The eye of the master II
MedEye: Perceiving dynamic medical images

Halszka Jarodzka, Els Boshuizen, & Kenneth Holmqvist

Eye tracking equipment at CELTEC
Mobile eye tracker: SMI HED
Monitor-integrated eye tracker: Tobii 1750
Monitor-mounted eye tracker that can be used as a stand-alone version: SMI RED 250

Prior project: IN THE EYE OF THE EXPERT – PERCEPTUAL SKILLS IN MEDICAL DIAGNOSIS

Procedure, Knowledge, & Skills
1. Specifying body parts that might be affected by the disease
2. Specifying the motion pattern of these body parts
3. Specifying the patient’s state of consciousness
4. Indicating the involvement of the face
5. Indicating a change in motion after tracking
6. Assigning observations to the matching diagnostic code

Perceptual skills
1. Specifying body parts that might be affected by the disease
2. Specifying the motion pattern of these body parts
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4. Indicating a change in motion after tracking
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Eye tracking: Tracking the movements of the eyeball(s) to where a person looked, for how long, and in what order.

From Holmqvist, Nyström, Andersson, Dewhurst, Jarodzka, & van de Wijer (2011)
Research questions

1. Analyzing the role of perceptual skills on different expertise levels
   - Expertise difference study with eye tracking and thinking aloud during task performance (Study 1)
2. Developing and testing a method to teach perceptual skills
   - Instruction based on eye movement modeling examples, studied with eye tracking and learning outcomes (Study 2)

ROLE OF PERCEPTUAL SKILLS IN MEDICINE – STUDY 1

Empirical task analysis


Design

N = 43

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<th></th>
<th>n</th>
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<th>gender (fem.)</th>
<th>experience (yrs.)</th>
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<td>26.8</td>
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<td>0</td>
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<tr>
<td>residents</td>
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<td>32.8</td>
<td>12</td>
<td>1.5 (0.5—3.0)</td>
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<td>experts</td>
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<td>50.8</td>
<td>4</td>
<td>18.3 (5.0—32)</td>
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Diagnosis of four patient video cases: two seizures and two disorders imitating seizures.

Procedure

1. Thinking aloud training
2. Mile's test for dominant eye, calibration
3. *“Please take a look at the way the infant behaves...”*

Results and conclusions

Novices:
- look less at relevant AOIs
- verbalize more data exploration, i.e., more visual search → perceptual skills!
- verbalize less hypothesis building and evaluation
- diagnose less accurate

Perceptual skills are a prerequisite for successful task performance. But how to convert these skills?
Conveying Perceptual Skills

No methods to convey perceptual skills, the development of this inspired by methods to teach cognitive skills.

A prototypical instructional method for initial cognitive skill acquisition is example-based learning, like

- Worked examples
- Cognitive modeling

Instructional Approach: Example-based learning

Learning by studying examples of successful task performance is more efficient than learning by problem-solving alone.

Learning by observing a model during task performance.

"Modeling" processes that are not directly observable, like cognitive processes:

- Model verbalizes her/his internal states (cf. cognitive apprenticeship, process-oriented worked-examples)

Conveying Perceptual Skills

HOW TO CONVEY PERCEPTUAL SKILLS IN MEDICINE?

Novel instructional approach: Eye movement modeling examples

Eye movement modeling examples

- Expert model
- Student

Design & sample size


N = 60 medical students in their final year

<table>
<thead>
<tr>
<th>Eye movement modeling examples during learning</th>
<th>Control (none)</th>
<th>Circle display</th>
<th>Spotlight display</th>
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<td>n = 20</td>
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Procedure

<table>
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<tr>
<th>Learning</th>
<th>Testing</th>
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<tbody>
<tr>
<td>EMME (no vs. dot vs. spotlight)</td>
<td>New videos without guidance</td>
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</table>

- Euclidean distance over time between model’s and student’s gaze points
- Time until looking at relevant areas
- Total dwell time on relevant areas
- Percentage correct on multiple-choice questionnaire on interpreting
Research questions

During learning:
- Does EMME guide the students’ attention?

During testing:
- Does EMME lead to a more efficient visual search?
- Does EMME lead to a better interpretation performance?

Summary

- Successful attention guidance:
  The Euclidean distance over time between the expert’s and the student’s gaze points is smaller for the spotlight display group compared to the other two groups.

- More efficient visual search:
  Students, who learnt with the spotlight EMMEs looked faster and longer on relevant areas compared to the other two groups.

- Better interpretation performance:
  Students, who learnt with the spotlight EMMEs had higher correctness scores in the MCQs compared to the control group.

For questions on this talk, please contact me:

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