Through the Eyes of an Expert:  
Role and Training of Perceptual Skills  

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Learning and Cognition Plenary  
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Papers addressed in this talk  

Let me introduce myself...  
• 2001-2007: Diploma in Psychology from the Eberhard-Karls University of Tuebingen, Germany  
• Student research assistant at the Max-Planck-Institute in the area of infant cognitive development, at the Knowledge Media Research Center in the area of computer-based knowledge exchange, at the University of Tuebingen in the area of social psychology, and at SAP research  
• Master thesis focused on the topic of how to overcome the information exchange dilemma via shared databases (implemented as a web-based computer game)  
• 2007-2010: Research scientist and Ph.D. candidate at the Knowledge Media Research Center in the Hypermedia Lab  
• Research stays in Sweden (Humanities Lab, Lund), Denmark (medical department of Aarhus University), and the Netherlands (Open University of the Netherlands)  
• Since July 2010: Assistant professor at the Center for Learning Sciences and Technologies of the Open University of the Netherlands

What are perceptual skills and when do we need them?

Complex, dynamic, perceptual tasks  
- air traffic control  
- meteorology  
- medical diagnosis  
- car traffic  
- biodiversity  

Complex, dynamic, perceptual tasks  
- air traffic control  
- meteorology  
- medical diagnosis  
- car traffic  
- biodiversity  

Complex, dynamic, perceptual tasks  
require: conceptual knowledge & the ability to perceive the relevant out of the irrelevant and interpret it correctly  
perceptual skills
Perceptual Skills

**Classification of the locomotion pattern**

Specifying the motion pattern of these body parts

Specifying body parts that are used to produce propulsion

Diagnosis of the disease

Assignment of observations to the according class /
diagnosis

Visual inspection and interpretation of relevant elements

Specifying body parts that might be affected by the disease

Perceptual Skills

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Research Questions

1. Analyzing the role of perceptual skills on different expertise levels.
   - Expertise difference studies with eye tracking and thinking aloud during task performance.

2. Developing and testing a method to teach perceptual skills.
   - Instructional design studies with eye tracking and learning outcomes.

Role of perceptual skills in expert performance

- ... in classifying locomotion patterns of reef fish (biodiversity).

- ... in diagnosing epileptic seizures in infants (pediatric neurology).

Diagnosis in pediatric neurology


Expertise Differences in Air Traffic Control


**Diagnosis in pediatric neurology**


**Expertise Differences in Air Traffic Control**

Many instructional materials use expert knowledge to convey skills to learners. Presentation of perceptual processes in video examples may be different for the other two looks.


**Characteristics of Visual Expertise**

- Perceptual skills required for dynamic stimuli
  - Efficient visually search within (equally) salient relevant and irrelevant elements and detection of relevant elements
  - Correct interpretation of these elements
- Knowledge- and experience-based shortcuts (fish)
  - 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 Savenije’s method of scanpaths)

**Fostering perceptual skills**

1. Worked examples
2. Cognitive modeling

**Conveying Perceptual Skills**

Many instructional materials use expert knowledge to convey skills to learners. Two prototypical instructional methods for initial skill acquisition are:

1. Worked examples
2. Cognitive modeling

**Novel Instructional Approach: Eye Movement Modelling Examples**


**Presentation of Perceptual Processes in Video Examples**


- Adding information on perceptual processes to already complex visualizations might cause mental overload; furthermore, this type of presentation excludes the relevant information
- An alternative is to present perceptual processes by reducing existing information and highlighting the relevant information by reducing spatio-temporal contrasts and color saturation.
EMME in different applications

Learning Phase: Attention Guidance
- Facilitates distance over time between model's and student's gaze points
- Two videos

"Please take a look at the way the infant behaves."
- 17-50 seconds
- 3 items
- Which body parts are affected by the disease?
- How do these body parts move?
- Is the face diseased?
- Do the movements change after touching the infant?
- Two single infants aged 3 weeks and 7 months; prototypical cases of epilepsy

Testing Phase: Visual Search of Relevant Elements
- Time until looking at and dwell time on relevant areas
- 3 items
- 17-50 seconds
- Blank

Testing Phase: Interpretation of Relevant Elements
- Multiple-choice questionnaire on detecting and interpreting
- 3 items
- 17-50 seconds
- Blank

Summary of Results (Compared to Control Group Without Cue)

<table>
<thead>
<tr>
<th>Task</th>
<th>Biological classification</th>
<th>Medical diagnosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>Dot</td>
<td>Blurring CCM</td>
</tr>
<tr>
<td>Attention guidance</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>Visual search</td>
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<td>✗</td>
</tr>
<tr>
<td>Interpretation</td>
<td>✗</td>
<td>✗</td>
</tr>
</tbody>
</table>

CCM = contrast, color, motion
C = contrast

For questions on this talk, please contact me:
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