Processes mediating expertise in air traffic control

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Processes Mediating Expertise in Air Traffic Control

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Air traffic controllers have to take fast and correct decisions based on visualizations of the surrounding (Figure 1). These visualisations are composed of many airplanes including labels with crucial information (i.e., call sign, speeds, heading, etc.) and a number of potential routes. Despite of increasing air traffic, live of people must not be at risk. Thus, a detailed understanding of the processes underlying successful air traffic control (ATC) as well as understanding the difficulties of less experienced air traffic controllers is crucial. Such findings may inform user interface designers and instructional designers in ATC. Hence, this study examines how experts, intermediates, and novices in ATC make decisions based on stills from air traffic scenarios (cf. limited-information tasks; Hoffman, 1987) on a cognitive level (by means of verbal reports) and perceptual level (by means of eye-tracking). Moreover, the actual ATC performance and spatial ability (as potential mediator) of each participant are included in the analysis.
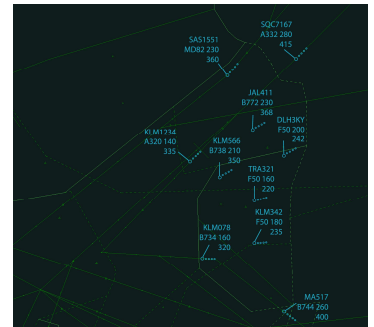

Figure 1, *still of an ATC situation*

Design

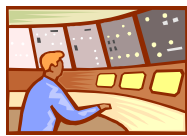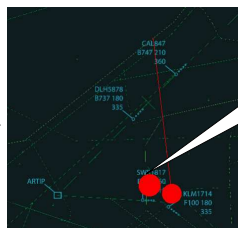| Knowledge Level		Task Difficulty		Spatial Ability Tests
Experts (n=8) Intermediates (n=8) Novices (n=15)	X	3 x Easy 3 x Medium 3 x Difficult	X	Logical Order (Stebner et al, 2009) Paper Folding (Ekstrom et al, 1976) Mental Rotation (Vandenberg et al, 1978)

Procedure

…Here I thought…

X 9

Performance and Perceptiual Processes (eye-tracking)

Cognitive Processes (Cued Retrospective Reporting, Figure 2 (Van Gog, Paas, Van Merriënboer, & Witte, 2005)

Spatial Ability (Questionaires)

Hypotheses

1) Experts will perform more accurately and faster than intermediates, which will outperform novices.

2) An efficient visual search for expert (looking quickly and for a long time on relevant areas), a detailed visual search for intermediates (looking at all potentially relevant areas with many transitions), and an inefficient and course visual search for novices (looking at salient, but irrelevant areas).

3) Experts are expected to verbalize less information than novices due to schema automation and, thus, use fewer words in their description of how they accomplish that task. Experts' verbalizations are expected to contain more encapsulating technical terms and indicators for relevant knowledge.

4) Novices' strategies will be guided by the salience of single features, intermediates will follow a text-book strategy, and experts' perceptual strategies are assumed to be characterized by experience- and knowledge-based shortcuts.

Figure 3, *fixations and saccades of expert (yellow) and novice (purple)*

Figure 2, *Cued Retrospective Reporting*

Planned Analysis & First Results

21 people participated in this study, so far: novices (n=6), intermediates (n=5), and experts (n=10).

-Time on task: Experts are faster than intermediates and both are faster than novices.

- Experts and Intermediates determine traffic conflicts which novices do not observe.

- Fixation analyses: Experts show less dispersed fixations (Figure 3).

- Knowledge: The solutions of experts are grounded on more domain specific knowledge.

-Planned: AOI analyses; Sequence analyses of E.T. and performance data; Mediation analyses of spatial abilities.

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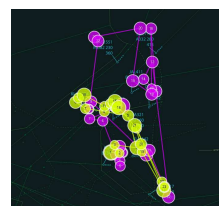
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