Fiscal Year:	FY 2004	**Task Last Updated:**	FY 03/20/2006
PI Name:	Bloomberg, Jacob J. Ph.D.		
Project Title:	Promoting Sensorimotor Response Generalizability: A Countermeasure to Mitigate Locomotor Dysfunction After Long-Duration Spaceflight		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Behavior and performance		
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:	77058-3607	**Congressional District:**	36
Comments:			
Project Type:	Flight	**Solicitation / Funding Source:**	98-HEDS-02
Start Date:	10/01/2000	**End Date:**	10/01/2005
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No. of PhD Candidates:	3	**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
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Flight Program:	ISS		
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Key Personnel Changes/Previous PI:			
COI Name (Institution):			
Grant/Contract No.:	None		
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Task Description:	Following spaceflight crewmembers experience locomotor dysfunction due to inflight adaptive alterations in sensorimotor function. These changes can pose a risk to crew safety if nominal or emergency vehicle egress is required immediately following long-duration spaceflight. At present, no operational countermeasure is available to mitigate postflight locomotor disturbances. Therefore, the goal of this study is to develop an inflight training regimen that facilitates the recovery of locomotor function after long-duration spaceflight. The countermeasure we are proposing is based on the concept of variable practice. During this type of training the subject gains experience producing the appropriate adaptive motor behavior under a variety of sensory conditions and response constraints. We are developing this inflight countermeasure built around current ISS treadmill exercise activities. Crewmembers will conduct their nominal inflight treadmill exercise while being exposed to variations in visual flow patterns, body load and treadmill speed. These variations will challenge the postural and locomotor systems repeatedly, thereby promoting adaptive reorganization in locomotor behavior. As a result of this training a subject learns to solve a class of motor problems, rather than a specific motor solution to one problem, i.e., the subject learns response generalizability or the ability to "learn to learn" under a variety of environmental constraints. We anticipate that this training will accelerate recovery of postural and locomotor function during readaptation to gravitational environments following spaceflight. We anticipate that this training regimen will facilitate neural adaptation to unit (Earth) and partial (Mars) gravity after long-duration spaceflight. Our specific aims are to (1) develop and validate procedures necessary to implement a sensorimotor variable practice treadmill-training regimen in a weightless environment. This will require both ground-based studies and testing on NASA's KC-135 aircraft during parabolic flight, and (2) determine if the proposed in-flight treadmill-training regimen facilitates recovery of locomotor function following long-duration spaceflight on the ISS. This will require pre and postflight testing of astronaut locomotor function.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	This investigation is one component of an integrated program of neuroscience experiments being conducted at Johnson Space Center designed to examine microgravity-induced adaptive modification of spatial orientation and motion perception processes, gaze control mechanisms, and postural and locomotor control. This information is also used to design countermeasures against the deliteroius effects of spaceflight on sensorimotor function. In addition to addressing crew health and safety, this research will also further our understanding of clinical gait syndromes. NASA and the National Institute of Aging (NIA) have entered into a collaborative agreement to pursue research topics of common interest. Both the elderly population and returning space travelers experience postural and gait instabilities. However, in the case of returning astronauts, observed adaptive changes are truly plastic as they resolve themselves following interaction with the terrestrial 1-G environment. Alternatively, in the elderly population, postural and gait instabilities may persist surpassing the ability of the CNS to adapt and compensate for dysfunction. However as we investigate adaptive changes associated with flight of longer duration, we may find changes are not so fully reversible. Understanding how the CNS adapts to change and exploring the limits and range of plastic modification, whether it is aging or lack of a gravity vector, is central to the NASA/NIA collaborative effort. The development of unique research protocols like the ones that have been developed in this study can be used by clinicians to evaluate rehabilitation techniques for patients with balance and gait disorders. Development of this new technology can lead to the establishment of worldwide clinical vestibular testing norms that can be used in medical facilities. In addition, this research can lead to the formulation of new models of neural activity based on known pathways and substrates. These models can be used to make predictions about response properties and transfer effects of a variety of motor subsystems following exposure to microgravity or as a predictive tool in clinical conditions. In addition, the data obtained in this study has lead to the development of second generation tests of locomotor stablity and sensorimotor function that will be used to evaluate the efficacy of countermeasures against the deleterious effects of long-duration spaceflight.
Task Progress:	No progress this reporting period.
Bibliography Type:	Description: (Last Updated: 06/03/2025)