Fiscal Year:	FY 2022	**Task Last Updated:**	FY 06/01/2022
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:**	07/31/2024
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:	4	**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Brocato, Becky	**Contact Phone:**	
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Flight Program:	Parabolic		
Flight Assignment:	NOTE: End date changed to 7/31/2024 per NSSC information (Ed., 6/15/22) 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 2, 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 new preliminary design of our experimental apparatus (i.e., customizing chairs provided by Novespace with our necessary hardware) to be used by our subjects during the parabolic flights. We have designed, constructed, and tested a new hardware/software interface for use in subsequent experiments, including, ultimately, the parabolic flight. In preparation for our parabolic flight, we have conducted two ground studies, and some of this work has already been published in refereed journals and professional conferences. Initial planning stages are completed, cooperation with Novespace in France is ongoing, and project implementation has begun. Finally, we have also submitted a new version of the required NASA Institutional Review Board (IRB) documentation. Once this IRB documentation is approved by NASA, we will establish a Reliance Acknowledgment between Texas A&M University and NASA. Thus, the NASA IRB will be the IRB on record and the one overseeing all our activities. During Year 2, we have also conducted experiments in the laboratory environment. We have implemented a tilt table paradigm as a simulated analog environment for hypogravity conditions. In a round of experiments following the previous year’s, 12 subjects conducted a force coordination task using a new tilt platform to simulate five g-levels (0g, 0.25g, 0.50g, 0.75g, and 1g) in a scanning manner, corresponding to the same gravitational loads that will be delivered in the parabolic flight. During the experiments, participants were required to coordinate 1:1 (i.e., in-phase) and 1:2 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 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 were familiarized with the apparatus but received no formal training on the tasks prior to their first trial. Similar to our first experiment, preliminary results showed very effective timing performance in both coordination tasks (1:1 and 1:2) and all altered-gravity conditions (0g, 0.25g, 0.50g, 0.75g, and 1g) after the very limited training received, supporting the efficacy of Lissajous feedback to increase coordination performance. However, differences were observed between gravity conditions for measures associated with force production (mean and peak force), and force harmonicity. We will continue to explore constraints that facilitate or interfere with bimanual coordination in altered-gravity environments using head-down tilt / head-up tilt (HDT/HUT), parabolic flight, and short-radius centrifugation analogs.
Bibliography Type:	Description: (Last Updated: 06/29/2025)
Abstracts for Journals and Proceedings	Keller N, Abbott R, Davis M, Wang Y, Wright T, Dunbar B, Kennedy D, Diaz-Artiles A. "Modeling work on bimanual coordination in altered gravity." 2022 NASA Human Research Program Investigators’ Workshop, Virtual, February 7-10, 2022. Abstracts. 2022 NASA Human Research Program Investigators’ Workshop, Virtual, February 7-10, 2022. , Feb-2022
Abstracts for Journals and Proceedings	Kennedy DM, Wang Y, Weinrich M, Abbott R, Diaz-Artiles A. "Bimanual force control in simulated martian gravity." 2022 North American Society for Psychology of Sport and Physical Activity (NASPSPA) Conference, Aloha, Hawaii, May 26-28, 2022. Proceedings. 2022 North American Society for Psychology of Sport and Physical Activity (NASPSPA) Conference, Aloha Hawaii, May 26-28, 2022. , May-2022
Articles in Peer-reviewed Journals	Diaz-Artiles A, Wang Y, Davis MM, Abbott R, Keller N, Kennedy DM. "The influence of altered-gravity on bimanual coordination: Retention and transfer." Front. Physiol. 2022 January 7;12:794705. https://doi.org/10.3389/fphys.2021.794705 ; PMID: 35069255; PMCID: PMC8777123 , Jan-2022