Fiscal Year:	FY 2020	**Task Last Updated:**	FY 03/18/2020
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		
PI Email:	jeff.lepine@asu.edu	**Fax:**	FY
PI Organization Type:	UNIVERSITY	**Phone:**	480-965-8652
Organization Name:	Arizona State University		
PI Address 1:	Department of Management		
PI Address 2:	PO Box 874006		
PI Web Page:			
City:	Tempe	**State:**	AZ
Zip Code:	85287-4006	**Congressional District:**	9
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:**	2
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:	Williams, Thomas	**Contact Phone:**	281-483-8773
Contact Email:	thomas.j.will1@nasa.gov		
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 Team Task Switching in Astronaut Crews on the International Space Station (ISS). We propose ground- and flight-based experiments to understand and mitigate the performance deficits caused by crew members switching between independent and interdependent tasks. Drawing on our own research, as well as that 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 make 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: Team Gap 1 (need to understand threats to teams during long duration missions), Team Gap 3 (need to identify countermeasures to support team function for all phases of autonomous, long duration missions), and Team Gap 8 (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 backward looking—tasks that crew members have already transitioned away from that may linger with them (Newton, LePine, Kim, Wellman, & Bush, 2020--see Bibliography section for reference). Although our ongoing work replicates previous findings in different habitats or contexts, we now consider future entrainment effects. That is, 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 2019, we conducted ground experiments within HERA (Human Explorations Research Analog) and NEK (Nezemnyy Eksperimental'nyy Kompleks, Russia's IBMP Ground-based Experimental Complex) that isolate this effect. Although we do not directly test this hypothesis aboard the ISS, our post-flight interviews have begun to 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. This could lead to the development of strategies to improve individual and team effectiveness in a variety of organizational contexts including exploration missions. HERA Campaigns: In 2019, we continued to test and find support for our hypotheses in HERA missions. 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 SMEs (subject matter experts), 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: Three crew members returned from orbit in 2019. While aboard the ISS, crew members reflected every two weeks on a recent transition between two tasks. They reported their level of engagement in the tasks, how seamlessly they transitioned, and what generally went well and what could have gone better. Following their return to Earth, we conducted 30-45 minute qualitative interviews with them, where we asked them about their experience transitioning aboard the ISS. These interviews gave insight into the task transition phenomenon. NEK Campaign: Based upon feedback from other crews, we examined the challenges in anticipating upcoming tasks in the NEK environment. We found that anticipating an upcoming task reduced engagement in a present task if the upcoming task was complex in nature. These effects appear to be stronger at the beginning of the mission prior to routinization. We plan to pursue this phenomenon in subsequent NEK missions in 2020 and 2021. Our aggregate findings reveal a better understanding of the transitional process that influences multifaceted work. Consistent with our previous findings, task engagement has positive and negative consequences on subsequent tasks. On the positive side, task engagement activates positive affect and thereby engagement in subsequent tasks, which increases crew member effectiveness. On the negative side, we find that 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 linger. When tasks are incomplete, the negative pathway remains active and reduces subsequent engagement and effectiveness. Moreover, preliminary evidence from NEK suggests that upcoming tasks impair current task engagement when the upcoming task is perceived to be complex. Our ongoing research aims at helping 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 Organizational Behavior, 18, 251-284.

Smith-Jentsch, K. A. (2015). On shifting from autonomous to interdependent work: What we know and what we need to learn (pp. 1-31). Houston, TX: National Aeronautics and Space Administration (NASA).

Leroy, S. (2009). Why is it so hard to do my work? The challenge of attention residue when switching between work tasks. Organizational Behavior and Human Decision Processes, 109(2), 168-181.

Bibliography Type:	Description: (Last Updated: 03/20/2020)
Articles in Peer-reviewed Journals	Newton DW, LePine JA, Kim JK, Wellman N, Bush JT. "Taking engagement to task: The nature and functioning of task engagement across transitions." J Appl Psychol. 2020 Jan;105(1):1-18. Epub 2019 Jun 17. https://doi.org/10.1037/apl0000428 ; PubMed PMID: 31204829 , Jan-2020