Dr. Ruth Madigan & Professor John Groeger

Learning to Drive: From Hazard Perception to Hazard Handling
Introduction

- Research Rationale
- Hazard Perception
  - Detection & Handling
- Declarative Knowledge of Driving
  - Driving Theory Test
- Conclusions
Background to Research

- Limited knowledge about the benefits of pre-driving education

- Some evidence linking hazard perception skill to driver safety
  - Experience-related differences have emerged
    - More experienced (safer) drivers respond more quickly to hazards than novice (less safe) drivers
What is a Hazard?
“any situation in which a collision or near collision with another road user or external object could occur unless you take some type of evasive action (e.g. braking, steering, etc.)”

What is Hazard Perception?
“the ability to quickly perceive and respond to a potentially dangerous driving event” (Crundall et al., 2003)

Contribution of Hazard Perception
- Only driver-specific skill found to correlate with crash involvement (Horswill & McKenna, 2004)
- Although only in limited circumstances (Wells et al., 2008)
Evaluating Hazard Perception Skill

- Majority of hazard perception tests consist of button press responses to hazards presented in filmed scenarios

- Response

  Discrete button press, analogous to simple reaction time vs Choice between several alternative actions
Selecting Hazardous Events

- Little knowledge of which particular stimuli discriminate between novice & experienced drivers
  - Or why?
- Hazards selected based on characteristics of young driver accidents
  - Events which naturally occur in the driving environment
    - Bends
    - Cars pulling out
    - Traffic Lights
    - Pedestrians
Driving Simulator Technology

- Provides high fidelity, fully immersive environment for drivers
- Allows manipulation of hazards
- UCC’s Simulator:
  - Augmented STISIM 400W
  - Full Size Vehicle
  - Output
    - Speed
    - Pedal and steering wheel movement
    - Lateral Position
Contrasting Detection and Handling

- Cognitive Account of Driving
  - Separates process of hazard responding into:
    - Hazard detection
    - Threat appraisal
    - Action selection
    - Action implementation

- Hazard Detection
  - Discrete response to viewing hazardous events incorporated within continuous drive

- Hazard Handling
  - Changes in driving when confronting identical events in the same setting
Research Questions

1) Are hazards detected in a fixed-speed, immersive driving environment
   - Speed, lane positioning etc. controlled
   - Outcome variables
     - Response Rate (no. of responses)
     - Response Time

2) Is there a discernable change in a hazard handling test which measures actual driving behaviour?
   - Outcome variables
     - Response Rate
     - Behavioural Response Time
Design of Drive

- Route length – 25km
- Five Speed Zones: 25kph, 40kph, 60kph, 70kph, 100kph
- Five hazard types
  - Traffic Lights
  - Bends
  - Car Emerging
  - Merging Traffic
  - Pedestrians
- Control events to check for false responding
Participants

- **Novice Drivers (N=18; 8 male, 10 female)**
  - Age Range: 19.45 years to 23.35 years (M=20.68; SD=.98)
  - Driving Experience: 0-2 years (M=1.01; SD=.65)

- **Experienced Drivers (N=18; 9 male, 9 female)**
  - Age Range: 21.49 years to 36.84 years (M=24.25; SD=3.58)
  - Driving Experience: 5-17 years (M=6.86; SD=2.79)

- Groups differed significantly in terms of age (t(34)=-4.09; p<.001)
Comparing Response Rates across Tests

Response Rate

Test Type

Hazard Detection  Hazard Handling

Novice

Experienced

*p<.05
Comparing Response Times across Tests

Hazard Detection

Hazard Handling

Response Time (secs)

Novice

Experienced

*p<.05

Test Type

46th CIECA
Congress Dublin 4th – 7th June 2014
Driving Theory Test:

- 40 questions on the topics such as the following:
  - The rules of the road
  - Risk perception
  - Hazard awareness
  - Good driving behaviour

- Participants need to get 35 questions correct to pass

- Maximum of 45 minutes to complete
Significant effect of experience on the number of correct responses made ($t(32)=-3.54; p<0.001$, $|d|=1.20$)

- Novice drivers ($M=80.38\%, SE=2.23$) making fewer correct responses than experienced drivers ($M=88.72\%; SE=1.06$).

No significant experience differences in average response time to DTT items ($t(33)=0.72; p=0.48$, $|d|=0.24$)
## Novice Drivers: Driving Knowledge & Hazard Perception

<table>
<thead>
<tr>
<th></th>
<th>DTT Score</th>
<th>DTT RT</th>
<th>HD-RR</th>
<th>HD-RT</th>
<th>HH-RR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. DTT Score</strong></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2. DTT Mean RT</strong></td>
<td>-0.20</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3. Hazard Detection Mean RR</strong></td>
<td><strong>0.62</strong>*</td>
<td>0.17</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4. Hazard Detection Mean RT</strong></td>
<td>-0.26</td>
<td>0.30</td>
<td><strong>-0.50</strong>*</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>5. Hazard Handling Mean RR</strong></td>
<td>0.04</td>
<td>-0.20</td>
<td>0.29</td>
<td>-0.43</td>
<td>1</td>
</tr>
<tr>
<td><strong>6. Hazard Handling Mean RT</strong></td>
<td>0.28</td>
<td>-0.37</td>
<td>-0.08</td>
<td>-0.34</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>DTT Score</td>
<td>DTT RT</td>
<td>HD-RR</td>
<td>HD-RT</td>
<td>HH-RR</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------</td>
<td>--------</td>
<td>-------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>1. DTT Score</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. DTT Mean RT</td>
<td>-0.05</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Hazard Detection Mean RR</td>
<td>0.12</td>
<td>0.25</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Hazard Detection Mean RT</td>
<td>-0.13</td>
<td>-0.14</td>
<td>0.10</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5. Hazard Handling Mean RR</td>
<td>0.08</td>
<td>0.13</td>
<td><strong>0.53</strong></td>
<td>-0.24</td>
<td>1</td>
</tr>
<tr>
<td>6. Hazard Handling Mean RT</td>
<td>0.07</td>
<td>0.09</td>
<td>0.14</td>
<td>-0.07</td>
<td>-0.20</td>
</tr>
</tbody>
</table>
Simulated delivery of hazard perception tests can work equally as well as video-based recording.

- Both Hazard Detection and Hazard Handling tests distinguish between novice and experienced drivers in immersive environments.

This allows more manipulation of potential hazards.

- Potential to design hazardous events around accident ‘black-spots’
Use of a simulator provides a more implicit test of hazard handling behaviour than traditional button-press response tests.

Evidence that for novice drivers hazard perception tests link more into their knowledge of driving theory than their ability to respond safely.

- Driving behaviour not correlated to this knowledge.
THANK YOU