Fiscal Year:	FY 2020	**Task Last Updated:**	FY 05/20/2020
PI Name:	Strangman, Gary E Ph.D.		
Project Title:	Brain-Related Assessments for Investigating the Neurophysiology of SANS (BRAIN-SANS)		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) **SANS**:Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS)		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	02129-2020	**Congressional District:**	7
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2018-2019 HERO 80JSC018N0001-SANS: Spaceflight Associated Neuro-ocular Syndrome Countermeasures. Appendix C
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No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
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Key Personnel Changes/Previous PI:			
COI Name (Institution):	Bershad, Eric M.D. (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Zhang, Quan Ph.D. (Massachusetts General Hospital)		
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Task Description:	Spaceflight Associated Neuro-ocular Syndrome (SANS) remains an important and unmitigated risk to long-duration spaceflight. Current hypotheses suggest that the lack of gravity leads to fluid shifting towards the head, resulting in congestion and/or elevated pressures in the cranial, vascular, and/or lymphatic compartments. NASA is proposing to conduct 30-day head-down tilt (HDT) experiments to test SANS countermeasures at the :envihab facility in Cologne, Germany. We propose to provide numerous key measurements in support of these planned 30-day missions. We will focus in particular on providing a toolkit for detailed neurophysiological and fluid shift assessment and monitoring suitable for measuring both SANS- and countermeasure-related changes. These tools will be designed to complement the standard ocular measures used for SANS diagnosis and monitoring (e.g., optical coherence tomography (OCT), ocular ultrasound (US), fundoscopy, visual acuity). Our proposed measures will include: • Intra-ocular pressure (IOP) tonometry, per our team's prior SANS-relevant work. • Relative intracranial pressure (ICP) measurements via distortion product otoacoustic emissions (distortion product otoacoustic emissions: DPOAE). • Blood volume shifts along the body axis via near-infrared spectroscopy (NIRS). • Intracranial blood inflow and outflow, via internal jugular vein (IJV) and carotid artery (CA) ultrasound cross-sectional imaging and Doppler. • Cerebral pulsatility assessment, per our parabolic flight and SPACE-COT (Studying Physiological and Anatomical Cerebral Effects of CO2 and Tilt) :envihab NIRS study. • Blood pressure at the level of the head via local, cuffless superficial temporal artery tonometry. • Sagittal sinus blood volume imaging and monitoring using diffuse optical tomography (DOT). • Cerebral edema assessment based on H2O concentration imaging, similar to that used in our previous altitude sickness studies. • Cerebral electrical activity, via electroencephalogram (EEG) measurements. • Dynamic cerebral autoregulation (CAR) assessment during countermeasure (CM) challenges, which can be derived from the NIRS signals used in the above measurements. Our tools will be made fully compatible with the planned SANS countermeasures, as well as with those of other teams proposing specific CMs. Along with the measures, we will provide the necessary expertise and analysis to quantify physiological changes associated with SANS countermeasures deployed during the 30-day HDT campaigns at :envihab. Our specific aims are as follows: Aim 1: Develop an integrated collection of hardware to support multiple simultaneous, continuous brain monitoring/imaging capabilities, and ensure the hardware and measurements are fully compatible with whatever countermeasures are deployed during the :envihab missions. Aim 2: Characterize and quantify individual subjects' physiological responses to each planned condition, including comparative assessment of SANS countermeasures. Aim 3: Relate neurophysiological changes over the 30-day HDT—both with and without SANS-CMs—to cognitive and operational performance, sleep, mood, and ocular measures. Given NASA's plan to deploy Standard Measures during the study, we expect data will be collected from Cognition, Robotic On-Board Trainer for Research (ROBoT-r), psychological/mood surveys, and the standard ocular measures (OCT, fundoscopy). We will obtain these measures through data sharing so we can investigate the relationship of our neurophysiological measures to each of these outcome assessments. We will focus particular attention on neurophysiological relationships with operational performance ROBoT-r, the development of which was led by Dr. Strangman and which we have deployed in Human Exploration Research Analog (HERA), Neumayer Station in Antarctica, and onboard the International Space Station (ISS). Jointly, the planned measures and Aims will enable NASA to quantitatively evaluate and compare the (neuro)physiological changes and fluid shifts associated with HDT and SANS countermeasures.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2020.
Bibliography Type:	Description: (Last Updated: 02/05/2025)