

## Leidos Cognitive Load Tool (CoLT)

#### **LEIDOS INNOVATION CENTER (LINC)**

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Approved for Public Release

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## **COGNITIVE WORKLOAD**

- Cognitive Workload (CW) is defined as:
  - "the degree of mental effort required to complete a task".
- CW can be measured as:
  - **Underload**—low mental effort is required to complete a task.
  - **Overload**-high mental effort is needed to complete a task.
- Ideally, users should experience a middling level of CW where they are engaged, but not overwhelmed.
- Example:
  - Fighter pilots handling various sensors while flying modern combat aircrafts were found to fall in an overload state
    - State of high physiological arousal
    - Dynamically measure a pilot's Cognitive Workload

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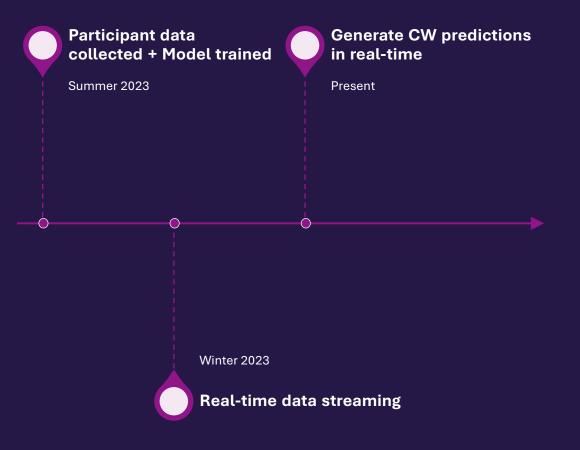
## MEASURING AND IMPROVING CW

- Automation is an increasing feature of emergent National Defense technologies
  - Calibrated CW is critical for operators supervising technologies
- Over-reliance on automation, and automation compliance have been found to hamper task performance
- To ensure operators are functioning at an optimal CW; we need:
  - A reliable real-time classification system,
  - A capability for a precise measurement of CW, and
  - A way to alter the HMI to facilitate optimal operator CW.
- We found that CW can be measured via physiological sensors

## **RESEARCH ACCOMPLISHMENTS**

**GOAL:** Development of a real-time Cognitive Load Classifier

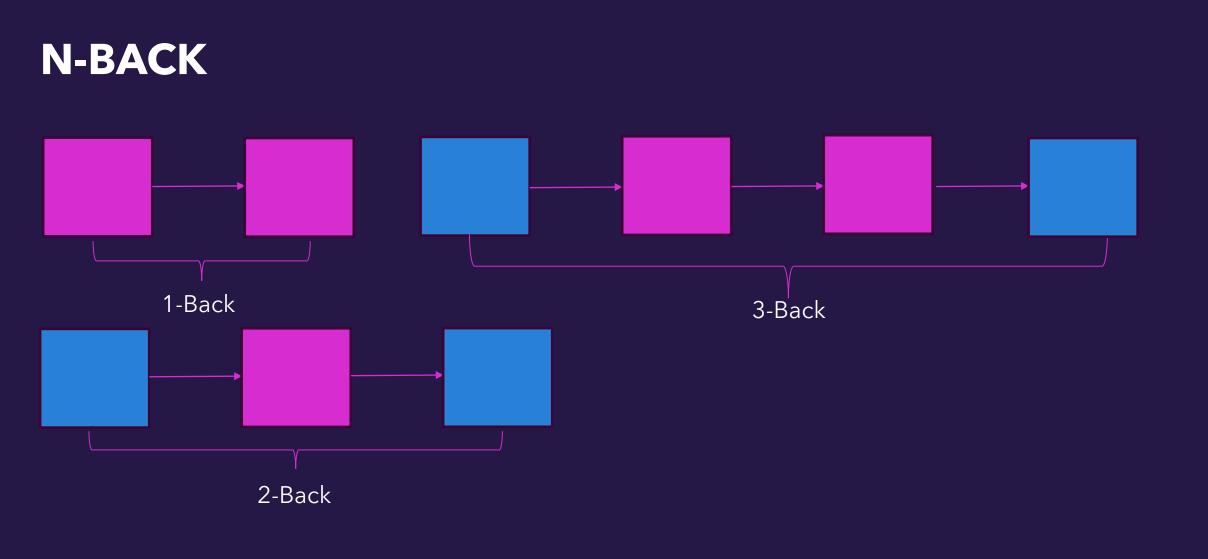
- Leidos Cognitive Load Tool (CoLT)
- "Phase 1" (Summer 2023)
  - Collect data in various CW states and create a post-hoc classifier
- "Phase 2" (Winter 2023)
  - Amend the classifier to collect physiological data in real-time
- "Phase 3" (Present)
  - Generate CW predictions in real-time in a dynamic task



#### METHOD

- Physiological data was collected from 34 participants
  - Physiological data included:
    - Heart Rate,
    - Electrodermal Activity (EDA), and
    - Eye-tracking (i.e., point-of-gaze, pupil dilation and fixations)
- Participants completed a series of n-backs (1-back, 2-back, 3-back)
  - The N-Back test: a cognitive task in which users must match a currently presented stimuli (a colored square) with a previously presented stimuli (n presentations back)
    - For 1-back, participants needed to match the current color of the square with the color 1 trial back.
    - For 2-back and 3-back, the compared color was 2 and 3 trials back respectively
- The classifier predicted which N-Back condition the participant was in based on the physiological data.

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#### RESULTS

- Model test accuracy of 66%
- Best combination
- Segment length: 18 seconds
- Baseline duration: 7 minutes

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30_second_baseline_duration -	0.00	0.00	0.52	0.51	0.56	0.48	0.54	0.56	0.55
60_second_baseline_duration -	0.57	0.56	0.56	0.57	0.57	0.56	0.56	0.60	0.58
90_second_baseline_duration -	0.58	0.59	0.56	0.57	0.56	0.57	0.55	0.57	0.57
120_second_baseline_duration -	0.59	0.60	0.58	0.59	0.58	0.57	0.56	0.59	0.58
150_second_baseline_duration -	0.60	0.60	0.58	0.61	0.60	0.58	0.57	0.59	0.59
180_second_baseline_duration -	0.61	0.62	0.60	0.61	0.60	0.59	0.58	0.59	0.58
210_second_baseline_duration -	0.62	0.61	0.59	0.61	0.61	0.59	0.58	0.60	0.59
240_second_baseline_duration -	0.62	0.62	0.59	0.61	0.61	0.60	0.58	0.60	0.59
270_second_baseline_duration -	0.62	0.62	0.60	0.61	0.60	0.59	0.58	0.61	0.60
300_second_baseline_duration -	0.63	0.62	0.61	0.62	0.60	0.60	0.60	0.62	0.61
330_second_baseline_duration -	0.63	0.62	0.61	0.63	0.61	0.61	0.59	0.63	0.61
360_second_baseline_duration -	0.64	0.63	0.62	0.64	0.62	0.61	0.60	0.63	0.61
390_second_baseline_duration -	0.65	0.64	0.62	0.64	0.63	0.61	0.59	0.63	0.62
420_second_baseline_duration -	0.66	0.64	0.63	0.63	0.62	0.61	0.60	0.63	0.63
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