inspect your tyres. Tyres that show uneven tread wear on the inside and outside areas or across the tread width may be a clue to wheel alignment problems. If the tread sections next to the grooves have feathered edges, it often indicates problems associated with the wheel alignment "toe angle." Any of these conditions is a good reason to have the wheel alignment checked by a service facility.

If any tyre has unusual wear in the form of flat spots or worn chunks of tread, it may indicate a wheel balance problem. This kind of tyre wear may be accompanied by noticeable vibration or steering wheel shaking at certain speeds. Regular tyre rotation and balancing not only prolongs tyre life, it contributes to safe vehicle control.

While you are checking the tyre tread, also look at the sidewalls for any cuts or bulges. These could be signs of impending tyre trouble. If you see any, you should have the tyre checked further by a professional technician. Surface scrapes from rubbing curbs and small indentations from the manufacturing process will not cause problems.

Appendix T: Materials Evaluation Form

Evaluation of reading materials

Please answer the following questions about the reading material we gave you by ticking the appropriate box

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The material was easy to read					
The material was easy to understand					
The format of the material made sense					
The material was interesting					

Please return this form in the reply paid envelope with your signed consent form

Appendix U: Questionnaire Employed in Study 4

In this questionnaire you are asked about your beliefs regarding the future for an average person of your age and gender, and about your beliefs regarding your future. You are also asked some personal details (age, gender etc).

Please answer as accurately and honestly as you can.
There are no right or wrong answers - we are interested in what you think, even if you are not sure it is correct.
Thank you for your participation and co-operation.

Please estimate the likelihood that the following events will happen to ***you*** *in the next 5 years, by circling a number from 1 to 7, where the numbers mean:*

1= ***Extremely unlikely*** *to happen to you*

2= ***Very unlikely*** *to happen to you*

3= ***Unlikely*** *to happen to you*

4= ***Neither likely nor unlikely*** *to happen to you*

5= ***Likely*** *to happen to you*

6= ***Very likely*** *to happen to you*

7= ***Extremely likely*** *to happen to you*

1. Have a car crash, as a driver	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. Not be hospitalised in the next 5 years for illness or injury	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. Travel overseas in the next 5 years	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4. Be booked for speeding	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. Have pneumonia	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6. Just avoid a car crash because you are able to stop quickly	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7. Be injured in a car crash, as a driver	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8. Be killed in a car crash, as a driver	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9. Have 3 consecutive years without having a car crash	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. Have 3 consecutive years without being booked	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. Have the car you are driving stolen	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12. Drive safely if driving while tired	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13. Be booked for running a red light	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14. Have gastrointestinal illness	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15. Have your wallet stolen	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16. Be injured in a car crash, as a passenger	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17. Be killed in a car crash, as a passenger	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18. Be booked for driving with a blood alcohol content over the legal limit	**1**	**2**	**3**	**4**	**5**	**6**	**7**

Please estimate the likelihood that the following events will happen to the ***average driver of your age and gender****, by circling a number from 1 to 7, where the numbers mean:*

1= ***Extremely unlikely*** *to happen to the average driver*

2= ***Very unlikely*** *to happen to the average driver*

3= ***Unlikely*** *to happen to the average driver*

4= ***Neither likely nor unlikely*** *to happen to the average driver*

5= ***Likely*** *to happen to the average driver*

6= ***Very likely*** *to happen to the average driver*

7= ***Extremely likely*** *to happen to the average driver*

1. Have a car crash, as a driver	**1**	**2**	**3**	**4**	**5**	**6**	**7**
2. Not be hospitalised in the next 5 years for illness or injury	**1**	**2**	**3**	**4**	**5**	**6**	**7**
3. Travel overseas in the next 5 years	**1**	**2**	**3**	**4**	**5**	**6**	**7**
4. Be booked for speeding	**1**	**2**	**3**	**4**	**5**	**6**	**7**
5. Have pneumonia	**1**	**2**	**3**	**4**	**5**	**6**	**7**
6. Just avoid a car crash because you are able to stop quickly	**1**	**2**	**3**	**4**	**5**	**6**	**7**
7. Be injured in a car crash, as a driver	**1**	**2**	**3**	**4**	**5**	**6**	**7**
8. Be killed in a car crash, as a driver	**1**	**2**	**3**	**4**	**5**	**6**	**7**
9. Have 3 consecutive years without having a car crash	**1**	**2**	**3**	**4**	**5**	**6**	**7**
10. Have 3 consecutive years without being booked	**1**	**2**	**3**	**4**	**5**	**6**	**7**
11. Have the car you are driving stolen	**1**	**2**	**3**	**4**	**5**	**6**	**7**
12. Drive safely if driving while tired	**1**	**2**	**3**	**4**	**5**	**6**	**7**
13. Be booked for running a red light	**1**	**2**	**3**	**4**	**5**	**6**	**7**
14. Have gastrointestinal illness	**1**	**2**	**3**	**4**	**5**	**6**	**7**
15. Have your wallet stolen	**1**	**2**	**3**	**4**	**5**	**6**	**7**
16. Be injured in a car crash, as a passenger	**1**	**2**	**3**	**4**	**5**	**6**	**7**
17. Be killed in a car crash, as a passenger	**1**	**2**	**3**	**4**	**5**	**6**	**7**
18. Be booked for driving with a blood alcohol content over the legal limit	**1**	**2**	**3**	**4**	**5**	**6**	**7**

*The next set of questions ask you how often **you** will do certain actions as a proportion of the time you spend driving. Think about your driving **over the next year**, and indicate how often you will do each action by circling a number from 0 to 6, where the numbers mean:*

0= Never

1= Hardly ever

2= Occasionally

3= Quite often

4= Frequently

5= Nearly all the time

6= Always

1. Run a red light	**0**	**1**	**2**	**3**	**4**	**5**	**6**
2. Keep driving even though you are very tired	**0**	**1**	**2**	**3**	**4**	**5**	**6**
3. Give way appropriately at intersections	**0**	**1**	**2**	**3**	**4**	**5**	**6**
4. Stop driving if you want to talk on a hand-held mobile phone	**0**	**1**	**2**	**3**	**4**	**5**	**6**
5. Move into a lane without checking properly for Vehicles in that lane	**0**	**1**	**2**	**3**	**4**	**5**	**6**
6. Drive with a blood alcohol content above the legal limit	**0**	**1**	**2**	**3**	**4**	**5**	**6**
7. Drive while under the influence of illegal drugs that may impair your driving	**0**	**1**	**2**	**3**	**4**	**5**	**6**
8. Travel as a passenger of a driver with a blood alcohol content above the legal limit	**0**	**1**	**2**	**3**	**4**	**5**	**6**
9. Wear a seatbelt	**0**	**1**	**2**	**3**	**4**	**5**	**6**
10. Reduce your usual speed appropriate to conditions	**0**	**1**	**2**	**3**	**4**	**5**	**6**
11. Turn right across a busy road even when there is a small chance of a collision	**0**	**1**	**2**	**3**	**4**	**5**	**6**
12. Exceed the speed limit by no more than 15km/hr	**0**	**1**	**2**	**3**	**4**	**5**	**6**
13. Keep a safe distance between your vehicle and the vehicle in front of you	**0**	**1**	**2**	**3**	**4**	**5**	**6**
14. Accidentally cause a dangerous situation	**0**	**1**	**2**	**3**	**4**	**5**	**6**
15. Not indicate when turning	**0**	**1**	**2**	**3**	**4**	**5**	**6**
16. Not give way to pedestrians when appropriate	**0**	**1**	**2**	**3**	**4**	**5**	**6**

The next set of questions ask you how often you think the ***average driver of your age and gender*** *will do certain actions as a proportion of the time they spend driving. Think about their driving* ***over the next year****, and indicate how often they will do each action by circling a number from 0 to 6 where the numbers mean:*

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

1. Run a red light	**0**	**1**	**2**	**3**	**4**	**5**	**6**
2. Keep driving even though you are very tired	**0**	**1**	**2**	**3**	**4**	**5**	**6**
3. Give way appropriately at intersections	**0**	**1**	**2**	**3**	**4**	**5**	**6**
4. Stop driving if you want to talk on a hand-held mobile phone	**0**	**1**	**2**	**3**	**4**	**5**	**6**
5. Move into a lane without checking properly for Vehicles in that lane	**0**	**1**	**2**	**3**	**4**	**5**	**6**
6. Drive with a blood alcohol content above the legal limit	**0**	**1**	**2**	**3**	**4**	**5**	**6**
7. Drive while under the influence of illegal drugs that may impair your driving	**0**	**1**	**2**	**3**	**4**	**5**	**6**
8. Travel as a passenger of a driver with a blood alcohol content above the legal limit	**0**	**1**	**2**	**3**	**4**	**5**	**6**
9. Wear a seatbelt	**0**	**1**	**2**	**3**	**4**	**5**	**6**
10. Reduce your usual speed appropriate to conditions	**0**	**1**	**2**	**3**	**4**	**5**	**6**
11. Turn right across a busy road even when there is a small chance of a collision	**0**	**1**	**2**	**3**	**4**	**5**	**6**
12. Exceed the speed limit by no more than 15km/hr	**0**	**1**	**2**	**3**	**4**	**5**	**6**
13. Keep a safe distance between your vehicle and the vehicle in front of you	**0**	**1**	**2**	**3**	**4**	**5**	**6**
14. Accidentally cause a dangerous situation	**0**	**1**	**2**	**3**	**4**	**5**	**6**
15. Not indicate when turning	**0**	**1**	**2**	**3**	**4**	**5**	**6**
16. Not give way to pedestrians when appropriate	**0**	**1**	**2**	**3**	**4**	**5**	**6**

*Please indicate which of the following statements apply to **you** by circling Yes (Y) or No (N).*

1. It is sometimes hard for me to go on with my work if I am not encouraged	**Y**	**N**
2. I sometimes feel resentful when I don't get my way	**Y**	**N**
3. On a few occasions, I have given up doing something because I thought too little of my ability	**Y**	**N**
4. There have been times when I felt like rebelling against people in authority even though I knew they were right	**Y**	**N**
5. No matter who I'm talking to I am always a good listener	**Y**	**N**
6. There have been occasions when I took advantage of someone	**Y**	**N**
7. I'm always willing to admit it when I make a mistake	**Y**	**N**
8. I sometimes try to get even rather than forgive and forget	**Y**	**N**
9. I am always courteous, even to people who are disagreeable	**Y**	**N**
10. I have never been bothered when people have expressed ideas very different from mine	**Y**	**N**
11. There have been times when I was quite jealous of the good fortune of others	**Y**	**N**
12. I am sometimes irritated by people who ask favours of me	**Y**	**N**
13. I have never deliberately said something that hurt someone's feelings	**Y**	**N**

Please answer to the following questions about yourself.

1. Are you male or female?_____
2. What is your date of birth? (DD/MM/YY) _____

2. What is the main language spoken at your home?_____

3. How many car crashes have you been in as a driver?_____

If you have ever had a car crash as a driver, think of the most severe, and answer the following questions by circling "Yes" or "No":

a) Were you at fault? Yes No

b) Was the crash reported to the police? Yes No

c) Was anyone injured and hospitalised? Yes No

Please collect the copy of your driving evaluation from the driving instructor, put it back in the envelope with this questionnaire, seal the envelope, and then hand it back to the driving instructor. Thank you!

Appendix V: Trent On-Road Test (TORT) Form

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TRENT ON ROAD TEST (TORT) ASSESSMENT SHEET

Student: [redacted] **Route:** [redacted]

Driver Trainer: [redacted] **Date:** [redacted] **Time:** 1:41

FAIL ITEMS

1. ☐ Not Give Way
2. ☐ Parking Too Far From Kerb
3. ☐ Disobey Lights; Traffic Signs; Road Markings
4. ☐ Not Following Early Directions
5. ☐ Exceeding Speed Limit
6. ☐ Driving Too Slowly
7. ☐ Give Way Unnecessarily
8. ☐ Disobeying a Police Officer's Direction
9. ☐ Requires Assistance From Trainer To Avoid A Dangerous Situation
10. ☐ Causing a Dangerous Situation
11. ☐ Not Signalling Intention
12. ☐ Disregarding Approaching Emergency Vehicle
13. ☐ Not Give Way to Pedestrians
14. ☐ Dangerous Procedure/Dangerous Lane Change
15. ☐ Unsafe at Point of Decision
16. ☐ Too Fast for the Situation
17. ☐ Following Distance Too Short

All -99

MANOEUVRES & PROCEDURES

	Yes	No	N/a
Leaving the Kerb			
Reverse Park			
Correct Procedure			
Distance to Kerb		✓	
Position - Parallel			
- Angle			
Traffic Checks		✓	
Slow Speed Control			
Signals Intention			
Three Point Turn			
Correct Procedure			
Distance to Kerb			
Slow Speed Control			
Traffic Checks			
Signals Intention			
Kerbside Stop			
Signals Intention			
Not Roll Back			
Traffic Checks			
Controls			
Position			
SUBTOTAL			

PERFORMANCE CHECKS

PERFORMED		Yes	✓	No	✓	N/A	✓	TOTAL Yes	TOTAL No	TOTAL N/A
Apply Brakes Smoothly	YES									
	NO									
	N/A									
Adjust Speed - Curve	YES									
	NO									
	N/A									
Adjust Speed - General	YES									
	NO									
	N/A									
Intersection Safety Procedure/ Observation	YES									
	NO		✓							
	N/A									
Keeps Within Lane	YES									
	NO									
	N/A									
Left Turn Positioning	YES									
	NO									
	N/A									
Maintaining Traffic Flow	YES									
	NO									
	N/A									
Observes Traffic Behind	YES									
	NO									
	N/A									
Observation When Diverging	YES									
	NO		✓							
	N/A									
Right Turn Positioning	YES									
	NO									
	N/A									
Selecting Adequate Gap	YES									
	NO									
	N/A									
Stopping Behind Line	YES									
	NO									
	N/A									
Satisfactorily Operating Controls	YES									
	NO		✓		✓					
	N/A									
Signalling When Necessary	YES									
	NO									
	N/A									
Unexpected Situation Mastery	YES									
	NO									
	N/A									
SUBTOTAL										

TOTAL YES 66 TOTAL YES & NO 72

$$\frac{\text{TOTAL YES}}{\text{TOTAL YES \& NO}} = 92\%$$

Below 60%	60-69%	70-74%	75-79%	80-89%	90-Plus%
☐	☐	☐	☐	☐	☑ ACCEPTABLE

RESULT WELL DONE! YOU PASSED ☑ SORRY! YOU DO NOT QUALIFY ☐ FAIL ITEM ☐

Appendix W: Trent Student Details Form

TRENT DRIVING SCHOOL ***STUDENT QUESTIONNAIRE***

Driver Trainer: [redacted] Date: 8/x/04.

[redacted] ISSUED: Handbook: ☑ Student Record Card: ☑

1. PERSONAL PARTICULARS

Full Name: [redacted]

Address: [redacted] Post Code: [redacted]

Telephone: Home: [redacted] Work: Mobile: [redacted]

2. LICENCE PARTICULARS

Learners: Number [redacted] Expiry: 1.5.07 Interim Expiry: _____ D.O.B [redacted]

Overseas: Country: _____ Arrival Date: _____ Number: _____ Expiry: _____

Licence Conditions: Earliest Test Date:

3. VERBAL DRIVING EVALUATION

1. Have you done any driving? Yes ☐ No ☑
2. Who with? Parent ☐ Friend ☐ Driving School ☐
3. How many hours driving? _____ Hours ☐
4. When did you last have tuition? Recent ☐ 1 month ☐ Over 6 months ☐
5. Where did you have the tuition? Off road ☐ Quiet area ☐ Busy ☐
6. What type of car did you drive? _____ Auto ☐ Manual ☐
7. Have you been in traffic? Yes ☐ No ☐

4. TRAINING CATEGORY

What do you expect from Trent?

1. Finalise training and presentation for a licence test. ☐
2. All instruction with Trent. ☐
3. Tuition with Trent and private tutor. ☑
4. Introductory lesson and home practice. ☐
5. Single item tuition. ☐ Item:

5. ESTABLISHING NEEDS

1. Are you going to have home practice? Yes ☑ No ☐ Who with?
2. How often would you like to have this practice, a session a day? Yes ☐ No ☑
3. Will you receive this? Yes ☐ No ☐
4. I must tell you the benefits of close together tuition. It will save you money.
5. We will now set a date for your licence test. Date 6/11/04
6. I will expect you to pass first go, so we will organise a programme to ensure that you do.
7. We will need to complete tuition by? Date 24/10/04

6. OCCUPATION

(Obtain this information during the first or second session).

School: ☐ Tertiary: ☐ Part-time work: ☐ Full time work: ☑ Shift work: ☐ Not working: ☐

Place: [redacted] Position: _____

Start: [redacted] Finish: [redacted]

Departure point: [redacted] Arrival Point: [redacted]

Best tuition days: [redacted] Best tuition times: [redacted]

[redacted]

Appendix X: Instructions to driver trainers

Strategies for improving risk perception in learner drivers

Chief Investigator: Dr Julie Hatfield
NSW Injury Risk Management Research Centre

Information for Driving Instructors
Updated 15th March, 2005

Thank you for agreeing to take part in our study. Below is some general information about the study, as well as a detailed description of what we'd like you to do.

Background

The research program aims to design and evaluate messages to improve risk perception in young drivers, and in turn improve road safety. In particular, the messages are designed to reduce "illusory invulnerability" – that is, people's perception that they are less likely than their peers to experience negative events (e.g., a car crash). If someone believes that they are not likely to have negative experiences on the road, then they may be more likely to engage in risky behaviours (e.g., speeding) or less likely to either engage in preventative behaviours (e.g., wearing a seatbelt).

The messages have been designed and evaluated in a university student sample. It is now important to trial them in a learner driver sample.

We are happy to give you more details about the messages, but we need to do this at the conclusion of the study. We must ensure that the students only receive the messages in the form of the materials we have prepared.

Brief overview

Learner Drivers who are within 2 weeks of their RTA driving test will be invited to participate in the study and given information envelopes (containing information, consent, study messages). Learner drivers who consent to participating in the study will read the materials provided to them (which may be relevant to improving risk perception, or not relevant, i.e., the control group). Subsequently, following a normal driving lesson, a copy of your driving evaluation (TORT) will be given to researchers, and students will complete some questionnaires.

Detailed Instructions

1. Students who are likely to complete their driving test in 2 weeks are identified by driving instructors as "potential participants".

1. Driving Instructors approach potential participants, giving them an envelope with study materials (the *information envelope*, containing information forms, consent forms and the reading materials). You mark on the "Driving Instructor checklist"(the blue form) which students have been offered and accepted the information envelopes. When you have 10 students who have *accepted* the envelopes, you send the blue checklist back to us in the reply paid envelope provided.

In doing so, you cannot exert any pressure on the student to participate.
You can use this standard script:

Trent is helping UNSW with a study about risky driving. If you choose to participate it might improve your danger perception and you could win one of ten CD vouchers. So you should read through all the information and materials very carefully.

The student may ask you a number of questions. Some of these are simple, and can be answered simply

e.g., Q. how long does it take?
A. About 10 minutes this week, for you to read the info and send the consent form back, and 10 minutes after another driving lesson.

Q. What's involved?
A. There is some material to read in this envelope. After another driving lesson you'll have to fill in questionnaires. You can read all about it in this envelope.

For any other questions, you can refer them to the info in the envelope, and tell them that the researcher's contact details are included.

This is especially important if they ask you anything regarding the messages. Say that you can't answer that and that if they have questions they should contact the researchers.

It is important that you **do not** know which messages your students have received. Knowing this may (unintentionally) bias your assessment of their driving (e.g., by noticing particular things, being more harsh or more lenient). Please ask the student to not tell you the nature of the messages they received.

2. Students return the consent forms to the researchers.

Researchers notify you of consenting participants by sending the questionnaire packages out to you. There will be a 2-week delay for each participant from when

1. they got the materials to the next step. When you receive the questionnaire packages marked with learner drivers' names, step 5 can occur.

2. After their driving lesson, which is a practice test, you give the "consenting participants" the appropriate *questionnaire envelope (which will be labelled with their name)*. They fill in the questionnaires (it takes about 10 minutes).

3. While students complete the questionnaires, record the student's name and the start and finish time of the lesson on your evaluation (TORT).

4. Researchers will get the carbon copy of your evaluation. Hand the carbon copy of the TORT evaluation to the student, to put it into the envelope with their completed questionnaires. This is to increase the perception of anonymity.

5. You take the envelope containing the completed questionnaires and a copy of the TORT back to the proprietor/head office. Alternatively you can mail them back to us (addresses below)

If you have any questions or problems, please contact us at any time:

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