A video-based investigation into driver’s (re-)orientation strategies

PhD title: Ready, Steady, Drive! How do we prepare the disengaged driver to resume navigation after a period of automated driving?

Research theme: HMI design for navigation systems in future highly automated vehicles

Supervision team:
Professor Gary Burnett (Human Factors Research Group)
Dr Gary Priestnall (School of Geography)
* Dr Holger Schnädelbach (Mixed Reality Lab)
Where am I?

Aims

- Introduce myself and the context of my research
- Overview of one PhD study (procedure & results of part 1)
- Where next?
My background

- Archaeology / Archaeozoologist (UCL)
  - Pre-Pottery Neolithic B (9,500 B.P.) Kefar Hahoresh, Israel
  - Iron Age France, Auvergne Archaeological Survey
  - African Archaeology, Mali, West Africa
  - Post-graduate research associate (Cambridge Field Archaeology Unit)

- Publishing, music business, rail

- MSc in GIS and Spatial Analysis (UCL)
  - Roman, Volubilis, Morocco

- Technical Consultant in GIS/Logistics, MapMechanics
  - CILT – Associate member

- Teacher, English for Special Purposes
  - Torbay, Antalya, Madrid, London, Berlin, Cheney Court

- PhD Candidate – University of Nottingham
How do we prepare the disengaged driver to resume NAVIGATION of their vehicle after a short/medium/long period of automated driving?

How does the driver know where they are:
- in their whole journey
- in relation to their immediate surroundings
Simulate a handover or takeover scenario where participant:
• Knows/doesn’t know the area
• Has/has not been paying attention to their surroundings

Are participants able to locate themselves?

What strategies do participants adopt to (re-)orientate themselves?

Methodology
• Santa Barbara Sense Of Direction Scale (adapted)
• Video
  • Video 1: A to B route video
  • Video 2: 360° video at Location B (destination)
• Navigation tasks (Questions 1 – 7)
• Map drawing task (Question 8)
• Interview questions (Questions 9-20)

<table>
<thead>
<tr>
<th>Observation opportunity</th>
<th>No observation opportunity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Known area</td>
<td></td>
</tr>
<tr>
<td>GROUP 1</td>
<td>GROUP 2</td>
</tr>
<tr>
<td>Route video</td>
<td>360° video of destination</td>
</tr>
<tr>
<td>360° video of destination</td>
<td></td>
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</tbody>
</table>

| Unknown area             |                            |
| GROUP 3                  | GROUP 4                    |
| Route video              | 360° video of destination  |
| 360° video of destination|                            |
Study 2 – Where am I? A video-based investigation into driver’s orientation strategies
Navigation tasks:

Question 1: Do you know where you are?

Question 2: Which (compass) direction are you heading in here?

Question 3: Where are you heading? / What is in this direction?

Question 4: Was it easy or difficult to locate yourself?

Question 5: What made it easy or difficult?

Question 6: Can you point the camera so that the following landmarks are in the centre of the screen?

Question 8: Could you draw me a map of the immediate area, including a couple of landmarks.
Where am I?
Study 2 – Where am I? A video-based investigation into driver’s orientation strategies

Results:

- Questions 1 to 3 – by group
- Questions 4 & 5 together
- Question 6 – in more depth
- Question 8 – in overview
**Where am I!?**

**Results: Questions 1 - 3**

<table>
<thead>
<tr>
<th></th>
<th>Group 1 Known Area Condition 1</th>
<th>Group 2 Known Area Condition 2</th>
<th>Group 3 Unknown Area Condition 1</th>
<th>Group 4 Unknown Area Condition 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Do you know where you are?</strong></td>
<td>80% correct/quickly 20% correct/hesitant</td>
<td>33% correct/quickly</td>
<td>Without map: 60% no idea, 20% England in the South, 20% local/Nottingham</td>
<td>Without map: 40% no idea, 20% described what seen, 40% UK/local area (Nottingham)</td>
</tr>
<tr>
<td><strong>2. Which direction are you facing here?</strong></td>
<td>![Diagram 1]</td>
<td>![Diagram 2]</td>
<td>![Diagram 3]</td>
<td>![Diagram 4]</td>
</tr>
<tr>
<td><strong>3. What is in this direction?</strong></td>
<td>50% correct/quickly 25% correct/hesitant 25% alternative answer</td>
<td>50% correct/quickly 16% correct/hesitant 34% not certain</td>
<td>Out of a town, to a motorway, no idea, a roundabout, away from a town, LIDL, home?</td>
<td>Out of a town, junction, roundabout, traffic lights, motorway, LIDL Distribution Centre</td>
</tr>
</tbody>
</table>
### Where am I?

**Results: Questions 4 and 5 – Was it easy/difficult to locate yourself? What made it easy/difficult?**

<table>
<thead>
<tr>
<th>Group 1 – Known area &amp; Condition 1</th>
<th>Group 2 – Known Area &amp; Condition 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 100% said it was easy</td>
<td>• 20% said it was easy</td>
</tr>
<tr>
<td>Easy:</td>
<td>• 80% said it was difficult</td>
</tr>
<tr>
<td>• Knowing the area</td>
<td>Easy:</td>
</tr>
<tr>
<td>• ‘Welcome to Southampton’ sign</td>
<td>• LIDL Distribution Centre</td>
</tr>
<tr>
<td>Difficult:</td>
<td>• Top-down view</td>
</tr>
<tr>
<td>• ‘If I hadn’t seen the route before, I wouldn’t be able to work out where I was’</td>
<td>• Familiarity with area/route</td>
</tr>
<tr>
<td></td>
<td>Difficult:</td>
</tr>
<tr>
<td></td>
<td>• Lack of defining features</td>
</tr>
<tr>
<td></td>
<td>• Unable to turn head</td>
</tr>
<tr>
<td></td>
<td>• Vehicles block view</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group 3 – Unknown Area &amp; Condition 1</th>
<th>Group 4 – Unknown Area &amp; Condition 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 40% said it was easy, with the maps</td>
<td>• 60% said it was easy, with the maps</td>
</tr>
<tr>
<td>• 40% said it was difficult</td>
<td>• 40% said it was difficult</td>
</tr>
<tr>
<td>• 20% said it was impossible</td>
<td>• 60% said it was easy, with the maps</td>
</tr>
<tr>
<td>Easy:</td>
<td>• Shape of the road, what is around, building on the left (LIDL)</td>
</tr>
<tr>
<td>• The maps (see what is ahead/around, labels, road names)</td>
<td>• Combination of video 2 and map</td>
</tr>
<tr>
<td>Difficult:</td>
<td>• Map: text labels, bird’s eye view, seeing ahead of where you are, assumption that North is up (allocentric map)</td>
</tr>
<tr>
<td>• Assumption/local bias</td>
<td>Difficult: rotation of video, assumption/local bias, false confirmation from ‘familiar landmarks’</td>
</tr>
<tr>
<td>• Static image</td>
<td></td>
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<tr>
<td>• ‘symmetry of the circle’</td>
<td></td>
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</table>
Where am I?

Question 6: Can you point the video to the following landmarks?

- Holiday Inn Express
- Walnut Tree Farm
- Ordnance Survey
- M271
- M27
- Southampton (city centre)
- Southampton Central Train Station
- Romsey
- Christchurch
Where am I?

Question 8: Map drawing task

- Pass 1: Individual
- Pass 2: By group
- Pass 3: By condition
- Pass 4: ‘Ground truth’ – how “accurate” are the maps
- Pass 5: Are the maps understandable by others?
- Pass 6: What have I missed
Ready, Steady, Drive!

Study 2 – Where am I? A video-based investigation into driver’s orientation strategies

Known area

Unknown area
Interesting overall findings:

- How well do you know your local area (presented with unexpected position/place/direction of travel)?
- Road-based bias in orientation/direction-giving in known area
- Road-name bias (known area)
- Greater accuracy in compass direction (unknown groups, with maps)
- Unknown area – tendency to explain what you can see
- Assumptions and bias to the ‘local’
- False confirmation from landmarks that seem familiar
- Driver or passenger? (see more/different detail)
- Who is in the vehicle with you?
Next steps:

- Complete analysis of interview questions
- Focus groups (Dec/Jan)
  - to develop scenarios
  - further development of taxonomy of handover scenarios
- develop design options
- ‘Wizard-of-Oz’ prototype design and testing
Where am I?

Remember the human ...

... so we can avoid this.
Thank you for listening

Any questions?

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