Hazard perception, attitudes and behaviours in riding

Based on :

Elliott & al. (2003). Motorcycle safety: a scoping study, TRL Report 581

Haworth & al. (2000). Hazard perception by inexperienced motorcyclists, Monash University Report 179.

1. Hazard Perception and risk taking

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.

1.1 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).

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. 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".

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.

1.1.1 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. 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. 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.

1.1.2.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.

1.2 Hazard perception and theoretical frameworks

1.2.1 Recognition primed decision making

According to Fitzgerald and Harrison (1999), hazard perception is a skill with cognitive and behavioural aspects that include cognitive workload, automation, and attention. 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 affect 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.

1.2.2 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. 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. 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.

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).

1.3 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.

It might be expected that lack of experience will be as important for motorcycle riders as it is for car drivers. 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.

The finding that the younger riders in the Schulz and Kerwien study were less able to perceive the situation imminent dangers in various traffic situations than older riders, suggests that there could be much of relevance in the growing literature on hazard perception in car drivers. Traditionally, driver and rider training has tended to pay more attention to control skills than to higher order cognitive skills such as those related to the anticipation, detection and assessment of hazards. Following an early study by Peltz and Krupat (1974), there has been much interest in hazard perception as a predictor of accidents at a theoretical level, but this has received only limited support at an empirical level. However, more recent studies based on relatively large samples have given some evidence of a link between hazard perception skills and accidents (Hull and Christie, 1993; McKenna and Horswill, 1999). Despite the interest in the topic regarding car drivers, only one instance could be found in the literature of an investigation exploring the hazard perception skills of motorcyclists. This was a recent study by Underwood and Chapman (1998), which compared the hazard perception skills of motorcyclists with those of car drivers, and hypothesised motorcyclists would have superior hazard detection skills. The results of this study suggest that motorcyclists have slightly faster reaction times in identifying hazards than car drivers, although there was no difference in the overall percentage of hazards identified. This might be explained by motorcyclists having slightly superior abilities, which come with mastering a less stable vehicle. In other words, the experience of riding a vehicle that places them more at risk of an accident may help motorcyclists to develop faster hazard identification skills. However, motorcyclists may also have slightly faster hazard identification skills owing to factors that caused them to choose to ride a motorcycle. The fact that many of the motorcyclists used in this study had experience of driving a car, while the car drivers had no experience of riding a motorcycle is a further complication when it comes to explaining why motorcyclists were found to have slightly faster reaction times to potential hazards.

In this context it is worthy of note that the Taylor and Lockwood (1990) study showed that experience of driving a car had a beneficial effect on the accident liability of motorcyclists. A further explanation of the faster reaction to hazards shown by motorcyclists might have to do with their internalised criterion of what constitutes a potential hazard. Because motorcycles are more difficult than cars to control in an emergency, and because motorcycle riders are much more vulnerable to injury than car drivers, it seems likely that a developing situation on the road will become a potential hazard for a motorcyclist (and require the motorcyclist to consider evasive action) sooner than would be the case for a car driver. 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).

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.

1.4 Risk Taking

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.

The literature on motorcycling and risk has mainly been concerned with *objective risk* rather than *perceived risk*, and there are only a limited number of studies relating to the perception of risk in motorcyclists.

Mannering and Grodsky (1995) pointed out the factors that may tend to bias an individual's perception of risk. These were:

- *Unwarranted optimism:* those who are more optimistic of their riding skill and likelihood of accident involvement are more likely to perceive a lower risk.

- *Anchoring bias:* this refers to tendencies to anchor risk estimates around the notion of overall risk based on riding experiences and general knowledge of overall accident risk. Therefore, involvement in training courses or previous accidents may be likely to affect estimates of perceived risk.

- *Availability bias:* this refers to the assessment of risk based upon disproportionate information. As a result, appropriate probabilities of risk may not be assigned to events which have been disproportionately experienced or recalled.

- *Deliberate under-estimates of risk:* this is the tendency to justify risk-taking behaviour by under-estimating risk deliberately.

- *Under-estimate the variance in accident risk:* this is the over-estimation of lower probability events and the under-estimation of higher probability events.

Another study by Leaman and Fitch (1986) asked 72 British motorcyclists aged between 17-28 years to estimate the risk of having an accident and the risk of being killed in an accident in the next two years. It was found that riders tended to under-estimate the probability of an accident, but riders who knew someone who had suffered a serious motorcycle accident perceived a higher risk of being involved in an accident themselves than riders who did not. For perceived fatality risk, however, it was found that riders over-estimated the risk compared with the national statistical probability. In addition, perceived fatality risk was directly related to the participants' own yearly accident rate, their total number of accidents, and the knowledge of someone involved in a serious accident. From their results, Leaman and Fitch suggested that prior knowledge of a serious accident is the single most important factor in motorcyclists' perceptions of risk. This is supported by Chesham *et al.* (1992) who surveyed motorcyclists' beliefs and behaviour using the Theory of Reasoned Action and the Health Belief Model and found that the only predictor of perceived risk was whether the rider had known a friend or relative killed in a motorcycling accident.

Other studies related to the perception of risk have come from Germany. One, by Rheinberg *et al.* (1986), interviewed 105 male motorcyclists aged between 18-55 years of age. They were able to differentiate between 'sporty-risky' riding styles and 'defensive' riding styles based upon a factor analysis of various scales on which participants rated their own manner of riding. They found that in comparison with motorcyclists with defensive behaviour, motorcyclists with sporty behaviour tended to give a lower assessment of the general probability of accidents, the probability of having an accident oneself and the probability of serious consequences as a result of an accident.

Another study, by Schulz and Kerwien (1990), used 129 male motorcyclists who were shown videos of 14 traffic situations. The results showed that riders in the younger age group (18-20 years) were less able than older drivers to perceive the situation-imminent dangers in all traffic situations. The attractiveness ratings for risky behaviour showed that younger motorcyclists attributed a higher value to the benefits of dangerous behaviour than did older riders. This greater acceptance of risk by the younger age group was explained by the finding that younger motorcyclists were of the opinion that they are expected to behave in a risky manner by other drivers in their peer group. In other words, the behaviour of younger riders was largely determined by *role expectations*. On the other hand, it was also found that younger riders regarded their own behaviour as a standard for other riders. Schulz and Kerwien (1990) suggested that these findings provide evidence that acceptance of risk can be traced back to a psychological cost-benefit calculation between attractiveness and dangerousness. In other words, risk acceptance in motorcyclists depends upon the degree of incentive to behave in a risky

manner and the degree of estimated danger, with risky traffic behaviour being caused by high positively valued attractions and by too low an assessment of the danger.

2. Attitudes and motivations

2.1 Motivations

2.1.1 Fifteen motivational factors

Schulz *et al.* (1991) suggested that there are twelve significant motivational aspects of motorcycle riding. In addition to these, a further three motivations for motorcycle riding can be found in the literature. The fifteen are described briefly as follows:

- Hedonism

For many riders, motorcycling is coupled with positive emotions such as joy, fun and pleasure. The desire for pleasurable experiences from motorcycling has been labelled hedonism (Battmann, 1984; Koch, 1990). Schulz *et al.* (1989) found that in a sample of 202 German motorcyclists, hedonism motives were the most influential of all the motivations investigated. Similarly in the UK, Hobbs *et al.* (1986) found that the majority of riders in their sample stated that their main motivation for riding was the enjoyment they obtained from the activity.

- Escapism

Motorcycle riding can involve a flight from everyday reality or an escape from civilisation (Nowak, 1979). The escapism motive includes aspects such as self-discovery, putting oneself in a good mood, forgetting everyday worries and 'letting off steam'. Schulz *et al.* (1989) found that some riders believed that it was important to achieve an empathy with the bike, to be in touch with nature and one's surroundings, to experience freedom and to 'let off steam'.

- Dynamic aspects of biking

Motivations relating to this category are the experience of acceleration, speed, power, mobility and cornering and they are related to the physics of the motorcycle (Rheinberg *et al.*, 1986; Schulz *et al.*, 1989).

- Performance aspects of biking

This is linked to the sporting side of riding and includes the motives to master the vehicle and cope with the physical and psychological demands of riding, and also testing the performance limits of oneself and the machine (Rheinberg *et al.*, 1986; Schulz *et al.*, 1989). Other research by Walters (1982) found that rider enthusiasts were motivated by riding a motorcycle to its full capability. It may also be expected that such riders choose to ride sports type motorcycles due to the importance they place on the performance motives.

- Exhibition riding

This motivation implies that competent riding is not always a 'self-fulfilling goal' and a certain amount of showing-off is intended, particularly when riding is viewed as a sport. Brendicke (1991) found that younger riders were more likely than older riders to state that they like to perform their riding skills in public. He suggested that motorcycle riding offers a possibility, especially for younger riders, to demonstrate riding skills to other road users. He also pointed out that the demonstration of riding skill in-traffic can be associated with a high exposure to risks due to extreme ways of riding.

- Rivalry

Motivations relating to this category include being faster and better than others. Schulz *et al.* (1991) state that this competitive nature is linked to the performance motive and the sporting nature of riding. In addition, the permanent need to assert oneself against other road users has been attributed to some riders of motorcycles (Dellen and Bliersbach, 1978; Brendicke, 1991).

- Thrill and adventure seeking

Such motivations are associated with a need to seek out risky situations and activities and to experience a subjectively optimal and pleasant state of physiological arousal (Zuckerman, 1984). Researchers have suggested a link between the dynamic aspects of motorcycle riding and thrill seeking (Dellen and Bliersbach, 1978; Brendicke, 1991). In addition, thrill seeking has been found to

be associated with younger age groups. Hobbs *et al.* (1986) found that 81% of riders in their sample believed that there is a thrill in motorcycle riding and 66% believed that motorcycling could sometimes be frightening. Although motorcyclists generally believe that there is a thrill in riding a motorcycle, the thrilling aspect may not be directly related to risk taking. Hobbs *et al.* (1986), for example, found that although a large proportion of motorcyclists agreed that there is a thrill in motorcycling, 72% disagreed with the statement, 'you have to take your chances when riding a bike'. One possibility here is that the thrill comes from perceived mastery of risks by ones own skill (see Control Beliefs below).

- Flow effects

Riders can be motivated to achieve 'flow states' where 'attention is narrowed down to a limited field, the self loses meaning, nothing disturbs the flow of action and complete control over the course of events seems to be present in highly practised, intrinsically motivated and competently executed activities' (Csikszentmihalyi, 1988). Hobbs *et al.*, (1986) found that 87% of riders agreed with the attitude statement: 'I like to feel part of the machine which I am riding', and this applied to both younger and older riders. While finding that younger riders were more motivated to achieve flow states compared to older riders, Brendicke (1991) found that older riders were also highly motivated.

- Identifying with the bike

For some riders, the motorcycle becomes an important part of their lives. Brendicke (1991) found that many riders have had 'a lot of good experiences with their bike and it is a good friend to them'. Hobbs *et al.* (1986) found that 62% of riders believed that riding is a way of life. The motivation to increase self-esteem has been attributed to such riders (Dellen and Bliersbach, 1978) and it has been suggested that this is particularly the case for young adolescent age groups who use the motorcycle to compensate for uncertainties in their developing years (Schulz *et al.*, 1991), while for older age groups they may be using the motorcycle to regain their youth and the experiences which they had when riding at an earlier age (the 'born-again bikers' effect).

- Safety behaviour

These are motives that are directed to gains in safety through active behaviour such as wearing protective equipment or efforts to safe riding behaviour in traffic. Schulz et al. (1989) found that defensive riding was rated as important by riders of touring machines compared to riders of normal, sport, enduro and chopper motorcycles.

- Control beliefs

The motive of control is attributed to riders who believe their riding qualifications are perfect. These people believe that they can control themselves, the vehicle, other road users and the situation all of the time. Schulz and Kerwien (1990) suggested that control beliefs may be rooted in an over-estimation of capabilities, and pointed out that such unrealistic control beliefs can be partially counteracted by safety motives.

- Social aspects

These motives derive from the desire to form part of a group and the involvement in group activities (e.g. conversations on biking). Schulz (1990) found that motorcycles play an important role in the social status of juvenile riders and the motorcycle is a linking element within the peer group. Also, Brendicke (1991) found that many riders ride a motorcycle in order to spend more time with people with similar interests, and this applied to both younger and older riders. Brendicke (1991), therefore, suggests that motorcycle riding offers an opportunity for social contacts, the motorcycle itself serving as an instrument of contact, a common basis and topic for discussion.

- Economic aspects

Economic reasons appear to be strong motivators to ride motorcycles. Many motorcyclists express the view that they ride motorcycles because they are cheap to run. Hobbs *et al.* (1986) found that 67% of their sample stated economy as a motivation to ride motorcycles. Economy motivations were more pronounced among young female, compared to young male riders, and featured highly among females of all ages, whilst for male riders, economy motivations were more pronounced among older male riders compared to younger male riders. It should be noted that trends in motorcycle use, i.e. with increasing use of larger engined bikes for recreational rather than utilisation purposes, appear to indicate that economic aspects today are rather different from what they were in 1986.

- Independence

Hobbs *et al.*, (1986) showed that 39% of riders gave independence as a motive for riding a motorcycle. As a motive, independence seems to apply to female riders more than male riders. In addition, there seems to be no effect of age in independence motives for female riders, whilst for male riders there is an age effect with younger males being more likely to express independence as a motive compared to older males.

- Convenience

For some motorcyclists convenience motives form their perception of motorcycling. Such motives include 'easy to park' and 'manoeuvrability in traffic'. Hobbs *et al.* (1986) reported that 36% of riders mentioned 'easy in traffic' (manoeuvrability) and 34% expressed 'easy to park' as motives for riding. Convenience motives were more pronounced in riders over the age of 25. Walters (1982) also showed that this was one of the main advantages for groups of 'practical riders'.

2.1.2 Classifications of motivations

Two investigations have found that the motivations of motorcycle riders can be grouped into three distinct categories. In the first, Schulz *et al.* (1991) conducted a survey of 376 motorcyclists' motivations to ride. Items on the survey questionnaire measured the scales of escapism, hedonism, flow, identification with the bike, social aspects, dynamic aspects, performance aspects, exhibition riding, thrill seeking, rivalry, control beliefs and safety behaviour. Inter-correlations between the scales showed that these 12 motivational aspects could be grouped into three broad categories:

1) biking for pleasure (escapism, hedonism, flow, identification with the bike, social aspects);
2) biking as a fast competitive sport (dynamic aspects, performance aspects, exhibition riding, thrill seeking and rivalry); and
3) control over the motorbike (control beliefs and safety behaviour).

Their analysis of rider motivations by age and type of motorcycle revealed that:

- Analysis by age:

- Younger riders were more influenced by riding pleasure (with the exception of social aspect where there were no significant differences).

- Younger riders were more influenced by exhibition riding, rivalry and thrill seeking motives compared to older age groups. However no significant age effects of dynamic aspects or performance aspects.

- Younger riders were less influenced by safety behaviour motives compared to these other motives and compared to older drivers.

- Younger riders had weaker control beliefs than older age groups.

- Analysis by motorcycle type:

- Riders with specialised motorcycles (choppers, sport bikes, and enduros) were more motivated in driving for pleasure.

- Riders of sports bikes were more influenced by dynamic aspects and exhibition motives compared to riders of other motorcycle types.

- Riders of sports bikes and enduros were more influenced by performance aspects and thrill and adventure seeking compared to riders of other motorcycle types.

- Riders of sport and touring bikes had higher control beliefs compared to riders of other motorcycles.

The conclusions drawn from this study were that the type of bike chosen by riders provides clear information on the bikers' motives, the experiences they seek and their concept of riding. However, Schulz *et al.* (1991) pointed out that this is only the case when riders can choose the bike they want (i.e. they may have constraints placed upon their choice of bike – such as money) and, therefore, a variability in the motives within each group (machine type) has to be assumed. One implication is that persuasive communications, tailored to the motivational requirements of the general rider of each motorcycle type, could be provided when buying a motorcycle in an attempt to encourage safe riding behaviour. Other interventions, such as large scale media campaigns, could also be tailored to the motivational requirements of riders of particular motorcycle types.

The second investigation that grouped riders motivations into categories was a study by Walters (1982), who conducted 100 in-depth interviews of motorcyclists in Wales to investigate their motivations and attitudes towards riding. She found that 35% of the sample could be classified as those who use a motorcycle for practical reasons, 48% could be classified as those who were enthusiasts and ride for pleasure and 10% could be classified as irresponsible and whose behaviour was considered by others to be immature and irresponsible. Only 7% of the sample could not be classified by these categories.

Motorcyclists who used a motorcycle for practical reasons perceived the main advantages to be economical to run and convenient to use and park. This group of riders was mostly female, and tended to ride smaller bikes for the purpose of short journeys and for travelling to and from work. In addition, such riders disliked the level of arousal generated in the course of riding, and tended to be cautious in their approach to riding in terms of their handling and their use of speed.

Motorcycle enthusiasts were likely to be younger riders, who used their motorcycles for work and also pleasure, and older riders, who had ridden a motorcycle for a long period of time and typically owned a car as an alternative mode of transport. Enthusiasts were found to accept the risk involved in riding, but unlike practical riders, tended to perceive it as a challenge rather than a deterrent. They were motivated by the excitement, exhilaration, and sense of freedom and control which they believed could not be obtained from driving a car. Riders in this category also claimed to be confident in their ability to handle the motorcycle correctly.

Irresponsible riders were found to have a lack of awareness of the risk in motorcycling, were overconfident, and perceived themselves as 'invincible'. Gaining attention, excitement and independence were cited as motivations to behave in such a manner. Such riders were young, typically 17-18 years old. Walters (1982) suggested that training for these riders may be dysfunctional, since making safety rules more explicit may cause these young riders to deliberately set out to break them.

2.2 Attitudes towards countermeasures

2.2.1 Leg protectors and protective clothing

Research suggests that motorcycle riders tend to have negative attitudes towards the use of leg protectors. A survey of 600 motorcyclists in Great Britain by Gosnell (1990) found that 37% of riders 'would choose to use leg protectors' compared to 51% who would not. Of those saying they would use leg protectors most were older riders (25 years +), female riders, and inexperienced motorcyclists with less than 1 years riding experience. Concerning protective clothing, Walters (1982) found that 48% of her sample of 100 motorcyclists could be classified under a category called 'rider enthusiasts' who believed that wearing leathers as a means of protection was an acceptable part of maintaining their 'self-image'. On the other hand, measures such as reflective clothing (see below) were perceived as detracting from their self-image.

2.2.2 Conspicuity devices

A study by Ravinder (1988) surveyed 496 active motorcyclists in Sydney, Australia and found 91% of motorcyclists believed that 'one of the most important aspects of safe riding is to ensure that the motorcyclist is visible'. However they disagreed about the relative usefulness of various conspicuity devices. Most riders (83%) believed that daytime running lights would increase their conspicuity and 85% believed that given the appropriate legislation they would always use daytime running lights. Similar results were reported by Gosnell (1990). It was found that 68% of riders and 80% of riders over 35 years stated that all new machines should be fitted with daytime running lights. However, fewer riders agreed with wearing reflective clothing, with 59% of riders (74% of older riders) stating that all riders should wear reflective clothing. Hobbs *et al.* (1986) reported different results. More motorcyclists (79%) believed that 'bikers should wear clothing which makes them easily seen' than believed that 'motorcyclists should use their headlights in daylight' (57%). A study by Walters (1982) found that 35% of the sample of 100 motorcyclists could be classified under a category called 'practical riders'. Such riders cited lack of conspicuity as a cause of accidents. In addition, 48% of the sample could be classified under a category called 'rider enthusiasts' who acknowledged that while reflective clothing was 'a good thing', they refused to wear it themselves because it was perceived to be 'silly' or because

it detracted from the individual's 'self-image'. However the use of dipped headlights as a means of conspicuity was perceived to be an acceptable part of maintaining the 'self-image' for these riders.

2.2.3 Rider training

As mentioned above, Walters (1982) found that 44% of 'practical riders' had received formal training and perceived it as being beneficial. Among the riders who had not received any training, there was an appreciation that it would be beneficial. 75% of 'rider enthusiasts' believed that experience is the important factor in developing safe riding behaviour and that it is difficult to teach such safe behaviour through training. Only 16% of these riders had experienced any formal training and many had received informal training from friends and/or relatives. A minority of 'rider enthusiasts' believed that training could be useful, but only for the case of the '17 year old who is learning to ride and is irresponsible'.

Hobbs *et al.* (1986) also assessed what motorcycle riders believed should be in a motorcycle training course for novice riders. The results suggest that the development of road safety, motorcycle maintenance and machine control skills are thought of as important. Nolen and Gregersen (1989) report similar results. They found in a survey of 662 randomly chosen owners of motorcyclists in Great Britain, aged 18-25 years, that 75% had never participated in any form of further training for motorcyclists. Despite this, most had positive attitudes towards the effects of extension courses on road safety. The intention to participate in extension courses was found to decrease with increasing fee.

2.2.4 Legislation

Walters (1982) found that 'practical riders' tended to comply with traffic law and the rules of safe riding. When such rules were broken, these riders said the main reason was to reduce anxiety (e.g. break the speed limit to reduce the anxiety of being late for work). 'Rider enthusiasts' had attitudes which condoned speeding through busy urban areas but not on long straights of motorway road. Riders breaking traffic rules in this category reported that they did so to generate a feeling of excitement. Rider enthusiasts also acknowledged the importance of courtesy and correct riding procedures as a factor in safe riding, but they reported instances of breaching such practices.

Gosnell (1990) found that, in general, motorcyclists did not believe that they 'are being legislated off the road'. Older riders and female riders were more likely to agree with the law than younger riders and male riders. Hobbs *et al.* (1986) found that riders' attitudes towards police and legislation were largely positive. Age comparisons in the Hobbs *et al.* (1986) study showed that for all items regarding the police and legislation, younger riders (<19 years of age) had more negative attitudes. These negative attitudes towards the police and legislation may possibly be attributed to younger riders' desire to rebel against authority.

Research on attitudes to violations has shown that compared to older riders, younger riders appear more likely to believe that having fun is a benefit of law and rule breaking behaviour, and less likely to perceive the risk of an accident as a barrier (Rutter *et al.*, 1995). Gender also seems to have a significant effect, with males reporting fewer negative views concerning the outcomes of drinking and driving and speeding than for females. Gender has also been found to be mediated by beliefs about taking care, with males being more likely than females to have negative beliefs. In addition, males are less likely to perceive feeling safe as a benefit of law and rule breaking compared to females and perceive risk of an accident as a barrier (Rutter *et al.*, 1995).

2.2.5 Attitudes about motorcyclists and other road users

Little research has been conducted into the attitudes and perceptions of motorcyclists towards motorcyclists. One study, Walters (1982) found that 'practical riders' had unfavourable attitudes towards group riding whilst 'rider enthusiasts' were more likely to favour group riding, perceiving this as part of the social element of riding. Such issues were also investigated by Hobbs *et al.* (1986). They found that riders were likely to support motorcyclists in general.

The small amount of research that has examined motorcyclists' attitudes to other vehicle road users generally shows that riders believe drivers of other vehicles are inconsiderate to motorcyclists on the road. Hobbs *et al.* (1986) found that most motorcyclists in their sample (70%) believed that

'Motorists are inconsiderate to bikers'. Age group comparisons showed a significant effect : very few teenagers held a favourable attitude towards the behaviour of some car drivers. Walters (1982) found that 'practical riders' and 'rider enthusiasts' both commonly believed that the main causes of accidents stemmed from the behaviour of other road users. They tended to claim that a number of potential accidents arose from motorists who do not provide sufficient room for motorcyclists when they have to avoid obstacles on the road (e.g. parked cars). Also, they expressed that no matter how careful they were while riding, they were highly susceptible to accidents because of the behaviour of other road users. They believed that accidents could be avoided if other road users were made more aware of the vulnerability of motorcyclists and exercised more care.

'Practical' motorcyclists also perceived riding to be hazardous and many stated that they did not ride in the winter months and that in poor weather conditions they use other modes of transport. Also, they perceived the hazards involved in riding as anxiety provoking and this was cited as a reason for changing modes of transport in the near future.

2.2.6 Attitudes towards accident involvement

Walters (1982) found in Wales that 'practical riders' and 'rider enthusiasts' believed that accidents stemmed from the behaviour of other road users. In addition, speed, human error and bad road surfaces were cited by such riders as a cause of accidents. However, for rider enthusiasts, speed itself was not perceived as a major cause and it was a typical attitude that they could ride fast but safely. Rider enthusiasts also believed that the majority of motorcycle accidents are the result of lack of experience on the part of the rider and their accident rates showed that most of their accidents occurred in their early stages of learning to ride. Related to this finding was that 'trial and error' was an important part of learning to ride rather than training.

Hobbs *et al.* (1986) study conducted in Great Britain also assessed attitudes towards motorcycle accidents, specifically accident avoidance. These results suggest that about half of riders believe *only they* can take responsibility to reduce their own accident risk, a large amount also believed that other road users have a responsibility. Both older and younger riders take responsibility to reduce *their own* accident risk, but younger riders are more likely to believe that it should not be the sole responsibility of motorcyclists to avoid accidents and other road users should take into consideration motorcyclists vulnerability. This is supported by the findings of Schulz and Kerwien (1990) who found that owing to younger riders under-estimating the dangerousness of a variety of traffic situations and over-estimating their control capabilities, they tended to think that the responsibility for a potential accident rests with other drivers and not themselves.

3. Attitude-behaviour models

3.1 Theoretical models

The theoretical models that have been used most extensively in motorcycling research are the Theory of Reasoned Action (TRA) of Fishbein and Ajzen (1975), its recent extension, the Theory of Planned Behaviour (TPB - Ajzen, 1988), and the Health Belief Model (HBM) of Becker and his colleagues (Janz and Becker, 1984).

The Theory of Reasoned Action provides a conceptual and empirical account of the relationships between beliefs, attitudes, intentions and behaviours. The theory predicts that a person's *intention* to perform a behaviour is the immediate determinant of that action. The stronger the intention to engage in a particular behaviour, the more likely it is that the behaviour will be performed. The TRA posits that behavioural intentions are a function of two basic components:

- *attitude towards the behaviour* – this is viewed as a personal factor and it is determined by what the individual believes the outcome of performing the behaviour will be (behavioural beliefs) and the positive or negative evaluation of those outcomes (outcome evaluation).

- *subjective norms* – these are a social influence and they are the person's perception of the social pressures put on him to perform or to not perform the behaviour in question (normative beliefs), weighted by their motivation to comply with these normative beliefs.

The TPB extends the conceptual framework of the TRA to include a further component:

- *perceived behavioural control* – this is the perceived ease or difficulty of performing the behaviour and reflects the perceived likelihood of encountering inhibiting and facilitating factors (control frequency beliefs) weighted by the perceived power of those factors to facilitate or inhibit behaviour (control power beliefs).

Work by Parker and associates (Parker *et al.*, 1995) has developed the model further by adding the aspects of personal norm, affect, habit and personal identity to the theory's three core components, although this has only been used in studies of car drivers, not motorcyclists.

In the Health Belief Model it is proposed that safety related behaviours are accounted for by means of three belief 'dimensions': vulnerability, severity and benefits and barriers. Within the context of motorcycling, vulnerability is concerned with how likely riders believe they are to have accidents; severity concerns the perceived seriousness of the consequences of accidents; and benefits and barriers are the perceived rewards and costs of safe and unsafe riding behaviours.

Although the Health Belief Model offers a slightly different theoretical perspective than the TRA/TPB, a considerable degree of overlap between the two theories can be seen. Recent work on the Health Belief Model has led to the inclusion of three additional factors, locus of control; habit; and social support.

3.2 Attitude-behaviour modelling in motorcycle research

Although a large part of the research on attitude-behaviour modelling has focused on car drivers, psychological models have been used in motorcycle research to study safety helmet use, and the social psychological determinants of safe and unsafe motorcycle riding.

Allegrante *et al.* (1980) used the TRA to identify the attitudinal factors that predict behavioural intention to wear a helmet. They found that the TRA predicted 53% of the total variance in behavioural intentions to wear a helmet. It was found that the attitude component of the TRA received the greatest weight in predicting behavioural intentions rather than the subjective norm component. Further analysis revealed differences between intenders and non-intenders to wear a helmet in two attitudinal factors:

- Safety: riders with the intention to wear a helmet had stronger safety beliefs compared to non-intenders (e.g. 'wearing a helmet would prevent head injury and increase visibility and feelings of safety'); and

- Comfort-convenience: riders with the intention to wear a helmet were less likely to express the inconvenience and discomfort possibly associated with helmet use (e.g. 'wearing a helmet would make me feel uncomfortable, hot and impair vision and hearing').

However, no differences were found between intenders and non-intenders in a third attitudinal category, 'social image'. This factor included beliefs such as 'wearing a helmet would make me.... look foolish to other motorcyclists/ appear less adventurous/ look less sexy'.

Rutter and associates (Chesham *et al.*, 1991; Chesham *et al.*, 1992; Rutter and Quine, 1994; Rutter *et al.*, 1993; Rutter *et al.*, 1995) have investigated the social psychological determinants of the behaviours associated with accident involvement using the conceptual frameworks of the TRA and the Health-Belief Model (HBM). Rutter and associates conducted a postal survey of 4,100 motorcycle riders. Questionnaires were sent out at two time intervals, twelve months apart. The research findings reported by Rutter and associates have a number of implications. They showed that motorcyclists' beliefs predicted accident related behaviour ('law and rule breaking'). For the TRA, beliefs regarding obeying the law and rules of safe riding and taking care predicted law and rule breaking. Those who were more likely to believe that they should follow the highway code, obey traffic laws, not speed and ride as they were taught were less likely to speed, break traffic laws, break the highway code and ride too close to other vehicles. Those who were more likely to believe that they should concentrate properly, maintain their bike and show consideration to other road users were less likely to engage in these behaviours. For the HBM, perceived vulnerability, the benefit factors of feeling safe, having fun and good bike performance, and the barrier factor risk of accident predicted law and rule breaking. Those riders who had higher perceived vulnerability believed that a benefit of motorcycling was feeling safe and a barrier of motorcycling was risk of having an accident were less likely to engage in law and rule breaking behaviours compared to those who did not hold such beliefs. Also, those riders who believed that the benefits of motorcycling were having fun and having good bike performance were more likely to engage in law and rule breaking.