Fiscal Year:	FY 2015	**Task Last Updated:**	FY 07/16/2015
PI Name:	Buckey, Jay C. M.D.		
Project Title:	Autonomous Behavioral Health Countermeasures for Spaceflight		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Neurobehavioral and Psychosocial Factors Team		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) **Bmed**:Risk of Adverse Behavioral Conditions and Psychiatric Disorders		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	03756-0001	**Congressional District:**	2
Comments:	Address updated 9/2008		
Project Type:	GROUND	**Solicitation:**	2013 HERO NNJ13ZSA002N-Crew Health (FLAGSHIP & NSBRI)
Start Date:	06/01/2014	**End Date:**	05/31/2017
No. of Post Docs:	1	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	0
No. of Master's Candidates:	2	**No. of Bachelor's Degrees:**	6
No. of Bachelor's Candidates:	14	**Monitoring Center:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Hegel, Mark Ph.D. (Dartmouth College) Loeb, Lorie M.A. (Dartmouth College)		
Grant/Contract No.:	NCC 9-58-NBPF03801		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	(1) Original project aims/objectives. Aim #1: Customize the Virtual Space Station (VSS) program for use by astronauts by evaluating the program in an isolated environment and collecting detailed information on program use, including user choices, ease of navigation, usability and acceptability. Aim #2: Modify the existing VSS conflict management program to add enhanced conflict resolution content and an integrated behavioral health assessment. Aim #3: Enhance the VSS program to include a mood enhancement system that allows users to experience immersive relaxing situations using virtual reality. (2) Key findings and (3) Impact of key findings on Specific Aims. During this reporting year, we have made progress on each of our three specific aims: Aim #1: The original plan was to deploy the programs to Antarctica, but this plan depends on NASA negotiating an agreement with the National Science Foundation (NSF) to have this National Space Biomedical Research Institute (NSBRI)-funded program deployed there. This agreement is still in work. While this is being negotiated we have been investigating other isolated and confined environments we can use. We were able to secure an agreement to deploy the programs to the Hawaii Space Exploration Analog and Simulation (HI-SEAS) analog, which simulates the isolation and confinement on long-duration space missions. The programs are currently in use at HI-SEAS, and all crewmembers there have completed work with the conflict and stress content. Work with the depression content is currently underway. The HI-SEAS deployment ends in June 2015. We have identified other alternative isolated, confined, environments (ICEs) and have been working to establish other collaborations in case an agreement between NASA and the NSF is not completed. In addition to evaluating the content, we are making multiple programming changes to improve both the usability and flexibility of the program. Aim #2: The structure of the integrated behavioral health assessment has been completed. It will be implemented in the existing content as a tool to determine the need for behavioral health countermeasures and guide the astronaut users accordingly. The VSS conflict resolution content is being expanded. We have created several conflict scenarios that will be vetted for acceptability with astronauts and others with experience in isolated, confined environments. Aim #3: We have acquired the necessary hardware and software, and have begun constructing new virtual reality scenarios to promote psychological wellbeing. (4) Proposed research plan. In our second year, we will complete our evaluation while on deployment at HI-SEAS. This information will be critical to guide our future content development. We hope an agreement between NASA and the NSF is forthcoming so we can implement in the US Antarctic stations. However, we will continue to pursue additional isolated, confined environments where we will evaluate the VSS. We will finish expanding the VSS content to include at least one new, fully vetted conflict scenario and the new virtual reality immersive environments.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Anyone can develop behavioral health problems. Factors such as confinement, under- or over- work, sleep loss, and monotony can combine to worsen interpersonal tensions or even lead to frank depression. Additionally, behavioral health problems are some of the most common and costly problems in the workplace. Programs that can deliver behavioral health countermeasures autonomously, confidentially, and at a place and time of the user's choosing, would have many applications. Conflicts can arise with a resulting loss of trust and teamwork. A chronic dispute between people can destroy team functioning and lead to errors or lack of situational awareness. Suppressed anger or frustration can erupt unexpectedly and create potentially hazardous situations. Computer-based behavioral health countermeasures can offer an autonomous way for anyone to address psychological and interpersonal issues. Content versions have been successfully implemented with business school students, clinically depressed patients, and in elderly individuals. This program provides a personalized experience similar to live therapy, while also lowering barriers to use by being easily accessible and convenient. Furthermore, computer-based treatments can be implemented in different environments with limited access to behavioral health resources such as in the military, at polar sites, or in culturally isolated settings. Virtual reality offers immersive experiences that mimic real-life exposure to nature and other relaxing settings. The final product from this research will provide an integrated, autonomous approach to behavioral health. The assessment component will begin with the assumption that the any issues are minor and transient, and can guide the user to a variety of options both within and outside of the program (movies/distraction, music, meals, photo/hobby, call home, Virtual Reality retreat). For moderate severity problems, the program includes a variety of self-assessment tools the user can try, and offers programs to assist with conflict and/or stress management. For high-severity problems, the program includes a validated 6- session depression treatment program based on problem solving therapy.
Task Progress:	• The VSS programs are currently deployed in an analog environment, HI-SEAS, that is designed to simulate a Mars mission. The 6 crewmembers have all used the conflict and stress content, and are currently working through the depression (problem solving treatment) module. The deployment ends in June 2015. • The structure of the integrated behavioral health assessment has been completed and will be implemented in the existing content to determine the need for behavioral health countermeasures and guide the astronaut user accordingly. • The VSS conflict resolution content is being expanded with a new scenario that provides interactive instruction on negotiating in situations where maintaining a good relationship is critical (such as between ground control and space). We have created several conflict scenarios that will be vetted for acceptability with astronauts and others with experience in isolated, confined environments. • We have made many programming improvements within the Virtual Space Station suite of software programs. • We have filmed our first 360 degree virtual reality scenes and are currently working to stitch the video together and to evaluate it for stress relaxation capabilities. • We are evaluating the Alive biofeedback suite as part of the deployment with the stress content.
Bibliography Type:	Description: (Last Updated: 04/16/2019)

Abstracts for Journals and Proceedings	Buckey J, Loeb L, Fellows A, Tregubov T, Harquail N, Crosier B, Fleischer J, Weiss J, Binsted K, Hegel M. "Autonomous behavioral health countermeasures for spaceflight." 2015 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 13-15, 2015. 2015 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 13-15, 2015. , Jan-2015
Significant Media Coverage	Garreffa A. "NASA wants to create a Holodeck using the Oculus Rift for astronauts." Tweak Town, October 17, 2014. http://www.tweaktown.com/ ; accessed 7/27/15., Oct-2014
Significant Media Coverage	Qaiser A. "Oculus Rift Could Make Grueling Trips to Mars More Bearable." Virtual Reality Times, October 24, 2014. http://www.virtualrealitytimes.com/ ; accessed 7/27/15., Oct-2014
Significant Media Coverage	Vincent J. "NASA looks to virtual reality 'holodecks' – powered by Oculus Rift to keep astronauts sane in space." The Independent, October 15, 2014. http://www.independent.co.uk/ , Oct-2014
Significant Media Coverage	Dartmouth Department of Public Affairs. "Houston: We Have A Problem…But No Worries, Our Virtual Therapist Is On It." Dartmouth Department of Public Affaris, October 2014. http://www.dartmouth.edu/ ; accessed 7/27/15., Oct-2014
Significant Media Coverage	Schilling D. "Using Virtual Space Station To Diagnose, Treat Psychosocial Problems." Industry Tap, December 20, 2014. http://www.industrytap.com/ , Dec-2014
Significant Media Coverage	Basulto D. "How the Oculus Rift could make grueling trips to Mars more tolerable." Washington Post. Innovations section, October 23, 2014. http://www.washingtonpost.com/ ; accessed 7/27/15., Oct-2014
Significant Media Coverage	Melanson D. "NASA's Latest Virtual Reality Is Designed to Soothe Homesick Astronauts." VICE Media's Motherboard, October 18, 2014. http://motherboard.vice.com/ , Oct-2014
Significant Media Coverage	Zolfagharifard E. "Could virtual reality prevent depression in ASTRONAUTS? Star Trek-style holodecks may help them escape the isolation of space." The Daily Mail, October 15, 2014. http://www.dailymail.co.uk/ , Oct-2014
Significant Media Coverage	Temple J. "Can a Virtual Therapist Keep the Peace on the Way to Mars? NASA Wants to Find Out." Recode, October 16, 2014. http://recode.net/ , Oct-2014
Significant Media Coverage	Lewis T. "Virtual Reality Could Let Astronauts 'Go to the Beach'." LiveScience, October 20, 2014. http://www.livescience.com/ , Oct-2014
Significant Media Coverage	Serrels M. "Astronauts Flying To Mars Could Be Kept Sane By Virtual Reality And Oculus Rift." Kotaku Australia, October 2014. http://www.kotaku.com.au/ , Oct-2014
Significant Media Coverage	Nagle M. "Is Oculus Rift Headed to Space?" Wearable Tech, October 2014. http://www.wearabletechworld.com/ , Oct-2014
Significant Media Coverage	Blanchini S. "Virtual Reality, Zero-G and yet more wonders: NASA has it all." The Earthian Hivemind, November 2014. http://earthianhivemind.net/ , Nov-2014
Significant Media Coverage	InHardFocus. "Virtual Reality Therapy for Astronauts in Development." InHardFocus.com, October 2014., Oct-2014
Significant Media Coverage	Science-Tech. "Could virtual reality prevent depression in ASTRONAUTS? Star Trek-style holodecks may help them escape the isolation of space." ScienceTech-Blog, October 2014. http://sciencetech-blog.blogspot.com/ , Oct-2014
Significant Media Coverage	Santus R. "Astronauts Are Using Oculus Rift to Put Their Minds at Ease." Mashable, October 22, 2014. http://mashable.com/ , Oct-2014
Significant Media Coverage	Brewster S. "On the long, long trip to Mars, virtual reality could keep astronauts sane." Gigaom Research, October 16, 2014. https:// , Oct-2014
Significant Media Coverage	Space Daily Staff Writers. "Houston: We Have A Problem...But No Worries, Our Virtual Therapist Is On It." Space Daily, October 20, 2014. http://www.space-travel.com/ , Oct-2014