



Dedicated to innovation in aerospace

**Optimizing Performance Based Training: Monitoring the flow
of cognitive load**

NATO HFM-334 RSY

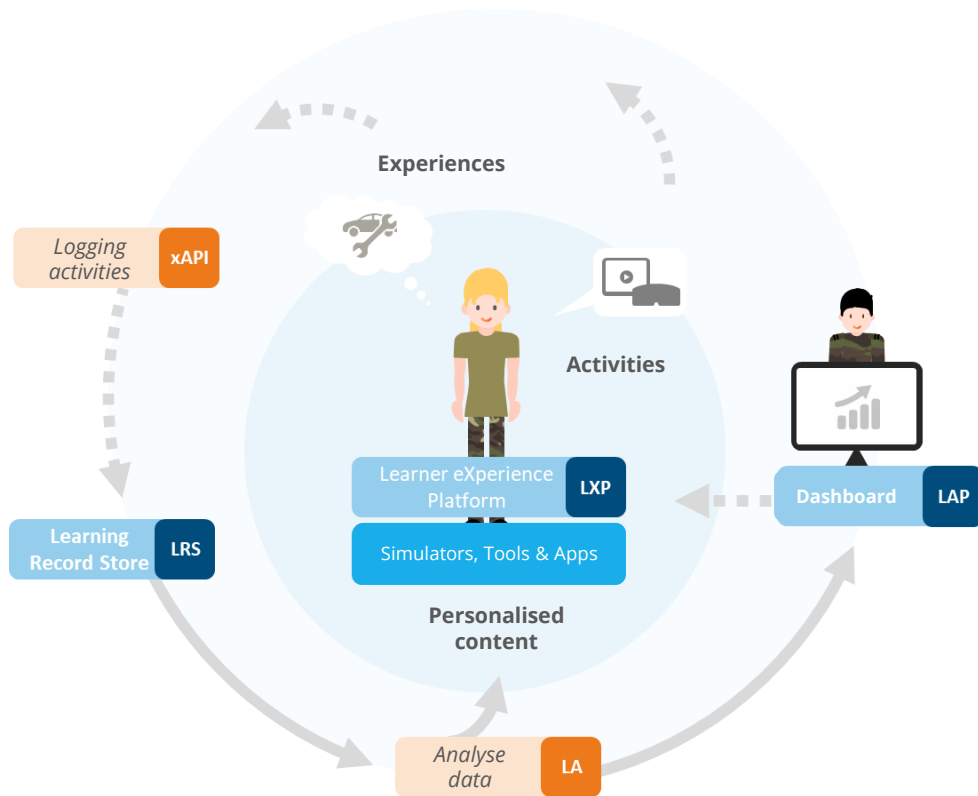
Maykel van Miltenburg
Rome, 12 October 2021



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Learning eco-system

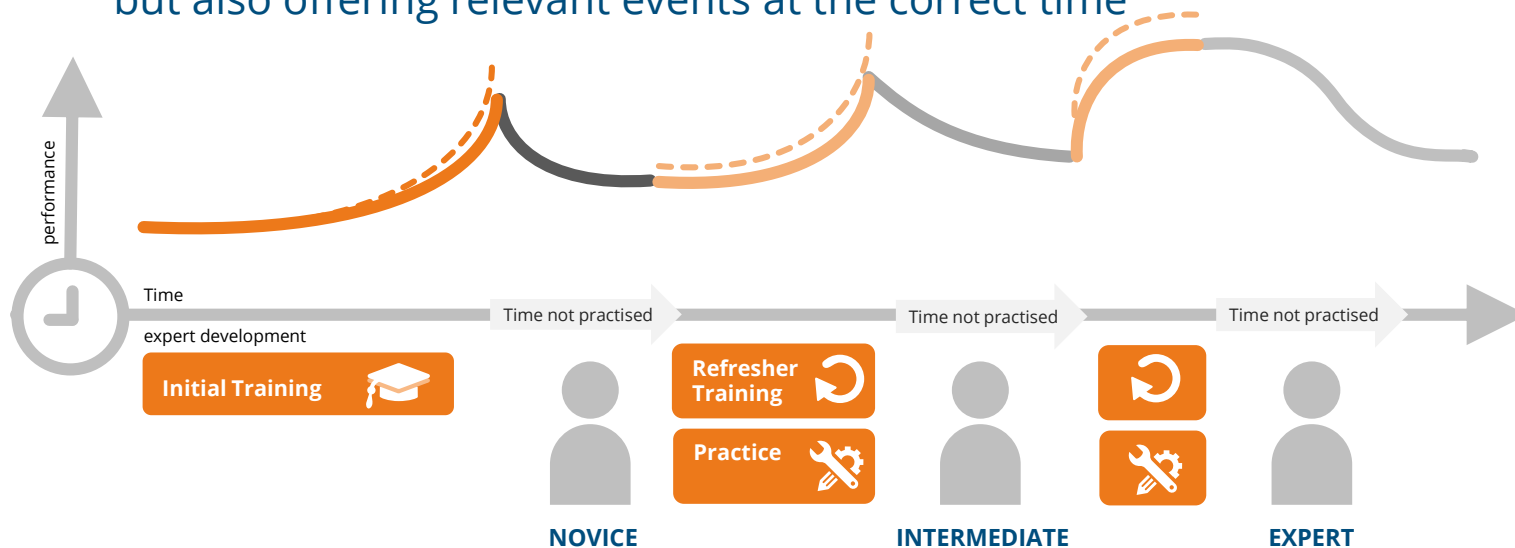


Connecting & Aligning

- Training media
- Data system
- Learning analytics
- Training organisation

Understanding the curves

Not only offering relevant training at the correct time, but also offering relevant events at the correct time



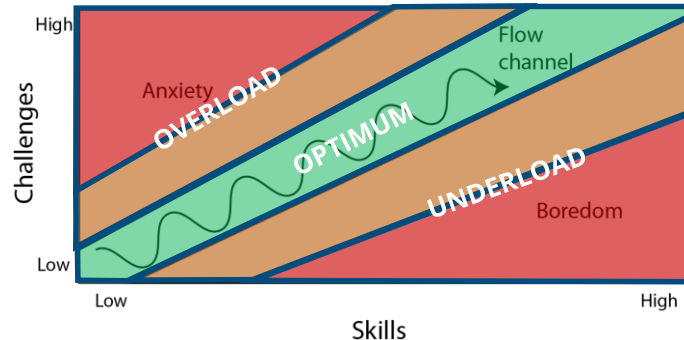
→ However, correct training concept remains fundamental and crucial

Relevant events at the correct time

Effective personalized learning assumes, at least, an optimal level of difficulty in the learning task.

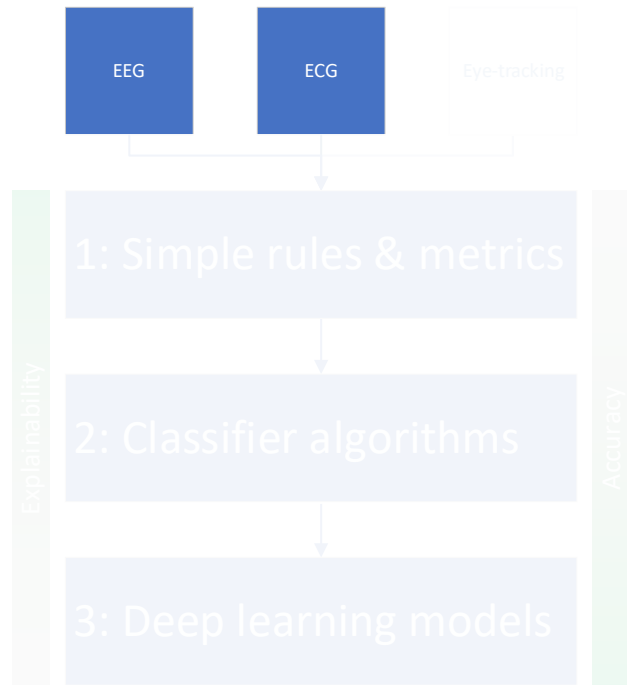
Task difficulty fluctuates between challenging and easy activities, while avoiding states of extreme frustration or boredom.

→ Flow channel / Optimum load



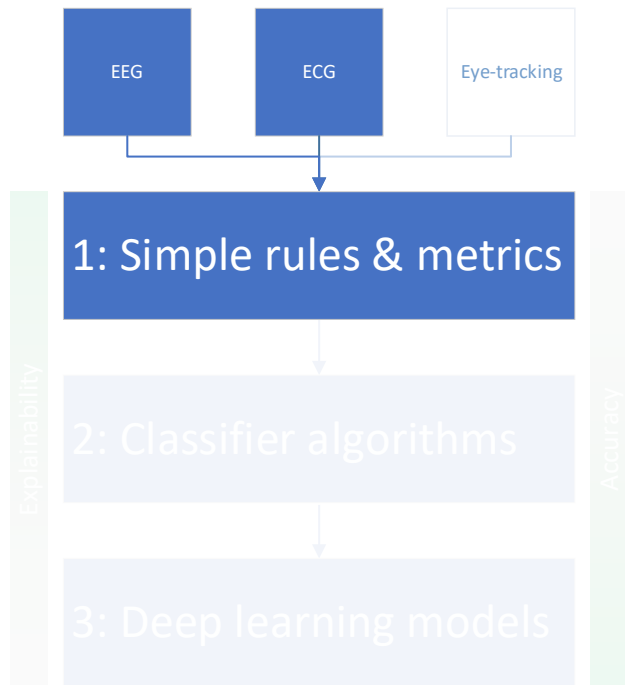
Nowadays being rated by instructors which is subjective, implicit and hard to align

Monitoring the flow of cognitive load



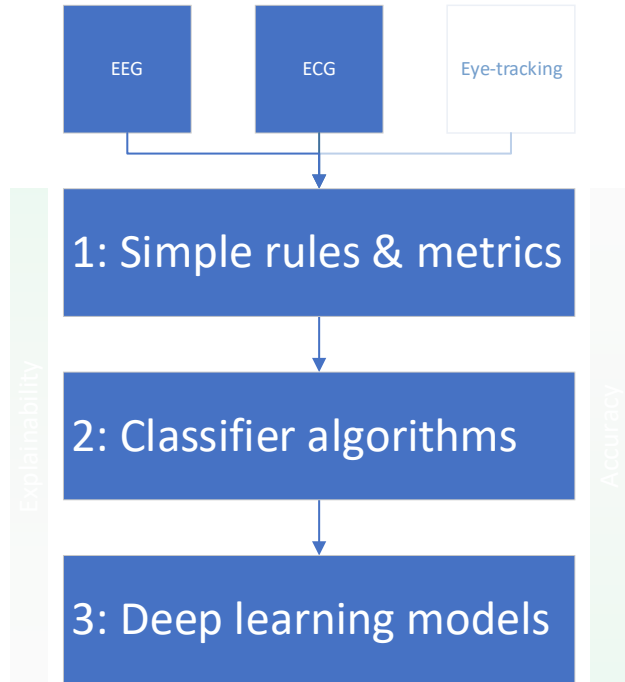
- High-end & active shielding
- 32 brain locations or less (customizable)
- ECG as well
- Starting point to downgrade EEG cap

Monitoring the flow of cognitive load



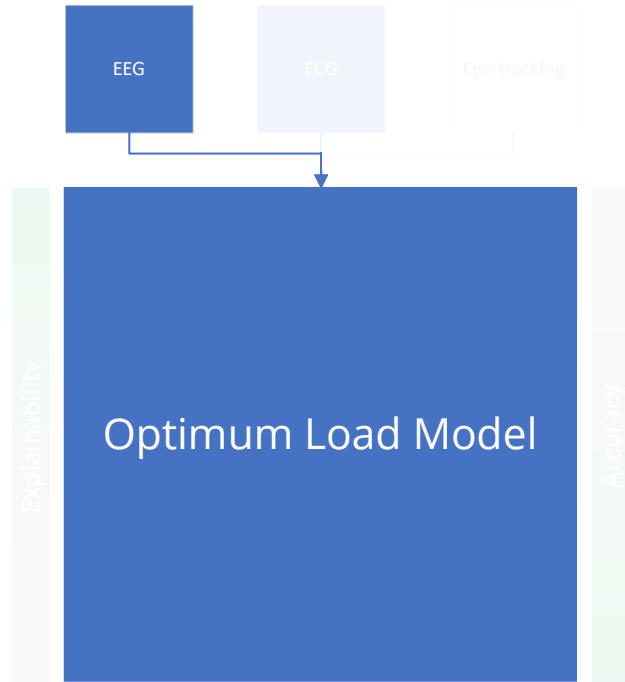
- HRV measures in frequency and time domain
- Brain rhythm measures
 - alpha
 - theta

Monitoring the flow of cognitive load

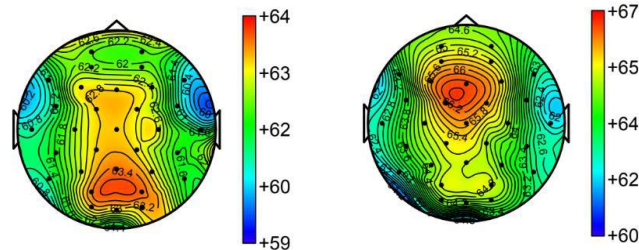


- Common Spatial Patterns and Riemannian Classifiers
- Convolutional Neural Network (EEGNet)

Monitoring the flow of cognitive load



- Brain rhythm measures
 - **individual upper** alpha
 - theta
- Other measures
 - NASA TLX (subjective workload)
 - performance



Approach

- Four participants with former position as F-16 pilot



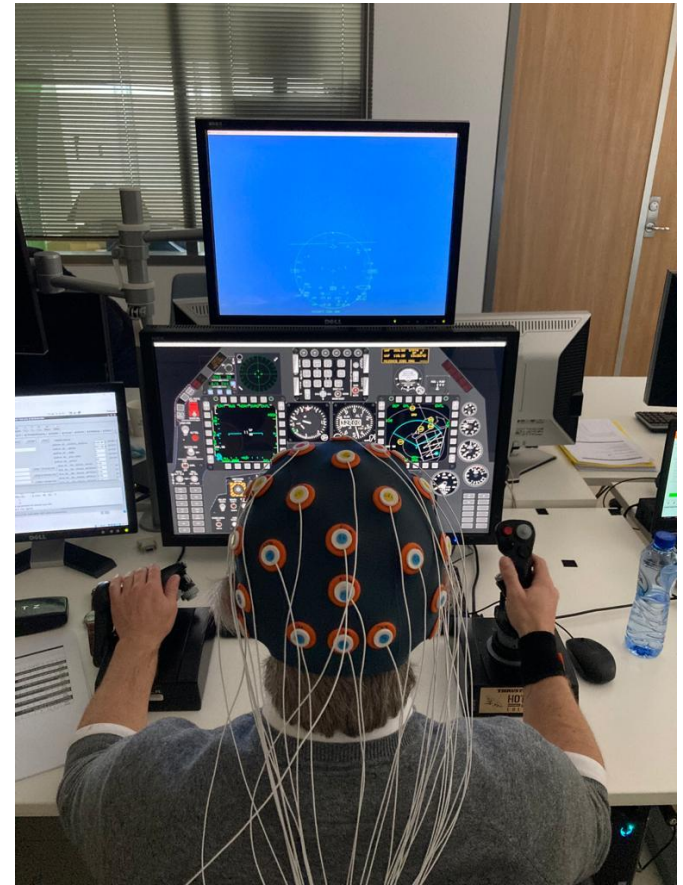


Tactical Intercept run

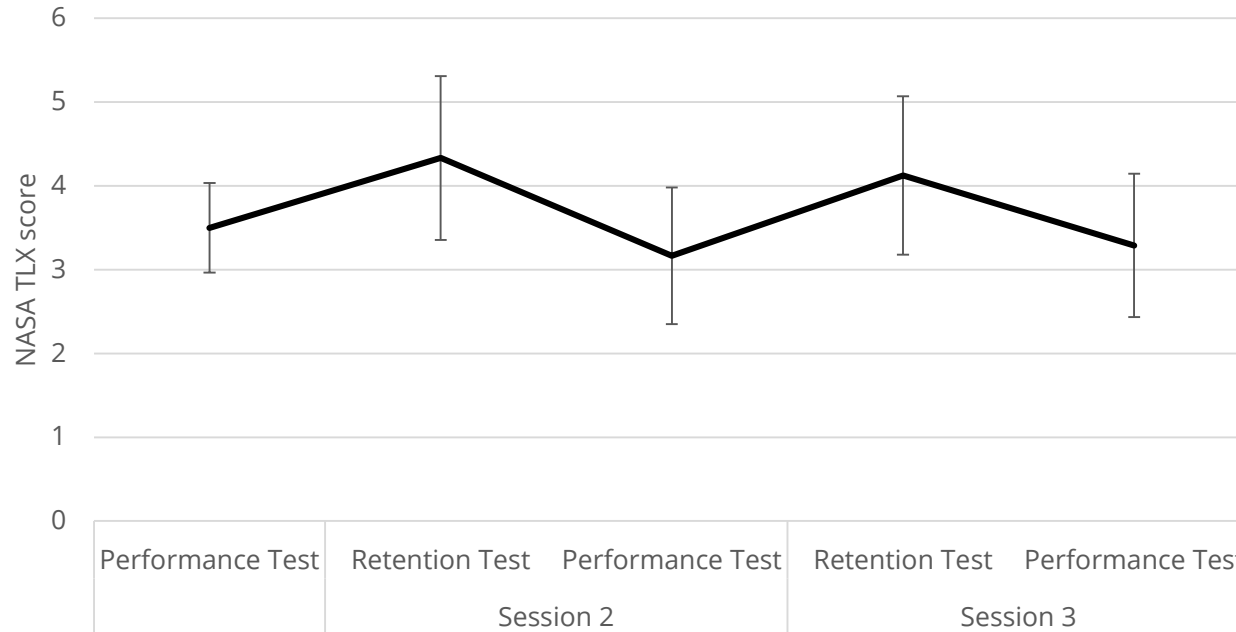


Performance Assessment

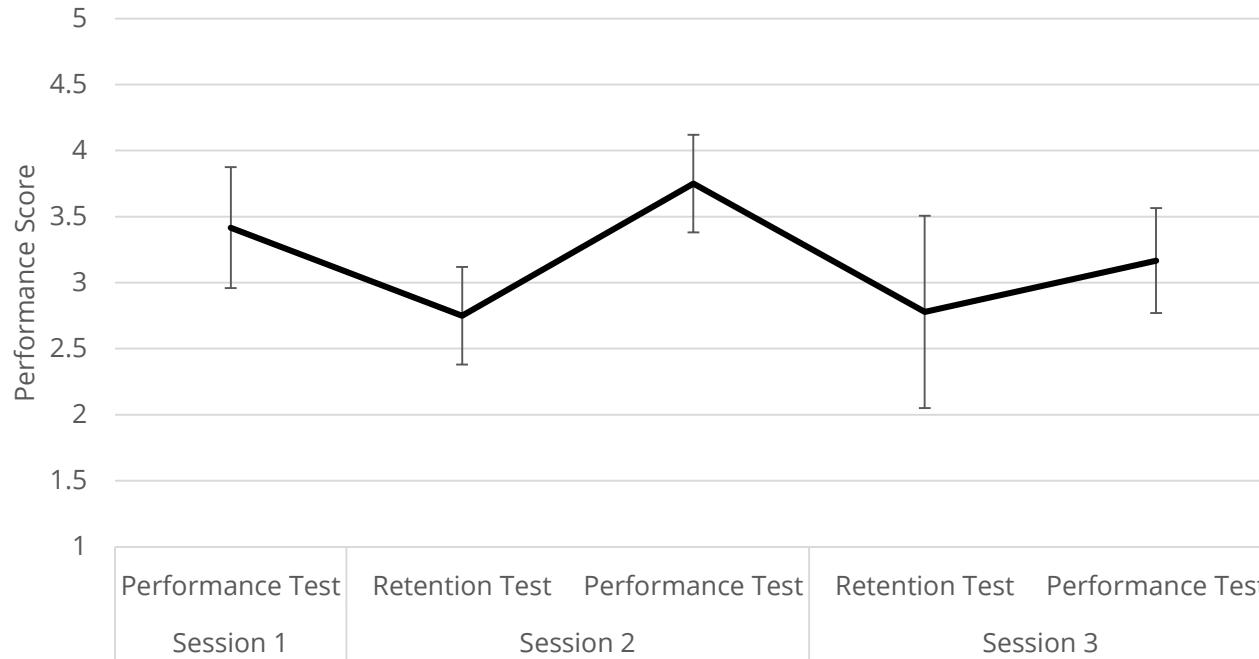
- Flight Geometry
- Weapon Management and
- Rules of Engagement/Communication



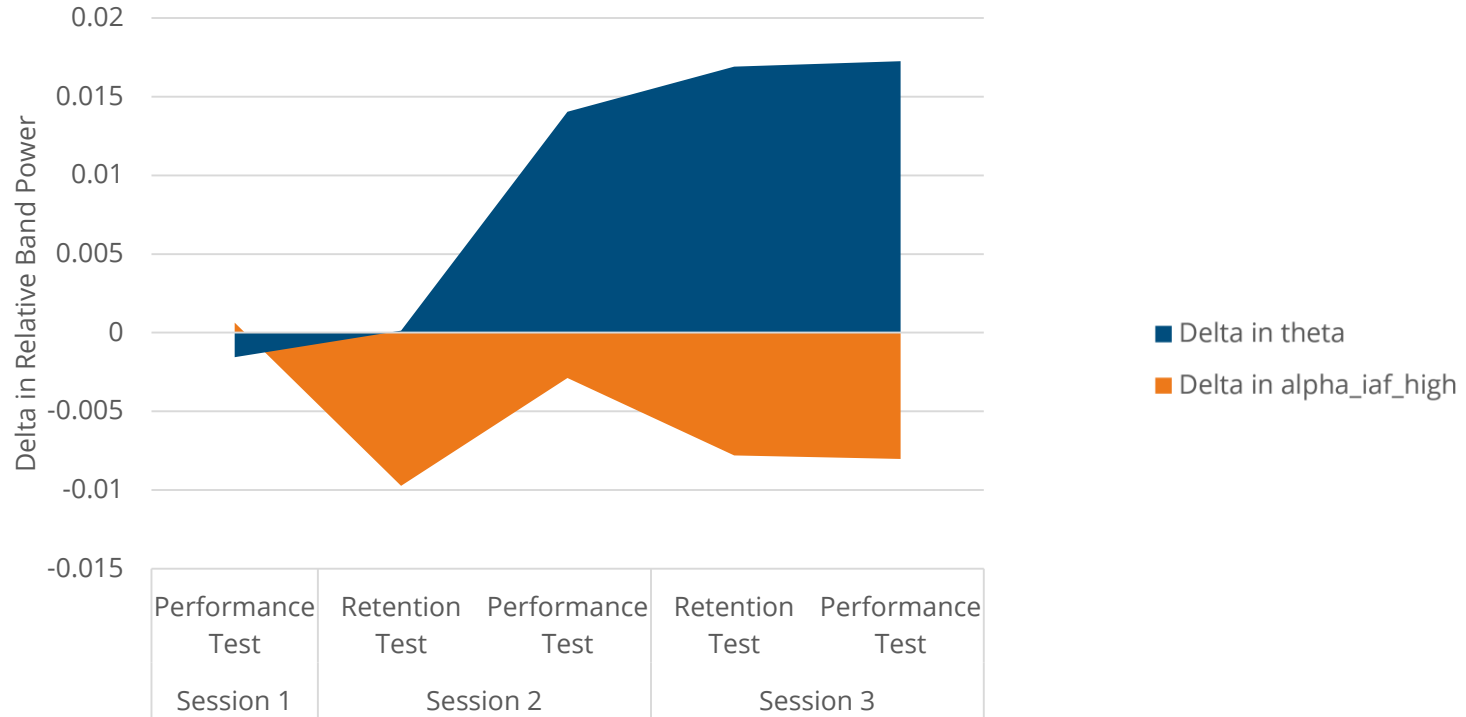
Aggregated results – NASA TLX



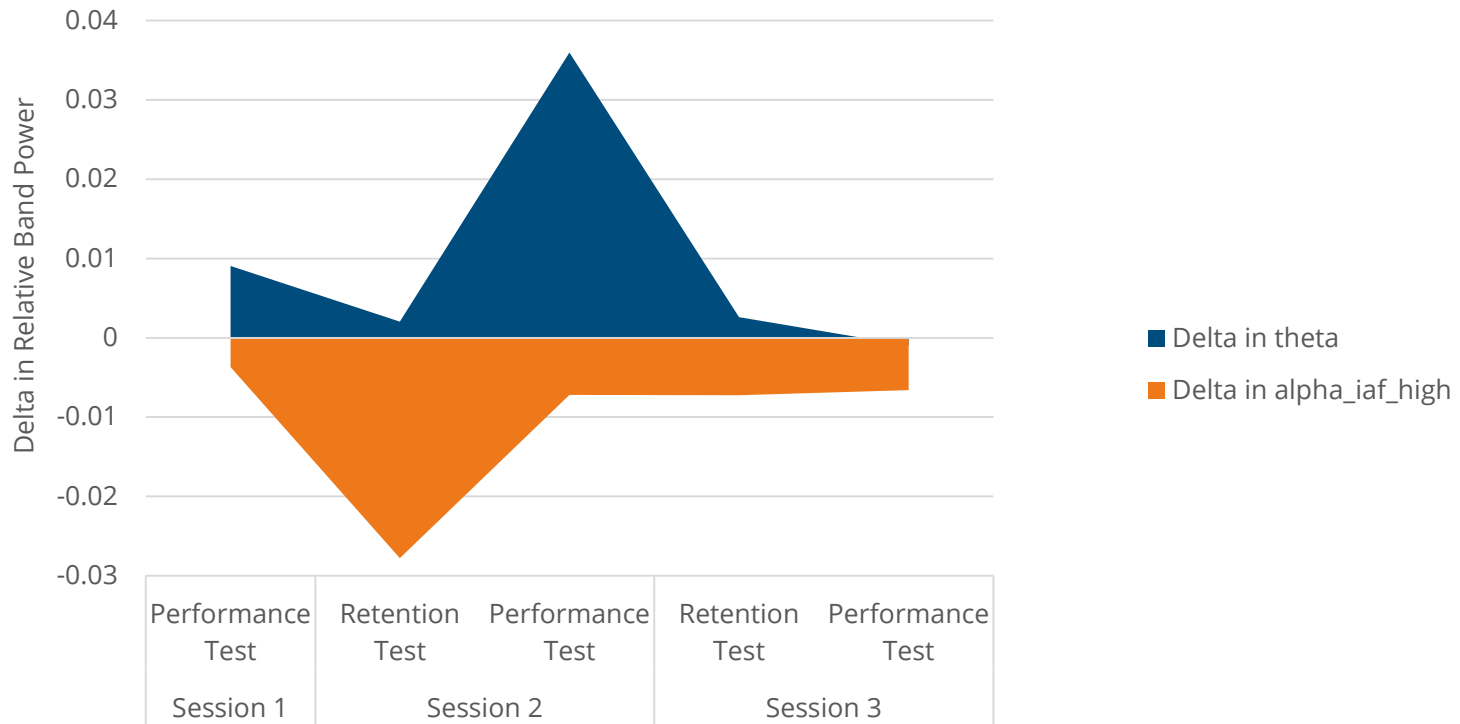
Aggregated results – Performance



Aggregated results – Cognitive Load (EEG)



Individual result – Cognitive Load (EEG)





Lessons Learned

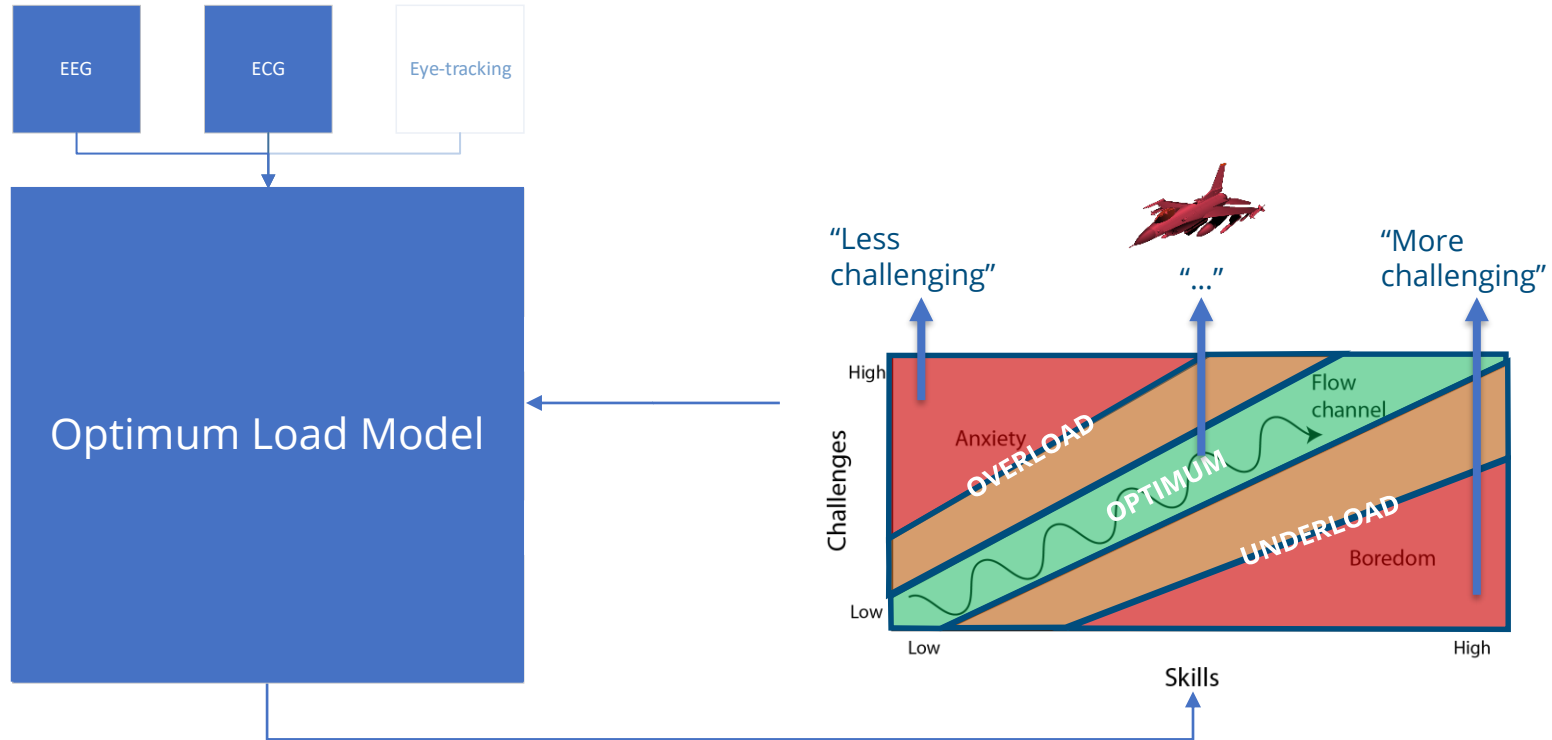
- Mixed results on cognitive load PT compared to RT
 - Difficult to interpret due to intra- and inter-individual differences
 - Mismatch between cognitive load based on EEG and subjective workload
 - Motivation?? Abandoning when target not within reach anymore?
- On the short term
 - Multimodal → analyse HR(V) data and compare to EEG
 - More sessions of the same individuals



Conclusion

- Relation between performance, subjective workload, and EEG as cognitive load metric is identified.
- The TI sessions appeared to be an suitable training setting to identify these relations and individual differences.

Auto-adapt in real-time task difficulty





Thank you



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