Fiscal Year:	FY 2021	**Task Last Updated:**	FY 12/03/2020
PI Name:	Reschke, Millard F Ph.D.		
Project Title:	Neuro-Vestibular Examination During and After Spaceflight (Vestibular Health)		
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:	millard.f.reschke@nasa.gov	**Fax:**	FY
PI Organization Type:	NASA CENTER	**Phone:**	281-483-7210
Organization Name:	NASA Johnson Space Center		
PI Address 1:	2101 NASA Pkwy # ONE, SK272		
PI Address 2:	Neuroscience Laboratories		
PI Web Page:			
City:	Houston	**State:**	TX
Zip Code:	77058-3607	**Congressional District:**	36
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	2017-2018 HERO 80JSC017N0001-BPBA Topics in Biological, Physiological, and Behavioral Adaptations to Spaceflight. Appendix C
Start Date:	01/30/2019	**End Date:**	12/01/2027
No. of Post Docs:	0	**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:	0	**Monitoring Center:**	NASA JSC
Contact Monitor:	Stenger, Michael	**Contact Phone:**	281-483-1311
Contact Email:	michael.b.stenger@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: End date is now 12/01/2027 per implementation phase extension, per L. Taylor/JSC (Ed., 7/29/2020)		
Key Personnel Changes/Previous PI:	December 2020 report: Scott Wood has been added as a Co-Investigator		
COI Name (Institution):	Clement, Gilles Ph.D. (NASA Johnson Space Center) Dervay, Joseph M.D. (NASA Johnson Space Center) Makishima, Tomoko M.D., Ph.D. (University of Texas Medical Branch at Galveston) Wood, Scott Ph.D. (NASA Johnson Space Center)		
Grant/Contract No.:	Internal Project		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Adaptation to the absence of Earth's gravitational environment during spaceflight causes neurological disturbances that are either directly or indirectly mediated by the vestibular system. These disturbances include space motion sickness, spatial disorientation, cognitive impairment, as well as changes in head-eye coordination, vestibulo-ocular reflex, and interactions with support surfaces. After return to Earth, astronauts experience other vestibular-driven behavioral changes, including re-entry motion sickness, motion illusions, gaze-induced nystagmus, and balance and locomotion deficits. Otolith-mediated reflex gain changes are striking shortly after g-transitions. However, animal studies have shown that structural modifications of the vestibular sensory apparatus may occur throughout an extended spaceflight exposure. To date, no long-duration flight studies have directly investigated potential changes in the vestibular organs of astronauts. As a part of the Complement of Integrated Protocols for Human Research (CIPHER), this study will address this gap by performing a systematic neuro-vestibular examination of crewmembers in orbit at regular intervals, as well as immediately after landing. Crewmembers from short-duration, six-month, and one-year missions will be recruited to investigate temporal changes, and to identify trends in adaptation to vestibular health and performance. In orbit, the subject will be exposed to various maneuvers executed by the operator. Observations and recordings of eye, head, and body movements, as well as the subjective perception of motion and verbal reports, will be used for evaluating the presence of abnormal eye movements, dysmetria, motion sickness symptoms, and illusions of motion during head or body movements. Tests will be performed both early in the mission and once every one or two months thereafter. The post-flight examination will be performed on R+0 and several times thereafter.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The tests proposed in this study are well established and validated protocols that are able to detect acute or chronic vestibular syndromes. Repeated measurements during adaptation to g-transitions will provide insight into the vestibular compensation process. If the observed physiological changes in the crewmembers are more deleterious after the year-long International Space Station (ISS) expeditions than those documented after standard-duration ISS expeditions, then relevant countermeasures will be required to enable longer duration missions. Depending on the etiology of the vestibular disorders revealed by our tests, monitoring for long-term health outcomes and vestibular rehabilitation countermeasures can be tailored to the deficits observed.
Task Progress:	This past reporting period, Vestibular Health was selected for flight as part of CIPHER's complement of studies (formerly referred to as the integrated One Year Mission project). A commercial binocular video eye tracker was selected for the data acquisition platform (Falcon DX goggles, Neurolign Technologies Inc, Toronto, CN) for both Space Station and ground testing. The inflight protocol was further refined on this platform and custom software changes were implemented to sequence the operator and subject through the experiment protocol using recorded instructions and audio prompts. This protocol includes skew deviation measures that will be shared with the Ocular Alignment investigation (Principal Investigator--PI Mark Shelhamer). A vestibular rotatory test system (I-Portal Neurotologic Test Center, Neuro Kinetics, Inc., Pittsburgh, PA) was installed in the neuroscience laboratory to support the ground testing for this study. While the initial ground testing for this study was delayed due to COVID-19 on-site restrictions, this study was approved as mission-critical work to begin the training and procedure development. Initial functional checkout of this system is planned during SpaceX Crew-3 by the first inflight operator. The initial Informed Crew Briefing (ICB) is planned for the fourth crew of NASA's Commercial Crew Program in 2021, with the initial CIPHER subject launching in 2022.
Bibliography Type:	Description: (Last Updated: 06/28/2023)
Abstracts for Journals and Proceedings	Clément G, Reschke MF, Dervay JP, Makishima T. "Neuro-vestibular examination during and following spaceflight (Vestibular Health)." Presented at the NASA Human Research Program Investigators' Workshop, Galveston, Texas (USA), January 27-30, 2020. Abstracts. 2020 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 27-30, 2020. , Jan-2020