Fiscal Year:	FY 2022	**Task Last Updated:**	FY 11/02/2021
PI Name:	Schubert, Michael Ph.D.		
Project Title:	Ground Validation of Self-Administered Incremental Rehabilitation Tool to Mitigate Motion Sickness and Enhance Sensorimotor Recovery		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **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:	mschube1@jhmi.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	410-955-6151
Organization Name:	Johns Hopkins University		
PI Address 1:	Department of Otolaryngology - Head and Neck Surgery		
PI Address 2:	601 N Caroline St, Rm 6245		
PI Web Page:			
City:	Baltimore	**State:**	MD
Zip Code:	21287-6921	**Congressional District:**	7
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2019-2020 HERO 80JSC019N0001-HHCBPSR, OMNIBUS2: Human Health Countermeasures, Behavioral Performance, and Space Radiation-Appendix C; Omnibus2-Appendix D
Start Date:	01/01/2021	**End Date:**	12/31/2023
No. of Post Docs:	1	**No. of PhD Degrees:**	3
No. of PhD Candidates:	0	**No. of Master' Degrees:**	1
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
Contact Monitor:	Brocato, Becky	**Contact Phone:**	
Contact Email:	becky.brocato@nasa.gov		
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:	No changes have been made to the Key Personnel		
COI Name (Institution):	Wood, Scott Ph.D. (NASA Johnson Space Center) Migliaccio, Americo Ph.D. (Neuroscience Research Australia)		
Grant/Contract No.:	80NSSC21M0057		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Astronauts returning from long duration spaceflight suffer from motion sickness, vertigo, and postural imbalance that risk their safety during and after landing. Vestibular patients typically suffer from similar problems that risk their safety during activities of daily living. For both groups, rehabilitation using head motion is the key to recovering from these symptoms, but current methods are uncontrolled and non-quantified. Our team has successfully implemented a self-administered rehabilitation protocol that can be performed by patients at home to improve vestibular function. Our current system measures head and eye movements to improve vestibulo-ocular reflexes. We propose to modify our system to provide additional feedback on head motion to reduce motion sickness for both astronauts and patients as they undergo rehabilitation. We will compare motion sickness and recovery following +3Gx centrifugation (spaceflight vestibular analog) in two groups: a treatment group given feedback to guide their head motion and a control group with no specific head movement strategy. We will also perform similar measurements in patients recovering from acute vestibular loss. We hypothesize this approach will result in a greater ability to tolerate head movements with fewer motion sickness symptoms. In addition to mitigating motion sickness and improving recovery when returning to Earth, our self-administered approach will enable astronauts to be more autonomous without the aid of their reconditioning experts during exploration missions.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	This project innovates upon two patented technologies developed from principal investigator Michael Schubert and co-investigator Americo Migliaccio (US20100198104 and US20160242642A1, https:// by refining users' ability to self-treat motion sickness. The device we are building for use in this project guides users to perform sinusoidal head rotations, matched to a metronome, about the yaw, pitch, and roll axes (90 sec epochs, 5 minutes per axis, 15 min total). In addition, the device will include the ability for subjects to rate their perception of motion sickness using a handheld controller. Video-oculography captures eye and head velocity; it also tracks the number of blinks and saccades, two metrics that can indicate worsening nausea. The benefits of this research to life are similar and critical in both space and Earth environs – validation of an autonomous treatment for motion sickness and balance disorders.
Task Progress:	Recent field tests provide direct evidence that long duration spaceflight increases the severity of motion sickness and impairs the crewmember's balance while doing functional tasks after returning to gravity. Our project addresses the “Risk of Impaired Control of Spacecraft, Associated Systems and Immediate Vehicle Egress Due to Vestibular/Sensorimotor Alterations Associated with Spaceflight”, and includes a rehabilitation device, the Disorientation Research Device, to be built and examined for effectivity in reducing motion sickness and improving balance. To date, we have secured a reliance agreement between NASA and Johns Hopkins University (JHU) that allows JHU to serve as the single Institutional Review Board (IRB) of record for the study. We have an approved IRB protocol to begin data collection at JHU for objective 1 (reduce motion sickness in civilians with vestibular nerve surgical ablation). We are working with Wright-Patterson Air Force Base (Dayton, OH) to secure local IRB approval to begin data collection on objective 2 (reduce motion sickness in healthy controls exposed to centrifugation using the Disorientation Research Device). We have submitted final paperwork to secure the data share agreement (Cooperative Research and. Development Agreement or "CRADA") between JHU and Wright-Patterson Air Force Base. Both the principal investigator (Michael Schubert), two co-investigators (Americo Migliaccio and Scott Wood), and a post-doctoral fellow have met biweekly during the year to develop the motion profile we will use in attempt to reduce motion sickness and improve balance. The motion profile will task users to perform sinusoidal head rotations, matched to a metronome, about the yaw, pitch, and roll axes (90 sec epochs, 5 minutes per axis, 15 min total). The assessment for each axis consists of the number of completed epochs, with each epoch requiring head rotations of a different frequency/amplitude/velocity. Subjects are instructed to begin with an ‘easy’ amplitude (i.e., small) and increase or decrease amplitude depending on their perception of motion sickness – which is input from 0 (absent motion sickness) to 10 (vomit) using a handheld controller. Video-oculography captures eye and head velocity; it also tracks the number of blinks and saccades, metrics that can indicate worsening nausea. Both objective 1 and 2 incorporate use of a rehabilitation device (patented) that uses video-oculography and provides auditory feedback for automated vestibular rehabilitation. The device will be innovated upon and built by the laboratory of Americo Migliaccio, in Sydney, Australia. Unfortunately, due to the outbreak of the COVID-19 Delta strain, the City of Sydney, Australia enforced a mandatory lockdown beginning June 26, 2021. In addition to the shutdown, the worldwide supply chain shortage of electronics has limited our ability to build the intended four devices. As a result, we remain at least six months behind schedule; that will impact our ability to complete objective 1 as originally intended. As mitigation, we are working hard to build three devices (not four) using parts salvaged from prototypes. We are hopeful to have the three devices built, tested for functionality, and delivered to the U.S. within the next four months. This ten-month delay is preventing data collection for objective 1 and 2. Given the delay, we will not conduct a clinical trial at the JHU site that was to compare outcome measures between traditional vestibular rehabilitation and the novel rehabilitation device. Instead, we will conduct an observational study that examines how well the device improves performance and is adopted by the patient subjects. This mitigation is a feasible step necessary to enable useful data for both the civilian and NASA objectives within the remaining two years of the study.
Bibliography Type:	Description: (Last Updated: 12/07/2023)