CHARACTERIZATION OF PSYCHOLOGICAL RESILIENCE AND READINESS: CROSS-VALIDATION OF COGNITIVE AND BEHAVIORAL METRICS DURING ACUTE MILITARY OPERATIONAL STRESS

BACKGROUND AND PURPOSE

Cognitive resilience can be operationally defined as "the capacity to overcome the negative effects of setbacks and associated stress on cognitive function or performance". Military operational stress can come in many forms via the singular or combined effects of physical exertion, cognitive overload, sleep restriction, energy insufficiency, and emotional and psychological stress. In the volatile, uncertain, complex, and ambiguous (VUCA) contemporary operating national security environment, both current and future operations demand and place a higher priority on enhancing and sustaining the cognitive readiness and resiliency of our military service members (SmMs). While there are studies in the literature that have reported on metrics of varied cognitive dimensions, these studies are currently available cognitive metrics to the metrics that will have the most military practicality and relevance, which will predict performance on marksmanship, individual movement techniques, and military communication and decision making (Phase 1). This will allow for an identification and validation process in the "down selection" of currently available cognitive metrics to the metrics that will have the most military practicality and relevance, which will be further validated using a military-relevant VR scenario (Phase 2).

SPECIFIC AIMS

- Identify individual characteristics of cognitive degradation through 7 testing batteries during acute military operational stress in controlled laboratory conditions
- Attempt to use these characteristics to predict performance on military specific skillsets
- Ultimate goal: identify the most pertinent metrics for maintaining military performance during simulated military environments

CONCEPTUAL FRAMEWORK

Individual Traits
- Dispositional Resilience
- Childhood Experiences
- Combat Exposure
- Post-Deployment Stressors
- Coping Styles
- Concurrent Mood/Axiety
- Fitness: Health Habits
- Sleep Parameters

Military-Centric Outcome Measures
- Marksmanship
- Individual Movement Techniques
- Communication Skills
- Adaptive Decision Making

Potential Mediating Domains
- Neurocognitive Functions:
  - Attention/Vigilance
  - Working Memory
  - Adaptability/Creativity
  - Psychomotor Performance
  - Sensorimotor/Neuromuscular Performance
  - Physiological Adaptability

Outcome Measures
- Personality
- Resilience
- Coping Styles
- Depression
- PTSD
- Sensorimotor Speed
- Spatial Learning
- Memory
- Abstraction
- Concept Formation
- Spatial Orientation
- Emotion Identification
- Abstract Reasoning
- Visual Tracking
- Risk Decisions
- Attention
- Marksmanship
- Adaptive Decision Making
- Tactical Movements
- Blood Biomarkers
- Transcranial Magnetic Stimulation
  - Motor evoked potentials
  - Cortical Silent periods
- Heart Rate Variability
- Aerobic Capacity
- Maximal Jumping Performance
- Maximal Contractile Force

MACHINE LEARNING ANALYSIS

Individual Traits
- Valid and reliable toolkit of cognitive metrics related to military tactical performance operationalized in a meaningful and military-relevant manner

Mediating Domains
- Prediction using Statistical Models
- Machine Learning Models

Military Specific Outcome Measures
- Training/Feature Selection

DELIVERABLES

1 Neuromuscular Research Laboratory, School of Health and Rehabilitation Sciences, University of Pittsburgh, Pittsburgh, PA; 2 Sleep and Chronobiology Laboratory, School of Psychiatry and Psychology, University of Pittsburgh, Pittsburgh, PA; 3 National Aeronautics and Space Administration, Houston, TX; 4 U.S. Army Training and Doctrine Command, Fort Eustis, VA; 5 Applied Physics Laboratory, Johns Hopkins University, Baltimore, MD; 6 U.S. Army Research Laboratory, Adelphi, MD; 7 Natick Soldier Research Development and Engineering Center, Natick, MA; 8 U.S. Army Research Institute of Environmental Medicine, Natick, MA; 9 Center for Innovation and Research on Veterans and Military Families, University of Southern California; 10 U.S. Army Medical Research and Material Command, Ft Detrick, MD