Fiscal Year:	FY 2014	**Task Last Updated:**	FY 09/08/2014
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		
PI Email:	rachaelseidler@ufl.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	352-294-1722
Organization Name:	University of Florida		
PI Address 1:	Applied Physiology & Kinesiology		
PI Address 2:	FLG 142, P.O. Box 118205		
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:	1	**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:	3	**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 is 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 are that measures of brain structure, function, and network integrity will 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 are 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 will acquire brain structural and functional images at two time points pre, two time points during, and three time points post bed rest in 13 individuals and 13 age and gender-matched controls. We hypothesize that bed rest participants will exhibit changes from pre to post the intervention that are significantly greater than those seen in control participants across the same time period. Scans conducted during and following bed rest will characterize 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 will administer a broad ranging battery of sensory, motor, and cognitive assessments at the time points described for Aim 1. We hypothesize that bed rest participants will exhibit pre- to post-intervention decrements in sensorimotor performance as we have shown in our past work, which will correlate with the neural changes identified under Aim 1. Additionally, for some measures and time points, we expect that there will be no performance effects despite alterations in brain structure and function due to compensatory brain processes, which will be identifiable with neuroimaging approaches. To date we have fifteen participants enrolled in the bed rest arm of this study; eleven of which have completed all seven of the test sessions. To summarize, the measures we acquire can be categorized into behavioral assessments and brain imaging assessments. The behavioral tests measured outside of the scanner include: 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 include: 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 include: 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 made significant progress during our second year of support. We continued data collection for our bed rest study and initiated the data collection of 8 normative control subjects, six of whom have completed all four time points. It should be noted that this normative control group will be used for comparison for both our NSBRI funded bed rest study and our NASA funded flight study. During Year 3 we will finish data collection for both the bed rest subjects and normative control subjects and continue analyses of our behavioral and MRI data, with a particular emphasis on addressing whether or how the two types of metrics change together as a function of bed rest. In addition, we will combine the results of the bed rest subjects and the normative control subjects in order to place the results of the bed rest subjects into perspective in terms of effects of bed rest versus potential task learning effects and stability of our protocol.
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 we 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:	To date, we have fifteen participants enrolled in the bed rest arm of this study; eleven of these have completed all seven of the test sessions. To summarize, the measures we acquire can be categorized into behavioral assessments and brain imaging assessments. The behavioral tests measured outside of the scanner include: 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; vestibular evoked myogenic potential to assess vestibular function. The neuroimaging tests of brain structure and function include: 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; functional MRI to measure brain networks engaged during the performance of various tasks. The latter tasks include 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; brain regions engaged for spatial working memory, and for foot tapping. We have made great progress during our second year of support. We initiated the data collection for normative control subjects and have obtained complete data for 6 subjects so far. Also, we added an extra structural MRI measure (i.e., T2-weighted image) to the MRI protocols of our normative and bed rest subjects. T2-weighted imaging is better able in visualizing fluid, and thus could be a more sensitive method to detect fluid redistribution as a result of spaceflight/bed rest that could induce increased intracranial pressure. Our analyses of brain structure have revealed focal and global changes in frontal, temporal, and parietal regions of the brain. Furthermore, we observed increases in third ventricle volume with accumulating time in bed rest.
Bibliography Type:	Description: (Last Updated: 03/18/2025)
Articles in Peer-reviewed Journals	Koppelmans V, Erdeniz B, De Dios YE, Wood SJ, Reuter-Lorenz PA, Kofman I, Bloomberg JJ, Mulavara AP, Seidler RD. "Study protocol to examine the effects of spaceflight and a spaceflight analog on neurocognitive performance: extent, longevity, and neural bases." BMC Neurol. 2013 Dec 18;13:205. http://dx.doi.org/10.1186/1471-2377-13-205 ; PubMed PMID: 24350728; PubMed Central PMCID: PMC3878338 , Dec-2013