Fiscal Year:	FY 2021	**Task Last Updated:**	FY 06/02/2021
PI Name:	Diaz Artiles, Ana Ph.D.		
Project Title:	Effects of Altered-Gravity on Perception and Bi-manual Coordination: Impacts on Functional Performance		
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:	77843-0001	**Congressional District:**	17
Comments:			
Project Type:	FLIGHT,GROUND	**Solicitation / Funding Source:**	2019 HERO 80JSC019N0001-FLAGSHIP & OMNIBUS: Human Research Program Crew Health. Appendix A&B
Start Date:	08/01/2020	**End Date:**	07/31/2022
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:	3	**No. of Master' Degrees:**	
No. of Master's Candidates:	1	**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:	1	**Monitoring Center:**	NASA JSC
Contact Monitor:	Stenger, Michael	**Contact Phone:**	281-483-1311
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 7/31/2022 per NSSC information (Ed., 7/6/21)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Dunbar, Bonnie Ph.D. (Texas A&M University) Kennedy, Deanna Ph.D. (Texas A&M University)		
Grant/Contract No.:	80NSSC20K1499		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Many of the activities associated with spaceflight require individuals to use both limbs simultaneously to accomplish the task. Motor control, as well as visual performance and spatial orientation are disrupted by gravitational transitions between 1 G and 0 G, but very little is known about the sensorimotor deficits between 0 G and 1 G. The objective of this analog-based research effort is to investigate the impact of partial G-levels on bimanual coordination tasks that are operationally relevant for spaceflight. The same set of human subjects will participate in two different bimanual coordination tasks during parabolic flight, which will deliver G-levels of 0, 0.25, 0.5, 0.75, 1, and 1.8 G. Sensorimotor dose-response curves will be generated between bimanual coordination operational variables as a function of G-level, and G-thresholds (which indicate when performance decrements occur) will be determined. We will also quantify the risk associated with the use of a common motion sickness drug (promethazine) during bimanual coordination tasks. Results will provide critical information for current and future countermeasure development and in-flight prescriptions.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	This project investigates the influence of gravity on bimanual coordination using a variety of altered-gravity analogs. Results will provide critical information for current and future sensorimotor-related countermeasures and in-flight prescription. In addition, this research effort has direct application to bimanual coordination tasks on Earth, for example during complex tasks that require a coordinated two-limb movement, as well as for rehabilitation purposes.
Task Progress:	At the end of year 1, we are about to complete the "Definition Phase" of this project. We have worked with NASA throughout this phase, providing the necessary inputs from our science and, in general, any aspect of our experiment. We have refined our experiment and experiment protocol (including subject selection criteria, protocols, and surveys to be implemented), and we have also conceived a preliminary design of our experimental apparatus (i.e., custom chair with the necessary hardware) to be used by our subjects during the parabolic flights. Finally, we have also submitted a first version of the required NASA Institutional Review Board (IRB), and we are in the process of responding to the comments received. Once this IRB is approved by NASA, we will establish a Reliance Acknowledgment between Texas A&M University and NASA. Thus, NASA IRB will be the IRB on record and the one overseeing all our activities. During Year 1, we have also conducted experiments in the laboratory environment. We have implemented a head-down tilt/head-up tilt (HDT/HUT) paradigm as a simulated analog environment for hypogravity conditions. In a first round of experiments, 12 subjects conducted a force coordination task using this tilt platform to simulate microgravity (6° HDT), Moon's gravity (9.5° HUT), Mars's gravity (22.3° HUT), and Earth's Gravity (90° HUT, or upright position). During the experiments, participants were required to coordinate 1:1 (i.e., in-phase) and 1:2 (i.e., anti-phase) rhythmical bimanual force production tasks when provided visual feedback in the form of Lissajous templates. For the in-phase or 1:1 bimanual force coordination task, participants were required to use both their left and right limb to simultaneously produce continuous patterns of forces. The 1:2 or anti-phase task required participants to produce two patterns of force with the right limb for every one pattern of force produced by the left limb. Participants received training in upright position (14 trials in each one of the coordination tasks), and after a 30 min break, they performed a retention test in upright position (2 trials in each one of the coordination tasks), followed by a transfer test (an additional 2 trials in each one of the coordination tasks) in each one of the three simulated altered-gravity environments: Mars, Moon, and microgravity (in counterbalanced order). Preliminary results showed very effective performance in both coordination tasks (1:1 and 1:2) and all altered-gravity conditions (Mars, Moon, microgravity) after the short training received, supporting the efficacity of Lissajous feedback to increase coordination performance. However, differences were observed between gravity conditions for measures associated with force production, specifically during the 1:1 task. Given that 1:1 coordination task is considered to be the brain default coordination mode, differences with gravity suggest that the coordination landscape differs between Earth and altered-gravity environments. We will continue to explore constraints that facilitate or interfere with bimanual coordination in altered-gravity environments using HDT/HUT, parabolic flight, and short-radius centrifugation analogs.
Bibliography Type:	Description: (Last Updated: 07/28/2023)
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