Fiscal Year:	FY 2022	**Task Last Updated:**	FY 07/11/2022
PI Name:	Stankovic, Aleksandra Ph.D.		
Project Title:	Quantification of Response to Virtual Reality-based Sensory Stimulation for Relaxation and Therapeutic Release in ICE		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) **BMed**:Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (2) **HSIA**:Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	Charlestown	**State:**	MA
Zip Code:	02129-2020	**Congressional District:**	7
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2017-2018 HERO 80JSC017N0001-HHCHFBP: Human Health Countermeasures, Human Factors, Behavioral Performance. Appendix D
Start Date:	09/09/2020	**End Date:**	09/08/2023
No. of Post Docs:	1	**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:	1	**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Buckey, Jay M.D. (Dartmouth College) Bovard, Pooja Ph.D. (Charles Stark Draper Laboratory Inc) Strangman, Gary (Massachusetts General Hospital/Harvard Medical School)		
Grant/Contract No.:	80NSSC20K1852		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The environmental conditions of prolonged spaceflight missions pose medical and psychological risks for astronauts. As identified by NASA Human Research Program (HRP), long duration exposure to an isolated, confined, and extreme (ICE) environment contributes to the risk of adverse cognitive or behavioral events which may compromise mission safety and success. Previous work has suggested a link between the reduced sensory stimulation associated with such environments and a loss of pleasure, satisfaction, and engagement ([1], [2], [3]). Effective countermeasures are necessary to promote individual behavioral health and performance by providing increased sensory stimulation, offering novelty, preventing boredom, reducing stress, and increasing attention. This study investigates the application of Virtual Reality (VR) stimulation for relaxation and therapeutic release to promote stress management and mitigate against the risk of adverse cognitive and behavioral effects in spaceflight-like isolated, confined, and extreme environments (ICEs). Expanding upon previous work which investigated the feasibility of nature-based sensory stimulation using VR to promote stress management and relaxation ([4]), this project will (1) optimize the VR-based sensory stimulation experience through the integration of additional immersive components (e.g. haptic cues, enhanced audio), to promote engagement and thereby facilitate therapeutic release; (2) incorporate non-intrusive physiological monitoring for the objective assessment of relaxation; (3) promote relaxation and therapeutic release through the introduction of biofeedback (i.e. VR presentation altered based on physiological cues); and (4) compare the effectiveness of various aspects of the VR experience for producing relaxation (via monitoring of physiological stress reduction) and restoring attention (through the measurement of performance on an operationally-relevant task). We will also examine individual preferences for sensory stimulation scenario characteristics (e.g. scene content, duration). References: [1] Kanas N, Sandal G, Boyd JE, Gushin VI, Manzey D, North R, (...), Inoue N. (2009). Psychology and culture during long-duration space missions. Acta Astronautica, 64(7-8), 659-77. [2] Stuster J. (2011). Bold endeavors: Lessons from polar and space exploration. Naval Institute Press. [3] Holland AW. (2000). Psychology of spaceflight. Journal of Human Performance in Extreme Environments, 5(1), 4-20. [4] Anderson, A. P., Mayer, M. D., Fellows, A. M., Cowan, D. R., Hegel, M. T., & Buckey, J. C. (2017). Relaxation with immersive natural scenes presented using virtual reality. Aerospace medicine and human performance, 88(6), 520-526.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Virtual Reality platforms offer tremendous promise as psychological support tools in conditions of prolonged isolation and confinement.
Task Progress:	This project aims to optimize and test virtual reality (VR) sensory presentation for behavioral health support in isolated, confined, and extreme (ICE) environments. The work will include integrated psychophysiological monitoring and feedback, and multisensory display presentations (e.g., haptic/tactile stimulation, enhanced audio), and will be tested in laboratory and ICE analog environments. The project includes three research phases: (1) evaluating the acceptance, perceived effectiveness, and operational feasibility of various VR parameters for relaxation, restoration, and therapeutic release, based on prior usage in operational ICE (e.g., Antarctica). (Aim completed. Please see Anderson, Stankovic, et al. 2022 for a summary of findings.) (2) manipulating various aspects of VR presentation (e.g., scene content, experience duration, presentation modality, and interactivity) in a high-fidelity, long-duration ICE analog to determine which VR attributes most optimize beneficial mood impacts related to relaxation, restoration, and therapeutic release. (Research currently in progress at the Antarctic South Pole Station during winter-over 2022.) (3) assessing experimentally in the laboratory the impact of various aspects of VR presentation (e.g., scene content, experience duration, presentation modality, and interactivity) on (1) psychophysiological response (to assess relaxation) and (2) performance on an operationally-relevant task (as a measure of cognitive performance and attention restoration), following stress induction. (Testing currently scheduled to commence in Fall 2022). The first phase of this investigation (which has just concluded) involved the analysis of subjective feedback questionnaires and post-mission interviews collected from participating members of a pilot cohort of Antarctic winter-over expeditioners, and other operational ICE environment volunteers, who interacted with a standard VR platform on an informal basis. The purpose of this exploratory, opportunistic research was to assess preference for VR scenarios (e.g., evaluating along attributes such as interaction duration and scene content), and to gather contextually-specific experiential data with the goal of optimizing future VR presentation for maximum restorative impact. This work has shown immersive VR to be highly rated, with natural scene content and dynamic scenes involving people and animals perceived as restorative following long periods of isolation and confinement. Findings suggest that options for personalized customization of the VR experience are also highly desirable. Data gathered from this investigation will help inform the future optimization of VR experience for spaceflight and spaceflight-like isolated and confined environments. We have also deployed -- for winter-over 2022 at the South Pole Station -- a set of VR experiences with enhanced immersion that allow for increased participant engagement to support relaxation and therapeutic release. This includes the design of several different VR scenarios which modulate one or more of four specific attributes of the VR experience: (1) scenario duration (short vs. long); (2) sensory modality (VR only, or VR with increased immersiveness through the addition of haptic cues and enhanced audio); (3) scene context (city or nature scenes); and (4) scene dynamic presentation (fixed scenes or dynamically explorable scenes with motion). We will be examining both subjective response to VR experience interaction (through self-reported mood and preference questionnaires) and objective physiological responses, to assess the emotional and psychological impacts of various platform configurations. We are now in the process of preparing for upcoming laboratory testing, currently scheduled to be in Fall 2022, which will expand upon our analog work and incorporate an investigation of the impact of various VR experiences (including the introduction of biofeedback) on operationally relevant performance. Reference: Anderson A, Stankovic A, Cowan D, Fellows A, Buckey J Jr. Natural scene virtual reality as a behavioral health countermeasure in isolated, confined, and extreme environments: Three isolated, confined, extreme analog case studies. Hum Factors. 2022 May 23. https:// ; PMID: 35604867.

Bibliography Type:	Description: (Last Updated: 04/19/2024)
Articles in Peer-reviewed Journals	Anderson A, Stankovic A, Cowan D, Fellows A, Buckey J Jr. "Natural scene virtual reality as a behavioral health countermeasure in isolated, confined, and extreme environments: Three isolated, confined, extreme analog case studies." Hum Factors. 2022 May 23. https://doi.org/10.1177/00187208221100693 ; PMID: 35604867 , May-2022