Visual Scanning of Motorcycle Riders –
A Preliminary Look

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## BACKGROUND TO THE PROBLEM

### Motorcycle Fatalities in the USA

<table>
<thead>
<tr>
<th></th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total killed on US roadways</td>
<td>41,259</td>
<td>37,423</td>
<td>33,883</td>
<td>32,999</td>
<td>32,367</td>
</tr>
<tr>
<td>Motorcyclists killed</td>
<td>5,174</td>
<td>5,312</td>
<td>4,469</td>
<td>4,518</td>
<td>4,612</td>
</tr>
<tr>
<td>% change of motorcyclists killed from previous year</td>
<td>+7.0</td>
<td>+2.7</td>
<td>-15.9</td>
<td>+1.1</td>
<td>+2.1</td>
</tr>
<tr>
<td>Motorcyclists injured</td>
<td>103,000</td>
<td>96,000</td>
<td>90,000</td>
<td>82,000</td>
<td>81,000</td>
</tr>
<tr>
<td>Motorcyclist fatalities as % of all fatalities</td>
<td>12.5</td>
<td>14.2</td>
<td>13.2</td>
<td>13.7</td>
<td>14.3</td>
</tr>
</tbody>
</table>

Source: NHTSA Fatality Analysis Reporting System (FARS)
### Distribution of Fatal Motorcycle Accidents in USA

<table>
<thead>
<tr>
<th></th>
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<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single vehicle accidents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>50%</td>
<td>53%</td>
<td>52%</td>
<td>49%</td>
<td>51%</td>
</tr>
<tr>
<td></td>
<td>n=3107</td>
<td>n=2736</td>
<td>n=2259</td>
<td>n=2151</td>
<td>n=2163</td>
</tr>
<tr>
<td>Collision with another</td>
<td>50%</td>
<td>47%</td>
<td>48%</td>
<td>51%</td>
<td>49%</td>
</tr>
<tr>
<td>vehicle in transport</td>
<td>n=2047</td>
<td>n=2554</td>
<td>n=2203</td>
<td>n=2351</td>
<td>N=2449</td>
</tr>
</tbody>
</table>

Source: NHTSA Fatality Analysis Reporting System (FARS)
BACKGROUND TO THE PROBLEM
INITIAL HYPOTHESES

• Poor scanning contributes to both single vehicle and multiple vehicle crashes
• Scanning patterns differ between car drivers and motorcycle riders
• Scanning patterns differ between beginner and experienced riders
• Rider training can improve scanning patterns
METHODOLOGY – SYSTEM DEVELOPMENT

• Arrington Eye Tracker System
• Speedbox - GPS and speed measurement
• Inertial motion units on helmet and motorcycle
• All instrumentation mounted on rider’s own motorcycle
• 31 riders recruited
  • Beginner Untrained – recent MC endorsement without any rider training
  • Beginner Trained – recent MC endorsement and signed up for Team Oregon BRT
  • Experienced – minimum of 5 years and 15,000 miles of riding experience
METHODOLOGY – EYE TRACKER TECHNOLOGY
METHODOLOGY – EYE TRACKER TECHNOLOGY
METHODOLOGY – DATA COLLECTION

- Both closed course and open road riding (9.4 miles)
- Helmet mounted two way communication with following rider
- 3 separate test sessions (one every 6 months)
METHODOLOGY – DATA ANALYSIS

- Over 30 hours of eye tracker data collected
- Data was parsed into 63 distinct segments
- 3 segments were analyzed in detail
  - Closed course left hand curve
  - Open road left hand curve
  - Open road straightaway
- Analysis of the speed to sight distance ratio
  - (distance required to stop with .7g braking at instantaneous speed)
- Visual gaze 95% confidence ellipse calculation
METHODOLOGY – DATA ANALYSIS
• Significant across test session (alpha = .05)
• Tukey Post-hoc significant difference between beginner untrained riders and beginner trained and exp. riders
RESULTS

[Bar chart showing mean 95% confidence ellipse area across test sessions for beginner-trained, beginner-untrained, and experienced participants.]
RESULTS

Team Oregon Open Road Ride

Beginner Untrained Rider  Experienced Rider
SUMMARY AND CONCLUSIONS

- No significant difference between beginner untrained and experience riders in terms of sight distance to stopping distance ratio during Session 1
- Significant difference between groups in terms of sight distance to stopping distance ratio (Sessions 2 and 3)
- Sight distance to stopping distance ratio dropped below 1.0 more often for beginner untrained riders
- Sight distance to stopping distance ratio dropped below 1.0 more often during Session 2 than Session 3
- Bottom line: Training improves sight distance to stopping distance ratio – but so does riding experience
SUMMARY AND CONCLUSIONS

• No significant difference between beginner untrained and experience riders in terms of gaze 95% confidence ellipse during Session 1
• Significant difference between groups in terms of gaze 95% confidence ellipse (Sessions 2 and 3)
• Gaze 95% confidence ellipse was significantly larger for beginner untrained riders as compared to experienced riders (Sessions 2 and 3)
• No significant difference between beginner trained riders and any other rider group (Sessions 2 and 3)
• Bottom line: Gaze area may not be a good indicator of visual strategies
SUMMARY AND CONCLUSIONS

- Beginner riders make more glances (total) and more glances to non-riding related targets
- Initial qualitative analysis suggests that beginner riders have no distinct scanning strategy
- As a rider gains more riding experience, their ability to focus upon riding related targets improves
- Collection and analysis of eye tracking information is critical to understanding visual targeting and hazard perception strategies for motorcycle riders
Thank You!