

Fiscal Year:	FY 2019	Task Last Updated:	FY 03/13/2019
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:			
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No. of Master's Candidates:		No. of Bachelor's Degrees:	
No. of Bachelor's Candidates:		Monitoring Center:	NASA JSC
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Flight Assignment:	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:			
COI Name (Institution):	Wellman, Edward Ph.D. (Arizona State University)		
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Task Description:	<p>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.</p>
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>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 those tasks as well as the impact 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.</p> <p>Monsell, S. (2003). Task switching. <i>Trends in cognitive sciences</i>, 7(3), 134-140. http://dx.doi.org/</p>
	<p>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).</p> <p>We consider how crew member entrainment (Ancona & Chong, 1996) is influenced by the linkage between employee 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.</p> <p>In previous years, we have viewed entrainment as backward looking—tasks that crew members have already transitioned away from that may linger with them. Although our ongoing work replicates our previous findings in different habitats or contexts, we have now begun to 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 another task. We are currently conducting 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. The collective findings from these examinations will 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.</p> <p>HERA Campaigns: In 2018, 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 non-astronaut crew members. In other words, we did not introduce any new tasks, but utilized the existing maintenance and other payload tasks which were scheduled to occur during the mission. With this information in mind, we were able to select 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 the tasks. Individuals in HERA mission control recorded notes about crew member task effectiveness. In upcoming HERA tasks, as mentioned, we will survey individuals about the extent to which they anticipated a second task, and whether this anticipation distracted or motivated them on the initial task in a "task-transition-task" sequence.</p>
Task Progress:	<p>ISS Campaigns: Two crew members flew and returned from orbit in 2018. Due to unforeseen circumstances, one crew member had his flight delayed until 2019. The crew members who participated in our study periodically (i.e., every two weeks) reflected on a recent transition between two tasks. They reported on 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, as alluded to above, indicated the importance of forward looking challenges associated with entrainment that we plan to examine in upcoming sister campaigns.</p> <p>NEK Campaign: We have been preparing to participate in NEK. Based upon feedback from other crews, we plan to examine the challenges in anticipating upcoming tasks and the potential negative effects these bring to present tasks. We have been identifying tasks with NASA crew members that again allow us to seamlessly integrate our study into a crew's natural work flow.</p> <p>Our findings thus far reveal a better understanding of the transitional process that influences effectiveness in multifaceted work. Importantly, we find that task one engagement has positive and negative consequences on subsequent tasks. On the positive side, task one engagement activates positive affect and thereby engagement in subsequent tasks, which increases crew member effectiveness. On the negative side, we find that task one engagement lingers after individuals move on 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. However, when previous tasks are completed, then the negative effects are short-circuited. Our ongoing research aims at helping NASA leverage the benefits of engaging work during task transitions, while limiting the associated risks of attention residue.</p>
	References

	<p>Ancona, D., & Chong, C. L. (1996). Entrainment: Pace, cycle, and rhythm in organizational behavior. <i>Research in Organizational Behavior</i>, 18, 251-284.</p> <p>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).</p> <p>Leroy, S. (2009). Why is it so hard to do my work? The challenge of attention residue when switching between work tasks. <i>Organizational Behavior and Human Decision Processes</i>, 109(2), 168-181.</p>
Bibliography Type:	Description: (Last Updated: 03/20/2020)
Articles in Peer-reviewed Journals	Bush JT, LePine JA, Newton DW. "Teams in transition: An integrative review and synthesis of research on team task transitions and propositions for future research." <i>Hum Resour Manage Rev.</i> 2018 Dec;28(4):423-33. https://doi.org/10.1016/j.hrmr.2017.06.005 , Dec-2018