Fiscal Year:	FY 2012	**Task Last Updated:**	FY 06/08/2012
PI Name:	Moore, Steven T. Ph.D.		
Project Title:	Assessment of Operator Proficiency Following Long-Duration Spaceflight		
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) **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:	s.moore@cqu.edu.au	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	212-241-1943
Organization Name:	Mount Sinai School of Medicine		
PI Address 1:	Human Aerospace Laboratory		
PI Address 2:	Department of Neurology		
PI Web Page:			
City:	New York	**State:**	NY
Zip Code:	10029	**Congressional District:**	14
Comments:	NOTE: PI moved to Central Queensland University, Australia, July 2016.		
Project Type:	FLIGHT,GROUND	**Solicitation / Funding Source:**	2008 Crew Health NNJ08ZSA002N
Start Date:	06/02/2009	**End Date:**	09/05/2012
No. of Post Docs:	3	**No. of PhD Degrees:**	
No. of PhD Candidates:	0	**No. of Master' Degrees:**	1
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Loerch, Linda	**Contact Phone:**	
Contact Email:	linda.loerch-1@nasa.gov		
Flight Program:	Pre/Post Flight		
Flight Assignment:	ISS NOTE: End date is now 9/5/2012 per PI, D. Stillwell/JSC, and NSSC (Ed., 2/28/2013) NOTE: End date is now 6/1/2013 per NSSC (Ed., 5/8/2012)		
Key Personnel Changes/Previous PI:	Co-Principal Investigator is Hamish MacDougall/University of Sydney (Australia).		
COI Name (Institution):	MacDougall, Hamish (University of Sydney (Australia))		
Grant/Contract No.:	NNX09AL14G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Our NASA-funded research on head-eye coordination during simulated shuttle landings (Moore et al. 2008; Aviat Space Environ Med) and automobile control (MacDougall & Moore 2005; Optom Vis Sci) have demonstrated the feasibility of obtaining complex measures of sensorimotor function and operator proficiency in operational environments. In the current proposal we will extend these techniques to develop a compact (2.2 x 2.2 m footprint) stand-alone full-motion simulator and sensorimotor test device, suitable for installation at Russian or US post-landing data collection sites. The system utilizes a 6 degree-of-freedom Stewart platform, upon which a racing seat and visual displays are mounted. Based on a review of relevant in- and post-flight studies, we have developed a 30-min battery of tests to be performed on seated ISS crewmembers pre- and post-flight. The test battery targets cognitive, oculomotor, fine motor, and vestibular mechanisms potentially underlying post-flight deficits in operator performance. In addition, we will obtain subjective and objective measures of sleepiness and fatigue to control for the cumulative effects of in-flight sleep deprivation and workload on post-flight sensorimotor and operator function. The results from these test batteries will be correlated with astronaut performance on three operationally-relevant simulator tasks: control of an automobile, operation of a Mars rover, and T-38A Talon landing simulations. Total test time will be 60 min. Our aim is to objectively define the effects of long-duration spaceflight on operator proficiency, and identify microgravity-related sensorimotor or cognitive deficits (or combinations thereof) underlying degradation of operator effectiveness. This study will answer four critical questions implicit in the IRP gap: 1. To what degree does long-duration spaceflight impair a crewmember's ability to operate a vehicle or other machinery? 2. What sensorimotor/cognitive functions underlie degradation of operator proficiency? 3. Are sensorimotor countermeasures required for lunar/Martian landings and surface operations? 4. If so, what areas should these countermeasures target?
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The techniques developed as part of this grant have potential application to assessment and rehabilitation of patients with a variety of neurological conditions, such as stroke, traumatic brain injury, and vestibular disease.
Task Progress:	This project requires the development of full motion simulators to perform both sensorimotor tests and operator proficiency assessments during simulated landings in a T-38 jet, driving a car, and operating a Mars rover. In April 2011 we completed installation of the primary system at NASA JSC. Backup systems have also been installed at the Human Aerospace Laboratory at Mount Sinai School of Medicine in New York, and the University of Sydney. The Sydney system has been utilized for development of experimental hardware and the New York system was used to develop and test experimental software. The JSC system is for pre and post-flight testing of astronaut subjects. Each system is based on a 6 degree-of-freedom stewart platform (V7, CKAS, Melbourne, Australia). A cylindrical polypropylene water tank (2.2 m diameter; 1.7 m height) formed the cabin, and was attached to a 50mm thick plywood base bolted to the motion platform. Three ceiling mounted short-throw DLP projectors (BENQ 515ST) provide a 180 deg field-of-view display. Subjects are placed in a racing seat and restrained by a 4-point harness (Corbeau A4, USA). The control pod includes a steering wheel and joystick, and three pedals (outer pedals used for rudder input during flight; right and middle pedal used for accelerator and brake for driving simulations). The simulator can be used for a variety of full-motion scenarios. To date we have implemented commercially available PC flight (X-plane and Microsoft) and driving (rfactor) simulations; and a custom developed simulation of a Mars rover operation. In second year of this project, we focused on implementation and validation of these simulations in preparation for baseline data collection. In addition, the simulator performs a variety of sensorimotor assessments including manual tracking, motion perception, and oculomotor function. Driving Task Objective: Drive a vehicle (Lexus ISF) along a 5 km winding mountain road as quickly and safely as possible within the maximum speed limit (55 mph). Measures: Average speed; braking at turns; speed during turns; lane deviations (number of times outside of lane, time to recover); collisions Flight Task Objective: Perform T-38 landings (3) at Ellington field runway 17R (initial conditions 3 NM from runway, 1500 ft altitude, 300 KIAS; using a modified overhead square pattern. Measures: Flaps, gear-down; appropriate airspeed during closed pattern; touchdown speed. Mars Rover Task Objective: Perform rover navigation and docking tasks. Measures: Accuracy in indicating initial direction to target; time to complete surface transit to docking target; time to complete the docking maneuver Year 2 Project Milestones April 2011: The pre/post-flight experimental system at JSC successfully passed a final delta User Readiness Review (URR) and Test Readiness Review (TRR) and is man-rated by the JSC safety panel. June 2011: Project selected for flight. September 2011: Informed consent briefings for Increment 33/34 (prime and backup) December 2011: First two subjects signed up for experiment. February 2012: Complete end-to-end run of entire protocol successfully performed for NASA management, including

	Linda Loerch and Peter Norsk. March 2012: Experiment Document submitted; project gained CPHS approval. July/August 2012: Pre-flight data collection scheduled on first subject. EDITOR'S NOTE (3/5/2013): In order to continue work on the flight phase of this project, it was requested by the PI that the new award (NNX12AM25G) commence 9/6/2012. See project with same title appended with NNX12AM25G for subsequent reporting.
Bibliography Type:	Description: (Last Updated: 09/07/2020)
Articles in Peer-reviewed Journals	Moore ST, MacDougall HG. "Journey to Mars: Physiological effects and operational consequences of long-duration microgravity exposure." J Cosmol. 2010 Oct- Nov;12:3781-93. http://journalofcosmology.com/Mars127.html , Nov-2010
Articles in Peer-reviewed Journals	Shine JM, Naismith SL, Palavra NC, Lewis SJ, Moore ST, Dilda V, Morris TR. "Attentional set-shifting deficits correlate with the severity of freezing of gait in Parkinson's disease." Parkinsonism Relat Disord. 2013 Mar;19(3):388-90. Epub 2012 Aug 18. http://dx.doi.org/10.1016/j.parkreldis.2012.07.015 ; PubMed PMID: 22906729 , Mar-2013
Articles in Peer-reviewed Journals	Shine JM, Moore ST, Bolitho SJ, Morris TR, Dilda V, Naismith SL, Lewis SJ. "Assessing the utility of Freezing of Gait Questionnaires in Parkinson's Disease." Parkinsonism Relat Disord. 2012 Jan;18(1):25-9 Epub 2011 Aug 26. http://dx.doi.org/10.1016/j.parkreldis.2011.08.002 ; PubMed PMID: 21872523 , Jan-2012
Articles in Peer-reviewed Journals	Morris TR, Cho C, Dilda V, Shine JM, Naismith SL, Lewis SJ, Moore ST. "A comparison of clinical and objective measures of freezing of gait in Parkinson's disease." Parkinsonism Relat Disord. 2012 Jun;18(5):572-7. http://dx.doi.org/10.1016/j.parkreldis.2012.03.001 ; PubMed PMID: 22445248 , Jun-2012
Articles in Peer-reviewed Journals	Shine JM, Matar E, Bolitho SJ, Dilda V, Morris TR, Naismith SL, Moore ST, Lewis SJ. "Modeling freezing of gait in Parkinson's disease with a virtual reality paradigm." Gait Posture. 2013 May;38(1):104-8. Epub 2012 Dec 4. http://dx.doi.org/10.1016/j.gaitpost.2012.10.026 ; PubMed PMID: 23218729 , May-2013