Fiscal Year:	FY 2019	**Task Last Updated:**	FY 04/30/2019
PI Name:	Seidler, Rachael D. Ph.D.		
Project Title:	Bed Rest Combined with 0.5% CO2 as a Spaceflight Analog to Study Neurocognitive Changes: Extent, Longevity, and Neural Bases		
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 (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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PI Web Page:			
City:	Gainesville	**State:**	FL
Zip Code:	32611-8205	**Congressional District:**	3
Comments:	NOTE: PI moved to University of Florida in July 2017; previous affiliation was University of Michigan.		
Project Type:	Ground	**Solicitation / Funding Source:**	2014-15 HERO NNJ14ZSA001N-MIXEDTOPICS. Appendix E: Behavioral Health & Human Health Countermeasures Topics
Start Date:	06/29/2017	**End Date:**	01/01/2021
No. of Post Docs:	2	**No. of PhD Degrees:**	
No. of PhD Candidates:	2	**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Williams, Thomas	**Contact Phone:**	281-483-8773
Contact Email:	thomas.j.will1@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: Changed end date to 1/01/2021 per L. Juliette/HRP (Ed., 2/19/2020) NOTE: Changed end date to 12/28/2019 per NSSC information (Ed., 10/9/19)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Bloomberg, Jacob Ph.D. (NASA Johnson Space Center) Mulavara, Ajitkumar Ph.D. (Universities Space Research Association) Kuehn, Simone Ph.D. (Max Planck Institute for Human Development) Stahn, Alexander Ph.D. (University of Pennsylvania)		
Grant/Contract No.:	80NSSC17K0021		
Performance Goal No.:			

Performance Goal Text:	
Task Description:	NRA NNJ14ZSA001N-MIXEDTOPICS requests proposals in the area of "Risk Characterization and Monitoring of Behavioral Health and Performance Relevant Outcomes" to determine the effects of 30 days head down tilt bed rest in a 0.5% CO2 environment on neurobehavioral signs and symptoms, neurostructural and neurofunctional alterations, and changes in cognitive function and operational task performance. Our Neuromapping studies measure precisely these metrics in a flight study and a 70 days head down tilt bed rest study under normative conditions. Here, our overarching goal is to quantify neurocognitive changes and associated neural structural and functional alterations occurring as a result of a 30 days head down tilt bed rest plus 0.5% CO2 environment, serving as a spaceflight analog exposure. We will identify the relationship between these neural changes and behavioral function. Our approach utilizes cutting edge neuroimaging techniques and a broad ranging battery of sensory, motor, and cognitive assessments to investigate neuroplastic and maladaptive brain changes occurring in a spaceflight analog environment. Success in this endeavor would 1) result in identification of the underlying neural mechanisms and operational risks of changes in behavior with a spaceflight analog, and 2) identify whether a return to normative behavioral function following bed rest is associated with a restitution of brain structure and function or instead is supported by substitution with compensatory brain processes. Moreover, addition of a CO2 group will enable us to parse out the multiple mechanisms contributing to any spaceflight induced neural structural and behavioral changes that we observe in our ongoing flight projects ((NASA flight project, Seidler Principal Investigator (PI); ILSRA flight study, Stahn PI)), and comparison with our recently completed bed rest projects (Seidler and Stahn, PIs) will allow us to delineate brain and behavioral changes occurring with long term exposure to slightly elevated CO2 levels.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	This project uses long duration head down tilt bed rest as a spaceflight environment analog. The intervention mimics several aspects of human spaceflight, including a shift of fluids towards the head and unloading of the body. Thus the results are relevant for clinical populations on Earth, including individuals who are bed ridden for extended periods of time. Moreover, the shifts that occur in how the brain weights sensory information show some similarities with age changes in sensory processing. Thus understanding how the brain and behavior change in response to this environment can also shed insight into the aging process on Earth.
Task Progress:	Data collection for this project was successfully completed at the :enivhab facility in Cologne, Germany, in December 2017 and all data have been transferred. We are in the process of completing data analyses and preparing manuscripts for submission. To date, we have found a facilitation of processing speed and a decrement in functional mobility for subjects undergoing head down bed rest (HDBR) HDBR+CO2 relative to our previous study of HDBR in ambient air. This suggests there may be combinatorial effects of elevated CO2 and the other physiological effects of HDBR including headward fluid shifts and body unloading. Interestingly, approximately half of the participants in this campaign developed signs of Spaceflight Associated Neuro-Ocular Syndrome (SANS). We found that participants who exhibited signs of SANS became more visually dependent and shifted their speed-accuracy tradeoff, such that they were slower but more accurate than those that did not incur ocular changes. These small subgroup findings suggest that SANS may have an impact on mission relevant performance inflight via sensory reweighting. In addition, we have found brain changes that occur throughout the HDBR+CO2 intervention, with correlate with pre to post bed rest changes in behavior. For example, we have found that connectivity between sensorimotor and higher-order visual brain areas increases with bed rest; moreover, greater increases were associated with more slowing on a functional mobility test post bed rest. We also found that subjects who did and did not develop signs of SANS were different at the outset of the study. Subjects who did not develop SANS had strong connectivity within a visual processing network at baseline, whereas those that did, did not have significant connectivity within this network. We are completing data analyses and preparing several manuscripts for submission.
Bibliography Type:	Description: (Last Updated: 03/18/2025)