‘Looked but failed to see’ collisions

August 2017
Fact of the day #1: It is difficult to detect motorbikes and judge their speed, because they are small.

Screenshots from 1975 UK ‘Think Once, Think Twice, Think Bike’ public information film
Fact of the day #2: It is difficult to detect and judge the speed of things at night, because it is dark
In short...

- These two things combined mean that motorcycles are doubly disadvantaged at night.

- A simple change to lighting patterns on motorbikes can result in safety benefits.

- A range of other measures beyond this (lower speeds, greater active searching for motorbikes by car drivers, greater care by bikers at night) are sensible.
# Table of contents

1. Conspicuity
2. Judging speed and time to contact
3. Novel motorcycle lighting – lab work
4. Novel motorcycle lighting – trials in New Zealand
5. Conclusions
Conspicuity
‘Looked but failed to see’ collisions

- Collision statistics show that a car driver violating a rider’s right of way at a junction is a very common accident scenario.

  “Sorry mate, I didn’t see you”

- Calls for increased conspicuity of motorcyclists are common (e.g. Williams & Hoffman, 1979; Olson, Hallstead-Nussloch & Sivak, 1981; Hole, Tyrrell & Langham, 1996; Rößger, Hagen, Krzywinski & Schlag, 2011)
‘Looked but failed to see’ collisions

- Data on contributory factors to injury accidents hint at multiple causes (DfT statistics)

Diagram:

Did not look → Inadequate looking → Adequate looking but did not see → Looked, saw, but failed to judge approach

Conspicuity

© 2017 TRL Ltd
Different types of conspicuity

- Visibility = “Can you see the motorcycle here?”
- Search conspicuity = “Where is the motorcycle?”
- Attention conspicuity = “What do you see?”
- Cognitive conspicuity = Expectation
Conspicuity of motorcyclists

- Many studies since the 1960s have shown that interventions such as bright clothing and extra lighting can improve the visibility and conspicuity of motorcycles - generally positive effects shown on measures such as detection time and visibility ratings in laboratory or roadside studies (see Helman et al., 2012 for a review)
Background is crucial (e.g. Hole et al., 1996)
Palmer (2010)
The problem of night time

- Motorcycle-car collisions are over-represented at night relative to daylight hours (Pai et al., 2009)

- Partly because headlights are even smaller than bikes... and they can ‘blend in’ to other vehicle headlights...
The problem of night time
Around four seconds later...
So...

- Bikes are small

- (Partly) because of this they are less conspicuous

- This is especially problematic at night as bike headlights can blend into the background

- One approach we could take is to make bikes bigger and more ‘distinctive’ (including at night) to make them more conspicuous
‘Looked but failed to see’ collisions

- It isn’t JUST about conspicuity...
‘Looked but failed to see’ collisions

- It isn’t JUST about conspicuity...

Did not look → Inadequate looking → Adequate looking but did not see → Looked, saw, but failed to judge approach

<-Time to contact->
Judging speed/time to contact
Time to contact
Time to contact
Time to contact
Judging time to arrival and speed

- Time to arrival overestimated for small objects – this has implications for motorcyclists approaching junctions (Horswill, Helman, Ardiles & Wann, 2005)
The problem of night-time

- Motorcycle-car collisions are over-represented at night relative to daylight hours (Pai et al., 2009)
So...

- Bikes are small

- (Partly) because of this it is more difficult for drivers to accurately judge their time to contact

- The problem may be worse at night as headlights provide almost no ‘size’ information

- One approach is to make bikes bigger (including at night) to make it easier for drivers to accurately judge their time to contact
Novel motorcycle lighting - lab work
Extra motorcycle lighting?
Motorcycles with ‘T’ formation of lighting are more quickly identified than motorcycles with a single headlight, and are fixated more rapidly.
Gould et al., 2012

- Participants viewed bikes or cars in simulated scenes under different lighting conditions – brief presentations
  - Reference vehicle was car travelling at 30mph with 4 second time to contact
  - Probe vehicle was car, motorcycle (single headlight), or motorcycle (tri headlight), -20mph to +180mph relative to reference vehicle
- Task was to detect which vehicle (reference or probe) was travelling faster
Findings
The story so far...

- LBFTS accidents are an important risk for motorcyclists
- Sometimes this is due to conspicuity
- Sometimes it is due to judgement of time to contact
- Small objects more difficult to detect, and to judge (TTC) than large ones – motorcycle headlights at night are the extreme example
- A simple engineering solution (more lights) could make a difference to this limitation – laboratory trials have shown promise both in terms of conspicuity and judgement of approach
Novel motorcycle lighting - NZ trials
Location
the future of transport.
Design

- N=400 (240 day, 160 night) – matched closely to NZ licence holders
- IV – lighting (C, V, Y)

Each participant saw three passes under each of three instruction types
- ‘Tell me what you see’ (attention conspicuity)
- ‘Tell me when you see the motorbike’ (search conspicuity)
- ‘Tell me smallest gap you would accept’ (TTC)

- DV – time from observation location (coded from video) when bike seen/ gap judged
Design (continued)

- Order of lighting counterbalanced within each instruction type (CVY, CYV, YVC, YCV, VCY, VYC)

- Measure number of other vehicles in scene when bike approaching (control for this in analysis – scene complexity)
## Results – Mean TTC in seconds (StDev)

<table>
<thead>
<tr>
<th>Time of day</th>
<th>Lighting</th>
<th>Attention</th>
<th>Search</th>
<th>Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Night</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>5.14 (3.37)</td>
<td>8.18 (3.79)</td>
<td>6.21 (1.95)</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>4.82 (3.32)</td>
<td>8.88* (4.46)</td>
<td>6.68** (1.98)</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>4.57 (3.33)</td>
<td>9.55** (4.74)</td>
<td>6.91** (2.05)</td>
<td></td>
</tr>
<tr>
<td><strong>Day</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>7.77 (4.56)</td>
<td>14.48 (4.70)</td>
<td>6.50 (1.83)</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>7.46 (4.37)</td>
<td>14.49 (4.70)</td>
<td>6.57 (2.11)</td>
<td></td>
</tr>
<tr>
<td>Y</td>
<td>7.66 (4.12)</td>
<td>14.58 (4.71)</td>
<td>6.53 (2.04)</td>
<td></td>
</tr>
</tbody>
</table>

(* = p<0.05 ** = p<0.001)
Results

- V and Y lighting lead to earlier detection than control at night, but only when participants told to look for bike

- V and Y lighting lead to larger gap accepted than control at night

- Detection better during the day, and when under ‘search’ instructions
### Results – Mean TTC in seconds (StDev)

<table>
<thead>
<tr>
<th>Time of day</th>
<th>Lighting</th>
<th>Attention</th>
<th>Search</th>
<th>Gap</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Night</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>5.14 (3.37)</td>
<td>8.18 (3.79)</td>
<td>6.21 (1.95)</td>
</tr>
<tr>
<td>V</td>
<td></td>
<td>4.82 (3.32)</td>
<td>8.88* (4.46)</td>
<td>6.68** (1.98)</td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td>4.57 (3.33)</td>
<td>9.55** (4.74)</td>
<td>6.91** (2.05)</td>
</tr>
<tr>
<td><strong>Day</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td></td>
<td>7.77 (4.56)</td>
<td>14.48 (4.70)</td>
<td>6.50 (1.83)</td>
</tr>
<tr>
<td>V</td>
<td></td>
<td>7.46 (4.37)</td>
<td>14.49 (4.70)</td>
<td>6.57 (2.11)</td>
</tr>
<tr>
<td>Y</td>
<td></td>
<td>7.66 (4.12)</td>
<td>14.58 (4.71)</td>
<td>6.53 (2.04)</td>
</tr>
</tbody>
</table>

(* = p<0.05 ** = p<0.001)
Future work and implications
Future work (direct implications)

 Fit extra lights to motorbikes in the patterns tested here
   They help with conspicuity and judging speed of approach at night

 Motorcyclists in daylight
   Bikers need to be educated as to their relative lack of conspicuity at night, even with extra lighting – how best to do this?

 Expectancy for motorcyclists
   How best to tell drivers to look for bikes?
An aside...
Another implication – some advice for motorcyclists

- When approaching junctions, slow down, so that...
  - ...with a four-second time to contact (the ‘critical point’?) you are closer...

- ...and therefore bigger...

- ...and therefore it is easier for car drivers to judge your speed and time to contact

- The thing is...we know that motorcyclists actually travel slightly faster than surrounding traffic, e.g.
  - Walton and Buchanon (2012) – Motorcyclists observed to ride on average 10% faster than cars in observations at motorcycle accident ‘black-spots’ (but no account for demographics)
  - Horswill and Helman (2003) – Motorcycles observed to ride faster in real-world observations (gender and age controlled)

- The problem is...car drivers cannot detect this...
Some old advice

- An ex-colleague of mine once told me that I should ride with the following attitude:

  "Assume that drivers cannot see you – that you are invisible to them"

- It turns out that with respect to your approach speed this is sometimes literally true
How to change this?

- Slow down
- Fit extra lights
Thank you

‘Looked but failed to see’ collisions

Presented by Shaun Helman
Tel: 01344 77 0650
Email: shelman@trl.co.uk
References


References


Future work (interesting research)

- This was relatively easy visual search – future studies need to look at boundary conditions …
  - What about more complex scenes?
  - What about secondary task interference effects?

- Unsure how findings will transfer to naturalistic behaviour
  - Future work could explore this using instrumentation (including front-facing cameras and ‘near-miss’ detection on equipped/unequipped bikes)

- The interesting effects of oncoming vehicles...
Number of other vehicles approaching camera – effect on attention conspicuity
Number of other vehicles approaching camera – effect on search conspicuity
Number of other vehicles approaching camera – effect on gap judgement