Fiscal Year:	FY 2017	**Task Last Updated:**	FY 02/13/2017
PI Name:	Basner, Mathias M.D., Ph.D.		
Project Title:	Hybrid Training - A Sensory Stimulation Countermeasure for Long Duration Space Exploration Missions		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Behavior and performance		
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		
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:	GROUND	**Solicitation / Funding Source:**	2014-15 HERO NNJ14ZSA001N-MIXEDTOPICS. Appendix E: Behavioral Health & Human Health Countermeasures Topics
Start Date:	04/19/2016	**End Date:**	04/18/2019
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:	Williams, Thomas	**Contact Phone:**	281-483-8773
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Flight Program:			
Flight Assignment:	NOTE: Element change to Human Factors & Behavioral Performance; previously Behavioral Health & Performance (Ed., 1/17/17)		
Key Personnel Changes/Previous PI:	N/A		
COI Name (Institution):	Dinges, David Ph.D. (University of Pennsylvania) Gur, Ruben Ph.D. (University of Pennsylvania) MGuire, Sarah Ph.D. (University of Pennsylvania) Stahn, Alexander Ph.D. (University of Pennsylvania)		
Grant/Contract No.:	NNX16AI53G		
Performance Goal No.:			

Performance Goal Text:	
Task Description:	This proposal addresses the risk of Adverse Behavioral Conditions and Psychiatric Disorders, and the need to identify and validate countermeasures and effective methods for modifying the habitat/vehicle environment that promote individual behavioral health and performance during exploration class missions (BMed1, BMed7). We propose to investigate the efficacy of physical exercise (using a cycle ergometer) combined with an interactive virtual environment, i.e., Hybrid Training, as a countermeasure for augmenting sensory stimulation during long-duration space missions. This countermeasure will combine validated tools and VR (virtual reality) technologies in a new way to reveal the full potential of Hybrid Training, and take into account (a) key needs that fulfill sensory stimulation, (b) “hedonic adaptation”, i.e., a reduced affective response to stimuli with continued or repeated exposure, (c) delivery schedule, and (d) size, mass, and volume requirements. We plan to investigate a crew of N=9 during two 12-14 month Antarctic winter-over missions in Neumayer station (total N=18). We will investigate both immediate and long-term benefits of Hybrid Training. Our primary outcomes are neurostructural and neurofunctional changes assessed with fMRI, and cognitive performance assessed with the Cognition test battery and a virtual maze. We will also assess biochemical markers of stress and neuroplasticity, objective measures of sleep-wake rhythmicity and sleep structure, subjective symptom reports, and group cohesion with unobtrusive proximity measurements as additional outcomes that will provide insights into mechanisms and consequences of the observed structural and functional brain changes, and their reversibility by Hybrid Training. These data will be compared to historic controls from Neumayer station and other Antarctic stations (Concordia, Halley), space analog environments (e.g., Mars500), and the International Space Station (ISS). At the end of the project, we will have a much clearer understanding whether and to what extent the detrimental effects of ICE (isolated, confined, and extreme) environments on neuroplasticity and behavioral health can be mitigated by Hybrid Training.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	With the proposed work we will relevantly contribute to the goal of the Human Research Program (HRP) to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration. More specifically, our findings, based on state-of-the-art neuroimaging technologies and on innovative, non-invasive, low burden, yet methodologically sound measurement technologies for cognitive, physiological, and crew cohesion outcomes, will relevantly contribute to the development of technologies to provide mission planners and system developers with strategies for monitoring and mitigating crew health and performance risks. These methodologies will also be useful for assessing subjects living in isolated, confined, and extreme environments on Earth.
Task Progress:	In the past 12 months, we accomplished the following project milestones: 1) received IRB (institutional review board) approval from all relevant institutions (NASA, University of Pennsylvania, Charité Berlin), 2) tested and selected the Hybrid Training equipment (Expresso HD Upright Bike), 3) purchased and prepared measurement equipment, shipped it, and installed it at Charité Berlin (for pre- and post-mission measurements) and at the Antarctic Neumayer station, 4) generated procedures for research subjects and wrote software for data harvesting, 5) briefed subjects, obtained informed consent, and performed baseline data acquisition (including neuroimaging) at Charité Berlin, 6) started data acquisition at Neumayer station in N=7 subjects that consented to take part in the study.
Bibliography Type:	Description: (Last Updated: 04/05/2024)