Fiscal Year:	FY 2021	**Task Last Updated:**	FY 03/11/2021
PI Name:	LePine, Jeffrey Ph.D.		
Project Title:	Understanding and Preventing Crew Member Task Entrainment		
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) **HSIA**:Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture (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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Comments:			
Project Type:	FLIGHT,GROUND	**Solicitation / Funding Source:**	2013-14 HERO NNJ13ZSA002N-ILSRA. International Life Sciences Research Announcement
Start Date:	06/01/2015	**End Date:**	12/31/2022
No. of Post Docs:		**No. of PhD Degrees:**	3
No. of PhD Candidates:	1	**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Whitmire, Alexandra	**Contact Phone:**	
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Flight Program:	ISS		
Flight Assignment:	NOTE: End date changed to 12/31/2022 per HRP and "in progress" information in NSSC (Ed., 3/20/2020) NOTE: Extended to 5/15/2020 per NSSC information (Ed., 6/28/19) NOTE: Extended to 5/15/2019 per NSSC information (Ed., 3/6/18) NOTE: Element change to Human Factors & Behavioral Performance; previously Behavioral Health & Performance (Ed., 1/18/17)		
Key Personnel Changes/Previous PI:	March 2020 report: Daniel Newton, Ph.D., is now CoInvestigator on the project.		
COI Name (Institution):	Wellman, Edward Ph.D. (Arizona State University) Newton, Daniel Ph.D. (University of Iowa)		
Grant/Contract No.:	NNX15AK77G		
Performance Goal No.:			

Performance Goal Text:	
Task Description:	The proposal responds to the request for research exploring task switching in crews in isolated habitats such as the International Space Station (ISS) and Human Exploration Research Analog (HERA). We propose ground- and flight-based experiments to understand and mitigate the performance deficits caused as crew members switch between tasks. Drawing on our own research, as well as research conducted by other scholars, we explain how crew member entrainment is produced by deep levels of cognitive, physical, and affective engagement or immersion in tasks, which immersion makes it difficult for members to disengage from those tasks – even after they have switched to a different task. We hypothesize that, as a result of this immersion/engagement, entrainment causes subsequent task engagement and effectiveness to suffer. We further hypothesize that the strength of this effect influenced by perceptions of task completion.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Scholars have conducted research on task transitions (Monsell, 2003) and considered what makes workers effective when transitioning. However, we do not fully understand how individuals' psychological connections to tasks fluctuate when they transition between tasks as well as what the impact is on subsequent task effectiveness. A more robust understanding of the psychological connections individuals maintain with tasks—after having previously transitioned and anticipating an upcoming transition—are critical to improving and maintaining the effectiveness of crew members as well as individuals on Earth. Monsell, S. (2003). Task switching. Trends in cognitive sciences, 7(3), 134-140. http://dx.doi.org/
Task Progress:	Aims of Proposal: The proposed research addresses the performance effects of entrainment during an operational space flight context. We explore what can be done to mitigate the negative effects of entrainment and improve individual and team capabilities to engage in effective task switching. We seek to address the following: Need to understand threats to teams during long duration missions, Need to identify countermeasures to support team function for all phases of autonomous, long duration missions, and Need to identify psychosocial and psychological factors, measures, and combinations thereof that can be used to compose effective crews for autonomous, long-duration missions. We consider the effects of crew member entrainment (Ancona & Chong, 1996) between crew member engagement and effectiveness. Entrainment may be especially problematic as astronauts shift between tasks that may vary significantly in their physical, cognitive, and emotional demands (Smith-Jentsch, 2015). Features of specific tasks that individuals transition between can foster attention residue, or the inability to decouple one's mental energies from previous tasks (Leroy, 2009), which in turn, hinders effectiveness in subsequent tasks. The difficulty in transitioning one's attention also creates problems with transitions between tasks, and in turn, hinders effectiveness in subsequent tasks. In previous years, we have viewed entrainment as retrospective—tasks that crew members have already transitioned away from that linger with them (Newton, LePine, Kim, Wellman, & Bush, 2020). Although our ongoing work replicates previous findings in different habitats or contexts, we now consider entrainment effects from anticipating upcoming tasks. It is possible that crew members may struggle to transition effectively between tasks when they anticipate or are preoccupied by an upcoming future task. In 2020, prior to COVID-19, we conducted one mission as part of campaign 5 in HERA to investigate this effect. Although we do not directly test this hypothesis aboard the ISS, our post-flight interviews explore this phenomenon. Our collective findings enhance our understanding of the psychological and interpersonal pathways through which entrainment operates (both backward and forward looking), and individual and task attributes that can mitigate its effects. Understanding this phenomenon could help develop strategies to improve individual and team effectiveness (i.e., including task scheduling) in a variety of organizational contexts including exploration missions. HERA Campaigns: In 2020, we found preliminary support for our anticipatory engagement hypotheses in one HERA mission. As with previous years, we sought to seamlessly integrate our study into the natural workflow of HERA crew members. That is, we utilized existing maintenance and payload tasks which were scheduled to occur during the mission. Working with subject matter experts (SMEs), we selected a finalized series of "task-transition-task" episodes to serve as the focal point of the study. After the completion of the second task, crew members completed a brief survey about their engagement and attention residue in past tasks and their anticipatory engagement in upcoming tasks—and whether this anticipation distracted or motivated them on the initial task in a "task-transition-task" sequence. ISS Campaigns: One crew member returned from orbit in 2020. While aboard the ISS, this crew member reflected every two weeks on a recent transition between two tasks. Reported were the level of engagement in the tasks, how seamlessly was the transition, and what generally went well and what could have gone better. Following return to Earth, we conducted a 30-minute qualitative interview, where we asked about experience transitioning aboard the ISS. These interviews gave insight into the task transition phenomenon. NEK (Nezemnyy Eksperimental'nyy Kompleks, Russia's IBMP Ground-based Experimental Complex) Campaign: We examined the challenges in anticipating upcoming tasks during 2019 in the NEK environment. We found that anticipating an upcoming task reduced engagement in a present task if the upcoming task were complex in nature. These effects appear to be stronger at the beginning of the mission prior to routinization. Although we planned to further investigate this phenomenon in 2020, COVID-19 has postponed subsequent NEK missions until 2021. Our findings reveal a rich understanding of task transitions that influence multifaceted work. Consistent with our previous findings, task engagement has positive and negative consequences on subsequent tasks. On the one hand, task engagement activates positive affect and thereby engagement in subsequent tasks, which increases crew member effectiveness. On the other hand, task engagement lingers after individuals move to subsequent tasks, negatively impacting subsequent task engagement and effectiveness. Completing a task is critical in reducing the negative cognitive effects that can impair subsequent engagement and effectiveness. Moreover, preliminary evidence from HERA and NEK missions suggests that anticipating upcoming tasks reduces task engagement, particularly when the upcoming task is perceived to be complex. Our ongoing research aims to help NASA leverage the benefits of engaging work during task transitions, while limiting the associated risks of attention residue and anticipatory engagement. References: Ancona, D., & Chong, C. L. (1996). Entrainment: Pace, cycle, and rhythm in organizational behavior. Research in

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Bibliography Type: Description: (Last Updated: 03/20/2020)