

Fiscal Year:	FY 2018	Task Last Updated:	FY 06/19/2018
PI Name:	Kozlowski, Steve Ph.D.		
Project Title:	Team Cohesion Monitoring Badge: Development of Galvanic Skin Resistance Modality		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Behavior and performance		
Joint Agency Name:	TechPort:	No	
Human Research Program Elements:	(1) HFBP: Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) Team: Risk of Performance and Behavioral Health Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Comments:	I moved from Michigan State University to the University of South Florida in August 2020.		
Project Type:	GROUND	Solicitation / Funding Source:	2015-16 HERO NNJ15ZSA001N-Crew Health (FLAGSHIP, NSBRI, OMNIBUS). Appendix A-Crew Health, Appendix B-NSBRI, Appendix C-Omnibus
Start Date:	08/25/2016	End Date:	12/31/2019
No. of Post Docs:		No. of PhD Degrees:	1
No. of PhD Candidates:	4	No. of Master' Degrees:	2
No. of Master's Candidates:	2	No. of Bachelor's Degrees:	
No. of Bachelor's Candidates:		Monitoring Center:	NASA JSC
Contact Monitor:	Williams, Thomas	Contact Phone:	281-483-8773
Contact Email:	thomas.j.will1@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: New end date is 12/31/2019 per NSSC information (Ed., 5/29/19) NOTE: New end date is 12/31/2018 per NSSC information (Ed., 3/14/18) NOTE: Element change to Human Factors & Behavioral Performance; previously Behavioral Health & Performance (Ed., 1/18/17)		
Key Personnel Changes/Previous PI:	June 2017 report: Co-Investigator Chu-Hsiang (Daisy) Chang's leave assignment to serve as NSF Science of Organizations Program Officer has been extended an additional year. August 2016 report: Co-Investigator Chu-Hsiang (Daisy) Chang started a one-year leave in July 2016 to assume the role of NSF (National Science Foundation) Science of Organizations Program Officer.		
COI Name (Institution):	Biswas, Subir Ph.D. (Michigan State University) Chang, Chu-Hsiang Ph.D. (Michigan State University)		
Grant/Contract No.:	NNX16AR52G		

Performance Goal No.:	
Performance Goal Text:	
Task Description:	<p>This proposal is for ground-based, technology development research designed to address: PRD (Program Requirements Document) Risk: Risk of Performance Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team.</p> <p>IRP (Integrated Research Program) Gap – Team2: We need to identify a set of validated measures, based on the key indicators of team function, to effectively monitor and measure team health and performance fluctuations during autonomous, long duration, and/or distance exploration missions.</p> <p>Research Plan: Our current research (NNX13AM77G) is developing a technology system that is designed to unobtrusively measure and support team collaboration and cohesion. One key component of the system is a monitoring badge – a wearable body sensor array – that is designed to assess the frequency, duration, and quality of collaborative interactions between team members as they work together to accomplish team tasks, as well as physiological metrics (i.e., heart rate [HR]; heart rate variability [HRV]).</p> <p>In prior research, we have evaluated the high frequency interaction data streamed by the badges, which are highly reliable and valid. In addition, we have promising experimental evidence indicating that positive and negative affective reactions to specific team member interactions can be predicted from the HR and HRV data streams. Although promising, we believe it is critical to add an additional sensor – galvanic skin response (GSR) – to the current sensor array to improve reliable detection of crew anomalies using badge data streams.</p> <p>Specific Aims and Deliverables: The purpose of this proposal is to extend technology development of the monitoring sensor system. The proposed work has been developed in consultation with the Element Senior Scientist responsible for our current NASA research. Specifically, the proposed research will (1) extend technology development of the sensor platform to integrate a GSR sensor, develop relevant software, and redesign the badge casework, and (2) validate the utility of the GSR sensor to improve discrimination of positive and negative affective states.</p>
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>Team cohesion is not just a critical factor for astronaut teams and ground crews; cohesion is important to the effectiveness of all teams and especially those that operate in critical, high reliability setting. Of the many team process factors that support team effectiveness, team cohesion is the most studied with over a half century of research. Yet, remarkably, very little is known about the characteristics that promote its development and maintenance. For example, we know that experience working together is associated with cohesion formation and maintenance, but what are the mechanisms? Teams that do not cohere replace problematic members or disintegrate so experience reveals only those teams that survive, but that does not tell us why or how. This research, which will create technologies to monitor team cohesion and guide interventions to restore it, has the potential for wide utility in aviation, military, medical, industrial, and other environments where society depends on the effective performance of high reliability teams.</p>
Task Progress:	<p>Aim 1: Development of a Bluetooth Low Energy (BLE) based Galvanic Skin Sensor (GSR) Design and production of BLE-GSR-enhanced Badges has been accomplished. Building on the design from the previous reporting year, the Engineering Team completed the following tasks.</p> <ul style="list-style-type: none"> • Development and integration of all software in: a) badge (in TinyOS operating system), b) base station for GUI/dashboard, and c) backend software for data storage in Google Firebase. <p>With this software stack, the new BLE-GSR enabled badges can be field-deployed and experimented with the same level of integration as the previous version of the badges.</p> <ul style="list-style-type: none"> • Construction of six production quality BLE-GSR enabled badges for functionality and performance validation by Dr. Kozlowski's team. <p>Aim 2: Validate the Utility of GSR Sensor Data</p> <p>With hardware and software development completed during spring 2018, research attention has turned to validation. The following tasks have been accomplished.</p> <ul style="list-style-type: none"> • Experimental design for the validation process has been completed. Modifications were made to increase the efficiency of the design. • The experimental protocol has been pilot tested; refinements have been made. • Validation data collection is scheduled to commence Fall 2018.
Bibliography Type:	Description: (Last Updated: 07/05/2023)
Articles in Peer-reviewed Journals	Kozlowski SWJ, Chao GT. "Unpacking team process dynamics and emergent phenomena: Challenges, conceptual advances, and innovative methods. " Am Psychol. 2018 May-Jun;73(4):576-92. https://doi.org/10.1037/amp0000245 ; PubMed PMID: 29792469 , Jun-2018
Articles in Peer-reviewed Journals	Golden SJ, Chang C-H, Kozlowski SWJ. "Teams in isolated, confined, and extreme (ICE) environments: Review and integration." Journal of Organizational Behavior. 2018 Jul;39(6):701-15. Review. https://doi.org/10.1002/job.2288 , Jul-2018