Fiscal Year:	FY 2024	**Task Last Updated:**	FY 03/14/2024
PI Name:	Basner, Mathias M.D., Ph.D.		
Project Title:	Temporal Nature of Cognitive and Visuospatial Brain Domain Changes During Long-Duration Low-Earth Orbit Missions		
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) **BMed**:Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (2) **Sensorimotor**:Risk of Altered Sensorimotor/Vestibular Function Impacting Critical Mission Tasks		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	19104-4209	**Congressional District:**	2
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	2017-2018 HERO 80JSC017N0001-BPBA Topics in Biological, Physiological, and Behavioral Adaptations to Spaceflight. Appendix C
Start Date:	06/01/2019	**End Date:**	09/30/2033
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	0
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
Contact Monitor:	Whitmire, Alexandra	**Contact Phone:**	
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 09/30/2033 per S. Mack-Phillips/JSC (Ed., 8/17/23) NOTE: End date changed to 12/31/2027 per NSSC information (Ed., 1/27/21)		
Key Personnel Changes/Previous PI:	CoI Sara Whiting was removed from the project. CoIs Vladimir Ivkovic and Sheena Dev were added.		

COI Name (Institution):	Dinges, David Ph.D. (University of Pennsylvania) Gunga, Hanns-Christian M.D. (Charite - Universitatsmedizin Berlin, Germany) Gur, Ruben Ph.D. (The Trustees of the University of Pennsylvania) Hartley, Tom Ph.D. (University of York, United Kingdom) Kuehn, Simone Ph.D. (Max Planck Institute for Human Development, Berlin, Germany) Moore, Tyler Ph.D. (Trustees of Tufts College) Riecke, Bernhard Ph.D. (Simon Fraser University, Canada) Roalf, David Ph.D. (University of Pennsylvania) Wolbers, Thomas Ph.D. (German Center for Neurodegenerative Diseases, Germany) Stahn, Alexander Ph.D. (Charite - Universitatsmedizin Berlin, Germany (University of Pennsylvania)) Bell, Suzanne (NASA) Ivkovic, Vladimir (Mass General Brigham) Dev, Sheena (NASA BHP Lab)
Grant/Contract No.:	80NSSC19K1046
Performance Goal No.:	
Performance Goal Text:	
Task Description:	As part of the CIPHER project (Complement of Integrated Protocols for Human Exploration Research), we are investigating visuospatial brain domain changes and spatial cognition in the up to 30 CIPHER crewmembers assigned to 6-, and 12-month ISS missions as well as in an equal number of age-, sex- and education-matched ground controls. The experiment is part of an international project consisting of three experiments (lead by Drs. Basner, Stahn, and Ivkovic, respectively) with synergistic aims that are being carried out in a joint effort by NASA and DLR/ESA. Dr. Stahn's project specifically targets spatial cognition, how it relates to structural and functional brain changes and their molecular signatures. Given the impact of visuospatial brain domain changes on neurobehavioral functioning, operations and safety during LDM (i.e., docking, landing, navigating on the planetary surface), spatial cognition and its neural basis are a key concern for extended mission durations. Dr. Ivkovic's team will assess sleep, stress and immune responses, and operational performance leveraging the Canada arm simulator— Robotic on Board Trainer for Research (ROBoT-r). These projects are presented separately in other abstracts. This project (PI Dr. Basner) focuses on neurostructural and cognitive changes. Astronauts will each perform NASA's Cognition test battery before, during, and after their 6-, or 12-month ISS missions. Based on protracted performance decrements observed in Scott Kelly after his one-year mission, the last test bout will be performed 1 year after return to Earth. The data will be used to generate temporal profiles of human cognitive performance that will inform future long-duration deep space missions. They will also be combined with existing Cognition data collected by the PI and his team on the ISS and in several space analog environments on Earth as the basis for a normative database for long-duration space missions. All astronauts will undergo structural and functional Magnetic Resonance Imaging (MRI) before and immediately after the mission (R+5, R+30). They will perform a version of the Cognition test battery that was specifically designed for the MRI (i.e., fCog) in the scanner. We will correlate structural and functional changes observed during fMRI scans post-flight relative to pre-flight with in-flight changes in Cognition performance to establish the biological basis for any observed cognitive performance changes. We will also integrate the general cognitive performance data from Cognition with spatial navigation, learning, and memory data as well as with biomarkers collected in Project B (Spatial Cognition and Hippocampal Plasticity During Long-Duration Low-Earth Orbit Missions: HypoCampus in i1YMP) before, during, and after flight. The current plan is to investigate 13 astronauts on 6- or 12-month ISS missions as well as 13 age and sex matched controls, who will perform tests/scans at the same intervals as the matched astronaut but with a 2-month delay.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The three projects will deliver a highly unique and comprehensive set of integrated neuroimaging and neurocognitive tools for the evaluation and ultimately prevention of adverse effects on brain structure and function that lead to behavioral effects associated with exploration-type missions. As the Cognition test battery was developed for high-performing subject populations, this work will also translate to high performing populations on Earth (e.g., physicians, submariners).
Task Progress:	At the time of this writing, four astronauts and one matched control have been enrolled in the study and are at various stages of the study (i.e., pre-, in-, and post-flight).
Bibliography Type:	Description: (Last Updated: 04/05/2024)
Articles in Peer-reviewed Journals	Seidler RD, Stern C, Basner M, Stahn AC, Wuyts FL, zu Eulenburg P. "Future research directions to identify risks and mitigation strategies for neurostructural, ocular, and behavioral changes induced by human spaceflight: A NASA-ESA expert group consensus report." Front Neural Circuits. 2022 Aug 4;16:876789. https://doi.org/10.3389/fncir.2022.876789 ; PubMed PMID: 35991346; PubMed Central PMCID: PMC9387435 , Aug-2022