Fiscal Year:	FY 2024	**Task Last Updated:**	FY 02/27/2024
PI Name:	Marquez, Jessica J. Ph.D.		
Project Title:	HCAAM VNSCOR: Crew Autonomy through Self-Scheduling: Guidelines for Crew Scheduling Performance Envelope and Mitigation Strategies		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	94035	**Congressional District:**	18
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2017-2018 HERO 80JSC017N0001-BPBA Topics in Biological, Physiological, and Behavioral Adaptations to Spaceflight. Appendix C
Start Date:	04/15/2019	**End Date:**	09/30/2025
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:	1	**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	1
No. of Bachelor's Candidates:	1	**Monitoring Center:**	NASA JSC
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Flight Program:			
Flight Assignment:	NOTE: End date changed to 09/30/2025 per A. Beitman/JSC (Ed., 2/21/23)		
Key Personnel Changes/Previous PI:	February 2020 report: Mr. Steven Hillenius (Co-Investigator) left NASA. Dr. Tamsyn Edwards is replacing Mr. Hillenius as Co-I. Dr. Edwards works at NASA Ames as part of San Jose University Research Foundation. February 2021 report: Dr. John Karasinski is now a Co-I. February 2022 report: Dr. Edwards has left NASA. March 2023 report: Dr. Karasinski has changed affiliations. February 2024 report: Dr. Karasinski has changed affiliations.		
COI Name (Institution):	Bresina, John Ph.D. (NASA Ames Research Center) Gregory, Kevin M.S. (San Jose State University Research Foundation) Zheng, Jimin M.S. (San Jose State University Research Foundation) Edwards, Tamsyn Ph.D. (San Jose State University Research Foundation) Karasinski, John Ph.D. (NASA Ames Research Center)		
Grant/Contract No.:	Internal Project		
Performance Goal No.:			

Performance Goal Text:	
Task Description:	This task is part of the Human Capabilities Assessments for Autonomous Missions (HCAAM) Virtual NASA Specialized Center of Research (VNSCOR). As NASA considers long-duration exploration missions (LDEMs), it is envisioned that crew will behave more autonomously as compared to low-Earth orbit missions. In this space environment, crew will have better and more timely insight as to how best to manage their own schedule, minimizing idle time as they wait for Mission Control Center (MCC) to respond or react to a delay in activity execution. Moreover, crew must be able to self-schedule, i.e., reschedule their own timeline without creating violations. NASA currently has not characterized crew performance for self-scheduling; specifically, non-expert human performance for the task of planning and scheduling has not been characterized experimentally. The focus of this proposal is to quantify crew performance envelope for the task of planning and scheduling as a function of plan complexity, and develop mitigations that are aimed at improving performance in the face of complex planning requirements. With regards to crew performance, we will study the relationship between planning efficiency, effectiveness, crew situation awareness, trust in planning software, and plan complexity. Once a performance envelope has been identified, we will shift our research emphasis to develop and evaluate countermeasures that mitigate adverse effects on performance. These mitigations will be evaluated in analogs and recommended countermeasures will be put forward if crew performance improves as compared to the baseline. Finally, based on research results, we will recommend corresponding standards and guidelines appropriate for autonomous crew in LDEMs.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	NASA currently has not characterized crew performance for self-scheduling; specifically, novice human performance for the task of planning and scheduling has not been characterized experimentally. As a result of this research, we will quantify the user performance envelope for the task of planning and scheduling, which impacts many jobs both on Earth and in spaceflight. The knowledge gained from our research can be generalized to benefit our understanding on how to improve roles that require planning and scheduling, such as project planning, personnel scheduling, and operational management. Our research will also contribute to developing the next generation of planning, scheduling, and execution software tools for NASA.
Task Progress:	As NASA considers long-duration exploration missions (LDEMs), it is envisioned that crew will behave more autonomously as compared to low-Earth orbit missions. In this space environment, crew will have better and more timely insight how to best manage their own schedule, minimizing idle time as they wait for Mission Control Center (MCC) to respond or react to a delay in activity execution. Moreover, crew must be able to self-schedule—that is, reschedule their own timeline without creating violations. NASA currently has not characterized crew performance for self-scheduling; specifically, non-expert human performance for the task of planning and scheduling has not been characterized experimentally. The focus of this research is to quantify crew performance envelope for the task of planning and scheduling as a function of plan complexity, and develop mitigations aimed at improving performance in the face of complex planning requirements. With regards to crew performance, we will study the relationship between planning efficiency, effectiveness, crew situation awareness, trust in planning software, and scheduling task complexity. Once a performance has been characterized, we will shift our research emphasis to develop and evaluate countermeasures that mitigate adverse effects on performance. These mitigations will be evaluated in analogs, and recommended countermeasures will be put forward if crew performance improves as compared to the baseline. Finally, based on research results, we will recommend corresponding standards and guidelines appropriate for autonomous crew in LDEMs. For Year 5 (4/2023 – 4/2024), our research team focused on NASA Human Exploration Research Analog Campaign 6 (HERA C6) research task, where we are assessing the countermeasures developed in previous years. As part of HERA C6 work, this past year we finished data collection, completed post-processing of data, and conducted statistical analysis. In previous years, we had started transcribing voice recordings to gain insight into timeline preference meetings and self-scheduling sessions. Our analysis revealed several interesting insights: 1) no usability issue of concern was encountered by the crew, 2) time spent discussing scheduling preferences decreased over time, 3) the crew collaborated and discussed preferences during self-scheduling, and 4) increased off-topic discussions while self-scheduling correlated to lower workload. With respect to human performance, we did not find significant differences due to the presence of countermeasure aid in time on task, number of violations created, or workload. However, in missions where the countermeasure was available, the trend indicates a decrease in time on task and the number of violations created, suggesting that the countermeasure aids provide assistance during self-scheduling. Evaluation of a novel, psychometric measure “plan goodness” was completed and the survey was adapted. A portion of Year 5 has also been spent preparing for HERA Campaign 7 (C7). Like HERA C6, participants will conduct self-scheduling. Notably, participants will be self-scheduling two days each, resulting in 18% of the mission being scheduled by the crew. We also have added trust measures and used our improved plan goodness survey.
Bibliography Type:	Description: (Last Updated: 03/21/2024)
Abstracts for Journals and Proceedings	Marquez JJ, Zheng J, Shelat S, Karasinski JA, Bresina J. "Crew autonomy through self-scheduling: guidelines for crew scheduling performance envelope and mitigation strategies." 2024 NASA Human Research Program Investigators' Workshop, Galveston, Texas, February 13-16, 2024. Presentation. 2024 NASA Human Research Program Investigators' Workshop, Galveston, Texas, February 13-16, 2024. , Feb-2024
Articles in Peer-reviewed Journals	Marquez JJ, Landon LB, Salas E. "The next giant leap for space human factors: The opportunities." Hum Factors. 2023 Sep;65(6):1279-88. https://doi.org/10.1177/00187208231174955 ; PubMed PMID: 37246369 , Sep-2023
Articles in Peer-reviewed Journals	Landon LB, Marquez JJ, Salas E. "Human factors in spaceflight: New progress on a long journey." Hum Factors. 2023 May 15:187208231170276. https://doi.org/10.1177/00187208231170276 ; PubMed PMID: 37183683 , May-2023

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Papers from Meeting Proceedings	Zheng J, Shelat S, and Marquez JJ. "Facilitating crew-computer collaboration during mixed-initiative space mission planning." SpaceCHI 3.0, Cambridge, MA, June 22-23, 2023. SpaceCHI 3.0, Cambridge, MA, June 22-23, 2023. , Jun-2023
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