ACCESSING MEANING, USABILITY, AND USER EXPERIENCE:
WHAT EYE TRACKING MIGHT AND MIGHT NOT TELL US IN THE
HEALTHCARE CONTEXT

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Accessing meaning, usability, and user experience: What eye tracking might and might not tell us in healthcare

1. Accessing meaning – developing mental models/knowledge clusters
2. Linking cognition to eye tracking
3. Eye tracking and healthcare – the usability problem
4. Potential uses
5. Eye tracking metrics and usability – minding the gap
Accessing meaning - knowledge clusters

**The Savoy**
- Beautiful restaurant
- Greeted
- Waitress/Waiter
- Menu
- Order food ...
- A very large bill!

**McDonalds**
- Busy with bright lighting
- Queue to order
- Look at pictures of meals
- Order food ...
- A smaller bill!
Accessing meaning - knowledge clusters

The Savoy

- Beautiful restaurant
- Greeted
- Waitress/Waiter
- Menu
- Order food ...
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“I went to the Savoy for lunch. ....

I had a hamburger and fries – great for a quick lunch and so cheap.”
The Savoy
- Beautiful restaurant
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“I went to the Savoy McDonalds? for lunch. ....

I had a hamburger and fries – great for a quick lunch and so cheap.”
Developing knowledge clusters/mental models from new information

A visual usability problem – lack of appropriate visual cues

From Bransford & Johnson (1972)
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Linking cognition to eye tracking

The eye-mind hypothesis

There is a direct link between what is fixated and how information is processed.

Just & Carpenter (1980)

The visual system is .... centrally implicated in learning, higher-order cognitive-affective processes and decision-making.

Wedel & Pieters (2007)
Linking cognition to eye tracking

Once upon a time there were three bears who lived in a house on the edge of a wood. Every day a little girl called Goldilocks walked through the wood on her way to her Grandmother’s house in the nearby village of Gorehampton.

**Fixations:** stops in eye movements where visual information is sampled.

**Saccades:** rapid eye movements between fixations
Eye tracking, attention and usability
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Eye tracking and healthcare

The usability problem

- Health technology has tremendous potential to improve quality of care, patient safety, efficiency within health care systems
- There are often strong forces driving the adoption of healthcare technology (e.g., government funding, incentives)

BUT

- Healthcare workers often not keen to adopt new technologies
- Patients often find equipment difficult to use and ‘give up’
- Due to design and usability problems creating errors and user frustration

Asan & Yang (2015)
Eye tracking and healthcare – healthcare professionals

The usability problem
Eye tracking and usability
How can eye tracking help with healthcare technology?

**Does this help solve the problem?**

- Indicates the visual cues employed by users
- No. of fixations and fixation duration can tell us where long processing times or confusion are arising
- The fixation ‘path’ can help to inform about ‘workflow’
- Workload may be indicated by pupil dilation

- Measures indicate the usability of equipment
- Can be used to evaluate if ‘improvements’ are effective
- Can be used to examine individual differences in use (e.g., differences arising from due to health, age, role in a team)
Eye tracking and healthcare

*Can be combined with other usability measures*

- Cognitive walkthroughs
- System usability scales
- Post-test interviews
- Gaze replay
- Workload (e.g. NASA-TLX)
- Situation awareness (e.g. SPASA questionnaire)
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Potential uses in healthcare?

- Surgical interfaces/healthcare devices
- Patient homecare support
- Alarms in theatres – multimodal systems
- Social systems and team work
- Mobile tracking of systems in use
- Hospital/care home navigation
- On-line health information (website design)
- Computerised order system
How can eye tracking help with healthcare technology?

**BUT ....**

*Need to be aware of what eye tracking measures really mean*

*Poole & Ball (2005)*

<table>
<thead>
<tr>
<th>Eye movement metric</th>
<th>What is being measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of fixations overall</td>
<td>More fixations indicate less efficient search</td>
</tr>
<tr>
<td>Fixations per interest area</td>
<td>More fixations indicate that the information is more important or more noticeable</td>
</tr>
<tr>
<td>Fixation duration</td>
<td>Indicates difficulty extracting information</td>
</tr>
<tr>
<td>Repeat fixations</td>
<td>Indicates confusion; inability to extract meaningful information</td>
</tr>
<tr>
<td>Time to 1st fixation</td>
<td>Faster times indicate that this information grabs attention</td>
</tr>
</tbody>
</table>
How can eye tracking help with healthcare technology?

*Need to be aware of what eye tracking measures really mean*

<table>
<thead>
<tr>
<th>Other metrics</th>
<th>Types of measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saccades</td>
<td>No. of saccades, regressive saccades, saccade amplitude ...</td>
</tr>
<tr>
<td>Scanpath</td>
<td>Duration, length, regularity, direction</td>
</tr>
<tr>
<td>Pupil response &amp; blink</td>
<td>Used to indicate workload, fatigue, situation awareness (e.g. Jiang, Zheng, Bednarik &amp; Stella, 2015)</td>
</tr>
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Mind the gap between processing and eye tracking

Eye tracking may not always indicate cognitive processing

Henneman et al. (2014)

- Found that healthcare workers did not notice errors in patient records even if the eye tracking data showed that they were looking at it.
- This indicates that there may be a mismatch between gaze, attention, and cognitive processing.

Pilot data from our laboratories

- Indicates that individuals may make instantaneous decisions before eye movements have really begun.
- This may be because users can make some decisions by taking in the gist of a scene which occurs in 60-70 milliseconds (see Oliva et al., 2006)
Potential uses in healthcare?

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