

<b>Fiscal Year:</b>	FY 2010	<b>Task Last Updated:</b>	FY 06/17/2010
<b>PI Name:</b>	Salas, Eduardo Ph.D.		
<b>Project Title:</b>	Optimizing Crew Performance in Long Duration Space Exploration: Best Practices for Team Training and Cohesion Measurement		
<b>Division Name:</b>	Human Research		
<b>Program/Discipline:</b>	HUMAN RESEARCH		
<b>Program/Discipline--Element/Subdiscipline:</b>	HUMAN RESEARCH--Behavior and performance		
<b>Joint Agency Name:</b>	<b>TechPort:</b>	No	
<b>Human Research Program Elements:</b>	(1) <b>BHP</b> :Behavioral Health & Performance (archival in 2017)		
<b>Human Research Program Risks:</b>	(1) <b>Team</b> :Risk of Performance and Behavioral Health Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team		
<b>Space Biology Element:</b>	None		
<b>Space Biology Cross-Element Discipline:</b>	None		
<b>Space Biology Special Category:</b>	None		
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<b>Comments:</b>	NOTE: Previous affiliation was University of Central Florida, until mid-2015		
<b>Project Type:</b>	Ground	<b>Solicitation / Funding Source:</b>	2008 Crew Health NNJ08ZSA002N
<b>Start Date:</b>	08/15/2009	<b>End Date:</b>	08/14/2012
<b>No. of Post Docs:</b>	0	<b>No. of PhD Degrees:</b>	0
<b>No. of PhD Candidates:</b>	1	<b>No. of Master' Degrees:</b>	0
<b>No. of Master's Candidates:</b>	3	<b>No. of Bachelor's Degrees:</b>	0
<b>No. of Bachelor's Candidates:</b>	2	<b>Monitoring Center:</b>	NASA JSC
<b>Contact Monitor:</b>	Shea, Camile	<b>Contact Phone:</b>	281-244-2017
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<b>Flight Program:</b>			
<b>Flight Assignment:</b>	NOTE: period of performance changed to 8/15/2009-8/14/2012 (from 5/22/09-5/21/12) per JSC (3/10)		
<b>Key Personnel Changes/Previous PI:</b>	NA		
<b>COI Name (Institution):</b>	Fiore, Stephen ( University of Central Florida ) Smith-Jentsch, Kimberly ( University of Central Florida )		
<b>Grant/Contract No.:</b>	NNX09AK48G		
<b>Performance Goal No.:</b>			
<b>Performance Goal Text:</b>			

**Task Description:**

This project addresses questions regarding methods and technologies for training crews to maintain crew cohesion and optimal performance during exploration missions (BHP Team GAP5; IRP Gap - BHP 2.3.1) and metrics for monitoring crew cohesion (BHP Team GAP2; IRP Gap - BHP 2.2.1). Specific aims of this project are threefold: (1) identify evidence-based guidelines/best practices for training to maximize team cohesion, and team performance, (2) design, develop, and validate evidence-based instructional strategies to mitigate performance failures from cohesion decrements among spaceflight crews and coordinating ground crews, and (3) design, develop, and validate an evidence-based index measuring and diagnosing cohesion over the course of a mission. These specific project aims meet NASA goals and objectives (BHP Team Gap 2 and Team Gap5) by capturing cohesion levels shown to be integral to long duration spaceflight mission success as well as developing countermeasures designed to mitigate the negative impact of cohesion issues. Organized as a multi-year project, primary tasks for the first year include the development of recommendations for training crews to optimize cohesion and team performance, mitigate negative impacts of long-duration missions, and measuring crew cohesion over time. Second and third years of the project focus on applying recommendations derived from year one research by developing, implementing, and evaluating instructional strategies to maximize crew cohesion and mitigate negative psychosocial impacts of long-duration missions. Overall, the project aims to mitigate performance failures due to a lack of cohesion between spaceflight crews and coordinating ground crews, provide mechanisms to diagnose cohesion decrements during exploration missions, and provide just-in-time training in the context of long-duration missions.

**Rationale for HRP Directed Research:****Research Impact/Earth Benefits:**

Working together on long-duration space exploration missions in conjunction with ground control requires the ability to communicate, coordinate, and cooperate for extended durations under complex, dynamic conditions such as extreme isolation and confinement (NASA, 2009). Factors related to team cohesion (e.g. interpersonal conflict, impaired communication) were noted as contributors in both the Challenger and Columbia shuttle accidents. Determining the best strategies for equipping crew members with the cognitive, behavioral, and attitudinal tools necessary to cope under such intense conditions while maintaining optimal performance, and developing a means to unobtrusively monitor crew adaptation over time are critical to the success of such missions. The multipronged research approach conducted during Year One as well as the proposed efforts for Year Two and Year Three will yield (1) an understanding of the factors that contribute to a lack of cohesion and (2) the identification of stressors relevant to spaceflight crews, which will aid in pinpointing training strategies and methodologies to equip team members with the competencies necessary for coping with isolated, confined environments for long durations. Additionally, the focus on self-correction and regulation will enable teams to maintain levels of cohesion and team performance as well as to mitigate the negative impact of cohesion decrements over the course of LDSF.

**Task Progress:**

Year one (Y1) efforts focused on (1) examining existing evidence regarding team cohesion, stress, and self-regulation in extreme environments, (2) conducting a team training needs analysis designed to identify critical training needs based upon the experiences of crew members with existing long-duration mission experience and projected similarities/differences between these experiences and projected LDSF missions to entities such as Mars, and (3) investigating the cohesion-performance relationship and empirically investigating the impact of a team training and debriefing strategy on team performance using two analogous populations (i.e., U.S. Navy submarine crews and air traffic control teams). Efforts within Research Thrust 1 (Cohesion) were dedicated to identifying factors affecting formation and maintenance of cohesion, examining the impact of cohesion on team performance, and initial identification of training strategies that may potentially optimize cohesion. Efforts related to Thrust 2 (Stress) focused on identifying key antecedents of stress, examining the impact of stress on team performance, and initial identification of training strategies that may mitigate the negative impact of stress on crew cohesion and performance. Thrust 3 (Self-regulation) efforts focused on understanding the role of self-regulation in team cohesion and the cohesion-performance relationship, as well as validation of the generalizability of training strategies aimed at enhancing team self-regulation in analogous populations.

Three overarching tasks were completed in Y1: a formal project kick-off meeting with sponsors and other key stake holders (Task 1), a scientific advisory board was formed (Task 2), and a team training needs analysis was conducted to identify critical training objectives, training strategy recommendations, and training methods for experimental validation in subsequent project work slated to occur in Y2 and Y3 (Task 3). The purpose of the kick-off meeting was to develop a shared understanding among the UCF research team and NASA sponsors regarding the project goals, to establish common ground, and to allow the team to make necessary adjustments based on sponsor requests. Task 2 was dedicated to identifying and convening a scientific advisory board (SAB) designed to provide a combination of scientific and operational expertise both supplementary and complementary to the expertise of the UCF team. Specifically, the objectives of the SAB are to provide suggestions, advice, feedback, and an external perspective throughout the life of the project in order to optimize the scientific merit and practicality of the research efforts conducted within the scope of this grant. SAB members have been identified and have received overview materials detailing project aims and progress to date. The SAB is scheduled to hold its first meeting in July, 2010. Results will be detailed in subsequent reports. Task 3 included a Team Training Needs Analysis (TTNA) designed to delineate and project critical training needs (i.e. team competencies) for extreme long-duration missions, thus allowing relevant training strategies to be mapped to identified needs. To this end, Task three included a review of existing published studies analyzing teamwork working in isolated, confined, environments, analog data analysis, and subject matter expert interviews conducted with a sample of long-duration astronauts.

Overall, Y1 efforts have been dedicated to identifying team training needs for LDSF missions that will guide training recommendations, instructional strategy development and validation, as well as metric development and experimentation in Y2 and Y3. The literature reviews, SME interviews, review of existing training curricula, and analyses of analog data to date have already identified several important task, person, and organizational factors that must be considered in developing training and measurement strategies that will be effective given the operational environment. For example, analyses of the SME interviews conducted in February 2010 revealed several key task characteristics that will moderate the type of training strategy and methods recommended for optimizing crew (ground and flight) performance and cohesion (BHP Gap Team5). Additionally, interim results derived using archival analog data have found support for the impact of a guided team-self correction training and debriefing strategy on both team and multi-team system performance (BHP Gap Team5). Additionally, interim results of these analyses demonstrate that this strategy improves both within team and between team performance through several mechanisms: by improving team knowledge stock, increasing team mental model accuracy, and improving effective usage of transactive memory systems. These results and additional interim findings from the second analog data set (Air Traffic Control) are currently being prepared as

	white papers for submission to sponsors. These results have been augmented by findings from the on-going review of extant literature. Furthermore, review work to date has revealed several themes regarding the measurement of team cohesion and its relationship to cohesion which will guide formation of the cohesion toolkit (BHP Gap Team2).
<b>Bibliography Type:</b>	Description: (Last Updated: 09/04/2023)
<b>Abstracts for Journals and Proceedings</b>	Weaver SJ, Bedwell WL, Salas E, Smith-Jentsch KA, Fiore S, Dietz A, Sierra MJ. "Team effectiveness in long duration spaceflight: A conceptual guiding framework." Poster presented at the annual NASA Human Research Program Investigators' Workshop, Houston, TX, February 2010. NASA Human Research Program Investigators' Workshop, Houston, TX, February 2010. , Feb-2010
<b>Abstracts for Journals and Proceedings</b>	Dietz A, Sierra MJ, Weaver SJ, Bedwell WL, Salas E, Smith-Jentsch KA, Fiore SM. "Teams in ICE: Identifying focal stressors in long-duration spaceflight." Paper accepted for presentation to the 5th Annual INGRoup Conference, Arlington, VA, July 22-24, 2010. INGRoup 2010 Conference, July 2010. , Jul-2010
<b>Abstracts for Journals and Proceedings</b>	Smith-Jentsch KA, Weaver SJ, Wiese C, Kraiger K. "Evidence of the reliability and validity of collective climates in work teams." Paper accepted for presentation to the 5th Annual INGRoup Conference, Arlington, VA, July 22-24, 2010. INGRoup 2010 Conference, July 2010. , Jul-2010
<b>Abstracts for Journals and Proceedings</b>	Weaver SJ, Bedwell WL, Dietz AS, Salas E, Smith-Jentsch KA, Fiore SM. "The science of team performance & training: Fuel for the long voyage to Mars." Paper accepted for presentation to the 5th Annual INGRoup Conference, Arlington, VA, July 22-24, 2010. INGRoup 2010 Conference, July 2010. , Jul-2010
<b>Abstracts for Journals and Proceedings</b>	Dietz AS, Sierra MJ, Bedwell WL, Weaver SJ, Salas E, Smith-Jentsch KA, Fiore SM. "Identifying antecedents to stress in long-duration spaceflight: A multilevel, interactive, and temporal perspective." Lecture presentation at the 2010 Florida Student Conference on Human Factors & Applied Psychology, Daytona Beach, FL, April, 15, 2010. Florida Student Conference on Human Factors & Applied Psychology, April 2010. , Apr-2010
<b>Abstracts for Journals and Proceedings</b>	Weaver SJ, Salas E. (Co-Chairs) "Training and measurement at the extremes: Developing and sustaining expert team performance in isolated, confined, extreme environments." Panel accepted for presentation at the 54th Annual Meeting of the Human Factors and Ergonomics Society, San Francisco, CA, September 27-October 1, 2010. 54th Annual Meeting of the Human Factors and Ergonomics Society, 2010. , Sep-2010
<b>Papers from Meeting Proceedings</b>	Dietz AS, Weaver SJ, Sierra MJ, Bedwell WL, Salas E, Smith-Jentsch KA, et al. "Unpacking the temporal and interactive effects of stress on individual and team performance." Paper accepted to the 54th Annual Meeting of the Human Factors and Ergonomics Society, San Francisco, CA, September 27-October 1, 2010. Human Factors and Ergonomics Society annual meeting, September 2010. , Sep-2010