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Pl Name: Robinson, Stephen K. Ph.D. Project Title: Customized Refresher and Just-fa-Time Training for Long-Duration Spaceflight Crows  Birksian Name: Human Research Program/Discipline- Remembloshdiscipline: NSBRI-Human Factors and Performance Team  Joint Agency Name: TechPort: No  Human Research Program Elements: (I) HFBP-Human Factors and Performance (IRP Rev H)  Human Research Program Risks: (I) HSBA-Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture  Space Biology Cross-Element: None  Space Biology Cross-Element: None  Space Biology Cross-Element None  Pl Corganization Type: UNIVERSITY Phone: 530-754-9495  Organization Type: UNIVERSITY Phone: 530-754-9495  Organization Name: University of Cultifornia, Davis  Pl Address 1: Department of Mechanical & Aerospace Engineering  Pl Address 2: 1 Shields Avenue, 2132 Bainer Hall  Pl Web Page:  City: Davis State: CA  Zip Code: Osfology Davis State: CA  Zip Code: Osfology Cross-State Osfol				
Project Title: Customized Refresher and Just-In-Time Training for Long-Duration Spaceflight Crews  Program/Discipline: NSDRI  Program/Discipline: NSDRI  Program/Discipline: NSDRI-Haman Factors and Performance Team  Libration Agency Name: TechPort: No  None  Space Biology Cross-Element: None  Space Biology Cross-Element  None  Space Biology Special Category: None  PI Email: Supplied None  PI Corganization Type: UNIVERSITY Phone: S0-754-9495  Organization Name: University of California, Davis  PI Address 1: Department of Mechanical & Aerospace Engineering  PI Address 2: 1 Shields Avenue, 2132 Bainer Hall  PI Web Page:  City: Davis State: CA  Zip Code: S616-5270 Congressional District: 3  Comments:  Project Type: GROUND Solicitation / Funding 2013 IIERO NNIJIZSA002N-Crew Source Health (FLAGSHIP & NSBRI)  Source Health (FLAGSHIP & NSBRI)  No. of Post Doc; Onlidete: Onlide	Fiscal Year:	FY 2015	Task Last Updated:	FY 07/16/2015
Division Name:   Human Research   Program Discipline:   NSBRI   Human Factors and Performance Team   February   No	PI Name:	Robinson, Stephen K. Ph.D.		
Program/Discipline: NSBRI - Human Factors and Performance Team     Fleenment/Subdiscipline-	Project Title:	Customized Refresher and Just-In-Time Training for Long-Duration Spaceflight Crews		
Program/Discipline-  Element/Subdiscipline-  Element	Division Name:	Human Research		
Element/Subdiscipline:   No	Program/Discipline:	NSBRI		
Human Research Program Elements: (I) HEBP-Human Factors & Bchavioral Performance (IRP Rev H)  Human Research Program Risks: (I) HSJA-Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture  Space Biology Cross-Element None  Space Biology Special Category: None  PI Email: stephenk kebinson/fuucdavis.edu Fax: FY  Programization Type: UNIVERSITY Phone: 530-754-9495  Organization Asame: University of California, Davis  PI Address 1: Department of Mechanical & Acrospace Engineering  PI Address 2: 1 Shields Avenue, 2132 Bainer Hall  PI Web Page:  City: Davis State: CA  Zipi Code: 95616-5270 Congressional District: 3  Comments:  Project Type: GROUND Solicitation Funding State (Ead Burley & State)  Start Date: 0601/2014 End Date: 05/31/2017  No. of Post Docs: 0 No. of PhD Degrees: 0  No. of Post Docs: 0 No. of PhD Candidates: 0 No. of Master's Candidates: 3 No. of Bachelor's Candidates: 4 No. of	Program/Discipline Element/Subdiscipline:	NSBRIHuman Factors and Performance	ee Team	
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Space Biology Cross-Element Space Biology Cross-Element Discipline: Space Biology Cross-Element Discipline: Space Biology Special Category: None PI Email: Stephen k-robinson/Guedavis.edu PI Camali: Stephen k-robinson/Guedavis.edu PI Camalii	<b>Human Research Program Elements:</b>	(1) <b>HFBP</b> :Human Factors & Behavioral	Performance (IRP Rev H)	
Space Biology Cross-Element Discipline:  None  PI Email: stephen krebinson@uedavis.edu Fax: FY  PI Organization Type: UNIVERSITY Phone: 530-754-9495  Organization Type: UNIVERSITY Phone: 530-754-9495  Organization Name: University of California, Davis  PI Address 1: Department of Mechanical & Acrospace Engineering  PI Address 2: 1 Shields Avenue, 2132 Bainer Hall  PI Web Page:  City: Davis State: CA  Zip Code: 95616-5270 Congressional District: 3  Comments:  Project Type: GROUND Solicitation / Funding 2013 HERO NNJ13ZSA002N-Crew Source: Health (FLAGSHIP & NSBRI)  Start Date: 6601/2014 End Date: 6/31/2017  No. of Post Does: 0 No. of PhD Degrees: 0  No. of PhD Candidates: 0 No. of Master' Degrees: 0  No. of Master's Candidates: 3 No. of Bachelor's Degrees: 0  No. of Bachelor's Candidates: 3 Monitoring Center: NSBRI  Contact Monitor: Contact Phone:  Contact Contact Changes/Previous PI:  Key Personnel Changes/Previous PI:  COI Name (Institution): Coman, Charles Ph.D. (Massachusetts Institute of Technology)  Byme, Vicky (Lockheed Marin Astronautics)  Mindock, Jennifer (Wyle Laboratories, Inc.)  NCC 9-58-HFP03801	Human Research Program Risks:	(1) HSIA:Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture		
Discipline: "None   None   Space Biology Special Category: None   Space Biology Special Category: None   Space Biology Special Category: None   Stephen & Robinson@ucdavis.edu   Fax: FY   PH Organization Type: UNIVERSITY   Phone: 530-754-9495   Organization Name: University of California, Davis   PI Address 1: Department of Mechanical & Aerospace Engineering   PI Address 2: I Shields Avenue, 2132 Bainer Hall   PI Web Page: City: Davis   State: CA   Zip Code: 95616-5270   Congressional District: 3   Comments: Project Type: GROUND   Solicitation / Funding   Solicitation / Funding   Source: Health (FLAGSHIP & NSBRI)   Start Date: 06/01/2014   End Date: 05/31/2017   No. of Post Does: 0   No. of PhD Degrees: 0   No. of PhD Candidates: 0   No. of PhD Degrees: 0   No. of Master's Candidates: 3   No. of Bachelor's   No. of Bachelor's Candidates: 3   No. of Bachelor's   No. of Bachelor's Candidates: 3   Monitoring Center: NSBRI   Contact Monitor: Contact Email: Flight Program: Flight Assignment:   Key Personnel Changes/Previous PI:   COI Name (Institution):   Oman, Charles Ph.D. (Massachusetts Institute of Technology)   Liu, Andrew Ph.D. (Massachusetts Institute of Technology)   Byme, Vicky (Lockheed Martin Astronautics)   Mindock, Jennifer (Wyle Laboratories, Inc.)   Organt/Contract No.: NCC 9-58-HIFP03801	Space Biology Element:	None		
PI Email:    Sephen k robinson/aucdavis.edu   Fax: FY     Phone: 530-754-9495     Organization Type: UNIVERSITY   Phone: 530-754-9495     Organization Name: University of California, Davis     PI Address 1: Department of Mechanical & Acrospace Engineering     PI Address 2: I Shields Avenue, 2132 Bainer Hall     PI Web Page:	Space Biology Cross-Element Discipline:	None		
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Contact Email:  Flight Program:  Flight Assignment:  Key Personnel Changes/Previous PI:  COI Name (Institution):  Oman, Charles Ph.D. (Massachusetts Institute of Technology )  Liu, Andrew Ph.D. (Massachusetts Institute of Technology )  Byrne, Vicky (Lockheed Martin Astronautics )  Mindock, Jennifer (Wyle Laboratories, Inc.)  Orant/Contract No.:  NCC 9-58-HFP03801	No. of Bachelor's Candidates:	3	Monitoring Center:	NSBRI
Flight Assignment:  Key Personnel Changes/Previous PI:  COI Name (Institution):  Oman, Charles Ph.D. (Massachusetts Institute of Technology ) Liu, Andrew Ph.D. (Massachusetts Institute of Technology ) Byrne, Vicky (Lockheed Martin Astronautics ) Mindock, Jennifer (Wyle Laboratories, Inc.)  Grant/Contract No.:  NCC 9-58-HFP03801  Performance Goal No.:	Contact Monitor:		Contact Phone:	
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Performance Goal No.:	COI Name (Institution):	Liu, Andrew Ph.D. (Massachusetts Inst Byrne, Vicky (Lockheed Martin Astron	itute of Technology ) nautics )	
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Project Goals: Our overall objective is to develop novel, context-sensitive, and customized onboard training techniques that can be adapted to different tasks and crewmembers, with ability to address both refresher training (for re-acquisition of expert performance) and just-in-time training (for tasks that have not been specifically trained previously, but require the integration of existing astronaut skills). To achieve this objective, we propose to test the hypothesis that multimedia training which is customized for the crewmember can be more efficient than traditional, generic format training for the same measured effectiveness.

The project will begin with the development of two tasks that represent typical complex and critical activities that are carried out by astronauts in space relatively infrequently. We will develop a set of training materials that follow the NASA style of briefings, procedures and hands-on practice. Once these tasks are developed, we will conduct an experiment with human subjects to determine if customized, self-made video training materials prove to be better refresher training materials than the generic materials that would typically be used by crewmembers. Subjects will receive initial training and their baseline performance evaluated. After a period of about 6 months, subjects will return to the lab, review the refresher training materials, and be re-evaluated on how well they have retained or re-acquired their task skills.

A second experiment will be conducted using the same two representative tasks, but will examine if the customized training materials developed in the first experiment could be used as just-in-time training materials for a new group of subjects with basic training, but no specific training in the given task. In both experiments, we also examine the correlation of subject learning styles with the content of the training materials, to determine whether learning style is a useful characterization for developing customized content. The results of this research project will provide operational guidelines and pedagogy for developing customized video training for astronauts on long-duration missions beyond Earth orbit. Since subject testing has just started, key findings are not yet available. For the coming year, the team will complete the experiment design, procedure development, subject testing, and preliminary analysis of results for Part A of the project (refresher training utilizing subject-produced video training synopses).

## Rationale for HRP Directed Research:

**Task Description:** 

## **Research Impact/Earth Benefits:**

Human exploration of space, especially with reduced real-time ground support due to increased distance from the Earth, will require training capabilities to support autonomous reacquisition of skills. Inadequate states of training are commonly related to skill-based errors such as task execution mistakes. Even in the highly trained military aviation environment, more than half of accidents in a multi-year meta-analysis have been shown to be associated with skill-based errors, and human error in general is widely accepted to contribute to 70% to 80% of all aviation accidents. This research will lead to the reduction of the likelihood of such errors and accidents due to inadequate training. The reduction in error-likelihood directly supports the mitigation of the Human Research Program's Risk of Performance Errors Due to Training Deficiencies. Development, maintenance, and re-acquisition of expertise is central to many types of human endeavor, especially safety-critical ones such as aviation, medicine, human/machine interaction in hazardous environments. Research gains from investigations such as this may thus be broadly applicable outside the world of human spaceflight.

The first year of the project has focused on the refresher training experiments (Part A of the project), in which subjects are trained in an astronaut-similar task, self-produce a refresher video at the peak of expertise, and return 6 months later to perform the task again using only the refresher video as training. The University of California (UC) Davis task is complex electro-mechanical system repair, and the Massachusetts Institute of Technology (MIT) task is manually control of a space robotic arm.

In the first year, the UC Davis section of the research team hired two undergraduate research assistants and two graduate research assistants to help develop the test facilities and tool station, select the mechanical system to be used for the repair task, develop procedures, write subject protocols and instructions, apply for UC Davis Institutional Review Board (IRB) approval, and identify video equipment and tools to purchase. In selecting the repair task, one of the drivers was that the equipment could be put into operation for testing after subject repair. After considering a variety of candidates (air compressor, water pump, cooling system pump, four-barrel carburetor, aircraft magneto, etc), we settled on a gas-powered electrical generator with its integration of mechanical and electrical systems, plus modern design and repair manuals to work from. Also during this first year, the MIT side of the team hired a graduate research assistant, and a freshman undergraduate student. Lynn Geiger (the GRA) traveled to NASA Johnson Space Center (JSC) in August 2014 to participate in a 1 week Generic Robotics Training (GRT) course set up by the Robotics Training Group. We developed an experimental protocol for pilot testing of our customized refresher training for a simulated set of International Space Station (ISS) robotic operations, including the robotic task simulations, training materials including videos and evaluation rubrics. Subjects will be trained to perform two specific robotics tasks and their performance measured to establish a baseline. Training consists of 4 3-hour sessions over three days. To date, 2 pilot subjects were tested at MIT in December and reevaluated 2 months later to develop a preliminary understanding of skill deterioration. Based on the feedback and responses of these pilot subjects, the protocol and scenarios were modified to increase the overall practice time and increased strategy training to help solidify the subject's understanding. Two more pilot subjects have completed the training and baseline evaluation with the new protocol and will be retested in 6 months. We plan to test 18 additional subjects before the end of the May 2015.

## Task Progress:

## **Bibliography Type:**

Description: (Last Updated: 01/29/2024)