Fiscal Year:	FY 2020	**Task Last Updated:**	FY 08/17/2020
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		
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PI Organization Type:	NASA CENTER	**Phone:**	281-483-7210
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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:	Norsk, Peter	**Contact Phone:**	
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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:	August 2020 report: Dr. Bloomberg retired in September 2019 and was removed from the investigator team. Dr. Tomoko Makishima is now a CoInvestigator.		
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)		
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 flight studies have directly investigated potential changes in the vestibular organs of astronauts. An examination of vestibular function in crewmembers is therefore necessary for establishing Human Research Program's risk and gaps associated with the sensorimotor system, and in particular the sensorimotor gap (SM-26) “to determine if exposure to long-duration spaceflight leads to neural structural alterations and if this remodeling impacts cognitive and functional performance.” We therefore propose to perform a systematic neuro-vestibular examination of crewmembers in orbit at regular intervals, as well as immediately after landing. 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 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. The whole examination will last less than 30 minutes. 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 R+9. Measurements will be the same as in-flight. The post-flight investigation will leverage on the results of the MedB posturography and sensorimotor standard measures also performed on R+0 and R+9. Preflight data collection will take place at L-90 using the same procedure/equipment as the post-flight examination. Crewmembers from short-duration, six-month, and one-year missions are requested to investigate temporal changes, and to identify trends in adaptation to vestibular health and performance. The question is whether the vestibular organs and/or the central vestibular system undergo some structural changes during long exposure to microgravity, which would be responsible for vestibular disorders when transitioning to a new gravitational environment.
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:	During the reporting period of 2019, progress was primarily focused on definition phase activities. The experiment was granted Institutional Review Board (IRB) approval. The draft Experiment Document was generated as the Research and Operations Element (ROI) proceeded with feasibility assessments and integrated one-year mission (i1YM) complement integration. The investigation team participated in a series of Investigator Working Group audio conferences in which each investigator team presented their background, experimental aims, and methodology. Through these activities it was determined that the Ocular Alignment (Principal Investigator-PI Mark Shelhamer) could be integrated with Vestibular Health with the inclusion of a binocular video goggle instead of the proposed Fresnel lens. A market survey was conducted to identify potential eye tracking solutions.
Bibliography Type:	Description: (Last Updated: 06/28/2023)