Fiscal Year:	FY 2016	**Task Last Updated:**	FY 05/18/2016
PI Name:	Seidler, Rachael D. Ph.D.		
Project Title:	Bed Rest as a Spaceflight Analog to Study Neurocognitive Changes: Extent, Longevity, and Neural Bases		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Sensorimotor Adaptation Team		
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **BHP**:Behavioral Health & Performance (archival in 2017)		
Human Research Program Risks:	(1) **HSIA**:Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture (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:**	2011 Crew Health NNJ11ZSA002NA
Start Date:	08/01/2012	**End Date:**	12/31/2015
No. of Post Docs:	2	**No. of PhD Degrees:**	0
No. of PhD Candidates:	1	**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:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:	NOTE: End date change to 12/31/2015 per NSBRI (Ed., 7/7/15)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Mulavara, Ajitkumar (Universities Space Research Association) Wood, Scott (Azusa Pacific University)		
Grant/Contract No.:	NCC 9-58-SA02802		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	In this project, our objective was to perform structural and functional brain imaging to identify changes in neurocognitive function due to 70 days of head down tilt bed rest. Our central hypotheses were that measures of brain structure, function, and network integrity would change from pre- to post- bed rest to a greater extent than that observed in matched control subjects, but to a lesser extent than what we will observe in crewmembers under our NASA funded flight study NNX11AR02G. Our Aims were to: Aim 1- Identify changes in brain structure, function, and network integrity as a function of 60 days head down tilt bed rest and characterize their time course: We acquired brain structural and functional images at two time points pre-, two time points during, and three time points post- bed rest in 18 individuals and 16 controls who were tested at four time points but otherwise went around their daily lives. We hypothesized that bed rest participants would exhibit changes from pre- to post- the intervention that were significantly greater than those seen in control participants across the same time period. Scans conducted during and following bed rest characterized the time course of changes and recovery. Aim 2- Specify relationships between structural and functional brain changes and performance and characterize their time course: We administered a broad ranging battery of sensory, motor, and cognitive assessments at the time points described for Aim 1. We hypothesized that bed rest participants would exhibit pre- to post-intervention decrements in sensorimotor performance as we have shown in our past work, which we expected would correlate with the neural changes identified under Aim 1. Additionally, for some measures and time points, we expected that there might be no performance effects despite alterations in brain structure and function due to compensatory brain processes, which would be identifiable with neuroimaging approaches. The measures we acquired can be categorized into behavioral assessments and brain imaging assessments. The behavioral tests measured outside of the scanner included: card and cube rotation tests of spatial working memory, digit symbol substitution test of processing speed, rod and frame test of visual bias, pegboard test of bimanual coordination, sensory organization test of vestibular-mediated balance, functional mobility test of obstacle course navigation and vestibular evoked myogenic potential to assess vestibular function. The neuroimaging tests of brain structure and function included: structural MRI to measure regional brain volumes and relative gray matter density, diffusion weighted scans (often referred to as DTI) to measure structural connectivity integrity, resting state functional MRI to measure functional connectivity integrity, and functional MRI to measure brain networks engaged during the performance of various tasks. The latter tasks included: imaging of the functional vestibular cortex, brain regions engaged during single and dual tasking of cognitive and motor behaviors, brain regions engaged during adaptation of pointing movements to perturbed visual feedback, and brain regions engaged for spatial working memory and foot tapping. We have nearly completed data analyses and manuscript preparation. We have one paper published, one under second review, and several more that are nearly ready to submit. We found robust changes with bed rest in balance and functional mobility, replicating other studies that have previously reported sensorimotor declines. We also observed changes in brain gray matter volume, functional connectivity, and task based activation that were specific to the time period of the bed rest intervention, many of which were associated with the magnitude of behavioral change. Some metrics exhibited complete recovery by our last time point 12 days post bed rest, while others were trending towards recovery but had not yet returned to baseline levels.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	While the corpus of research on adaptive plasticity associated with behavioral training has greatly expanded over the past two decades, research on maladaptive plasticity occurring with immobilization is scant. A greater understanding of brain structural and functional changes, and the concomitant behavioral effects, resulting from limb disuse and unloading has implications for rehabilitation of those immobilized by injury, disease, or even simple inactivity. We also have been transferring our new methods for imaging the functional vestibular cortex to the University of Michigan. We will leverage the experience that we attained through development and validation of these methods to conduct some (separately funded) studies related to aging, balance, and vestibular function.
Task Progress:	We are completing our analyses of bed rest induced changes in brain activity during sensorimotor adaptation, spatial working memory, foot movement, and vestibular stimulation tasks. These analyses are nearly complete and we are drafting manuscripts. Publication in revision: Kopplemans V, Bloomberg JJ, De Dios YE, Wood SJ, Reuter-Lorenz PA, Kofman IS, Riascos R, Mulavara AP, & Seidler R., "Brain plasticity and sensorimotor deterioration as a function of 70 days head down tilt bed rest." [Ed. note August 2017--now published August 2017 in PLoS One; see Bibliography section]
Bibliography Type:	Description: (Last Updated: 01/24/2024)
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