Turn-by-Turn Displays versus Electronic Maps: An On-the-Road Comparison of Driver Glance Behavior

University of Michigan
Ann Arbor, Michigan, USA

Aaron Brooks, Christopher Nowakowski, and Paul Green

1 ISSUES

1. Which display was glanced at more, the turn-by-turn or route map?
2. What factors affected glances to the turn-by-turn and route map displays?
3. When did display glances occur along the road segments?

2 METHOD

On-the-Road Driving Scenario

Magellan PathMaster navigation units (2)

Sample Display Screens

Turn-on-Turn

Route Map

(exact 80% of actual size)

<table>
<thead>
<tr>
<th>Subjects</th>
<th>Left</th>
<th>Right</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young (18-30)</td>
<td>map</td>
<td>turn</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>turn</td>
<td>map</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Older (65+)</td>
<td>map</td>
<td>turn</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>turn</td>
<td>map</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Protocol

• Experimenter remotely enters destination from back seat
• Subject drives to destination using both displays
• Repeat for two practice destinations and six test destinations (total of 37 miles and 45 turns)
4 RESULTS

Issue 1 - Which display was glanced at most?

Overall display and location effects

<table>
<thead>
<tr>
<th></th>
<th>Configuration 1</th>
<th>Configuration 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Glances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Right</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
- Turn-by-turn display glanced at 3.75 times more often than route map display
- Both displays glanced at more when on the right side of the steering wheel

Issue 2 - What factors affected display glances?

Age and gender effects

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Older Age</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Age and gender affected glances
  - young women similar to older men
  - young men similar to older women
- Average of 291 glances per subject (9.5 glances per mile over the 30.7-mile route)

Issue 3 - When did display glances occur?

Glance rate summaries for freeway and city roads

- Turn-by-turn display
  - Burst of glances at segment start
  - Steady glance rate over remainder of segment, with slight increases when system spoke
- Route map display
  - Low uniform glance distribution

5 CONCLUSIONS

- Drivers relied primarily on the turn-by-turn display for navigation, not the route map.
- Glance rate was highest at the segment start, within 0.2 miles from the previous turn.
- Glance rate depended on the type of road being driven and the road segment length (7 to 11 total glances per mile for each subject was typical).
- In the U.S., navigation displays should be located to the right of the steering wheel, if possible.