

Fiscal Year:	FY 2022	Task Last Updated:	FY 09/17/2021
PI Name:	Reschke, Millard F Ph.D.		
Project Title:	Recovery of Functional Performance Following Long Duration Space Flight (Field Test)		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:	TechPort:	No	
Human Research Program Elements:	(1) HHC: Human Health Countermeasures		
Human Research Program Risks:	(1) Cardiovascular: Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes (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		
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Zip Code:	77058-3607	Congressional District:	36
Comments:			
Project Type:	Flight,Ground	Solicitation / Funding Source:	Directed Research
Start Date:	10/22/2013	End Date:	06/30/2022
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:	1
No. of Bachelor's Candidates:	1	Monitoring Center:	NASA JSC
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Flight Program:	PostFlight		
Flight Assignment:	ISS Postflight studies NOTE: End date changed to 6/30/2022 per HHC (Ed., 6/28/2022)		
Key Personnel Changes/Previous PI:	August 2022: Dr. Reschke has retired from NASA. The new Principal Investigator is Scott Wood, Ph.D. For information on the continued investigation, see "Recovery of Functional Performance Following Long Duration Space Flight (Field Test) (PI: Wood)". September 2021 report: None. August 2020 report: Inessa Kozlovskaya passed this past February and was replaced with Elena Tomilovskaya as the Russian Co-Principal Investigator (PI). Jacob Bloomberg retired in September 2019 and was replaced with Scott Wood as Co-Investigator. Michael Stenger moved to a new science management position within Human Research Program (HRP) and was replaced by Stuart Lee as the lead of the Specific Aim 3 compression garment evaluation.		
COI Name (Institution):	Tomilovskaya, Elena Ph.D. (Institute of Biomedical Problems, Moscow) Rosenberg, Marissa Ph.D. (KBR/NASA Johnson Space Center JSC Neuroscience Laboratory) Lee, Stuart Ph.D. (KBR/NASA Johnson Space Center Cardiovascular and Vision Laboratory) Wood, Scott Ph.D. (NASA Johnson Space Center/Neuroscience Laboratory)		
Grant/Contract No.:	Directed Research		

Performance Goal No.:	
Performance Goal Text:	
Task Description:	<p>The Field Test (FT) proposal represents a joint effort between the Neuroscience and Cardiovascular Laboratories at the Johnson Space Center and the Institute of Biomedical Problems Sensorimotor Laboratory and Cardiovascular Laboratory, Moscow, Russia. The primary goal of this proposal is to determine functional performance in long-duration space flight crews beginning as soon after landing as possible (<2 hr) with one to three immediate follow-up measurements on the day of landing. This goal has both sensorimotor and cardiovascular elements with an evaluation of NASA's new compression garment with the Russian traditional Kentavr garment. In addition to the immediate post-landing collection of data, post-flight data was acquired at several timepoints on landing day to characterize recovery to preflight baseline levels. Clearly measurable performance parameters such as the ability to perform a seat egress, recover from a fall or the ability to see clearly when walking, and related physiological data (orthostatic responses) are required to provide an evidence base for characterizing programmatic risks and variability among crewmembers. Overall, these early functional and related physiological measurements will allow for the establishment of a sensorimotor and cardiovascular recovery time constant that has not been previously captured in over 50 years of space flight.</p> <p>Specific Aims:</p> <ol style="list-style-type: none"> 1. Quantify functional performance from measurements on long-duration crewmembers taken as close in time to landing as possible. 2. Develop a recovery timeline of functional performance on long-duration crewmembers. 3. Determine the efficacy of U.S. and Russian compression garments as countermeasures for alleviating orthostatic intolerance.
Rationale for HRP Directed Research:	<p>This research is directed because it contains highly constrained research, which requires focused and constrained data gathering and analysis that is more appropriately obtained through a non-competitive proposal.</p>
Research Impact/Earth Benefits:	<p>Vestibular and sensorimotor alterations represent one of the greatest clinical challenges impacting crew activities following G-transitions. In order to capture the initial decrements in performance, we successfully developed a portable set of measures and recording instrumentation that was compatible with relatively harsh environments. The fall risks on Earth associated with vestibular and sensorimotor impairment are underestimated largely due to the lack of testing available to the general population. The National Institutes of Health has been actively funding efforts to develop a Toolbox of field measures for the vestibular, vision, and motor sensory domains. We propose that the portable measures validated during our Field Tests will be beneficial for the broader characterization of how vestibular and sensorimotor deficits contribute to fall risks on Earth.</p>
Task Progress:	<p>Ed. Note, August 2022: Dr. Reschke has retired from NASA. The new Principal Investigator is Scott Wood, Ph.D. For information on the continued investigation, see "Recovery of Functional Performance Following Long Duration Space Flight (Field Test) (PI: Wood)".</p> <p>September 2021 Report:</p> <p>During this reporting period, our Institute of Biomedical Problems (IBMP) colleagues received permission to resume their portion of the Field Test (FT) to achieve the originally agreed upon subject count of 30. During this reporting period, IBMP collected data on the final three Russian subjects during 62S (October 2020 landing) and 63S (April 2021 landing). As previously reported, eighteen subjects (7 Russian, 11 USOS) had completed the reduced FT (pilot) protocol between Expeditions 36 and 43 (September 2013 - June 2015 landings). The full protocol included 19 Russian and 11 USOS subjects between Expeditions 44 and 63 (September 2015 – April 2021). Of the full FT, two (1 Russian, 1 USOS) were one-year mission crewmembers and one (USOS) was on orbit for 9 mo. It is also important to note that 9 of the Russian FT subjects had previously participated in either the pilot (n=6) or full (n=3) protocols. In summary, the NASA and Russian teams collected data on a total of 39 different United States Orbital Segment (USOS) and Russian crewmembers in both the pilot and full Field Test, with 9 Russian crewmembers being tested twice (total of 48 subject assignments).</p> <p>The special issue of the Russian journal Aerospace and Environmental Medicine honoring the Co-Principal Investigator of the FT, our long-time colleague Dr. Inessa Kozlovskaya, was published in December 2020. As previously reported, Reschke et al. summarized the FT methodology in this issue, which provided the basis for the sensorimotor portion of the Standard Measures to be conducted throughout the remainder of the International Space Station (ISS) program. As an example of the functional deficits observed, Reschke et al. (Aerosp Environ Med, 2020--see Bibliography section) presented results for the seat egress and walking task that involved turning 180 degrees and stepping over obstacles. This task referred to as the Walk and Turn with Obstacle was subsequently added to the Standard Measures protocol.</p> <p>Another manuscript in preparation is focused on the time course of recovery using data from both the pilot and full FT protocols. Based on this combined data set, 100% of crewmembers experienced some level of motion sickness symptoms upon landing. However, the incidence and severity of motion sickness is dramatically reduced within the first 24 hr. Both pilot and full FT included sit-to-stand, prone-to-stand (also referred to as recovery from fall), and the tandem walk with eyes open and closed. The time course of recovery varied by task difficulty; however, performance improved across all tasks within the first 24 hrs.</p> <p>One of the general findings of FT is that the multiple test sessions on landing day seem to enhance readaptation. An additional manuscript is in preparation to capture this finding by comparing the results of FT participants and controls not participating in FT on the required medical test using Computerized Dynamic Posturography. This test is typically performed immediately following return to Johnson Space Center (JSC) on all crewmembers. While there is a high degree of variability in both groups, the FT participants on average performed better on the posture tests following the direct return. This provides evidence that the sensorimotor recovery may be enhanced with incrementally increasing rehabilitation tasks similar to what was used in FT.</p>

	<p>The results from FT have been included in several briefings on deconditioned crewmembers this past year, including to the Commercial Crew Program, as well as the Orion and Human Landing System management teams. The FT data was also a critical part of the evidence base for the December 2020 Human System Risk Board (HSRB) review of the risk of altered sensorimotor/vestibular function impacting critical mission tasks (Sensorimotor Risk). During the upcoming year, the two manuscripts mentioned above will be submitted following the inclusion of the final subjects. In addition, a comprehensive manuscript including all of the FT tasks will be submitted with our Russian colleagues. This manuscript will also utilize the repeated tests (n=9) to examine the effect of previous flight experience.</p>
Bibliography Type:	Description: (Last Updated: 06/03/2025)
Abstracts for Journals and Proceedings	<p>Rosenberg MJF, Kozlovskaya IB, Tomilovskaya ES, Kofman IS, Kitov V, Rukavishnikov I, Mercaldo N, Clément G, Wood SJ, Reschke MF. "Results of the Field Test and transitioning to Sensorimotor Standard Measures." 2021 NASA Human Research Program Investigators' Workshop, Virtual, February 1-4, 2021.</p> <p>Abstracts. 2021 NASA Human Research Program Investigators' Workshop, Virtual, February 1-4, 2021. , Feb-2021</p>
Articles in Peer-reviewed Journals	<p>Lee SMC, Miller A, Ribeiro LC, Rosenberg M, Miller CA, Laurie SS, Young M, Lytle JR, Kofman I, Clement G, Wood S, Rukavishnikov I, Kitov V, Kozlovskaya I, Tomilovskaya E, Reschke M, Macias BR. "Cardiovascular responses to standing with and without lower body compression garments after long-duration spaceflight." J Appl Physiol (1985). 2025 May 8. Online ahead of print. https://doi.org/10.1152/jappphysiol.00646.2024 ; PMID: 40338620 , May-2025</p>
Articles in Peer-reviewed Journals	<p>Reschke MF, Kozlovskaya IB, Lysova N, Kitov V, Rukavishnikov I, Kofman IS, Tomilovskaya ES, Rosenberg MJ, Osetsky N, Fomina E, Grishin A, Wood SJ. "Joint Russian-USA Field Test: Implications for deconditioned crew following long duration spaceflight." Aviakosm Ekolog Med. 2020;54(6):94-100. Russian. https://doi.org/10.21687/0233-528X-2020-54-6-94-100 , Dec-2020</p>