MOTORCYCLE SAFETY RESEARCH PROJECT

Interim Summary Report 3:
TRAINING AND LICENSING INTERVENTIONS FOR RISK TAKING AND HAZARD PERCEPTION FOR MOTORCYCLISTS

Report to Queensland Department of Transport and Main Roads

Prepared by Narelle Haworth, Peter Rowden, Darren Wishart, Lisa Buckley & Barry Watson

April 2012

Deliverable Task 3.5

The Centre for Accident Research & Road Safety - Queensland is a joint venture initiative of the Motor Accident Insurance Commission and Queensland University of Technology

Preface

Project Manager / Team Leader:

Professor Narelle Haworth

Research Team:

Mr Peter Rowden

Professor Barry Watson

Mr Darren Wishart

Dr Lisa Buckley

Ms Kristi Greig

Certain information in this research report has been withheld, as the Department of Transport and Main Roads does not hold the intellectual property rights to the information.

Executive Summary

Motorcycle trauma is a serious road safety issue in Queensland and throughout Australia. In 2009, Queensland Transport (later Transport and Main Roads or TMR) appointed CARRS-Q to provide a three-year program of Road Safety Research Services for Motorcycle Rider Safety. Funding for this research originated from the Motor Accident Insurance Commission. This program of research was undertaken to produce knowledge to assist TMR to improve motorcycle safety by further strengthening the licensing and training system to make learner riders safer by developing a pre-learner package (Deliverable 1), and by evaluating the Q-Ride CAP program to ensure that it is maximally effective and contributes to the best possible training for new riders (Deliverable 2). The focus of this report is Deliverable 3 of the overall program of research. It identifies potential new licensing components that will reduce the incidence of risky riding and improve higher-order cognitive skills in new riders.

This report presents the findings from the four research deliverables which were completed between March 2009 and July 2010:

- Review of the literature (Del D3.1)
- Assessment of alternatives identified in the literature for incorporation into current Queensland motorcycle licensing schemes (Del D3.2)
- Interviews with Queensland motorcycle safety stakeholders (Del D3.3a, D3.3b)
- Development of recommendations (Del D3.4).

Collectively, the research findings indicate that evidence for the effectiveness of existing programs is sparse and implementation of interventions within the existing Queensland licensing context faces several practical constraints. It was concluded that the process of addressing risk taking and hazard perception is qualitatively different to traditional rider training programs that focus on skill development for licensing purposes. The success of interventions to address risk taking and hazard perception within the licensing process is reliant not only upon program content, but also the teaching skills and support of instructors for face-to-face programs. Sufficient duration of programs and motivation for riders to learn program material is potentially restricted within the current Q-Ride structure.

The recommendations for motorcycle safety interventions are:

1. The content of the hazard perception program should include recognising and predicting the behaviour of other road users, recognising road-based hazards and how to select and implement the most appropriate response.
2. The content of the program for reducing risk taking behaviour should focus on factors underlying risk taking such as sensation seeking and self-monitoring,

rather than focusing on the direct effects of factors such as alcohol, speeding, and non-use of protective clothing.

3. It would be useful to consider packaging together the hazard perception and risk taking programs to increase uptake, particularly of the latter.

4. An integrated approach to addressing hazard perception and risk taking should be adopted where the emphasis is on intervening at multiple points in the riding history, rather than a single "inoculation" approach.

5. As one component of an integrated approach to hazard perception and risk taking, the potential for developing and implementing a DVD or web-based hazard perception training tool for Queensland riders should be investigated.

6. As one component of an integrated approach to hazard perception and risk taking, a module to address risk taking and hazard perception should be developed and trialled for incorporation in Q-Ride.

7. In addition to programs designed for delivery to all riders, the potential for a more extensive program that addresses risk taking for delivery to offenders should be examined.

8. Ways to increase the extent of on-road training to facilitate the development of hazard perception skills should be examined.

9. The potential for a tailored hazard perception and risk taking program for riders undertaking training to move from the RE to the R licence should be examined.

Table of Contents

Executive Summary iii

Table of Contents v

1. INTRODUCTION 1

2. STRUCTURE OF THIS REPORT 2

3. METHOD 3

3.1 LITERATURE REVIEW 3
3.2 ASSESSMENT OF ALTERNATIVES FOR CURRENT SYSTEMS 3
3.3 STAKEHOLDER INTERVIEWS REGARDING MOTORCYCLE SAFETY INTERVENTIONS: ROUND ONE 4
3.3.1 Participants 4
3.3.2 Measures and Procedures 4
3.3.3 Data Analysis 6
3.4 STAKEHOLDER INTERVIEWS REGARDING MOTORCYCLE SAFETY INTERVENTIONS: ROUND 2 6
3.4.1 Participants 7
3.4.2 Materials 8
3.4.3 Procedure 8
3.4.4 Data Analysis 9
3.5 CARRS-Q WORKSHOP TO DEVELOP RECOMMENDATIONS 9

4. LITERATURE REVIEW – RISK TAKING AND MOTORCYCLING 11

4.1 RISK TAKING IN MOTORCYCLING 11
4.1.1 Speeding 12
4.1.2 Alcohol and Drug Impairment 13
4.1.3 Fatigue 15
4.1.4 Non-usage of Helmets 16
4.1.5 Non-usage of Protective Clothing 17
4.1.6 Unlicensed Riding 17
4.1.7 Summary of contribution of risk taking behaviours to motorcycle crashes 18
4.2 PSYCHOSOCIAL INFLUENCES ON RISK TAKING 19
4.2.1 Riding Motives 19
4.2.2 Overconfidence 20
4.2.3 Personality 21
4.2.4 Social Norms 22
4.2.5 Summary of contribution of psychosocial factors to risk taking behaviours 23
4.3 INTERVENTIONS TO REDUCE RISK TAKING 23
4.3.1 Attitudinal and Behaviour Change Interventions for Motorcyclists 24
4.3.2 Attitudinal and higher-order cognitive interventions for car drivers 37
4.4 SUMMARY OF MOTORCYCLING AND RISK TAKING LITERATURE REVIEW 43

5. LITERATURE REVIEW – HAZARD PERCEPTION IN MOTORCYCLING 45

5.1 WHAT IS HAZARD PERCEPTION? 45
5.2 HAZARD PERCEPTION IN MOTORCYCLING 46
5.3 INTERVENTIONS TO IMPROVE HAZARD PERCEPTION BY MOTORCYCLISTS 50
5.3.1 Ride Smart CD-ROM 51

5.3.2 Hazard Perception Licensing Tests for Motorcyclists 52
5.3.3 Simulator-based Training 52
5.3.4 The KNMV Early Hazard Perception Course 54
5.3.5 The German Safety Tour 55
5.3.6 The R3 Model - Commentary riding 57
5.3.7 Summary of review of interventions to improve hazard perception 57
6. ASSESSMENT OF SUITABILITY OF INTERVENTIONS FOR POTENTIAL APPLICATION IN QUEENSLAND 59
6.1 PROGRAMS ADDRESSING ATTITUDES AND MOTIVATIONS FOR RISK TAKING 59
6.1.1 Program Characteristics & Constraints 60
6.2 PROGRAMS ADDRESSING HAZARD PERCEPTION 63
7. FINDINGS FROM STAKEHOLDER INTERVIEWS REGARDING MOTORCYCLE SAFETY INTERVENTIONS 65
7.1 STAKEHOLDER VIEWS ON HAZARD PERCEPTION TRAINING AND ASSESSMENT 65
7.1.1 Content issues 65
7.1.2 Delivery methods 66
7.1.3 Challenges to implementation 67
7.1.4 General issues 68
7.2 STAKEHOLDER VIEWS ON ADDRESSING RISK TAKING BEHAVIOUR IN TRAINING 68
7.2.1 Content issues 68
7.2.2 Delivery methods 68
7.2.3 Challenges to implementation 69
7.3 SUMMARY OF INTERVIEW FINDINGS 70
8. DISCUSSION 71
8.1 HOW DOES THE LITERATURE REVIEW INFORM RECOMMENDATIONS? 71
8.2 HOW DO THE STAKEHOLDER INTERVIEWS INFORM THE RECOMMENDATIONS? 72
8.2.1 Hazard perception training and assessment 73
8.2.2 Risk taking interventions 75
8.2.3 Barriers to Implementation 76
8.3 STAKEHOLDER INTERVIEW SUMMARY 77
9. RECOMMENDATIONS 79
9.1 RATIONALE FOR RECOMMENDATIONS 79
9.2 RECOMMENDATIONS FOR MOTORCYCLE SAFETY INTERVENTIONS 80
10. REFERENCES 84

Interim Report 3: Training and Licensing Interventions for Risk Taking and Hazard Perception for Motorcyclists

1. INTRODUCTION

There have been many calls for motorcycle rider education programs to address safety attitudes and motives and/or hazard perception in addition to riding skills to enhance the safety of riders (Haworth & Mulvihill, 2005; Jonah, 1992; Watson et al., 1996). However, reviews of motorcycle rider training have concluded that the vast majority of existing training focuses on vehicle-handling skills with comparatively little attention to higher order cognitive factors (Haworth, Smith, & Kowadlo, 2000; Sudlow, 2003). While skills-based training teaches riders to control a motorcycle, existing programs may fail to teach riders responsible self-management strategies and also fail to sufficiently develop hazard perception skills.

As part of a broader motorcycle safety research program, CARRS-Q was commissioned by the Queensland Department of Transport and Main Roads (TMR) to identify approaches to motorcycle training and licensing interventions directed at risk taking or hazard perception and to ascertain how these may be incorporated into the existing licensing systems in Queensland (Q-SAFE and Q-Ride). This report presents the findings from the four earlier deliverables:

- D3.1 Literature review of motorcycle safety interventions that address attitudinal and higher order cognitive skills (Rowden & Haworth, 2009b)
- D3.2 Assessing alternatives for incorporation of interventions that address risk taking and hazard perception deficiencies into Q-Ride and Q-SAFE (Rowden & Haworth, 2009a)
- D3.3a Stakeholder interviews regarding motorcycle safety interventions (Buckley, Haworth, Rowden & Wishart, 2009)
- D3.3b Stakeholder interviews regarding motorcycle safety interventions: Round Two (Rowden, Buckley, Haworth & Wishart, 2010)
- D3.4 Recommendations for motorcycle safety interventions (Haworth, Rowden, Buckley & Wishart, 2010).

2. STRUCTURE OF THIS REPORT

The methods used to undertake each of the earlier Deliverables are described in Section 3. Sections 4 and 5 present the results of the literature reviews regarding risk taking and hazard perception, respectively. The intervention alternatives identified in the literature reviews are assessed in terms of their potential for application in Queensland in Section 6. The outcomes of the stakeholder interviews are then presented in Section 7. The overall results are discussed in Section 8 and the recommendations are presented in Section 9.

3. METHOD

Several stages of research were undertaken to inform this report:

1. Review of the literature;
2. Assessment of alternatives identified in the literature for incorporation into current Queensland motorcycle licensing schemes;
3. Interviews with Queensland motorcycle safety stakeholders; and
4. Development of recommendations.

These stages were completed in succession between March 2009 and July 2010 with a draft report resulting from each stage. The specific methods for each of the stages are described in this section.

3.1 LITERATURE REVIEW

The literature review examined research and current practice reported in academic journal publications, conference materials, industry specific training documentation, government and non-government documentation relevant to motorcycle licensing, training and education. Published materials relating to risk taking and hazard perception interventions were examined for their relevance to this project. However, while some motorcycle rider training programs, for example, that of the Motorcycle Safety Foundation (MSF) in the United States (see http://www.msf-usa.org/), stated that they addressed these issues in their training programs, the published information lacked sufficient specific detail to effectively inform this review regarding intervention or evaluation. As organisations often wish to protect the intellectual property of commercially developed products and programs, published information regarding specific applications of such programs was found to be limited. While broader public education media campaigns and enforcement initiatives may also aim to reduce risk-taking by motorcyclists, the scope of the review did not extend to such issues.

3.2 ASSESSMENT OF ALTERNATIVES FOR CURRENT SYSTEMS

This stage of research assessed alternatives for incorporation of higher-order rider training interventions into the current motorcycle licensing systems in Queensland. Specifically, the nature of interventions identified in Deliverable D3.1 *Literature Review of Motorcycle Safety Interventions that Address Attitudinal and Higher Order Cognitive Skills* (Rowden & Haworth, 2009b) were examined regarding content issues, target audience, time and cost issues, and delivery issues for their compatibility to the existing Queensland motorcycle licensing schemes (i.e. Q-Ride and Q-SAFE). Commonalities amongst programs (e.g. trained

instructors) and practical constraints for the application of programs (e.g. brief timeframes) were reviewed.

3.3 STAKEHOLDER INTERVIEWS REGARDING MOTORCYCLE SAFETY INTERVENTIONS: ROUND ONE

3.3.1 Participants

Participants included 26 motorcycle licensing and training stakeholders recruited from two sources: (1) Q-Ride organisations (Registered Service Providers (RSPs) and Accredited Rider Trainers (ARTs)); and (2) Queensland Department of Transport and Main Roads (TMR) driving examiners. All participants were over the age of 35 years with a range of years of motorcycle riding experience and were recruited from across Queensland.

The 12 participants recruited from Q-Ride organisations (10 male, 2 female) included seven registered service providers and five accredited rider trainers. These experts all had recent experience with motorcycle rider training and were located across the state, including Townsville, Brisbane, and the Gold Coast. Training conducted by these RSPs includes locations across South East Queensland (SEQ) and various regional centres (e.g. Townsville, Cairns, Bowen, Kingaroy, Longreach). Some RSPs thus provided training across multiple and diverse sites. All RSPs are qualified trainers and responsible for the ARTs they employ.

Fourteen TMR staff participated. All of these participants were directly involved in motorcycle licence testing and included 11 TMR Driving Examiners (8 male, 3 female), all of whom regularly conduct motorcycle licence assessments. The TMR participants also included three Principal Advisor Driver Assessment officers (PADAs). Again, participants were located across the state, with participants involved in licensing across the South region, North region, Central region, SEQ South region, and SEQ north region of TMR. Many of the driving examiners rotate through a number of Customer Service Centres and other testing locations (e.g. police stations) throughout their respective regions, representing a collective experience across urban and rural locations.

3.3.2 Measures and Procedures

The research procedures adhered to those approved by the Queensland University of Technology Human Research Ethics Committee. At the commencement, participants were provided with an information sheet which included details about the voluntary and anonymous nature of participation and their right to withdraw from the study at any time. All participants signed a consent form and volunteered their time to participate in the study however for TMR employees, discussions were held during work time.

3.3.2.1 Recruitment Procedure

Recruitment of Q-Ride experts involved contacting RSPs from across the state. The RSPs were selected on the basis of having a large number of Q-Ride enrolments in the past year while selecting a range of providers across the state including coverage of rural, remote and metropolitan regions. Initial contact involved phoning the RSP with an invitation to participate or request that they invite an ART in their organisation to participate. If possible, a suitable interview time was then arranged. Participants were provided with the key interview questions at this time via email so that they had at least one day to peruse the prompts. Two Q-Ride experts, however, were recruited face-to-face. A member of the research team arrived at the premises of the RSP and introduced themselves and the study and then invited the RSP or any ART to participate.

The recruitment of TMR assessors began with a member of the research team contacting a Q-SAFE Senior Policy Advisor within TMR. Following this, the Coordination Unit provided confirmation of support and dissemination of the project aims to the regional managers within TMR assessment centres. The regional managers then provided the research team with an initial contact (generally the PADA). Following phone contact with the PADA providing an introduction to the research project and researcher, for those interested a follow-up email was provided that included the key interview questions so that prospective participants could consider the central issues prior to interview. In two instances, the PADA indicated that they did not have time on the available day and there were no other refusals to participate.

3.3.2.2 Procedure of Discussions

All discussions were face-to-face and held at the primary location of the participant. Discussions were facilitated by one of two experienced group facilitators and motorcycle riders. Most of the discussions were one-to-one except at the request of either the RSP or PADA when there were small group interviews conducted, for example with either the RSP and an ART or all of the driving examiners in a single office.

Table 3.1 Prompts used to assess risk-taking and hazard perception issues

1. How can future rider training address risk taking?
2. What are the important components that need to be addressed?
3. How could hazard perception be incorporated into future rider training programs?
4. What problems do you see with future programs incorporating risk taking and hazard perception?

The interviews ranged in length from 19 to 52 minutes (mean duration 29 minutes) and were digitally recorded (in audio format only). Participants were instructed in an initial

introduction that their opinion was valued and encouraged to share their thoughts. The discussions were guided by semi-structured questions that explored the key constructs of interest: pre-learner motorcycle rider training, and addressing risk taking and hazard perception as part of the licensing system (presented in Table 3.1).

3.3.3 Data Analysis

Qualitative analysis enables the exploration of the relationships between identified themes and involves a process of managing, summarising and finding meaning in large semi-structured quantities of data. A decision about the depth of analysis depends on the purpose and theoretical grounding of the research. In the case of this exploratory study, theoretical testing or development was not undertaken as the aim of the interviews was to gather information on pre-learner strategies and risk taking and hazard perception issues. Although not directly testing a theory, prompts were developed so that key areas were covered (see Table 3.1).

To increase the rigour and reliability of the study a number of processes were implemented. Checks occurred through the discussion process by the facilitator's use of paraphrasing and summarising, to check the accuracy of the facilitator's understanding of participants' responses in situ. Through familiarisation and ongoing interpretation of the data, a theme was first generated to index categories of information. This is the process of conceptually dividing the raw data. At the simplest level, when a concept or theme is noted a textual label is attached and when it reappears the label is attached again until no new themes emerge. Theme content identification continued with refining codes to form more well-defined categories or content.

The themes along with sub-themes or content were checked across interviews to assess dependability (reliability) and confirmability (confirmation/agreement in the interpretation of the information). Themes were those concepts/categories that were expressed with frequency, extensiveness, or intensity (Krueger, 1998). To strengthen the validity and reliability attributed to each theme, a consultation process occurred with the research team. The team reviewed the themes generated. These additional researchers were able to review the analysis with "fresh eyes". Thus, they provided additional clarification and explanation in identifying themes and subsequent interpretations. The combined efforts provide a thorough and well-justified analysis which in turn, provides a comprehensive and accurate reflection of the data received (Lewis et al., 2007).

3.4 STAKEHOLDER INTERVIEWS REGARDING MOTORCYCLE SAFETY INTERVENTIONS: ROUND 2

The principal aim of the second round of interviews was to investigate options for implementation of motorcycle rider training interventions (beyond skills-based training) if introduced in Queensland at various licensing stages as required. As such, this data provides information regarding *how* training interventions could be implemented in Queensland to

complement the existing data from the initial round of interviews and the previous literature review. Given that implementation issues were likely to differ across geographical regions of Queensland and between small and large providers, the second round included more participants from regional and smaller training providers.

3.4.1 Participants

3.4.1.1 Rationale for Sampling

The first round of interviews with TMR personnel were conducted in every TMR region. Many of the driving examiners rotate through a number of Customer Service Centres and other testing locations (e.g. police stations) throughout their respective regions, representing a collective experience across urban and rural locations. Accordingly, few further interviews with TMR motorcycle licence testing personnel were identified as being required, with the exception of SEQ South region (where only one interview was previously conducted) and Far North Queensland (specifically Cairns).

In comparison, the interviews with Q-Ride RSPs and trainers were not as geographically diverse as the TMR interviews in the first round. While the first round of interviews focussed on major RSPs, smaller providers (locally based) were the main focus for participants from Q-Ride for this study. This arguably strengthens the research methodology by conducting interviews with a broader sample of Q-Ride RSPs in terms of both location and the size of the organisation (i.e. smaller operators may potentially identify different issues).

Additionally, while not having any direct involvement in motorcycle licensing, motorcycling groups (e.g. MRAQ, i.e. Motorcycle Riders Association of Queensland) and Police are stakeholders in motorcycle safety in Queensland and were therefore consulted. The vast majority of stakeholders that were asked to participate in the study agreed, with the only exceptions being three Q-Ride RSPs located at the Sunshine Coast, Toowoomba, and Ipswich. However, the final sample was generally representative of geographical areas not directly covered in the first round of interviews.

3.4.1.2 Final Sample

The final sample for this round of interviews consisted of:

- Five TMR personnel: two SEQ South region staff (PADA and Customer Service Manager), and three Northern region driving examiners in Cairns;
- Seven locally based Q-Ride RSPs and ARTs across each of the following regional areas:
    - Cairns
    - Mackay
    - Toowoomba

- Sunshine Coast;

- A representative from the Motorcycle Riders Association (MRA) Qld Chapter;
- Two representatives from Queensland Police Service involved in motorcycling and/or rider training; and
- Two representatives from RACQ.

In contrast to the first round of stakeholder interviews, not all of the participants in the current research were directly involved in motorcycle licence assessment as this was a broader group of stakeholders.

3.4.2 Materials

The previous round of interviews indicated that a global view of motorcycle training and licensing as a complete system was rarely considered by participants. Therefore, this current round of interviews reframed the core questions in order to encourage consideration of issues primarily associated with possible implementation of rider training interventions across Queensland as shown in Table 3.2.

Table 3.2 Second-round interview prompts for risk taking and hazard perception intervention implementation for rider training in Queensland

1. How can future rider training address risk taking (e.g. computer-based programs or face-to-face or DVD) and at what licensing stage should this occur?
2. What are the important issues that need to be addressed in attitudinal programs for risk taking (i.e. what type of beliefs or behaviours)?
3. How could hazard perception be incorporated into future rider training programs?
4. What potential issues do you see for the implementation of future programs incorporating risk taking and hazard perception (e.g. trainer skills, not enough time)?

3.4.3 Procedure

3.4.3.1 Recruitment Procedure

Recruitment of Q-Ride experts involved contacting RSPs from across the state. Initial contact involved phoning or emailing the RSP with an invitation to participate or request that they invite an ART in their organisation to participate. A suitable interview time was then arranged for those that elected to participate. As contact details for the PADAs from TMR regional offices were already held from the first round of interviews, the PADA at both the Northern Region and the SEQ South Region were contacted directly to arrange for the current round of interviews. Recruitment of *other* stakeholders followed a similar procedure in terms

of initial phone or email contact with an invitation for others in their organisation to participate (e.g. police). Participants were provided with the key interview questions at this time via email so that they had at least one day to peruse the prompts.

3.4.3.2 Interview Procedure

The research procedures adhered to those approved by the Queensland University of Technology Human Research Ethics Committee. At the commencement, participants were provided an information sheet which included details about the voluntary and anonymous nature of participation and their right to withdraw from the study at any time. All participants signed a consent form and volunteered their time to participate in the study; however, for TMR employees, discussions were held during work time.

All discussions were face-to-face and held at the primary location of the participant during April and May 2010. Discussions were facilitated by one of two experienced facilitators who are motorcycle riders. Most of the discussions were one-to-one except at the request of either the RSP, PADA, or other stakeholder contacts when there were small group interviews conducted. For example, these were held with either the RSP and an ART or all of the driving examiners in a single office.

The interviews ranged in length from 13 to 49 minutes and were digitally recorded in audio format only. Participants were instructed in an initial introduction that their opinion was valued and encouraged to share their thoughts. The discussions were guided by semi-structured questions that explored the key constructs of interest for the overall study: 1) pre-learner motorcycle rider training; and 2) addressing risk taking and hazard perception as part of the licensing system.

3.4.4 Data Analysis

As with the analysis for the first round of stakeholder interviews outlined in Section 3.3.3, qualitative analysis was also undertaken for this stage of the research. Qualitative analysis enables the exploration of the relationships between identified themes and involves a process of managing, summarising and finding meaning in large semi-structured quantities of data. The procedure for analysing the data in the previous round of interviews was replicated in this round.

3.5 CARRS-Q WORKSHOP TO DEVELOP RECOMMENDATIONS

A one day workshop was held where the project team brainstormed ideas for recommendations based on the findings of previous stages of research undertaken regarding interventions for risk taking and hazard perception. Fundamental criteria were developed regarding the aims of this stage of research. These aims formed an overarching rationale for recommendations outlined in the findings.

Prospective recommendations were reviewed by the project team in relation to how they met the criteria. Advantages and disadvantages of each intervention were scoped and discussed. This involved not only the potential effectiveness of specific programs but also their target audience and the practical constraints associated with implementation. Particular to this was the compatibility of each intervention with the existing Q-Ride and Q-SAFE approaches to licensing employed in Queensland.

4. LITERATURE REVIEW – RISK TAKING AND MOTORCYCLING

Much concern has been expressed regarding the risk-taking behaviour of motorcyclists (Bellaby & Lawrenson, 2001; Clarke, Ward, Bartle & Truman, 2007; Mullin, Jackson, Langley, & Norton, 2000; Rutter & Quine, 1996; Queensland Parliamentary Travelsafe Committee, 2007; Watson, Tunnicliff, White, Schonfeld & Wishart, 2007). For example, speed has been implicated in 70% of single-vehicle fatalities for motorcyclists in Australia (Johnston, Brooks & Savage, 2008). While the causal relationship between on-road behaviour and attitudes is somewhat contentious (Hendersen, 1991), several modern theories prescribe that behaviour is underpinned by attitudes (e.g. Theory of Planned Behaviour; Theory of Reasoned Action, Ajzen, 1991). Hence, it is often asserted that risk-taking behaviour can be addressed (in part) by modifying attitudes. Other higher order cognitive factors such as risk perception (Deery, 1999; Harre, 2000), riding motives (Broughton & Stradling, 2005), and optimism bias (see Rowden & Watson, 2008) are also linked to risk taking.

This section reviews the role of risk taking in motorcycling and motorcycle crashes before research regarding some of the underlying psychosocial influences on risk taking is considered.

4.1 RISK TAKING IN MOTORCYCLING

Males constituted 94% of all motorcycle fatalities in Australia for the years 2004 and 2005 (ATSB, 2005) and consistently show motorcycle-related injury counts more than 12 times that of females (ATSB, 2004). Young male riders (aged 17-25) have been consistently shown to be the highest risk group for motorcycle crashes per kilometre travelled (Haworth, Mulvihill & Rowden, 2006). The higher propensity for risk taking amongst young male riders has been shown to be a key factor for crash involvement (Rutter & Quine, 1996). However, concern has also been raised in regard to the increasing number of mature-aged riders (aged over 40) involved in crashes in recent years in Australia and abroad (ATSB, 2002; Baughan, Sexton, & Elliott, 2004; Haworth, Mulvihill, & Rowden, 2006; Marottoli, 2002). For example, in Australia between 1991 and 2001, fatalities for mature riders increased by 77% (ATSB, 2002). Unlike younger riders, the increasing crash prevalence for older riders is a product of the escalation in the number of riders in this age group rather than crash risk based on distance travelled. A substantial contribution of alcohol to motorcycle fatalities of mature riders has been found in the United States (Paulozzi & Patel, 2004; Shankar & Varghese, 2006), however in Australia there has been little published research differentiating specific risk-taking factors for this group from all other riders.

When considering broad risk taking issues for all motorcyclists, there are several factors that consistently appear in injury statistics. Stella, Cooke and Spivulis (2002) investigated 39 motorcycle fatalities in Western Australia and found that the majority could be attributed to

unsafe rider behaviours. These included alcohol consumption (31%), drugs (28%), speeding (31%), and lack of safety equipment (13%). Similarly, for riders involved in fatal crashes in New South Wales for the period 1998 to 2002, speed (54%), alcohol (20%), fatigue (7%), and the non-wearing of helmets (9%) were the main contributing factors (RTA, 2004). Johnston et al. (2008) found the main contributing factors to fatal motorcycle crashes in Australia for the period 1999-2003 were excessive speed (70%), alcohol and other drugs (46%), learner rider (8%), hit animal (5%), skylarking or racing (2%), and road infrastructure (2%). While some disparity exists between the above studies, a consistent pattern of risk taking by motorcycle riders is apparent.

Haworth, Smith, Brumen and Pronk (1997) conducted a case-control study examining motorcycle casualties and fatalities in Melbourne and reported that the most significant contributing factors for riders who crashed compared to those who didn't (i.e. controls) were:

- Being aged under 25 years;
- Never being married;
- Unlicensed;
- Off-road riding experience before being licensed;
- Having limited on-road riding experience;
- Riding less than three days a week;
- Having attended a beginner rider course as opposed to an advanced course;
- Having consumed alcohol; and,
- Not wearing a helmet.

A recent European review for the 2BeSafe Project additionally highlighted the following risky riding behaviours for motorcyclists: smoking while motorcycling, talking with a passenger, using a cell phone, running yellow lights, and riding with too little headway (i.e. tailgating) (ICCS, 2010). Overall, the abovementioned findings show several consistent factors that reflect deliberate risk taking by motorcyclists. The following section provides further detail for key risk taking behaviours that may be beneficial for interventions to address.

4.1.1 Speeding

Speeding for motorcyclists appears to be a product of the performance characteristics of the vehicle and the nature of many people that are attracted to motorcycling (i.e. personality and motivation). Watson et al. (2007) found that many riders "bend" the road rules to suit their journey purpose. They found that riding above the posted speed limit was not considered to be *breaking* the law; rather *bending* it as speeding was often considered necessary by

motorcyclists to keep ahead of traffic. Hence, a culture of speeding is often accepted by motorcyclists and deemed somewhat justified by riders to maintain their safety. Unfortunately the injury statistics do not support this notion, as excessive speed is the predominant contributing factor in motorcycle fatalities in Australia (Johnston et al., 2008) and, furthermore, speed has been found to be twice as likely to contribute to fatal crashes for motorcyclists than other road users (RTA, 2004). Speed is implicated in a far higher proportion of fatal crashes than minor injury crashes. This is more pronounced for motorcyclists than for car drivers due to the lack of protection offered by the vehicle.

Elliott, Sexton and Keating (2003) surveyed 8,666 British motorcyclists regarding a range of specific riding behaviours and their crash involvement over the previous 12 months. When factoring in all variables they found that riding errors were the main predictor of at-fault crash involvement, however speeding was also shown to be a significant predictor. Hence, even when relying on self-report data, which has potential for riders to cast themselves in a more socially desirable light, speeding is a major factor in motorcycle crashes.

Ormston, Dudleston, Pearson and Stradling (2003) evaluated the Bikesafe assisted ride program in Scotland and expressed concern that while the proportion of riders indicating they would ride below the speed limit in built up areas increased following the program, there was also an increase in the proportion of riders that indicated they would ride at higher speeds on the open road. Therefore, it appears that riders became more vigilant about riding in traffic, however as they perceived their skills to increase as a result of the course they also increased their intended open road speed, leaving them more susceptible to single vehicle loss-of-control type crashes. The increase in risky behaviours such as speeding as a result of training is a major concern that has been previously discussed at length (see Henderson, 1991). This represents a type of risk compensation where, as performance (what a rider is capable of) increases, risk behaviour (what a rider chooses to do) may also unfortunately increase. A more detailed discussion of overconfidence can be found in Section 4.2.2 of this document.

Despite the evidence that speeding is a risk factor in motorcycle crashes, riders commonly ignore statistical information and rely on their own prior personal experiences as a measure of risk (Bellaby & Lawrenson, 2001). Their experience is often of regularly speeding and rarely being detected and punished, so their belief that it does not lead to crashes or to penalties is strengthened. One difficulty for educational interventions is challenging riders' dysfunctional beliefs about speeding when riders (and sometimes trainers) are likely to reject expert opinion.

4.1.2 Alcohol and Drug Impairment

Impairment by alcohol and other drugs is potentially more risky for motorcyclists than for car drivers due to the balance and awareness required to ride in the traffic environment. Deleterious effects of alcohol at *legal* BACs have been found for obstacle avoidance for motorcyclists (NHTSA, 2008).

Between 2003 and 2007, alcohol was detected at an illegal level in 19% of fatal motorcycle crashes and was detected below the legal level in another 7% of fatal motorcycle crashes

(Queensland Transport, 2008). Similarly, in New South Wales between 1998 and 2002, alcohol at illegal blood alcohol concentrations (BACs) was implicated in 20% of rider and pillion fatalities compared to 11% in fatalities of other motor vehicle controllers (RTA, 2004). Johnston et al. (2008) reported that alcohol and/or drugs were involved in 46% of single vehicle and 21% of multi-vehicle (on the part of the rider) motorcycle rider and pillion fatalities in Australia for the period 1999-2003. While reporting criteria often differ across publications in terms of any alcohol involvement in crashes *per se* versus those including illegal BACs only, it is apparent that alcohol is a major contributor to motorcycle fatalities. Comparisons between the prevalence of alcohol in motorcycle and car crashes are affected by the percentage of single and multiple vehicle crashes differing between each type of road user and across jurisdictions. Where there are relatively more single vehicle motorcycle fatal crashes, then the prevalence of alcohol appears greater.

In the United States there is considerable concern regarding alcohol-related motorcycle crashes, particularly for riders aged between 30 and 49 riding large capacity machines (Shankar & Varghese, 2006). In 2007, 23% of motorcycle-related fatalities in the United States involved alcohol at illegal BACs (>.08) (Insurance Institute for Highway Safety, 2008). This figure escalated to 41% for single-vehicle crashes.

Like speeding, alcohol is involved in a higher percentage of fatal crashes than lower severity casualty crashes. For example, Hurt et al. (1981) reported 11.5% alcohol involvement amongst a sample of 900 motorcycling casualties, and 40.9% amongst fatalities. In New South Wales in 2006, 21.9% of fatally injured riders had an illegal BAC, compared with only 6.1% of injured riders (RTA, 2007). Alcohol additionally renders the body more likely to be injured in the event of a crash, hence increasing severity.

Alcohol is also often associated with other risky behaviours which may in part explain the increased severity. Peek-Asa and Kraus (1996) examined 3,000 fatality and casualty cases for motorcyclists and noted that 42% tested positive for alcohol. The riders who tested positive for alcohol were more likely to also be speeding and not wearing a helmet than riders testing negative. In New South Wales from 1998-2002 42% of unlicensed rider fatalities exceeded the legal BAC compared to 17% of legally licensed riders. Haworth (2000) reported on a case-control study of motorcycle crashes, finding that a positive BAC for crashed riders was associated with:

- Greater riding experience;
- Unlicensed riding;
- Riding a borrowed motorcycle;
- Carrying a pillion passenger;
- Illicit drug use;

- Excessive speed; and,
- Single-vehicle crashes.

The relationship between alcohol and other forms of risk taking is not necessarily causal as it may merely be indicative of the type of person who is prepared to take risks in general; however the clustering of such behaviours is of considerable concern for the safety of motorcyclists.

A higher likelihood of alcohol-related motorcycle crashes on weekends compared to weekdays has been found in previous research (Kasantikul, Ouellet, Sirathranont & Panichabhongse, 1994). This suggests that recreational riders, predominantly riding on the weekend, may be likely to stop for a social drink. This aspect of social recreational riding requires more specific, contemporary research to ascertain and disseminate the specific patterns of impaired riding in Queensland.

Relatively less is known about the involvement of drugs other than alcohol in motorcycle crashes. Drummer (2003) found that motorcyclists were over-represented in fatal crashes involving cannabis, however a similar proportion of motorcycle riders and car drivers were found for alcohol-related fatalities. In the Melbourne Case-Control Motorcycle study, Haworth et al. (1997) found that crashed riders were more likely than those who did not crash (controls) to have taken illicit and prescription drugs. Cannabis was the most frequently used illicit drug. Additionally, the combination of alcohol and drugs was found to be more likely for crash involved riders than controls.

Overall, alcohol is more likely to be implicated in severe, single-vehicle motorcycle crashes (potentially recreational riders on the weekend), while less is known in regard to drug impairment for riders.

4.1.3 Fatigue

Australian (Haworth & Rowden, 2006) and British (Horberry, Hutchins & Tong, 2008) literature reviews have concluded that very little research exists in relation to motorcycle rider fatigue, but that motorcyclists commonly note fatigue as a safety risk. Anecdotal accounts of rider fatigue are posted on the internet along with prescribed countermeasures such as ensuring the motorcycle is correctly set-up for long rides and wearing ear plugs to avoid the effects of constant noise (http://www.ride4ever.org/news/fatigue.php). The importance of wearing appropriate clothing for the conditions and maintaining hydration is also commonly asserted. Hence, riding while fatigued is frequently regarded as a largely avoidable behaviour that places the rider at risk and can therefore be construed as risk-taking.

One of the few empirical studies was undertaken by Ma, Williamson and Friswell (2003) who measured reaction time and subjective reports of fatigue symptoms before and after a five-hour daytime ride. They found 40% of riders reported experiencing fatigue on at least half of their long journeys. This subjective measure was defined as feeling drowsy, sleepy, tired, lethargic, bored, unable to concentrate, unable to sustain attention, or being mentally

slowed. However, reaction time tests found no significant impairment on performance compared to a control condition where no riding was undertaken.

Tunnicliff (2005) conducted interviews and focus groups with riders in Brisbane and found that some riders described how the exhilaration from riding overrode any fatigue effects even following a long day at work. They felt that riding rejuvenated them rather than fatigued them. This finding must be interpreted with caution however, as subjective ratings of fatigue can be somewhat unreliable and the riders may therefore unknowingly be at risk.

The contribution of fatigue to motorcycle crashes is difficult to quantify because of the use of surrogate reporting measures by transport agencies. Motorcycling is far less likely at night time compared to car or truck driving and because surrogate measures are based primarily on night time crashes (e.g. midnight to 6am), the extent of involvement of fatigue in motorcycle crashes remains unclear.

In summary, the review of rider fatigue by Haworth and Rowden (2006), pg 9, concluded that:

> *"Currently, we do not have the information needed to draw reliable conclusions regarding the magnitude of the effects of factors that potentially contribute to motorcycle fatigue or to assess the real contribution of fatigue to motorcycle crashes or the crash risk associated with riding while fatigued. However, the limited research suggests that fatigue is likely to be an issue in motorcycling, and therefore more knowledge of the phenomenon is needed to allow countermeasures to be developed."*

4.1.4 Non-usage of Helmets

Extensive research has been conducted regarding the effectiveness of motorcycle helmets in preventing or reducing injury. Those who do not wear a helmet have consistently been shown to be at greater risk of fatal injury (see Coben, Steiner & Miller, 2006; Dee, 2008; Houston, 2007; Mertz & Weiss, 2008; NHTSA, 2008).

The wearing of approved helmets for motorcyclists is compulsory in Australia with high compliance rates, however many other jurisdictions, including some states of the United States and many developing countries, face the continued challenge of non-wearing of helmets. Motorcycle crash trauma in Australia has been shown to include upper and lower limbs (more than half of all injuries), head (10%), chest (8%), hip and thighs (7%), neck (2%), and abdomen, back, and pelvic injuries (collectively approximately 9%) (ATSB, 2004). In other countries where helmet wearing is not mandated a different pattern of injury predominantly occurs, with far greater likelihood of head injury causing death (Kraus, Peek-Asa, & Cryer, 2002; NHTSA, 2002; Swaddiwudhipong, Boonmak, Nguntra, & Mahasakpan, 1998). Hence, there is much scope internationally for the improvement in motorcycle safety by increasing helmet usage. While not wearing a helmet in the Australian context (where it has been mandated for several decades) is clearly a volitional act, it is perhaps more difficult to label the same act as intentional risk taking in developing countries as there is generally reduced awareness of the associated risk.

Data on helmet use in non-fatal motorcycle crashes may have limited reliability because the helmet is often removed before police arrive. In New South Wales in 2007, 5% of killed motorcycle riders and passengers and 4% of those injured were recorded by police as not wearing a helmet (RTA, 2008). Analyses of Queensland data (Haworth, Greig & Nielson, 2009) found that only about 0.5% of motorcycle riders in crashes in Queensland in 2000-2005 were coded as not wearing a helmet, but helmet status was unknown for 9.4% of riders. Recent national data are not available, but data from 1999 to 2003 based on investigations by police and coroners found that 10% of riders and passengers killed were not wearing a helmet and 18% were wearing a helmet that was judged to have come off or 'probably came off' (Johnston et al., 2008).

4.1.5 Non-usage of Protective Clothing

It is arguable whether the non-use of voluntary safety measures such as protective clothing for motorcyclists actually represents risk-taking behaviour. It is contended here that not covering hands, limbs, feet, or the torso at all while riding a motorcycle can be interpreted as volitional risk-taking behaviour in Australia because riders are largely aware of the potential consequences. However, those riders who cover their feet and legs (but with gear that has little protective value such as jeans and runners), may think that they are sufficiently protected, and therefore this behaviour probably should not be considered conscious risk-taking. . Therefore, it is difficult to broadly define the non-wearing of protective clothing as risk taking. Nonetheless a brief overview of the issues relating to motorcyclists not wearing protective clothing is provided.

While the use of protective clothing other than a helmet is not mandatory, rider specific protective clothing such as jackets, pants, boots, and gloves can reduce injury (for a review see Haworth, de Rome, Varnsverry & Rowden, 2007). The Motorcycling Accident In-Depth Study (MAIDS) in Europe found that 90% of minor injuries could be either prevented or reduced by wearing protective clothing (ACEM, 2004). It has been found that optimal leg protection (e.g. leather pants or Kevlar lined jeans) are far less likely to be worn than other protective clothing (de Rome, 2006; Reeder, Chalmers, & Langley, 1996; Wishart, Tunnicliff, Watson, & Schonfeld, 2005). This is of particular concern since leg injuries constitute a substantial proportion of all motorcycle crash trauma. Additionally, particular at-risk groups who are less likely to wear appropriate protective clothing are pillion passengers (ACEM, 2004) and unlicensed young riders (Reeder et al., 1996).

Regardless of whether riders make an informed decision not to use protective clothing or whether they are ignorant to the benefits, interventions to target the increase in protective apparel usage have great potential to reduce road trauma if combined with a certified standard or quality rating for such products.

4.1.6 Unlicensed Riding

While unlicensed riding does not explicitly represent risk-taking behaviour *per se*, unlicensed riders have been shown to be over-represented in crash statistics and unlicensed riding is commonly associated with an assortment of risky riding behaviours (Watson & Steinhardt,

2006). Unlicensed riding is normally addressed by enforcement or through incentives within the licensing system (see Braver et al., 2007), however unlicensed riding may still be targeted by educational interventions (e.g. Devon Shire recidivist offender course). Hence, this section will provide some brief information regarding the characteristics of unlicensed riding.

Fatal crash involvement for unlicensed motorcyclists has been shown to be higher than for unlicensed car drivers (FORS, 1997; Watson & Steinhardt, 2006). Furthermore, unlicensed riders are more likely to be involved in a crash than licensed riders and, additionally, in more severe crashes (Haworth et al., 1997; Watson, 2004). In New South Wales for the period 1998-2002, unlicensed riders were more likely than licensed riders to be involved in fatal crashes involving speed, drink riding, and not wearing a helmet (RTA, 2004).

Motorcycling is unique compared to other modes of road transport in that a substantial proportion of overall riding occurs off-road using unregistered machines. This presents a challenge to road safety in that such machines may often be used on-road in transit between off-road destinations (Blackman, 2008). While many off-road dirt bike riders may hold valid licences to ride on-road, many do not. Riding on the road has been shown to be a particular problem during adolescence prior to being eligible for a licence (Haworth et al., 1997; Reeder, Chalmers, Marshall & Langley, 1997; Watson & Steinhardt, 2006).

Borrowing a friend's motorcycle has also been shown to put riders at risk, with Haworth et al. (1997) finding that, of the 11 crashed riders that were unlicensed in the Melbourne Case Control Study, seven did not own the motorcycle.

Other issues for unlicensed riding include:

- A higher likelihood of being involved in "hit fixed object" crashes (indicating poorer control skills);
- Being involved in crashes on the weekend; and,
- Being involved in crashes at night (Watson & Steinhardt, 2006).

Overall, unlicensed riders appear to be less skilled, more likely to take deliberate risks, and more often riding a motorcycle which is stolen or borrowed compared to licensed riders.

4.1.7 Summary of contribution of risk taking behaviours to motorcycle crashes

Collectively, the above findings show that risk taking by riders contributes to a substantial amount of motorcycle-related injury and death. Risk taking plays a larger role in single-vehicle than multi-vehicle crashes and a larger role in fatal than non-fatal motorcycle crashes. The risk factors often occur together. For example, non-use of helmets and unlicensed riding are often associated with drink riding. However, while the above findings provide valuable information to inform countermeasures to improve motorcycle safety, they rarely account for the underlying factors that may motivate unsafe rider behaviour. Such influences need to be

addressed by interventions if behaviour change is likely to occur. These issues are reviewed in the next section.

4.2 PSYCHOSOCIAL INFLUENCES ON RISK TAKING

While a range of aforementioned risk taking factors have been associated with motorcycle crashes, it is important to identify individual differences that underpin such risky riding. Behaviours such as speeding and drink riding are commonly highlighted in road safety statistics as contributing factors in motorcycle crashes, however little attention has been directed at addressing the underlying psychosocial influences on such behaviour. Such influences are often central to the reasons people choose to ride motorcycles or an inherent characteristic of the rider and, as such, may be difficult to change.

4.2.1 Riding Motives

It has been posited that people with an increased propensity for risk taking may be attracted to motorcycling (Horswill & Helman, 2003). Indeed, people are attracted to motorcycling for a variety of reasons including image, the thrill of riding, the feeling of freedom, and to impress others (Watson et al., 2003). In addition to the practical motives for riding such as convenience and economy, Schulz et al. (1991, as cited in Elliott et al., 2003) noted three main classifications for rider motives:

1. Biking for pleasure;
2. Biking as a fast competitive sport; and,
3. Control over the motorbike.

Broughton and Stradling (2005) found that risk taking is an inherent part of enjoyment during riding for some participants (accordingly labelled 'risk seekers' and 'risk acceptors') while for others (labelled 'risk averse') the enjoyment of riding came from a sense of freedom rather than risk. This highlights the importance of considering fundamental rider motives when attempting to change behaviour and the understated role of emotions in riding in terms of hedonic motives.

Noordzij et al. (2001) reviewed previous research into riding motives and categorised findings under eight overarching themes:

- Positive experiences (e.g. joy, fun, please, escapism);
- Dynamic aspects of riding (e.g. acceleration, manoeuvrability);
- Performance aspects (limits of oneself and machine);
- Social aspects;

- Control beliefs;
- Identification with the motorcycle;
- Flow effects (a state of perfection); and,
- Sensation seeking.

These issues highlight that recreational riding is often underpinned by motivational influences that are not necessarily consistent with road safety objectives. Reasons for riding and motorcyclists' subjective views of risk often do not readily reconcile with expert perceptions of risk (Bellaby & Lawrenson, 2001; Natalier, 2001). That is, an unrealistic optimism is sometimes held about their own riding skills and their ability to control outcomes (Rutter, Quine, & Albery, 1998). Tunnicliff (2005) found two distinct groups of riders: those who had a realistic view and acceptance of the risks associated with riding (often learned from experience); and those who were supremely confident in their own riding skills. Other related riding motives that may influence risk taking can be: an expression of independence; to achieve heightened arousal; as a means to impress others; and an outlet for stress (ICCS, 2010).

4.2.2 Overconfidence

Concern has been expressed regarding the possible negative effects of overconfidence, particularly for novice drivers following training. For example, the Queensland Parliamentary Travelsafe Committee (2003) argued that the acquisition of vehicle handling skills during training may instil a sense of overconfidence in novice drivers, thereby fostering riskier behaviours on the road once unsupervised. Such overconfidence has been posited to contribute to increased crash rates found for young drivers following driver skid-pan training focussing on advanced driving skills (Gregersen, 1996; Katila, Keskinen, Hatakka, 1996). Similarly, motorcyclists may be at risk from overconfidence.

The psychological construct of unrealistic optimism is related to overconfidence and refers to the innate tendency for individuals to over-rate their own abilities and chances of positive outcomes compared to those of other people. The majority of people tend to rate themselves as 'above average' compared to their peers. Unrealistic optimism is often found when measuring self-reported driving skill, with a general overconfidence existing in many Western cultures, particularly for young males (Harré & Sibley, 2007; Sűmer, Özkan, & Lujunen, 2006). In their study of optimism bias for the Australian Transport Safety Bureau, Hatfield and Job (2001) asserted that increased confidence is likely to result from traditional driver training programs, increasing potential crash risk. The paradox exists between increased skills (performance) and how this may motivate active risk taking (behaviour) (see Henderson, 1991). If a rider is tempted to push the limits of their riding ability because they falsely believe their newly acquired skills are superior, then this places them in an increasingly vulnerable situation. Hence, while skill development is undeniably a necessary part of safe motorcycling, it is not sufficient in its own right to protect riders against injury unless accompanied by a realistic appreciation of the associated risks.

While limited research has been conducted regarding unrealistic optimism or overconfidence for motorcyclists, the available evidence suggests that there is a consistent effect not necessarily confined to inexperienced riders. For example, Sexton, Hamilton, Baughan, Stradling and Broughton (2006) found that two thirds of riders in a British study rated themselves as "less likely" or "far less likely" than other riders of the same age and experience to be involved in a crash in the next 12 months.

Symmons, Mulvihill and Haworth (2007) conducted a study of riders over the age of 25 and similarly found that two thirds of all riders sampled rated themselves as "much less likely" to crash in the next 12 months than other riders of similar age and gender. Symmons et al. also reported that riders who admitted to crashing in the past five years rated themselves as significantly better at handling a motorcycle and significantly better at getting out of hazardous situations than those riders who had not crashed. Unfortunately, it is impossible to assign crash causation to the over-optimistic attitudes of crashed riders in the study due to the temporal order of sampling (the 'chicken or the egg' dilemma). That is, riders' attitudes may have been developed as a result of crashing rather than being a factor that contributed to them crashing. Nonetheless, these results provide a further indication of the link between over-estimation of skill and negative safety outcomes.

Rowden and Watson (2008) examined optimism bias regarding riding skills as a function of motorcycle rider training in a sample of 244 learner riders. The competency-based training course was delivered by a single organisation specialising in motorcycle training and assessment. The course did not endeavour to address or manipulate optimism bias as part of the training. It was found that, as a whole, the sample did not display optimism bias in relation to their perception of their own riding skills at the commencement of training. However, a small effect was found when riders rated their own skills at the end of training. A significant increase in perceived skill levels from the start of training to the end was evident, however at a level that was unlikely to be indicative of *overconfidence* across the sample. Twenty-nine percent of participants rated themselves as "above average" or "well above average" regarding their riding skills at the end of training. While the optimism bias effect was not as pronounced as that found in previous research by Symmons et al. (2007) and Sexton et al. (2006), further follow-up research is required to ascertain if perceptions of skill (compared to others) increases as a function of experience in this cohort of newly trained riders.

Overall, the available evidence suggests overconfidence is an issue of concern regarding motorcyclists, however further research is required. Additionally, for those riders who are found to be overconfident it is important to investigate any other possible characteristics that may be common amongst this group, that might increase crash risk or alternatively, provide guidance regarding potential approaches to targeting this group.

4.2.3 Personality

Several personality characteristics have been linked to risky riding by motorcyclists. Further to the discussion in Section 4.2.1 regarding the motives that people have for riding

motorcycles, a certain type of personality may also be attracted to motorcycling consistent with motives such as thrill seeking (Horswill & Helman, 2001; Miles et al., 2001; Watson et al, 2007). From a sociological perspective, it is recognised that a motorcycling culture exists which, at least in part, reflects the "rebel without a cause" type of character as depicted in some early Hollywood movies. Such personalities may be attracted to motorcycling for the image and potentially have a low regard for safety as dictated by authorities. No research was found regarding specific personality types being attracted to specific types of motorcycles however anecdotal evidence from discussions riders and rider trainers suggests that motorcyclists commonly identify with a particular style of motorcycle which to a large degree reflects their riding motives and their subsequent patterns of riding. For example, sensation seeking personalities may be attracted to the performance capabilities of a sports bike and therefore be prone to speeding and other forms of risky riding such as racing others. Importantly, the interaction between personality, the type of motorcycle, and the potential for risk taking may impact on rider safety in terms of where, when, why and how certain motorcyclists ride.

Watson et el. (2007) found that participants that scored highly on sensation or thrill seeking and aggressive personality measures were more likely to perform risky riding behaviours and express intentions to do so in the future than riders that were low in these personality characteristics. For example, sensation or thrill seeking was found to contribute to riders' pushing their individual limits. As personality is a relatively stable construct, this finding perhaps reflects broader lifestyle issues also (i.e. a general propensity for risk taking).

A recent review for the European 2BeSafe project (ICCS, 2010) noted a range of personality influences including low scores on traits such as emotional stability, social responsibility, empathy and anxiety contributed to risk taking. Furthermore, they reported that risk taking is linked to higher levels of aggression and anger. These were predominantly linked to males rather than females (consistent with gender differences seen in the general motorcycling population).

4.2.4 Social Norms

Consistent with the range of riding motives expressed in earlier sections, riding is largely a social event for many motorcyclists. Hence, there is potential for risky riding attitudes and behaviours to be influenced by others. It is a well established psychological phenomenon that behaviour is influenced by others that have a significant role in the lives of people (see Ajzen, 1991). Significant others may instil basic beliefs (e.g. we may adopt the beliefs of our parents) and, importantly, model appropriate or inappropriate behaviour. While significant others may be represented in the form of close friends and family, Watson et al. (2007) found that risk taking by motorcyclists was influenced more by immediate riding companions. As there is considerable camaraderie amongst many riders, the impact of peer influence on risky riding styles is not a surprising finding. Peer influence has been recognised as an issue for many types of risky behaviour and interventions often target this factor in an endeavour to modify behaviour (e.g. cigarette smoking by adolescents). Therefore, there is also much potential for interventions to target peer influence in motorcycling.

Normative behaviour can also be conceived in a broader sense in relation to general societal norms. Risk taking for motorcyclists may reflect high levels of normlessness or general antisocial behaviour (ICCS, 2010).

4.2.5 Summary of contribution of psychosocial factors to risk taking behaviours

The information reviewed in this section provides an overview of the various underlying factors that may influence rider behaviours such as speeding, drink riding, or other issues known to affect the safety of road users. Educational or psychological interventions that aim to change dysfunctional behaviour may benefit from focusing on the issues identified in this section if any meaningful change in attitudes towards risk is to result. However, due to the group nature of most attitudinal interventions in the realm of rider training and education, the challenge exists to identify issues specific to each individual and provide personally meaningful information to facilitate attitude and behaviour change.

4.3 INTERVENTIONS TO REDUCE RISK TAKING

This section will initially outline the types of interventions to be examined in this document then review interventions that have been applied to motorcyclists regarding attitudes and motivations for risk-taking. Interventions of this nature that have been applied to car drivers will also briefly be reviewed with a view to establish their potential relevance for motorcyclists.

Interventions within the context of road safety can be regarded as programs put in place to prevent or minimise risk or injury. These may be education or communication based (including training and broad public education campaigns), enforcement based, engineering based, or simply aim to reduce the amount of an activity (e.g. motorcycling) that is undertaken. Interventions in road safety are also commonly referred to as countermeasures.

Educational road safety interventions or countermeasures that focus on human factors commonly aim to enhance road user:

- Vehicle control skills;
- Knowledge;
- Attitudes;
- Behaviours; and / or,
- Perceptual skills.

This report focuses on education-based interventions for motorcyclists that can be applied in the training or licensing context to address either risk taking attitudes and behaviours, or

hazard perception deficiencies. However, these may be perceived as communication-based (e.g. peer persuasion) or psychology-based (e.g. with grounding in psychological theories of behaviour change).

Broad road safety measures such as advertising campaigns aimed at reducing drink driving/riding target the risk taking behaviours of all road users (Queensland Transport, 2006a) as do driver reviver rest stops to combat driver/rider fatigue (Queensland Transport, 2006b). Additionally, enforcement by police for illegal behaviours (e.g. drink driving) endeavours to act as a deterrent aimed at preventing road crashes (Homel, 1993). Countermeasures that have been specifically designed to improve motorcycle safety include public education campaigns to increase awareness of motorcyclists amongst other road users, the hardwiring of motorcycle headlights for daytime running, and the use of fluorescent/reflective material on helmets and clothing. Haworth and Schulze (1996) outlined other countermeasures including licence restrictions, airbags, modification of the road environment, improvements to motorcycle braking, improvements to rider field of view, and restricting off-road riding by adolescents. A document by the US National Highway Traffic Safety Administration (2008) titled *Countermeasures That Work* highlights the fact that the effectiveness of many countermeasures for motorcycle crashes is largely unknown. A review of motorcycle and moped crashes in Europe also lists a range of countermeasures, but many relate to restrictions within the licensing system rather than educational interventions (Noordzij et al., 2001).

Rider education and training has potential to modify risk taking behaviour and other higher order cognitive factors. Education/training in the road safety context is often perceived as a panacea to many road safety problems, particularly in regard to novice driver crash involvement (Bailey, 2002; Watson et al., 1996). While intuitively appealing, this perception is unfortunately misguided, with past reviews of empirical research suggesting little or no benefit from either formal pre-licence, or post-licence training and educational programs in terms of crash risk reduction for drivers or motorcyclists (Christie, 2001; Haworth & Mulvihill, 2005; Mayhew, Simpson, & Robinson, 2002; Watson et al., 1996). However as previously noted, traditional motorcycle rider training rarely sufficiently addresses attitudes to safety, hazard perception, or other cognitive factors. The following section will review programs that specifically target such issues for novice riders or in a post-licence context.

4.3.1 Attitudinal and Behaviour Change Interventions for Motorcyclists

Several different educational interventions targeting knowledge, attitudes, or specific behaviours have been trialled for motorcyclists. However, few of these have been evaluated and few applied within an existing licensing system. Nonetheless, this section reviews the available literature commencing with interventions delivered as part of the training and licensing system. A model considered as best practice from Norway is examined first followed by the Initial Rider Training Project in Europe. A new intervention trialled in the Queensland licensing context is then reviewed followed by a community program in Thailand. Next, post-licence assisted rides are described, followed by a post-licence diversion program and a peer education program. All of the interventions reviewed involve face-to-face

training programs, however scope for development of computer-based programs should not be discounted.

4.3.1.1 The GDE matrix

The GDE matrix (see Figure 4.1) has been developed to guide the structure of training programs (Hatakka, Keskinen, Gregersen, Glad & Hernetkoski, 2002). This framework is currently being used as the basis of several pre-licence and post-licence motorcycle training programs in Scandinavia including Norway (CIECA, 2002; Lund, 2006). It aims to improve the safety of motorcyclists by taking a holistic approach to riding, including the targeting of higher-order cognitive factors relating to psychosocial influences and lifestyle influences.

Hierarchical level of behavior (extent of generalization):	**Central content of driver and rider education:** Knowledge and skills the driver/rider has to master	Risk increasing factors the driver/rider must be aware of	Self-evaluation
Goals for life and skills for living (global)	**Knowledge about / control** over how general life goals and values, behavioral style, group norms etc. affect riding.	**Knowledge about / control over** risks connected with life goals and values, behavioral style, social pressure, substance abuse etc.	**Awareness of personal tendencies** re. impulse control, motives, lifestyle, values, etc. Developing self-evaluation skills.
Goals and context of riding (specific journey)	**Knowledge and skills** re. journey related considerations (effect of goals, environment choice, effects of social pressure, evaluation of necessity, etc.).	**Knowledge and skills** re. risks connected to journey goals, riding state, social pressure, purpose of riding, etc.).	**Awareness of personal** planning skills, typical riding goals, riding motives, etc. Developing self-evaluation skills.
Mastery of traffic situations (specific situation)	**General knowledge and skills** re. rules, speed adjustment, safety margins, signaling, etc.	**Knowledge and skills** re. inappropriate speed, narrow safety margins, disregard for rules, difficult riding conditions, vulnerable road-users, etc.	**Awareness of personal** skills, riding style, hazard perception, etc. from the viewpoint of strengths and weaknesses. Developing self-evaluation skills.
Vehicle maneuvering (specific task)	**Basic knowledge and skills** re. vehicle control, vehicle properties, friction, etc.	**Knowledge and skills** re. risks connected with vehicle control, vehicle properties, friction, etc.	**Awareness of personal** strengths and weaknesses re. Basic riding skills and vehicle control (especially in hazardous situations), etc. Developing self-evaluation skills.

Figure 4.2 The GADGET (GDE) Matrix applied to motorcycling (Source: Lund, 2006).

The matrix provides a hierarchical framework to guide training development and focuses on driver or rider goals (motivations). Importantly, it asserts that goals should be considered at four hierarchical levels:

- Goals for life and skills for living (highest level);
- Goals and context of driving;

- Mastery of traffic situations; and,
- Vehicle manoeuvring (lowest level).

Notably, vehicle-handling skills are considered the most basic part of training while the highest level of the hierarchy focuses on broader lifestyle and psychosocial influences intrinsic to the individual. For example, personal values, conformity to social pressure, sensation seeking personality, and skills for self-control are all intrinsic aspects of the person that can influence behaviour in a range of contexts. Accordingly, it would appear that the future challenges for motorcycle rider training lie within the top two levels of the GDE hierarchy.

Psychosocial influences on riding as previously discussed in Section 4.2 can be considered with the GDE framework at the second highest level of the hierarchy: goals and context of riding (specific journey). This is consistent with the argument put forth in previous research that effective training needs to target the factors that directly impinge on road user behaviour and crash risk for specific target groups (Mayhew et al., 2002; Watson, 2003). Factors such as motives for riding, peer influence, and rider state (impairment) are among key considerations at this level.

Central to each level of the GDE matrix is self-evaluation as shown in Figure 4.1. Self-evaluation promotes self-awareness throughout the training process of riding abilities, goal planning, and lifestyle influences on riding. This is analogous to the concept of self-monitoring which has been used extensively in behaviour modification programs by psychologists. Bailey (2003) argued that driver training needs to address what he refers to as 'metacognitive' factors. He further prescribed self-monitoring of driving behaviour as a key metacognitive factor.

4.3.1.2 Norwegian Licensing and Training Initiatives

Norway introduced new licensing and training initiatives based on the GDE matrix in 2005 for novice car drivers and motorcyclists. A detailed description of the curriculum for motorcycle licence training is available electronically at the following address: http://www.vegvesen.no/binary?id=2665. A diagrammatic representation of the Norwegian motorcycle licensing requirements from this document is shown in Figure 4.2. The Norwegian Public Roads Administration website suggests that there is no specific learner permit, but any learner motorcyclist who intends to "practice drive" – accompanied by a lay or paid instructor - must have completed the course in Basic Road Traffic Knowledge which is common for all light vehicles. This is Step 1 of the licensing process and involves 17 lessons (unless they already have completed this course for another category of licence). Step 2 is termed "technical driver training" and comprises three lessons on motorcycle riding, the environment, safety and training. At the completion of Step 2 the learner rider must complete a mandatory evaluation and guidance lesson which includes practice riding as well as a guidance interview. Step 3 "traffic training" differs somewhat between young riders attempting to gain an A1 (light motorcycle) and older riders attempting to gain an A

(unlimited motorcycle) licence. The "Safety Course in Precise Riding Technique" is compulsory for Category A only. Assessment occurs at the end of Step 3 for both Category A1 and A learners. Step 4 "final training" includes theoretical and practical on-road lessons (four for Category A1 and eight for Category A). The theoretical and practical riding tests to obtain the licence are taken at the end of Step 4.

Due to the extreme cold of the Northern winter, motorcycling is not undertaken year round in Norway. Hence, training and licensing are spread over an extended period; usually 18 months to obtain a provisional licence. The system also encourages voluntary practice to consolidate riding skills.

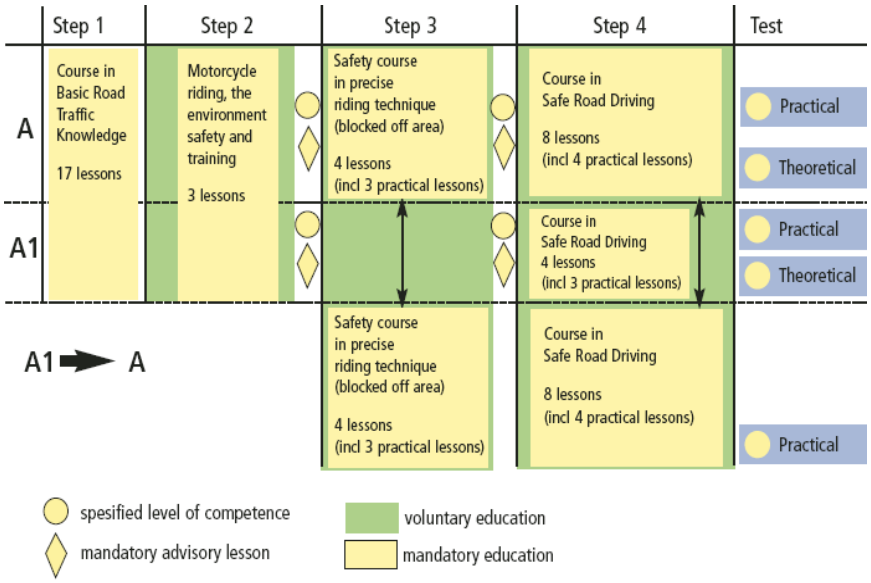

Figure 4.2 Norwegian Motorcycle Licensing System Components (Source: Norwegian Public Roads Administration Handbook 251E).

A key feature of the Norwegian motorcycle licensing system is the step-by-step incremental training blocks. This comprehensive licensing model not only requires multiple training sessions, it also aims to build rider knowledge and skills as they progress through the system. This is based on the rationale of spaced learning and incremental learning to allow consolidation of previous learning and prevent information overload that may be associated with accelerated licensing and training systems (such as Q-Ride).

While the Norwegian motorcycle licensing system incorporates the GDE model into training, to date there is unfortunately no published evidence of its effectiveness in reducing motorcycle crashes, injury to motorcyclists, or improving attitudes towards safe riding. An evaluation of the effectiveness of the Norwegian motorcycle licensing system was due in 2009 (Lund, personal communication), however to date no evaluation has been observed.

4.3.1.3 The Initial Rider Training Project

Figure 4.3 shows the training components developed in the Initial Rider Training (IRT) project in Europe which has also utilised the GDE matrix as a guide. The project, which is a collaborative effort between several motorcycling stakeholders in Europe (e.g. FEMA, the Federation of European Motorcyclists' Associations, ACEM, the Swedish Road Traffic Authority) and the European Commission, aims to address risk-taking attitudes and motives during training similar to the aims of the Norwegian system (for details see http://www.initialridertraining.eu/index.php?p=downloads). The IRT has been under development for several years, however the actual level of implementation amongst European nations remains unclear. A report by the European Commission (2007) regarding the development of the IRT outlines the inclusion of attitude and behaviour as one of the theoretical components in the training package, however no further details are provided as to how this is addressed.

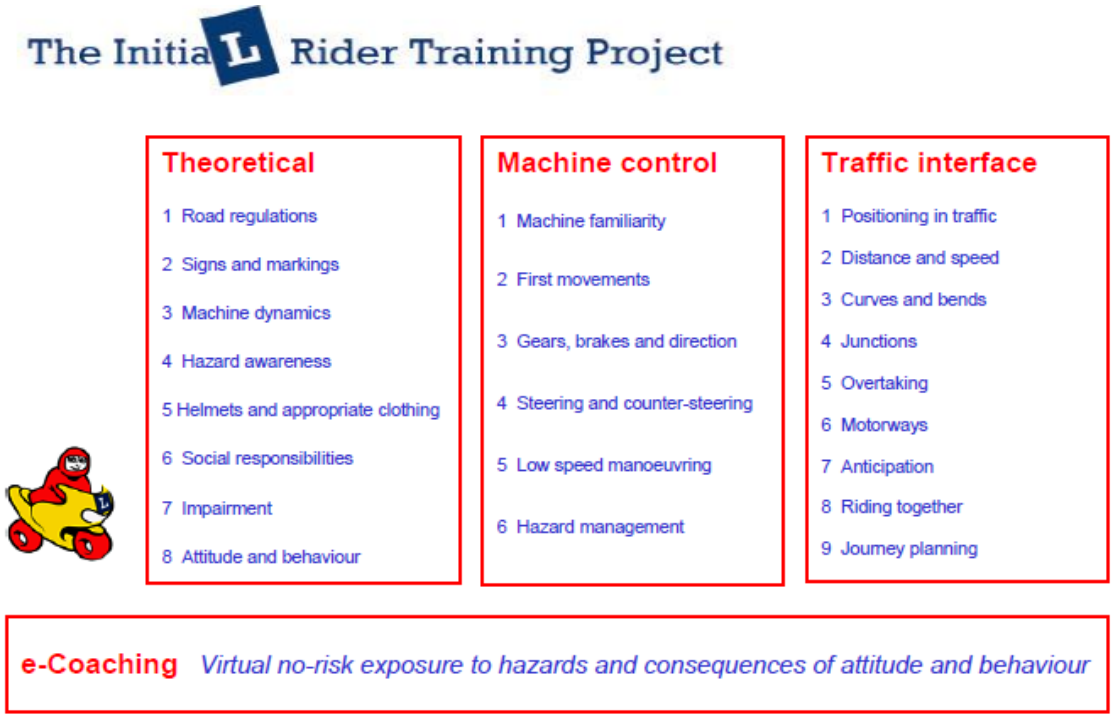

Figure 4.3 Components of the Initial Rider Training Project (Source: European Commission, 2007).

Importantly, the IRT program also promotes an electronic training resource, 'e-coaching', which has potential for enhancing rider safety through computer-based technology. To date it appears that IRT partners have merely scoped the development of e-coaching tools and have not yet developed any particular technology. However, Ranta, Maki and Huikkola (2007) have provided an overview of the intricacies and likely cost involved in developing a broad-based e-coaching tool to address risk taking and hazard perception in novice riders. Such a

tool has the potential to facilitate standardised self-paced learning anywhere that has computer availability. In addition to emphasising the potential application of such a tool, Ranta et al. note the following:

> "The road-safety research literature of the last two decades indicates a shift from training manoeuvring skills to training higher-order skills, i.e. hazard perception and anticipation skills, risk perception, as well as self-assessment. It appeared that combining practical exercises, theory and self-evaluation of one's own behaviour may increase safety of novice drivers. A promising way to train cognitive skills are multimedia PCs and driving simulators. The main advantage of using these devices, instead of real-car and/or theoretical training, is that trainees can experience the consequences of their own decisions and actions in risk-inducing and hazardous scenarios, which is impossible on the real road. Trainees can develop these skills even before they have fully automated their manoeuvring and vehicle control skills." (p.12)

In addition to the IRT project, one of the stakeholders (FEMA) has also publicly promoted and conducted a worldwide competition that called for motorcycle rider training industry personnel to submit training exercises that have been found to be useful. While there were no instructions regarding the specific nature of submissions it is expected that the vast majority of these will be skills-based. However, it is possible that training exercises targeting hazard perception and those of an attitudinal and motivational nature will be submitted and valued. Therefore, future announcements from FEMA in this regard may provide more insight into some of the commercial applications of attitudinal and motivational interventions in the rider training industry.

4.3.1.4 The Three Steps to Safer Riding Program

The Three Steps to Safer Riding Program has been developed by CARRS-Q within the context of Q-Ride through a partnership with Morgan & Wacker Motorcycle Training and TMR.

The program was developed as an adjunct to existing rider training to specifically address risk taking attitudes and behaviour by novice riders. It was designed to be delivered in a one hour classroom session at the start of training, with a 20 minute debrief to revise the key concepts at the end of training. The program was structured to be delivered in a standardised PowerPoint format to enhance consistency across various instructors. Video vignettes of riding scenarios are utilised along with quotes from experienced riders and crashed riders to provoke group discussion of the relative issues. Instructors were initially trained by CARRS-Q personnel then subsequently monitored by the Chief Instructor to ensure training delivery was consistent with the overall objectives of the program. Additionally, a preliminary study was undertaken to assess if the educational skills of the instructors were suitable for delivery of a program of this nature (see Rowden, Watson & Haworth, 2007).

The target audience for the intervention is novice riders that are either attending competency-based training to obtain a provisional motorcycle licence or to graduate from a provisional licence to an open "R" class licence. The intervention was primarily developed to get students to recognise their own psychosocial *Personal Risk Factors* and to provide them with the cognitive skills to overcome such risks (based on previous research undertaken by Watson et al, 2007). Crash scenarios and rider quotes from real life events are utilised to engage students in discussion about the risks encountered. A strong point of the program development was that it was underpinned by accepted psychological theory.

[redacted]

The program has been piloted with 518 participants. Data from these participants has been compared to a "control" cohort of [redacted] student riders who received standard [redacted] training only from the same training organisation. Preliminary results for the program are promising, however follow-up of long-term crash involvement is required to ascertain the full benefits (Rowden, Watson, Wishart & Schonfeld, 2009).

[redacted]

[redacted] a statistically significant difference for the intervention effects over and above that of the control group was found for attitudes to safe riding. That is, participants of the Three Steps to Safer Riding program were found to have higher increases in attitudes to safe riding upon finishing the course than the standard Q-Ride training program of the industry partner organisation. Multivariate analyses controlling for the possible influence of demographic variables also confirmed this finding.

Unfortunately, no evaluation of program components such as the take-home Toolkit is possible as it forms part of the overall intervention. That is, no experimental condition was created in the pilot intervention program to allow some riders to receive the Toolkit and some not. All participants of the Three Steps to Safer Riding program received the Toolkit. Currently, trials of the program incorporate a take-home DVD. The project team intends to evaluate the effects of this component separately in the future.

Comparison between the Three Steps Pilot and control groups at the ***end*** of training showed the Three Steps Pilot group rated themselves significantly ***higher*** for:

- "Learnt to recognise hazards";
- "The course has really changed the way I think about safety";
- "The trainers repeated things until I knew what I was doing";
- Being more conscious of the potential influence of their peers on risky riding;
- Being more conscious of the potential influence of family and friends on risky riding; and,
- Self reported rating of safe riding ability/motivation.

Three focus groups and one interview (totalling 18 riders) were also conducted as part of the evaluation to gain feedback from trainees who had participated in the intervention pilot. These were conducted five to eight months after the riders had initially commenced training (the majority of the intervention was presented on their first day). The focus groups were designed to ascertain if the intervention concepts made sense to the trainees, how much of the information was retained, and to what extent they had utilised it in their subsequent riding.

Initial analysis of the discussions with these riders suggests that new riders (complete novices) embraced and internalised many of the intervention concepts. For riders who had

some previous experience prior to training there were mixed results with some riders supporting and utilising the intervention information in their subsequent riding while others felt it was all "common sense". While they stated these issues were common sense, some riders still expressed riding styles that were contrary to some of the key messages (e.g. bending road rules). Overall it appears that the pilot intervention was successful in raising awareness of risk factors, however its effect on actual behaviour remains unclear (Rowden et al., 2009). Further quantitative follow-up is required to ascertain the actual behavioural effects of the program. Further refinement of the intervention program has taken place and data collection is continuing.

4.3.1.5 Rider Education Program in Thailand

Motorcycling in developing countries is considerably different to Western societies in terms of the proportion of motorcycles within the traffic mix, the types of motorcycles ridden (predominantly <250cc), the traffic infrastructure and environment, and the level of enforcement to deter risky riding. However, while the scope for risk taking may be somewhat different in relation to engine size and top-end speed, other behaviours such as riding under the influence of alcohol and riding without a helmet are common (Swaddiwudhipong, Boonmak, Nguntra & Mahasakpan, 1998).

Swaddiwudhipong et al. (1998) implemented and evaluated a motorcycle rider education intervention in rural Thailand that endeavoured to reduce risk taking. The program was delivered free in rural villages across three subdistricts, with follow-up interviews conducted two years after the intervention (*N*=1,141). Data from the intervention sites were compared to data gathered from 'control' villages across a further three subdistricts where the intervention had not taken place (*N*=1,297). The researchers asserted that broad-based road safety campaigns delivered during the intervention period were consistent across all villages and therefore any change in safety outcomes between districts could be assigned primarily to the intervention (however this lacked any measure of exposure).

The researchers found that several self-reported risk-taking behaviours were significantly reduced at the intervention sites compared to control sites after two years. While the proportion of riders that reported always wearing a helmet was 46% at the intervention sites, it was only 20.5% at control sites. Similarly, at the intervention sites 69.7% of motorcyclists were found to be appropriately licensed while this figure was 46.5% at control sites. This result is not surprising as the education intervention was delivered in conjunction with a licensing and training package delivered by the Department of Land Transport. Nonetheless, given the context of the intervention in rural areas where direct road safety initiatives are rare, the program can be seen to have largely achieved its goals through direct contact with the target population. The incidence of drink riding was not however reduced when compared to the control sites. In addition to the interview data, the researchers also examined motorcycle-related injury hospitalisation data and found substantial reductions in the intervention subdistricts compared to the control subdistricts in the year following the intervention. It appears this assertion was not based on rigorous examination of possible extraneous variables, however.

While this intervention was applied in a different context to that of Queensland, one positive aspect of the delivery of the program was the direct outreach to the target population. By implementing a direct intervention at no cost to participants, uptake and acceptance of the program may have been higher than if it was delivered at a cost to participants.

4.3.1.6 Assisted ride programs

Bikesafe is an assessed ride program implemented in Scotland aimed at reducing injury to motorcyclists. Licensed riders are accompanied on group day rides by police motorcyclists who model correct riding techniques and road position. They often offer commentary during the ride with the use of communications equipment. However, some ambiguity exists regarding the level of feedback provided to participants about individual deficiencies in skill during the ride. Ormston, Dudleston, Pearson and Stradling (2003) noted that there are insurance issues if the program is perceived as training. However, each rider receives an assessment of their ride at the finish of the on-bike session. Rides vary in duration between one and a half hours and three hours depending on location and police region.

Theory sessions are delivered in addition to the practical rides (some on the same day, some on separate evenings) and often address issues such as cornering, road positioning, hazard awareness, and overtaking (Ormston et al., 2003). However, as Bikesafe is a co-operative initiative among various police forces, there appears to be no standardised approach to theory training. In their evaluation of Bikesafe, Ormston et al. (2003) state that the theory sessions only sometimes specifically addressed risk-taking. The program website (http://www.bikesafe.co.uk/) provides very minimal coverage of risk-taking issues, however it does highlight other higher order factors such as anticipation of hazards (e.g. other road user movements at intersections) and the importance of planning each ride.

Despite the ambiguity regarding formal instruction about risk taking in the program, Ormston et al. (2003) found significantly lower self-reported speeds in built up areas. However, this positive finding was countered with the alarming finding that self-reported speed on the open road increased significantly. A marginal increase in the use of protective clothing was found, however there was little or no change in pre and post course self-reported risky riding behaviours such as lane splitting, racing other road users, and dangerous overtaking. Hazard perception skills were unfortunately not assessed.

Overall, it appears that the Bikesafe program focuses more on technical skill improvement than rider attitudes and motivation. This is reflected in the evaluation findings. While it appears hazard perception and appreciation is addressed in the program, it remains unknown what affect the program had on this factor.

Several assisted rides programs currently exist in Australia, however to date no evaluations of their effectiveness have been published. Bikesafe run on the Gold Coast (unrelated to Bikesafe Scotland) is conducted by Bradyn Murphy from Queensland Police. Another example is the program (SMART) overseen by the Gold Coast City Council, with day rides conducted by Honda Australia Rider Training (HART) through the Gold Coast Hinterland.

Costs for the day ride are partly met by the council in an endeavour to reduce motorcycle-related trauma in the area. A similar program was conducted in the Yarra Ranges in Victoria (McGuire, 2004). A large scale assisted rides program has been introduced in Victoria and is being evaluated by the George Institute. While the effectiveness of such programs for improving riders' skills and attitudes is unknown, they have high face validity with riders.

4.3.1.7 Rider Risk Reduction Course

The Rider Risk Reduction (RRR) course commenced in 2004 and is delivered by the Devon County Council in England with the aim of modifying motorcyclists' risk taking behaviour. It was developed based on a meld of accepted psychological theories of behaviour change (Burgess, 2006). Unlike the Three Steps to Safer Riding intervention, the RRR course is a post-licence police diversion program for existing riders who have committed serious breaches of traffic laws (on machines >500cc capacity). Hence, it is delivered to a known population of traffic offenders. Riders are referred by Devon and Cornwall Police to attend the course rather than pay a fine or lose their licence, with a 65% uptake rate.

The course does not aim to discourage riding; rather it aims to provide insight into the risks of motorcycling and addresses optimism bias. The program was developed in conjunction with riding groups and endeavours to maintain face validity with riders. Hence, it does not use "shock" tactics such as images of injured riders, rather it highlights the often hedonic (positive emotion) nature of riding, human limitations, and realistic risk assessment. The course comprises eight modules delivered by trained facilitators in a one day classroom session at a cost of £80 (see http://www.devon.gov.uk/rider_risk_reduction_course.htm). The Devon County website shows the following components of the course:

- Session 1: Facts of life;
- Session 2: Why am I here?;
- Session 3: Human limits;
- Session 4: Hazard perception;
- Session 5: I'm in control;
- Session 6: Bad habits and emotional baggage;
- Session 7: Video scenarios; and,
- Session 8: Ride safe, keep riding.

Preliminary evaluation of the RRR course has been conducted, however limited participant numbers (*N*=25) restricted meaningful statistical analyses (Burgess, personal communication). Nonetheless, it appears that the course has had a positive influence on risk-taking behaviour with changes on responses to questionnaire items in the desired direction

when self-report behavioural data gathered six weeks following the course was compared to self-reported riding in the six weeks immediately before referral to the intervention.

A national motorcycle offender program "RIDE" was developed based on the RRR course (Centre for Transport & Psychology, 2009). While both the RRR course and the RIDE course are aimed at recidivist offender populations, the content of such courses may hold value for application within a broad training and licensing system, however would require tailoring to suit *all* riders. Unlike riders who have been identified as high-risk traffic offenders, the majority of riders within the general population applying for a motorcycle licence may not currently exhibit such behaviours. The program, therefore, may need to adopt a *learning* perspective for some riders in the licensing context (i.e. regard them as a 'blank slate') rather than purely a behaviour change perspective that seeks to modify existing dysfunctional behaviours.

An evaluation of the RIDE program found benefits in terms of reduced speed preference, decreased 'deviant beliefs', and decreased influence of others ('norms') on riding behaviour for course participants compared to a control group (Broughton, Burgess, Fylan & Stradling, 2010). However, the control group appeared to differ from the RIDE intervention group in several key areas: riding experience, crash history, offence history, gender, age, and the capacity of motorcycle ridden. Baseline measurement for nearly every attitudinal or behavioural variable differed between the control group and intervention group. While age and baseline scores were controlled for in analyses, other differences suggest that the control group was not appropriate. Hence, results of the quantitative component of the evaluation must be interpreted with caution. Qualitative research was also conducted, suggesting that RIDE participants valued the course and many felt it changed their riding styles.

4.3.1.8 Riders Helping Riders – Drink Riding Intervention

Peer to peer programs for motorcyclists are commonly promoted within the United States to address behaviours such as drink riding. For example, the Riders Helping Riders program aims to reduce alcohol-related motorcycle crashes by empowering riders to intervene when they believe another rider may be alcohol impaired (McKnight, Becker & Hohn, 2009). As peer influence has been shown to predict risk-taking behaviour for motorcyclists (e.g. Watson et al., 2007), such peer to peer programs operate on the rationale that riders need to accept some responsibility for fellow riders whose judgement may be impaired, and that the influence of another rider may have comparatively more impact than other sanctions or general deterrence measures due to the camaraderie that exists within the motorcycling community.

The Riders Helping Riders program was originally developed and piloted in the US state of Maryland and then applied in a limited sense in South Carolina and statewide in Georgia (McKnight et al., 2009). The 35-minute program includes the following key issues for discussion:

- Highlighting the importance of intervention to reduce injury;

- The appropriateness of peer intervention;
- Separating drinking from riding (e.g. planning group rides to avoid premises that serve alcohol);
- Discouraging riders from becoming impaired;
- Recognising impairment (e.g. observing riders who are drinking – count drinks);
- The signs of impairment;
- Discouraging impaired riders from riding;
- Preventing impaired riders from riding;
- Pledging to intervene; and,
- Optional role plays (McKnight, 2009).

Evaluation of the Riders Helping Riders program (*N*=5,252) found significant positive effects on rider attitudes towards intervening when another rider has been drinking as well as a significant increase in the willingness to intervene. However, no significant difference was found when comparing actual alcohol-related motorcycle crashes to alcohol-related car crashes in the state of Georgia during the intervention period (McKnight, 2009). Unfortunately, this result may be an artefact of the study design whereby crash data represented all alcohol-related motorcycle crashes in the state, while a comparatively low proportion of active riders within the state actually took part in the program. Hence, far more participants are required before any significant findings are likely to be detected, based on the present methodology. Additionally, no adjustment for exposure was noted by McKnight in his analysis. This may potentially bias results if the popularity of motorcycling (or car driving) results in comparatively more riders being on the road over the study period or comparatively more distance travelled by either group.

NHTSA (2008) noted that in the United States there is concerted effort to address drink riding through peer to peer programs such as Riders Helping Riders and other educational programs such as the Motorcycle Safety Foundation rider training, however the effectiveness of such programs is largely unknown.

4.3.1.9 Summary of programs to address risk-taking attitudes, motivations and behaviours

The importance of addressing risk-taking attitudes, motivations, and behaviour for motorcyclists is widely acknowledged. This section has reviewed programs that aim to address such factors. In addition to the interventions reviewed above, riding guides and handbooks such as the MSF's *Motorcycling Excellence* and on-line resources also offer important information regarding management of risk-taking. These are integral to effective

licensing systems, however these are regarded as educational resources rather than stand alone interventions and are too numerous to comprehensively review.

Where interventions have been applied, evaluations show some promising results, however these are limited to intermediate measures and unfortunately more extensive evaluations are required to determine effects on crash reduction. While conceptual models such as the GDE matrix provide a sound framework for intervention programs, more broad scale research and evaluation is required. Crash reduction is considered the ultimate outcome measure in road safety, however the logistics and cost of obtaining the extremely large number of participants required to show any effect on crash reduction (because crashes are rare events) hinders such evaluations. Hence, other measures of risk-taking such as self-reported behaviour, attitudes, intentions to engage in risk-taking, thrill seeking, and official violation or offence data provide a more immediate indication of the success of interventions aiming to address the attitudes and motivations for risky riding for motorcyclists.

4.3.2 Attitudinal and higher-order cognitive interventions for car drivers

Unlike motorcycling, a wide range of interventions addressing attitudinal and higher-order cognitive factors have been trialled for car drivers. While a complete review of all programs applicable to car drivers is beyond the scope of this report, several interventions will be briefly reviewed in this section with a view to their potential application for motorcycling. Attitudinal or behavioural driver improvement programs usually target recidivist traffic offenders with the aim of addressing specific dysfunctional behaviours such as drink driving or speeding. In a comprehensive review of driver improvement interventions, Masten and Peck (2004) found that programs of this nature have a small effect in terms of crash reduction and violation reduction. This section will review several attitudinal or behavioural driver improvement programs and, additionally, assess the utility of several other interventions that are commonly aimed at young drivers, such as insight training and optimism bias training.

4.3.2.1 South Australian Driver Intervention Program (Driver Improvement)

This state-implemented deferral program for young traffic offenders in South Australia aims to reduce risk-taking behaviour by car drivers who have been disqualified from driving for breaches of their learner permit or provisional licence. The objective of this driver improvement program (DIP) is to modify behaviour through classroom training sessions where group discussion is facilitated to assist participants to identify their own risk issues and plan how they might effectively address these (Hutchinson, Kloeden & Wundersitz, 2007).

The 90 minute program is delivered by trained facilitators to groups of no more than 16 participants. To allow for effective group discussion, the overall class is separated into smaller groups of no more than eight participants. Wundersitz and Hutchinson (2006) reported that while participants have committed traffic offences early in their driving careers, they possess personality characteristics similar to the broader population of comparable age with the exception of elevated scores on aggression scales for young male participants. Attitudes to safety were also found to be lower in the intervention group, however

Wundersitz and Hutchinson asserted that the personality characteristics of the sample suggest they are not a socially 'deviant' group.

Wundersitz and Hutchinson (2006) reviewed other driver improvement programs with similar aims during the process of developing the South Australian program, with a view to establishing best practice. They noted the following:

- The general quality of empirical evidence about the effectiveness or otherwise of these programs is quite poor;
- No exemplar driver improvement programs exist that convincingly establish best practice;
- It is unlikely that any program will have a large effect on crashes;
- The cost of such programs is low compared with the costs of deaths and injuries, and even if effectiveness is low, the programs may be worthwhile; and,
- Several ideas have been proposed in recent years that offer some hope for better programs in the future.

While Wundersitz and Hutchinson (2006) acknowledged that it was unlikely that the program would have a large effect on crashes, they highlight the cost to society of young driver crashes and traffic offences is high and therefore even a small effect would result in the program being cost effective. One key limitation to the likely success of the program is the limited time for delivery (90 minutes), however this appears to be a requisite trade-off for the cost-effectiveness of the course.

As the allocated time for delivery of the program is limited, the content of the program is not exhaustive in terms of risk taking. Even if more time were available it is questionable how much participants are likely to cognitively process and retain. The program content is structured around five key areas of concern:

- Characterising risk-taking behaviour and crash involvement;
- Social norms and behaviour rationalisations;
- Lifestyle issues;
- Consequences of crashing; and,
- The reinforcement of vulnerability.

Examples of driving topics within these categories that are discussed are drink and drug driving, fatigue, speeding, inexperience, and peer pressure (Wundersitz & Hutchinson, 2006).

The structure of the program appears to be consistent with the rationale of the GDE Matrix and further addresses optimism bias in terms of perceived vulnerability.

A follow-up of crash and offence involvement compared course participants to those who were directed to attend the course but instead elected to pay an expiation fee. It was found that the intervention group did not differ from the comparison group in terms of crash involvement after six months. However, traffic offending was found to be significantly lower in the intervention group (Kloeden et al, 2007). While this result somewhat affirms the objectives of the program, it must be considered with caution due to the lack of any measure of exposure such as distance travelled for each group and the possibility of self-selection bias (i.e. there may be some underlying difference between those who chose to complete the program and those who chose to pay the expiation fee).

In reviewing the overall effectiveness of the intervention process Wundersitz and Hutchinson (2006) concluded the following:

> "If it were desired to make DIP a stronger intervention without changing its general approach, it would be possible to reduce the size of the groups, make the program more therapeutic, and make it longer." (p.14)

4.3.2.2 Thames Valley Speeding Awareness Scheme for Speeding Offenders

The Thames Valley Speeding Awareness Scheme was implemented in Britain to address speeding for two specific target audiences: low-speed offenders (those who had only marginally exceeded the speed limit); and high-speed offenders (those who had been detected exceeding the speed limit by a 'considerable' margin) (McKenna, 2004). Unfortunately, no details of exact cut-offs for exceeding the speed limit were provided by McKenna for either group of drivers. The participants were not necessarily recidivist offenders; rather they were drivers from the general population who had been detected speeding by police on any occasion during the trial. McKenna noted that as speeding is largely a socially acceptable behaviour and the majority of the general population engage in regular speeding, there is a need to address the attitudes of 'normal' drivers in addition to recidivist groups that are usually the target of other driver improvement programs. Four hundred and ten drivers participated in the intervention for high-speed offenders, while 4,678 participated in the intervention for low-speed offenders.

For the low-speed offender group the intervention consisted of completing a 40-50 minute on-line driving behaviour inventory from which they then received a printed feedback form and engaged in discussion with a trainer regarding their individual driving risk behaviours that were identified in the inventory. They also completed on-line interactive video tasks that assessed close following, speed choice, and hazard perception. The high-speed offender group completed the same on-line inventory and video tasks as the low-speed offenders and discussed the results with a trainer; however they also participated in an on-road driving task with feedback from the trainer. Additionally, the high-speed offenders also received a reward in the form of a refund of demerit points to their licence.

The course was designed to challenge drivers' attitudes to risk-taking and speed enforcement. The inventory for driving behaviours included a range of common risk-taking behaviours so, while participant recruitment was based on speeding behaviour, the intervention aimed to change overall driving behaviour. Personalised safety messages tailored to each individual's inventory results were incorporated into the course with the aim of motivating responsible road user behaviour.

Unfortunately, McKenna (2004) did not report any follow-up of subsequent speeding offences or crashes for course participants. However, some interesting comparisons between the two offender groups were provided. McKenna compared the high-speed offender group characteristics to those of the low-speed group and found that the high-speed group:

- Was younger;
- Was more likely to be male;
- Displayed higher speed choice on the interactive driving task;
- Reported more previous driving offences;
- Reported more previous crashes; and,
- Rated the usefulness of the course as lower, indicating resistance to the program.

These results suggest that the high-speed offender group were significantly more deviant or dysfunctional than the low-speed group. However, while both groups reported intentions to slow down in the future, the high-speed group actually reported intentions to drive slower than the low-speed group. Based on these findings, McKenna (2004) asserted that the education of speeding drivers, rather than purely adopting punitive measures, was a useful method of addressing speeding behaviour.

Further review of the Thames Valley Speed Awareness program found that the project is ongoing with several subsequent publications (McKenna, 2005, 2006). However, none of these publications revealed any actual outcomes of the program in terms of subsequent crash involvement or traffic offending. Therefore, it is impossible to assert the actual effectiveness of this intervention as a road safety countermeasure.

4.3.2.3 Optimism Bias Training

Optimism bias (or unrealistic optimism) is a psychological construct that can be linked to overconfidence in motorcyclists as previously described. Interventions that endeavour to address optimism bias aim to align participants' subjective perceptions of risk with objective reality.

Hatfield and Job (2001) reported lower optimism bias regarding road-related events for participants who completed a driver training intervention compared to a waiting list control

group. The intervention explicitly provided information regarding the risk of optimism bias then involved participants in personal reflection on past events and the possibility of their involvement in future negative events. They found that by eliciting a more realistic view of past events, optimism bias for future events was reduced.

McKenna and Myers (1997) found that unrealistic optimism in regard to driving risk could be reduced by manipulating young drivers' perceptions of personal accountability. For the experimental group this was achieved by stipulating that their driving skills would be assessed in a simulator following their self-ratings and comparisons made. Therefore, the awareness of being objectively assessed resulted in reduced illusory self-perceptions of driving skill compared to a control group without the threat of objective assessment.

The implications of the above studies for motorcycling are that:

1. Licence training may benefit from reflections on personal experiences of risk; and,

2. Regular assessment of skill (e.g. at various stages during GDL) may assist in more realistic appreciation of riders' abilities and exposure to risk. Additionally, the feedback provided from assessment may assist in identifying realistic strengths and weaknesses.

Accordingly, optimism bias may be reduced from a combination of such measures. The alignment of riders' subjective perceptions of skill and risk with realistic indicators of each may be useful in addressing overconfidence.

4.3.2.4 Insight Training for Young Drivers

'Insight' training was pioneered in Scandinavia as a method to positively influence young driver attitudes, behaviours, and perceptions of risk, and reduce overconfidence (Gregersen, 1996; Senserrick & Swinburne, 2001). Rather than teaching drivers how to control a vehicle in difficult driving situations, insight training focuses on calibrating participants' perceptions of their own skill and risk with objective reality (i.e. increasing self-awareness of one's own driving abilities and limitations). Overall, it aims to create a more realistic perception among participants of risky behaviours in the driving environment and is akin to the process of reducing unrealistic optimism dependent on the specific application.

Senserrick and Swinburne (2001) evaluated the AAMI Skilled Drivers post-licence insight training program for young drivers in Australia. The primary aim of the course was to allow young drivers to experience the anxiety associated with a loss of control rather than to teach them advanced driving skills. The single day program incorporated both a classroom-based theory session and a practical driving session. The classroom session utilised a variety of presentation and teaching modes such as video, audio, overhead slides, and face-to-face group discussion facilitated by the instructor (Senserrick & Swinburne, 2001). Issues covered in the theory session were the factors contributing to road crashes with a focus on the human element. Information learnt from the theory sessions regarding driver behaviour was reinforced in the practical driving sessions on a custom built closed facility.

Intervention participants completed questionnaires at the commencement of training (Time 1) and shortly following completion of the course (Time 2). These results were compared to a similar group of drivers that were allocated to a waiting list and completed identical questionnaires, except at Time 2 the control group had not yet undertaken training yet (i.e. not received the intervention at this time). All participants, including the control group, eventually completed the training and follow-up questionnaires were completed eight to nine weeks following the course (Time 3). Notably, Senserrick and Swinburne (2001) found that the intervention participants showed a greater change in attitude regarding close following of another car than control participants between Time 1 and Time 2 and a greater reduction in their self-reported undesirable driving behaviours (mistakes, violations, and lapses). The difference in scores for perceptions of intervention participants for their ability to avoid hazards was also significantly greater than controls between Time 1 and Time 2.

While Senserrick and Swinburne (2001) found that insight training had some positive influence on driver road safety attitudes, behaviours, and risk perceptions there was no attempt to assess it's efficacy in terms of crash reduction due to the relatively small number of course participants (*N*=220). As such, while more evidence is required regarding the possible crash benefits of insight training, it offers promise for future training for young drivers.

A study by Rosenbloom, Sharar, Elharar and Danino (2008) also reported results from an insight training program in Israel that was centred upon skid pan training (i.e. loss of vehicle control) for 224 car drivers of varying ages. Findings from the study indicate that skid pan training had an immediate positive affect upon driver risk perception following training and that this effect was maintained two months later for a subset of 28 drivers that were sampled. Unfortunately the study did not include a control group and, therefore, results must be interpreted with caution.

4.3.2.5 Computer Based Risk Assessment Software Applications

Software applications are perhaps the most standardised way to deliver educational road safety interventions to broad-based, geographically diverse audiences. The Attitude Advisor (see Johnson, 2009) is an application that was developed to identify and provide feedback on risk taking in young drivers, however it could be equally effective for motorcyclists with some modifications. The web-based PC program presents drivers with traffic scenarios from a car drivers' perspective and a risk inventory of 100 items based on the Theory of Planned Behaviour concepts. Responses to the inventory generate an individual profile where protective risk management messages are subsequently presented as feedback, similar to the previously mentioned Thames Valley Speeding Awareness Program.

Several concepts are represented in the Attitude Advisor: social responsibility (endangering others and thoughtlessness), individual risk taking, and compliance. Validation of the Attitude Advisor items was undertaken using an eclectic sample (*N*=331) of students, prisoners, personnel from the UK armed forces and commercial organisations. It was found that young drivers scored highly on most of the risk indicator categories, consistent with the

known facts that young drivers are a high risk group of road users. It was also found that drivers with traffic convictions scored higher on the risk indicators than others. The program is being further refined and shortened for future applications (Johnson, 2009). Therefore, this program appears to offer much promise for addressing risk taking in drivers.

A similar PC-based product named Driver Profiler 2 has been developed by The Royal Society for the Prevention of Accidents (RoSPA) for application to fleet drivers and motorcyclists, however no information was found to be readily available regarding program specifics or any evaluation of its effectiveness. The RoSPA website states the following in regard to Driver Profiler 2:

> "This online assessment takes around 20 minutes to complete and consists of two sections, firstly identifying information personal to the driver such as accident history, mileage and they type of driving they do. The second section consists of a series of 98 statements regarding driving attitudes whereby employees have to decide the extent that each statement applies to them. At the end of the assessment, employees will receive an individual report which allows them to see 'at risk' areas of their driving and provides tips and advice to improve these areas. The traits measured by the risk assessment are: aggression, alertness, stress, dislike of driving, anticipation, attention, violation, and error"
>
> http://www.rospa.com/drivertraining/managementinfo/driverprofiler.htm.

Integral to the accuracy of such software applications (or indeed any self-report risk assessment measure) is the honesty and accuracy of respondents when reporting their behaviours. Therefore, respondents must be motivated to respond honestly and not misrepresent their true risk taking disposition. This represents challenges for the application of such software within licensing systems where applicants are motivated to respond in a way that they feel will assist them obtain their licence.

4.3.2.6 Summary of programs developed for car drivers

The abovementioned interventions for car drivers offer prospective ideas for structuring interventions that address risk taking by motorcyclists. In addition to the previously mentioned attitudinal or motivational and hazard perception intervention applications to motorcycling populations, these applications for car drivers suggest that there are in fact several different approaches that are possible.

4.4 SUMMARY OF MOTORCYCLING AND RISK TAKING LITERATURE REVIEW

This review has identified key issues relating to risk-taking behaviour by motorcyclists as well as the dangers of deficient hazard perception skills. A variety of behavioural intervention programs for different target groups of motorcyclists were found. These included brief face-

to-face programs for both novice riders (e.g. Three Steps to Safer Riding) and recidivist traffic offenders (Rider Risk Reduction Course), and various programs that required active community outreach and involvement (e.g. Riders Helping Riders, Bikesafe Scotland, and a program in Thailand). The GDE model promotes addressing psychosocial influences on riding and broader lifestyle issues and provides a framework for many of the recent developments in training in Europe. Computer-based resources for delivery of attitudinal programs for motorcyclists were found to require further development, however programs developed and validated for drivers may have potential for application to motorcyclists. Overall, evaluations of attitudinal and motivational programs for motorcyclists were limited to intermediate measures, however some showed promising results.

It is apparent that educational interventions to address motorcyclists' risk-taking attitudes and motives *or* hazard perception are best applied within the licensing system in order to gain any broad-scale effect (as opposed to post-licence programs where numbers are limited). Motorcycle rider training is predominantly perceived by the motorcycling community as a credible and worthwhile safety initiative. This perceived legitimacy is important to ensure the adoption of road safety initiatives by the public and is something that authorities have the potential to capitalise on for the introduction of attitudinal and other higher-order cognitive training programs for motorcyclists within licensing systems.

The lack of ability to objectively assess higher-order cognitive skills has played a major role in these skills receiving insufficient attention in novice rider courses that are part of the licensing process. It is the test (or the competencies that are assessed) that influences what is trained, and what is perceived by riders to be important. If higher-order skills are not assessed, then there is little motivation for them to be taught or learnt. The development and implementation of a motorcycle-specific hazard perception test as part of the licensing process could provide a real opportunity for motivating the teaching and learning of these skills. Further discussion of the implications of the information reviewed for the Queensland motorcycle licensing systems can be found in Section 6 of this report.

5. LITERATURE REVIEW – HAZARD PERCEPTION IN MOTORCYCLING

In addition to risk-taking behaviour, hazard perception is also central to the safety of motorcyclists (Haworth, Mulvihill & Symmons, 2005; Horswill & Helman, 2001). It can be argued that high level hazard perception skills are indeed more pertinent to the safety of motorcyclists than car drivers due to the vulnerability of riders and the potentially serious consequences of inappropriate responding.

5.1 WHAT IS HAZARD PERCEPTION?

Haworth, Mulvihill, Wallace, Symmons and Regan (2005) reviewed hazard perception research and highlighted how this could be potentially applied to motorcycling. They provided the following definitions of hazards in the road environment and hazard perception for road users:

> "We have defined a **hazard** as *any permanent, transitory, stationary or moving object in the road environment that has the potential to increase the risk of a crash. Hazards exclude characteristics of the rider or the vehicle, which are classed as modifying factors*. **Hazard perception** is defined as *the process whereby the road user notices the presence of a hazard*" (pg 1).

Haworth Mulvihill, Wallace, Symmons and Regan (2005) represented the process of hazard perception in Figure 5.1 which highlights the distinction between modifying factors (e.g. speed and alcohol), which are commonly associated with risk taking, and hazard perception factors such as recognizing hazards and responding.

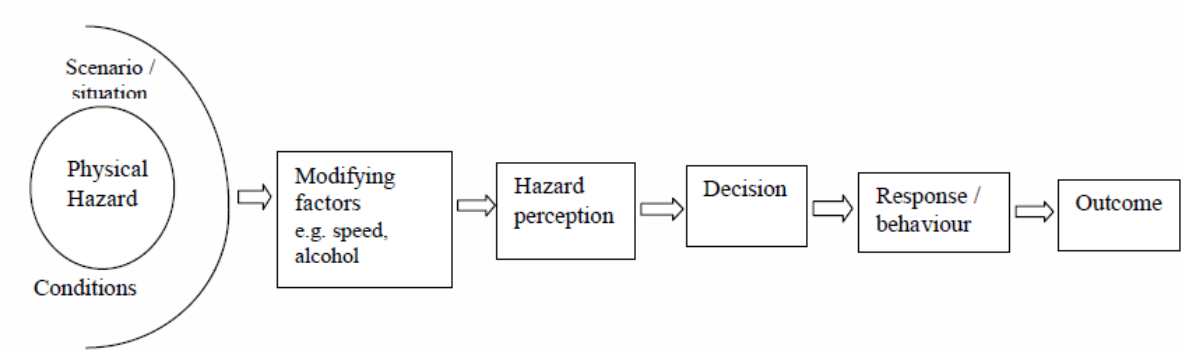

Figure 5.1 A model of the role of hazard perception in the chain of processes linking the existence of physical hazards and outcomes. (Source: Haworth Mulvihill, Wallace, Symmons and Regan 2005).

As Figure 5.1 shows, the issues of risk taking and hazard perception can be difficult to separate at a conceptual level as they are inherently entwined. Hence, while this report endeavours to discuss hazard perception and risk taking separately, it must be noted that there is somewhat of a reciprocal relationship between the two issues. That is, risk taking such as impaired riding or speeding may compromise hazard perception and enhancing hazard perception skills may reduce risk-taking behaviour.

However, hazard perception generally relates to a specific environmental hazard while concepts of risk (e.g. risk perception) are generally conceived at a broader level and also encompass modifying factors such as the perception that it is in fact risky to drink alcohol then ride. Each of these processes relies on the subjective interpretation of the individual and an appreciation of what constitutes a risk or a hazard. Banet and Bellet (2008) noted that: "*risk perception refers to the subjective experience of risk in potential traffic hazards or is considered a precursor of present driving behaviour*". Hence, a hazard or a potentially dangerous behaviour must both first be perceived as a risk in order for the rider to decide on an appropriate course of action.

The related nature of hazard perception and risk taking was noted in the recent European 2BeSafe project report (ICCS, 2010). They noted that as risk perception is subjective any particular physical hazard may be interpreted differently by different individuals. When presented with a hazard some riders may be cautious, however others who detect the hazard may still elect to take a risk as they fail to perceive it as dangerous. This is reflected in the following quote (ICCS, 2010):

> "A driver may identify a hazard in a situation but judge that they would respond in such a way that the likelihood of an accident would not be increased, and so not alter their driving behaviour significantly. For example, an overconfident driver may drive at high speed through residential streets, believing that they will be able to react quickly enough to avoid any unexpected obstacles, such as a child running into the road (p10)."

"Roadcraft" is a term commonly used by motorcycle rider trainers that lacks specific definition, however it is commonly associated with hazard perception and, hence, requires mention. While roadcraft can be interpreted as a combination of many behaviours, it usually includes road positioning to avoid hazardous situations and predicting and recognising potential hazards (e.g. the movements of other road users). The amorphous nature of the concept of roadcraft makes it difficult to specifically integrate within the hazard perception process, however training programs that address roadcraft promote preparedness (e.g. for braking) and early responding rather than emergency responding. To this end, hazard perception is integral to roadcraft.

5.2 HAZARD PERCEPTION IN MOTORCYCLING

Many multi-vehicle crashes involve deliberate breaches of road rules by other road users, an inability for other road users to perceive motorcyclists, or inappropriate responding by

motorcyclists (Hurt et al., 1981). As such, motorcyclists need to be particularly skilled at perceiving and avoiding potential hazardous situations as well as being adept at responding safely when required. Alternately, at-fault motorcycle crashes appear to be primarily due to rider errors in hazard perception or deliberate risk taking by the rider (Elliott, Baughan & Sexton, 2007). These patterns of motorcycle crashes provide strong evidence that a reduction in death and injury to motorcyclists can be achieved by addressing rider-specific factors such as safety attitudes and hazard perception.

This section examines the available literature regarding hazard perception in regard to motorcycling. As much of the previous research regarding hazard perception for road users has been conducted with car drivers, a discussion of this research is also included.

Among experience-related factors, deficient hazard perception skills have been found to make an important contribution to novice driver accident involvement. Compared to more experienced drivers, novice drivers are slower to detect and respond to hazards in the driving environment (Quimby & Watts, 1981) and are less likely to detect child pedestrians and cyclists in the driving environment (Egberink, Lourens & van der Molen, 1986). Quimby, Maycock, Carter, Dixon and Wall (1986) found that slow hazard detection (measured in a driving simulator) is associated with a history of greater self-reported accident involvement. Catchpole, Cairney and Macdonald (1994) and Catchpole (1998, cited in Catchpole & Leadbeatter, 2000) have shown that deficiencies in hazard perception skills account for a large proportion of the accidents in which novice drivers are involved.

The notion of hazard perception training for motorcyclists is a challenging prospect, however one that has potential to result in considerable benefits. These benefits may be threefold: 1) assisting riders to identify fixed hazards in the on-road environment (hence reducing rider error); 2) better predicting the movements of other road users (hence avoiding potential crashes where other road user errors are present); and 3) reduction of risk-taking behaviour. In regard to the latter, Haworth and Mulvihill (2005) asserted that positive results found for hazard perception training for the reduction of risk-taking in car drivers may have relevance for motorcyclists due to their propensity to exhibit behaviours that contribute to heightened crash risk.

While hazard perception programs for car drivers have been developed and are often implemented within a graduated licence testing regime, these may be inappropriate or insufficient for motorcyclists due to the different types of hazards encountered by the two groups. For example, motorcyclists need to identify and avoid environmental hazards such as uneven road surfaces, manhole covers, line markings (particularly during rain), loose gravel or grass on the road surface, as well as objects that may obstruct the view of other road users, and the movement of other road users. While this list is not exhaustive, attention to such issues is paramount. Existing knowledge in regard to driver hazard perception training is valuable, however may not give a sufficient account of the complexity of issues faced by motorcyclists.

Underwood and Chapman (1998; as cited in Elliott et al., 2003) conducted an experiment comparing the hazard perception skills of motorcyclists and car drivers. They presented participants with 13 video clips of traffic scenes and instructed participants to press a button when a hazard was perceived. They found that while there was no difference in the number of hazards identified, experienced drivers showed slower reaction times than experienced riders. Furthermore, they found that experienced drivers displayed longer decision intervals (difference between eye fixation interval and actual response time) than experienced motorcyclists. Based on these findings, Elliott et al. (2003) asserted that:

> "the experience of riding a vehicle that places them more at risk of an accident may help motorcyclists to develop faster hazard identification skills. However, motorcyclists may also have slightly faster hazard identification skills owing to factors that that caused them to choose to ride a motorcycle." (p.44)

Similarly, Horswill and Helman (2003) used a simulator to examine hazard perception and behavioural differences between experienced motorcyclists and experienced car drivers. However, in addition to the group of car drivers who had never ridden a motorcycle, two groups of motorcyclists were used: one group responding as if riding a motorcycle, and the second group responding as if they were driving a car. The researchers presented participants with traffic scenarios using video clips. Hazard perception was assessed using a response time measure (pushing a button when a hazard was detected). It was found that motorcyclists who were directed to respond as if driving a car had quicker response times to hazards than car drivers. However, the motorcyclists directed to respond as if they were riding their motorcycle had slower response times than the other groups. The researchers suggested that this was because the simulated traffic scenarios failed to account for motorcycle-specific hazards which may have tainted the results.

The Case-Control Study of Motorcycle Crashes (Haworth et al., 1997) identified a substantial number of crashes in which the rider either failed to perceive a hazard or made an incorrect or poorly timed response to the hazard. The hazards were often other vehicles but sometimes included motorcyclist-specific hazards such as aspects of the road surface. Many of the riders who had crashes involving deficiencies in hazard perception or responding were inexperienced. The requirement for improvements in hazard perception and responding for motorcycling is highly warranted in light of these results. However, most rider training courses do not focus on hazard perception and other higher order cognitive skills. Existing rider training may inform students that hazard awareness or roadcraft are imperative skills, however the dilemma is that to sufficiently develop these skills *in situ* a rider must be exposed to such hazards, hence increasing his/her risk. The challenge, therefore, is to devote sufficient time to learning these skills within a relatively safe environment.

Haworth et al. (2005) examined crash patterns for motorcyclists in an endeavour to establish what type of hazard perception errors were involved. They found that errors in predicting and responding to other road user movements were predominant in built up urban areas. Many of the multi-vehicle crashes were primarily the fault of other road users with crash types such as; u-turn, turn right through (not at intersection), adjacent directions right rear (at

intersection), head-on not overtaking, and rear end. Given these findings it is imperative that motorcyclists gain experience in scanning for (and predicting) such movements as well as preparing to respond (e.g. covering brakes) and road positioning to minimise the likelihood of such events.

In a more recent study, Liu, Hosking and Lenne (2009) used a Honda Riding Simulator at Honda Australia Rider Training (HART) Centre, Melbourne to compare hazard perception skills for experienced motorcyclists with novice motorcyclists. However, the groups also differed in car driving experience to investigate the possible influence. Therefore, there were four groups:

- Experienced motorcyclists with an open car licence;
- Inexperienced motorcyclists (learner permit) with an open car licence;
- Novice motorcyclists (pre-learner) with an open car licence; and,
- Novice motorcyclists (pre-learner) with a probationary car licence.

Three different riding scenarios were used in the study: touring (rural); avenue (medium density traffic); and path (high density traffic). They found that the novice rider group with a probationary car licence crashed more than the other groups in the touring scenario only. This is perhaps surprising as it would be expected that the experienced rider group should outperform all other groups in all scenarios in terms of crash involvement. However, the researchers also found that the experienced rider group showed more immediate reduction of speed in response to hazards (one second after presentation) than the other groups in some situations. While the researchers acknowledge that age potentially influenced the findings, this study offers further support for heightened hazard perception skills and responding by experienced riders.

An earlier series of studies conducted by Liu, Hosking, Bayly, Mulvihill and Lenne (2008) indicated that experienced riders also showed more complete visual scanning processes than inexperienced riders and identified more road-surface-based hazards than experienced drivers. From the overall program of simulator research conducted, the researchers asserted that not only do experienced riders exhibit better hazard perception and responding skills than car drivers or novice riders, hazard perception for motorcyclists is qualitatively different from car drivers. The implication of this is that hazard perception tests for motorcyclists within a licensing regime need to be different to that for car drivers.

While the above research highlights hazard perception abilities of experienced motorcyclists, it can be argued that motorcyclists seldom respond *ideally* to most emergency situations. For example, most riders' initial instinct is to brake heavily, often causing a loss of control that results in a crash (see Hurt et al., 1981). However, the concept of roadcraft promotes early identification of hazardous situations to avoid potential conflicts and strategies such as allowing sufficient 'survival space'. Perhaps the most pragmatic aspect of roadcraft for a

rider is learning how to avoid putting themselves in harms way by developing high level hazard perception and risk perception skills.

In summary, hazard perception skills are more vital for motorcyclists than car drivers due to the severity of outcomes if hazard perception skills are poor. Accordingly, experienced riders appear to have developed greater hazard perception skills than experienced car drivers. Novice riders may be particularly at risk until such skills are developed, therefore interventions that train novice riders to develop hazard perception skills are greatly needed.

5.3 INTERVENTIONS TO IMPROVE HAZARD PERCEPTION BY MOTORCYCLISTS

As there has been limited application of hazard perception training for motorcyclists, some of the foundations for development of programs (including the value of programs for car drivers) are initially discussed in this section. The developing area of interventions for hazard perception for motorcyclists is then considered by first examining interventions that attempt to enhance hazard perception skills off-road (e.g. computer or simulator based) followed by an examination of programs that aim to develop these skills on-road.

As discussed in previous sections, hazard perception is integral to safe motorcycling. Hazard perception skills are perhaps more important to motorcyclists than car drivers due to the vulnerability of motorcyclists and the potential consequences in the event of a crash. If riders can identify and recognise threats quickly within the traffic environment they are arguably more likely to be able to avoid a hazardous situation or at least have more time to employ an appropriate response. Experienced riders have been shown to be less likely to be involved in crashes requiring hazard perception skills than novice riders (Haworth, Symmons & Kowaldo, 2000), and more likely to immediately reduce speed in response to a hazard (Liu et al., 2009). Novice riders are particularly at risk until such skills are sufficiently developed. Hence, there is a specific need to develop training programs to enhance novice rider hazard perception. However, such programs may potentially benefit all riders.

Research has shown that hazard perception training in novice *drivers* leads to improved performance on hazard perception tests (McKenna & Crick, 1991; Mills, Hall, McDonald & Rolls, 1998), although it is not yet known whether these drivers go on to be safer drivers and have fewer crashes (McMahon & O'Reilly, 2000). No research has examined whether hazard perception training by motorcyclists leads to improved performance on hazard perception tests or, indeed, whether it leads to increased safety on the road.

Some of the methods used for hazard perception training for car drivers may not be feasible for motorcyclists. For example, while instructors travelling with novice car drivers and providing feedback on hazards (or listening to commentaries) has been used, it may not be appropriate for an instructor to travel as a pillion with a novice rider. Moreover, many of the approaches to hazard perception training for car drivers require only detection of the hazard

and response by pressing a button. Thus, they do not train improved execution of responses to hazards; an area that the crash data suggest is of greater importance to riders than drivers.

Wallace, Haworth and Regan (2005) detailed how hazard perception skills can be developed for motorcyclists with particular consideration of the potential utility of simulator training and the transfer of learnt skills to the real-world riding situation. They prescribed an *incremental learning* model for the transfer of hazard perception skills as the rider progresses through the learning process: knowledgeable, to prepared, to trained, to skilled, to expert. In this process riders may benefit in the initial stages from classroom materials such as written materials then progress to video and PC-based learning applications. To allow practice, PC-based programs offer a relatively affordable option in a safe environment. Riding simulators offer more thorough learning in a safe environment, however are expensive and as such may not be a practical option for broad-scale implementation (at least under current levels of resourcing of motorcycle safety interventions). Where simulator-based training is applied it should be done so in conjunction with on-bike sessions to promote learning transfer. However, simulators are ideal for situations that are too dangerous to be executed on-bike.

Unfortunately, while tools and programs to improve hazard perception in motorcyclists have been developed, no formal evaluation of their effectiveness in terms of crash reduction for riders has been published to date. Nonetheless, the following section will outline existing interventions described in the literature.

5.3.1 Ride Smart CD-ROM

The Victorian Transport Accident Commission (TAC)'s "Ride Smart" computer based training package aims to enhance hazard perception by motorcyclists. Ride Smart was developed from the earlier Drive Smart program for novice car drivers and presents on-road situations that may be expected to be commonly encountered by motorcyclists. It includes 102 exercises and takes five hours to complete (Tierney & Cockfield, 2005), although the trainee can save the results at any stage and complete the exercises over an extended time period (i.e. self paced). The interactive CD-ROM is free to all motorcycle learner permit and licence holders in Victoria.

As part of Ride Smart, the trainee is asked by a commentator to identify possible hazards in a range of situations, with feedback provided on the risks involved with each hazard. The package progressively trains riders to initially scan for hazards then respond.

Tierney and Cockfield (2005) describe development of the program which included extensive consultation with stakeholders in the motorcycle safety field such as the Victorian Motorcycle Advisory Council, motorcycle rider trainers, motorcycle safety researchers, and the Victorian Police. They note that Ride Smart is founded on the basic principles of Observe-Anticipate-Respond.

A preliminary evaluation of Ride Smart was conducted before its release, however this focussed on the content of the program with respect to desired learning outcomes (rather than assessing safety outcomes). Using both experienced rider trainers and novice riders to

critique the program, it was found that minimal undesirable learning effects were present (Tierney & Cockfield, 2005). The identified deficiencies were then corrected prior to the release of the program. Unfortunately, no evaluation has been published regarding the road safety benefits of Ride Smart, for example, indications of increased hazard perception performance by trainees or crash reductions.

5.3.2 Hazard Perception Licensing Tests for Motorcyclists

While hazard perception tests as part of the licensing process are not 'interventions' *per se*, they do encourage motorcyclists to develop hazard perception skills to pass the test, and hence, may be viewed as proxy interventions that deserve mention in this section. However, only the United Kingdom, Victoria and Western Australia include a hazard perception test as part of the requirement for riders to gain a motorcycle licence (if they do not already hold a car licence) and this test is designed specifically for car drivers. No jurisdiction has implemented a hazard perception test designed specifically for motorcyclists. This is largely because more comprehensive empirical research needs to be done in terms of what affects motorcycle rider hazard perception, how this varies among the different classes of hazards, and the extent to which hazard perception in motorcyclists can be trained.

Horswill and Helman (2001) claimed that the United Kingdom Hazard Perception Test may disadvantage riders. They asserted that squeezing through a narrow gap in traffic would be less of a problem for motorcyclists than for drivers of cars and that this may explain why a group of experienced motorcyclists performed worse on the test than car drivers as they were assessed by responses appropriate for driving (i.e. not riding specific). Horswill and Helman consider that similar results could occur with the United Kingdom Hazard Perception Test used for licensing and recommend that a separate hazard perception test for motorcyclists with associated training should be introduced into licensing systems. It is also questionable whether the hazard perception tests developed for car drivers give sufficient emphasis to hazards specific to motorcyclists such as road surface hazards. This would limit their ability to be able to predict later crash involvement. In summary, the use of hazard perception tests designed for car drivers may lack validity for motorcyclists. No evaluations of such measures were found.

5.3.3 Simulator-based Training

As mentioned earlier in this section, Wallace et al. (2005) asserted that simulator-based training for hazard perception has great potential to assist in the safety of motorcyclists. The findings from Liu et al. (2008) reviewed in Section 5.3 suggested that experienced riders displayed more enhanced hazard perception and responding skills than novice riders or car drivers. However, there was no indication of how motorcyclists' hazard perception could be improved over time using a simulator. The HART training simulator in Melbourne was used in one of the aforementioned experiments. While it was noted that the simulator has reasonable functional fidelity (interactive controls), it is limited in terms of peripheral vision and it remains unknown how effective it is as a training tool for hazard perception. Additionally, the simulator does not look or perform like a motorcycle, with no physical movement. Difficulties with functional fidelity was reported by Espiê (2010) regarding the

development of a motorcycle simulator at the French National Institute for Transport and Safety Research (INRETS) research centre as shown in Figure 5.2 despite efforts of designers to replicate a realistic riding position and movement (Nehaoua, Hima, Arioui & Sêguy, 2008).

Figure 5.2 INRETS motorcycle simulator

Stedmon et al. (2009) reported on the recent MotorcycleSim project in Great Britian and noted that the quality of physical fidelity (presentation of riding scenarios on the screen) was not as important as functional fidelity to riders when testing the simulator (as can be seen in Figure 5.3). Though these are only preliminary investigations, the results of this study indicate that unless motorcycle simulators actually closely replicate the feel of real riding then they may not be a valid training tool beyond that which can be offered by computer-based applications that can be completed on a PC.

Motorcycle simulator training has been commonly used in Japan as a licensing requirement, in the context of a licensing system that does not permit on-road training or practice by learners. Unfortunately, the exact nature of such training for hazard perception is unknown. The use of simulators in motorcycle training began in Japan in 1996 with the use of simulation exercises for training prior to obtaining a licence to ride a large-sized motorcycle (over 400 cc). Training sessions with simulators were made a compulsory part of training for a motorcycle licence prior to 1998. There is very little description of these programs and evaluations available in English. However, a partly translated Japanese document supplied by the Honda Australia Roadcraft Training complex in Sydney shows that the death rate per 10,000 motorcycle riders has decreased substantially since the introduction of simulator training in September 1996. The document stated that understanding of other traffic's characteristics and the ability of hazard prediction are the factors believed to have contributed to the findings, and these were mainly done by using the driving simulators (Yuhara, Oguchi & Ochiai, 1993). A variety of riding simulators were being developed ranging from a fixed-base simulator for basic riding training to a simulator equipped with a visual system to allow different traffic environments to be presented.

Figure 5.3 MotorcycleSim at the University of Nottingham, UK.

5.3.4 The KNMV Early Hazard Perception Course

A program for early detection of hazards has been developed and applied in the Netherlands by the Royal Dutch Motorcyclists Association (KNMV). The course specifically trains riders to recognise and appraise risks within the riding environment. However, rather than focusing on emergency responding, the course promotes early detection with the rider learning how to anticipate hazards and therefore avoid emergency situations. The course is conducted in a post-licence context and therefore is an intervention for existing riders rather than a developmental program for novice riders. While the course name suggests a sole focus on hazard perception, it broadly addresses risks associated with riding in an endeavour to develop a realistic sense of risk or threat appreciation for riders.

The course incorporates extensive theory sessions with on-road practical rides. The theory sessions address:

- Defining risk;
- Observation of risks;
- Risk acceptance;
- Risk compensation;
- Overestimation of skill;
- Trained responses versus evolutionary responses (e.g. fight or flight);

- Road positioning; and,
- Slowing down when potential risks are present (Wildervanck, 2008).

While the term 'roadcraft' is not mentioned in Wildervanck's description of the course, it essentially addresses most components that are commonly associated with roadcraft. Due to the weather conditions in the Netherlands, the course also recognises that all riders may lose valuable skills during the winter period when riding is not possible. Hence, there is a need for all riders to hone and practise hazard perception skills each summer.

During the on-road training, instructors travel on their own motorcycle and are in radio contact with each trainee. However, it is unknown how much the course focuses on instructor feedback or what learning mechanisms are employed following on-road sessions. The course was commenced in early 2008 and qualitative responses are sought by KNMV from trainees regarding the perceived effectiveness of the course. However, no evaluation of the program has been conducted to date.

5.3.5 The German Safety Tour

Like the KNMV course, the German Safety Tour is a post-licence course that incorporates on-road riding exercises and feedback. The course is operated by the German Insurance Association and conveys vital safety information to riders online prior to the on-road exercises.

A limited evaluation of the program gathered self-report data from 78 riders during 2008. A broad range of riders participated, aged 18-65 years with varying previous experience. However, many were very experienced as indicated by an overall average of 14 years riding experience, travelling 8,000 kms per year.

The course includes the following topics relating to hazard perception and roadcraft:

- Seeing and being seen;
- Road surfaces;
- Course of the road (bends etc);
- Vehicles from the sides; and
- Vehicles in the direction of travel.

In addition, the course covers topics such as 'riding in a group' and 'traffic signs and rules'. Unfortunately there was no comparison/control group within this evaluation and much information was focussed on participants subjective interpretations of the course, therefore results must be interpreted with caution.

Figure 5.4 Poster for German Safety Tour.

Conclusions from the project report (Degener, 2009, p. 16) were:

- "The feedback on the safety tour is very positive (also in the subsequent survey). In the subsequent survey, for instance, almost 80% of those asked still said that the training given on the German Safety Tour is to be recommended;
- Traditional safety training is, however, also rated equally highly;
- Riders of sports bikes and chopper riders on the other hand are conspicuous for a reduced sense of safety;
- Riders who have not had an accident have a greater respect of motorcycling and a greater sense of safety;
- Riders who have taken part in (previous) training courses ride more anxiously and more cautiously than those who have never taken part in a training course; and
- These considerable successes have led to the German Road Safety Council (DVR) renewing accreditation for the "Training under Real Traffic Conditions" and is currently drafting a Manual for course leaders to allow the content of the German Safety Tour to be offered as "Training under Real Traffic Conditions" across the whole of Germany in the future.

5.3.6 The R3 Model - Commentary riding

McInally (2003) developed the R3 Model (risk, reaction, review) for motorcycle training to enhance hazard perception skills and internalise concepts of risk for riders. It is a conceptual model for interventions rather than an intervention that has been applied and evaluated. Nonetheless, the R3 Model provides an interesting perspective on how hazard perception skills may be developed through on-road experience. The rather simplistic model promotes self-commentary during riding, with the "review" of on-road experiences a key component. Such techniques may assist to reinforce attitudinal and motivational components of training and further develop hazard perception skills by getting the rider to verbalise potential risks or hazards during riding and indicate response choices. McInally asserts that a constant cycle of scanning for risks, choosing a response, then reviewing the action is required for riders to learn to improve their skills. As such, this represents a constant learning 'loop'. Verbalisation of each action is assumed to result in increased internalisation of the process.

An interesting aspect of the model is that riders are required to review their responses while riding. This is similar to the concept of self-monitoring used widely in behaviour modification programs and promoted by Bailey (2003) for novice driver training. Rather than assuming riders learn from their actions, the review phase of the R3 model provides a link to *how* learning can be enhanced from every experience. However, the model promotes immediate review of each action during riding. This is perhaps not ideal as it may actually divert cognitive resources from the ongoing scanning process and essentially momentarily distract the rider. Review following each ride (once stopped) may be a more suitable option.

While the R3 model provides a theoretical structure for the development of hazard perception techniques, no application of the model was found in the literature. McInally (2003) does however mention that the concepts in the model are similar to those used in the UK Police System of Motorcycle Control. Additionally, commentary techniques have been used for training novice car drivers. However, this is usually incorporated with supervisor feedback to allow the driver to learn from their actions. The increased risk of carrying a pillion supervisor would make this option unsuitable for motorcycling, however feedback from a supervisor or trainer following the rider in a car or on another motorcycle may be an option (akin to assessed rides).

5.3.7 Summary of review of interventions to improve hazard perception

The importance of hazard perception skills for motorcyclists is widely acknowledged. Unfortunately the review of interventions to improve hazard perception found a lack of programs applied to motorcyclists. Hazard perception for car drivers is a growing area of research and application in the form of licence testing; however the application of hazard perception measures to motorcycling appears to be lagging in comparison. This is disappointing considering the importance of hazard perception to the safety of motorcyclists.

Interventions that have been applied for motorcyclists were found to be largely technology based (i.e. PCs and simulators) or road-based. Technology based programs allow novice riders to develop hazard perception skills in a protected environment and ideally riders should

be introduced firstly to these then the skills transferred to the road environment through graduated exposure and practice. However, no interventions were found to encapsulate this complete process. The TAC Ride Smart training program is perhaps the most comprehensive computer-based training tool available for hazard perception skills for riders. Riding simulators as used in Japan may somewhat bridge the gap between PC-based programs and the traffic environment, however they are expensive and little is known regarding their effectiveness.

However, as asserted by Wallace et al. (2005), to progress sufficiently through the learning process, the initial skills obtained from computer-based programs must be gradually transposed to the real-world traffic environment and practised. On-road training courses such as that offered by KNMV may result in more direct application of hazard perception skills; but there is no reliable evidence for the effects of this course or any other hazard perception training package for motorcyclists to date.

6. ASSESSMENT OF SUITABILITY OF INTERVENTIONS FOR POTENTIAL APPLICATION IN QUEENSLAND

An assessment of the findings from the literature review for potential application in Queensland was undertaken. Commonalities and differences in programs reported in Section 4 are examined and, furthermore, these are discussed in terms of best practice for rider training as established by Haworth and Mulvihill (2005).

6.1 PROGRAMS ADDRESSING ATTITUDES AND MOTIVATIONS FOR RISK TAKING

Seven initiatives were reviewed in Section 4.3.1 of this report:

- the Norwegian Licensing and Training system;
- the European Initial Rider Training project (IRT);
- the CARRS-Q Three Steps to Safer Riding Program;
- a rider education intervention in Thailand;
- Bikesafe Scotland and other assisted rides programs;
- the Rider Risk Reduction (RRR) Course in Great Britain; and
- the Riders Helping Riders drink riding intervention in the United States.

Each of the abovementioned programs aimed to reduce risk taking behaviour by motorcyclists, however were varied in approach. Most programs targeted several risky riding issues, while one focused on the specific behaviour of drink riding. Some interventions involved brief face-to-face training programs for both novice riders (e.g. Three Steps to Safer Riding) and recidivist traffic offenders (Rider Risk Reduction Course), while others involved active community outreach and involvement (e.g. Riders Helping Riders, Bikesafe Scotland, and a licensing program in Thailand).

The GDE model which promotes addressing psychosocial influences on riding and broader lifestyle issues provides a framework for the Norwegian motorcycle licensing model and the IRT, and partly guided the development of the Three Steps to Safer Riding intervention. Computer-based resources for delivery of attitudinal programs for motorcyclists were found to require further development, however programs developed and validated for drivers may have potential for application to motorcyclists. Overall, evaluations of attitudinal and

motivational programs for motorcyclists were limited to intermediate measures, however showed promising results.

In addition, a number of risk taking interventions for car drivers were reviewed. While these interventions were not applied to motorcycle riders there is scope for such application with modification to suit the target audience. Programs for car drivers included:

- the South Australian driver intervention program (Driver Improvement);
- the Thames Valley Speeding Awareness Scheme for speeding offenders;
- optimism bias training;
- insight training for young drivers; and
- computer based risk assessment software (e.g. the Attitude Advisor).

6.1.1 Program Characteristics & Constraints

This section identifies key issues in the content and delivery of the abovementioned interventions. It also includes discussion regarding how each type of intervention is tailored to specific audiences (i.e. specific groups of drivers or riders) and potential issues for their application within the current motorcycle licensing systems in Queensland.

There are some commonalities in the programs reviewed in Section 4 that are useful to note in regard to face-to-face attitudinal and motivational programs:

1. programs are often delivered within a short time period (less than one day);
2. programs usually have a narrow focus (i.e. not too many issues to address); and
3. programs utilise trained instructors as the skills required to deliver cognitive-based programs are different than those required for vehicle handling and manoeuvring training.

6.1.1.1 Time limitations

In regard to the first abovementioned point, practical limitations often dictate that the program length is shorter than ideal, as noted by Wundersitz and Hutchinson (2006). This may account for the often minimal effect of such programs (where known). Accordingly, Haworth and Mulvihill (2005) noted that brief interventions are unlikely to have the desired lasting effect on road user attitudes and behaviour. This view is consistent with well established principles of adult learning. A conundrum exists however for programs delivered within the training and licensing context in that if the system is a voluntary user pays system (e.g. Q-Ride) then few people may be attracted to the program due to the additional cost. Hence, any effect will be limited. However, if such programs are delivered within a mandatory training and licensing system (such as that in Norway) then there is more

likelihood of the desired wide scale effect. To this end, if an attitudinal and motivational program for motorcyclists is to be introduced in Queensland then it should:

1. be mandatory for all new licence applicants;

2. be delivered over an extended period within a GLS context (several phases is optimal allowing for spaced learning and attitude 'building' over time);

3. aim to deliver content that is personally relevant to riders based on their experience level (i.e. some information may not be meaningful until some riding experience is gained); and

4. incorporate transition from classroom / technological tasks to on-road practice.

Furthermore, a complete intervention package may benefit from several complimentary approaches identified in this review to enhance the safety of riders. A brief intervention may be possible by means of computer-based programs such as the initial phase of McKenna's (2004) Thames Valley Speeding Awareness program. Integral to this approach is effective feedback combined with a range of realistic riding responses for various risk scenarios and risk profiles. It is possible that motorcycle specific information and scenarios could be developed for a computer-based application modelled on the Attitude Advisor program (also reviewed in Section 4.3.2.5. The Three Steps to Safer Riding has incorporated a take-home 'Toolkit' booklet for exemplars of management of certain riding situations as discussed during the intervention to also achieve this goal and extend learning beyond the classroom, however the effectiveness of this component has not been evaluated separately from the overall pilot intervention.

Three Steps to Safer Riding was designed for implementation as part of Q-Ride training where the opportunity for face-to-face delivery exists. For Q-SAFE, it may be necessary to develop an intervention that can be delivered electronically, either as a DVD that is issued with the learner permit or accessible on a website (e.g. the Attitude Advisor).

6.1.1.2 Need for a specific focus

In regard to point #2 mentioned at the start of section 6.1.1, attitudinal and motivational interventions are best served by limiting their focus. While a plethora of risk taking behaviours is possible for motorcyclists, there is a limit to the amount of information that trainees can cognitively process and retain from training, and often a limit on time for delivery of such programs. Hence, programs predominantly focus on few factors and aim to elicit discussion and engage participants in the level of cognitive processing required to facilitate effective learning and challenge existing beliefs.

However, it also critical that trainees assign *personal meaning* to the intervention concepts. If riders adopt the perspective that such concepts apply to others and not themselves then it is likely that the intervention messages will be largely ignored. To this end, the approach by

McKenna (2004) in utilising a risk inventory initially to identify individual areas of concern for participants then providing specific feedback is highly credible.

Another reason programs may benefit from adopting a narrow focus is that there is a need to not only provide awareness training of risk issues, but also a need to train riders in **managing risk (what action to take)**. Indeed, in order for riders to adopt the desired riding behaviour this is a more crucial aspect. Regardless of whether the intervention is delivered face-to-face or electronically, the need for a specific focus remains relevant.

6.1.1.3 Training of instructors

This section specifically applies to face-to-face delivery of programs. In regard to point #3 mentioned at the start of section 6.1.1.1, it is evident that some specific training is required to be able to facilitate delivery of such programs as intended. However, while many of the programs reviewed in this report were developed by psychologists, they do not necessarily need to be delivered by psychologists. Indeed, for any broad-scale program that is to be implemented it is impractical to engage only psychologists for their everyday delivery. The Three Steps to Safer Riding intervention was developed by psychologists in conjunction with an accredited rider training provider. With some additional training and monitoring, the motorcycle rider trainers (who held a qualification in Workplace Training and Assessment) employed by this provider had the requisite skills to facilitate a structured attitudinal / motivational program to address risky riding (Rowden et al., 2009).

As motorcycle rider trainers are generally regarded by the riding public as having considerable expertise and the motorcycling community is rather insular, the legitimacy of such programs may actually be enhanced by the use of rider trainers in delivery of interventions rather than psychologists. Broad-scale implementation would, however, require behavioural scientists specialising in Traffic and Transport Psychology to oversee implementation and ongoing monitoring of such a program. Acceptance and support for such a program, accompanied by a genuine motivation for safety by instructors is also paramount to instil, foster, and monitor.

While driver improvement programs have been found to have minimal effect in general, the advantage of applying attitudinal and motivational interventions during motorcycle licence training is that it targets riders in the early stage of their riding careers. Hence, such programs may be conceived as educational rather than behaviour change *per se* for many motorcycle licence applicants. Some licence applicants may have previously developed dysfunctional riding behaviours (e.g. from dirt bike riding), however these are unlikely to have been habitually developed in regard to on-road riding. Nonetheless, a challenge exists for skilled instructors to highlight the specific nature of on-road riding risk to trainees and to challenge any previously held misconceptions regarding risky riding.

6.2 PROGRAMS ADDRESSING HAZARD PERCEPTION

Potential ways of enhancing hazard perception for motorcyclists that were reviewed were:

- Ride Smart produced by the Victorian TAC;
- Hazard perception tests applied by licensing authorities;
- Motorcycle simulators;
- The KNMV Early Hazard Perception Course;
- The German Safety Tour; and
- The R3 Model for commentary riding.

Unfortunately, none of these initiatives have been validated in terms of subsequent crash involvement, as evaluation of this nature for motorcycling initiatives is rare. Therefore, until evaluations are undertaken it is unclear whether introducing a program based on one of these initiatives would reduce crashes involving Queensland motorcyclists. One approach may be to pilot and evaluate particular programs that are compatible with the current Queensland licensing systems. However, a large scale pilot would be required to show any effect on crashes. A smaller pilot would have the potential to detect changes in intermediate behaviours such as attitudes and self-reported behaviours that could provide support for wider implementation.

The methods employed in the abovementioned initiatives vary in their compatibility with Q-Ride and Q-SAFE. They can be categorised in three ways:

- Computer-based applications;
- Simulators; and
- Face-to-face programs.

Ideally, novice riders should commence with the method that is least likely to cause harm, however with the aim of developing an appreciation of hazards and how to avoid or respond to them. Computer-based (PC) applications have no functional fidelity as they do not attempt to replicate physical riding characteristics. However, this does not mean they are not useful in providing a starting point for hazard perception training. The Ride Smart program is perhaps a useful package that can potentially be modified to suit the Queensland context with permission of the developers (TAC). It could easily be applied at the pre-learner or learner stage and is compatible with both Q-Ride and Q-SAFE. There is little evidence to support the recommendation of specific face-to-face hazard perception initiatives beyond the requirement in the current Q-Ride competencies for roadcraft to be addressed (albeit with more time devoted to consistently display the current competencies). Simulator research is continuing,

however more evidence is required to support particular applications for implementation within Q-Ride or Q-SAFE at this point of time.

7. FINDINGS FROM STAKEHOLDER INTERVIEWS REGARDING MOTORCYCLE SAFETY INTERVENTIONS

Participants were asked to discuss their beliefs about addressing hazard perception skills in future riding training that might become part of the motorcycle licensing system. In addition, the participants were asked about general motorcycle rider risk-taking, particularly in the context of hazard perception. Responses from participants were divided into two overarching themes: (1) the message or material that may be delivered (content area); and (2) the way in which messages are delivered (process area). However it must first be noted that not all participants agreed that hazard perception skills could be incorporated into training and licensing. The content and process issues raised by participants are discussed below followed by overall issues that were raised by participants.

In general, participants appeared to find it easier and spoke at greater length regarding how to improve hazard perception than how to reduce risk taking. A minority of participants reported that nothing could be done, for example, *"can't legislate against stupidity."* This was particularly so for TMR licensing examiners who had to be given numerous prompts. In response to the prompts, some of the TMR licensing examiners responded that a wider approach was required, and that increased enforcement might act as a deterrent to reduce risk-taking.

7.1 STAKEHOLDER VIEWS ON HAZARD PERCEPTION TRAINING AND ASSESSMENT

7.1.1 Content issues

Participants identified several components that might be covered under the broad concept of hazard perception including: hazard identification and recognition; hazard avoidance at a planning and immediate response stage; and a psychological component of avoiding risk. While not all participants identified all concepts related to hazard perception, there was a general recognition that components needed to cover identification and avoidance of hazards. For example, one participant indicated that training and assessment could, *"take into account (the) traffic situation,"* another commented that it must have, *"(a) cognitive side, recognition, I've got a problem here that I need to deal with."*

The use of scenario-based learning was a popular method suggested by participants. This might, for example, include several case studies in which the motorcycle trainee examines a crash scenario (or near-miss) and the events leading up to the incident that either increased the likelihood of the crash or the severity of the injury experienced. One participant suggested that this might involve, *"going through the accident, what happened, road marked on training room, get actively thinking about it."*

Other participants noted that general motorcycle riding could be used as an example similar to the current process involved with young novice car drivers. To follow on from the examination of a case study it was accepted that students then develop, *"knowledge of basics, concepts,"* related to hazard perception. In addition, TMR examiners also indicated that this might include better understanding and knowledge of rules, protective clothing, and leading causes of crashes (e.g. fatal four). It should also be noted that this is a different focus, in particular on the nature of risks, rather than specifically hazard perception.

7.1.2 Delivery methods

With regard to hazard perception training a number of different delivery options were put forward focused on options of electronic delivery and face-to-face interaction (often as follow-up after computer-based applications). For example: *"see how they react, maybe a scale of assessment...have someone there to talk through...you missed this and you missed that...what hazards do you spot"* and; *"can be done in the classroom, in a DVD, in a vehicle ...because it's real life"*.

There were a number of suggested methods by which to implement the scenario-based learning, most commonly this included discussion with a small group led by a suitably trained facilitator or through an electronic means (for example, simulator, DVD, computer delivered). With regard to small groups and processing scenarios, participants noted advantages of discussion and interactive processes to develop and promote hazard perception skills. Participants identified some potential concerns that this should not be didactic in delivery of material, for example, *"like whiteboard, flexibility, not didactic."*

As mentioned, the use of electronic media was a popularly reported tool for delivering hazard perception skills however this was often reported with a number of caveats. Some participants felt simulators lacked accuracy in terms of the 'feel' of the motorcycle, *"controls aren't relative, (they) don't give the same feedback as a motorcycle."* While a DVD was identified as a cost effective approach, limitations were similarly recognised, *"doesn't incorporate those hazards in a DVD, (there is) no perception of speed."*

There was some support for computer-based applications regarding hazard perception, however this was also tempered with an acknowledgement of the limitations of such. For example: *"computer-based training, not ideal…..would give them a basis….. and they would have to achieve a certain level…..and discuss with them"* and; *"I haven't got a lot of faith"* and additionally; *"when (motorcyclists) get on road (they) have to think in microseconds... anything can happen, doesn't matter how good you are on a computer you've got to go out there"*. In particular there was little support for motorcycle simulators: *"(I) question the effectiveness of simulators. (It) might be (there are) some things you could cover...maybe some road rules or general advice."* However, it was unclear what degree of sophistication of motorcycle simulator the participants were considering.

Some recognised the existing Queensland hazard perception task undertaken for car licensing and many agreed this was a potential start, however that it also could be more stringent: *"something similar to P2 separate for motorcycle ... probably make a bit more stringent"*.

Further, that there was a possibility of developing options: *"can do more with it (not just picking hazards) but selecting options"*. This comment implies that it is considered important for novice riders to learn options for responding to hazards once identified.

There was also an acknowledgement that actively training for hazard perception (i.e. on the motorcycle) is potentially difficult: *"can't take them out to do oral commentary",* however another participant said the opposite in regard to practising hazard perception skills*: "commentary.... talking about road conditions, traffic conditions, road marking, reinforcing, in helmet…nobody's going to know"*.

There were few comments regarding the ideal timing of the application of hazard perception interventions within the licensing system, however there was mention that it should be conducted early: *"at the learner stage*", and also an implication that it may be suitable at the provisional stage "*something similar to P2"*.

7.1.3 Challenges to implementation

Stakeholders mentioned several issues that they viewed as possible implementation limitations. Primarily these related to the time involved in training riders and the associated cost, for example: *"cost is going to be the main one...cost and time. Possibly time for the people but they'll probably accept it…… for the trainers possibly the time factor. I'm going to charge for my time"*. There was also an acknowledgement that if implemented, hazard perception training would require resources and appropriately skilled instructors, also implying that time may compromise delivery: *"if not addressed properly and done in a half hearted matter …… needs to be addressed seriously, with dedicated team and dedicated backing…….. we're not going to take shortcuts."*

There was also concern that smaller RSPs would be disadvantaged: *"public liability.....going to be left to the big fellas. Out west I don't know what we're going do"*. This quote also highlights concerns regarding public liability by RSPs regarding conduct of in-traffic (on-road) training sessions which may potentially compromise their commitment to any on-road program that is prescribed.

Further to this, there appeared to be conjecture as to whether there would be any benefit in teaching hazard perception during training: *"the only way to get better hazard perception (skills) comes with experience"*. This quote suggests that extensive on-road training and practice may be required to obtain any benefit. This is perhaps a challenge to implementation also in terms of orienting instructors to any program that is introduced if they do not believe it to be potentially worthwhile. Another participant highlighted the potential difficulty in engaging students in the process: *"first one mental block, 'I don't need that'...'can't teach me anything about that'"*. This is also a potential challenge if instructors feel they will have no effect.

7.1.4 General issues

Some participants articulated overall challenges in incorporating hazard perception training into the licensing system. Importantly, this included appropriately managing over-confidence and managing and aligning perceived skill level with actual skill level, *"(novice riders) understand (there is a) need but have no idea what to do."* Issues of cost and access were raised and managing such issues by the curriculum developer such that the developer had an understanding of the key issues on the ground. The issue of cost was raised in relation to potential differences between city and remote areas and getting individuals together for classes.

7.2 STAKEHOLDER VIEWS ON ADDRESSING RISK TAKING BEHAVIOUR IN TRAINING

7.2.1 Content issues

Specific factors that should be addressed in interventions for risk taking were rarely mentioned with the exception of: *"(address) impression...because of the age groups...behave differently on their own,...with friends,...in a group"*. The interviews suggested that existing Q-Ride providers are often attempting to address attitudes towards risk taking during classroom training and during practical riding, however may not have specific knowledge as to what aspects of risky riding should ideally be addressed.

7.2.2 Delivery methods

Despite many participants being unsure as to how to reduce risk-taking behaviour through training, and in particular through pre-learner training, a number of potential suggestions were made. The suggestions were typically based on either personal experience, in particular Q-Ride RSPs suggested ways that they currently try to bring about change. Many of these methods included interactive discussion on options in different scenarios (often personal scenario). For example, *"Drawn up pictures, like traffic situations, model cars and bikes on carpet [mats], sit here and talk through the Ride On video in segments we stop and start the video and tell them what can happen. Pull them up on the road in the road rides. Did you think about... we try and drum it in through the whole program. The risk-taking pre-ride safety check*". In this example, the participant demonstrated how he made sessions interactive by using demonstrations through models, pictures and videos and leading discussions based on the scenarios presented.

Another trainer suggested: *"have got model cars we can play with, we've got the whiteboard and then pull up quite a bit on the road. This is what's done... did you think about. The thing that jogs people the most is the Ride On video with the bloke standing out and ...knocks him out. Something a little bit more graphic but I think it's important to show prospective bike riders....when they see it actually happen...that's when they actually think. Instead of talking them through it...showing it. Got their attention."*

Such discussions were sometimes prompted by audiovisual material, for example, *"Ride On...a great DVD...talked about their mates getting killed"*. Further, sometimes they reported

on the manner in which discussions were to take place, for example, avoid being patronising, *"talk about being a professional standard of rider...rather than say being safe"* and *"talking to people one on one..... I was using that video until I just found people falling asleep"*.

The overwhelming majority who commented on the timing of addressing risk-taking behaviour indicated that it should commence early on in the licensing process: *"have to do from the first step"*; *"the brain doesn't think of the consequences...in the very early stages belt it home to them, this is what can and does happen"*; and *"I think it's got to occur in pre and during the licence training prior to and during, because you've go to develop some attitudes in people and you've got to start at the beginning"*.

However another participant indicated that addressing issues of risk taking should be ongoing throughout the licensing process: *"I think again it's a matter of the continuing the message, like a kid learning to read and write, it's continuing"*.

7.2.2.1 Approaches beyond training

Some participants suggested more community-wide options, including school-based education and advertising. For example: *"education type programs...used to have them in schools"*. Also there appeared to be substantial support for graphically showing riders the consequences of crashes, for example: *"take them to the hospital"; "maybe some advertising...horror shots";* and "*would like to see a bit more aggressive programs of...the aftermath. Be made aware of what can happen. People don't realise how fast they're going. I think the ads on TV should be a little bit harder. Show how it happens"*. Further, overall potential positives in advertising were reported: *"advertisements are good because they reach everyone...risks associated with motorcycling"*.

In addition, there were participants that reported some options that they acknowledged were not entirely practical. For example: "*stop them riding until they're 25";* and *"can't take fast bikes off the market"*. Expert influence was also suggested: *"maybe someone like Wayne Gardner talking about safety"*.

These responses suggest that stakeholders often believe broader approaches to solutions for risk taking are required rather than rider training. While other approaches exist (e.g. enforcement), some stakeholders appear to believe that training is not a feasible solution and may believe that responsibility should rest with broader community-based solutions. The findings also indicate a general support for the use of graphic images regarding crash consequences to address rider attitudes.

7.2.3 Challenges to implementation

The predominant response when asked about addressing risk-taking was that such behavioural change was challenging: *"that's a tough one.....it's tough, can teach someone mechanical skills but teaching them an attitude?"*, and another example from a regional participant was: *"very hard to change attitude.....just don't know"*.

Further comments indicated that training to address attitudes to safety is simply not feasible and that such issues are not for trainers to deal with: *"it's very difficult to deal with attitude... you've got that sense of he's telling me what I want to hear... we can't be the police and say your attitudes not right"*; and *"peer pressure...but if I've got that attitude... no matter what you do...can't control it"*. This was also confirmed in the following quote: *"if I've got the mindset...you're not going to stop me."*

These statements suggest that, for at least some stakeholders, the issue of addressing rider attitudes is not well understood and not considered a realistic option as part of rider training.

Few participants directly mentioned challenges facing the implementation of interventions to address risk taking perhaps because they generally regarded the entire notion as challenging. While some stakeholders expressed a belief that a DVD was useful (specifically Ride On), others indicated that this was insufficient in its own right to affect actual change. Challenges may therefore more so rest with the manner in which such tools are used within the training environment. For example, one existing RSP mentioned that playing small sections of the Ride On video to guide further discussion with students was useful.

Perhaps the greatest challenge apparent in the data is orienting some trainers towards training processes and skills required for addressing risk taking. This is reflected in the following comment: *"got to have subject knowledge...quality instructors"*.

7.3 SUMMARY OF INTERVIEW FINDINGS

In summary, participants identified risk-taking as a safety issue for motorcycle riders. Further, hazard perception was recognised as a skill needed for safe motorcycle riding. While participants identified a number of challenges with training in hazard perception, there were a number of potential content and process components suggested for hazard perception and skill development.

8. DISCUSSION

As much previous research has suggested, there is a clear need for motorcycling training programs that address risk-taking behaviour and deficiencies in hazard perception. The research conducted for this project aimed to establish the extent of injury resulting from risk taking and deficient hazard perception and, additionally, identify existing programs (validated where possible) that may be beneficial in addressing these issues for Queensland riders. The project further aimed to scope stakeholder perceptions of these issues and how they may be addressed within the Queensland motorcycle licensing systems, Q-Ride and Q-SAFE. These aims were met through the delivery of several distinct stages of research. The discussion that follows in the rest of this section will be centred upon the findings from each research stage.

8.1 HOW DOES THE LITERATURE REVIEW INFORM RECOMMENDATIONS?

The review of interventions to address risk taking identified a variety of programs for various target groups of motorcyclists. These included brief face-to-face programs for both novice riders and recidivist traffic offenders and programs that involved active community outreach. The GDE model which promotes addressing psychosocial influences on riding and broader lifestyle issues provides a framework for many of the recent developments in training in Europe. Computer-based resources for delivery of attitudinal programs for motorcyclists were found to require further development, however programs developed and validated for drivers may have potential for application to motorcyclists. Overall, evaluations of attitudinal and motivational programs for motorcyclists were limited to intermediate measures, however showed promising results.

The review of interventions to improve hazard perception found a lack of programs applied to motorcyclists. Hazard perception for car drivers is a growing area of research and application in the form of licence testing; however the application of hazard perception measures to motorcycling appears to be lagging in comparison. This is disappointing considering the importance of hazard perception to the safety of motorcyclists. Interventions that have been applied for motorcyclists were found to be largely technology based (i.e. PCs and simulators) *or* road-based. Technology based programs allow novice riders to develop hazard perception skills in a protected environment and ideally riders should be introduced firstly to these then the skills transferred to the road environment through graduated exposure and practice. However, no interventions were found to encapsulate this complete process. Of those that were conducted, no outcome evaluations were found.

Some educational interventions for car drivers provided specific information regarding the content and delivery of the program that the review of motorcycling interventions found lacking. Hence, some of the principles and concepts used in interventions for car drivers (e.g.

the South Australian Driver Intervention Program) may also be beneficial in the application of motorcycling interventions.

While evidence for the effectiveness of attitudinal and hazard perception interventions for motorcyclists was found to be limited to date, this may be partly because of the commercial nature of motorcycle rider training and the need for organisations to protect their intellectual property. Hence, there may be a reluctance to publish details of program content and how programs are delivered. Nonetheless, the need remains to develop, implement, and evaluate such programs in an endeavour to enhance the safety of motorcyclists. The outcomes of programs, where known, are encouraging yet somewhat in their infancy.

It is apparent that educational interventions to address motorcyclists' risk-taking attitudes and motives *or* hazard perception are best applied within the licensing system in order to gain any broad-scale effect (as opposed to post-licence programs where numbers are limited). Motorcycle rider training is predominantly perceived by the motorcycling community as a credible and worthwhile safety initiative. This perceived legitimacy is important to ensure the adoption of road safety initiatives by the public (McKenna, 2004) and is something that authorities have the potential to capitalise on for the introduction of attitudinal and other higher-order cognitive training programs for motorcyclists within licensing systems.

The lack of ability to objectively assess higher-order cognitive skills has played a major role in these skills receiving insufficient attention in novice rider courses that are part of the licensing process. It is the content of the test (or the competencies that are assessed) that influences what is trained, and what is perceived by riders to be important. If higher-order skills are not assessed, then there is little motivation for them to be taught or learnt. The development and implementation of a motorcycle-specific hazard perception test as part of the licensing process could provide a real opportunity for motivating the teaching and learning of these skills.

8.2 HOW DO THE STAKEHOLDER INTERVIEWS INFORM THE RECOMMENDATIONS?

The aim of the first round of interviews was to investigate rider trainers' and government motorcycle licence testing officers' opinions regarding the content of intervention initiatives to address hazard perception deficiencies and risk taking by motorcyclists as part of the training and licensing regime in Queensland. The second round of interviews focussed more on implementation issues (the form of delivery) for the potential introduction of risk taking and hazard perception interventions, however overlap with the findings from the first round of interviews was evident as expected. The following sections discuss the implications of these findings for the introduction of programs to improve hazard perception and reduce risk taking among Queensland riders. The implications which are specific to hazard perception are discussed first, then risk taking, then general issues are discussed.

8.2.1 Hazard perception training and assessment

8.2.1.1 Support for Implementation

Overall there was support for the implementation of hazard perception training and/or testing in Queensland. Participants reported on a number of issues to address and include and participants reported on ways in which this might be delivered. It is encouraging to note that a number of participants' comments were thus in line with the evidence that suggests deficiencies in hazard perception contribute to motorcycle crashes, particularly for novice riders (Haworth & Mulvihill, 2005). Novice riders have been shown to be more likely than experienced riders to be involved in crashes where a lack of hazard perception skills has been evident (Haworth et al., 2000). Novice riders are particularly at risk until such skills are sufficiently developed.

In addition, the findings might suggest that the scope of any training addressing motorcycle rider risk-taking behaviour and/or hazard perception be managed. In line with best practice strategies, there is a limit to the amount of information that trainees can cognitively process and retain from training, and often a limit on time for delivery of such programs. Hence, programs predominantly focus on few factors and aim to elicit discussion and engage participants in the level of cognitive processing required to facilitate effective learning and challenge existing beliefs.

8.2.1.2 Content Issues

Key content issues identified for training and/or testing to address hazard perception deficiencies and risk taking as perceived by rider trainers and government licence testing officers were provided. Importantly, participants reported a number of components that might be included under the broad concept of hazard perception including; hazard identification and recognition (risk management); hazard avoidance both at a planning and immediate response stage; and a psychological component of valuing and having a positive attitude toward avoiding risk. Although not all participants identified all concepts, almost all at least mentioned those related to risk assessment. The breadth of concept however reflects hazard perception being conceptualised as both an awareness entity and a procedural or 'doing' entity.

While the use of scenario-based learning tools is a delivery issue, the type of scenario and subject matter can be considered content issues. Participants generally identified the use of case studies that were based on real life events, personal anecdotes and experiences of actual riding behaviour. Such an approach has been used in other areas, for example the method undertaken in the Thames Valley Speeding Awareness Scheme for speeding offenders includes describing a range of realistic responses for various driving risk scenarios, compiling risk profiles, along with providing feedback to participants (McKenna, 2004). Literature suggests that trainees assign personal meaning to the intervention concepts. If riders adopt the perspective that such concepts apply to others and not themselves then it is likely that the intervention messages will be largely ignored. The extent to which such content is personally meaningful to participants was identified by both RSPs and driving examiners.

8.2.1.3 Process Issues

The content and process issues are best understood together. Participants identified a number of ways in which material could be delivered in training to address hazard perception deficiencies and risk taking. The delivery methods identified included strategies that fit on a continuum approach including strategies for developing basic awareness, identifying hazards, responding to scenarios (perhaps through PC then simulator) and on-road application of skills. RSPs in particular noted the usefulness of scenario-based learning to develop awareness and identify hazards in the example situation. Discussions associated with the scenario based learning were seen as an effective component.

In promoting skills in responding to hazards in the example scenarios, there were a number of processes identified that did not require use of a motorcycle, including computer-based or simulator-based training. While there was general support for such approaches there was a strong caveat which questioned whether they could provide accurate representation of real world riding. In line with the literature in the area, computer-based resources for delivery of attitudinal programs for motorcyclists have been found to require further development although they show promise. Participants similarly identified such challenges suggesting that if an approach is taken in this regard issues of effectiveness may need to be addressed in education and awareness.

The first round of stakeholder interviews established that there was a general awareness that increased hazard perception would be beneficial to rider safety. The second round of interviews overwhelmingly found that stakeholders have few ideas regarding how this problem can be best addressed in training apart from current practice within Q-Ride. Furthermore, it was apparent that there was only limited support for computer-based interventions to address hazard perception. Useful suggestions were made for face-to-face classroom based training in regard to using whiteboards, model cars, and the existing Ride On video as training tools to educate riders of potential hazards. However there were less applications of actual hazard awareness training in-situ during on-road riding. Suggestions regarding the need for further focus on hazard responding as well as hazard awareness reflect the need for a broad focus on hazard perception for motorcyclists in order to avoid injury.

Overall, similar to the risk taking interventions, none of the participants mentioned existing interventions reported in the literature review in Section 4 apart from the Ride On DVD. Stakeholders perceive a range of impediments to applying hazard perception interventions in the context of licence training. The concerns regarding cost and the lack of time are well founded and are something that requires substantial consideration by policy makers. Furthermore, stakeholders expressed concern regarding public liability issues that relate primarily to on-road riding. While the concept of roadcraft was not directly mentioned, existing competency standards in Q-Ride require roadcraft to be addressed and hazard perception is integral to this. The literature review in Section 5 suggested that while hazard perception skills may possibly be enhanced using computer-based programs and simulators, these skills required practice in traffic. The concerns for public liability may seriously limit

the application of roadcraft and, in turn, the development of hazard perception skills during training. Hence, this is an issue that requires further investigation by TMR.

8.2.2 Risk taking interventions

Despite the recognition by many that hazard perception could be incorporated into motorcycle rider training and/or licensing, not all participants agreed that risk taking could be included. A minority reported that nothing could be done and in particular suggested that risk-taking was an inherent part of motorcycle riding. Such a finding suggests that there may be scope for including raising awareness of key issues among the community. The issue has specific implications for the level of training for providers of novice rider training. Research suggests that some specific training is required to be able to facilitate delivery of such programs as intended however the scope of such training may need to include education components.

Some stakeholders identified challenges in addressing risk taking within the training and licensing context and many felt it was an issue that required broader community approaches rather than training. However, others highlighted current approaches to addressing the problem during training. These findings indicate some disparity in opinion that may merely reflect the heterogeneity of the sample, however also suggests that some stakeholders regard motorcycle rider training as only being suitable for acquisition of vehicle control skills. None of the participants mentioned existing interventions found in the literature review by Rowden and Haworth (2009) apart from the Ride On DVD and, unfortunately little further valuable information was forthcoming beyond that which was reflected in the first round of stakeholder interviews.

The issue of the potential lack of time to address risk taking over and above current practices was sometimes recognised by stakeholders. That is, in a competitive commercial market and under the current competency-based training and assessment regime in Q-Ride, RSPs generally train students to meet the assessment criteria in as short a time period as possible to ensure they are cost competitive. As such, most time is devoted to practical riding components as there are no clear competencies required relating to rider attitude. The problem of being able to devote sufficient time to addressing attitudes in face-to-face training is a major issue experienced by CARRS-Q regarding design and implementation of the Three Steps to Safer Riding program (Rowden, Watson, Wishart & Schonfeld, 2009). The findings in this regard from stakeholder interviews highlight such pragmatic challenges regarding implementation and ensuring any programs that are introduced at various licensing stages have a set curriculum and delivery timeframe.

However, the findings also suggest that some RSPs may not be ideally suited to delivering particular face-to-face interventions. Clearly, some stakeholders do not think it is possible to address risk taking issues within the context of rider training. While they may have demonstrated competence in training and assessing motorcycle handling skills, many existing Q-Ride instructors may not have the requisite skills to deliver behavioural programs that aim to challenge existing beliefs and promote risk-management strategies. Additionally, group

focused interventions (e.g. Three Steps to Safer Riding by CARRS-Q) may not be ideally suited to one-on-one training situations as provided by smaller operators.

8.2.2.1 The Hidden Curriculum

Even though some trainers may indicate they are uncertain about how rider attitudes to safety can be influenced, modelling appropriate behaviours and attitudes by riding instructors is an essential aspect of training. Students attending training hold instructors in high regard (Rowden et al., 2007) and therefore any example they set, either formally or informally, will influence student learning. In terms of attitudes and safe riding behaviours, this may be reflected in issues as straightforward as the instructor wearing protective clothing during training. This "hidden curriculum" may also negatively influence attitudes to safety if, in a group training situation, students and/or instructors portray risk taking behaviour as representing highly skilled riding (e.g. cornering at high speed). While the intention may be to promote the learning of riding skills (i.e. performance ability), this is in direct contrast to behaviour that should be promoted to riders regarding safety. As such, vehicle skills training can often inherently, and unintentionally, undermine attitudes to safety. Even in a structured attitudinal intervention applied within the context of Q-Ride by CARRS-Q it has been noted that instructors find it difficult to follow the prescribed program when their personal beliefs regarding speeding do not align with safety goals (Rowden, unpublished).

8.2.3 Barriers to Implementation

There were a number of barriers in relation to implementation as perceived by rider trainers and government licence testing officers. Such barriers relate to the potential to develop over-confidence with novice motorcycle riders and the timing and duration of training. Issues also arose regarding the linking of training with other motorcycle safety countermeasures and considerable discussion was had about the development and implementation of any training and licensing issues.

8.2.3.1 Overconfidence

While the relationship between risk taking and skill development during rider training requires further investigation from a research perspective, previous studies have highlighted the need to develop training programs that address risk-taking factors in concert with vehicle-handling skill development (Elliott et al., 2003; Jonahet al., 1982; Watson et al., 1996). A few participants identified a potential negative consequence to training. Managing potential over-confidence and having motorcycle riders understand their skills were seen as important issues likely to impact upon the effectiveness of training.

8.2.3.2 Timing of Training

The short duration of training may contribute to the often minimal effect of such programs (where known). Accordingly, Haworth and Mulvihill (2005) noted that brief interventions are

unlikely to have the desired lasting effect on road user attitudes and behaviour. This view is consistent with well established principles of adult learning. A conundrum exists however for programs delivered within the training and licensing context in that if the system is a voluntary user pays system (e.g. Q-Ride), then fewer people may be attracted to the program due to the additional cost. Hence, any effect will be limited.

8.2.3.3 Location of Training: Rural versus Metropolitan Areas

Participants generally agreed that there are challenges with implementing the same program across the state. In particular, participants agreed that the skills needed to avoid and respond to hazards were the same despite the hazard itself perhaps being different in different locations.

8.2.3.4 Aligning with Additional Safety Measures

Some of the TMR driving examiners also noted that a wider approach was required, and that increased enforcement might act as a deterrent to reduce risk-taking.

8.2.3.5 The Developer

The issue of responsibility for developing and for subsequently managing the quality of any training was raised. Participants generally recognised that there was a role for government however the extent of this role was less clear. The role of deliverer of any training however was suggested to depend somewhat on the nature of the training. With regard to computer-based training, there were suggestions that this might be facilitated by government. Training that involved instruction, discussion or on-motorbike components were generally considered appropriate for delivery by RSPs. Again however there was debate about the role of government in designing material to be implemented by RSPs and how much RSPs could be free to adapt based on guidelines and there was debate about the role of government in ensuring quality control.

8.3 STAKEHOLDER INTERVIEW SUMMARY

The stakeholder interviews conducted in the two rounds of interviews yielded information regarding content for intervention programs and delivery options. Generally, the suggestions from stakeholders in this regard specified little beyond what the literature review had identified, however the interviews did importantly gauge stakeholders' *acceptance* of particular concepts and approaches.

Some consensus was met in regard to the following:

- Interventions to reduce risk taking behaviour should be initially implemented early in the licensing process and continue throughout; and

- Computer-based training for hazard perception was not highly valued as a stand alone measure.

While the application of interventions at various licensing stages was mentioned by some, there was little elaboration on what components should be addressed at each stage or the pre-requisite riding experience that might be beneficial in order to comprehend the intervention information at each stage. Hence, the findings of this round of stakeholder interviews have serious implications for the potential implementation of training interventions to address risk taking and hazard perception as a function of licensing. These relate primarily to the relative lack of exposure that Q-Ride instructors have had to these issues. It also indicates that training of instructors would be required to facilitate successful implementation.

Important information was gained regarding potential barriers to implementation. The following points require careful consideration regarding the introduction of training interventions:

- Standardisation of curriculum, duration and affordability to riders;

- Affordability of resources required for delivery of programs to smaller training operators and regionally-based training organisations; and

- Not all current rider trainers may possess all of the pedagogical skills needed to effectively deliver hazard perception and risk taking interventions within the current rider training approaches. Considerable support may be needed to address this issue.

9. RECOMMENDATIONS

Each stage of the research contributed to the development of the recommendations. In formulating the recommendations many factors regarding program content, program delivery, and practical implementation concerns were examined to identify the fundamental issues underpinning each of the recommendations and outline the rationale for the recommendations. Central to this is the premise that a carefully structured licensing system can influence the degree to which licence applicants engage in learning throughout their riding career.

9.1 RATIONALE FOR RECOMMENDATIONS

A one day workshop was held where the project team brainstormed ideas for recommendations based on the findings of previous stages of research undertaken regarding interventions for risk taking and hazard perception. Fundamental criteria were developed regarding the aims of this stage of research. These aims formed an overarching rationale for recommendations outlined in the findings.

Most of the points made in this rationale section constrain or guide the recommendations. Hence, the brief findings presented here have important implications for how the recommendations can be implemented and the pragmatic issues that may restrict other options from being implemented.

1. There are few and limited evaluations of programs addressing hazard perception and reducing risk taking in the literature. This constrains the ability to make firm and rigorous recommendations regarding implementing new programs. Instead, promising approaches have been identified and recommended for further investigation and/or trialling.

2. The ability to deliver widespread programs for improving hazard perception and/or reducing risk taking that are spread over time is severely constrained in the current licensing and training system by the very short duration of the learner period for most Queensland learners (median 27 days).

3. The take-up of post-licence training programs is small and therefore delivering hazard perception or risk taking programs by incorporation in post-licence training courses or through clubs is unlikely to have a wide reach and may arguably not target those who could most benefit.

4. In generating the recommendations, the emphasis was on ways of delivering hazard perception and risk taking programs that would fit with minimal or no change to the current Queensland motorcycle licensing and training system, before examining more

options that might be more effective but would require more significant legislative or regulatory change.

5. Government, the training industry and potential riders appear to be limited in the amount of resources they are willing to commit to improving motorcycle safety, which is reflected in the duration of safety programs being brief to reduce costs. This means that training courses are shorter than they are in some northern European countries where the expectations of the resources needed to create safer riders are much higher. The competitive environment in which Q-Ride operates exacerbates the constraints on time and money in relation to training.

6. Q-Ride trainers are skilled in helping trainees achieve the current competencies but they cannot be expected to develop new approaches without effective professional development, and implementation is more likely to occur and be consistent if programs are highly structured and materials provided. Trainers as a whole cannot be expected to possess the degree of expertise required for developing and delivering behaviour change programs.

7. There is a need to motivate both those who are delivering a program and those who are receiving it to both complete and assimilate the information. For example, we know that information that is going to be tested is a governing factor in ensuring material is taught.

8. The framework of competency based training and assessment poses great challenges for ensuring that material is covered if it is not directly tied to assessed competencies (which is hard to do for higher-order skills) and for ensuring that sufficient time is devoted to programs.

9. Individual trainers play a crucial role in the delivery of programs to reduce risk taking. They are strong role models for trainees and if they do not value the aims of the program (e.g. do not personally accept the need to reduce speeds), then they may not deliver (or may not effectively deliver) the program.

9.2 RECOMMENDATIONS FOR MOTORCYCLE SAFETY INTERVENTIONS

The recommendations for motorcycle safety interventions are:

1. The content of the hazard perception program should include recognising and predicting the behaviour of other road users, recognising road-based hazards and how to select and implement the most appropriate response.

2. The content of the program for reducing risk taking behaviour should focus on factors underlying risk taking such as sensation seeking and self-monitoring, rather focusing

on the direct effects of factors such as alcohol, speeding, and non-use of protective clothing.

3. It would be useful to consider packaging together the hazard perception and risk taking programs to increase uptake, particularly of the latter.

   Hazard perception is generally seen in a positive light by riders and trainers, as a valuable skill needed for riding. Risk reduction is seen, at least by some, as attacking the very motivation for riding. To package them together in terms of developing strategies to manage the hazards of the road environment (both by recognising external hazards and riding in such a way as to maximise the ability to deal with them), may be a more attractive approach. It is acknowledged that TMR focus groups suggested that risk taking programs were unattractive to RE learner riders and that this might suggest that combination would have the effect of reducing uptake of hazard perceptions programs.

4. An integrated approach to addressing hazard perception and risk taking should be adopted where the emphasis is on intervening at multiple points in the riding history, rather than a single "inoculation" approach.

   It is not sufficient to provide information or interventions once for each rider. The potential for interventions to be delivered at each point in the riding history in order to build upon prior learning and provide new messages that are relevant to the current stage should be considered. These points in the licensing history include: at learner licence application, when signing up for Q-Ride, at the start, during and at the end of Q-Ride training, at the time of application for a licence, and later when the licence or registration or insurance is renewed.

5. As one component of an integrated approach to hazard perception and risk taking, the potential for developing and implementing a DVD or web-based hazard perception training tool for Queensland riders should be investigated.

   The first step is probably to examine the RideSmart DVD developed by the Victorian Transport Accident Commission to assess the extent to which the material covered and the approach taken is suitable for use with Queensland riders. Given that the DVD contains Melbourne footage and addresses issues such as tram tracks, it is likely that directly adopting it for use in Queensland would be neither appropriate, nor well-accepted.

   The second step would be to examine options for delivery and implementation. Including a mechanism whereby completion of the program is assessed and a certificate generated which is presented as a requirement of issue of the motorcycle licence or the learner licence would motivate use. This approach would fit within Q-SAFE or Q-Ride and does not require the direct involvement of Q-Ride trainers.

The suitability of making the program available as a refresher to interested rider organisations and individuals could also be considered.

6. As one component of an integrated approach to hazard perception and risk taking, a module to address risk taking and hazard perception should be developed and trialled for incorporation in Q-Ride.

   In terms of content, this could be modelled on the 3 Steps to Safer Riding Program which currently addresses risk taking only but could be widened to include hazard perception. Given the time constraints of a module for incorporation in Q-Ride, the content may need to be carefully selected to allow adequate coverage of the issues which are considered most relevant at that stage. Some issues (e.g. impaired riding) may be better addressed later in the riding history. The module needs to be developed and a large trial undertaken to investigate acceptability, needs for professional development, and modifications needed for one-to-one delivery where necessary. Some other issues to be investigated are whether a minimum time for the module needs to be specified and how this can be monitored, whether assessment is needed to motivate delivery and whether a short module is sufficient to bring about change.

7. In addition to programs designed for delivery to all riders, the potential for a more extensive program that addresses risk taking for delivery to offenders should be examined.

   Programs presented over an extended period of weeks to drink driving offenders (e.g. the Under the Limit program) have shown good effects and the potential for a program to change the behaviour of riders who are detected undertaking illegal risky riding behaviours should be examined. The first step would be to analyse offence data to establish whether such a group can be identified and what is their size and characteristics. If the outcomes of this step are promising, then a program could be developed and piloted to assess whether participants can be effectively recruited and retained and process and intermediate measures could be taken.

8. Ways to increase the extent of on-road training to facilitate the development of hazard perception skills should be examined.

   The research suggests that hazard perception skills improve through on-road experience of hazardous road situations but there appears to be very limited on-road training in Q-Ride. It appears that the limited time has its foundation in cost issues. More on-road training means longer training and greater costs to the training organisation which are hard to pass on to the rider in a competitive environment. In addition, more on-road training is considered to lead to more insurance liability. These issues need to be examined and potential ways of addressing them identified and tested.

9. The potential for a tailored hazard perception and risk taking program for riders undertaking training to move from the RE to the R licence should be examined.

   It may be that riders who chose to graduate from an RE to an R licence are a subset who could benefit from an additional program that focuses on the risks associated with riding larger, potentially faster bikes. An examination of crash and licensing statistics should be undertaken as a first step to identify the size of the potential target group and its characteristics. Regardless of whether or not this is the case, it provides another point at which at least some riders can receive an intervention. One of the potential drawbacks to be considered is whether such a program would be misconstrued as suggesting that these skills are not required for an RE licence.

10. REFERENCES

Ajzen, I. (1991). The theory of planned behaviour. *Organizational Behavior and Human Decision Processes, 50,* 179-211.

Association of European Motorcycle Manufacturers (ACEM) (2004). *Motorcycling accident in-depth study (MAIDS)*. Retrieved from http://maids.acembike.org/

Australian Transport Safety Bureau (2002). *Motorcycle rider age and risk of fatal injury – Monograph 12*. Retrieved 3/3/06 from www.atsb.gov.au

Australian Transport Safety Bureau (2004). *Serious injury due to road crashes.* Retrieved 25/2/06 from www.atsb.gov.au

Australian Transport Safety Bureau (2005). *Road deaths in Australia: 2004 statistical summary*. Retrieved 18/1/06 from www.atsb.gov.au

Bailey, T. (2002). *Novice driver self-monitoring*. In proceedings of the Development of Safer Drivers and Riders Conference. Brisbane: Australian College of Road Safety.

Bailey, T. (2003). *Differences in teaching approaches among car driving instructors*. In proceedings of the Road Safety Research, Policing, and Education Conference – Sydney.

Banet, A., & Bellet, T. (2008). *Risk awareness analysis: A comparison between car drivers and motorcyclists.* In Proceedings of the European Conference on Human Centred Design for Intelligent Transport Systems. Lyon, France.

Baughan, C, Sexton, B., & Elliott, M. (2004). *Motorcyclists' accident risk: Results from a new survey.* In Behavioural Research in Road Safety 14th Seminar. London: British Department of Transport.

Bellaby, P., & Lawrenson, D. (2001). Approaches to the risk of riding motorcycles: Reflections on the problem of reconciling statistical risk assessment and motorcyclists' own reasons for riding. *Sociological Review, 49*(3), 368-389.

Broughton, P., Burgess, C., Fylan, F., & Stradling, S. (2010). Evaluation of the National RIDE Scheme. Leeds Metropolitan University.

Broughton, P. S., & Stradling, S. G. (2005). *Why ride powered two-wheelers?* In proceedings from Behavioural Research in Road Safety: Fifteenth seminar. London: Department of Transport.

Buckley, L., Haworth, N., Rowden, P. & Wishart, D. (2009). Stakeholder interviews regarding motorcycle safety interventions (Deliverable 3.3a). CARRS-Q report to Queensland Department of Transport and Main Roads.

Buckley, L. D., & Sheehan, M. C. (2007). *Does an ecological model explain self-reported motorcycle use and injuries among early adolescents?* In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Melbourne.

Burgess, C. (2006). *Rider Risk Reduction Course. Course summary document*. Unpublished paper.

Catchpole, J., Cairney, P. & Macdonald, W. (1994). *Why are Young Drivers Over-Represented in Traffic Accidents?* Special Report No. SR 50. Vermont South, Victoria: Australian Road Research Board.

Catchpole, J., & Leadbetter, C. (2000). *Redevelopment of Victoria's hazard perception test.* In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Brisbane.

Centre for Transport and Psychology (2009). *The Rider Risk Reduction Course.* Retrieved from http://vctp.org/vctp/rider_risk_reduction.html

Christie, R. (2001). The effectiveness of driver training as a road safety measure: A review of the literature. Noble Park, Victoria: Royal Automobile Club of Victoria.

CIECA (2002). *The EU ADVANCED project: Description and analysis of post-licence driver and rider training. Final report.* The Hague, Netherlands: CIECA.

Clarke, D. D., Ward, P., Bartle, C., & Truman, W. (2007). The role of motorcyclist and other driver behaviour in two types of serious accident in the UK. *Accident analysis and Prevention, 39,* 974-981.

Coben, J.H., Steiner, C. A., & Miller, T. R. (2006). Characteristics of motorcycle-related hospitalizations: Comparing states with different helmet laws. *Accident Analysis & Prevention, 39*(1), 190-196.

Dee, T. S. (2008). Motorcycle helmets and traffic safety. *Journal of Health Economics, 28*(2), 398-412.

Deery H. (1999). Hazard and risk perception among young novice drivers. *Journal of Safety Research, 30*(4), 225-236.

Degener, S. (2009). German Safety Tour: Survey on the training course for motorcycle safety in traffic. Berlin: German Insurance Association.

de Rome, L (2006) *Planning for motorcycle safety: measures of success*. In proceedings of the Australasian Road Safety Research, Policing and Education Conference. Gold Coast..

Drummer, O. (2003). The incidence of drugs in drivers killed in Australian Road Crashes. *Forensic Science International, 134,* 154-162.

Egberink HO, Lourens PF & van der Molen HH (1986). Driving strategies among younger and older drivers when encountering children. *Accident Analysis and Prevention, 18 (4)*, 315-324.

Elliott, M., Baughan, C., Broughton, J., Chinn, B., Grayson, G., Knowles, J., Smith, L. & Simpson, H. (2003). *Motorcycle safety: a scoping study*. TRL Report TRL 581. Crowthorne: Transport Research Laboratory.

Elliott, M. A., Baughan, C. J., & Sexton, B. F. (2007). Errors and violations in relation to motorcyclists' crash risk. *Accident Analysis & Prevention, 39*(3), 491-499.

Elliott, M. A., Sexton, B., & Keating, S. (2003). *Motorcyclists' behaviour and accidents*. In: Behavioural Research in Road Safety: Thirteenth Seminar (pp.139-152). London: Department for Transport.

Espié, S (2010). Simulation research for Powered Two Wheelers (PTW); Research challenges and progress. Presented at the 27th International Congress of Applied Psychology. Melbourne.

European Commission (2007). *Developing a European approach to the initial training of motorcyclists. TREN-SUB-2003-S07.30333.* Retrieved from www.initialridertraining.eu

Germeni, E., Lionis, C., Davou, B., & Th Petridou, E. (2009). Understanding reasons for non-compliance in motorcycle helmet use among adolescents in Greece. *Injury Prevention, 15*(1), 19-23.

Gregersen, N. P. (1996). Young drivers' overestimation of their own skill – an experiment on the relation between training strategy and skill. *Accident Analysis and Prevention, 28*(2), 243-250.

Harré, N. (2000). Risk evaluation, driving, and adolescents: A typology. *Developmental Review, 20,* 206-226.

Harré, N., & Sibley, C. G. (2007). Explicit and implicit self-enhancement biases in drivers and their relationship to driving violations and crash-risk optimism. *Accident Analysis and Prevention, 39,* 1155-1161.

Hatakka, M., Keskinen, E., Gregersen, N. P., Glad, A., & Hernetkoski, K. (2002). From control of the vehicle to personal self-control: Broadening the perspectives to driver education. *Transportation Research Part F, 5,* 201-215.

Hatfield, J., & Job, R. F. S. (2001). *Reduction of road related optimism bias and risk taking: Final Report.* Canberra: Australian Transport Safety Bureau.

Haworth, N., de Rome, L., Varnsverry, P., & Rowden, P. (2007). Motorcycle protective clothing: Are stars better than standards? In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Melbourne.

Haworth, N., Greig, K., & Nielson, A. (2009). A comparison of risk taking in motorcycle and moped crashes. *Transportation Research Record, 2140*, 182-187.

Haworth, N. & Mulvihill, C. (2005). *Review of motorcycle licensing and training* (Report No. 240). Melbourne: Monash University Accident Research Centre.

Haworth, N., Mulvihill, C., & Rowden, P. (2006). *Teaching old dogs new tricks: Training and older motorcyclists.* In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Gold Coast, Australia.

Haworth, N., Mulvihill, C., & Symmons, M. (2005). *Hazard perception and responding by motorcyclists – background and literature review. Report no. 235*. Melbourne: Monash University Accident Research Centre.

Haworth, N., Mulvihill, C., Wallace, P., Symmons, M., & Regan, M. (2005). *Hazard perception and responding by motorcyclists: Summary of background, literature review and training methods. Report no. 234.* Melbourne: Monash University Accident Research Centre.

Haworth, N., Rowden, P., Buckley, L. & Wishart, D. (2010). Recommendations for motorcycle safety interventions (Deliverable 3.4). CARRS-Q report to Queensland Department of Transport and Main Roads.

Haworth, N, & Schulze, M. (1996). *Motorcycle Crash Countermeasures: Literature review and implementation workshop*. *Report # 87.* Melbourne: Monash University Accident Research Centre.

Haworth, N., Smith, R., Brumen, L., & Pronk, N. (1997). *Case-control study of motorcycle crashes (Contract report CR174).* Canberra: Federal Office of Road Safety.

Haworth, N., Smith, R., & Kowadlo, N. (2000). *Evaluation of rider training curriculum in Victoria* (Report No.165). Melbourne: Monash University Accident Research Centre

Henderson, M. (1991). *Education, publicity and training in road safety: A literature review, report No.22.* Melbourne: Monash University Accident Research Centre

Homel, R. (1993). Random breath testing in Australia: Getting it to work according to specifications. *Addiction, 88* (supplement), 27s-33s.

Horberry, T., Hutchins, R., & Tong, R. (2008). *Motorcycle rider fatigue: A review. Road Safety Research Report No. 78*. London: British Department of Transport.

Horswill, M.S., & Helman, S. (2001). A comparative approach to differential accident liability: Motorcyclists versus car drivers. In Grayson, G.B. (Ed), *Behavioural Research in Road Safety: Eleventh Seminar.* London: Department of Environment, Transport, and the Regions.

Horswill, M. S. & Helman, S. (2003). A behavioural comparison between motorcyclists and a matched group of non-motorcyclists car drivers: Factors influencing accident risk. *Accident Analysis and Prevention, 35,* 589-597.

Houston, D. J. (2007). Are helmet laws protecting young motorcyclists? *Journal of Safety Research, 38*(3), 329-336.

Hung, D. V., Stevenson, M. R., & Ivers, R. Q. (2008). Barriers to, and factors associated, with observed motorcycle helmet use in Vietnam. *Accident Analysis and Prevention, 40*(4), 1627-1633.

Hurt, H., Ouellet, J, & Thom, D. (1981). *Motorcycle accident cause factors and identification of countermeasures, Volume 1 technical report.* Prepared for the U.S. National Highway Traffic Safety Administration, Washington.

Hutchinson, T. P., Kloeden, C. N., & Wundersitz, L. N. (2007). *South Australia's driver intervention program: Personality characteristics of participants and their subsequent crash and offence experience.* In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Melbourne.

ICCS (2010). *Understanding risk taking behaviours within the context of PTW riders. 2BeSafe Project Report.* Greece: Author.

Jonah, B. A., Dawson, N. E., & Bragg, B. W. E. (1982). Are formally trained motorcyclists safer? *Accident Analysis and Prevention, 14*(4), 247-255.

Johnson, C. (2009). The Attitude Advisor: Attitude assessment for learner drivers. Presentation at the CIECA-VdTÜV Congress on Technology, Training and Testing. Germany.

Johnston, P., Brooks, C., & Savage, H. (2008). Fatal and serious road crashes involving motorcyclists. Road safety research and analysis report: Monograph 20. Australian Department of Infrastructure, Transport, Regional Development and Local Government: Canberra.

Katila, A., Keskinen, E., Hatakka, M., & Laapotti, S. (2004). Does increased confidence amongst novice drivers imply a decrease in safety: The effects of skid training on slippery road accidents. *Accident Analysis & Prevention, 36,* 543-550.

Kraus, J. F., Peek-Asa, C., & Cryer, H. G. (2002). Incidence, severity, and patterns of intrathoracic and intra-abdominal injuries in motorcycle crashes. *The Journal of Trauma Injury, Infection, and Critical Care, 52*, 548-553.

Lewis, I. M., Watson, B. C., White, K. M. & Tay, R. S.T. (2007) Promoting public health messages: Should we move beyond fear-evoking appeals in road safety? *Qualitative Health Research, 17(1)*, 61-74.

Liu, C. C., Hosking, S. G., Bayly, M., Mulvihill, C., & Lenne, M. G. (2008). Hazard perception and responding by experienced and inexperienced motorcyclists. In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Adelaide.

Liu, C. C., Hosking, S. G., & Lenne, M. G. (2009). Hazard perception abilities of experienced and novice motorcyclists: An interactive simulator experiment. *Transportation Research Part F, 12,* 325-334.

Lund, B. A. (2006). *New rider training system in Norway.* Paper submitted to The Human Element International Motorcycle Safety Conference: California.

Ma, T., Williamson, A., & Friswell, R. (2003). *A pilot study of fatigue on motorcycle day trips.* Sydney: NSW Injury Risk Management Research Centre.

Marottoli, R. A. (2002). Commentary: Riding off into the sunset: Implications for an aging motorcyclist population. *Annals of Emergency Medicine, 39,* 196-197.

Masten, S. V. & Peck, R. C. (2004). *Problem driver remediation: A meta-analysis of the driver improvement literature. Journal of Safety Research, 35*(4). 403-425.

Mayhew, D. R., Simpson, H. M., & Robinson, A. (2002). The safety value of driver education and training. *Injury Prevention, 8,* 3-8.

McGuire, M. (2004). *Making motorcycling safer.* In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Perth.

McInally, S. (2003). R3 – a model for motorcycle rider skill development. In L. Dorn's (Ed.) *Driver behaviour and training.* Aldershot, UK: Ashgate Publishing Company.

McKenna, F. (2004). *The Thames Valley speeding awareness scheme: A comparison of high and low speed courses*. In Behavioural Research in Road Safety 2004: Fourteenth Seminar. London: British Department of Transport.

McKenna, F. P. (2005). *Why do drivers break the speed limit?* In Behavioural Research in Road Safety 2005: Fifteenth Seminar. London: British Department of Transport.

McKenna, F. P. (2006). *Should speed awareness courses be only about speed?* In Behavioural Research in Road Safety 2006: Sixteenth Seminar. London: British Department of Transport.

McKenna, F., & Crick, J. L. (1991). *Hazard perception in drivers: A methodology for testing and training.* Transport Research Laboratory. London: British Department of Transport.

McKenna, F. P., & Myers, L. B. (1997). Can accountability reduce or reverse existing illusory self-assessments? *British Journal of Psychology, 88,* 39-51.

McKnight, A. S. (2009). *Riders Helping Riders: An alcohol peer intervention program for motorcyclists*. Presentation to the Governor's DWI Research Forum. Albuquerque, NM.

McKnight, A. S, Becker, L. R. & Hohn, R. L. (2009). *Riders Helping Riders: An alcohol peer intervention program for motorcyclists.* Retrieved from http://www.msf-usa.org/imsc/proceedings/c1-McKnight-RidersHelpingRiders.pdf

McMahon, K., & O´Reilly, D. (2000). Evaluation of road safety education and novice driver safety measures in Great Britain. *The ICTCT-workshop of 2000 in Corfu.* www.ictct.org/workshops/00-Corfu/McMahon.pdf

Mertz, K. J., & Weiss, H. B. (2008). Changes in Motorcycle-Related Head Injury Deaths, Hospitalizations, and Hospital Charges Following Repeal of Pennsylvania's Mandatory Motorcycle Helmet Law. *American Journal of Public Health, 98*(8), 1464-1467.

Miles, D. R., van den Bree, M. B. M., Gupman, A. E., Newlin, D. B., Glantz, M. D., & Pickens, R. W. (2001). A twin study on sensation seeking, risk taking behaviour and marijuana use. *Drug and Alcohol Dependence, 62,* 57-68.

Mills, K.L., Hall, R.D., McDonald, M., & Rolls, G.W.P. (1998). *The effects of hazard perception training on the development of novice driver skills.* Report to Department Environment, Transport & Regions (http://www.roads.detr.gov.uk/roadsafety/hazard).

Motorcycle Safety Foundation. (2005). *Motorcycling excellence 2nd Edition.* New Hampshire: Whitehorse Press.

Mullin, B., Jackson, R., Langley, J., & Norton, R. (2000). Increasing age and experience: are both protective against motorcycle injury? A case control study. *Injury Prevention, 6,* 32-35.

Natalier, K. (2001). Motorcyclists interpretation of risk and hazards. *Journal of Sociology, 37*(1), 65-80.

National Highway Traffic Safety Administration (2002). Recent trends in motorcycle fatalities. *Annals of Emergency Medicine, 39*, 195-196.

Nehaoua, L, Hima, S, Arioui, H., & Sêguy, N. (2008). *A new motorcycle simulator platform: Mechatronics design, dynamics modelling and control.* In proceedings of the 17th IFAC World Congress. Seoul.

NHTSA (2008). *Countermeasures that work: A highway safety countermeasure guide for state highway safety offices, Third Ed.* Washington, DC: National Highway Traffic Safety Administration.

Noordzij, P. C., Forke, E., Brendicke, R., & Chinn, B. P. (2001). Integration of needs of moped and motorcycle riders into safety measures. Leidschendam: SWOV.

Norwegian Public Roads Administration (2004). *Curriculum driving licence categories A and A1. Handbook 251E – English version.* Norwegian Public Roads Administration.

Ormston, R., Dudleston, A., Pearson, S., & Stradling, S. (2003). *Evaluation of Bikesafe Scotland*. Edinburgh: Transport Planning Research Group.

Parliament of Victoria (1993). *Inquiry into motorcycle safety in Victoria.* Retrieved 2/3/06 from parliament.vic.gov.au

Paulozzi, L. J., & Patel, M. D. (2004). *Trends in motorcycle fatalities associated with alcohol impaired driving: United States 1983-2003.* Atlanta, U.S.: Centres for Disease Control and Prevention.

Pham, K. H., Le Thi, Q.X., Petrie, D. J., Adams, J., & Doran, C. M. (2008). Households' willingness to pay for a motorcycle helmet in Hanoi, Vietnam. *Applied Health Economics and Health Policy, 6*(2-3), 137-144.

Queensland Travelsafe Committee (2003). *Reducing the road toll for young Queenslanders – is education enough? Report # 40.* Brisbane: Parliament of Queensland.

Queensland Parliamentary Travelsafe Committee (2007). *Report on the inquiry into Q-RIDE.* Brisbane: Legislative Assembly of Queensland.

Queensland Transport (2006). *Queensland road toll - 2005 in review*. Retrieved 2/6/06 from www.roadsafety.qld.gov.au

Queensland Transport (2006a). *Drink drive – you're a loser*. Retrieved 2/6/06 from www.roadsafety.qld.gov.au

Queensland Transport (2006b). *Driver reviver and driving tired*. Retrieved 2/6/06 from www.roadsafety.qld.gov.au

Queensland Transport (2008). Motorbike safety in Queensland – Consultation Paper. Brisbane: Queensland Transport.

Queensland Transport (2009). *Queensland road toll weekly report. Report 589*. Brisbane: Queensland Transport.

Queensland Transport (2009). *The facts of life for motorcycle riders.* Retrieved from http://www.motorcyclesafety.qld.gov.au/index.php/qt/site/the_facts_of_life_for_motorcycle_riders/

Quimby, A. R., Maycock, G., Carter, I. D., Dixon, R., & Wall, J. G. (1986). *Perceptual abilities of accident involved drivers* (Research Report 27). Crowthorne, England: Transport and Road Research Laboratory

Quimby, A.R. & Watts, G.R. (1981). *Human factors and driving performance.* Laboratory report 1004. Transport and Road Research Laboratory, Crowthorne.

Ranta, P., Maki, A., & Huikkola, M. (2007). *An evaluation of the potential of e-coaching for riders.* Federation of European Motorcyclists' Association.

Reeder, A.I., Chalmers, D.J., & Langley, J.D. (1996). Rider training, reasons for riding, and the social context of riding among young on-road motorcyclists in New Zealand. *Australian & New Zealand Journal of Public Health, 20,* 369-374.

Reeder, A.I., Chalmers, D.J., Marshall, S. W., & Langley, J.D. (1997). Psychosocial and social predictors of motorcycle use by young adult males in New Zealand. *Social Science and Medicine, 45,* 1357-1376.

Rosenbloom, T, Shahar, A., Elharar, A., & Danino, O. (2008). Risk perception of driving as a function of advanced training aimed at recognizing and handling risks in demanding driving situations. *Accident Analysis & Prevention, 40.* 697-703.

RoSPA (2009). *Driver Profiler 2*. Retrieved from http://www.rospa.com/drivertraining/managementinfo/driverprofiler.htm

Rowden, P., Buckley, L., Haworth, N. & Wishart, D. (2010). Stakeholder interviews regarding motorcycle safety interventions: Round Two (Deliverable 3.3b). CARRS-Q report to Queensland Department of Transport and Main Roads.

Rowden, P. & Haworth, N. (2009a). Assessing alternatives for incorporation of interventions that address risk taking and hazard perception deficiencies into Q-Ride and Q-SAFE (Deliverable 3.2). CARRS-Q report to Queensland Department of Transport and Main Roads.

Rowden, P. & Haworth, N. (2009b). Literature review of motorcycle safety interventions that address attitudinal and higher order cognitive skills (Deliverable 3.1). CARRS-Q report to Queensland Department of Transport and Main Roads.

Rowden, P., & Watson, B. (2008). *Motorcycle rider training and perceptions of skill.* In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Adelaide.

Rowden, P., Watson, B., & Haworth, N. (2007). *What can riders tell us about motorcycle rider training: A view from the other side of the fence.* In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Melbourne.

Rowden, P., Watson, B., Wishart, D., & Schionfeld, C. (2009). *Three Steps to Safer Riding: Update on progress, preliminary results of evaluation. Unpublished report to Morgan and Wacker Motorcycle Training Centre.* Brisbane: Centre for Accident Research and Road Safety – Queensland.

RTA (2004). Motorcycle Safety. *Issues and countermeasures.* Publication no. 04.092. Sydney, Australia: NSW Roads and Traffic Authority.

RTA (2007). *Road Traffic Crashes in New South Wales. Statistical Statement for the Year Ended 31 Dec 2006.* Sydney, Australia: NSW Roads and Traffic Authority.

Rutter, D. R., & Quine, L. (1996). Age and experience in motorcycle safety. *Accident Analysis and Prevention, 28*(1), 15-21.

Senserrick, T. M., & Swinburne, G. C. (2001). Evaluation of an insight driver-training program for young drivers. Report #186. Melbourne: Monash University Accident Research Centre.

Sexton, B., Hamilton, K., Baughan, C., Stradling, S., & Broughton, P. (2006). *Risk and Motorcyclists in Scotland*. Edinburgh: Scottish Executive Research Unit

Shankar, U., & Varghese, C. (2006). *Recent trends in fatal motorcycle crashes: An update. DOT Report HS 810 606.* Washington; National Highway Traffic Safety Administration.

Stedmon, A. W., Hasseldine, B., Rice, D., Young, M., Markham, S., Hancox, M., Brickell, E., & Noble, J. (2009). 'MotorcycleSim': Evaluation of rider interaction with an innovative motorcycle simulator. *The Computer Journal,* 1-16.

Stella, J., Cooke, C., & Spivulis, P. (2002). Most head injury related motorcycle crash deaths are related to poor riding practices. *Emergency Medicine, 14*, 58-61.

Sudlow, D. (2003). *Scoping study on motorcycle training. Road safety research report No. 36.* London: British Department of Transport.

Sűmer, N., Ozkan, T., & Lajunen, T. (2006). Asymmetric relationship between driving and safety skills. *Accident Analysis and Prevention, 38,* 703-711.

Swaddiwudhipong, W., Boonmak, C., Nguntra, P., & Mahasakpan, P. (1998). Effect of motorcycle rider education on changes in risk behaviours and motorcycle-related injuries in rural Thailand. *Tropical Medicine and International Health, 3*(10), 767-770.

Symmons, M., Mulvihill, C., & Haworth, N. (2007). *Motorcycle crash involvement as a function of self-assessed riding style and rider attitudes*. In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Melbourne.

Tierney, P. & Cockfield, S. (2005). *The development of Ride Smart – A cognitive skills CD-ROM training product for motorcyclists*. In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Wellington, NZ.

Transport Accident Commission (2009). *Ride Smart CD-ROM*. Retrieved from http://www.spokes.com.au/#/rider-safety/ride-smart-cd-rom

Tunnicliff, D. (2005). *Psychosocial factors contributing to motorcyclists' intended riding style: An application of an extended version of the theory of planned behaviour.* Unpublished Masters thesis. Brisbane: Queensland University of Technology.

Wallace, P., Haworth, N., & Regan, M. (2005). *Best training methods for teaching hazard perception and responding by motorcyclists.* Report #236. Monash University Accident Research Centre. Melbourne.

Watson, B. (2003). *Research priorities in driver training: Bridging the gap between research and practice.* In the proceedings of the Road Safety Research, Policing, and Education Conference - Sydney.

Watson, B., Fresta, J., Whan, H., McDonald, J., Dray, R., Beuermann, C., & Churchward, R. (1996). *Enhancing driver management in Queensland.* Brisbane: Queensland Transport.

Watson, B., Tay, R., Schonfeld, C., Wishart, D., Tunnicliff, D., Lang, C. & Edmonston, C. (2003). *Short-term process and outcome evaluation of Q-RIDE.* Report to Queensland Transport. Brisbane: Centre for Accident Research and Road Safety -Queensland.

Watson, B., Tunnicliff, D., White, K., Schonfeld, C., & Wishart, D. (2007). *Psychosocial and social factors influencing motorcycle rider intentions and behaviour. ATSB research and analysis report.* Canberra: Australian Transport Safety Bureau.

Wildervanck, C. (2008). *Early hazard perception course*. In proceedings of the Australasian Road Safety Research, Policing, and Education Conference. Adelaide.

Wishart, D., Tunnicliff, D., Watson, B., & Schonfeld, C. (2005). *Motorcycle safety apparel observation study: Westridge Outlook Mt Nebo Road.* Unpublished report. Brisbane: Centre for Accident Research and Road Safety – Queensland.

Wundersitz, L. N., & Hutchinson, T. P. (2006). *South Australia's driver intervention program: Participant characteristics, best practice discussion and literature review. CASR021.* Adelaide: Centre for Automotive Safety Research.