Fiscal Year:	FY 2022	**Task Last Updated:**	FY 01/14/2022
PI Name:	Basner, Mathias M.D., Ph.D.		
Project Title:	Long-Term Brain Structural and Functional Consequences of Spaceflight		
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) (2) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **BMed**:Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (2) **SANS**:Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS) (3) **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		
PI Email:	basner@pennmedicine.upenn.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	215-573-5866
Organization Name:	University of Pennsylvania		
PI Address 1:	Department of Psychiatry, Division of Sleep and Chronobiology		
PI Address 2:	423 Service Dr, 1013 Blockley Hall		
PI Web Page:			
City:	Philadelphia	**State:**	PA
Zip Code:	19104-4209	**Congressional District:**	2
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2019-2020 HERO 80JSC019N0001-HHCBPSR, OMNIBUS2: Human Health Countermeasures, Behavioral Performance, and Space Radiation-Appendix C; Omnibus2-Appendix D
Start Date:	03/15/2021	**End Date:**	03/31/2029
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:**	
Contact Email:	alexandra.m.whitmire@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: End date changed to 03/31/2029 per L. Juliette/JSC (Ed., 5/3/22).		
Key Personnel Changes/Previous PI:			

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) Riecke, Bernhard Ph.D. (Simon Fraser University, Canada) Roalf, David Ph.D. (University of Pennsylvania) Bell, Suzanne Ph.D. (NASA Johnson Space Center) Stangl, Matthias Ph.D. (University of California, Los Angeles) Whiting, Sara Ph.D. (NASA/Lyndon B Johnson Space Center) Wolbers, Thomas Ph.D. (German Center for Neurodegenerative Diseases, Germany) Stahn, Alexander Ph.D. (Charite - Universitatsmedizin Berlin, Germany)
Grant/Contract No.:	80NSSC21K1698
Performance Goal No.:	
Performance Goal Text:	
Task Description:	Magnetic Resonance Imaging (MRI) of the brain before and immediately following long-duration International Space Station (ISS) flights as well as Antarctic winter-over missions have revealed structural changes, but the time course of recovery and clinical significance remain unclear. This international proposal will "determine if exposure to long-duration spaceflight leads to neural structural alterations and if this remodeling impacts cognitive and functional performance" (HRP Gap BMed-107). To accomplish this, we propose to leverage data from our already funded integrated 1-Year Mission Project (i1YMP) and extend the follow-up period for N=20 astronauts on 6- and 12-month ISS missions to 3-years post-flight (this follow-up period can be extended should structural and functional brain changes not be fully reversible within 3 years after return from the ISS). Measures of cognitive function include the Cognition test battery (developed by NASA Principal Investigator Dr. Basner and his team), a Spatial Cognition test battery (developed by German Aerospace Center (DLR)/European Space Agency (ESA) Principal Investigator Dr. Stahn and his team), and NASA's standard WinSCAT test battery (which currently is last performed 30 days post-flight). These tests will be performed up to 7 times post-flight, which will provide an exceptional resolution in mapping the recovery time course of any observed decrements in cognitive performance across a wide range of cognitive domains and constructs. The cognitive data will also be used to either extend existing or start building normative databases. In our i1YMP, we perform structural and functional MRI scans in astronauts before and immediately after the mission. These scans include, but go beyond, protocols that were the basis for several recent publications that observed structural brain changes in astronauts immediately post-flight and can thus augment these data sets. In our i1YMP, astronauts perform a functional MRI version of Cognition (Project A) as well as a complex Mars navigation task (Project B) in the scanner, which allows us to link task-specific changes in brain plasticity with any relevant changes in neurobehavioral performance with the Cognition and Spatial Cognition batteries, and assess their neural basis. T1- and T2-weighted structural scans will be used to investigate changes in brain structures that have been implicated in the development of the Spaceflight Associated Neuro-ocular Syndrome (SANS) (e.g., upward shift of the brain, increases in cerebrospinal fluid (CSF) volume with periventricular white matter hyperintensities; Human Research Program (HRP) Gaps SANS1 and 13; Project A) and that have been shown to be most vulnerable to spaceflight stressors (i.e., visuospatial brain domain changes; Project B). Seven post-flight scans (R+3, R+5, R+30, R+180, R+360, R+720, R+1080) will provide an unmatched resolution in mapping the recovery time course. Clinical significance of cognitive and MRI data will be based on deviations from pre-flight measurements as well as from normative data collected in other astronauts and astronaut-surrogate populations. In summary, this international project will monitor changes in brain structure and function up to 3-years post-flight to determine 1) whether they persist in some astronauts, 2) if so, for how long, and 3) whether there are any long-term health consequences. It will thus deliver critical insights into the time course of brain changes and their functional relevance observed in astronauts after ISS missions lasting 6-months and longer. Synergies between the projects will be used to provide NASA and DLR/ESA with insights that go beyond the specific aims of the individual projects.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Detailed astronaut follow-up after return from spaceflight has historically been limited to a few weeks, which prevents conclusions about long-term health consequences of astronauts, especially after longer stays in space. This study will follow astronauts for up to 5 years after >=6 months missions. The research partially translates to similar stressful long-term exposure situations on Earth.
Task Progress:	This project is being combined with the work of three other PIs who responded to the same solicitation with independent proposals. During this reporting period, the protocols and aims from all four PIs are being integrated into a revised integrated proposal that will be delivered to NASA Human Health Countermeasures (HHC) and NASA Human Factors and Behavioral Performance (HFBP) Element scientists in January 2022. To reach this goal, the research team determined how to combine MRI sessions from multiple PIs, identified and removed overlapping procedures, and made substantial progress towards having a single, integrated budget.
Bibliography Type:	Description: (Last Updated: 04/05/2024)