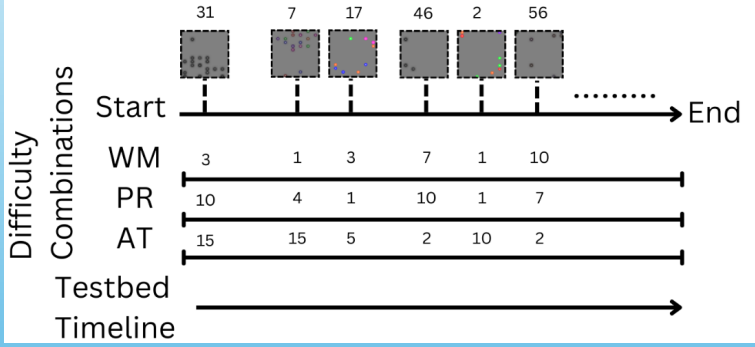
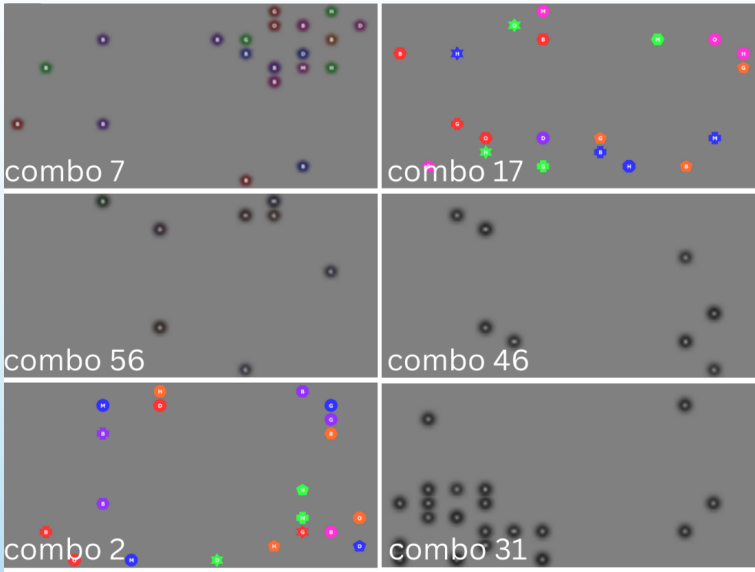


# Advancing Mental Workload Prediction: A Multidimensional Approach to Cognitive Facet Modeling



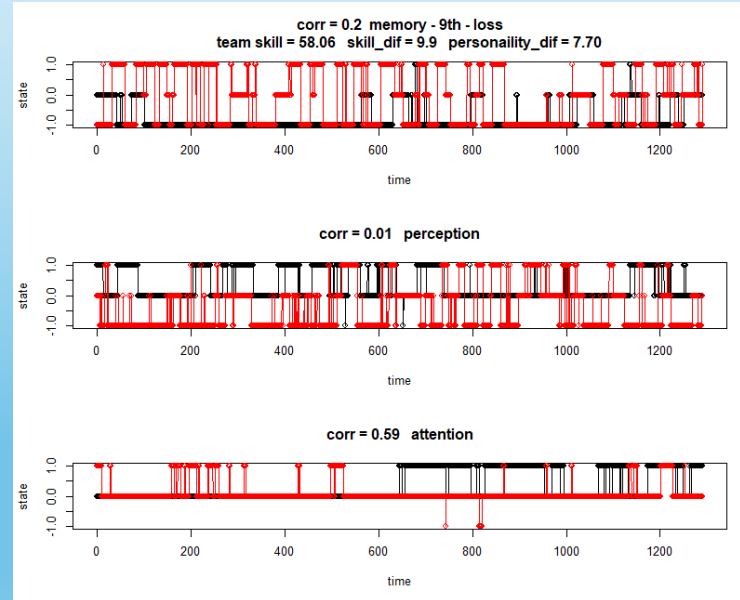
Example of combination of levels for 2<sup>nd</sup> generation mental workload classifier.

The Northrop Grumman HAPII developed real-time mental workload (MWL) classification algorithms that identify cognitive drivers—working memory, perception, and attention. Using specialized testbeds to isolate and combine these facets, our models capture nuanced interactions, enabling precise, adaptive interventions. This enhances task guidance systems by dynamically adjusting support based on user-specific cognitive states.



Real-time dashboard for representing cognitive load predictions for 1<sup>st</sup> gen NGC classifiers. Red is overload, gray is adequate load, and the height of each bar is the confidence in the estimate.

Our focus remains on practical application. And while our first-generation algorithms have been successfully deployed for real-time workload monitoring and diagnostic assessment....



Using 1<sup>st</sup> generation classifier to explore team synchrony in cooperative tasks.

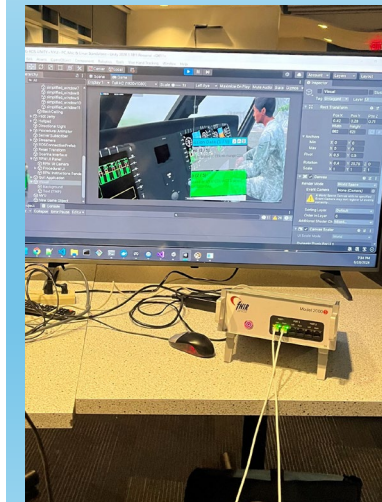
We are advancing to second-generation solutions utilizing a combinatory understanding of cognitive facet interactions allowing us to dive deep into the issues that drive the use, misuse, and overuse of technology in the warfighter's day-to-day lives.

# NORTHROP GRUMMAN



Generic dog-fighting simulation incorporating LLM based tips based on modeled cognitive workload

Our MWL approach, combined with our HAPII lab suite like emotional valence recognition, local pre-trained LLMs, platform agnostic AI, and facial expression monitoring, provides a dynamic, non-invasive solution for enhancing human-system interaction. By deepening our understanding of MWL and its cognitive facets, we



enable smarter, more responsive human-machine systems tailored to customer needs.

Emergency and pre-flight procedures in UH-60 Blackhawk cockpit utilizing real time mental workload monitoring to prompt LLM to provide tips based on facet-specific mental workload