

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

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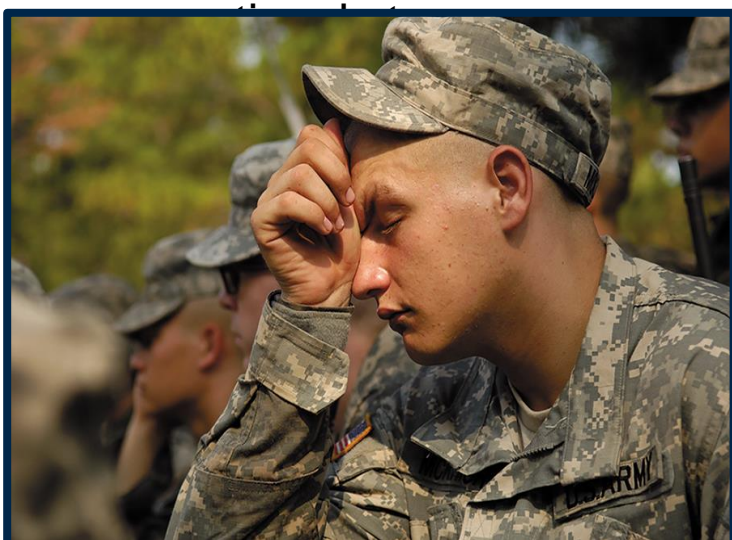


BACKGROUND AND PURPOSE

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 (SMs). While there are studies in the literature that have reported on metrics of varied cognitive dimensions, these studies are **replete with limitations in their ability to predict real-world performance or capacity for performance, particularly with regard to high-stress military training and occupational environments**. For these metrics to be of benefit to the military, their relationship to Service member health and performance must be established under acute and chronic military operational stress scenarios. This study will deliver individual characteristics, physiological correlates, and neuropsychological indices of cognitive degradation during acute military operational stress (sleep restriction, caloric restriction, and sustained physical work) under controlled laboratory conditions that 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



CONCEPTUAL FRAMEWORK

Individual Traits

- Dispositional Resilience
- Childhood Experiences
- Combat Exposure
- Post-Deployment Stressors
- Coping Styles
- Concurrent Mood/Anxiety
- 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

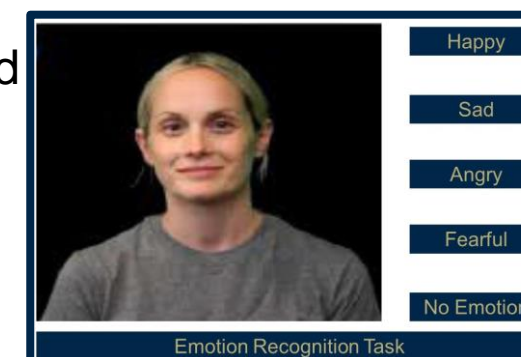
1. Psychological Battery

- Personality
- Resilience
- Coping Styles
- Depression
- PTSD



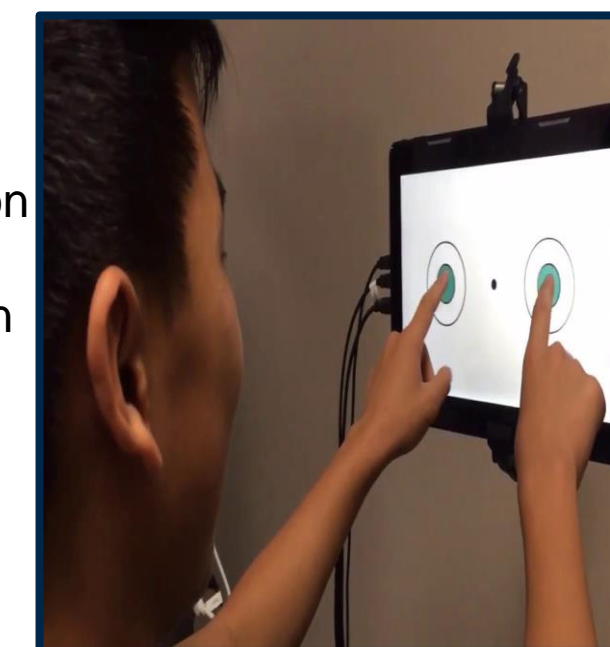
2. Neurocognitive Battery

- Sensorimotor Speed
- Spatial Learning
- Memory
- Abstraction
- Concept Formation
- Spatial Orientation
- Emotion Identification
- Abstract Reasoning
- Visual Tracking
- Risk Decisions
- Attention



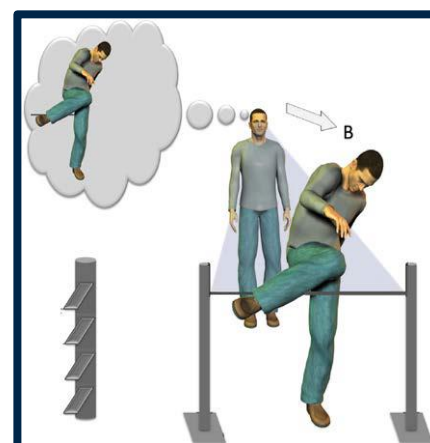
3. Psychomotor Battery

- Dynamic Visual Acuity
- Depth Perception
- Perception Span
- Multiple Object Tracking
- Reaction Time



4. Sensorimotor Battery

- Obstacle Cross
- Perception Action Coupling Task



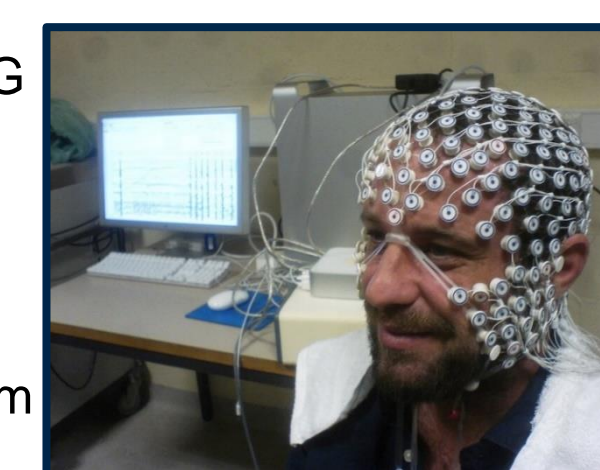
5. Tactical Battery

- Marksmanship
- Adaptive Decision Making
- Tactical Movements



6. Sleep Battery

- High-density EEG
- Breathing Rate
- Actigraphy
- Electrocardiogram



7. Physiological Battery

- 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

Mediating Domains

Prediction using Statistical

Machine Learning Models

Military Specific Outcome Measures

Training/Feature Selection

DELIVERABLES

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



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