View metadata, citation and similar papers at core.ac.uk

brought to you by CORE

provided by Open University of the Netherlands Research Portal

Expertise development for a visual task: Eye movements, verbal reports, and spatial abilities in air traffic control

Citation for published version (APA):

Van Meeuwen, L., Jarodzka, H., Brand-Gruwel, S., Kirschner, P. A., De Bock, J., & Van Merriënboer, J. (2011). *Expertise development for a visual task: Eye movements, verbal reports, and spatial abilities in air traffic control*. Poster session presented at European Conference on Eye Movements 2011, Marseille, France.

Document status and date:
Published: 23/08/2011

Document Version:
Peer reviewed version

Please check the document version of this publication:

• A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
• The final author version and the galley proof are versions of the publication after peer review.
• The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

• Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
• You may not further distribute the material or use it for any profit-making activity or commercial gain
• You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the “Taverne” license above, please follow below link for the End User Agreement:

https://www.ou.nl/taverne-agreement

Take down policy
If you believe that this document breaches copyright please contact us at:

pure-support@ou.nl

providing details and we will investigate your claim.

Downloaded from https://research.ou.nl/ on date: 09 Sep. 2021

Open Universiteit
www.ou.nl

knowledge & development centre
Mainport Schiphol

Expertise development in a visual task

Ludo W. van Meeuwen[1,2], Halszka Jarodzka[1], Saskia Brand-Gruwel[1], Paul A. Kirschner[1], Jeano J.P.R. de Bock[2], & Jeroen J.G. van Merriënboer[1,3]

[1] Open Universiteit, The Netherlands, [2] Air Traffic Control, The Netherlands, [3] Maastricht University, The Netherlands *Correspondence to:* **Ludo.vanMeeuwen@OU.nl / Halszka.Jarodzka@OU.nl**

Errors in Air Traffic Control (ATC) are a risk to human life hence, air traffic controllers have to make fast and correct decisions. These decisions are based on complex visualizations of a surrounding area (*figure 1*). These visualisations are complex because they involve representations of many moving airplanes including their labels with crucial information (i.e., call sign, speeds, heading, etc.). Despite of increasing air traffic, live of people must not be at risk, so further understanding the causes for successful air traffic controllers 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 examined how experts, intermediates, and novices in ATC perceive and interpret ATC stimuli on a perceptual level (by means of eye-tracking) and on a performance level. Furthermore, the potentially mediating influence of spatial abilities was investigated. ATC decisions and a potential mediating influence of spatial abilities was investigated.

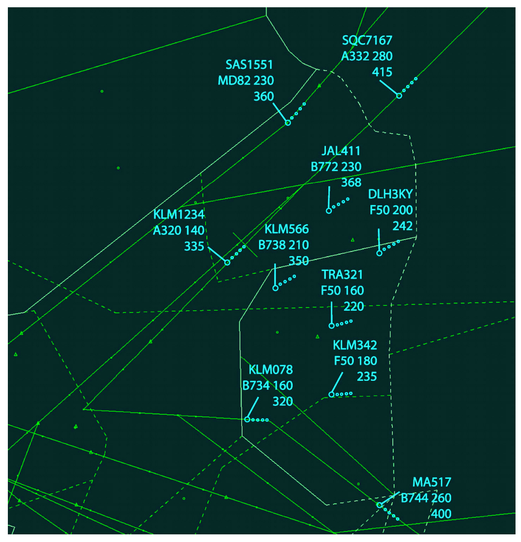


figure 1

Method

Knowledge Level

Experts (n=10)
Intermediates (n=9)
Novices (n=12)

X

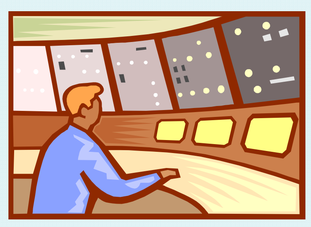
Spatial Ability Tests

Logical Order (Stebner et al, 2009)
Paper Folding (Stebner et al, 2009)
Mental Rotation (Vandenberg et al, 1978)

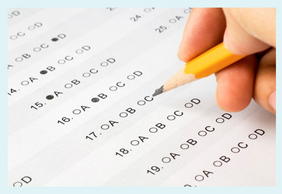
X

Task Difficulty

3 x Easy
3 x Medium
3 x Difficult

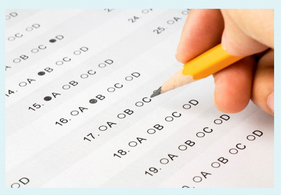


Performance and Perceptiual Processes (eye-tracking)



Mental Effort Questionaire (Paas, 1992)

X 9



Spatial Ability (Questionaires)

Participants

31 individuals
(*M* = 26.45 years, *SD* = 6.31; 8 females and 23 males):

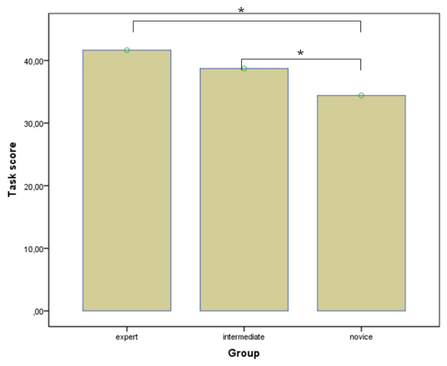
10 experts
(full licensed air traffic controllers);

9 intermediates
(trainees in the final phase of their on the job training);

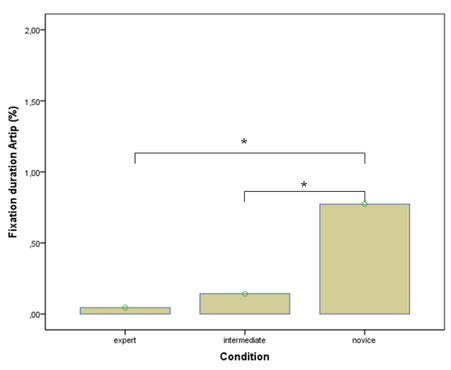
12 novices
(trainees in the initial phase of the ATC training)

Results

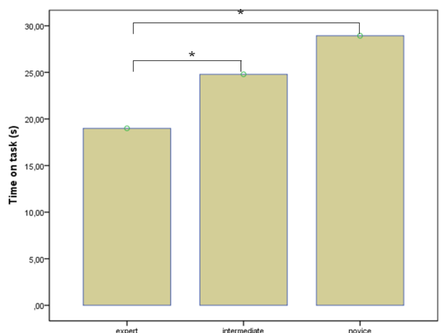
Performance



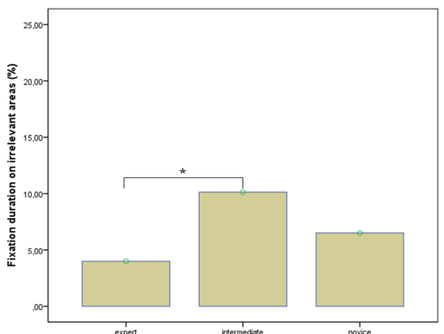
Fixation Duration Artip



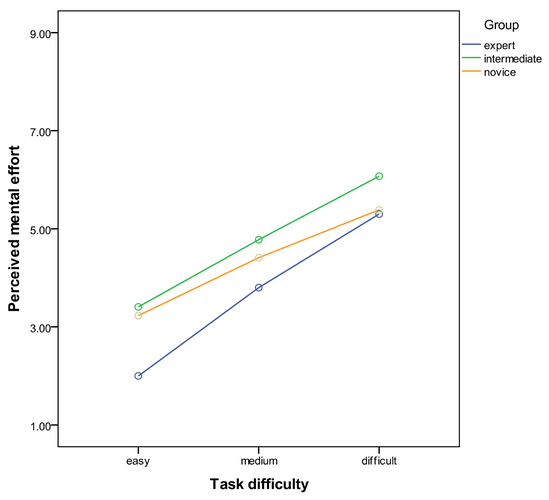
Time on Task



Fixation Duration Content



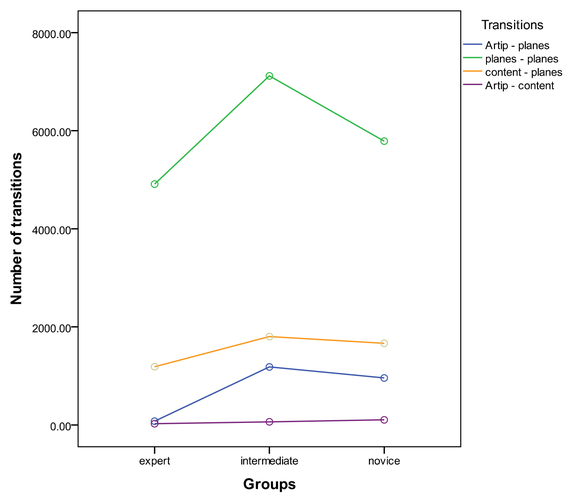
Mental Effort



Main effect on expertise level

And main effect on task difficulty

Transitions



Main effect on expertise level

And main effect on transition type

Conclusions

Experts…
- and intermediates perform better than novices.
- are faster than intermediates and novices.
- perceive less mental effort than intermediates.
- need fewer transitions between AOIs than intermediates and marginally fewer than novices.

Novices…
- need to look more on Artip (and look sooner on Artip) than intermediates and experts.

Intermediates…
- look more on content than experts.

But: No expertise difference were found in spatial ability.

References

Stebner, F., Lebens, M., Wirth, J., & Opfermann, M., (March, 2009). Learning from animations and static pictures: The impact of spatial ability and cognitive load. Paper presented at 3th International Cognitive Load Conference, Heerlen, The Netherlands.

Paas, F. (1992). Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive-load approach. *Journal of Educational Psychology, 84*, 429-434.

Vandenberg, S. G. & Kuse, A. R. (1978). Mental rotations, a group test of three dimensional spatial visualization. *Perceptual Motor Skills, 47,* 599-604.

Ministerie van Verkeer en Waterstaat
Luchtverkeersleiding Nederland
Air Traffic Control the Netherlands
Amsterdam Airport Schiphol
KLM SKYTEAM
NLR
U M
TU Delft Delft University of Technology
Open Universiteit
celstec.org