Fiscal Year:	FY 2023	**Task Last Updated:**	FY 04/29/2023
PI Name:	Fischer, Ute Ph.D.		
Project Title:	Understanding Key Components of Successful Autonomous Space Missions		
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) **BMed**:Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (2) **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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Zip Code:	30332-0165	**Congressional District:**	5
Comments:			
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:	06/29/2016	**End Date:**	03/31/2024
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**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:**	
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 03/31/2024 per NSSC information (Ed., 11/15/23) NOTE: End date changed to 11/30/2023 per A. Beitman/JSC (Ed., 9/12/23) NOTE: End date changed to 9/30/2023 per V. Lehman/JSC (Ed., 4/18/23) NOTE: End date changed to 3/31/2024 per NSSC information (Ed., 7/12/21) NOTE: End date changed to 6/28/2021 per NSSC information (Ed., 5/21/2020) NOTE: End date changed to 6/28/2020 per L. Juliette/HRP (Ed., 2/19/2020) NOTE: Element change to Human Factors & Behavioral Performance; previously Behavioral Health & Performance (Ed., 1/18/17)		
Key Personnel Changes/Previous PI:	May 2020 report: Dr. Tofighi withdrew as Co-Investigator from the project effective July 1, 2019.		
COI Name (Institution):	Mosier, Kathleen Ph.D. (Teamscape LLC)		

Grant/Contract No.:	NNX16AM16G
Performance Goal No.:	
Performance Goal Text:	
Task Description:	Exploration space missions will require that space crews manage tasks more autonomously than in current operations, although they will continue to be part of the multi-team system (MTS) comprised of members in space and on the ground. The overall goal of the proposed research is to develop countermeasures that will enhance the ability of MTS members to maintain effective team performance and manage autonomous operations during Long Duration Exploration Missions (LDEMs). We will use NASA Life Sciences Data Archive (LSDA) data collected in space analogs and the International Space Station (ISS) to develop models of the individual- and team-level relationships between crew autonomy, emergent states, and team performance. Additionally, several simulations will be conducted in space analogs to assess the impact of different autonomy implementations on MTS performance in long-duration missions. Data from this study will be used to refine the individual- and team-level models, and to create a MTS-level model of the autonomy-performance relationship. Our approach is comprehensive in that we will examine different implementations and levels of autonomy, experience with interdependent and autonomous operations, individual and team process variables as well as varying task constraints. A set of products to support space and mission control teams during long-duration exploration missions will be delivered. These include: a validated model of factors related to team autonomy and team performance in LDEMs; recommendations for how team autonomy should be managed within a MTS during LDEMs, including countermeasures to mitigate potential negative effects; and recommendations for future research on autonomous team functioning.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Multiteam collaboration is not a unique feature of spaceflight operations but common to many organizations, as is the question of how best to implement task autonomy within a multiteam system. We therefore expect that our research findings not only generalize to other isolated and confined extreme (ICE) environments, such as Antarctica, but also apply to any organization that require the collaboration by different work units.
Task Progress:	The current report summarizes data collected in SIRIUS 21 as this simulation ended on July 3, 2022, while the final mission of HERA C6 was just completed on March 12, 2023. To date analyses at the level of the crew/mission control center (MCC) multiteam system (MTS) concerned crewmembers' and mission support personnel's team concept, their perception of MTS cohesion, efficacy, and taskwork. Analyses at the level of the crew are ongoing and address crewmembers' team concept and team dynamics, their understanding of teamwork, and the interrelationships of these variables. Interviews with crewmembers explored their definition of crew autonomy and relationship with ground support. Analyses at the MTS level indicate that crewmembers and mission controllers not only were physically apart but also had different views on important aspects of their collaboration. Their team concepts did not overlap and MCC tended to be more optimistic about the efficacy and collaboration of the MTS than crewmembers were about their relationship with MCC. The interviews we conducted with SIRIUS 21 crewmembers provided some insights into the reasons for these discrepancies. Thirty-minute interviews were conducted with crewmembers, split into two groups. One group of three included English-speaking members; the second group consisted of two Russian-speaking crewmembers and one translator. Interviews were recorded and automatically transcribed, and the accuracy of the transcriptions was verified by the research team. Interviews addressed broad questions, such as crewmembers' experience of autonomy during the mission, the impact of crew autonomy on the crew/MCC MTS, and how MCC could best support crewmembers during long-duration exploration missions. The interviews made clear that crewmembers primarily associated crew autonomy with self-sufficiency; that is, a crew should be able to complete tasks on their own. However, a recurrent sentiment in the interviews was that crewmembers did not feel autonomous because they lacked the necessary information or required training and thus had to rely on MCC. Crewmembers reported that they turned to MCC for assistance but as a last resort and felt that having to do so curtailed their autonomy. They considered autonomy as a natural consequence of becoming proficient in tasks, a development which also entailed that fewer interactions or communications with MCC were required. Crewmembers emphasized that crew autonomy should be based on a partnership between the crew and MCC. For crewmembers, this meant that MCC treat them as professionals, respond to them in a timely fashion, and provide clear and timely input. The interviews also revealed that there was disagreement concerning the role of MCC, disagreement both within the crew as well as between some crewmembers and "people on the outside." For some crewmembers, it was important to have a personal relationship with the MCC, to get to know them and feel supported by them. Other crewmembers, and apparently members of Institute of Biomedical Problems (IBMP), wanted to define the relationship as one that is strictly task-related and impersonal. Together our survey and interview data suggest that crew autonomy may exacerbate fault lines of remote collaborations that have been observed in past crew/MCC interactions and concern issues, such as Us versus Them thinking, psychological closing by crewmembers, displacement of negative emotions by crew onto MCC, and disconnects in crew and MCC's task and team models. Our data further suggest that introducing crew autonomy into spaceflight will require that members of the MTS have a shared understanding of what autonomy entails in terms of both the distribution of responsibilities between crew and MCC and the collaboration between the teams. Specifically, there needs to be a shared understanding of the boundaries for self-sufficient crew action as well as of the parameters defining the collaboration between crew and MCC. Clearly, crew autonomy should not mean that the crew considers turning to MCC for assistance as an infringement on their autonomy. Conversely, MCC's behavior should not infringe on the crew's sense of agency. Our interview data showed that crewmembers reacted strongly, and negatively if they perceived that MCC were not treating them as an equal and competent partner. Analyses at the crew level have examined the team dynamics of the crew based on crewmembers' team concept and their responses to the SYMLOG (=Systematic Multi-Level Observation of Groups) instrument. Ongoing analyses address similarities and differences in crewmembers' teamwork models and the relationship between crew cohesion

	and MTS cohesion. Analyses of crewmembers' team concept and team dynamics indicated the presence of subgroups and showed their influence on crewmembers' assessment of their teamwork. Additional analyses will be conducted to explore the relationship between subgrouping, team dynamics variables and team measures, such as team conflict and crew cohesion.
Bibliography Type:	Description: (Last Updated: 03/22/2024)
Abstracts for Journals and Proceedings	Mosier, K, Fischer, UMueller, S, Veinott, E. "Building shared perceptions of teamwork across time." 66th Annual Meeting of the Human Factors and Ergonomics Society, Atlanta, Georgia, October 10-14, 2022. Abstracts. 66th Annual Meeting of the Human Factors and Ergonomics Society, Atlanta, Georgia, October 10-14, 2022. , Oct-2022
Papers from Meeting Proceedings	Fischer U, Mosier K. "Crew Autonomy within the Space/Ground Multiteam System." NASA Human Research Program Investigator Workshop in Galveston, Texas, February 7-9, 2023. Abstract. NASA Human Research Program Investigator Workshop in Galveston, Texas, February 7-9, 2023. , Feb-2023