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PPR615

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Transport Research Laboratory
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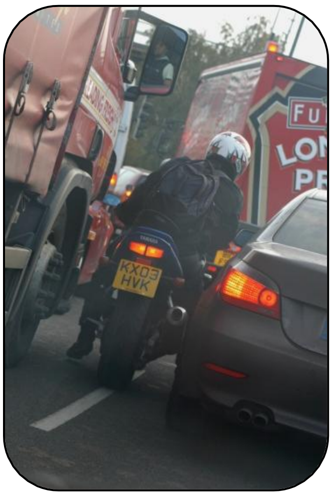

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Development of a video measure of hazard perception skill and a group-discussion-based hazard perception training package for motorcyclists

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Executive summary

Hazard perception is an important driving skill and has been shown to predict collision involvement across a number of studies (Horswill & McKenna, 2004). It is also known to increase with on-road experience, and be trainable (McKenna, Horswill & Alexander, 2006; Grayson & Sexton, 2002; Sexton, 2000; McKenna & Crick, 1993; Crick & McKenna, 1991; McKenna & Crick, 1991; Quimby, Maycock, Carter, Dixon & Wall, 1986).

Despite a great deal of work studying hazard perception in car drivers, very little work has been done in this area with motorcyclists. This is surprising given that hazard perception, with its focus on avoidance of accidents, is arguably even more important to motorcyclists than it is to car drivers; motorcyclists benefit especially from avoidance of collisions due to their physical vulnerability, and are less able than car drivers to rely on secondary safety systems (Horswill & Helman, 2003).

Against this background and given that motorcyclists arguably experience a different range of hazards on the road than car drivers do (due to their relative position on the road, and their instability relative to cars), there is a need to develop a measure of hazard perception skill specifically for motorcyclists.

As hazard perception is a skill that is trainable (and given that there is some suggestion that such training should have a safety benefit – see Wells et al., 2008) there is also a need to develop a training package aimed at improving motorcyclists' hazard perception skill; existing training products are either filmed from cars (for example those stimuli developed in the programme of research at TRL described in Grayson and Sexton, 2002) or have not been evaluated (any number of commercially available products).

This project therefore sought to develop and validate a measure of hazard perception skill, and a training package, aimed specifically at measuring and developing this skill in motorcyclists.

Video stimuli were filmed from a motorcycle and edited to result in matched pairs of road scenes. The matched clips usually included footage from the same section of road, but with an explicit hazard or hazards in one and no such explicit hazard in the other. This type of measure has been used before with car drivers (McKenna, Horswill and Alexander, 2006), with participants being asked to give the speed at which they would choose to travel (in their usual vehicle) in each scene; hazard perception skill is related to the difference in speed choice given for the 'hazard' and 'no hazard' scenes (with increased hazard perception skill corresponding to a greater reduction in speed choice for the 'hazard' scenes).

A hazard perception training package was developed that focused on having small groups (4 to 8 in size) of motorcyclists viewing video filmed from the same motorcycle (but not including the same clips) and engaging in group discussion and commentary under the facilitation of an experienced motorcyclist.

Experienced and novice motorcyclists were recruited and took part in either the hazard perception training or a 'placebo' training session that used the same techniques (video, group discussion) but focused on another topic related to motorcyclist safety but unrelated to hazard perception (maintenance and riding gear selection). After their respective training, participants completed the speed-based measure of hazard perception skill.

The study had four hypotheses:

1. Firstly it was expected that the hazard perception measure would discriminate between novice and experienced motorcyclists; experienced motorcyclists were expected to show a greater difference in their speed choice to the hazard and non-hazard scenes (lower speeds in hazard scenes) on account of their greater on-road riding experience giving them better hazard perception skill.
2. Secondly it was expected that the hazard perception training intervention would lead to lower speed choice on the hazard perception measure overall, relative to the maintenance/gear training intervention. This would indicate that the hazard perception training intervention encourages lower risk taking.
3. Thirdly it was expected that the effect of the hazard perception training intervention on risk taking (i.e. speed choice) would be greater for novice riders, on account of the widely reported tendency for younger, less experienced road users to take greater risks than more experienced road users.
4. Fourthly it was anticipated that any hazard perception training intervention effect would be greater in magnitude for the hazard scenes than for the no hazard scenes.

The data supported the first and third hypotheses. The hazard perception measure discriminated between experienced and novice riders and the training intervention resulted in a general lowering of speed choice (but only for novice riders). The training effect was not specific to the hazard scenes however.

The hazard perception measure shows promise in being used in future work to assess the hazard perception skill of motorcyclists (especially when evaluating interventions that claim to address this important skill), as also as a measure of risk taking. The training package also shows great promise as an intervention that could lead to reduced risk taking by novice riders if their slower reported speeds to video scenes translate to on-road behaviour.

Further work will examine in more detail the individual scenes in the hazard perception measure to establish how these should be developed further, and also to establish whether there is a sub-set of scenes that demonstrate a hazard-scene specific training effect.

Abstract

Hazard perception skill is an important skill for road safety. There is a reasonable body of evidence that drivers with better hazard perception skill have fewer accidents, and also that the skill can be trained and may be especially beneficial to inexperienced road users (see e.g. Wells et al., 2008). Despite the great deal of work in hazard perception generally, there has been very little looking at this skill specifically in motorcyclists. This project sought to develop a measure of hazard perception skill and a training package to address this gap. The measure was based on the speed choice method used by McKenna, Horswill and Alexander (2006) and the training package based on having small groups of either experienced or novice motorcyclists engage in commentary and discussion using video clips filmed from a motorcycle. Results showed that both experienced and novice groups showed a sensitivity to the hazards in the test (through choosing lower speeds in those clips with hazards than in those without), but that experienced riders were more sensitive to the presence of hazards than novices were. The training intervention made novice riders reduce their speed choice but did not have any impact on those of experienced riders. The findings are discussed and next steps for the measure and the training package are outlined.

1 Introduction

The skill of hazard perception (sometimes described as 'reading the road') is the only driving skill shown to be related to accident involvement across a number of different studies (Horswill & McKenna, 2004).

Hazard perception skill has been shown to increase with driving experience (e.g. Grayson & Sexton, 2002; McKenna & Crick, 1991; Quimby, Maycock, Carter, Dixon & Wall, 1986) and is a skill that can be trained (e.g. McKenna, Horswill & Alexander, 2006; Sexton, 2000; McKenna & Crick, 1993; Crick & McKenna, 1991). Given this, it follows that increasing the hazard perception skills of inexperienced drivers may help to lower their collision risk when they begin driving. There is some evidence that the introduction of hazard perception testing into the GB driving theory test in 2002 has lowered the collision risk of new drivers (Wells et al., 2008).

Despite the large literature on hazard perception in car drivers, very little work has been done to examine the hazard perception skill of motorcyclists. Hazard perception skill is arguably even more important to motorcyclists than it is to car drivers; their greater physical vulnerability means that avoiding a collision in the first place is crucial, while car drivers are able to rely relatively more on secondary safety systems such as airbags and seat belts to lessen the impact of a collision if it does occur. There is some evidence that motorcyclists do protect themselves from collisions somewhat through increased hazard perception skills. Horswill and Helman (2003) showed that a group of motorcyclists were better at hazard perception than car drivers of matched experience, although interestingly this difference was only present in a group of motorcyclists who took the test (a video-based test of anticipation time to hazards) while imagining that they were driving a car; a group of motorcyclists who took the same test while imagining that they were on a motorcycle performed no better than the non-motorcycling car drivers.

Horswill and Helman (2003) concluded that this pattern of findings may have been due to the fact that the hazard perception test used was filmed from a car, and therefore may not have contained enough hazards that were suitably relevant to motorcyclists. For example, because of their physical vulnerability and instability relative to cars drivers, motorcyclists must be aware of hazards related to the quality of the road surface. In addition, because of the smaller size of motorcycles relative to cars, motorcyclists often find themselves in specific parts of the road space that are likely to present specific issues (for example when a motorcyclist is filtering through slow moving traffic vehicles can swap lanes and come into conflict with the motorcyclist). The viewpoint from a motorcycle is also often different to that from a car; traditional hazard perception tests filmed from cars may simply not have the face validity required to be used to test hazard perception skill specifically related to riding a motorcycle.

There is a need, therefore, for a measure of hazard perception skill designed specifically for motorcyclists. The first aim of this project is to create one and validate it. In addition, because hazard perception skill is known to be trainable, the project will also seek to develop a simple training intervention that is focused on hazard perception from the motorcyclists' perspective.

1.1 Measuring hazard perception

The usual way of measuring hazard perception skill is through having drivers view traffic scenes and press a button whenever they perceive a road hazard developing. Hazard perception skill is typically measured in terms of how early drivers spot the hazards. Quicker (i.e. earlier) detection is, by definition, associated with greater hazard perception skill. Grayson and Sexton (2002) provide a useful overview of the original programme of work at TRL (and various partner organisations) to create this type of test, which has become the method used in the hazard perception component of the Driving Theory test administered by the Driving Standards Agency (DSA).

One problem with this method is that it requires a great deal of piloting to find stimuli that discriminate between experienced and novice drivers (a key way of validating the test). Another problem with it is that it requires equipment that is capable of measuring accurate and precise response times.

A simpler way to measure hazard perception skill is to use video-footage of matched pairs of traffic scenes, both with and without hazards (McKenna et al., 2006). Drivers are asked to indicate the speeds at which they would drive in the situations depicted. A lower speed rating in scenes with hazards than in scenes without hazards indicates that drivers are sensitive to the presence of the hazards. A greater difference in speed choice between the hazardous and non-hazardous scenes indicates a greater sensitivity to the hazards. McKenna et al. (2006) used this methodology with car drivers and showed that drivers' speed choice did indeed discriminate between the hazardous and non-hazardous scenes.

In the current project, stimuli were filmed to create a speed-based hazard perception measure like that used in McKenna et al. (2006) but using a motorcycle as the camera platform. This was to ensure face validity for motorcyclists viewing the footage, and also to permit the filming of a range of hazards relevant to motorcyclists such as surface hazards and those related to filtering, in addition to generic hazards such as the presence of other road users. The measure was designed to be deliverable using only simple technology such as a DVD player and paper-and-pencil response sheets; this decision was made deliberately to ensure that any eventual applied version of the measure would be useable in contexts that do not have access to Information Technology (IT) equipment required for collecting and automatically collating responses from participants.

1.2 Training hazard perception

McKenna et al. (2006) showed that training in hazard perception made drivers more sensitive to hazards in their speed-based hazard perception measure; drivers who were trained by watching a video of driving with commentary from an expert driver showed greater differences in speed choice on the later measure than did drivers who only watched the video, without the training commentary. This finding adds to the existing literature showing that hazard perception skill can be trained in car drivers through short courses designed to encourage different aspects of road scanning (e.g. Sexton, 2000; McKenna & Crick, 1993; Crick & McKenna, 1991)[1].

[1] The precise mechanisms by which this training might transfer to on-road hazard perception are not yet fully understood. It is known that on-road experience is associated with better performance in video-based hazard perception tests. It is also known that better performance on hazard perception tests is associated with lower crash risk. It is unlikely that training hazard perception skill using video and other stimuli can fully substitute for on-road experience; however it does seem like a promising avenue of research for driver training.

However since motorcyclists experience different hazards to car drivers, it can be argued that there is a need to develop a training package specifically for motorcyclists. To this end, in the current project an experienced motorcycle trainer developed a short group discussion based training intervention for motorcyclists. As with the measure of hazard perception skill, a deliberate attempt was made to keep the materials and equipment needed as simple as possible, so that the training package, should it be shown to be effective, would be accessible without complex IT equipment.

1.3 Overall approach and hypotheses

Footage was filmed from a motorcycle and then edited to contain matched pairs of stimuli (usually the same stretches of road) either containing an unambiguous hazard (hazard scenes) or no such hazard (non-hazard scenes).

Two groups of motorcyclists (experienced and novice riders) were used to validate the measure by being asked to indicate the speed they would choose to travel in each scene if riding their usual motorcycle. Before taking part, participants in each of these groups received either hazard perception training or a training intervention based on motorcycle maintenance and riding gear selection; this training was intended to serve as a 'placebo' in that it exposed the control participants to the general effects of training such as being involved in a group session and discussion, but without the hypothesised 'active ingredient' of the hazard perception content.

There were four hypotheses.

1. Firstly it was expected that the hazard perception measure would discriminate between novice and experienced motorcyclists; experienced motorcyclists were expected to show a greater difference in their speed choice to the hazard and non-hazard scenes (lower speeds in hazard scenes) on account of their greater on-road riding experience giving them better hazard perception skill.
2. Secondly it was expected that the hazard perception training intervention would lead to lower speed choice on the hazard perception measure overall, relative to the maintenance/gear training intervention. This would indicate that the hazard perception training intervention encourages lower risk taking.
3. Thirdly it was expected that the effect of the hazard perception training intervention on risk taking (i.e. speed choice) would be greater for novice riders, on account of the widely reported tendency for younger, less experienced road users to take greater risks than more experienced road users.
4. Fourthly it was anticipated that any hazard perception training intervention effect would be greater in magnitude for the hazard scenes than for the no hazard scenes.

2 Method

2.1 Participants

For the purpose of the study, novice riders were initially defined as those riders who had fewer than six months of motorcycling experience, and no more than three years of experience as a car driver. However due to problems finding enough participants that met these criteria, the eventual definition of a novice rider was someone with no more than three years of motorcycling experience, and as little car driving experience as possible. The definition of an experienced rider was initially someone with more than ten years of motorcycling experience, but again to ensure sufficient numbers of participants this was changed to allow in anyone who had more than three years of motorcycling experience. In practice, most of the experienced riders had more than 10 years of riding experience and most of the novices had fewer than two.

Both novice and experienced riders were recruited using a variety of methods. Information about the research was posted on online biker forums and leaflets were distributed at local advanced motorcyclist group meetings. Local motorcycle shops, dealerships and training schools were informed of the study and asked to display information about it. TRL's intranet and email system was also used to inform staff (including those of three companies who share TRL's building) of the research and asked them to notify any friends or family who may be interested in taking part. Recruitment of novice riders also involved adverts placed in local newspapers, and emails being sent to local colleges.

The final samples of experienced and novice riders are shown in Table 2-1, along with relevant demographic and experience characteristics.

Table 2-1: Final sample of experienced and novice riders, by group

	N	Mean age in years (range in brackets)	Mean years in possession of relevant motorcycle licence (range in brackets)	Mean reported annual riding mileage (range in brackets)	Mean on-road riding experience* (range in brackets)
Experienced (hazard perception training)	30	49.7 (32 to 67)	25.63 (5 – 48)	6,650 (1,500 to 25,000)	166,350 (13,500 to 625,000)
Experienced (maintenance/gear training)	26	50.4 (33 to 70)	26.94 (3.5 – 54)	9,020 (2,000 to 22,500)	208,154 (36,000 to 600,000)
Novice (hazard perception training)	18	25.9 (16 to 51)[2]	1.07 (0.25 to 2.75)	4,031 (2,000 to 8,000)	4,599 (1,340 to 13,360)
Novice (maintenance/gear training)	14	25.3 (16 to 40)	1.18 (0.5 to 2)	5,393 (1,500 to 12,000)	6,118 (1,740 to 12,000)

* Years in possession of relevant bike licence multiplied by reported annual mileage

[2] The wide ranges of ages in the novice groups were not originally intended in the design, but recruitment problems for these groups necessitated accepting older novice bikers. Both groups of novices had almost the same proportion of participants in the 17–25 and 26–35, and 36+ age groups.

Both experienced groups were statistically significantly older and more experienced in terms of years they had held their motorcycle licence, and in terms of mean on-road riding experience, than the novice groups. There were no statistically significant differences in age, years of licence possession, mean reported annual mileage, or mean on-road riding experience between the two novice groups, or between the two experienced groups.

2.2 Materials

2.2.1 Measure of hazard perception skill

Footage was filmed using a CCD camera fitted to a bracket that was secured onto a rucksack (on the shoulder strap) worn by its rider as he rode a Honda Pan European motorcycle on various roads around TRL's Crowthorne offices. The footage was recorded on a Mini HDVR recorder attached to the camera and stowed within the rucksack. The bike and camera/recording equipment are shown in Figure 2-1. The rider was accompanied by another researcher in a car so that some scenes could be filmed with 'stooge' vehicles and pedestrians when needed, although in practice almost all scenes were obtained under naturalistic conditions.

Figure 2-1: Bike, camera and recorder used for filming.

Footage was edited within Windows Moviemaker (version 5.1). Each clip was edited to include at least 4 seconds (and up to 12 seconds) of 'lead in' to the point at which the clip froze; this was the point at which the hazard (in the hazard scenes) was visible and developing, but not 'critical' and requiring an immediate behavioural avoidance response from the rider. The frozen scene was shown for 5 seconds before disappearing[3]. Figure 2-2 shows two such 'frozen' examples of scene pairs used in the test.

[3] In this way the measure is similar to the 'adaptation test' used by de Craen, Twisk, Hagenzieker, Elffers & Brookhuis (2008), although note that test uses only pictures and not video 'lead-in' footage.

Figure 2-2: The 'frozen' parts of scenes showing two examples of matched hazard/no hazard scene pairs. Hazard scenes of each pair are on the right.

In the top pair in Figure 2-2 there is a car in each scene passing a junction in the distance, but in the hazard scene the car has its brake lights on and indicating right. In the bottom pair hazard scene a pedestrian is approaching the pedestrian crossing while talking on his mobile telephone. Table 2-2 has descriptions of all 14 scene pairs used in the measure.

Table 2-2: Description of all scene pairs used

	'No hazard' clip	**'Hazard' clip**
Pair 1	Suburban B-road – approaching junction	Same stretch, cyclist and car emerging from junction
Pair 2	Approaching pelican pedestrian crossing on suburban road	Same with pedestrians waiting at crossing
Pair 3	Rural bend	Same bend with car reversing from gate
Pair 4	Bend on residential road	Same with oncoming cars passing cyclists

	'No hazard' clip	'Hazard' clip
Pair 5	Section of motorway	Same with road work vehicles and workers on hard shoulder
Pair 6	Approaching bus stop	Same but with bus present and pedestrian going to step into road
Pair 7	Approaching zebra crossing	Same with pedestrian approaching crossing talking on phone
Pair 8	Following car approaching junction on bend	Same but car is braking and indicating to turn right
Pair 9	Urban street	Stretch just before no hazard section with several dynamic hazards
Pair 10	Rural A-road bend	Different bend but more severe and with more warning signs/chevrons
Pair 11	Residential street – some cars parked	Same but also bin-men and lorry moving around
Pair 12	Rural A-road bend with good surface	Different bend with warning chevron and poor surface
Pair 13	Residential road approaching bend	Same bend but with car parked blocking view
Pair 14	Filtering with obvious large gap to allow escape route	Filtering in very tight space

In addition to these pairs, the measure contained eight filler clips. The first three of these were shown at the beginning of the sequence to ensure that participants were familiar with the procedure before they began rating the hazard/no hazard pairs. The other five 'filler' clips were interspaced throughout to try and make it less obvious to participants that clips were in pairs.

Two versions of the measure were created. Each version had the three 'practice' filler clips first, and then had two blocks of mixed 'hazard' and 'no hazard' scenes. The block order was reversed for the two versions. The remaining five filler clips were split between the blocks.

2.2.2 *Training package*

The hazard perception training package was based around the approach used previously in TRL studies in driver hazard perception training of showing video clips of traffic scenes so that these could form the basis of commentaries and discussion of hazard types, and the risks these presented to participants when riding. The training focused on thinking about those areas of the road that should be subjected to scrutiny when riding, and hazard types. The hazards included within the training were representative of those which occur frequently within motorcycle accident statistics, but none included the stretches of road used in the later measure of hazard perception skill. 'Changing speed' was mentioned only once in the training script for the hazard perception training, in passing, as one possible behavioural response to lower risk once hazards have been spotted (others including changing road position and signalling). The broad format of the training was based on the small group discussion approach that has been explored previously by Lang, Vandrevala and McWhirter (2009) when applied to attitudes to risk taking in learner drivers, and also by Gregersen, Brehmer and Morén (1996) with fleet drivers. The facilitator followed a script when prompting discussions and moved through the slides in a set order, however discussion was allowed to develop within each group of participants.

The maintenance/gear ('placebo') training package was created by using (with permission) two video sequences from the Highways Agency's 'Great Roads Great Rides' DVD. These covered pre-ride checks and maintenance and also what to look for when choosing riding gear such as leathers, helmets, and boots. As with the hazard perception training, prompts and discussion points were inserted into the slides surrounding the video sequences and into the facilitator notes. The placebo package was thus designed to act as a true placebo within the design, in that it satisfied the requirement that the control groups had a similar quality of interaction in the session before their hazard perception skill was measured, but without the active hazard perception content.

2.3 Design

A three-way mixed design was used. The dependent variable was the mean speed choice reported by participants. The independent variables were experience level (between participants, two levels, 'experienced' and 'novice'), training (between participants, two levels, 'hazard perception training' and 'maintenance/gear training') and scene type (within participants, two levels, 'hazard' and 'no hazard'. Data were analysed using a 3-way analysis of variance (ANOVA). Initial exploration of the data suggested that the assumptions required for the parametric ANOVA were broadly met, although some cells of the design did contain data that were not normally distributed. Simple main effects were therefore run using non-parametric tests.

Half of the participants in each cell of the experimental design saw one version of the hazard perception measure and half saw the other version. This ensured that any order effects were be balanced.

2.4 Procedure

Participants were recruited into groups of between four and eight people. Each group consisted of either experienced or novice riders. Participants were informed during recruitment that the research involved them attending a short discussion session to receive some training or education, and that their feedback would be sought on the training received. Each session was pseudo-randomly allocated as either the hazard perception training or the maintenance/gear training.

When they arrived for their session (which were run mostly at evenings and weekends to facilitate participant attendance, with some daytime weekday sessions) they were greeted by the person facilitating the training and invited to a room in which they completed consent forms and paperwork. Participants received as small cash payment to compensate them for taking part. They were reminded that the purpose of the session was to give feedback on the training they would be receiving, and also that at the end of the session there was another short task for them to do, to assist another project that was being run. This pre-warning was worded to give the impression that the second session – actually the speed based hazard perception measure – was not linked to the training.

The training session then commenced, with the facilitator (an experienced motorcyclist) following strictly a script of prompts that accompanied the video and slide materials, to encourage open discussion of the issues covered. This format was the same for the hazard perception and for the placebo training; the only differences between the two were in content.

At the end of the training, participants were given a short feedback sheet to provide their opinions and ratings on the training itself. These data are not reported here. Participants also completed a short form outlining their experience level (years licence held, annual mileage) and basic demographic details (age, gender).

After this, participants were reminded that there was another short task related to another project being run at TRL. They were told that the project was to do with understanding the speeds at which all kinds of road users choose to travel in different types of road situations. Again the impression was given to participants that this was not related to the training they had received and that it was simply fortuitous that they could quickly take part while they were on site.

Participants sat through the measure of hazard perception skill with on-screen instructions explaining what they needed to do. Participants then watched the video scenes, and indicated on the response sheet the speed they would choose to travel in each scene, in mph. The instructions and response sheet are provided in Appendices A and B. The facilitator answered any further questions and then started the video. After the video had ended (around 15 minutes for the 36 scenes) participants were thanked for their time, and were told that they could leave.

3 Results

Figure 3-1 shows the speed choice data from the experienced and novice rider groups separated by the training they received, and the scene types in the measure of hazard perception skill. The same data are shown in Table 3-1.

Table 3-1: Mean speed choice by experience, training, and scene type (hazard/no hazard)

Group	Mean speed choice for 'no hazard' clips (standard deviation in brackets)	Mean speed choice for 'hazard' clips (standard deviation in brackets)
Experienced – hazard perception training	37.82 (3.24)	33.23 (3.82)
Experienced – maintenance/gear training	38.76 (4.32)	34.24 (4.16)
Novice – hazard perception training	33.23 (4.01)	31.14 (4.78)
Novice – maintenance/gear training	40.34 (4.5)	38.41 (5.91)

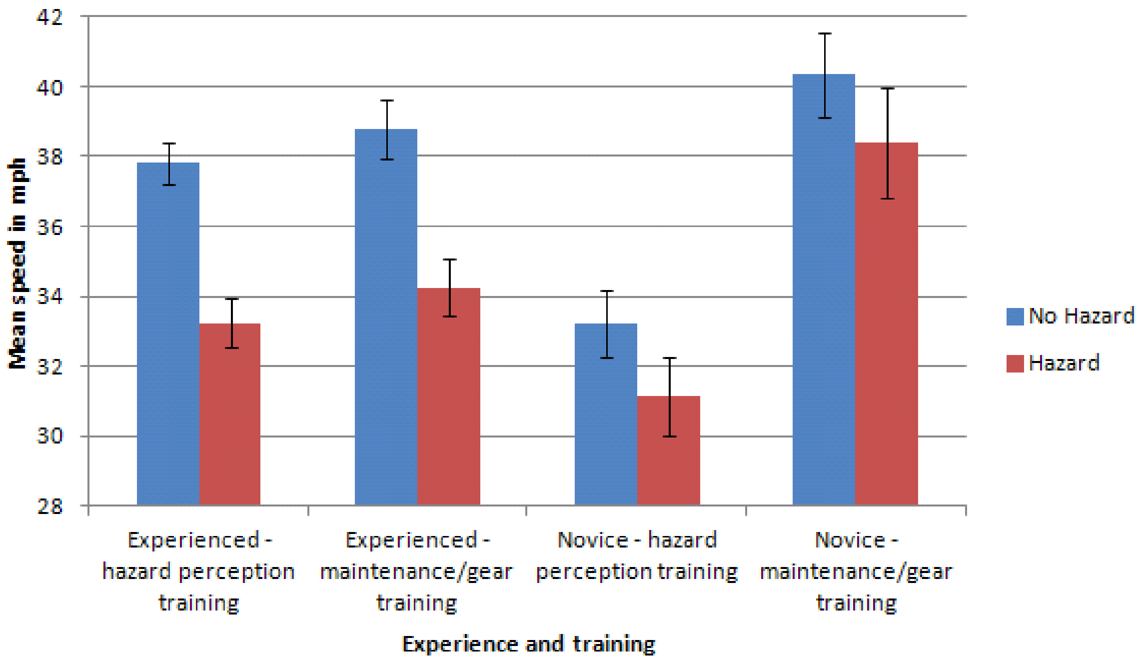

Figure 3-1: Mean speed choice by experience, training, and scene type (hazard/no hazard). Error bars are standard error of the mean.

Two things are immediately apparent. Firstly, the difference between speeds given to the 'no hazard' and 'hazard' scenes is greater for the experienced groups than it is for the novice groups. This suggests that the measure possesses criterion validity in that we predicted that experienced riders would be more sensitive to the hazards than novice riders were (see Coolican, 2004, p194 for a discussion of different forms of criterion validity); it is widely accepted that measures of hazard perception should be able to distinguish between experienced and novice road users, with experienced road users being more sensitive to hazards. The second thing apparent from the data is that for the novice riders the hazard perception training seems to lead to much lower speed choices overall, when compared with the maintenance/gear training, although the same cannot be said for the experienced riders.

The 3-way mixed ANOVA supported this interpretation of the findings. The analysis showed that the main effects of scene type and training were statistically significant, [$F(1, 84)=160.29$ $p<0.001$ and $F(1, 84)=20.26$ $P<0.001$ respectively), as were the interactions between scene type and experience [$F(1, 84)=24.09$ $p<0.001$] and between training and experience [$F(1,84)=11.76$ $p<0.001$]. All other main effects and interaction terms were non-significant.

Simple main effect analyses using non-parametric tests within the interactions confirmed that although both groups of riders gave lower speed choices to the hazard scenes, the difference between hazard and no hazard speeds was greater for the experienced riders; this supports the first hypothesis. These analyses also confirmed that the hazard perception training reduced speed choices overall for novices but not significantly so for experienced riders; thus the second hypothesis is not supported, but the third hypothesis is. The fourth hypothesis is not supported, since the training effect for the novices was not greater in magnitude for the hazard scenes; in fact it applied to hazard and no hazard scenes equally.

4 Discussion

There were four hypotheses in the study.

1. Firstly it was expected that the hazard perception measure would discriminate between novice and experienced motorcyclists
2. Secondly it was expected that the hazard perception training intervention would lead to lower speed choice on the hazard perception measure overall.
3. Thirdly it was expected that the hazard perception training intervention effect would be greater for novice riders.
4. Fourthly it was anticipated that any hazard perception training intervention effect would be greater in magnitude for the hazard scenes than for the no hazard scenes.

The findings from the study support the first and third hypotheses.

The measure of hazard perception skill discriminated between experienced and novice riders in that the difference in speed choice for 'hazard' scenes and 'no hazard' scenes was greater for experienced riders than it was for novice riders (although novice riders in both training conditions still gave lower speed choices to 'hazard' than to 'no hazard' scenes). The magnitude of the difference for experienced riders was similar to that seen in McKenna et al. (2006) in an advanced police driver group (around 4mph slower in the hazard scenes). The findings suggest that the measure is suitable for use in assessing hazard perception skill in motorcyclists, since it is clearly able to distinguish between riders who would be expected to have high hazard perception skill (experienced riders) and those who would not (novice riders). Although further development is advised (for example to understand which scene pairs are most effective, and also to potentially expand the item bank, and with higher quality footage) the measure as it stands should serve as a useful tool in evaluating training and educational programmes that focus on increasing hazard perception skills in motorcyclists.

The hazard perception training did lead to lower speed choice overall, but the difference was only statistically significant for novice riders. This is consistent with the idea that very experienced motorcyclists will be much better calibrated in terms of the speeds at which they travel to remain safe, while novices (due partly to their younger age and partly due to their lack of experience) will tend to choose higher speeds by default. The novice group with the maintenance/gear training gave an average speed choice of around 39mph (combined for both scene types) and this dropped to around 32mph for the hazard perception training group. Thus the effect of the hazard perception training for the novice riders was large (around a 7mph reduction in stated speed choice); if this translates into on-road behaviour it has the potential to have a real road safety impact given the well-established link between speed choice and accident risk/severity. As with the hazard perception measure, further work will be useful (for example in understanding whether the general approach can be extended to other formats such as e-learning); as it stands however the training represents a promising approach to lowering speed choice in novice riders.

One other area of further work related to the hazard perception measure will be in trying to understand the mechanism by which the hazard perception training has led to lower speed choices in novices. The overall reduction in speed, based on the data we have, seems like it might be based on a general reduction in risk taking, as opposed to an increased ability to detect explicit hazards. If it had been due to the latter of these two possibilities, we would have expected to have seen a greater reduction in speeds in the 'hazard' scenes than in the 'no hazard' scenes for novices who received hazard perception training (as shown in McKenna et al., 2006). In fact the training effect was the same for both scene types. It is possible that an item analysis of the clip pairs may reveal more about the mechanism by which the hazard perception training is having its effect; for example there may be a subset of clips for which there is a specific hazard perception training effect rather than a general risk-reduction effect. Future work with the dataset will explore this issue. In any case, it is still plausible that even the general reduction in speed choice found was due to the specific hazard perception content in the hazard perception training, given previous findings showing that such content is a key component to effective training programmes (e.g. McKenna et al., 2006; McKenna & Crick, 1997). Finally, as the control group in the current study received training focused on road safety and risk reduction in terms of safe protective motorcycle equipment and safety related maintenance, it seems plausible that the reduction in speeds seen in the hazard perception group could only have been due to the hazard perception content (although see second limitation below).

One limitation of the current study is that the outcome measure was administered immediately after the training, and thus we do not know from the current data how long the training effect seen might last. Previous work with car drivers has shown that similar training can have long-lasting effects however; for example McKenna and Crick (1994) showed that training involving commentary techniques led to increased hazard perception scores (using the response time technique) when the training preceded the testing by around nine months. Further work with this training package should seek to demonstrate longer lasting effects.

A second limitation is that at least some of the effect of the hazard perception training may be due to socially desirable responding. Although the control group novices received training related to safety, it is possible that they did not notice as explicit a link between the training and the later hazard perception measure as did the novices who received the hazard perception training. The novices receiving the hazard perception training may have noticed this link and felt under pressure to respond with slower speeds, given the training they had received. Further work should seek to rule out this possible explanation for the results. For example, it could establish whether the magnitude of the effect seen in this study can be replicated using other more objective outcome measures that are not subject to socially desirable responding (for example a response-time hazard perception test).

In summary, the current study sought to develop and validate a speed-choice-based measure of hazard perception skill for motorcyclists. In addition it sought to develop and validate a short, group discussion-based motorcyclist hazard perception training package. The project has succeeded on both counts; although further work to develop the measure and training package is desirable (in terms of gathering further validation data, expanding the scope of the materials, and ruling out alternative explanations for the training effects) both can be used to support ongoing road safety work and intervention evaluation with motorcyclists (especially novice motorcyclists).

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Appendix A Instructions for hazard perception measure

You will see a series of video clips from the perspective of a motorcyclist riding in different road situations. You should watch each clip and imagine that you are riding your usual motorcycle in the road situation depicted.

Each clip will 'freeze' when it finishes, like this:

We are interested in finding out what kinds of speeds motorcyclists would choose to ride at in the situations depicted.

Based only on what you see in the clip, you should write (on the response sheet provided) the speed (in mph) that you think personally you would choose to ride at, on your usual motorcycle, at the point at which the clip freezes.

So, in this example, if you thought that you would be riding at 50mph, you would write '50' on the response sheet for that clip. It is up to you to decide the speed that you think you personally would ride at – there is no 'right or wrong' answer.

So, at the end of the session, you will have written a single speed for each clip you have seen. You only need to write a number – you do not need to write 'mph' after the number, but ensure that your numbers represent a speed in mph.

In the example below, the respondent has decided on speeds of 45mph, 52mph, 60mph and 37mph for clips A, B, C and D respectively.

Clip A	45
Clip B	52
Clip C	60
Clip D	37

Even if you find it difficult to make a judgement of the speed you would ride at in the situation depicted, please ensure that you write a response for each clip.

Recap:

1. You will see video clips from a motorcyclist's perspective of different road situations.
2. You should write the speed at which you personally would choose to ride, at the point at which the clip freezes, if you were riding your usual motorcycle in the situation depicted.
3. Base your choice of speed only on the things you see in the clip.
4. There are no 'right or wrong' answers – we are only interested in your honest answers regarding your own behaviour.
5. Your answers will be completely anonymous.

Appendix B Response sheet for hazard perception measure

Response sheet MC Speed video clips

Clip	Speed in Mph you personally would choose to travel in the situation depicted when the scene freezes, on your usual motorcycle.
1	
2	
3	
4	
5	
6	
7	
8	
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35	
36	

Please turn over…

About you (note all your responses are anonymous)

Age in years:_____

Gender:_____

Years you have held your motorcycle licence:_____

Years you have held your car licence:_____

Average mileage per year on motorbike:__________

Average mileage per year in car:__________

Development of a video measure of hazard perception skill and a hazard a group-discussion-based hazard perception training package for motorcyclists

Hazard perception skill is an important skill for road safety. There is a reasonable body of evidence that drivers with better hazard perception skill have fewer accidents, and also that the skill can be trained and may be especially beneficial to inexperienced road users (see e.g. Wells et al., 2008). Despite the great deal of work in hazard perception generally, there has been very little looking at this skill specifically in motorcyclists. This project sought to develop a measure of hazard perception skill and a training package to address this gap. The measure was based on the speed choice method used by McKenna, Horswill and Alexander (2006) and the training package based on having small groups of either experienced or novice motorcyclists engage in commentary and discussion using video clips filmed from a motorcycle. Results showed that both experienced and novice groups showed a sensitivity to the hazards in the test (through choosing lower speeds in those clips with hazards than in those without), but that experienced riders were more sensitive to the presence of hazards than novices were. The training intervention made novice riders reduce their speed choice but did not have any impact on those of experienced riders. The findings are discussed and next steps for the measure and the training package are outlined.

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