Fiscal Year:	FY 2023	**Task Last Updated:**	FY 03/16/2023
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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Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2017-2018 HERO 80JSC017N0001-BPBA Topics in Biological, Physiological, and Behavioral Adaptations to Spaceflight. Appendix C
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No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:	1	**No. of Master' Degrees:**	1
No. of Master's Candidates:	2	**No. of Bachelor's Degrees:**	2
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.		
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)		
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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 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—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 the 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 4 (4/2022 – 4/2023), our research team continued analyses for our controlled lab experiment on human self-scheduling performance (completed in Year 2). In conjunction with the usability self-scheduling strategy study we did in Year 1, we identified self-scheduling strategies and heuristics used by participants to address scheduling problems. We found that, even when participants are instructed to follow a given strategy, they rapidly develop their own self-scheduling heuristics as they learn to successfully complete the task. Based on this research, future scheduling tools should support and enable the variety of emergent self-scheduling strategies. This will ensure that future astronauts may conduct self-scheduling, managing the nuanced changes in schedule and priority as they see fit. Future experiments may focus on training participants using different strategies in order to determine how these strategies quantitatively impact human performance in the scheduling task. Based on our controlled lab experiment, we were also able to define a concrete, quantitative usability testing framework for future iterations of Playbook, our self-scheduling software platform. The dataset from this experiment can be used as a satisfaction baseline that future Playbook designs can be compared to, in order to preserve the positive user experience. Furthermore, we can now compare usability and satisfaction results from the NASA Human Exploration Research Analog (HERA) in the context of a controlled dataset. During Year 3, we designed three countermeasure aids to support self-scheduling. In Year 4, we completed the implementation of the mixed-initiative scheduling aids and integrated them into our HERA Campaign 6 (C6) study. We deployed novel interface countermeasures and aids (“No-Go Zones” and “Suggested Fixes”) to evaluate effects on self-scheduling performance, workload, and usability in an analog setting. By the end of Year 4, we will have collected all the data from our participation in HERA C6. Initial work has focused on post-processing data collected from Missions 1, 2, and 3. By far, the largest effort has been to analyze voice recordings. We transcribed and analyzed voice recordings during Campaign 6 to gain insight into timeline preference meetings and self-scheduling sessions. We are observing collaboration occurring during self-scheduling sessions, which was unexpected. Additionally, we are evaluating the novel psychometric called the “Plan Goodness” questionnaire, readying ourselves for refinements for HERA Campaign 7. Once all the data is collected, we will finish post-processing and analyzing HERA C6 data while preparing for HERA C7, where we will have the opportunity to increase our number of participants. Finally, we have started the process of compiling necessary guidelines for mixed-initiative scheduling during long-duration exploration missions based on what we have learned from four years of research.

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