

**AWARD NUMBER:** W81XWH-17-2-0070

**TITLE:** Characterization of Psychological Resilience and Readiness: Cross-Validation of Cognitive Behavioral Metrics During Acute Military Operational Stress

**PRINCIPAL INVESTIGATOR:** Bradley C. Nindl, PhD

**CONTRACTING ORGANIZATION:** The University of Pittsburgh  
Pittsburgh, PA 15203

**REPORT DATE:** Oct 2019

**TYPE OF REPORT:** Annual Report

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# REPORT DOCUMENTATION PAGE

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<b>14. ABSTRACT</b> Military operational stress can come in many forms via physical exertion, cognitive overload, sleep restriction, energy insufficiency, and emotional or psychological stress. In 2013, a DoD Human Performance Optimization Metrics Conference was held and identified the lack of a consensus for operationally relevant and standardized metrics that meet military requirements as the single most important issue related to the translation of cognitive readiness to operational and military leader utility. For 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. Our objective is to validate a comprehensive series of neurocognitive, psychological, psychomotor, sensorimotor, physiological, and sleep metrics within military operational stress paradigms to assess military-relevant and tactical cognitive readiness and resiliency. Our study proposes to use an ecologically valid model of simulated military operational stress (sleep restriction, caloric deficit, and physical work). This model will provide a biomedical framework to quantify temporal changes in metrics across the neurocognitive, psychological, psychomotor, sensorimotor, physiological, and sleep domains. Machine learning will be used to provide a dashboard and predictive algorithm for dependent variables centered on military-relevant and tactical cognitive readiness and resiliency.		

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None provided					
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**1. INTRODUCTION:** *Narrative that briefly (one paragraph) describes the subject, purpose and scope of the research.*

Military operational stress can come in many forms via physical exertion, cognitive overload, sleep restriction, energy insufficiency, and emotional or psychological stress. In 2013, a DoD Human Performance Optimization Metrics Conference was held and identified the lack of a consensus for operationally relevant and standardized metrics that meet military requirements as the single most important issue related to the translation of cognitive readiness to operational and military leader utility. For 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. Our objective is to validate a comprehensive series of neurocognitive, psychological, psychomotor, sensorimotor, physiological, and sleep metrics within military operational stress paradigms to assess military-relevant and tactical cognitive readiness and resiliency. Our study proposes to use an ecologically valid model of simulated military operational stress (sleep restriction, caloric deficit, and physical work). This model will provide a biomedical framework to quantify temporal changes in metrics across the neurocognitive, psychological, psychomotor, sensorimotor, physiological, and sleep domains. Machine learning will be used to provide a dashboard and predictive algorithm for dependent variables centered on military-relevant and tactical cognitive readiness and resiliency.

**2. KEYWORDS:** *Provide a brief list of keywords (limit to 20 words).*

Resilience, readiness, sleep, health, performance

**3. ACCOMPLISHMENTS:** *The PI is reminded that the recipient organization is required to obtain prior written approval from the awarding agency grants official whenever there are significant changes in the project or its direction.*

**What were the major goals of the project?**

*List the major goals of the project as stated in the approved SOW. If the application listed milestones/target dates for important activities or phases of the project, identify these dates and show actual completion dates or the percentage of completion.*

- Major Task 1: Secure Human Research Approvals - completed
  - o University of Pittsburgh IRB approval 2/2/18
  - o HRPO Approval 6/1/18
- Major Task 2: Hire/Train Study personnel – completed
- Major Task 3: Prepare/finalize materials for participant recruitment – completed/ongoing
  - o Recruitment materials have been finalized, IRB approved, and disseminated
  - o Recruitment briefs ongoing. Plan to reach out to local ROTC recruiting offices.
- Major Task 4: Launch Study, initiation of enrollment – completed 6/5/18 (2 pilot subjects)
- Major Task 5: Completion of experimental study procedures – ongoing
- Major Task 6: Data and Safety Monitoring – ongoing
  - o Monthly meetings
- Major Task 7: Preliminary and confirmatory data analysis – ongoing
  - o Seven abstracts on preliminary data analysis submitted and accepted to the International Congress on Soldier’s Physical Performance (ICSPP) February 11-14, 2020.
  - o One abstract on preliminary data presented to the Military Health System Research Symposium (MHSRS) on August 19-22, 2019.
  - o Six abstracts on preliminary data to be presented by doctoral students at MARC ACSM November 1-2, 2019.

- One Freddie H. Fu, MD Graduate Research Award awarded on 10/15/19. Another contender to present on 10/31/19.

*For this reporting period describe: 1) major activities; 2) specific objectives; 3) significant results or key outcomes, including major findings, developments, or conclusions (both positive and negative); and/or 4) other achievements. Include a discussion of stated goals not met. Description shall include pertinent data and graphs in sufficient detail to explain any significant results achieved. A succinct description of the methodology used shall be provided. As the project progresses to completion, the emphasis in reporting in this section should shift from reporting activities to reporting accomplishments.*

Initial Pitt IRB approval was obtained 2/2/18 and subsequent HRPO approval was obtained 6/1/18. Two pilot subjects were enrolled on 6/5/18 and completed testing on 6/10/18. As of **10/21/19**, 192 subjects have been screened, 61 subjects have been enrolled, and 52 subjects have completed the study. Pitt IRB modification was approved on 9/28/18 to use additional recruitment methods including social media, geofencing, and Craigslist advertisements to enhance recruitment efforts. Dr. Nindl received verbal approval from Claudio Ortiz on 7/2/19 to decrease female recruitment from 40 to 12 women due to difficulty recruiting female participants. We will continue to aggressively recruit women to attain as close to 40 as possible. The study team conducts regular meetings to ascertain subject eligibility, discuss recruitment efforts, data collection processes during study visits, as well as potential opportunities to speak at local Army Reserve units. Study team conducts regular data meetings to ascertain data quality.

**What opportunities for training and professional development has the project provided?**

*If the project was not intended to provide training and professional development opportunities or there is nothing significant to report during this reporting period, state “Nothing to Report.”*

*Describe opportunities for training and professional development provided to anyone who worked on the project or anyone who was involved in the activities supported by the project. “Training” activities are those in which individuals with advanced professional skills and experience assist others in attaining greater proficiency. Training activities may include, for example, courses or one-on-one work with a mentor. “Professional development” activities result in increased knowledge or skill in one’s area of expertise and may include workshops, conferences, seminars, study groups, and individual study. Include participation in conferences, workshops, and seminars not listed under major activities.*

This project has provided the opportunity for many Pitt undergraduate and graduate students to gain experience in research and internship credit hours as part of their course curriculum. Preliminary data was presented at the Military Health System Research Symposium (MHSRS) on August 19-22, 2019. Preliminary data will be presented by doctoral students at the upcoming Mid-Atlantic American College of Sports Medicine Regional Meeting on November 1-2, 2019 and the International Congress on Soldier’s Physical Performance (ICSPP) on February 11-14, 2020. Current doctoral student, William Konkright, for his presentation entitled, “Dynamic Variation of Extracellular Vesicles as Resilience Biomarkers During Simulated Military Operational Stress” was awarded the Freddie H. Fu, MD Graduate Research Award on 10/15/19 in the amount of \$5,000. In summary, extracellular vesicles (EVs) are involved in intercellular communication and remain an unexplored domain of resilience that may provide a more individualized molecular signature of operational readiness. The primary purpose of this sub-analysis is to characterize acute changes in circulating EVs, including size and concentration

of both total EVs and EV subtypes, before and after a military-relevant physical exertion protocol under baseline and simulated military operational stress (SMOS) conditions. SMOS is characterized by physical exertion, sleep and caloric restriction, and cognitive overload. Fellow doctoral student Meaghan Beckner, presenting on 10/31/19, is also a contender for this award for her work entitled, “biological Variances in Extracellular Vesicle Profiles Related to Neurocognitive Resilience During Simulated Military Operational Stress.” In summary, Extracellular vesicles (EVs) are involved in intercellular communication and remain an unexplored domain of resilience that may provide a more individualized molecular signature of operational readiness. This sub-analysis aims to determine differences in morning time EV profiles from baseline compared to two nights of sleep restriction, and how these differences may relate to neurocognitive performance.

### **How were the results disseminated to communities of interest?**

*If there is nothing significant to report during this reporting period, state “Nothing to Report.”*

*Describe how the results were disseminated to communities of interest. Include any outreach activities that were undertaken to reach members of communities who are not usually aware of these project activities, for the purpose of enhancing public understanding and increasing interest in learning and careers in science, technology, and the humanities.*

Doctoral students will present preliminary data in the form of thematic posters and podium presentations at the following conferences:

The Mid-Atlantic American College of Sports Medicine Regional Meeting on November 1-2, 2019:

- Lagoy, Alice. Increased deep sleep may relate to compromised perception-action coupling performance in military personnel
- Sinnott, Aaron. Association between Affordance-Detection Accuracy and Marksmanship Performance during Sleep and Caloric Restriction among Active Duty Soldiers
- Conkright, Will. Implications on Estimated Susceptibility to Enemy Fire Following 5-Days of Simulated Military Operational Stress
- Beckner, Meaghan. Simulated Military Operational Stress Negatively Impacts Psychomotor Vigilance and Neurocognitive Biomarkers in Men and Women
- Proessl, Felix. Normalization Removes Differences in Contractile Properties and Corticospinal Excitability Between Single- and Multi-Joint Exercises
- Agostinelli, Philip. Differences in Performance Decline Between Sex Under Simulated Military Operational Stress

The Military Health System Research Symposium (MHSRS) on August 19-22, 2019:

- Lagoy, Alice. Changes in affordance perception behaviors during exposure to acute military operational stress

The International Congress on Soldier’s Physical Performance (ICSPP) on February 11-14, 2020:

- Lagoy, Alice. Visuomotor performance is maintained under conditions of military operational stress
- Conkright, Will. Implications on Estimated Susceptibility to Enemy Fire Following 5-Days of Simulated Military Operational Stress
- Beckner, Meaghan. Emotion Recognition and Vigilance is Compromised During Military Operational Stress
  - Second Abstract: High Grit Scores Associated with Elevated BDNF During Military Operational Stress

- Canino, Maria. Impact of Operational Stress on Motor Evoked Potentials in Military Personnel
- Eagle, Shawn. Simulated Military Operational Stress Impairs Action Boundary Perception
- Haufler, Amy. Adaptability, Emotion, Perception and Attention: Tactical Cognitive Resilience in Response to Operational Stress

**What do you plan to do during the next reporting period to accomplish the goals?**

*If this is the final report, state “Nothing to Report.”*

*Describe briefly what you plan to do during the next reporting period to accomplish the goals and objectives.*

The objectives for the next reporting period are to maximize participants enrolled during the remaining 5-day iteration through December. Ultimately, we maintain a projected recruitment target of 80 subjects by May of 2020 with a tentative 9 iterations scheduled between the date of this report and May 2020. Should we fail to meet this projected recruitment target, an additional 4 iterations are tentatively scheduled into July. We plan to continue to generate relevant interest in study participation through actively seeking briefing opportunities as well as continued dissemination of information through conference participation. Regarding the current status of IRB approval at CCDC SC (previously USAMRMC), the protocol for scientific review on March 5th and scientific review comments were returned on April 18th. Based on reviewer comments, the Cognitive Resilience work was included in an existing protocol, and the modification for that is due to be submitted to our internal HPA next week.

**4. IMPACT:** *Describe distinctive contributions, major accomplishments, innovations, successes, or any change in practice or behavior that has come about as a result of the project relative to:*

**What was the impact on the development of the principal discipline(s) of the project?**

*If there is nothing significant to report during this reporting period, state “Nothing to Report.”*

*Describe how findings, results, techniques that were developed or extended, or other products from the project made an impact or are likely to make an impact on the base of knowledge, theory, and research in the principal disciplinary field(s) of the project. Summarize using language that an intelligent lay audience can understand (Scientific American style).*

Nothing to Report.

**What was the impact on other disciplines?**

*If there is nothing significant to report during this reporting period, state “Nothing to Report.”*

*Describe how the findings, results, or techniques that were developed or improved, or other products from the project made an impact or are likely to make an impact on other disciplines.*

Nothing to Report.

**What was the impact on technology transfer?**

*If there is nothing significant to report during this reporting period, state “Nothing to Report.”*

*Describe ways in which the project made an impact, or is likely to make an impact, on commercial technology or public use, including:*

- *transfer of results to entities in government or industry;*
- *instances where the research has led to the initiation of a start-up company; or*
- *adoption of new practices.*

Nothing to Report.

**What was the impact on society beyond science and technology?**

*If there is nothing significant to report during this reporting period, state “Nothing to Report.”*

*Describe how results from the project made an impact, or are likely to make an impact, beyond the bounds of science, engineering, and the academic world on areas such as:*

- *improving public knowledge, attitudes, skills, and abilities;*
- *changing behavior, practices, decision making, policies (including regulatory policies), or social actions; or*
- *improving social, economic, civic, or environmental conditions.*

Nothing to Report.

5. **CHANGES/PROBLEMS:** *The PD/PI is reminded that the recipient organization is required to obtain prior written approval from the awarding agency grants official whenever there are significant changes in the project or its direction. If not previously reported in writing, provide the following additional information or state, "Nothing to Report," if applicable:*

**Changes in approach and reasons for change** *Describe any changes in approach during the*

Nothing to Report.

**Actual or anticipated problems or delays and actions or plans to resolve them**

*Describe problems or delays encountered during the reporting period and actions or plans to resolve them.*

Though we had a successful summer recruitment, recruitment of participants has been an ongoing problem. Pitt IRB modification was approved on 9/28/18 to use additional recruitment methods including social media, geofencing, and Craigslist advertisements to enhance recruitment efforts. Personnel change at the M-STARRT program who were actively involved in recruitment as well as a change of command at 316<sup>th</sup> has also induced some delay in recruitment possibly at that specific site. In an effort to resolve this issue and generate interest in study participation, members of the study team completed a brief at the Marine Reserve Center in North Versailles, Pennsylvania on 1/12/19, then briefed on 1/26/19 at an Army base in Twinsburg, Ohio. Additionally, the PI conducted a briefing at Fort Drum on 9/3/19 and at the Army Public Health Command on July 17<sup>th</sup>, 2019. The 911<sup>th</sup> Air Force Wing was recommended as a next potential recruitment site and a recent NMRL visitor, Captain Ryan Shore of the National Guard Bureau will be contacted for potential recruit contacts and insights.

**Changes that had a significant impact on expenditures**

*Describe changes during the reporting period that may have had a significant impact on expenditures, for example, delays in hiring staff or favorable developments that enable meeting objectives at less cost than anticipated.*

As we have expanded recruitment efforts, the subsequent compensation for travel was not budgeted in the original proposal. We have therefore used laboratory discretionary funds to cover participant travel funds.

**Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents**

*Describe significant deviations, unexpected outcomes, or changes in approved protocols for the use or care of human subjects, vertebrate animals, biohazards, and/or select agents during the reporting period. If required, were these changes approved by the applicable institution committee (or equivalent) and reported to the agency? Also specify the applicable Institutional Review Board/Institutional Animal Care and Use Committee approval dates.*

**Significant changes in use or care of human subjects**

Nothing to Report.

**Significant changes in use or care of vertebrate animals**

Nothing to Report.

**Significant changes in use or care of vertebrate animals**

Nothing to Report.

**Significant changes in use of biohazards and/or select agents**

Pitt IRB modification approved 5/21/19 updating location where standard laboratory immunoassays will be conducted. NMRL has the capabilities to conduct standard laboratory immunoassays internally and will be conducted by trained personnel listed in the protocol.

**6. PRODUCTS:** *List any products resulting from the project during the reporting period. If there is nothing to report under a particular item, state “Nothing to Report.”*

- **Publications, conference papers, and presentations**

*Report only the major publication(s) resulting from the work under this award.*

**Journal publications.** *List peer-reviewed articles or papers appearing in scientific, technical, or professional journals. Identify for each publication: Author(s); title; journal; volume; year; page numbers; status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).*

Nothing to Report.

**Books or other non-periodical, one-time publications.** *Report any book, monograph, dissertation, abstract, or the like published as or in a separate publication, rather than a periodical or series. Include any significant publication in the proceedings of a one-time conference or in the report of a one-time study, commission, or the like. Identify for each one-time publication: author(s); title; editor; title of collection, if applicable; bibliographic information; year; type of publication (e.g., book, thesis or dissertation); status of publication (published; accepted, awaiting publication; submitted, under review; other); acknowledgement of federal support (yes/no).*

Nothing to Report.

**Other publications, conference papers and presentations.** *Identify any other publications, conference papers and/or presentations not reported above. Specify the status of the publication as noted above. List presentations made during the last year (international, national, local societies, military meetings, etc.). Use an asterisk (\*) if presentation produced a manuscript.*

MARC ACSM 2019:

Lagoy, Alice. Increased deep sleep may relate to compromised perception-action coupling performance in military personnel

Summary – Active duty and reserve status military service personnel who spent more time in slow wave sleep responded slower on a perception-action coupling task than personnel with less slow wave sleep.

Sinnott, Aaron. Association between Affordance-Detection Accuracy and Marksmanship Performance during Sleep and Caloric Restriction among Active Duty Soldiers

Summary- Affordance detection accuracy was associated with marksmanship accuracy and may represent a relationship between a novel psychomotor assessment and military-relevant performance.

Conkright, Will. Implications on Estimated Susceptibility to Enemy Fire Following 5-Days of Simulated Military Operational Stress

Summary- Circulating concentrations of IGF-I but not GH declined following simulated military operational stress. While GH and IGF-I increased significantly following TMT, the magnitude of response was not different over time.

Beckner, Meaghan. Simulated Military Operational Stress Negatively Impacts Psychomotor Vigilance and Neurocognitive Biomarkers in Men and Women

Summary- Simulated military operational stress has a similar negative impact in men and women on psychomotor vigilance and neurocognitive biomarkers IGF-I and klotho. However, women demonstrate higher concentrations of BDNF in the presence of simulated operational stress.

Proessl, Felix. Normalization Removes Differences in Contractile Properties and Corticospinal Excitability Between Single- and Multi-Joint Exercises

Summary- Corticospinal excitability and muscle activity were greater during an isometric knee extension compared to an isometric squat. Since normalization of corticospinal excitability measures to contractile responses vanished these differences, altered muscle activity may explain some of the control strategies at the corticospinal level.

Agostinelli, Philip. Differences in Performance Decline Between Sex Under Simulated Military Operational Stress

Summary- Short-term exposure to military operational stress leads to a decline in anaerobic capacity regardless of gender. The preliminary findings suggest SMOS affect women and men equally. Even though there was not a statistical difference in CD time; there were possible relevant differences related to operationally differences that should be considered.

MHSRS 2019:

Lagoy, Alice. Changes in affordance perception behaviors during exposure to acute military operational stress

Summary – During exposure to simulated military operational stress, active duty and reserve status military personnel were able to maintain affordance perception, an aspect of sensorimotor performance, during perception-action coupling task completed in the evening

ICSPP 2020:

Lagoy, Alice. Visuomotor performance is maintained under conditions of military operational stress

Summary – Active duty and reserve status military personnel were able to maintain performance on a visuomotor task throughout acute exposure to simulated military operational stress but individual differences in rapid-eye movement sleep may relate to visuomotor capabilities.

Conkright, Will. Implications on Estimated Susceptibility to Enemy Fire Following 5-Days of Simulated Military Operational Stress

Summary- 300-meter unloaded shuttle run (i.e., speed and anaerobic capacity) was most negatively affected by simulated military operational stress, while other tactically-relevant events remained stable or improved over time. Decreased speed on the battlefield has a direct impact on Soldier survivability. Further, strength and aerobic fitness, but not trait measures of resilience, influenced RM times.

Beckner, Meaghan. Emotion Recognition and Vigilance is Compromised During Military Operational Stress

Summary- Morning time emotion recognition declined by ~35% after one night of sleep restriction and psychomotor vigilance declined by ~37% after two nights of sleep restriction. Performance improved after one night of recovery sleep.

Second Abstract: High Grit Scores Associated with Elevated BDNF During Military Operational Stress

Summary- IGF-I and klotho declined by ~6.5% and ~8.1%, respectively, during simulated military operational stress, whereas BDNF decreased ~20.2% after one night of sleep restriction but recovered with adequate sleep. High grit individuals had significantly higher BDNF concentrations at various timepoints throughout simulate military operational stress compared to low grit individuals.

Canino, Maria. Impact of Operational Stress on Motor Evoked Potentials in Military Personnel

Summary- Our findings highlight the ability of TMS to capture subtle but significant increases in corticospinal excitability after exposure to simulated operational stress. Furthermore, Boltzmann sigmoid curve fitted maximal motor evoked potentials remained elevated on D4, suggesting one day is inadequate recovery time after operational stress.

Eagle, Shawn. Simulated Military Operational Stress Impairs Action Boundary Perception

Summary- Accuracy decreased steadily ~3% each day with a steeper drop off in performance (~6% from previous day) during the second night of sleep restriction. Response time was prolonged during sleep disruption but rebounded between midpoint of simulated operational stress and recovery.

Haufler, Amy. Adaptability, Emotion, Perception and Attention: Tactical Cognitive Resilience in Response to Operational Stress

Summary- Reading the mind in the eyes accuracy predicted security force assistance scores after two nights of sleep restriction, accounting for 29.3% of the explained variability.

- **Website(s) or other Internet site(s)**

*List the URL for any Internet site(s) that disseminates the results of the research activities. A short description of each site should be provided. It is not necessary to include the publications already specified above in this section.*

Nothing to Report.

- **Technologies or techniques**

*Identify technologies or techniques that resulted from the research activities. Describe the technologies or techniques were shared.*

Nothing to Report.

- **Inventions, patent applications, and/or licenses**

*Identify inventions, patent applications with date, and/or licenses that have resulted from the research. Submission of this information as part of an interim research performance progress report is not a substitute for any other invention reporting required under the terms and conditions of an award.*

Nothing to Report.

- **Other Products**

*Identify any other reportable outcomes that were developed under this project. Reportable outcomes are defined as a research result that is or relates to a product, scientific advance, or research tool that makes a meaningful contribution toward the understanding, prevention, diagnosis, prognosis, treatment and /or rehabilitation of a disease, injury or condition, or to improve the quality of life. Examples include:*

- *data or databases;*
- *physical collections;*
- *audio or video products;*
- *software;*
- *models;*

- *educational aids or curricula;*
- *instruments or equipment;*
- *research material (e.g., Germplasm; cell lines, DNA probes, animal models);*
- *clinical interventions;*
- *new business creation; and*
- *other.*

See Section 3: Accomplishments.

## 7. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

### **What individuals have worked on the project?**

*Provide the following information for: (1) PDs/PIs; and (2) each person who has worked at least one person month per year on the project during the reporting period, regardless of the source of compensation (a person month equals approximately 160 hours of effort). If information is unchanged from a previous submission, provide the name only and indicate “no change”.*

*Example:*

*Name:* Mary Smith  
*Project Role:* Graduate Student  
*Researcher Identifier (e.g. ORCID ID):* 1234567  
*Nearest person month worked:* 5

*Contribution to Project:* Ms. Smith has performed work in the area of combined error-control and constrained coding.

*Funding Support:* The Ford Foundation (Complete only if the funding support is provided from other than this award.)

Name: Bradley C. Nindl

Project Role: co-PI

Nearest person month worked: 1

Contribution to project: Dr. Nindl has provided oversight of NMRL study preparations, coordinated collaborator efforts and recruitment procedures.

Name: Fabio Ferrarelli

Project Role: co-PI

Nearest person month worked: 1

Contribution to project: Dr. Ferrarelli has provided oversight of M-STARRT study preparations, coordinated collaborator efforts and recruitment procedures.

Name: Chris Connaboy

Project Role: PhD

Nearest person month worked: 1

Contribution to project: Dr. Connaboy has provided oversight over the sensorimotor and psychomotor task batteries, including study procedures, relevant metrics, and training of necessary personnel.

Name: Shawn Flanagan

Project Role: PhD

Nearest person month worked: 1

Contribution to project: Dr. Flanagan has provided oversight over neurophysiological task batteries, including study procedures, relevant metrics, and training of necessary personnel.

Name: Qi Mi

Project Role: PhD

Nearest person month worked: 1

Contribution to project: Dr. Mi has provided oversight over statistical modeling, as well as database management.

Name: Mita Lovalekar

Project Role: PhD

Nearest person month worked: 1

Contribution to project: Dr. Lovalekar has provided oversight over statistical analysis as it relates to changes in study design and protocol management.

Name: Hassen Khan

Project Role: Database Manager

Nearest person month worked: 1

Contribution to project: Mr. Khan has provided oversight over database development and management procedures.

Name: Mackenzie Osborn  
Project Role: Lab technician  
Nearest person month worked: 1  
Contribution to project: Recruitment, phone screening, and scheduling participants

Name: Maggie Sphar  
Project Role: Lab technician  
Nearest person month worked: 1  
Contribution to project: Recruitment, phone screening, and scheduling participants

Name: Alice Lagoy  
Project Role: Graduate student  
Nearest person month worked: 1  
Contribution to project: Lab procedures for heart rate variability, psychological measures and sleep

Name: Jenna Parrish  
Project Role: PhD  
Nearest person month worked: 1  
Contribution to project: Dr. Parrish has provided oversight over M-STARRT sleep study procedures, relevant metrics, and training of necessary personnel.

Name: Brian Martin  
Project Role: PhD  
Nearest person month worked: 1  
Contribution to project: Dr. Martin has provided oversight over blood analysis, including study procedures, relevant metrics, and training of necessary personnel.

Name: Amy Haufler  
Project Role: PhD  
Nearest person month worked: 1  
Contribution to project: Dr. Haufler has provided oversight over SPEAR test, including study procedures, relevant metrics, and training of necessary personnel.

Name: Peter Roma  
Project Role: PhD  
Nearest person month worked: 1  
Contribution to project: Dr. Roma has provided oversight over Cognition test battery, including study procedures, relevant metrics, and training of necessary personnel.

Name: Nicole Sekel  
Project Role: Research Assistant and Project Manager  
Nearest person month worked: 0.5  
Contribution to project: Ms. Sekel joined the project in August as a Research Assistant and Project Manager assisting primarily in data collection as well as regulatory processes.

Name: Meaghan Beckner

Project Role: Graduate Student

Nearest person month worked: 1

Contribution to project: Ms. Beckner has provided oversight over NMRL study procedures, relevant metrics, and training of necessary personnel. She also submitted the local IRB protocol to HRPO.

Name: Aaron Sinnott

Project Role: Graduate Student

Nearest person month worked: 1

Contribution to project: Mr. Sinnott has provided oversight over NMRL study procedures, primarily EST 3000, and training of necessary personnel.

**Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?**

*If there is nothing significant to report during this reporting period, state “Nothing to Report.”*

*If the active support has changed for the PD/PI(s) or senior/key personnel, then describe what the change has been. Changes may occur, for example, if a previously active grant has closed and/or if a previously pending grant is now active. Annotate this information so it is clear what has changed from the previous submission. Submission of other support information is not necessary for pending changes or for changes in the level of effort for active support reported previously. The awarding agency may require prior written approval if a change in active other support significantly impacts the effort on the project that is the subject of the project report.*

Dr. Fabio Ferrarelli succeeded Dr. Anne Germain as project co-PI. IRB approval received on 1/4/19 for addition of Dr. Fabio Ferrarelli. HRPO was notified on 1/7/19 via email sent to Anastasia Zuppe.

**What other organizations were involved as partners?**

*If there is nothing significant to report during this reporting period, state “Nothing to Report.”*

*Describe partner organizations – academic institutions, other nonprofits, industrial or commercial firms, state or local governments, schools or school systems, or other organizations (foreign or domestic) – that were involved with the project. Partner organizations may have provided financial or in-kind support, supplied facilities or equipment, collaborated in the research, exchanged personnel, or otherwise contributed.*

Provide the following information for each partnership:

Organization Name:

Location of Organization: (if foreign location list country)

Partner's contribution to the project (identify one or more)

- Financial support;
- In-kind support (e.g., partner makes software, computers, equipment, etc., available to project staff);
- Facilities (e.g., project staff use the partner's facilities for project activities);
- Collaboration (e.g., partner's staff work with project staff on the project);
- Personnel exchanges (e.g., project staff and/or partner's staff use each other's facilities, work at each other's site); and
- Other.

Nothing to Report.

## 8. SPECIAL REPORTING REQUIREMENTS

**COLLABORATIVE AWARDS:** For collaborative awards, independent reports are required from BOTH the Initiating Principal Investigator (PI) and the Collaborating/Partnering PI. A duplicative report is acceptable; however, tasks shall be clearly marked with the responsible PI and research site. A report shall be submitted to <https://ers.amedd.army.mil> for each unique award.

**QUAD CHARTS:** If applicable, the Quad Chart (available on <https://www.usamraa.army.mil>) should be updated and submitted with attachments.

9. **APPENDICES:** Attach all appendices that contain information that supplements, clarifies or supports the text. Examples include original copies of journal articles, reprints of manuscripts and abstracts, a curriculum vitae, patent applications, study questionnaires, and surveys, etc.