Fiscal Year:	FY 2005	**Task Last Updated:**	FY 07/22/2005
PI Name:	Moore, Steven T. Ph.D.		
Project Title:	Head-eye Coordination during Simulated Orbiter Landings		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Physiology		
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 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:	GROUND	**Solicitation / Funding Source:**	2003 Biomedical Research & Countermeasures 03-OBPR-04
Start Date:	05/15/2004	**End Date:**	06/01/2009
No. of Post Docs:	1	**No. of PhD Degrees:**	
No. of PhD Candidates:	0	**No. of Master' Degrees:**	
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	MacDougall, Hamish (Mt Sinai School of Medicine) Clark, Jonathon (NASA Johnson Space Center) Wuyts, Floris (University of Antwerp) Lesceu, Xavier (Airbus) Speyer, Jean-Jacques (Airbus)		
Grant/Contract No.:	NNJ04HF51G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Up to 90% of crewmembers experience spatial disorientation during reentry and landing of the Orbiter, with prevalence proportional to the length of the mission. The possibility of extending shuttle missions is currently under investigation, and it is likely that the incidence and severity of spatial disorientation during reentry will increase with flight duration. This is a critical issue, as Orbiter landing data shows a decrement in performance following microgravity exposure compared to simulated landings in the Vertical Motion Simulator (VMS) at NASA Ames and the NASA Shuttle Training Aircraft. Despite the potential impact on landing operations, the basis of microgravity-related spatial disorientation is poorly understood. The aim of this proposal is to obtain basic data on the characteristics of head and eye movements during simulated Orbiter landings. This information will be used to determine landing tasks that may induce spatial disorientation. In addition, two paradigms will be used to model spatial disorientation due to microgravity exposure: 1) long-duration hyper-gravity exposure in a centrifuge, and 2) galvanic vestibular stimulation (GVS). Preliminary results suggest that post-centrifuge disorientation, and per-GVS exposure, generate symptoms of spatial disorientation comparable to space flight. Simulated landings in the VMS will be performed both post-centrifugation and with GVS, to test the hypothesis that spatial disorientation diminishes head-eye coordination and landing performance. This may serve as a model for the deterioration in pilot performance during reentry, and provide a training regimen to allow commanders and pilots to experience spatial disorientation in a simulator. To develop a model of spatial disorientation (SD) due to microgravity exposure that can be used to familiarize shuttle pilots with SD symptoms during simulated landings, as well as a training tool to improve landing performance after space flight. This project addresses several questions from the Bioastronautics roadmap concerning disorientation and vertigo during g-level transitions, such as experienced during landing. Development of a ground-based model will help improve shuttle landing performance in the in the short term and will significantly improve mission safety, as several SD incidents impacting Orbiter safety during landing have been documented. In the long term, the SD model developed by this project will have application to future long-duration missions to ensure pilots can monitor automatic landings, and can take manual control of the space craft in off-nominal situations. The SD model may also be used to train astronauts for emergency egress and EVA on a planetary body after g-level transitions.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Development of a training regime incorporating a model of SD is of potential use in commercial and military aviation, where significant losses of aircraft and life occur each year due to SD-related mishaps.
Task Progress:	A laptop-based system for measuring head, eye, and cabin movement has been developed and tested in both a commercial flight simualtor (Airbus A340-600) and the Vertical Motion Simulator (VMS) at NASA Ames (used for shuttle landing training). Ambulatory system for delivering Galvanic Vestibular Stimulation to simulate postural, perceptual and oculomotor effects of microgravity-induced spatial disorientation has been developed. Head-eye coordination during simulated shuttle landings has been assessed in 6 subjects in a commercial flight simulator (Airbus, Toulouse, France). GVS as a model for SD has been verified using tests of postural stability, performance on an obstacle course, and dynamic visual acuity. (These tests are routinely performed on returning astronauts). The data demonstrate that our GVS paradigm generates deficits in these areas very similiar to that observed in astronauts after flight.
Bibliography Type:	Description: (Last Updated: 09/07/2020)
Abstracts for Journals and Proceedings	Moore, S.T.; MacDougall, H.; Clark, J.B.; Wuyts, F.; Lesceu, X.; Speyer, J.J.; Cohen, B. "Spatial disorientation - how the brain interprets linear acceleration during flight" Barany Society International Congress, Paris, France J Vest Res 14: 114 (ABSTRACT), , Jul-2004
Abstracts for Journals and Proceedings	MacDougall, H.G.; Moore, S.T.; Cohen, B. "Ambulatory monitoring of high frequency otolith stimulation" Society for Neuroscience Annual Meeting, San Diego, CA. Program No. 867.11 , Nov-2004
Abstracts for Journals and Proceedings	Moore, S.T.; MacDougall, H.; Clark, J.B.; Wuyts, F.; Lesceu, X.; Speyer, J.J.; Cohen, B. "Head-eye coordination during simulated Orbiter landings" Bioastronautics Investigators Workshop, Galveston TX, January 2005 Proceedings Bioastronautics Investigators Workshop, Galveston TX , Jan-2005
Abstracts for Journals and Proceedings	Moore, S.T.; MacDougall, H.; Clark, J.B.; Wuyts, F.; Lesceu, X.; Speyer, J.J.; Cohen, B. "Head-eye coordination during simulated Orbiter landings" Humans in Space Symposium, Graz Austria Proceedings Humans in Space Conference, Graz, Austria, , May-2005
Articles in Peer-reviewed Journals	Moore ST, Cohen B, Raphan T, Berthoz A, Clément G. "Spatial orientation of optokinetic nystagmus and ocular pursuit during orbital space flight." Exp Brain Res. 2005 Jan;160(1):38-59. PMID: 15289967 , Jan-2005
Articles in Peer-reviewed Journals	Moore ST, Hirasaki E, Raphan T, Cohen B. "Instantaneous rotation axes during active head movements." J Vestib Res. 2005;15(2):73-80. PMID: 15951621 , Jun-2005
Articles in Peer-reviewed Journals	MacDougall HG, Moore ST. "Functional assessment of head-eye coordination during vehicle operation." Optom Vis Sci. 2005 Aug;82(8):706-15. PMID: 16127336 , Aug-2005