Car Drivers' Attitudes and Visual Skills in Relation to Motorcyclists

Abstract

Motorcyclists are grossly overrepresented in the crash statistics, but many collisions are actually caused by other road users. Previous research has suggested that poor attitudes (e.g. lack of empathy with motorcyclists) or perceptual problems (e.g. Look But Fail To See errors) may help explain why car drivers collide with motorcyclists. Three studies were undertaken to address these issues. In Study 1 we induced a self-reported improvement in attitude following a presentation of hazardous video clips from a motorcyclist's perspective. In Study 2 we identified the perceptual measures that might lead to Look But Fail To See errors. Study 3 demonstrated the difficulties in trying to train perceptual strategies to overcome these problems.

Main findings

- When compared with dual drivers (who both drive a car and ride a motorcycle, and are documented as having fewer car–motorcycle collisions), average car drivers report negative attitudes and a lack of empathy towards motorcyclists. We created an intervention to improve attitudes which included the presentation of hazardous video clips from a motorcyclist's perspective and use of a motorcycle simulator. Self-reported improvements in attitudes were most apparent following the video presentation.

- We have developed and validated a presentation platform that provides drivers with video clips filmed from a car driver's perspective that contains nearly 180 degrees of forward-facing information and has mirror information inset. Combined with an eye tracker, this system has identified differences between novices, experienced drivers and dual drivers when presented with two scenarios involving car–motorcycle interactions (the Sanctioning Manoeuvres task).

- When sanctioning manoeuvres, all drivers were more cautious in the presence of motorcycles than cars. Dual drivers were the most cautious when pulling out of a T-junction.

- There were no differences between groups in how they visually searched an empty T-junction, or when changing lanes. Neither were dual drivers faster to first look at an approaching motorcycle. This suggests that drivers have similar visual search strategies in these particular scenarios.

- The main difference between our groups was the length of time spent looking at the approaching motorcycles. Dual drivers typically gave more attention to approaching motorcycles than cars, whereas experienced drivers gave more attention to cars. As motorcycles are smaller and are encountered less frequently, we need to look at them for longer to work out what they are. The fact that experienced drivers look at motorcycles for less time than cars, suggests they do not realise that they were looking at a motorcycle.

- We believe this provides the first experimental evidence that drivers might truly look at an approaching motorcycle but 'fail to see it'. This suggests that future interventions to improve car drivers' ability to process and thus recognise approaching motorcycles may hold promise.

Background

Motorcyclists in the UK are over-represented in the crash statistics: they account for around 1% of vehicle miles travelled but 21% of road fatalities. Many collisions are primarily caused by other road users. Cars pulling out from side roads in front of motorcycles and drivers changing lanes without spotting an overtaking motorcycle are two such common causes of collision. Often drivers say they looked in the appropriate direction but did not see the motorcycle. This research was designed to assess factors that lead to these Look But Fail To See errors and intervene to help reduce them. Three important behaviours were questioned:

- Does the driver look?
- Does the driver perceive?
- Does the driver appraise the risk appropriately?

A failure in any of these behaviours could lead to a typical car–motorcycle collision. Furthermore these behaviours are influenced by a number of factors, including the car drivers' attitudes towards motorcyclists, their knowledge, and the visual skills and strategies they employ when performing certain manoeuvres.

This project involved three studies to explore these issues further:

- A study to increase car drivers' empathy for motorcyclists – previously we noted that empathy for the on-road dangers that riders face was lacking in those drivers who were more likely to collide with motorcyclists. We aimed to improve attitudes and empathy by exposing drivers to motorcycle-related hazards.
- A study to investigate how drivers search for motorcycles at T-junctions and when changing lanes – combining eye tracking technology with a video-based task (a variant on a traditional hazard perception task) we aimed to identify whether risky car drivers **look for**, **perceive** and **appraise** motorcycles appropriately.
- A study to assess whether training interventions can address drivers' poor visual skills at T-junctions and when changing lanes.

Research findings

Study 1

To improve empathy for motorcyclists, we exposed car drivers to dangers that a rider might face on the road, using both hazardous video clips filmed from a motorcycle, and a motorcycle simulator with virtual hazards. A car simulator and hazard clips filmed from a car provided control interventions.

Car drivers filled in a questionnaire before and after the intervention regarding their attitudes towards various sub-groups of road user, including motorcyclists. The interventions improved attitudes to motorcyclists rather than to other road users.

When asked directly about their attitudes towards motorcyclists, participants who had seen the motorcycle hazard clips reported the greatest level of improvement (Figure 1). This suggests that film clips from a motorcyclists' point of view could be a useful tool in future safety interventions.

Figure 1: Self-reported improvement in attitudes towards motorcyclists for four groups of drivers with different interventions (with standard error bars; $*p<0.05$; $**p<0.01$)
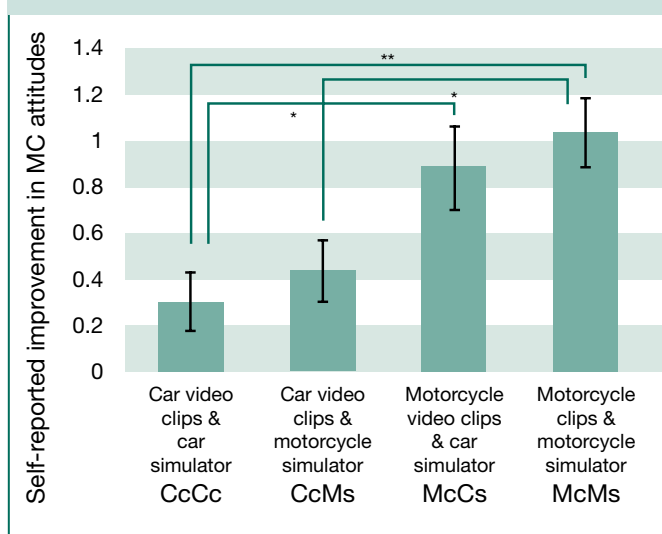
Study 2

This study aimed to assess drivers' visual skills at T-junctions and when changing lanes. Digital videos from six cameras on a car were filmed during a series of T-junction and change-lane manoeuvres. The video streams were edited to provide a wide field of view of the road ahead, with mirror information inset. The clips were presented to participants on three 40-inch LCD monitors in the laboratory (Figure 2).
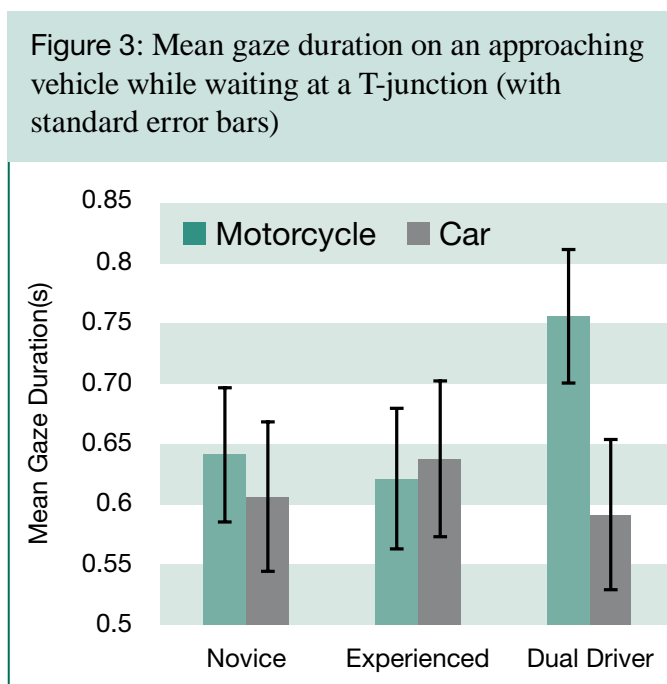

Figure 2: The multi-screen Sanctioning Manoeuvres test

Participants had to watch the clips and press a button when they thought it was safe to either pull out from the junction or change lanes (this the Sanctioning Manoeuvres task). Some clips contained approaching cars or motorcycles, while other clips had none.

Novice and experienced drivers' response times and eye movements were compared with those of a group of dual drivers (those who both ride a motorcycle and drive a car) (Figure 3). Dual drivers are the safest car drivers in relation to car–motorcycle collisions and provide an *a priori* benchmark for performance.

Dual drivers were most sensitive to motorcycles at T-junctions. Novices gave the least cautious responses, sometimes pressing the button to pull out from the T-junction in front of approaching vehicles. Overall, motorcycles were treated with more caution than cars, though dual drivers were the most cautious of all.

When no approaching vehicles were present, all drivers searched the junction to the same extent. Dual drivers, however, gave more attention to approaching motorcycles than cars (evident in longer gazes upon motorcycles), possibly reflecting the fact that motorcycles are harder to see compared with cars, which should increase the amount of processing required. Novices had the shortest gazes on approaching vehicles (equally for cars and motorcycles). Experienced drivers gave less attention to motorcycles than cars, suggesting that sometimes they might move their eyes away from the motorcycle before realising what it is. This is suggestive of a true Look But Fail To See error.

Figure 3: Mean gaze duration on an approaching vehicle while waiting at a T-junction (with standard error bars)

In the change-lane scenarios, motorcycles again received the safest responses, but dual drivers were no safer than the other driver groups.

All drivers looked in the rear-view mirror before the right side mirror when checking for overtaking vehicles. However, the first gaze to the rear-view mirror was delayed if an approaching vehicle was visible in the mirrors. We suggest that peripheral vision might detect clutter in the mirrors when approaching vehicles are present, which then encourages the driver to spend longer looking forward before inspecting the mirrors. The rationale for this is that, in anticipation of long gazes on approaching vehicles in the mirror (which do indeed occur), the drivers first give more attention to assessing their headway to the vehicle in front. Once a more thorough check of headway has been completed, the drivers then look at the rear-view mirror.

Dual drivers delay their first gaze to the rear-view mirror for even longer than the experienced drivers, but then have longer gazes upon the rear-view mirror if a approaching motorcycle is visible. We suggest the increased delay to look at the mirror prepares them for longer gazes upon the mirror once they look at it (by providing more in-depth analysis of the forward headway prior to looking at the mirror).

Experienced drivers had shorter gazes on the right side mirror than dual drivers. Novices were very similar in gaze length to the dual drivers on the right side mirror.

Overall the results argue for differences in processing time between groups on approaching motorcycles. At T-junctions, and when changing lanes, dual drivers dwell more on motorcycles. The lack of differences in trials with no approaching vehicles suggests that all drivers are **looking**, and the cautious behaviour suggests that all drivers are **appraising** motorcycles as more dangerous than cars. The major differences between groups are noted in their gaze durations on vehicles, which is indicative of problems in **perceiving** motorcycles. We believe that this is the first experimental evidence of problems with visual processing in relation to Look But Fail To See errors.

Study 3

This study was an attempt to change the behaviour of car drivers in regard to their eye movements and response times. Three training interventions (targeting **looking**, **perceiving** and **appraising**) were given prior to participants undertaking the

Sanctioning Manoeuvres task. Drivers in the **look training** group received explicit instruction on where to look during the video scenarios. Drivers in the **perceive training** group undertook training designed to reduce the processing threshold for subsequent motorcycles in the video scenarios. Finally, drivers in the **appraisal training** group viewed hazardous video clips from a motorcyclist's perspective (used in Study 1), with the possibility that awareness of the vulnerability of motorcycles might reduce risky appraisals. Performance of the trained groups was compared with an untrained control group.

The training interventions had no appreciable positive impact on decision times or eye movements to approaching vehicles on T-junction scenarios. Changes in eye movements were noticeable in the change-lane scenarios, though any benefits occurred early in the clips (increasing early use of the rear-view mirror) and had potentially negative side-effects (decreasing use of the right side mirror).

While the results show that some of the visual measures in our scenarios are open to modification (especially though the use of **look training**), it is too early in our understanding of how instruction affects eye movements to make definitive suggestions that will guarantee desired results.

Conclusions

We have shown that attitudes towards motorcyclists can be improved with hazard-based training. Car drivers report more favourable responses to motorcyclists after viewing hazard perception clips taken from a motorcyclist's perspective.

We have developed and validated an innovative testing rig that presents drivers with a wide field of view and mirror information. This apparatus has successfully identified important differences between different groups of drivers in regard to how they process approaching motorcycles.

The key difference between dual drivers and other drivers is in the length of time spent looking at approaching motorcycles. We believe this provides the first experimental evidence for true Look But Fail To See errors in motorcycle collisions.

While training interventions hold promise for the future, current attempts have identified several problems. The results of Study 2, however, favour an approach that will increase car drivers' familiarity with motorcycles, hopefully reducing the time they need to spend working out that they are looking at motorcycles.

About the project

Study 1 had 136 participants split into four groups, with each group receiving one set of video clips (filmed from a car or motorcycle) and undertaking one simulator trial (car or motorcycle). The simulators were a Faros GB3 (car) and a Honda MRT (motorcycle). Study 2 had 74 participants (25 novices, 25 experienced and 24 dual drivers).The multiple-screen video clips were filmed with the assistance of Cantab Films and Full Throttle. The eye tracker was a four camera system supplied by SmartEye. Study 3 had 70 participants divided across three training groups.