Fiscal Year:	FY 2015	**Task Last Updated:**	FY 07/07/2015
PI Name:	Mulavara, Ajitkumar P. Ph.D.		
Project Title:	Developing Personalized Countermeasures for Sensorimotor Adaptability: A Bedrest Study		
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) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Sensorimotor (SM)**:Risk of Impaired Control of Spacecraft, Associated Systems and Immediate Vehicle Egress Due to Vestibular/Sensorimotor Alterations Associated with Space Flight		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	ajitkumar.p.mulavara@nasa.gov	**Fax:**	FY 281-244-5734
PI Organization Type:	NASA CENTER	**Phone:**	281-483-8994
Organization Name:	KBRwyle/NASA Johnson Space Center		
PI Address 1:	2101 Nasa Parkway, NASA/JSC		
PI Address 2:	MC: SK2/B21		
PI Web Page:			
City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	36
Comments:	NOTE: Formerly at Universities Space Research Association		
Project Type:	GROUND	**Solicitation:**	2013 HERO NNJ13ZSA002N-Crew Health (FLAGSHIP & NSBRI)
Start Date:	06/01/2014	**End Date:**	05/31/2017
No. of Post Docs:	0	**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:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Peters, Brian Ph.D. (Wyle Laboratories) Feiveson, Alan (NASA Johnson Space Center) Bloomberg, Jacob (NASA Johnson Space Center) Ploutz-Snyder, Lori (Universities Space Research Association) Seidler, Rachael Ph.D. (University of Michigan) Reschke, Millard (NASA Johnson Space Center) Cohen, Helen Ed.D. (Baylor College of Medicine) Wood, Scott Ph.D. (Azusa Pacific University) Zanello, Susana (Universities Space Research Association)		
Grant/Contract No.:	NCC 9-58-SA03801		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	A targeted research area described in the current National Space Biomedical Research Institute (NSBRI) Research Announcement is: Employing a bed rest study, identify and characterize sensorimotor mal-adaptations that may impact performance during a series of g-transitions following long periods in microgravity. Integrate physiological observations and –omics data to develop personalized countermeasures to any observed sensorimotor mal-adaptations. In response to this call this project will identify and characterize a set of predictive measures that include: 1) behavioral tests to assess sensory bias and adaptability; 2) imaging to determine individual brain morphological and functional features; 3) genotype markers for genetic polymorphisms that play a role in the neural pathways underlying sensorimotor adaptation. Information from this study will help in the design of sensorimotor adaptability training countermeasures that may be customized for each crewmember's individual characteristics. The study is almost completely retrospective, in that no new bed rest or flight studies are required. To achieve these goals the following Aims will be pursued: 1) Aim 1: Determine whether baseline individual sensory biases and capabilities for strategic and plastic-adaptive responses predict both change and also the ability to re-adapt sensorimotor and functional performance after 70 days bed rest or short/long duration space flight. We will determine if participants' individual sensory biases in use of vision, vestibular, and proprioception as well as tests of strategic and long-term adaption predict the change from pre to post-tests after bed rest or space flight and determine if those biases predict rates of re-adaptation in sensorimotor performance. 2) Aim 2: Determine if baseline brain morphological and functional metrics predict both change and also the ability to re-adapt sensorimotor and functional performance after 70 days bed rest or short/long duration space flight. We will determine if individual differences in regional brain volumes (structural MRI), white matter integrity (diffusion tensor imaging, or DTI), functional network integrity (resting state functional connectivity MRI), and sensorimotor adaptation task-related functional brain activation (functional MRI) predict pre to post levels of decrements and their rates of re-adaptation in sensorimotor performance. 3) Aim 3: Determine if genetic markers predict both change and also the ability to re-adapt sensorimotor and functional performance after 70 days bed rest or short/long duration space flight. We will determine whether genetic polymorphisms in COMT, DRD2, BDNF and genetic polymorphism of alpha2-adrenergic receptor are associated with pre to post levels of decrements in sensorimotor performance and rates of re-adaptation. Developing predictive measures of sensorimotor adaptability will allow us to better design and implement sensorimotor adaptability training countermeasures that are customized for each crewmember's sensory biases, adaptive capacity, brain structure and functional capacities, and genetic predispositions. We will be conducting a retrospective study leveraging data already collected from relevant ongoing/completed bed rest and space flight studies. This data will be combined with predictor metrics -- behavioral, brain imaging, and genomic measures collected from these returning subjects to build models for predicting post-mission (bed rest or space flight) adaptive capability as manifested in their outcome measures. Comparisons of model performance for various groups of predictors will provide insight into how to design subject-specific countermeasures against decrements in post-mission adaptive capability. This ability will allow more efficient use of crew time during training and will optimize training prescriptions for astronauts to ensure expected outcomes.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	This project will produce a set of predictive measures to determine individual capability for rapid sensorimotor adaptation. This will allow the implementation of sensorimotor adaptability rehabilitation and re-conditioning training programs that may be customized for vestibulopathic or elderly patients' sensory bias, motor learning modes and individual adaptive capability, brain structural and functional characteristics, or targeted single nucleotide polymorphisms. This will optimize training prescriptions to enable efficient use of patient time during rehabilitation and re-conditioning training programs to ensure expected outcomes.
Task Progress:	During the last funded year: 1. NASA Institutional Review Board (IRB) approved study for 51 subjects. 2. NASA Test Readiness Review Board Approved study implementation. 3. Subject recruitment for this study - International Space Station Medical Project (ISSMP) and Flight Analog Project (FAP) have agreed to facilitate recruitment of returning astronauts and bed rest subjects who participated in the Functional Task Test Flight and CFT 70 bed rest analog studies. 4. Review of literature that has resulted in a review paper being submitted for possible publication in the Frontiers of Systems Neuroscience by Dr. Rachael Seidler (Co-Investigator in this project). 5. Identification of new tests that have shown potential predictors of adaptability and recruitment of two additional collaborators to participate in this study. Both of these identified collaborators are NSBRI First Awardees. 6. Leveraging data already collected from another project within the sensorimotor adaptability Team : Dr. Bloomberg's project on developing predictors for sensorimotor adaptability program is being leveraged to include data collected from 16 normative subjects as part of an effort to identify tests that contribute significantly towards identifying adaptability to novel sensorimotor environments. This also meets one of the goals laid down by the NASA Sensorimotor Review Panels to reduce the number of tests to overcome redundancies and find efficiencies to stream line testing paradigms in post flight and post bed rest participants.
Bibliography Type:	Description: (Last Updated: 10/09/2019)
Articles in Peer-reviewed Journals	Seidler RD, Mulavara AP, Bloomberg JJ, Peters BT. "Individual predictors of sensorimotor adaptability." Front Syst Neurosci. 2015 Jul 6;9:100. eCollection 2015. http://dx.doi.org/ ; PubMed PMID: 26217197; PubMed Central PMCID: PMC4491631 , Jul-2015

Articles in Peer-reviewed Journals	Oddsson LI, Finkelstein MJ, Meissner S. "Feasibility of early functional rehabilitation in acute stroke survivors using the balance-bed–A technology that emulates microgravity." Front Syst Neurosci. 2015 May 12;9:83. http://dx.doi.org/ , May-2015