Fiscal Year:	FY 2022	**Task Last Updated:**	FY 04/28/2022
PI Name:	Rosenberg, Marissa Ph.D.		
Project Title:	Development of Sensorimotor Fitness for Duty Assessments Using Ground Analogs		
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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Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	Directed Research
Start Date:	10/27/2021	**End Date:**	05/27/2022
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 05/27/2022 as Dr. Sarah Moudy took over the project in May 2022 (Ed., 8/12/22)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Wood, Scott Ph.D. (NASA Johnson Space Center) Peters, Brian Ph.D. (NASA Johnson Space Center) Reschke, Millard Ph.D. (NASA Johnson Space Center) Clark, Torin Ph.D. (University of Colorado, Boulder) Schubert, Michael Ph.D. (Johns Hopkins University)		
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Exploration class missions including Artemis, Gateway, and beyond will require a new level of autonomy around periods of gravitational transition, where sensorimotor disturbances are great. The operational support that is available upon return to Earth -- including rescue teams, medical interventions, and the ability to rest as needed -- will not be available after landing on the lunar or Martian surface. Because of this, there is a need to define fitness for duty standards that will help inform crew capabilities during and soon after gravitational transitions. Here, we propose a multi-phase study that will help define these assessments. The first aim will assess the suitability of a proposed set of exploration field measures, or measures that would be feasible with the limited time, resources, and space of a lunar/Martian lander, for use in defining fitness for duty standards. A Sensorimotor Adaptation Analog (SAA) that can provide different levels of acute disorientation through combined vestibular, visual, and proprioceptive disruptions will be used to increase the range of performance in exploration field measures, simulating the moderate-to-severe performance decrements observed in spaceflight. The levels of SAA will be titrated and validated by comparison to gold standard measures that have a wealth of spaceflight data at different time points during recovery. Referencing existing postflight data from the gold standard measures will help us characterize how each magnitude of SAA disorientation compares to recovery from long-term microgravity exposure. In the second aim of this study, we will utilize a similar approach as implemented by Ryder et al. (2019), where a weighted suit was used to map various strength-to-body-weight ratios with operational performance. Similarly, we will obtain the exploration field measures at varying levels of the SAA magnitude to map sensorimotor ability (strength equivalent) to the probability of completion of operational performance measures. Our third aim involves 90 minutes of prolonged +3GX centrifugation to mimic the vestibular alterations with gravity transitions, followed by a simulated lunar landing. Our final aim will utilize the NASA Johnson Space Center (JSC) Active Response Gravity Offload System (ARGOS) to characterize the effects of a reduced gravity load on balance-related exploration and operational measures. The main deliverable from this project will be recommended sensorimotor standards tied to fitness for duty for exploration tasks that provide a quantitative index of readiness to perform key exploration tasks. 1. Specific Aim 1 a. The first session for this aim will be exploratory in nature. Each subject will perform the gold standard measures at each SAA magnitude, as described above: 1) zero, 2) low, and 3) high magnitude of SAA. The order of tasks and order of disorientation level will be randomized and counterbalanced to the extent possible. If there is a clear performance decrement observed that worsens with increasing disorientation and the range of performances are similar to the range observed pre- to postflight, we will keep the proposed levels of SAA. If adjustments need to be made, we will systematically either reduce or increase the level of disorientation to elicit clear changes in performance. b. Once the levels of SAA have been defined, we will test subjects' performance in the exploration field measures at each level of disorientation to assess the suitability of each measure as a fitness for duty standard. Similarly to part (a), we will be looking for changes in performance that correlate to changes in disorientation. 2. Specific Aim 2 Each subject will perform the exploration field measures and operational performance measures in one session under three different disorientation conditions: 1) zero, 2) low, and 3) high magnitudes of SAA. Depending on the results of Specific Aim 1, we may identify that one or more of the measures and/or one of the SAA levels is not particularly sensitive or useful. We will decide to exclude those measures and/or SAA level to simplify this Specific Aim. The order of tasks within each block will be randomized and the order of disorientation magnitude will be counter-balanced. 3. Specific Aim 3 Subjects will undergo 90 minutes of sustained +3GX centrifugation. Immediately after egress from the centrifuge, subjects will perform a lunar landing simulation followed by a subset of the exploration field measures. These measures are planned to be performed using the Disorientation Research Device (also known as "Kraken"), located at the Naval Aerospace Medical Research Unit - Dayton. During a second part of Aim 3, subjects will perform a manual crew override during a lunar landing simulation following the sustained centrifugation. The exploration field measure for the lunar landing will be an “on-orbit just-in-time” trainer using a laptop system to assess the crew’s proficiency and readiness to perform the lunar landing simulation. 4. Specific Aim 4 Subjects will be offloaded to lunar gravity. Subjects will perform a subset of the exploration field measures, followed by the emergency extravehicular activity (EVA) operational performance measure. This operational performance measure was selected since it is the most relevant task to be affected by lunar gravity. Reference: Ryder JW, Fullmer P, Buxton RE, Crowell JB, Goetchius E, Bekdash O, DeWitt JK, Hwang EY, Feiveson A, English KL, Ploutz-Snyder LL. A novel approach for establishing fitness standards for occupational task performance. Eur J Appl Physiol. 2019 Jul;119(7):1633-48. doi: 10.1007/s00421-019-04152-3 , PMID: 31069517.
Rationale for HRP Directed Research:	This research is directed because it contains highly constrained research. This project is in direct response to the baselined Human Research Program (HRP) Path to Risk Reduction milestone of providing updates to the NASA Fitness For Duty Standards. The new standards should be tied to fitness for duty for exploration tasks and provide a quantitative index of readiness to perform key exploration tasks. This research effort will leverage expertise based upon HRP-funded flight research investigations including Functional Tasks Test, Field Test, Standard Measures, and Manual Control, as well as MedB computerized dynamic posturography. This project will leverage critical mission tasks previously established by Ryder et al. ("A novel approach for establishing fitness standards for occupational task performance." Eur J Appl Physiol, 2019) for standards related to the risk of reduced muscle mass, strength, and endurance. This project must also leverage experience with vestibular spaceflight analogs (e.g., Galvanic vestibular stimulation, sustained 3Gx centrifugation) to characterize how the deconditioned state following G-transitions (e.g., postural instability, motion sickness, head movement restrictions) map to functional performance.

Research Impact/Earth Benefits:	
Task Progress:	New project for FY2022.
Bibliography Type:	Description: (Last Updated: 03/22/2017)