

# Please have a Look here: Successful Guidance of Air Traffic Controller's Attention



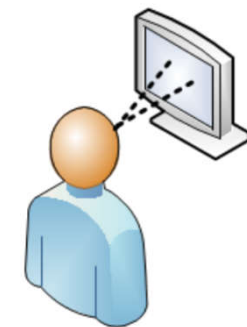
9<sup>th</sup> SESAR Innovation Days

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# Air Traffic Controller Attention

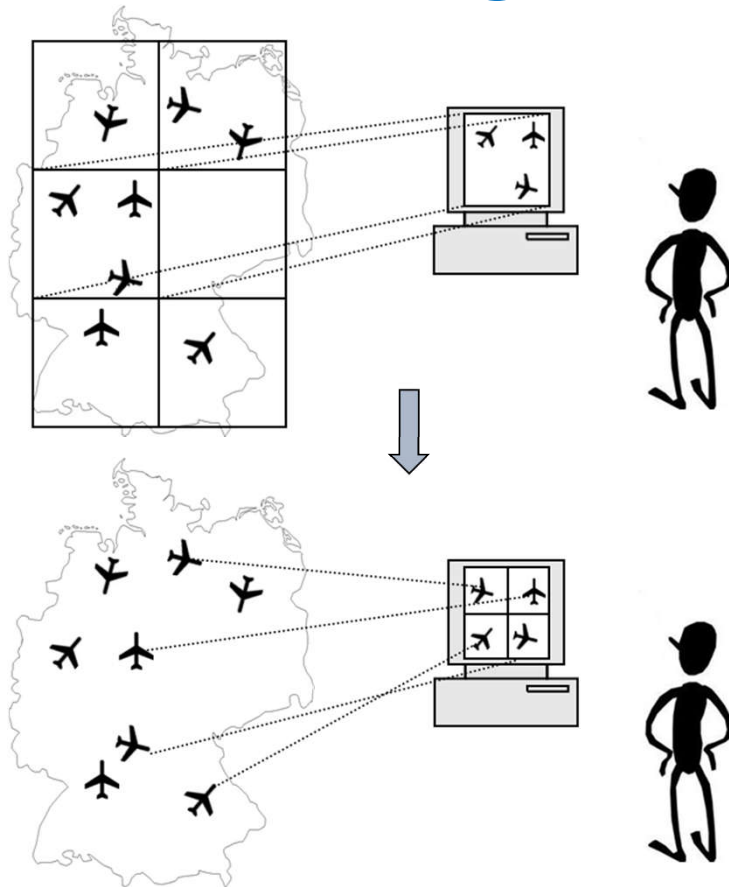
- Air Traffic Controller (ATCo)
  - Ensures safe and efficient air traffic
  - Supported by a situation data display
  - Assuming: Eye gaze focus = Attention focus
- Challenge: **Visual attention** at the right spot
  - Dense traffic (efficient task order)
  - Adopted air traffic control (ATC) methods (modified tasks)
  - Large screens (not miss information)
  - More automation (“passive” traffic monitoring)



→ Need for Attention Guidance



# Use Case: Flight-Centric ATC



- Sectorized control

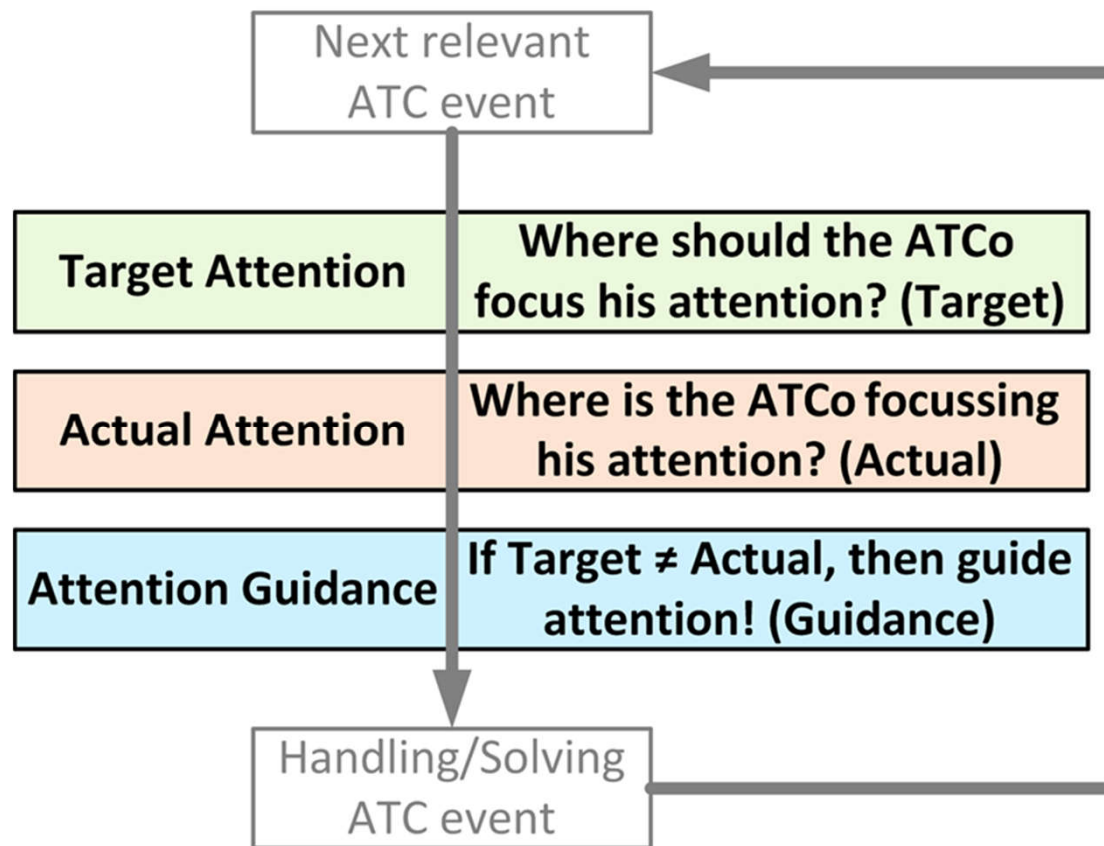
- Sectorless / flight-centric control



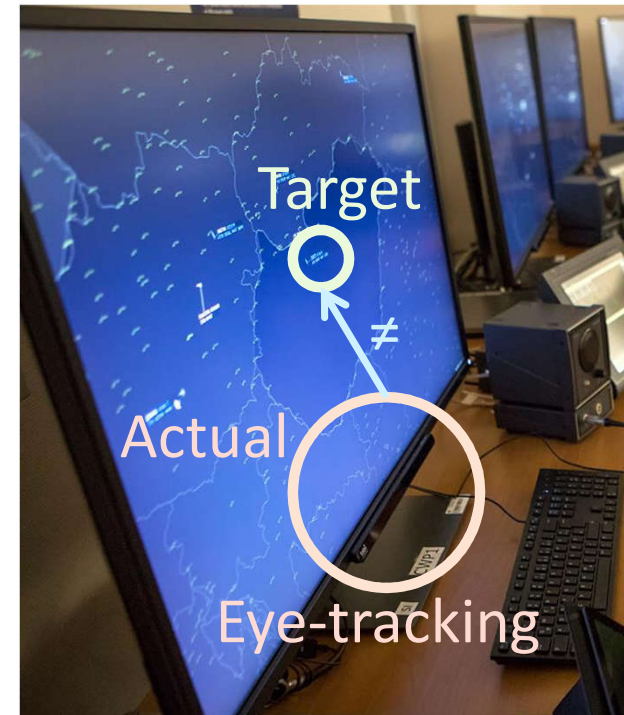
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# Loop for DLR Attention Guidance (AG) Prototype



- Mouse cursor as backup for attention focus





# Trigger Logic for ATC Events

- Global
  - Prioritize currently active ATC events (short-/medium-term conflict/handover)
  - Weighting regarding importance and time criticality
  - Unawareness (no cue if ATCo focus on respective area)
  - Which event to display/delete?
- Local
  - **Escalation level** per event
  - Priority and time of non-observance
  - Increase or decrease of escalation level



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# Escalation Levels for Visual Cues





# Validation Trials in Budapest (HungaroControl)



- 5 ATCos
- Two simulation runs of 50 min
- Baseline run (just flight-centric setup, no AG functionality)
- Solution run (flight-centric setup with AG functionality)



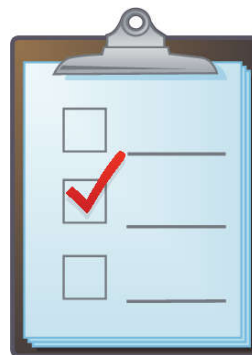
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# ATCo Tasks during Validation Exercise

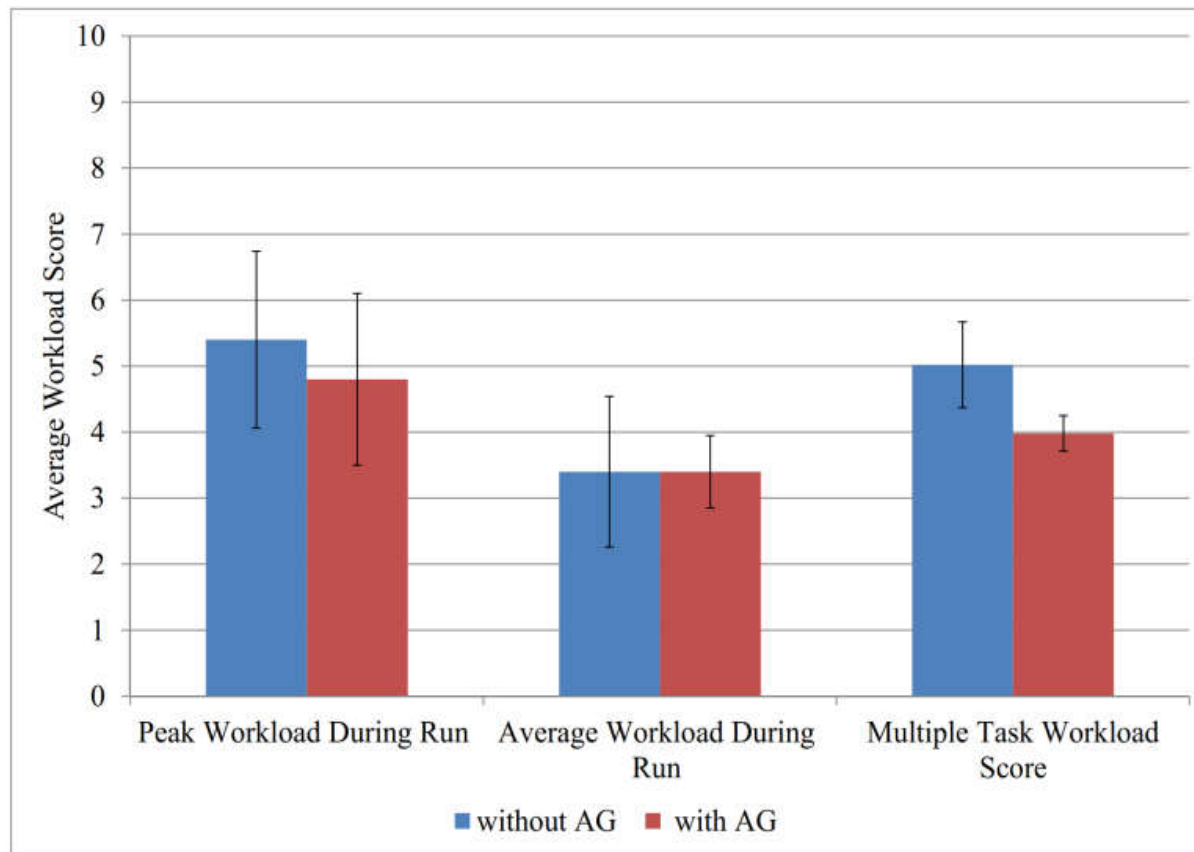
- ATCos to control dense traffic as trained the 3 days before
- Afterwards rate questionnaire items
- Debriefing following semi-structured interview method
- Log files of eye-tracking and mouse were captured







# Results: Workload



- Lower scores are better
- AG solution yielded lower peak and lower multiple task workload

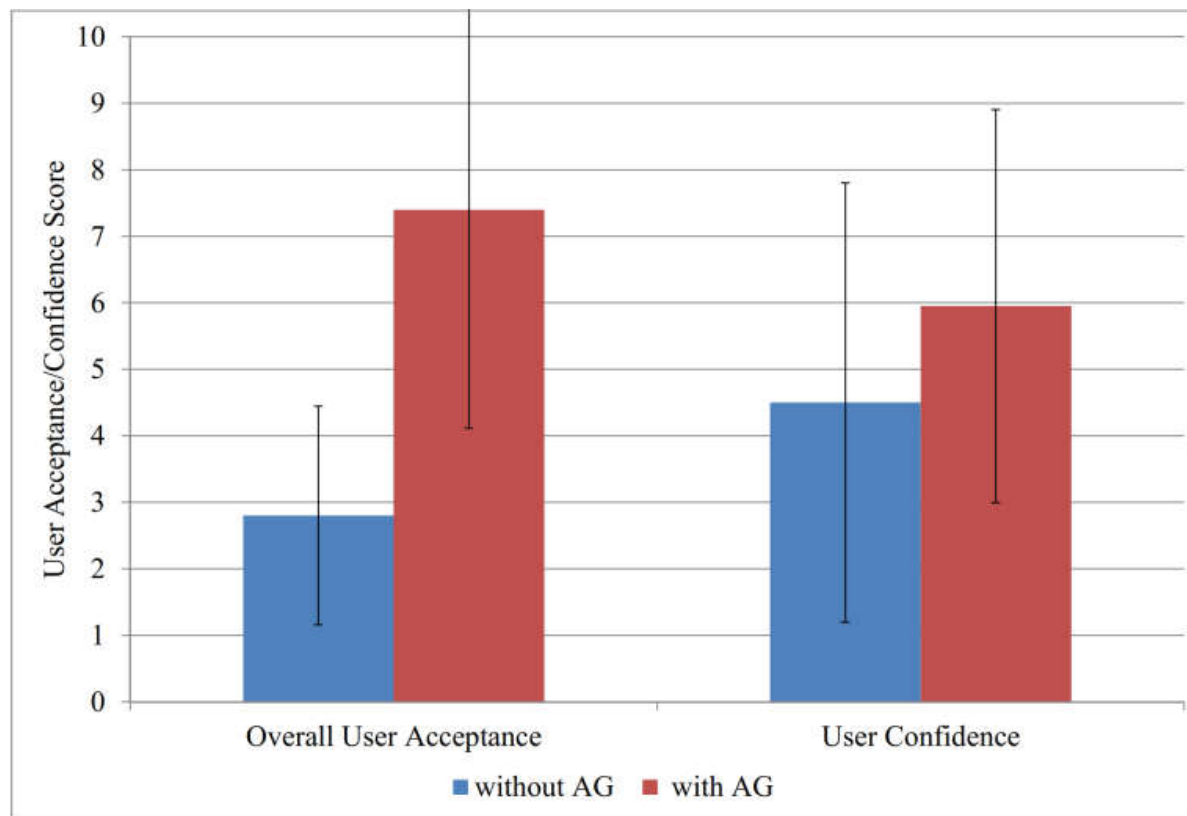


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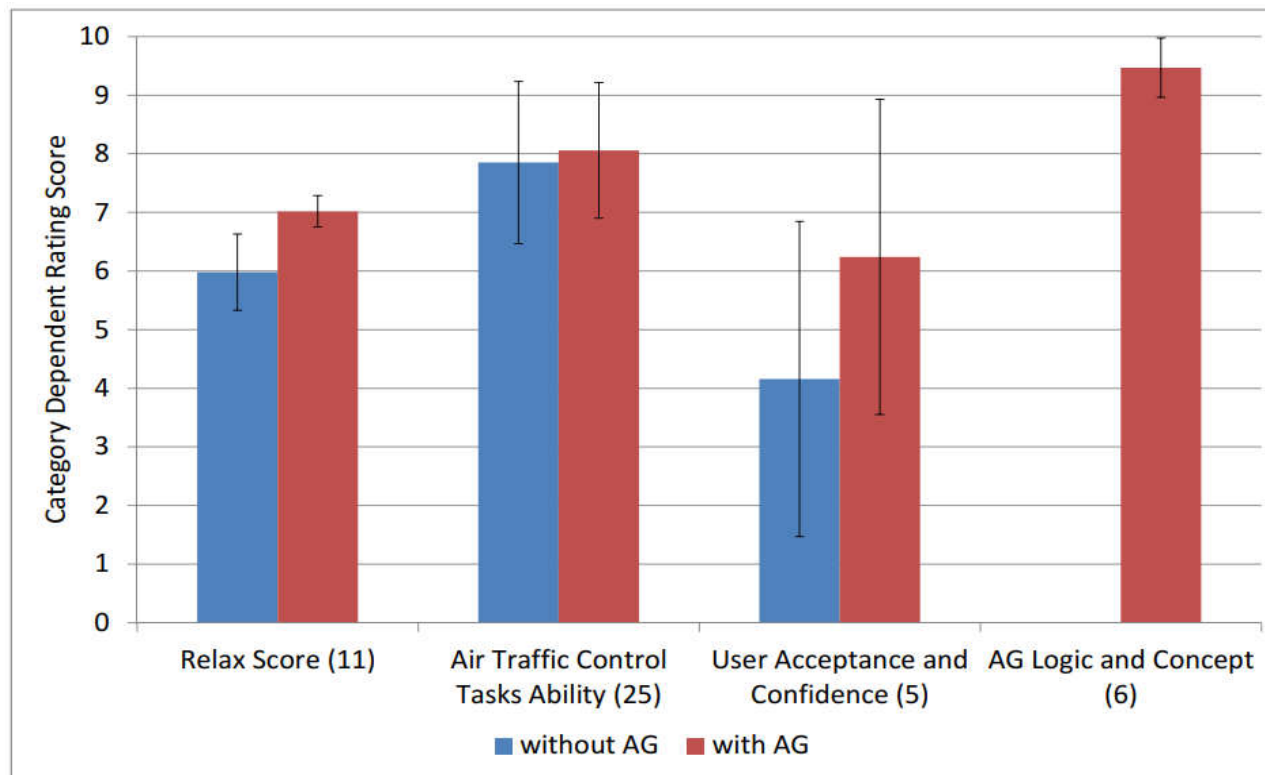
# Results: User Acceptance and Confidence



- Higher scores are better
- AG solution yielded better user acceptance and confidence



# Combined Results



- Higher scores are better
  - AG solution yielded
    - less workload
    - comparable tasks ability
    - better confidence and acceptance
- compared to baseline run without AG
- AG concept and logic was well-understood and transparent

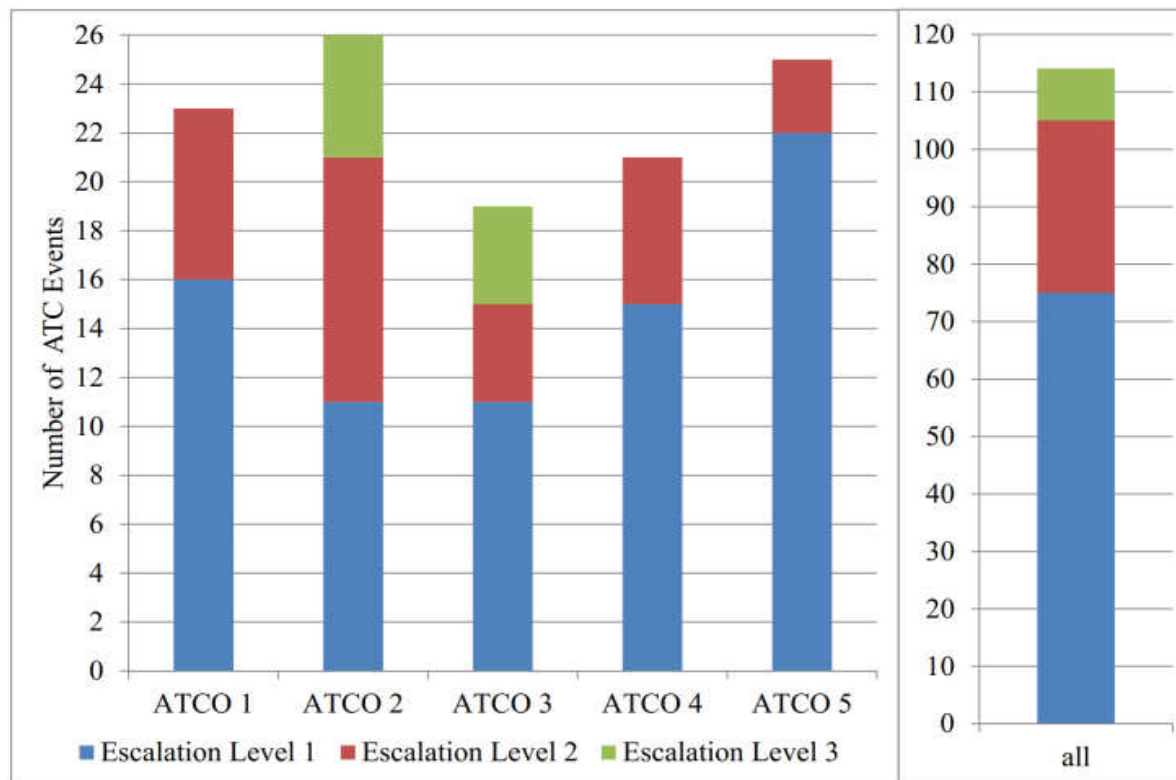


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# Number of Escalated ATC Events



- Most escalated ATC events are detected in low escalation levels

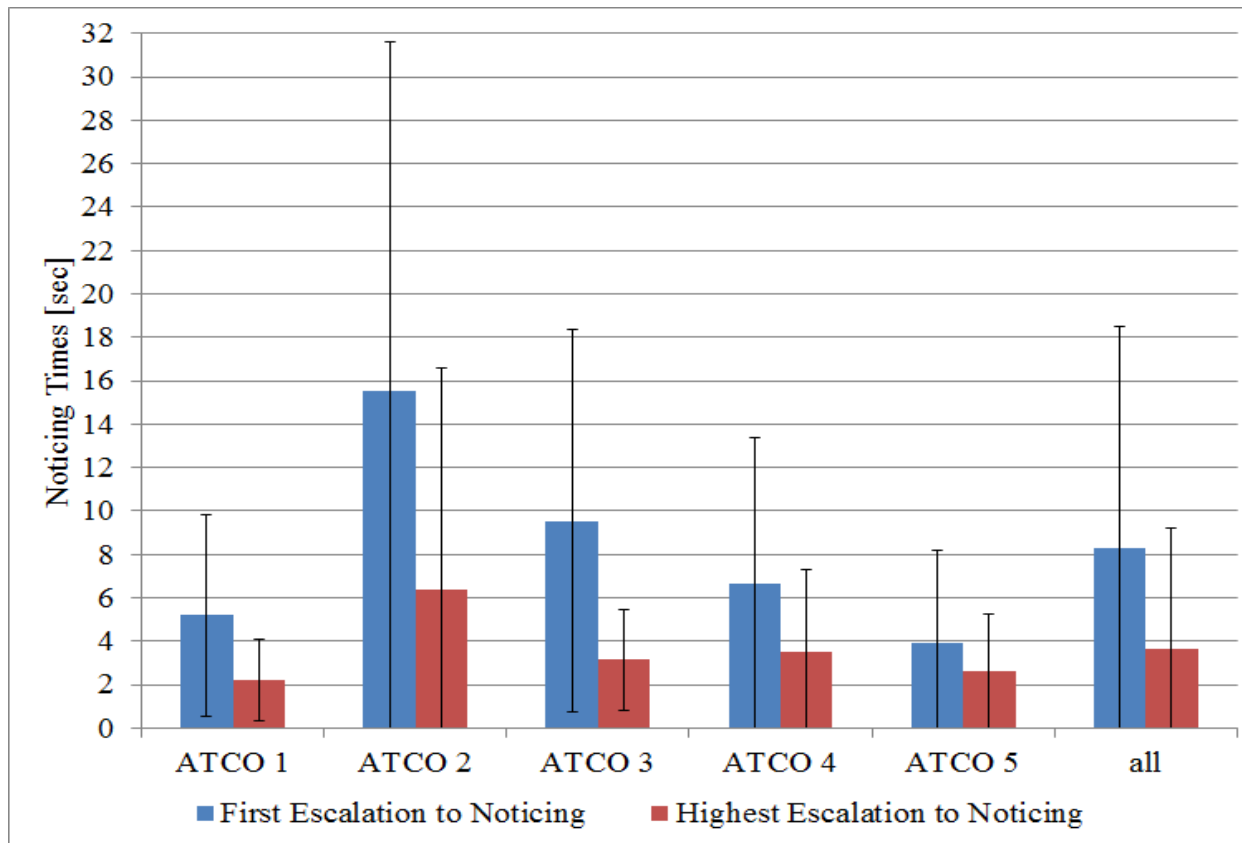


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# Average Time for Noticing ATC Events



- Escalated ATC events are noticed in appropriate time



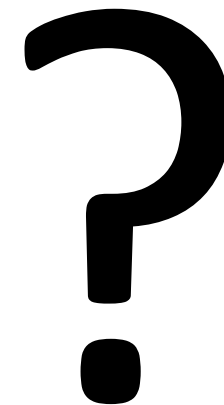
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## Tailor-made Attention Guidance Questionnaire (1)

- When using **Solution** system, I **liked** best that...
  - ...incoming and outgoing traffic is **highlighted if not scanned**.
  - ...it **highlighted** the conflicts, in case I **forgot**.
  - ...it is really a **good idea** and **simple** to use.
  - ...it really **helped** to find blind spots: very cool!





## Tailor-made Attention Guidance Questionnaire (2)

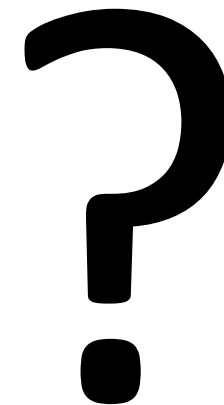
- For **Solution** system the main **disadvantage** that I can think of is that...
  - ...it sometimes asks to **take you away**  
from an area or problem you need to **focus** on.
  - ...**no** disadvantage was present due to attention guidance.





## Tailor-made Attention Guidance Questionnaire (3)

- I could imagine to **work** with **Solution** system, because...
  - ...I think the visual guidance tool has **only advantages**.
  - ...it's an addition that can **complement** the existing **features**.
  - ...but only in **training** new ATCos.
  - ...it can help in a **dense traffic** situation.
  - ...it helps to draw my attention when I am more **tired**.

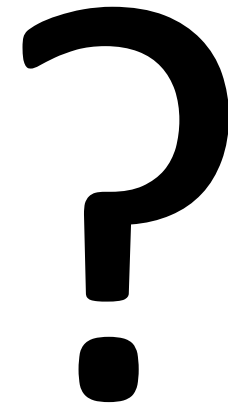






## Tailor-made Attention Guidance Questionnaire (4)

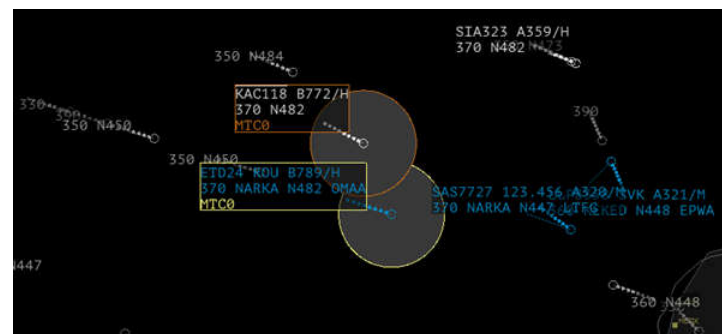
- I could **not** imagine to work with **Solution** system, because...
  - ...somebody may not want to get **tracked**.
  - ...I **can't** imagine.
- For an **additional implementation** in Solution system, I would wish that...
  - ...it was **already implemented** as it really gives me help.





# Debriefing Comments

- The visual **clues** are **non-intrusive**.
- **Eye-tracking** works really **robust** after calibration and thus interaction is fine.
- The AG functionality really **supports** me to have a look at HMI spots that I would not have looked at this **timely**.
- The AG system is already **ready** to be used in **operational life**.
- I want to have AG in my current **CWP tomorrow**.





# Outlook on Future Work

- Cues for other ATC events
  - Wrong Mode-S settings
  - Route adherence monitoring
  - Approaching restricted areas
  - Cleared flight level alarm
  - Current flight level different to exit flight level close to exit point
  - Unattended aircraft
- “Working time” dependent on current gaze focus
- Technical zoom issue
- SESAR Wave 2 PJ.10-96 “HMI Interaction modes for ATC centre”
  - 3 Exercises of European partners
- Automatic Speech Recognition as sensor for AG and vice versa





# Summary

- Indicators that assumption (gaze=attention) holds true
- ATCos felt supported by *Attention Guidance* prototype
- Very positive and encouraging results
- Found to be ready for operationalization

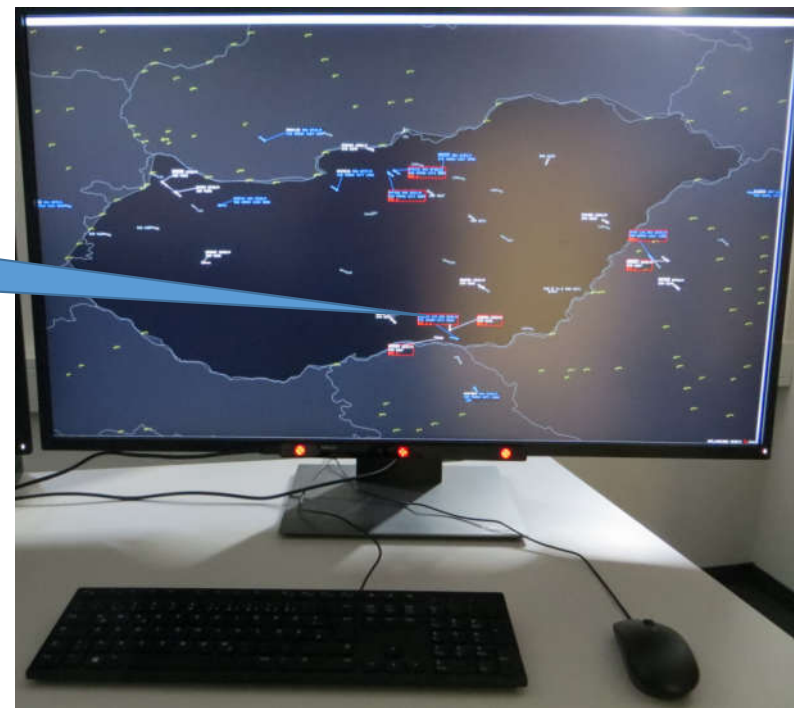




# Thank you



## CWP HMI PJ.16-04-03 AG-EXE-310



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