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HAZARD PERCEPTION BY INEXPERIENCED MOTORCYCLISTS

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Abstract:

The project aimed to investigate how hazard perception and responding is affected by level of experience as a motorcycle rider and to assess the extent to which hazard perception and responding can be improved by specific training.

The literature review showed that car drivers with fewer crashes and older or more experienced drivers respond more quickly on hazard perception tasks and that at least some types of training can improve hazard perception abilities for car drivers. However, the nature and likely consequences of hazards for motorcyclists differ and the relationships between novice status, level of experience and age are complicated for motorcycle riders. Thus the findings that hazard perception in car drivers improves with age may not necessarily generalise to motorcycle riders. It may be that hazard behaviour (perception plus responding) is more important for motorcyclists (relative to car drivers).

Very few visually-based tests have been used in licensing in other parts of the world. Motorcycle simulation shows promise in the short-term as a research tool for the evaluation of different training programs with respect to hazard perception. In the longer-term, PC-based simulations may be useful for motorcyclist hazard perception training.

A limited re-examination of crash data showed that crash risk decreased as a function of years of on-road riding experience but not as a function of a definition of inexperience. Failure to respond appeared to reflect a failure of hazard perception but did not change systematically with experience. In general, younger and less experienced riders were more likely to report behaviours consistent with good hazard perception techniques than older and more experienced riders. However, these findings are clouded by differences in training and uncertain reliability of self-report data.

A useful first step in assessing the need for a specific motorcycle hazard perception test would be to examine the relationship between scores on the current Hazard Perception Test and actual hazard perception ability of motorcycle riders. Other issues in relation to the future of hazard perception training and testing for motorcyclists relate to format of presentation, content and structure of the licensing system. The opportunity may also exist to evaluate training and testing methods using a motorcycle simulator located in Sydney.

Key Words:
motorcycle, motorcyclist training, hazard perception

Disclaimer

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EXECUTIVE SUMMARY

The project has two aims:

- to investigate how hazard perception and responding is affected by level of experience as a motorcycle rider
- to assess the extent to which hazard perception and responding can be improved by specific training.

The results of Stage 1: Literature review and Stage 2: Re-examination of crash data are presented in this report, along with recommendations for future directions in hazard perception training and testing for motorcyclists.

LITERATURE REVIEW

The research undertaken with car drivers shows that drivers with better driving records and older or more experienced drivers respond more quickly on hazard perception tasks. Studies using on-road and off-road methods have found similar results. At least some types of training have been demonstrated to improve hazard perception abilities for car drivers.

However, differences between motorcyclists and car drivers with respect to hazard perception were identified in the literature review. Road-based hazards are of greater importance for motorcyclists and hazards pose a greater potential injury threat to motorcyclists. In addition, the relationships between novice status, level of experience and age are complicated for motorcycle riders. While age may reasonably be used as a proxy for driving experience for car drivers, motorcycle riders of the same age vary markedly in their riding experience. Thus the findings of studies showing hazard perception of car drivers improving with age may not necessarily generalise to motorcycle riders.

These issues are relevant to the interpretation of studies that have attempted to assess how much benefit experience as a car driver provides to novice motorcyclists. These studies vary in the extent of benefit they identify – from none to a substantial amount for some categories of rider.

It may be that hazard behaviour (perception plus response choice and execution) is more important for motorcyclists than hazard perception (relative to car drivers). Even with adequate abilities in hazard perception, deficiencies in decision making, execution skills and confidence may prevent the appropriate avoidance behaviour from occurring.

The literature review found very few visually-based tests which have been used in licensing in other parts of the world. A number of visually-based tests have been used in research, however. A slide-based test for moped licensing has been developed in the Netherlands where motorcycling and moped riding are very common. Many of the other jurisdictions where powered two-wheelers comprise a large amount of traffic are less developed and have less developed licensing systems.

The issues of moving versus still representation of scenes and methods for testing hazard perception and responding has not been systematically explored. The literature shows that results from on- and off-road methods are consistently similar, but the off-road methods have used moving representations of scenes only.

Motorcycle simulation shows promise in the short-term as a research tool for the evaluation of different training programs with respect to hazard perception. In the longer-term, PC-based simulations may be useful for motorcyclist hazard perception training.

RE-EXAMINATION OF CRASH DATA

A limited re-examination of crash data collected for the Case-Control Study of Motorcycle Crashes (Haworth, Smith, Brumen & Pronk, 1997) was undertaken to identify specific rider and crash characteristics that relate to deficiencies in hazard perception and responding.

There was a statistically significant reduction in crash risk as a function of years of on-road riding experience. However, inexperienced riders (defined as riders who had ridden on the road for less than three years or rode less than three days or less than 100 km per week) were not found to be associated with a statistically significant increase in crash risk.

Failure to respond was more common in multi-vehicle crashes than single vehicle crashes, as might be expected of a factor reflecting a failure of hazard perception. However, experienced and inexperienced riders had similar proportions of multiple-vehicle crashes. Failure to respond was a little more common in crashes of inexperienced riders than experienced riders but the difference was not large.

In general, younger and less experienced riders were more likely to report behaviours consistent with good hazard perception techniques than older and more experienced riders. The greater likelihood that younger riders, many of whom were not fully licensed, had completed at least one training course somewhat complicates the interpretation of the observed differences. Interpretation is also more difficult given the lack of ability to validate these self-report responses.

FUTURE DIRECTIONS FOR HAZARD PERCEPTION TRAINING AND TESTING OF MOTORCYCLISTS

There is a need for future research to answer the following questions:

- Is there a need for a specific hazard perception test for motorcyclists?
- What should be the aims of a motorcycle-specific hazard perception test?
- If hazard perception training and testing for motorcyclists were to be developed, what would be the most effective and feasible format of presentation, what type of scenarios should be presented and what role in the licensing system should it play?

1.0 INTRODUCTION

The other vehicle is commonly at fault in multi-vehicle crashes involving motorcycles. In an analysis of 900 motorcycle accidents in Los Angeles Hurt, Oullet and Thom (1981) found that the most common motorcycle accident involved another vehicle (75%) causing the collision by violating the right-of-way of the motorcycle at an intersection, usually by turning left in front of the oncoming motorcycle. In Victoria, motorcyclists are commonly the vehicle going straight ahead in right-turn crashes, being in the rear in rear-end crashes and in the ongoing lane in sideswipes.

The Case-Control Study of Motorcycle Crashes (Haworth, et al., 1997) identified a sizeable 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. Inexperience is much more common among motorcycle riders than car drivers. Inexperienced motorcyclists include those riders who have little total riding experience, those who ride infrequently and those who have not ridden frequently for a number of years. Thus there are many inexperienced motorcyclists who are not young or new riders.

There is a need to investigate and improve hazard perception and responding across the range of rider ages and motorcycle licence statuses. This project attempts to address these issues.

1.1 AIMS OF THE PROJECT

The project has two aims:

- to investigate how hazard perception and responding is affected by level of experience as a motorcycle rider

- to assess the extent to which hazard perception and responding can be improved by specific training.

1.2 STRUCTURE OF THE PROJECT

This report presents the results of a literature review and re-examination of crash data as the first stages of an examination of the role of hazard perception in motorcycle safety. Based on the results of these first two stages, recommendations will be made about future directions for hazard perception training and testing of motorcyclists.

1.2.1 Stage 1: Literature review

The first stage of the project is a critical examination of the extent to which hazard perception tests (and the theories underlying them) are applicable to motorcyclists. It includes an examination of visually-based tests which have been used in other parts of the world. The issues of moving versus still representation of scenes and methods for testing hazard perception and responding is explored.

1.2.2 Stage 2: Re-examination of crash data

A limited re-examination of crash data will be undertaken to identify specific rider and crash characteristics that relate to deficiencies in hazard perception and responding. This needs to be based on detailed data, rather than mass data.

2.0 HAZARD PERCEPTION AND OTHER CONCEPTS

The literature associated with hazard perception testing and training contains several terms that are often used interchangeably, such as hazard and risk. There is also a lack of consensus as to what constitutes the definition of a hazard. This section discusses these terms and the definitions that occur in the literature, followed by the definitions that are to be used for the current project. There will be an exploration of the scope of hazard perception followed by an examination of some related theoretical concepts.

2.1 DEFINITIONS – HAZARDS, RISKS AND HAZARD PERCEPTION

Mills, Hall, McDonald and Rolls (1998) define a hazard as "any aspect of the road environment or combination of circumstances which exposes an individual to an increased possibility of an accident" (Section 2.1, p.1). Graham and Kinney's (1980) definition of a hazard is "some potential danger beyond one's immediate control" (p.13). Benda and Hoyos (1983) state that "a road hazard is the possibility that a mass, i.e. a vehicle, might undergo a change in velocity or direction by colliding with a moving or non-moving object or by swerving off the road" (p.1).

Armsby, Boyle and Wright (1989) define risk as the level of danger associated with a hazard, as perceived by the individual. However, this definition appears unsatisfactory, since it excludes objective risks which the driver fails to perceive. For example, a motorcycle rider may be riding in a driver's rear-vision blind spot but not perceive this, and so be placing themselves at an increased risk of a collision. In addition, the objective risk of a given physical situation may vary according to the behaviour patterns of the road users involved. For example, if the aforementioned car driver is in the habit of checking over their shoulder before changing lanes there will be a decreased probability of a crash.

The Concise Oxford Dictionary (Hughes, Michell & Ramson, 1997) defines a hazard as "a danger or risk" (p. 517), a risk as "a chance or possibility of danger, loss, injury or other adverse consequences" (p. 988), and danger as "…exposure to harm…a thing that causes or is likely to cause harm" (p. 280). In terms of hazards to road users, these definitions suggest that any object, situation, occurrence or combination of these that introduces the possibility of the individual road user experiencing harm should be included. Hazards may be obstructions in the roadway, a slippery road surface, merging traffic, weather conditions, distractions, a defective vehicle, or any number of other circumstances. Harm may include damage to one's vehicle, injury to oneself, damage to another's property, or injury to another person.

An objective hazard may not necessarily receive attention from a driver. And even if it is noticed, the situation may not be recognised as a hazard. However, this failure of hazard perception may not necessarily result in a crash. For example, a driver may not notice a nail on the road – clearly a hazard in terms of damaging a tyre, which may cause a crash – and so not steer to avoid it. However the tyres may not actually run over the nail and no adverse consequences occur. Crick and McKenna (1991) state that hazard perception refers to the ability to identify potentially dangerous traffic situations. Mills et al. (1998) describe it as the ability to "read the road".

Another important issue to consider is that the process of avoiding a hazard may actually create a more serious situation. For example, steering to avoid a nail on the road may place the driver in the path of oncoming traffic and a more severe crash might occur. Likewise, a driver may falsely perceive a situation to be hazardous and take unnecessary actions to avoid it, potentially posing hazards to others. Clearly then, perception of a hazard is not enough – the driver must have sufficient training to successfully avoid a hazard without *creating* hazards for other road users. It is therefore important to examine the factors that contribute to a driver noticing some unusual element to their situation, perceiving it as a hazard and therefore potentially dangerous, and then deciding on and taking appropriate action to avoid a crash.

2.2 TYPES OF HAZARDS

For the purposes of their study, Mills et al. (1998) classified hazardous situations into those where the driver could be a threat to others and hazards that could be a threat to the driver. They provided a rather extensive but not exhaustive list of hazards. Some of the hazards where the driver could be a threat to others included scenarios such as a stray dog by the kerb, a pedestrian trying to cross the street, and a cyclist on a country road. The hazards where there was a threat to the driver included scenarios of another vehicle doing a U-turn on the brow of a hill, parked vehicles, roadworks, and a bus pulling out into traffic. The scenarios were further classified into events occurring in front of the car, something joining the car's path, and events occurring in opposing traffic.

Motorcyclists share these hazards but are also at risk from situations not hazardous for car drivers, such as gaps in bridge decking wide enough to catch a motorcycle wheel but too narrow to effect a car tyre. The reactions required from riders also need to be different, as motorcycles handle differently to cars. The extent of potential harm associated with any given hazard is commonly greater for motorcyclists, given their comparative lack of protection.

2.3 INDIVIDUAL DIFFERENCES

Benda and Hoyos (1983) note that the evaluation of the hazardousness of a situation by individuals can sometimes be clouded by evaluations of their own risk of experiencing an accident in that situation. 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 over-confident 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.

In a related concept, Finn and Bragg (1986) and Matthews and Moran (1986) talk about acceptance of risk. By simply driving a vehicle most people understand that there is an element of inherent risk. However, individuals vary in the level of risk they are willing to accept. For example, it would be expected that there is more inherent risk in driving at night or in foggy conditions, and individuals vary in their willingness to accept this increased risk level and drive under such conditions.

2.4 HAZARD PERCEPTION AND THEORETICAL FRAMEWORKS

According to Fitzgerald and Harrison (1999), hazard perception is a skill with cognitive and behavioural aspects that include cognitive workload, automation, and attention. Humans possess finite cognitive resources, and anything that requires attention taxes these resources. While driving there are many situations both within and external to the vehicle that require the attention of the driver, such as reading dash instrumentation to maintain a legal speed and analysing the movements of the traffic around the vehicle.

A safe driver must concentrate on all of the space around the vehicle, not just in the direction of travel. In order to 'read the scene' for potential hazards the driver needs to continuously redirect their attention all around the vehicle in an ever-changing environment. Visually scanning the scene, recognising potential hazards and devoting extra attention to them without ignoring the rest of the scene is a skill that requires practice.

In order to attend to and assess all of these variables on a continuous basis a finite amount of cognitive resources must be devoted to each one. Under such circumstances cognitive overload can easily occur, possibly leading to the ignorance of potential hazards.

With sufficient practice, the skills involved in driving a car become automatic, requiring little cognitive attention for each of the component skills. However, by their nature hazards that require some change in behaviour of the driver may not occur often enough for their processing to become automated. For example, relative to the amount of time spent driving, the number of times a driver would need to swerve to avoid an obstacle is minimal. While the swerve itself may be reflex-like, the skills involved in emergency braking, keeping control of a possibly skidding vehicle, analysing the scene for new obstacles as the vehicle moves into another stream of traffic, and then regaining the original direction of travel – all while under a heightened level of arousal – are unlikely to be automatic behaviours for most drivers. As such, each action would have a high cognitive demand, quickly over-taxing the system and increasing the likelihood of error in any of these elements, possibly leading to a crash.

While hazard perception is an important aspect of safe driving behaviour, on its own it does not make a driver safer. After a hazard has been perceived the driver must choose and implement an appropriate response in order to avoid a crash, which involves decision making (Fitzgerald &Harrison, 1999). The complexities of decision making for a particular situation are the subject of several theoretical frameworks involving sensation, perception, allocation of resources (possibly at the expense of other situations), cognitive processing of incoming information with memories and motivations, and selection and implementation of an appropriate response.

2.4.1 Recognition primed decision making

Fitzgerald and Harrison (1999) invoke Klein's (1989, 1993) recognition-primed decision making model (RPD) to explain hazard perception by drivers of vehicles in dynamic, sensation-rich environments. RPD involves a number of steps between devoting attention to a situation and producing an appropriate behaviour in response.

'Situation recognition' is the first stage of the process, where the situation or context is classified as either novel or familiar, based on comparisons of the current events and stimuli with memories of situations encountered previously. If a match is found and the new event classified as familiar, previous responses and their outcomes can be evaluated for their potential effectiveness in the new situation.

Once a list of potential behaviours or responses is generated, the individual progresses to the second stage of RPD. 'Serial option evaluation' involves testing each possibility in the list of potential responses generated in Stage 1 in a mental simulation of its consequences to determine the most appropriate response. The optimality of this response will depend on the prior experience of the individual. For example, the most technically appropriate response may not be considered as a viable option because the driver has not used it previously, or the response may not have been successful for the driver in a previous situation. Furthermore, the driver may not have been in such a situation at all before.

If the driver has encountered a similar situation previously, the degree of similarity of the prior and current situations is important. For example, the particular actions in emergency braking and swerving to avoid an obstacle will be different depending on weather conditions, type of road surface, and whether the obstacle is dynamic or static (such as an animal versus a lump of wood). If several similar rather than one identical option is available, then time must be devoted to the mental testing of each one and a choice made, theoretically lengthening the response time.

Fitzgerald and Harrison (1999) point out that 'hazard perception' as it is generally viewed only involves the situation recognition phase of RPD – deciding whether the situation is novel or familiar. They suggest that the focus should be on 'hazard behaviour'. As indicated earlier, perceiving a hazard in itself does not allow a driver to avoid an accident, there must be an appropriate behaviour as well. Viewing the process in terms of a complete action (i.e. hazard behaviour rather than just the perception of a hazard) allows for the isolation of factors that can effect the likelihood of avoiding an accident. For example, hazard perception would depend on visual scanning effectiveness but not the effectiveness of the cognitive process of testing and evaluating potential responses. Clearly an inefficient handling of the 'option testing' due to increased cognitive workload may make an accident more likely, and so Fitzgerald and Harrison suggest that this aspect may require particular attention when determining methods of training for novice drivers.

2.4.2 Situational awareness theory

Situational awareness simply refers to an individual's understanding of a dynamic environment. This includes the perception and interpretation of both environmental and personal stimuli, and making predictions of the status of various elements of the situation in the near future. For example, the situational awareness (SA) of a motorcycle rider in a typical traffic situation may be an awareness of where other vehicles are around him, maintaining a suitable speed for the weather and road conditions, being vigilant for obstacles, and making predictions based on that information. An example of the latter might be expecting a particular car to change lanes due to a slow-moving truck in front of it – this judgement is made from observation and prior experience of similar situations.

According to Endsley (1995) there are three steps to SA in a hierarchical structure. Level 1 involves the perception of environmental elements, including sounds, sights, and textures. In Level 2 these stimuli are drawn together in a holistic understanding of the situation. This understanding will be very individualistic as interpretations will depend on the person's goals, motivations and prior knowledge. For example, an aggressive, time-pressured driver will concentrate on different stimuli and make different interpretations while looking for openings in the traffic, whereas a "Sunday driver" will have a different set of motivations and so will analyse the information differently.

From comprehension and understanding, the third level of SA should arise. Level 3 is the prediction of future actions of the various elements within the situation – essentially projecting how things will change. From these predictions decision making can occur, and Endsley (1995) stresses that this is separate to but dependent on SA. As such, good decisions will be contingent upon making quick and valid predictions. Endsley also suggests that this process is similar to any skill, in that with practice comes automaticity.

When a skill is mastered it is said to become automatic and require little conscious effort. For example, learning to ride a bike initially requires training and practice, where the beginner must concentrate on each component skill. Once these skills have been mastered one can ride without devoting any attention to the individual skills involved, and indeed may find it difficult to explain the process to a novice.

According to Endsley (1995), the transfer from concentrating on each component skill to automaticity can occur for any skill or action that is practised often enough to form mental schemas (i.e. frameworks built up of past experiences and knowledge and schema scripts (essentially an accompanying "running sheet" of actions to be performed) in long term memory. Once automatic, it becomes a process of unconscious pattern matching. The elements of a particular stimulus or situation are compared to those in memory, and a relevant schema and its accompanying actions are triggered almost instantly, removing the time required to weigh up the options and make a considered decision.

Clearly the speed and ease of making SA predictions and then decisions depends very much on experience. Unless an individual has had practice in vehicle handling skills so that they can swerve to avoid an obstacle on the road, maintain control while emergency braking and avoid colliding with other traffic (which were not obstacles previously), they will not have an automatic response ready for when they see a child run onto the road in front of them. Without an automatic response there is unlikely to be time for the driver to absorb sufficient information, make considered judgements and take action to safely and successfully avoid the child. Due to the relatively rare occurrence of hazards to road users, without regular practice it is likely that few drivers are properly prepared to quickly deal with them.

Endsley (1995) outlines other factors and processes that are important considerations in SA. While scanning the environment a road user will be exposed to a lot of sensory information. The saliency of this information to the individual will determine what aspects receive extra attention. For example, the colours of the vehicles are not as important as their relative speeds in "fitting in" with the surrounding traffic. Those aspects that receive directed attention are processed in working memory in terms of the individual's goals. For example, hearing an odd noise may indicate a potential problem for a motorcyclist and so receive a lot of attention as the rider checks their bike (such as the instrument panel and other immediately visible parts) and looks around for the source of the noise. Thus, people are actively involved in the process of information perception and attention.

Directing attention is also a skill that can be practised and improved, and individuals can be taught to divide their attention between multiple stimuli (Damos & Wickens, 1980, cited in Endsley, 1995). Being able to quickly direct attention to and divide attention between stimuli is particularly important for drivers due to the complex and dynamic nature of the information that must be processed in a short time. Regan, Triggs and Deery (1998) have demonstrated that risk perception by novice drivers can be indirectly enhanced through training in attentional control. So rather than only training novices in the hazards to look out for, drivers should be given training in how best to devote attention to these hazard stimuli while still paying attention to the driving process to ensure that all pertinent information will be sufficiently processed.

As real-time mental processing occurs in working memory, there is the potential to quickly reach a situation of overload, especially if attention is being divided between many stimuli. However, when cues trigger automatic responses from long term memory, working memory can be kept free of processing load, shortening the reaction time (Endsley, 1995).

It is also possible that a cue will trigger a response that was not specifically learnt for that situation. For example, a rider may develop bike handling skills at a training track. It is unlikely that an orange cone will “jump out” at a motorbike in a real situation, but the skills should be sufficiently generalisable that a dog running onto the road will trigger the same emergency response. A further advantage to automaticity is that a cue can trigger a response without waiting for all of the information to be perceived or processed. Noticing a dog on the side of the road looking at a child on the other side may be enough of a cue to heighten the driver’s attention and trigger an initial response of slowing down and checking the traffic situation – preparing to take evasive action should the dog attempt to cross in front of the vehicle.

With increased experience and a history of successful hazard avoidance, a driver’s confidence level will increase, further improving their performance (Endsley, 1995). Conversely, a lack of experience and skill will place stress on the novice driver. While some stress can produce an improvement in performance (Kahneman, 1973; cited in Endsley, 1995), too much stress tends to cause the driver to narrow their focus to a limited number of cues, increasing the likelihood that they will miss important hazard information. In addition, it is suggested that stress may also decrease working memory capacity and retrieval (Endsley, 1995).

Endsley (1995) describes four SA scenarios that vary depending on the situational awareness of the individual and the workload (i.e. complexity) of the situation.

- Low SA and low workload – inattentiveness and little vigilance produces an apathetic operator;
- Low SA and high workload – too much information for the operator to cope with;
- High SA and low workload – an ideal situation where information is easily processed;
- High SA and high workload – the operator is working hard but managing to process all of the necessary information.

A low level of SA or too high a workload can cause errors to be made due to incomplete information or inaccuracies in processing the information, respectively. Such errors can occur at any of the three levels of SA – perception of the environment, comprehension of the situation, or projection of future status.

Errors in performance can also occur when the correct response is not known or an incorrect one is enacted, or if the individual is limited in some way (e.g. time) from carrying out an appropriate response. An awareness of the error can enable the individual to 'update' the system to improve performance for the next time the situation occurs. However, in terms of hazards, an individual may be unaware that they have made an error as not all hazards will cause an accident (for example, a driver may not notice a nail on the road but miss it anyway, or cut off a motorcyclist and not realise that they have done so).

2.4.3 Models of risk

According to Saad (1989), there are four risk models:

1. Risk homeostasis (Wilde's model): The driver maintains a certain target level of risk (greater than zero) and will adjust their behaviour in response to changing traffic conditions in order to maintain this level of risk.

2. Zero risk (Naatanen and Summala's model): The driver's perceived level of risk is zero most of the time. There is a threshold of perceived risk and only when this level is exceeded does the driver adjust their behaviour. The model suggests that this threshold is generally too high (i.e. the real risk is higher than the perceived risk) and crashes occur due to this gap.

3. Threat avoidance (Fuller's model): In an extension of the 'zero risk' model, 'threat avoidance' suggests that perceiving a risk would be uncomfortable psychologically, and so drivers would seek to avoid situations that could cause such an experience. Anticipatory avoidance action is reinforced when it is followed by a feedback response confirming that it was indeed necessary. If that is not the case, the need for such action does not arise. Subjective probabilities do not relate to accidents as such but to the potential dangers of the environment in relation to which avoidance action may have to be taken at any moment.

4. Hierarchical (Michon's model): This model requires an assessment of a potential hazard at three hierarchical levels:

- Strategic level: Planning the journey (route, time of day, etc.) requires risk acceptance;
- Tactical level: The choice of a specific action or a given manoeuvre such as overtaking is risk taking;
- Operational level: The chosen manoeuvre is carried out by an adjustment of the vehicle's speed and trajectory, and consists of either of two forms of behaviour. Normal operational behaviour consists of continued adjustment according to the road environment, and threat coping is emergency action in response to dangers that suddenly present themselves.

2.5 CONCLUSIONS

For the purposes of this report a hazard for a particular driver is defined as any combination of road environment situation and/or circumstances that increases the probability of a crash, and is beyond the immediate control of the driver in question. The behaviour and level of experience or skill of the particular driver are not considered to fall within the definition of hazards, even if they increase the probability of a crash. Hazards therefore include:

- Semi-permanent physical characteristics of the road environment (such as potholes, traffic merge points and visual obstructions);
- Temporary physical characteristics of the road environment (e.g. fog, oil on the road or sun glare);
- Behavioural aspects of the surrounding traffic (such as the movements and positions of other road users, including pedestrians and bicycles).

A hazardous situation is any situation involving a hazard. Following this, hazard perception is the process of noticing and attending to a hazard. A hazard may or may not be noticed for the danger it poses, or it may be judged to be more or less dangerous than it actually is. Such judgements involve evaluation of the available stimuli, and are primarily based on prior experiences of similar situations and evaluating likely outcomes of encountering the hazard. Beyond hazard perception comes decision making – deciding what action (if any) should be taken.

Risk is the likelihood of the occurrence of a crash. Once an individual evaluates the level of risk of a situation, a variety of factors will influence the level of risk they are comfortable with. The level of risk accepted will be based in part on the rider’s beliefs about their own level of skill in successfully avoiding the hazard. There may also be differences between perceived and objective levels of risk. For example, a motorcyclist riding in a car driver’s blindspot is at objective risk whether he perceives this risk or not.

The definition of hazard outlined earlier excluded the driver’s behaviour and attitudes, while the concept of risk includes such factors. According to Hoyos (1988), "Perceiving a risk means, first of all, perceiving hazards which constitute a risk" (p. 571). Hazards are therefore a subset of risks and hazard perception is part of risk perception.

3.0 HAZARD PERCEPTION RESEARCH

3.1 ON- AND OFF-ROAD METHODS

Research into hazard perception began in the 1960's. In one of the earliest studies, Currie (1969) used model cars on an electric race track where the 'drivers' had to operate the cars to avoid collisions with other model cars. In attempting to avoid several staged crashes, the drivers provided a picture of hazard perception.

There are essentially two methods used for hazard perception evaluation – laboratory based trials and on-road trials. Laboratory based procedures include methods such as model cars (Currie, 1969), questionnaires such as the Driving Hazard Questionnaire (Soliday, 1975), and the more recent use of driving simulators. On-road methods commonly involve observers riding with drivers, making observations of their driving behaviours as they negotiate a course in real traffic.

While laboratory methods are becoming more sophisticated with advances in driving simulators, they still bear some criticism for a lack of reality or the element of artificiality – there are no real consequences of making a mistake. However, on-road testing lacks consistency in the situations the drivers encounter (one driver might have to deal with many hazards while another experiences few), relies on observer ratings and bears an element of risk – particularly if novice drivers are being tested.

Currie (1969) attempted to address the question of realism in off-road procedures. In order to introduce consequences for mistakes, the drivers were informed that they would receive a mild electric shock if they made an error such that their electric model car was involved in a crash. This was an empty threat, as no electric shocks could be administered because the wire that the driver expected would deliver the shock was not actually connected to anything. However, many drivers reported feelings of "butterflies" and nausea, and many physically flinched when they crashed their model cars. According to Currie, these reactions suggested that the drivers were feeling some of the emotions that might be experienced in an on-road test. Quimby and Watts (1981) measured arousal level via skin conductance and heart rate while drivers watched videotape in a simulator to assess the level of arousal experienced by the drivers.

In an examination of risk perception by young drivers, Finn and Bragg (1986) showed photographs and videotapes to drivers of a range of ages, and asked them to identify and rate any hazards that they perceived. In research published elsewhere they also had the same drivers complete a four-mile course in real traffic. They did not directly compare the on-road and off-road tests, but both methods showed that younger drivers evaluated potentially hazardous situations as less risky than did older drivers. The authors suggested that this was a case of misperception (or underestimation) of risk by the younger drivers.

Hughes and Cole (1986) had drivers drive around a 36 kilometre course comprised of residential streets, arterial roads and shopping centres, and asked the drivers to identify things that attracted their attention. They then showed footage of the drive taken by a video camera mounted to record what the driver saw to a new group of observers in the laboratory. They reported minimal differences between the on- and off-road results.

Watts and Quimby (1979, cited in Quimby & Watts, 1981) reported a 0.78 correlation between drivers' risk rankings on a simulator task of a particular route when compared with rankings obtained driving the actual route. The measures were based on changes in skin conductance at various stages of the drive. Salter, Carthy, Packham and Rhodes-Defty (1993, cited in Bailey, 1994) reported a correlation of 0.94 between risk ratings obtained from individuals who watched video footage from the driver's point of view and risk ratings given by a group who actually drove over the filmed route.

Mills et al. (1998) compared the effects of on-road and classroom hazard perception training on the acquisition of hazard perception skills and subsequent improvement in safety and general driving skills for a sample of young novice drivers. Good relationships between hazard perception results in the laboratory and those in on-road testing were found. Drivers who saw hazards early on the road had faster average hazard perception times in the laboratory, both before and after training. Drivers who missed hazards on the road had slower average hazard perception times in the laboratory, both before and after training. There was a significant positive correlation between the number of hazards missed in the laboratory and the proportion of hazards missed during on-road assessments. They concluded that "the laboratory test is a valid test of hazard detection" (p.4).

Endsley (1995b) suggests that a method currently used to evaluate situational awareness (SA) – Situation Awareness Global Assessment Technique (SAGAT) – could be used to assess hazard perception. An individual is provided with a realistic situation in a simulator. At various times during the session the simulation is frozen and a series of questions asked. The information obtained is compared with that amassed by the simulator computer. According to Endsley, the simulation can be frozen multiple times during a session, for up to six minutes at a time, and restarted, without detriment to performance or influencing the participant's SA.

3.2 HAZARD PERCEPTION AND CRASH INVOLVEMENT

Theory suggests that drivers who possess good hazard perception skills should be involved in fewer crashes. Using videotape footage of traffic situations, Pelz and Krupat (1974, cited in Mills et al. 1998) found that a group of drivers with low accident rates reacted more quickly to hazards than did a group of drivers with a higher accident rate, or a group with more traffic violations. Evans and Wasielewski (1983) found that drivers with a history of accidents or violations demonstrated riskier driving, assessed by photographic footage of shorter headways (the following distance between a car and the vehicle in front) in freeway traffic.

Quimby and Watts (1981) constructed a measure they called the "safety index" for their on-road testing. As the driver approached predetermined potential hazard spots their speed was noted. The index was calculated from derived stopping distance and known visibility for that particular point on the driving route. They found that better scores on the safety index were correlated with a better accident history and fewer errors (on items such as car positioning, turning, braking, etc.) as assessed by observers while the drivers negotiated 26 kilometres of traffic. Driving errors were also significantly correlated with accident history and the number of errors made was inversely proportional to the number of hazards identified. Others have also found a correlation between crash history and performance in a hazard perception task in terms of both number of hazards perceived and latency of this perception (e.g. Currie, 1969).

The decision making theories described earlier suggest that reaction time decreases as a driver gains experience – but that this is due to the number of stored schemata rather than physiological reaction time per se. However, in order to build up a good repertoire of schemata to compare the current situation with, the driver's experience must involve a variety of locations and conditions, rather than simply more hours behind the wheel. It has been suggested that many young drivers falsely believe that their quicker physiological reaction time will enable them to avoid potential crashes.

Quimby and Watts (1981) found that potential hazards presented in a simulator were responded to less quickly by drivers less than 25 years old compared with drivers aged between 25 and 55. As the reaction times of the younger drivers were faster than the older age groups for simple stimuli, it was concluded that the younger drivers were not recognising the presented situations as hazardous. The finding that novice drivers do not perform as well on hazard perception tasks compared with more experienced drivers has been reported many times (e.g., Armsby et al., 1989; Benda & Hoyos, 1983; Finn & Bragg, 1986).

Brown and Groeger (1988) suggested that younger drivers might be involved in more risky manoeuvres due to sensation-seeking and autonomy of development (i.e. rebelliousness). This higher acceptance of risk level may combine with or confound hazard perception. Benda and Hoyos (1983) found that less experienced drivers paid more attention to details and so were more likely to suffer from information overload. According to Bailey (1994), novices do not scan as well as or use their mirrors as much as experienced drivers, and concentrate on non-moving objects as reference points for vehicle positioning.

Australia's Federal Office of Road Safety (FORS) (1999) reanalysed motorcycle injury statistics by separating out those who were unlicenced or drunk at the time of their crash, leaving so-called "responsible drivers". In single vehicle crashes involving responsible riders, 75% of the fatalities occurred when the rider ran off the road. In multi-vehicle crashes with a rider fatality, 41% of the crashes were the fault of the rider, and half of these involved excessive speed; in 42% of the crashes the other road user was at fault. In the cases where both were at fault, the rider was generally speeding. Wells (1986) made observations of 651 motorcycle riders at 5 different intersections and noted that 75% of them made some errors, most commonly regarding rear observation, signals and speeding (not necessarily exceeding the limit but riding too fast for the conditions). These statistics suggest that while skills are important, rider behaviour and attitude is also a significant factor.

3.3 MOTORCYCLE RIDER HAZARD PERCEPTION

As indicated earlier, motorcycle riders are subject to specific hazards in addition to those that they have in common with car drivers. Riders' evaluation of level of risk also needs to take account of the different performance characteristics of a motorcycle compared with a car and the lower levels of injury protection they have.

Armsby et al. (1989) noted that the types of hazards reported by motorcyclists differed from those reported by other motorists. Regardless of whether nondirective, focussed or critical incident interviews were conducted, over 70% of the hazards mentioned by car drivers with no motorcycle riding experience arose from the behaviour of other road users, rather than features of the road environment. Car drivers who also rode (or had ridden) motorcycles, however, were able to identify specific features of the road, and specific actions of other road users, as hazards to motorcyclists. They conclude that “this might be expected, given that motorcyclists are more at risk from physical deficiencies in the road environment, such as a road surface with low skid resistance, and more vulnerable to injury if they are involved in an accident” (p.56).

It might be expected that lack of experience will be as important for motorcycle riders as it is for car drivers (as outlined earlier). Lin (1998) studied a sample of 4729 motorcycle riders and found that past crash history and lack of experience were both positively related to an increase in risk of a motorcycle crash.

Hull (1981) found that the exposure-adjusted accident rate for motorcyclists in New Zealand with less than six months riding experience was significantly higher than the rates for riders with 6-11 months experience or those with over a year of experience. The exposure-adjusted accident rate was also substantially and significantly lower for riders aged 20 years old or older compared with those aged 19 or less. The accident rate for the youngest group was exceeded only by that for the group with less than 6 months riding experience.

Also looking at motorcyclists in New Zealand, Mullin, Jackson, Langley and Norton (1998) found a strong relationship between increasing age of rider and decreasing risk of moderate to fatal injury from a motorcycle crash. Riders aged over 25 years had less than half the risk of 15 to 19 year olds. There was no association between gender and risk. They did not look at experience per se, but found that those who had ridden their current motorcycle for 10 000 kilometres or more had a 48% reduced risk compared to those who had ridden a particular bike for less than 10 000 kilometres. Riding frequently in the previous year had no association with crash rate, nor did familiarity with the road.

In their study of motorcycle crashes, Hurt, et al., (1981) found that the rider was usually inconspicuous in traffic, inexperienced, untrained, unlicensed, unprotected, uninsured, and did a poor job of avoiding the collision. Also, 16-24 year olds were over-represented in the crash statistics, as were those with a recent history of traffic violations and/or accidents. Lack of attention to the driving task was a significant factor for the rider. Alcohol was involved in almost half of the fatalities. Collision avoidance skills were lacking (a typical accident allows the rider less than 2 seconds to complete any avoidance actions).

3.3.1 Effect of car-driving experience

As a motorcycle is often an additional mode of transport, many novice riders already possess a car licence and some experience driving a car. A number of studies have examined whether experience as a car driver improves the safety of novice motorcycle riders. One reason for this could be that hazard perception skills learned as a car driver can be used in motorcycle riding. Another reason may be that these novices are older and their safety has improved as a result of increased maturity, rather than experience.

After controlling for exposure, Taylor and Lockwood (1990) found that driving a car reduced the frequency of motorcycle crashes for riders until they reach their early thirties, with the magnitude of the reduction being greatest for young riders. For older riders, the effect was reversed and its magnitude smaller. They comment that this may be because the skills required for driving safely on the road are developed whilst driving a car and these skills are also useful when riding a motorcycle. But the effect was found to vary with age, rather than riding experience, and so it is possible that young riders who also drive a car may represent a different, and perhaps more mature, group than those who do not. Socioeconomic status may also affect access to other vehicles.

In a New Zealand study, Mullin (1997) found no reduction in risk of involvement in a motorcycle crash associated with driving other vehicles regularly over some years or in the previous year. There was a possible association with a small increase in risk among motorcyclists driving another vehicle more than three days per week in the last year (age-adjusted RR=1.26, 95% CI 0.95-1.66). After adjustment for a range of factors (including socioeconomic status) the association disappeared.

3.3.2 Novices and other types of inexperienced riders

In relation to drivers, the term "novice" generally refers to someone who has not been driving or riding for very long. For car drivers, in most cases the term "novice" is synonymous with "inexperienced". However, as many motorcyclists also have a car licence and therefore often another means of transport other than their motorcycle, a rider may be licensed but not ride very often. In this way a rider may no longer be a novice in terms of the length of time they have been licensed, but still be inexperienced in that they have not accumulated many hours or kilometres of riding. Or the rider may have had experience in a limited range of settings. For example, the rider may only ride their bike as a hobby rather than as regular transport, only taking to country roads in summer.

The reasons for riding may also be important. For this reason research should examine what the bike means to a particular rider as it may provide information as to why they ride the way they do. For example, there is likely to be a difference in riding styles and behaviours between a rider who rides for the feelings of freedom or thrill, and another who rides as a means of transport. Both may exist to some extent in every rider such that the bike represents transport during the week and the thrill is more important on the weekends on the open road.

The previous two sections demonstrate that the relationships between novice status, level of experience and age are somewhat more complicated for motorcycle riders than for car drivers. While age may reasonably be used as a proxy for driving experience for car drivers, motorcycle riders of the same age vary markedly in their riding experience. Thus the findings of studies showing hazard perception of car drivers improving with age may not necessarily generalise to motorcycle riders, so there is a need to try to partial out the relative contributions of age and experience to crash data.

4.0 HAZARD PERCEPTION TRAINING

If safe riding is partially dependent on hazard perception, and hazard perception ability increases with experience, then an important question is whether the process of gaining experience can be accelerated in a safe environment. In the same way that hazard perception can be studied either on- or off-road, training can be administered in either mode. On-road training may involve an instructor travelling with the learner and directing their attention to likely hazards and discussing potential avoidance techniques. Off-road training may involve a classroom situation with an instructor using videotape and photos. Simulator training is also an option, although it is relatively expensive and resource intensive as only one candidate can be trained at a time. The two methods could be combined and variations used, such as a defensive driving course on a controlled track.

Classroom training in hazard perception has typically involved students watching video footage of driving through an area where hazards exist. Mills et al. (1998) had groups of 4-5 drivers watch a video of hazards for approximately two hours. A local driving instructor taught them how to identify the hazards and assess them. The aim was for the drivers to begin to learn some of the characteristics of moving vehicles and pedestrians, which would allow them to predict future hazards. "Emphasis was placed on the subjects looking ahead, using critical scanning areas and anticipating hazards in order to identify them as early as possible" (Section 3.6).

In the on-road training reported by Mills et al. (1998), subjects drove on selected routes in the local area for two one-hour sessions, a week apart. They were accompanied by a driving instructor and were required to continuously describe the road situation and to nominate and explain changes in road speed and direction in advance. This technique was used to help the driver learn to identify potential hazards on the road. At the end of the first training period, the instructor discussed areas which needed improvement and set the driver goals to aim toward and practice during the following week.

Mills et al. (1998) found that the combination of on-road and classroom hazard perception training led to the greatest reduction in reaction times to perceive hazards. The second greatest reduction was for on-road training, followed by classroom training. On the second assessment, all groups responded more quickly to hazards in which they could be a threat to others. The group who had both on-road and classroom training and the group who only had on-road training responded more quickly on the second assessment to hazards which could be a threat to them.

Mills et al. (1998) caution against interpreting their findings in terms of on-road training or combined on-road and classroom training being more effective than classroom training. On-road training was not statistically significantly better than classroom training in most analyses. The combined training was found to be better but this may have resulted from it comprising four hours of training, rather than the two hours for on-road or classroom training alone.

McKenna and Crick (1992, cited in Crick & McKenna, 1991) found that their test of hazard perception discriminated between a group of expert police drivers and a group of experienced drivers. They considered that this difference most likely resulted from the difference in the quality and quantity of training received by the two groups. They concluded that "this implies that hazard perception skills are amenable to modification and improvement through advanced training courses, which, given the established link between hazard perception and accident involvement, suggests in turn the potential value of advanced training courses as a means of countering road accidents" (Crick & McKenna, p.100).

Crick and McKenna (1991) ascribe the lack of evidence for the benefits of advanced training in road safety to a lack of methodological soundness in previous evaluations and to the content of the courses: "it may be the case that the [advanced] courses assessed have focused very little on the acquisition of hazard perception skills. The same might be said of basic, pre-licensure training courses, which if true, may explain other puzzling or paradoxical findings in the literature" (p.104).

In another study, Crick and McKenna (1991) examined the hazard perception skills of a group of experienced drivers before and after an advanced training course. Hazard perception was measured in terms of reaction times to hazards depicted in video footage taken from a driver's point of view. For those who did not notice particular hazards a maximum latency was recorded. The course participants were matched with control drivers for both age and exposure who did not participate in the course. The post-test was carried out 8-9 months after the course. Results indicated that the untrained group showed no significant change in hazard perception times, while the trained group responded significantly more quickly to hazards.

Another way of improving hazard perception may be to simply provide hazard information, such as identifying accident blackspots or providing statistics of the increased risk of driving at night. However, such information does not mean that a particular situation is hazardous for a particular driver. The risk at a blackspot intersection is based on the number of accidents that have happened there without regard for the number that have *not* occurred. Also, as many drivers consider themselves to be safer and more skilful than the average driver, they are likely to consider the risk information to be irrelevant to them, and this view is reinforced when they pass through the intersection without being involved in an accident (Brown & Groeger, 1988).

Gregersen (1996) suggests that simply making drivers realise their own limitations and that there will be situations that they cannot handle may make them safer drivers. Simpson and Mayhew (1990) discuss taking a "health promotion" perspective – how a person drives may be no more important than how a person chooses to drive – i.e. take into account lifestyle factors rather than simply concentrating on skills improvement. Deliberate risk taking, such as drink driving, can be targeted in this manner,.

A more recent innovation is a CD-based computer application (Regan, Triggs & Godley, 2000). By encapsulating the whole process of an instructor, video footage and interactive activities such as driving tasks using the mouse to steer a virtual car, hazard perception training can be accessed by a larger market. Rather than providing only training to classes of novice drivers, all drivers with access to a computer can work through the materials at their own pace and in their own home. The project is yet to be evaluated for its effectiveness in reducing crashes.

4.1 HAZARD PERCEPTION AND MOTORCYCLE TRAINING

A number of authors have concluded that the apparent lack of success of rider training in reducing accident risk or number of violations may stem from the content of the training programs (Chesham, Rutter & Quine, 1993; Crick & McKenna, 1991; Haworth, Smith & Kowadlo; 1999; Reeder Chalmers & Langley, 1996; Simpson & Mayhew, 1990). The rider training programs currently in use focus mainly on the development of vehicle control skills. This is not necessarily through choice but is often brought about through time constraints and the need to prepare a rider for an end test that is skill-based.

There is considerable room for the important attitudinal concepts of cognition, perception and reaction to be more effectively delivered. Rothe and Cooper (1988) concluded that “the lack of riding skill is not the major problem. Attitudes, personality and awareness of others are”. They went on to recommend that “motorcycle rider training courses should be more attentive to education than training” and these courses “should use instructors who are better prepared to implement the education-oriented programs” (p.203). Chesham et al. (1993) concluded that “training courses concentrate on riding technique and pay little attention to why safe riding is important. That is, they offer little by way of cognitive underpinning for the behaviours they promote.” (p.428).

Jonah, Dawson and Bragg (1981) attributed the failure of the Motorcycle Operator Skill Test (MOST) to predict accident involvement to the absence of testing for danger perception and risk-taking. “The focus of the MOST test and indeed most licensing tests is still primarily geared towards the acquisition of basic vehicle control, a fact which inevitably influences the content of elementary training courses aimed essentially, whether consciously or unconsciously, at equipping novices to pass the test” (Crick & McKenna, 1991, p.104).

Simpson and Mayhew (1990) speculate that some riders may benefit from skills training while others will not. They posit that perhaps trainees who begin with a relatively low level of skill development could benefit from training while others who are more skilled in vehicle control may find little safety benefit in completing such a course. Rider motivations are also important, such as the reason for enrolling in the course (e.g. to satisfy parental requests). They also point to some ‘well designed’ studies that have actually found that formally trained riders had the same risk of being involved in an accident as riders who did not receive the instruction. Some studies have even found that formally trained riders had higher accident rates (per miles ridden).

Simpson and Mayhew (1990) also point out that much of the outcome data analysed is simply number of crashes. If severity and type of crash were analysed the data may reflect more favourably on training programs. For example, a rider may avoid an obstacle and slide or fall off as opposed to crashing into the obstacle. This would indicate a heightened hazard perception ability, but lack of practice in avoidance actions. While number of crashes is often the ultimate assessment of improved rider ability, some weighting of the crash based on severity as measured by injury (e.g. number of days of hospitalisation) may be more appropriate.

For motorcyclists, hazard perception requires knowledge of both the physical hazards associated with the road layout and the hazards associated with the behaviour of other road users. The draft new course for proceeding to a licence without a learner permit (Haworth &

Smith, 1999), includes material on “coping with the road”, which identifies road-related hazards, and “coping with other road users” to help riders to predict what other road users are likely to do. In order to identify a vehicle as a hazard or potential hazard, there is a need to be able to predict what it is likely to do. This is also covered in the session on “roadsense” (road rules).

There can be deterrents to enrolling in a training course, such as the cost and availability in some areas. The Australian Transport Safety Bureau (ATSB) has just released a new motorcycle rider training video and booklet called “Ride On” that can be purchased or ordered via the internet. The video runs for 43 minutes and provides instruction in “bike control skills plus mental skills to anticipate danger as well as skills for self control” (FORS, 2000). Rather than simply demonstrating examples of riding safely, the video includes four camera angles with zoom-ins, split screens and inserts to provide detailed information throughout the production. The video and accompanying booklet were produced with collaboration from experienced motorcyclists and instructors. While it is stressed that neither the booklet nor the video are meant as replacements or substitutes for personal training, these self-paced and accessible materials should be a useful addition.

A significant theoretical finding emerging from the simulator research program referred to earlier (see Regan, Triggs & Deery, 1998) is that risk perception can be indirectly enhanced through training in attentional control. This has not been demonstrated previously and suggests that attentional control is an important underlying component of risk perception. This underscores the importance of providing complementary training in attentional control in any product designed to enhance risk perception in novice drivers - novice drivers can be given training in what to look out for, but if they cannot give attention to those things, they will not be processed.

A further consideration is the fact that increased training provides increased confidence. There is a possibility that the confidence extends further than the new skill acquired, so that training may actually make it more likely that the driver will be involved in a crash, as their increased confidence leads them to drive beyond their abilities.

4.2 USE OF SIMULATORS IN MOTORCYCLIST TRAINING

In Japan, driving and riding schools and driving and riding licensing centres have started to use simulators for training and education. There is very little description of these programs and evaluations available in English. The material below is taken from an article by Tatsuhiko Awane of the Driving Safety Promotions Centre of Honda Motor Company in Japan.

The use of simulators in motorcycle training began in Japan in 1996 with the use of simulation exercises for large-sized motorcycles (over 400 cc). Training sessions with simulators were made a compulsory part of training for a motorcycle licence prior to 1998. Awane (1999) notes that some rider re-education programs have started to include danger anticipation training using simulators in their regular curricula. This is in line with the suggestions that the emphasis in simulator training should be on recognition of ‘accident configurations’ rather than ‘last-second collision avoidance measures’ (Hancock, Wulf, Thom, & Fassnacht, 1990).

Awane (1999) contends that “the best way to teach drivers real skills, including sound judgment and control, is to give them direct experience of controlling a vehicle....an effective approach to driver education is to allow people to vividly experience the unfortunate consequence of careless driving with a systematic way of helping them to understand the cause of such errors and to reflect on their driving performance. Simulators are a type of tool well suited to this kind of education method” (p.26).

Awane maintains that classroom teaching of what he terms “danger anticipation” cannot provide training in all the activities involved in riding and, in particular, does not teach trainees to develop the moment-to-moment awareness and judgment necessary to control a motorcycle. On-road training is also constrained for motorcycle riding because it is difficult for the instructor to notice important details like the delays in the responses of trainees. With a simulator, however, these behaviours can be noted immediately, or on replay of the recorded riding sequence.

He stresses the importance of replaying exercises to trainees from different angles to teach them to recognise problems that they failed to notice when riding. As part of this process, the instructor encourages the trainee to observe how the problem occurred, reflect on why it occurred, and determine what should be done to correct it. Awane believes that the role of the instructor in simulator training is different to that in real vehicle training, but is still important.

Awane notes that the use of a check list of trainee behaviour during simulated riding can help to establish common items by which to assess riding performance and minimise the role of the instructor’s own personal views. The check lists can function as a personal performance record for each trainee and monitor whether specific problems have been overcome.

Several problems have arisen with the use of simulators, however (Awane, 1999). Motion sickness affects some trainees, a certain time is needed for familiarisation with the simulator, and often there is insufficient time available for trainees to gain enough practice on the simulator to take full advantage of the training (due to a shortage of simulators).

Awane proposes that a comprehensive rider education system should include classroom training, skills practice using real vehicles and simulation training to learn to handle situations that are too dangerous to practice using a real vehicle. He maintains that for inexperienced trainees, the simulator should be used first for teaching basic motorcycle handling skills, before moving on to practice with real vehicles. Danger anticipation training can be deepened at each stage of training using a real vehicle and simulator in turn.

According to Awane, it is not necessary to use simulators prior to real vehicles for experienced riders. The simulator can be used as a diagnostic tool to identify bad riding habits in experienced riders. Then they can practice riding real motorcycles to correct any bad riding habits revealed during their simulator sessions. It is also possible to go back to the simulator to check that their riding technique has indeed been corrected.

Awane notes that the most objective criterion for evaluating the effectiveness of simulator education is accident reduction. He notes, however, that it is currently too early to be able to conduct such an evaluation accurately. Instead, he reports the results of a survey of graduates of a large number of driving and riding schools. The purpose of the study was to find out whether the graduates found the simulator exercises to be useful in practice. The response rate was very low – less than 2% – and therefore the results may not be reliable. Another survey by the Automobile Safety Driving Centre, a public organisation, found that many people reported that they found simulator training a valuable opportunity to face dangerous situations that cannot be practised using real vehicles. Awane concludes that the use of simulators in training has highlighted to trainees the importance of danger anticipation.

The main challenge that Awane has identified for the future is to increase the amount of time that each trainee can spend on the simulator. One option to allow more widespread use of simulators is that simulator equipment be designed and manufactured to be less expensive. Better utilisation of simulators may be possible by dividing trainees into groups and having some undertake training using real motorcycles while others are using the simulator(s) and then rotating.

Awane also notes that the lack of time for repetitive practice in motorcycle training at the licensing stage may be constraining training in danger anticipation (a point also relevant in Victoria, e.g. see Haworth & Smith, 1999). He identifies the potential to make danger anticipation training compulsory at driving/riding schools or special traffic education facilities within six months or perhaps one year after obtaining a motorcycle licence.

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. It states that "understanding of other traffic's characteristics and the ability of hazard prediction are the factors believed to have contributed to this, and these were mainly done by using the driving simulators".

Quimby, Maycock, Carter, Dixon and Wall (1986) found that drivers who quickly perceived hazards in a driving simulator had better accident records, while drivers with a lower level of performance had worse accident records. This finding may generalise to motorcycle riders.

4.2.1 Motorcycle simulator training in Australia

One of the simulators developed by the Honda Motor Company is currently located at the Honda Australia Roadcraft Training complex at St Ives in Sydney. It has been used as a demonstration tool for visiting Year 9 school students, to demonstrate hazard perception skills in a post-learner course and for similar purposes in a risk management course for experienced riders. Anticipated future uses include training car drivers to ride scooters (if no licence is required) and possible incorporation into car courses to teach hazard perception.

They do not currently keep performance data for trainees but note that a score sheet system is used in Japan.

The current simulator shows a range of scenarios that were developed for Japanese conditions. While vehicles drive on the left-hand side of the road, the road markings are not the same as those found in New South Wales and Victoria. This does not appear to pose major problems for trainees, however. There is no Australian ability to change the characteristics or range of the scenarios.

The simulator has a range of modes. In practice mode, use of brakes, gears and steering are required but there are no consequences associated with the hazards. The motorcycle mode includes curves, braking in a curve, braking in response to a truck coming out from an intersection, wet and dry road and wind effects. There are six different street scenarios. The scan danger mode includes a range of hazards. There is also an expressway mode. The instructors commented that novice riders do not see hazards in the scenarios but experienced riders do. The hazards include other vehicles, pedestrians and bicycles. There are no road surface hazards such as potholes.

The simulator is programmed to perform as a CB400, as a 750 or as an automatic scooter with a 60 km/h limit.

It takes about 10 minutes for riders to become accustomed to the simulator. Some problems with simulator sickness arise with trainees who spend more than 15 minutes at a time on the simulator.

4.3 CONCLUSIONS

The research examining the effectiveness of rider training programs has generally produced disappointing results, suggesting that training may not lead to a decrease in crash incidence. This may be because the rider training programs currently in use focus mainly on the development of vehicle control skills, rather than hazard perception. However, much of the research is lacking in the control of other variables or there are questions as to the suitability of the evaluation methods.

Some of the training research has become somewhat dated and has not kept up with new training techniques such as Regan's (1999) hazard perception training CD-ROM or other technological developments in areas such as simulators. Bailey (1994) says that while driver training in conjunction with simulator time has been found to be neither more or less effective than on-road training, this may not be the case as simulators become more realistic. Regan's CD-ROM is designed for novice car drivers. With the differences between motorcycle riding and car driving there is a question as to whether any benefit from such initiatives can be generalised to riding, however the possibility exists to design a motorcycling-specific product.

There may be some benefit to a range of training strategies. Most jurisdictions offer either compulsory or voluntary short rider training courses. In the New Zealand rider licensing system the time the rider is under riding restrictions is shortened by half if a sanctioned, professional course is undertaken. Courses might be tailored where necessary to include some hazard perception skills. There may also be a place for a riding-specific multimedia program and other classroom training using videos. There needs to be an evaluation of the degree of realism required for simulators to be effective. Perhaps video presentation technology is sufficient without the full immersion of such devices as the HART simulator. This would make such technologies more affordable for mass production and allow it to be used for all novices.

5.0 HAZARD PERCEPTION TESTING

In 1996 VicRoads introduced the Hazard Perception Test (HPT) as a requirement for gaining a driver's licence in Victoria (Fitzgerald & Harrison, 1998). The HPT is a multimedia presentation that incorporates video-footage of traffic scenes. The novice has the driver's view of the scene and touches the screen when they feel that "their" vehicle should change speed or commence a manoeuvre in order to avoid a crash. The situations presented to the candidate currently involve following distance, safe gap and visual scanning.

According to Congdon and Cavallo (1999), the HPT is one of the first tests of its kind designed to assess the hazard perception abilities of novice drivers. There are other tests such as the Shell (UK) Driver School HPT that shows a video clip and requires novices to identify the hazards (Bailey, 1994), but no other examples have been found of a test with the level of sophistication of the VicRoads HPT.

Congdon and Cavallo (1999) examined casualty-related crash data where the HPT scores of any of the individuals were known. They found that drivers with lower scores on the HPT were more likely to be involved in crashes within the first 18 months following their licensure (driving time or distance travelled was not found to differ between the groups). Experienced drivers have also been found to perform better on the HPT than inexperienced drivers (Hull & Christie, 1992, cited in Congdon & Cavallo, 1999).

The HPT does not directly measure skills such as attentional control or time taken to detect a hazard, and is actually more a test of risk than hazard perception according to the definitions suggested earlier. There is also a "primacy of expectancy" effect (Evans, 1991, cited in Bailey, 1994), where it is to be expected that reaction times may be shorter for those individuals who have primed themselves for the test. Once driving on the road it is unlikely that the drivers will maintain the same level of alertness for hazards as they did while completing the HPT. Another criticism is the relatively narrow range of the categories of hazards that a driver may encounter on the road. However, despite these concerns, the HPT does seem to be an indicator of likely crash involvement and was designed on the basis of road crash data.

Fitzgerald and Harrison (1998) interviewed 50 professional driving instructors and found that their attitude towards the test was neutral overall. A majority of the instructors had not changed their teaching methods subsequent to the introduction of the test. While many criticised the test for its artificiality, some suggested that the concept was worthwhile and the test only needed improvement (improvements to the initial test are in progress).

While the HPT may prove useful in testing car drivers for hazard perception skills, there is a question as to whether it would prove useful for motorcycle riders. In the Netherlands a licensing system for moped riders is being instituted that uses a slide-based test (Wijnolst, 1995), but there does not seem to be an equivalent of the HPT specifically for motorcycle riders.

The relationship between HPT score and crash involvement for car drivers mentioned earlier would not necessarily generalise to motorcycle riders. A rider's score on the British Motorcycle Operators Skills Test (MOST) was not found to predict a rider's total number of crashes, their number of reportable crashes (those that resulted in a certain amount of property damage), or the number of crashes recorded in the rider's police file (Chesham, et al., 1993). Age and exposure were the only predictors in all three categories. However, Chesham et al. suggests that it is not youth per se that is critical, but the attitudes that typically go with it.

Christie, Cummins, Fabre, Harrison, Hill, Johnston, Newland and Robertson (1998) describe the design and testing of a new full licence test (FLT), introduced in May 1999 as part of New Zealand's graduated licensing scheme. The test was designed based on the crash profile of novice New Zealand drivers and a search of international practice. The crash profile was similar between novice car drivers and novice motorcycle riders in that there were greater problems with left/right turns, U-turns and loss of control (perhaps due to speed control) than for more experienced drivers. The FLT was designed to assess cognitive factors such as hazard perception, gap selection, and higher speed zone driving on both straight and curved roads.

The FLT is carried out in real traffic conditions and consists of three parts. The first part is a basic drive to ensure that the candidate has very basic driving skills. Part 2 is "detecting and responding to hazards in built up areas", and is 15 minutes in duration. Part 3 goes for 20 minutes and is in higher speed zones. In Part 2, as the candidate approaches a particular driving situation the tester asks them to note and remember all of the hazards they see as they perform a particular driving manoeuvre. They then pull over and describe the hazards and how they responded to them – this must match the tester's assessment of the situation. Part 3 is similar except that the speed zones are higher (70-100 km/h) and they must describe the hazards and how they are responding at the same time as they negotiate the situations. The FLT motorcycle test is also split into three parts, where the only major difference between it and the car test is that the rider is followed by the tester in another vehicle. The authors suggest the use of voice-activated communications between the candidate rider and the assessor.

The test was trialed with car drivers and motorcycle riders, but not analysed separately (only 5 riders participated in the testing). The FLT received a positive response from the testers, candidates and seemed to have a good degree of reliability and validity.

6.0 STAGE 2 - RE-EXAMINATION OF CRASH DATA

A limited re-examination of crash data was undertaken to identify specific rider and crash characteristics that relate to deficiencies in hazard perception and responding. This needs to be based on detailed data, rather than mass data. For this reason, analyses were undertaken of the data collected for the Case-Control Study of Motorcycle Crashes (Haworth, et al., 1997). This study compared injured riders and pillion passengers from 222 crashes in Melbourne, with 1200 motorcyclists riding through the crash sites at the same time of day and week.

6.1 MEASURING RIDER EXPERIENCE

Information was collected about how many years the rider had been riding (experience) and how often and far the rider usually rode (exposure).

The number of years of on-road riding experience varied from 0 to 40 for cases and from 0 to 41 for controls. After adjusting for the greater tendency of more experienced riders in crashes to have positive BAC readings, there was a statistically significant reduction in crash risk as a function of years of on-road riding experience. The magnitude of the reduction was small, however, equating to a rider with ten years experience having about a 25% lower risk than a rider with one year of on-road riding experience.

In order to examine the issue of inexperienced riders who are not novices, Haworth et al. (1997) defined inexperienced riders as those who had ridden on the road for less than three years or who rode less than three days or less than 100 kilometres per week. Overall, 55% of crashed riders and 45% of control riders were inexperienced (see Table 1). As expected, most riders aged under 25 were inexperienced, but 50% of crashed riders (and 30% of control riders) aged 35 and over were also inexperienced. The analyses showed that 40% of fully licensed riders in crashes and 37% of fully licensed control riders were inexperienced. While inexperience was widespread, none of the odds ratios for this factor showed a statistically significant increase in crash risk.

6.2 CONTRIBUTORY FACTORS TO CRASHES

The Motorcycle Consultant reviewed the cases and identified several common contributory factors to crashes: failure to respond, ineffective braking, inappropriate positioning and mechanical faults. Failure to respond could be considered to have a large component of failure of hazard perception.

Table 1. Percentages of crash-involved and control riders of different age groups according to riding experience and exposure.

Age group	% ridden less than 3 years	% ride less than 3 days per week	% ride less than 100 km per week	% inexperienced
Crash-involved				
Under 21	84.0	34.6	32.0	84.0
21-24	56.4	26.2	13.3	65.1
25-34	21.9	28.1	23.5	40.6
35-44	14.7	32.4	15.2	44.1
45 and over	5.6	57.9	21.0	61.1
Total	35.0	32.4	20.7	54.9
Controls				
Under 21	82.4	13.3	17.6	94.1
21-24	49.1	26.4	24.5	60.4
25-34	24.9	22.0	18.3	47.0
35-44	7.4	20.2	13.8	28.7
45 and over	16.1	16.1	16.2	32.3
Total	25.8	21.4	17.9	45.3

For 94 crashes (42%) there was insufficient information available to judge whether any of these factors had contributed to the crash. Crashes were separately coded for whether excessive speed for the conditions had contributed to the crash. This was able to be coded for all crashes. Overall, 23% of crashes involved excessive speed for the conditions.

The contributory factors are summarised in Table 2. Ineffective braking was the most common contributor to crashes with excessive speed. Failure to respond was found in crashes without excessive speed only.

Table 2. Rider contribution to crashes with and without excessive speed for the conditions. Percentages are of known.

Rider contribution to the crash	Crashes with excessive speed (n=10)	Crashes without excessive speed (n=118)	All crashes (n=128)
Failed to respond	0	19	17
Ineffective braking	60	16	20
Inappropriate positioning	30	20	20
Mechanical fault	10	12	12
No rider contribution	0	34	31

Failure to respond was more common in multi-vehicle crashes than single vehicle crashes (see Table 3), as might be expected of a factor reflecting a failure of hazard perception. However, the proportion of crashes which were multiple-vehicle crashes did not differ between experienced and inexperienced riders (66.7% versus 69.3%, $\chi^2(1)=0.70$). Similarly, the pattern of type of crash (impact with object or vehicle, fell avoiding impact, and loss of control) did not vary between experienced and inexperienced riders (see Table 4).

Table 3. Rider contribution to single and multi-vehicle crashes. Percentages are of known.

Rider contribution to the crash	Single vehicle crashes (n=29)	Multi-vehicle crashes (n=99)	All crashes (n=128)
Failed to respond	3	21	17
Ineffective braking	41	13	20
Inappropriate positioning	3	25	20
Mechanical fault	28	7	12
No rider contribution	24	33	31

Table 4. Types of crashes involving inexperienced and experienced riders. Percentages are of all crashes by riders of that level of experience.

Type of crash	Inexperienced (n=101)	Experienced (n=84)	Total (n=185)
Impact with object or vehicle	69.3	70.2	69.7
Fell avoiding impact	4.0	2.4	3.2
Loss of control	26.7	27.4	27.0
Total	100.0	100.0	100.0

Failure to respond was a little more common in crashes of inexperienced riders than experienced riders but the difference was not large (13.9% versus 9.5%, see Table 5). Table 6 shows that no significant relationship was found between type of rider contribution to the crash and rider experience when single-vehicle crashes ($\chi^2(5)=2.06$, p=0.84) and multiple-vehicle crashes were examined separately ($\chi^2(5)=3.07$, p=0.69).

Table 5. Contribution to the crash by inexperienced and experienced riders. Percentages are of all crashes by riders of that level of experience.

Rider contribution to the crash	Inexperienced (n=101)	Experienced (n=84)	Total (n=185)
Failed to respond	13.9	9.5	11.9
Ineffective braking	8.9	9.5	9.2
Inappropriate positioning	14.9	9.5	12.4
Mechanical fault	6.9	7.1	7.0
No rider contribution	14.9	22.6	18.4
Unknown	40.6	41.7	41.1

Table 6. Contributions to single vehicle and multi-vehicle crashes by inexperienced and experienced riders. Percentages are of all crashes by riders of that level of experience.

Rider contribution to the crash	Inexperienced	Experienced	Total
Single vehicle crashes	(n=31)	(n=28)	(n=59)
Failed to respond	3.2	0.0	1.7
Ineffective braking	16.1	21.4	18.6
Inappropriate positioning	3.2	0.0	1.7
Mechanical fault	9.7	10.7	10.2
No rider contribution	9.7	10.7	10.2
Unknown	58.1	57.1	57.6
Multi-vehicle crashes	(n=70)	(n=56)	(n=126)
Failed to respond	18.6	14.3	16.7
Ineffective braking	5.7	3.6	4.8
Inappropriate positioning	20.0	14.3	17.5
Mechanical fault	5.7	5.4	5.6
No rider contribution	17.1	28.6	22.2
Unknown	32.9	33.9	33.3

6.3 RIDING STYLES OF EXPERIENCED AND INEXPERIENCED RIDERS

As part of their study, Haworth et al. (1997) asked crashed riders and control riders a series of questions about their riding skills and strategies. For other items in the questionnaire, there was evidence of socially desirable responding by crashed riders. Given that most of the questions related to riding skills and strategies were self-reported and unable to be verified, the decision was made to report this information for control riders but not riders involved in crashes.

While there were some differences identified, in general the riding styles and strategies adopted were similar across rider age groups, experience, licence status and training history. In general, younger and less experienced riders were more likely to report behaviours consistent with good hazard perception techniques than older and more experienced riders. The greater likelihood that younger riders, many of whom were not fully licensed, had completed at least one training course complicates the interpretation of the observed differences somewhat. Interpretation is also more difficult given the lack of ability to validate these self-report responses.

Younger riders more often looked behind over one shoulder, were more likely to travel in the safest position in the lane (the right-hand wheel track) and reported a higher number of near misses per month. Inexperienced riders were more likely to decrease speed when approaching an intersection, adopt a longer following distance, use the horn less and were more likely to have practised emergency braking and/or counter-steering in the last six months. Riders who had completed training courses more often looked behind over one shoulder, were more likely to change position to improve visibility when approaching an intersection, were more likely to travel in the safest position in the lane (the right-hand wheel track), were less likely to speed up in response to being tailgated and were more likely to have practised emergency braking and/or counter-steering in the last six months.

7.0 CONCLUSIONS AND FUTURE DIRECTIONS

The project has two aims:

- to investigate how hazard perception and responding is affected by level of experience as a motorcycle rider
- to assess the extent to which hazard perception and responding can be improved by specific training.

The sections which follow present the conclusions from Stage 1, the literature review and Stage 2, the re-examination of crash data, before discussing future directions for hazard perception training and testing for motorcyclists.

7.1 CONCLUSIONS FROM THE LITERATURE REVIEW

The vast bulk of the literature relating to hazard perception and its role in traffic safety comes from research undertaken with car drivers. The research shows that drivers with better driving records and older or more experienced drivers respond more quickly on hazard perception tasks. Studies using on-road and off-road methods have found similar results.

Other studies have shown that drivers with a high level of training perform better on hazard perception tasks than drivers with similar levels of experience, but little training. Specific hazard perception training, on-road or off-road, can improve performance on hazard perception tasks. Thus, at least some types of training may improve hazard perception abilities for car drivers.

However, a number of differences between motorcyclists and car drivers with respect to hazard perception were identified in the literature review. The first difference relates to the nature of the hazards and their likely consequences. Motorcycle riders are vulnerable to an additional class of hazards – road-based hazards – which are much less important to car drivers. There is also a need for riders to take account of the different performance characteristics of a motorcycle compared with a car and the lower levels of injury protection they have. The same physical hazard can result in much more severe injury consequences to a motorcyclist than a car driver. Thus, the relative importance of “threat to self” hazards may be much greater than “threat to other road users” hazards for motorcyclists than for car drivers.

The second difference between motorcyclists and car drivers with respect to hazard perception that was identified in the literature review is that the relationships between novice status, level of experience and age are somewhat more complicated for motorcycle riders. While age may reasonably be used as a proxy for driving experience for car drivers, motorcycle riders of the same age vary markedly in their riding experience. Thus the findings of studies showing hazard perception of car drivers improving with age may not necessarily generalise to motorcycle riders.

These issues are relevant to the interpretation of studies that have attempted to assess how much benefit experience as a car driver provides to novice motorcyclists. These studies vary in the extent of benefit they identify – from none to a substantial amount for some categories of rider.

It may be that hazard behaviour (perception plus response choice and execution) is more important for motorcyclists than hazard perception (relative to car drivers). Even with adequate abilities in hazard perception, deficiencies in decision making, execution skills and confidence may prevent the appropriate avoidance behaviour from occurring.

The literature review found very few visually-based tests that have been used in licensing in other parts of the world. A number of visually-based presentations have been used in research, however. A slide-based test for moped licensing has been developed in the Netherlands where motorcycling and moped riding are very common. Many of the other jurisdictions where powered two-wheelers comprise a large amount of traffic are less developed and have less developed licensing systems.

The issues of moving versus still representation of scenes and methods for testing hazard perception and responding has not been systematically explored. The literature shows that results from on- and off-road methods are consistently similar, but the off-road methods have used moving representations of scenes only.

Motorcycle simulation shows promise in the short-term as a research tool for the evaluation of different training programs with respect to hazard perception. The usefulness of the current Honda simulator is, however, limited by the available scenarios and the lack of road-based hazards. There is also a need to develop an appropriate scoring system for use in research. In the longer-term, PC-based simulations may be useful for motorcyclist hazard perception training.

7.2 CONCLUSIONS FROM THE RE-EXAMINATION OF CRASH DATA

A limited re-examination of crash data collected for the Case-Control Study of Motorcycle Crashes (Haworth, et al., 1997) was undertaken to identify specific rider and crash characteristics that relate to deficiencies in hazard perception and responding.

After adjusting for the greater tendency of more experienced riders in crashes to have positive BAC readings, there was a statistically significant reduction in crash risk as a function of years of on-road riding experience. The magnitude of the reduction was small, however, equating to a rider with ten years experience having about a 25% lower risk than a rider with one year of on-road riding experience.

In order to examine the issue of inexperienced riders who are not novices, Haworth et al. (1997) defined inexperienced riders as those who had ridden on the road for less than three years or rode less than three days or less than 100 kilometres per week. While inexperience was widespread (40% of fully licensed riders in crashes and 37% of fully licensed control riders), this factor was not associated with a statistically significant increase in crash risk.

Failure to respond was more common in multi-vehicle crashes than single vehicle crashes, as might be expected of a factor reflecting a failure of hazard perception. However, the proportion of crashes which were multiple-vehicle crashes did not differ between experienced and inexperienced riders. Similarly, the pattern of type of crash (impact with object or vehicle, fell avoiding impact, and loss of control) did not vary between experienced and inexperienced riders. Failure to respond was a little more common in crashes of inexperienced riders than experienced riders but the difference was not large.

As part of their study, Haworth et al. (1997) asked riders a series of questions about their riding skills and strategies. In general, younger and less experienced riders were more likely to report behaviours consistent with good hazard perception techniques than older and more experienced riders. The greater likelihood that younger riders, many of whom were not fully licensed, had completed at least one training course complicates the interpretation of the observed differences somewhat. Interpretation is also more difficult given the lack of ability to validate these self-report responses.

7.3 FUTURE DIRECTIONS FOR HAZARD PERCEPTION TRAINING AND TESTING OF MOTORCYCLISTS

There is a need for future research to answer the following questions:

- Is there a need for a specific hazard perception test for motorcyclists?
- What should be the aims of a motorcycle-specific hazard perception test?
- If hazard perception training and testing for motorcyclists were to be developed, what would be the most effective and feasible format of presentation, what type of scenarios should be presented and what role in the licensing system should it play?

7.3.1 Is there a need for a specific hazard perception test for motorcyclists?

There is an argument that a specific hazard perception test for motorcyclists need only be developed if the current HPT for car licence applicants does not adequately test hazard perception for motorcyclists, or if motorcycle licence applicants have not undertaken the test.

Currently, applicants for a motorcycle licence do not have to pass the HPT, unlike applicants for a car licence. In reality, most of the applicants for a motorcycle licence already hold a car licence and those who have obtained their car licence recently would have passed the HPT. However, some new applicants for motorcycle licences received their car driving licence before the introduction of the HPT and so have never sat the HPT.

No evidence exists that relates performance on the HPT with later motorcycle crash involvement. Collection of such information would be difficult given the relatively small number of motorcycle crashes that would occur within a short period of undertaking the HPT. It would be difficult to infer that differences in crash involvement were related to HPT performance if the time between taking the test and the crash was substantial. In addition, there would be a need to control for extraneous factors affecting crash involvement, such as amount and type of riding.

An alternative approach would be to measure the relationship between performance on the HPT and hazard perception as a motorcyclist using a laboratory-based technique. The Honda motorcycle simulator might be useful as a device for testing motorcyclist hazard perception.

Regardless of the methodology used to examine the relationship between HPT score and later involvement in motorcycle crashes, if a strong relationship were found, it could be argued that the current HPT was adequate for assessing hazard perception ability for motorcyclists. If no strong relationship was found, then the need for a motorcycle-specific hazard perception test should be further examined.

7.3.2 What would be the aims of a motorcycle-specific hazard perception test?

A possible aim for a motorcycle-specific hazard perception test would be to predict subsequent crash involvement and attempt to screen out those whose performance is unsatisfactory. This may not be feasible if a test with such predictive validity cannot be developed or if the test cannot be implemented for a variety of non-technical reasons.

An alternative is that a motorcycle-specific hazard perception test be developed, not as a screening instrument, but as an incentive for training to focus on hazard perception. The literature review has shown that hazard perception training has the potential to improve hazard perception and thus has the potential to improve the safety of riders. There is less evidence that hazard perception tests, per se, are effective in reducing crashes.

7.3.3 What would be the most appropriate format, content and role in the licensing system?

Format of presentation

The issue of moving versus still representation of scenes and methods for testing and training in hazard perception and responding has not been systematically explored. From a theoretical base, still photographs or representations would be unlikely to be effective because the speed and direction of movement are important determinants of whether a particular object is likely to be a true (or perceived) hazard. In addition, it is not just the ability to identify the hazard but the speed with which this can be done in a dynamic environment that is important for successful hazard perception.

Car driver hazard perception research has found similar results whether on-road or off-road methods were used. The extent of realism needed for motorcyclist hazard perception testing and training is so far unknown. It may be that in motorcycle riding it is more important to integrate vehicle control and hazard perception activities and that any predictive test would need to incorporate both components. This issue could be tested by comparing judgments of the same scene on video and presented in the Honda simulator.

Content of motorcycle hazard perception training and testing

The literature suggests that there is a need to include scenarios involving road-based hazards in motorcycle hazard perception training and testing.

A hazard behaviour approach that combines detection of the hazard and selection of the appropriate response may be more effective than an approach that is limited to hazard perception alone. This still would not ensure that the rider would necessarily successfully implement the desired response in an on-road environment.

Structure of the licensing system

If a motorcyclist-specific hazard perception test is developed in the future, there would need to be consideration of how, when, where and to whom the test would be administered. Depending on the nature of the equipment used to present the test, the number of venues at which it could be administered might need to be limited. The timing of the administration of the test (and training) within the licensing scheme would depend to some extent on whether a learner permit is obtained and then a restricted licence or whether a combined test is undertaken. While there are many licensed riders who remain inexperienced, the application of the test is probably limited to those who are applying for a licence.

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