Fiscal Year:	FY 2021	**Task Last Updated:**	FY 09/07/2021
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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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:**	09/30/2022
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	1	**No. of Master' Degrees:**	0
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
Contact Monitor:	Whitmire, Alexandra	**Contact Phone:**	
Contact Email:	alexandra.m.whitmire@nasa.gov		
Flight Program:			
Flight Assignment:	NOTE: End date changed to 9/30/2022 per A. Beitman/HFBP and NSSC information (Ed., 10/20/21) 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 the past year, we continued to make progress on each of our three research aims (as identified in previous task book and annual reports): (1) 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; (2) 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; and (3) to conduct an initial validation of the model we developed in LDSE analogs. In addition to the above tasks, we have also worked to incorporate additional data into our models and analyses, in order to establish credibility and robustness of our results. This has included both the incorporation of new data from HERA (Campaign 6), as well as adjusting models originally developed using HERA to also incorporate data from NEK SIRIUS (Nezemnyy Eksperimental'nyy Kompleks / Scientific International Research In a Unique terrestrial Station) analog missions. These steps help ensure that our model is appropriate given the availability of new data. Progress on 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. Over the reporting period, we continued to make incremental developments and refinements on the agent-based model (ABM) we developed of social relationships within crews. We split our model into two parts: one part focusing on positive and negative relationships (task affect and hindrance) between crew members, and the other part focusing on claiming and granting leadership between crew members. Within each of the two parts, we implemented code to model the interaction between different types of ties: interactions between positive and negative relationships, and interactions between relationships claiming leadership and relationships granting leadership. Progress on 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. During the past reporting period, using the new model fit, we began conducting these virtual experiments using computational simulation. In these virtual experiments, we examine how different hypothetical team compositions (team member's demographics, relationships, task schedules) would perform during LDSE according to our model. Using optimization methods, we have developed a way to select high-performance teams based out of a pool of different potential crew members. Progress on Research Aim #3: Our third research aim is to conduct an initial validation of the model developed in LDSE analogs. This year, we analyzed results of the validation test of the model conducted in Campaign 5, and began compiling the results for presentation and publication. Our ABM was used to preemptively recommend "best" and "worst" pairings of crew members for the Rover and Phobos tasks in mission. Using surveys gathered over the course of each mission, we were able to evaluate the outcomes of using both "best" and "worst" pairings (the change in social relationships, their satisfaction with each pairing, viability). By performing new statistical analyses, we were able to demonstrate the viability of using our ABM to identify best pairings in advance of a future mission. These results will be presented at the upcoming International Astronautical Congress in October 2021.

Bibliography Type:	Description: (Last Updated: 04/29/2025)
Abstracts for Journals and Proceedings	Antone B, Lungeanu A, Bell ST, DeChurch LA, Contractor NS. "CREWS: A successful crew composition countermeasure validated in HERA." Presented at 2021 NASA Human Research Program Investigators' Workshop, Virtual, February 1-4, 2021. Abstracts. 2021 NASA Human Research Program Investigators' Workshop, Virtual, February 1-4, 2021. , Feb-2021
Abstracts for Journals and Proceedings	Antone B, DeChurch LA, Morton D, Bell S, Contractor NS. "A Network-Based Method to Recommend Optimal Team Compositions for Space Exploration." Presented at 36th Society for Industrial and Organizational Psychology (SIOP), Virtual, April 14-17, 2021. Abstracts. 36th Society for Industrial and Organizational Psychology (SIOP), Virtual, April 14-17, 2021. , Apr-2021
Abstracts for Journals and Proceedings	Contractor N. "Pairing Teams for, and (Re)pairing Teams during Long-Duration Space Exploration." Understanding and Enabling Human Travel to the Moon and Mars. Panel discussion conducted at the 2021 American Association for the Advancement of Science (AAAS) Annual Meeting, Virtual, February 8-11, 2021. 2021 American Association for the Advancement of Science (AAAS) Annual Meeting, Virtual, February 8-11, 2021. , Feb-2021
Abstracts for Journals and Proceedings	Antone B, Gruest V, Gupta A, DeChurch LA, Bell S, Contractor NS. "Team Performance in Space Crews." Presented at 2021 NASA Human Research Program Investigators' Workshop, Virtual, February 1-4, 2021. Abstracts. 2021 NASA Human Research Program Investigators' Workshop, Virtual, February 1-4, 2021. , Feb-2021
Books/Book Chapters	Antone B, Lungeanu A, Bell S, DeChurch L, Contractor N. "Computational modeling of long-distance space exploration: A guide to predictive and prescriptive approaches to the dynamics of team composition." in "Psychology and Human Performance in Space Programs: Research at the Frontier, vol. 1." Ed. L.B. Landon, K.J. Slack, E. Salas. CRC Press, 2021. p. 107-130. (eBook Published 9 October 2020.) Book doi: https://doi.org/10.1201/9780429440878 , Jan-2021