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PI Address 1: Department of Psychiatry PI Address 1: 149 13th Street, Suite 2651 PI Web Page: Contracts City: Charlestown State: MA Zip Code: 02129-0200 Congressional District: 7 Comments: Comments: 2018-2019 HERO Project Type: Ground Solicitation / Funding: Solicitation / Solicitation / Funding: No. of Post Docs: 1 No. of PhD Degrees: Contermeasures. Appendix Contact Phone: No. of PhD Candidates: No. of Master' Degrees: Degrees: Contact Monitoring Center: NASA JSC No. of Bachelor's Candidates: Whitmire, Alexandra Contact Phone: NASA JSC Contact Monitoring Center: NASA JSC NASA JSC NASA JSC Contact Monitoring Center: NASA JSC NASA JSC	PI Organization Type:	NON-PROFIT	Phone:	617-724-0662
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Zip Code02129-2020Congressional District:7Comments:Comments:FoundProject Type:GroundGroundSolicitation / Funding Source2018-2019 HERO SourceStart Date:04/01/2020Edata03/31/2023No. of Post Docs:1No. of PhD Degrees:No. of PhD Candidates:No. of Master' Degrees:No. of Master's Candidates:No. of Master' Degrees:No. of Bachelor's Candidates:Minine, AlexandraContact Monitoring Center:NASA JSCContact Email:alexandra m whitmire@nasa.govFlight Program:Ed. note - PI addition to Feb 2022 report: Jimmy Wu, of the Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (B	PI Web Page:			
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No. of Post Docs:INo. of PhD Degrees:No. of PhD Candidates:No. of Master' Degrees:No. of Master's Candidates:No. of Bachelor's Degrees:No. of Bachelor's Candidates:Monitoring Center: NASA JSCContact Monitor:Whitmire, AlexandraContact Email:alexandra.m. whitmire@nasa.govFlight Program:IFlight Assignment:IKey Personnel Changes/Previous PlEd. note - PI addition to Feb 2022 report: Jimmy Wu, of the Baylor College of Medicine, was added to the project due to his expertise in biomedical engineering.Col Name (Institution):Ed. note - PI addition to College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.) Ivkovic, Vladimir Ph.D. (Massachusetts General Hospital) Jimmy, Wu (Baylor College of Medicine, Inc.)Grant/Contract No.:80NSSC20K0841	Project Type:	Ground		80JSC018N0001-SANS: Spaceflight Associated Neuro-ocular Syndrome
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operational performance, sleep, mood, and ocular measures. This will include the Cognition battery, psychol ogical/moos surveys, and a suite of ocular measures (OCT, findoscopy). We will obtain as many measures as possible through data sharing and investigate the relationship of our neurophysiological measures to each of these outcome assessments. 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: Our work will involve developing a detailed toolbox of measures for assessing brain physiology. These technologies will be compatible with the planned SANS countermeasures, and hence could be deployed in multiple other settings on Earth, ranging from intensive care units to exercise settings. The detailed and simultaneous monitoring of numerous cerebral physiology variables is expected to provide new insights into how the bodyand brain responds to various types of interventions. As such, the data could provide insights into how the bodyand brain responds to pre-syncope, bedrest, exercise, fluid shifts, and sequestration of blood in the extremities. All of these have implications in medicine here on Earth. PROJECT OVERVIEW Background: Spaceflight associated neuro-ocular syndrome (SANS) is an unsolved risk for astronauts have exhibited SANS, although related ocular findings are more common (e.g., acquire do Paperopia, globe flattening, achoroidal folds, retinal fiber nerve layer thickening). Unexpectedly, SANS signs do not always spontaneously resolve upon return to Earth gravity. While the cause of SANS is unknown, the hyperopia, globe flattening, achoroidal folds, retinal fiber nerve layer thickening). Unexpectedly, SANS signs do not always spontaneously resolve upon return to Ear		 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: Relative intracranial pressure (ICP) measurements via distortion product otoacoustic emissions (distortion product otoacoustic emissions: DPOAE). 			
rense-sectional imaging and Dorpler. Carebral patientify associated, pre-are yransholic flight and SPACE-COT (Studying Physiological and Anatonical Cerebral Effects of CO2 and Tith) erwithab NIRS study. Blod pressure at the level of the head via local, offifes superficul emporal arety tonometry. Signital sinus bodo volume imaging and monitoring using diffus optical comography (DDT). Cerebral electrical activity, via electroencephalogram (EEG) measurements. Optimatic cerebral actoregulation (CAR) associated measurements. Optimatic cerebral activity, via electroencephalogram (EEG) measurements. Optimatic cerebral activity, via electroencephalogram (EEG) measurements. Optimatic cerebral activity associated with SANS countermeasures deployed during the 30-day HDT campaigns at cervitab. Our rock will be made HDP concentration imaging, similar to that used in our precision system. Anin 2. Cheaneterized collection of hardware to support multiple simultaneous: continuous brain munitoring/imaging apphilitios. Anin 2. Cheaneterized collection of hardware to support multiple simultaneous: continuous brain munitoring/imaging apphilitios. Anin 2. Cheaneterize and quarity individual subjects' physiological responses to each planned condition, including comparitive activity, the planned measures and Anio with BANS contermeasures. Rationale for HRP Directed Research: Our vork will involve developing a detailed toolbay. IDDT—both with and without SANS Coductromeasures. Anin 3. Etale neurophysiological changes are for assessing brain physiology. These technologies will be compatible with the planned SANS contermeasures. Rationale for HRP Directed Resear		Blood volume shifts along the body axis via near-infrared spectroscopy (NIRS).			
Research Imper/Earth Benefits Corebral Effects of CO2 and TED) servicibal NRS study. Task Description: • Blood pressure at the level of the head via local, cuffless superficial temporal attry tonometry. • Sagital simuls blood volume imaging and monitoring using diffuse optical concernpts (DOT). • Carebral electrical activity, via electroencephalogram (EEG) measurements. • Carebral electrical activity, via electroencephalogram (EEG) measurements. • Dynamic correly and unorregulation (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 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 countermeasure, the provide than coccasive previne and analysis on quantify physiological enages as follows: • Arian 1: Develop an integrated collection of hardware to support multiple simultaneous, continuous brain monitoring imaging capobilities, and ensure the hardware and measurements are fully compatible with all countermeasures. Bloyel doiting the eroshito missione. • Arian 1: Develop an integrated collection of hardware to support multiple simultaneous, continuous brain monitoring unsegitable thereids than solid enable solid collection and particular pleromance. Slags and Multi al subjects' physiological responses to each of these outcome assessments. • Arian 1: Develop an a site of coular measures. This will mitoluke the Cognition battery, psychological changes arerethable of an aneusary to assessment of SANS					
rask Description: Sagital sinus blood volume imaging and monitoring using diffuse optical tomography (DOT). Cerebral electrical activity, via electroencephalogram (EEG) measurements. Dynamic cerebral altoregulation (CAR) assessment during countermeasures (CM) challenges, which can be derived from the NUSS signalus used in the alove measurements. Dynamic cerebral altoregulation (CAR) assessment with the planned SANS countermeasures will provide the necessary expertise and multysis to quantify physiological changes associated with SANS countermeasures (CM) challenges, which can be derived from the NUSS signalus used in the alove measurements. Dynamic cerebral autoregulation (CAR) associated with SANS countermeasures (CM) challenges, which can be derived from the NUSS signalus cerebral autoregulation and measurements are fully compatible with all countermeasures deployed during the 30-day HDT campaigns at :envilueb. Our specific insta are a follows: Aim 1: Develop an integrated collection of fardware to support multiple simultancous, continuous brain monitoring imaging coppositions, and mere the handwares. Aim 2: Characterize and quantify individual subjects' physiological responses to each planned condition, including comparative sessement of SANS countermeasures. Aim 3: Relate neurophysiological changes over the 30-day IDT—both with ad without SANS-CM-are cognitive and operational performance, deeperduations of our measures to ach of these counce assessments. Aim 3: Relate neurophysiological changes over the 30-day IDT—both with ad without SANS-CM-are cognitive and performance, deeperduations, including the compatible with the planned SANS countermeasures. The software of the second conce assessments are allowed on the two services and a site of occure meassessments to ach of these counce assessments.					
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	SANS-CM Study at the German Space Agency (Deutsches Zentrum fur Luft-und Raumfahrt or "DLR") Envihab Facility:
	To address the lack of SANS CMs, NASA negotiated a plan with the DLR German Aerospace Center's Envihab (:envihab) facility to conduct 30-day head-down tilt (HDT) bedrest studies—the SANS-CM study. This effort currently includes 4 study arms:
	1. 60 HDT bedrest alone (Reference) 2. 60 HDT bedrest plus two 3-hour periods per day seated upright (Seated CM) 3. 60 HDT bedrest plus two 3-hour periods per day of LBNP (LBNP CM) 4. 60 HDT bedrest plus two ~1-hour periods of exercise plus an additional 2 hours of VTC (Exercise CM)
	Each arm will consist of n=12 subjects, and different investigators will be involved in different portions of the overall SANS-CM study.
	BRAIN-SANS Contribution:
Task Progress:	This BRAIN-SANS project seeks to provide a wide range of brain-related measures for all subjects in all study arms. These include changes in (i) intracranial pressure (ICP), (ii) blood flow in/out of the brain, (iii) cerebral blood flow velocity, (iv) brain perfusion and oxygenation, (v) blood distribution along the body axis, (vi) intracranial pulsatility, (vii) sagittal sinus imaging of potential venous congestion, (viii) intracranial water concentration, (ix) functional brain activation, (x) electrical brain activity, as well as (xi) cognitive performance data (Cognition). We also plan to compare these measures with measures from other groups including ocular measures, mood and sleep, 1-carbon single nucleotide polymorphisms, and magnetic resonance imaging (MRI).
	ACHIEVEMENTS IN YEAR 2
	By the end of the 2nd year of this project, we will have completed the following major tasks:
	Hardware & Supplies Shipping: After COVID-related scheduling delays at DLR, all hardware for our BRAIN-SANS monitoring toolkit—developed in Aim 1—was shipped to the DLR for training and use.
	Training: All :envihab personnel were trained to use the various toolkit instruments, including NINscan CW-NIRS (continuous wave/near-infrared spectroscopy) systems, the OptiplexTS RF-NIRS system, the Mimosa Acoustics HearID DPOAE (distortion-product otoacoustic emissions) system, and MAICO EasyTymp tympanometer.
	Dry runs: Full-up dry runs were conducted with DLR personnel to demonstrate the integration of the above devices, as well as how to further integrate the DLR imaging ultrasound, transcranial Doppler (TCD), and finometer devices.
	Finalizing protocols: The dry runs were used to finalize all protocols, customized to the specific DLR testing environment. This included tilt-testing for calibration, orthostatic tilt testing, rest measurements, and measurements during onset, maintenance, and offset of countermeasures.
	Campaign 1: Data acquisition (and troubleshooting as needed) was completed for the entirety of Campaign 1, from Sept-Nov 2021. A total of 735 data files (out of a nominally expected 744 data files) were collected, for a 98.8% data collection rate. Quality control assessments for all Campaign 1 datasets were conducted during and immediately after Campaign 1.
	Campaign 2: Preparations for Campaign 2—which is conceptually a repeat of Campaign 1 involving n=6 additional seated-upright CM subjects plus n=6 LBNP subjects—was initiated in Jan 2022 and is expected to complete in Mar 2022. Initial data collection sessions went smoothly.
	SUMMARY
	Despite challenges bought on by COVID-19 from the beginning of our funding, we initiated and completed running n=12 volunteers in Campaign 1 of the SANS-CM study (n=6 using the LBNP CM and n=6 as seated-upright controls). We have also started Campaign 2, with n=6 additional LBNP and n=6 seated-upright participants. We are on-track to complete Campaign 2 as planned. Campaigns 3-4 are currently scheduled to be conducted in the first half of 2023.
Bibliography Type:	Description: (Last Updated: 02/05/2025)
Abstracts for Journals and Proceedings	Thoolen S, Zhang Q, Ivkovic V, Voss S, Moestl S, Frett T, Tank J, Wu J, Bershad E, Strangman G. "BRAIN-SANS: Brain-related assessments for investigating the neurophysiology of SANS." 2022 NASA Human Research Program Investigators' Workshop, Virtual, February 7-10, 2022. Abstracts. 2022 NASA Human Research Program Investigators' Workshop, Virtual, February 7-10, 2022 (Abstract # 1133-000156). Feb-2022