Interactive Driving Simulators: Implications for Clinical Use

Anne E. Dickerson, PhD, OTR/L, SCDCM, FAOTA
Department of Occupational Therapy
East Carolina University
Background

Simulators are showing promising potential:

• **Assessment** — Bédard et al. 2010; Shechtman et al., 2009

• **Intervention** — Devos et al., 2009; Devos et al. 2010; Akinwuntan et al., 2005; Unsworth & Baker, 2014

Drawback or Barriers

• **Simulation Sickness** — Park et al, 2006; Classen et al. 2011

• **Expense** — Gibbons et al. 2014; Lemieux et al., 2014

• **Outcome Measures** — Classen et al. 2013
What is the Face Validity for Older Adults?
Older Adults: Responses After Performance on Simulator  N = 31

- Is Driving Simulator Realistic to Real Driving?
- How Acceptable were Results of Simulator to Your Performance?
- How Realistic did Feedback Information Compared to Performance of Simulator Drive?
- How Acceptable Is Simulator for Testing Driving Skills

Number of Participants

- Not Acceptable/Realistic
- Probably Acceptable/Realistic
- Very Acceptable/Realistic

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Responses concerning Performance of Persons with Medical Conditions

- Acceptable for Practicing Driving Skills after Medical Condition
- Identify Issues for Someone with Condition that Significantly Affects Driving
- Identify Issues for Someone with Condition that Slightly Affects Driving

Number of Participants vs. Number of Confidence

- No Ability
- Some or Good Ability
- Excellent Ability

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What About Performance?
Exploratory study: Learning effects

• 80 healthy older adults – AMPS screened
• 57 able to complete the simulator study
  – 34 ages 60-69;  23 ages 70-79
  – 31 women;       26 men
  – 33 familiar;    24 unfamiliar
• 9 participants came back within 10 days and completed same drives.
Data

• Familiarization – 10 minutes
• Second drive – complex, environments & events

Outcome Measures

• Simulator report: Reaction times, crashes, lane maintenance
Critical Events Between Age Groups

Between Age Groups - Not significant for total score (p=.079)
## Results: Driving Simulator Output

<table>
<thead>
<tr>
<th>8 out of 34 comparisons</th>
<th>Mean (Standard Deviation)</th>
<th>t-test</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>60-69</td>
<td>70-79</td>
<td></td>
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<tr>
<td>Minimum time to collision with vehicles in the driver's lane 1 (seconds)</td>
<td>2.73 (1.5)</td>
<td>4.02 (2.4)</td>
<td>-2.6</td>
</tr>
<tr>
<td>Minimum distance to vehicles in the driver's lane 1 (feet)</td>
<td>39.2 (20.3)</td>
<td>60.0 (41.5)</td>
<td>-2.5</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td>M F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average Speed, vehicle control avoidance (mph)</td>
<td>51.8 (5.8)</td>
<td>47.3 (7.4)</td>
<td>2.2</td>
</tr>
<tr>
<td>Minimum Speed, vehicle control avoidance (mph)</td>
<td>42.8 (6.6)</td>
<td>38.6 (6.7)</td>
<td>2.1</td>
</tr>
<tr>
<td>Gas Pedal Reaction Time 7, head on collision (seconds)</td>
<td>27.5 (7.1)</td>
<td>32.5 (7.9)</td>
<td>-2.2</td>
</tr>
<tr>
<td><strong>Familiar vs Unfamiliar</strong></td>
<td>F U</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gas Pedal Reaction Time 1, sudden lead vehicle braking (seconds)</td>
<td>15.4 (1.9)</td>
<td>14.6 (1.0)</td>
<td>2.1</td>
</tr>
<tr>
<td>Average Speed, vehicle control avoidance (mph)</td>
<td>50.5 (5.8)</td>
<td>47.0 (7.8)</td>
<td>1.9</td>
</tr>
<tr>
<td>Gas Pedal Reaction Time 7, head on collision (seconds)</td>
<td>29.1 (7.1)</td>
<td>33.3 (7.6)</td>
<td>-2.1</td>
</tr>
</tbody>
</table>
9 Repeaters

- 5 males, 4 females
- 5 familiar, 4 unfamiliar
- Ages: 63, 65, 69, 70, 70, 71, 72, 73, 79
Data

• Familiarization – 10 minutes
• Second drive – complex, environments & events

Two Outcome Measures

• Simulator report: Reaction times, crashes, lane maintenance
• 5 point scale – based on the critical events in the drive; each event scored.
Figure 1. Comparison of Scores by Time, N=9

Critical Events

Score

Hiddenstopsign  Pedestrian2  Leftturn  Pedestrian3  ApproachingCar

Time 1  Time 2
Paired t test 2.08 = p < .07
Time 1, Time 2, Number of Errors on Road
Implications

• Even healthy older adults make errors on the simulator –
  – Performance not based on age, gender, or familiarity of technology
  – Practitioners must learn to differences between “common” errors with critical events and errors from cognitive impairment.
  – Cannot depend solely on the simulator’s output measures

• Differences between two time periods supporting the “learning curve”.

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Limitations

- Small number of repeaters
- Repeating same scenario – learning scenario or learning how to use technology?
- Simulation sickness
- Need to compare to on road performance
Future Work

• Young adults and older adults
• Comparison of same drive and different drive.
• Compare other assessment tools
• Driving performance comparison of the on road
References:

Thank you & Questions

• Collaborators
  – Andrew Grossman
  – Kate Boyd
  – Jenna Mullet
  – Lara Keyes
  – Alina Avanesova

• Dickersona@ecu.edu