Fiscal Year:	FY 2020	**Task Last Updated:**	FY 05/21/2020
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		
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PI Organization Type:	UNIVERSITY	**Phone:**	217-390-6270
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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:**	09/30/2021
No. of Post Docs:	0	**No. of PhD Degrees:**	3
No. of PhD Candidates:	5	**No. of Master' Degrees:**	1
No. of Master's Candidates:	1	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	2	**Monitoring Center:**	NASA JSC
Contact Monitor:	Williams, Thomas	**Contact Phone:**	281-483-8773
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 9/30/2021 per NSSC (Ed., 4/1/21) NOTE: End date changed to 3/31/2021 per NSSC (Ed., 5/21/2020) NOTE: End date changed to 6/30/2020 per NSSC (Ed., 10/10/19) NOTE: End date shows 6/30/2019 in NSSC (Ed., 4/2/19) NOTE: End date changed to 5/17/2019 per D. Arias/HRP (Ed., 3/22/18) 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. (Northwestern University)		
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, teams of scientists, and squadrons of military personnel, to give but a few examples.
Task Progress:	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. In year 4, we have made significant progress on our three research aims: (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) using specific manipulations of key factors (e.g., compositions; situational characteristics). Research Aim #1: Our first research aim is to 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. During year four, we developed an approach to train and validate our model off of empirical data using genetic search algorithms and approximate bayesian computation. This allowed us to test our models based on the observational data collected from the HERA crews, as well as identify new parameters and effects that should be added into our model in order to improve performance. By looking. at the out of sample performance of our model, we were able to confirm which components did and did not result in successful predictions. Research Aim #2: Our second research aim is to 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. We developed a framework for how to conduct these experiments going forward. In order to design meaningful experiments, we identified a way to explore the effects of possible interventions that would improve crew functioning and performance. We applied the model to examine “What If” scenarios about hypothetical new team compositions, to extrapolate about what would happen in such crews. Research Aim #3: Our third research aim is to conduct an initial validation of the model developed in Phase 2 in the Human Exploration Research Analog (HERA). To support this aim, we have been collecting data on trait constructs, sociometric constructs, and team dynamics measures, with many of these constructs and measures being collected over time. In Campaign 5, we began to use the model to implement countermeasures -- the pairing of crew members on different tasks (Rover and Phobos) -- our ABM was used to recommend pairing assignments for these tasks in advance of the start of each mission. We identified a “good” pairing and a “bad” pairing based on our predictions, and alternated between using these pairings on the task in-mission. Using new data collected through these missions, we were able to demonstrate that the “good” pairings identified based on our model helped to improve team functioning.
Bibliography Type:	Description: (Last Updated: 04/29/2025)

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Abstracts for Journals and Proceedings	Antone B, Lungeanu A, Bell ST, DeChurch LA, Contractor NS. "Crew Recommender for Effective Work in Space (Project Crews): Validation & Countermeasure Development." 2020 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 27-30, 2020. Abstracts. 2020 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 27-30, 2020. , Jan-2020
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