Fiscal Year:	FY 2016	**Task Last Updated:**	FY 07/14/2016
PI Name:	Contractor, Noshir Ph.D.		
Project Title:	CREWS: Crew Recommender for Effective Work in Space		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Behavior and performance		
Joint Agency Name:		**TechPort:**	Yes
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		
PI Email:	Nosh@northwestern.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	217-390-6270
Organization Name:	Northwestern University		
PI Address 1:	Industrial Engineering & Management Sciences		
PI Address 2:	2145 Sheridan Rd, TECH C210		
PI Web Page:			
City:	Evanston	**State:**	IL
Zip Code:	60208-0834	**Congressional District:**	9
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2014-15 HERO NNJ14ZSA001N-Crew Health (FLAGSHIP & NSBRI)
Start Date:	07/01/2015	**End Date:**	06/30/2018
No. of Post Docs:	1	**No. of PhD Degrees:**	0
No. of PhD Candidates:	1	**No. of Master' Degrees:**	0
No. of Master's Candidates:	1	**No. of Bachelor's Degrees:**	2
No. of Bachelor's Candidates:	5	**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: Element change to Human Factors & Behavioral Performance; previously Behavioral Health & Performance (Ed., 1/17/17)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Bell, Suzanne Ph.D. (DePaul University) DeChurch, Leslie Ph.D. (Georgia Tech Research Corporation)		
Grant/Contract No.:	NNX15AM32G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Team composition, the configuration of member attributes and their relationships, is a critical enabling feature of fostering effective teamwork and likely to play an important role in the effectiveness of future long-duration space exploration (LDSE). Limited research on team composition in environments analogous to LDSE exists, and currently how team composition can be used to optimize crew functioning and performance is unclear. Our research aims to: (1) identify the effects of team composition on team functioning in LDSE and the critical factors of team composition driving this effect, (2) identify particular patterns of this effect with different team compositions, (3) identify methods for composing teams for LDSE, (4) develop a predictive team composition model for use in composing teams and identify potential issues with already composed teams, and (5) provide recommendations for composing teams for LDSE. To address these critical aims, we propose a 3-year, multi-method research effort, in which we: (1) develop an agent-based model of team composition for LDSE based on empirical data linking key model inputs (e.g., individual difference variables, network relational factors, task characteristics) to team functioning (e.g., social integration, team processes, team cohesion, team conflict) in LDSE-relevant contexts; (2) conduct virtual experiments using characteristics and relationships identified in Phase I to identify the team functioning patterns that arise under different member compositions, and create a predictive model of team composition; and (3) conduct an initial validation of the model developed in Phase 2 in the Human Exploration Research Analog (HERA) and NASA Extreme Environment Mission Operations (NEEMO) analogue environments using specific manipulations of key factors (e.g., compositions; situational characteristics). Research products critical to closing Team Gap 8 will be developed including a predictive model of team composition in LDSE, evidence in support of the model, and a mockup of a proposed interface to assist in the staffing and management of LDSE crew and mission teams.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	While the primary objectives of this project are to be applied to astronaut crews in LDSE contexts, results from this research may also benefit teams on Earth in similar ICE (Isolated, Confined, and Extreme) conditions. Teams such as those sent to winter-overs in Antarctica or submarine crews that spend months underwater would be analogous environments in which the results of this research may prove useful. In a general sense, our findings could have implications for composing optimal teams that are not in ICE conditions, such as work teams at an organization, teams of students working on a project, and squadrons of military personnel, to give but a few examples.
Task Progress:	In the first year of the CREWS project we developed a refined conceptual framework focused on teaming episodes in which we link team member attributes to the development of affective, behavioral, and cognitive ties. We made substantial progress in collecting the evidence that will provide the empirical basis for the Agent Based Model (ABM) including: data collection in the Human Exploration Research Analog (HERA) and research labs at Georgia Tech and Northwestern University, and the creation of an extensive database of the team composition literature based on a meta-analytic review. We have also created the initial architecture of the ABM that we will continue to refine as we analyze data from the broad scale data collection efforts. In order to effectively address our research questions and ultimately build a predictive model of team composition, we first developed a refined conceptual model. This model incorporates the dynamic nature of LDSE, accounts for how individual differences may affect team functioning over an extended length, and allows for the important role of relational ties between team members (e.g., failures in social integration such as subgrouping and isolation) in mission success. Our conceptual model focuses on the recursive developmental trajectory of a teaming episode and the emergence of teaming capital. We define a teaming episode as a period of interaction between two or more members in which there is collaboration towards a common goal. Examples of teaming episodes include working to repair a broken robot, preparing for an EVA (extravehicular activity), and even social activities, such as gathering around the table for lunch. We are specifically concerned with how relational ties develop overtime in these teaming episodes; examples include positive affective ties, negative affective ties, informational ties, and behavioral ties. The positive and negative affective ties will help to determine to what extent a team is socially integrated or if there are subgrouping or isolation risks for a particular composition. Informational and behavioral ties will help to determine if teams are establishing effective processes to be successful in LDSE missions. Together the team member attributes and relations form the crew's teaming capital. Teaming capital is the team member knowledge, skills, abilities, and other characteristics (KSAOs) and relational (e.g., positive and negative) ties between team members from which team members can draw for effective functioning and performance. The first six months of our grant included extensive preparation for data collection in the 2016 HERA campaign (Campaign 3). We completed data collection on mission 1 (C3M1) and are currently collecting data on the second mission of the 2016 HERA campaign (C3M2). During the HERA campaigns we administered two unique and proprietary measures, in the form of games in order to test team performance. The first game, Project Red Design, asked HERA participants to collaborate with students at Georgia Tech to build a well on Mars. The second game, Project Red Relay, had the same group of participants attempt to route messages to each other in the most efficient way possible. Relationships established in Project Red Design would help complete the tasks in Project Red Relay. In addition to collecting data in HERA, we are conducting a meta-analysis of the extant team composition literature coded for fidelity and contextual moderators related to LDSE. We are using this meta-analysis to help identify key composition variables and configuration of variables that affect team processes, emergent states, and performance. Along with HERA data, the meta-analytic effects will help to guide the rules of the ABM. During the first year, we made substantial progress on the meta-analysis and have completed extensive literature searches, coded 12,648 dependent effect sizes from 517 sources, and prepared the data sets for analysis. Our initial ABM was focused on how crew members (e.g., agents) operate within the teaming episodes model, specifically the extent to which individual difference predict the relational ties that develop between team members. The relational ties form patterns between crew members that, in conjunction with the individual differences, contribute to the effectiveness of teaming episodes. A LDSE mission is depicted as a series of teaming episodes. A mission can be "played out"; success across teaming episodes defines effective team composition. We continued to develop this ABM to focus on the effective team composition of HERA participants, using information from the HERA playbook to indicate the tasks the crew is engaged in, as well as the directed and valued links between them. This model will continue to be developed as we include HERA data and effects from the meta-analysis. We will also add interactive relations, both between crew member (e.g., agent; referred to as turtles in the ABM program used)

	attributes and between crew member attributes and contextual features (e.g., task switching). Data collection for HERA 2016 and the analyses for the meta-analysis are still underway, but we did uncover some preliminary results by conducting simulations with the ABM. Moving forward, we will conduct analyses on HERA, complete our analyses for the meta-analysis, expand the empirical basis of the ABM (e.g., text mine oral histories), and refine our ABM. Our more refined agent-based model will include how team member attributes interact with one another as well as how team member attributes interact with the context.
Bibliography Type:	Description: (Last Updated: 04/29/2025)
Abstracts for Journals and Proceedings	Jones BR, Larson LE, DeChurch LA. "We and they: Pronouns & individuals' psychological representations of groups." The many "I"s of a team: Person-centric perspectives on teamwork--Symposium accepted at the 31st Annual Conference of the Society of Industrial and Organizational Psychology, Anaheim, CA, April 14-16, 2016. 31st Annual Conference of the Society of Industrial and Organizational Psychology, Anaheim, CA, April 14-16, 2016. , Apr-2016
Abstracts for Journals and Proceedings	Bedwell WL, Bell ST, Contractor NS, Fiore SM, Kozlowsk, SWJ, Salas E, Tannenbaum SI. "Organizing that's out of this world!" Ignite and Panel Discussion at the 31st Annual Conference of the Society of Industrial and Organizational Psychology, Anaheim, CA, April 14-16, 2016. 31st Annual Conference of the Society of Industrial and Organizational Psychology, Anaheim, CA, April 14-16, 2016. , Apr-2016
Abstracts for Journals and Proceedings	Contractor NS, Bell S, DeChurch LA, Brown S, Hernandez I, Forbush E, Jones BR. "CREWS: Crew Recommender for Effective Work in Space." Poster presented at the 2016 NASA Human Research Program Investigators' Workshop, Galveston, TX, February 8-11, 2016. 2016 NASA Human Research Program Investigators' Workshop, Galveston, TX, February 8-11, 2016. , Feb-2016
Significant Media Coverage	Morris A. "Press Release titled, 'Students Use NetLogo to Plan Mars Mission, Model New Societies.' " Northwestern University McCormick School of Engineering News, June 17, 2015., Jun-2015
Significant Media Coverage	Bell ST. (interview of Suzanne Bell) "Interview titled 'Putting together a team to travel to Mars.' " Interview on Morning Shift, Chicago Public Radio NPR, September 29, 2015., Sep-2015
Significant Media Coverage	Arruza E. (Interview of Suzanne Bell) "Interview titled 'Mission Impossible? 'The Martian' Aims for Realism in Outer Space.' " WTTW Television Chicago broadcast, October 5, 2015. http://chicagotonight.wttw.com/2015/10/05/mission-impossible-martian-aims-realism-outer-space , Oct-2015
Significant Media Coverage	Bell ST. "Keynote address titled 'Teamwork in and out of this world.' " Keynote address at the 103rd undergraduate commencement for Olivet Nazarene University, Bourbonnais, IL, May 7, 2016. , May-2016
Significant Media Coverage	Mathews KC. "Cover story about Suzanne Bell, titled 'Psychologist helps NASA build teams for mission to Mars.' " Association for Women in Science May Scientist of the Month Web Article, May 2016., May-2016