Visual expertise: Characteristics and instructional attempts

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Symposium 4C-ID: Hoe implementeer je de blauwdruk?

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Let me introduce myself...

• Background
  – Psychology with focus on educational & media psychology
  – Ph.D. thesis: characteristics and training of visual expertise investigated via eye tracking and verbal reports
  – Assistant professor at the CELSTEC, OU (since July 2010)

• Expertise
  – Guest researcher in a large eye tracking lab in Sweden (Humanities Lab in Lund)
  – Research on both applied (dynamic scenes, expertise differences, EMME, mental effort, web search, ...) and basic eye tracking topics (scanpath similarity measure, eye-hand measure)
  – Trainings on the eye tracking methodology (IPN Kiel, JURE, ICO, Stanford, ...)
  – Part of Orga team of the European Conference of Eye Movements (ECEM) 2013
Professions related to information-dense, dynamic scenes

- Air traffic control
- Marine zoology
- Meterology
- Medical imaging
- Car traffic
## Task analysis: Procedure, knowledge, and skills

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### Perceptual skills

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Based on **perceptual input**, i.e., perceptual skills

Based on **conceptual knowledge**
Goals

1. Analyzing the **role** of perceptual skills on different expertise levels.
   - To find the optimal approach to the task from experts
   - To detect deficiencies in novices
   - To get hints for instructional design

2. Developing and testing a method to **teach** perceptual skills.
Investigating the role of perceptual skills with increasing expertise
**Eye tracking:** Tracking the movements of the eyeball(s) to learn where a person looked, for how long, and in what order.
Eye tracking equipment at CELSTEC

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
Eye tracking data does tell us where a participant was looking at but not why.

**Methodological triangulation** with other data sources, like *verbal reports* and *performance* data.

Holmqvist, Nyström, Andersson, Dewhurst, Jarodzka, & van de Weijer, 2011. *Oxford University Press*
Analysis of the role of visual expertise in diverse professions

- Marine zoology
  Jarodzka, Scheiter, Gerjets, & Van Gog (2010). *Learning and Instruction*

- Medical diagnosis

- Air traffic control
  Van Meeuwen, Jarodzka, Brand-Gruwel, Van Merriënboer, De Bock, & Kirschner (in prep)

- Teachers’ classroom management
  Wolff, Van t’Zelfde, Jarodzka & Boshuizen
Empirical findings on the role of perceptual skills in domain-specific expertise

• Improving perceptual skills required for dynamic stimuli
  – efficient visually search within (equally) salient relevant and irrelevant elements and detection of relevant elements
  – correct interpretation of (the motion of) these elements

• Expert-specific strategies (*fish only*)
  – Knowledge- and experience-based shortcuts increase with expertise & enable a fast and correct reaction
  – found in verbal and in eye tracking data
  – strategies become more diverse with increasing expertise (as measured by string-editing Levenshtein method of scanpaths)
Training perceptual skills via EMME
Conveying Perceptual Skills

No methods to convey *perceptual* skills, the development of this inspired by methods to teach *other* skills.
Instructional Approach: Example-based learning

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

“modeling” processes that are not directly observable, like cognitive processes:

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

**HOWEVER:**
Only cognitive skills were modeled so far (reading, writing, calculating,...).

We need to model **perceptual** skills!
Novel instructional approach: Eye movement modeling examples

Moreover: Dorr, Jarodzka, & Barth, 2010; Jarodzka, Scheiter, Gerjets, Van Gog, & Dorr, 2009; Jarodzka, Balslev, Holmqvist, Nyström, Scheiter, Gerjets, & Eika, 2010;
Presentation of perceptual processes in video examples

- **Adding** information on perceptual processes to complex visualizations: overload → **Dot**

- Presenting perceptual processes by **reducing** existing information (e.g., Dorr, Vig, Gegenfurtner, Martinetz, & Barth, 2008; Nyström & Holmqvist, 2008) → **Spotlight**
EMME implemented in different domains

- leapfrog flash game

- classifying locomotion patterns of reef fish

- diagnosing epileptic seizures in infants
  Jarodzka, Balslev, Holmqvist, Nyström, Scheiter, Gerjets, & Eika, 2011. *Instructional Science*
Research questions

During **learning**:  
1. Does **EMME guide** the students’ attention?  
   ![Smiley face]

During **testing**:  
2. Does **EMME** lead to a more efficient **visual search**?  
   ![Smiley face]

3. Does **EMME** lead to a better **interpretation** performance?  
   ![Smiley face]
Take home message ...

What I wanted to convince you about today:

• Many professions have a complex perceptual part

• It is worth to have a closer look at the development of visual expertise in these professions
  – To understand the optimal approach to a task
  – To detect the difficulties of a task

• Teaching visual expertise is possible! For instance, by means of EMME
Thank you for your eye movements!

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