

Fiscal Year:	FY 2016	Task Last Updated:	FY 03/30/2016
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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Flight Assignment:	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. With independent tasks, crew member immersion is grounded in features of the task, whereas in interdependent tasks, immersion is grounded in the task as well as in the connections that exist between members to coordinate interaction. We hypothesize that, as a result of this immersion/engagement, entrainment should cause the performance of teams that switch between independent and interdependent tasks to suffer. We further hypothesize that the strength of this effect influenced by member cognitive ability, goal difficulty, engagement, task complexity, and time spent on the prior tasks. We draw upon our understanding of the entrainment process to propose an intervention that will help crews transition more efficiently between critical independent and interdependent tasks and improve collective performance.</p>
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>Scholars have conducted research on task transitions and highly variable work (Louis & Sutton, 1991; Marks et al., 2001; Rotundo & Sackett, 2002), considering what generally makes an effective transition or worker. Unfortunately, we do not fully understand how individuals' psychological connections to the tasks they perform influences transitions between those tasks as well as subsequent task effectiveness. A more robust understanding of the psychological connections individuals maintain with tasks – after having previously transitioned – are critical to improving and maintaining the effectiveness of crew members as well as individuals on Earth.</p> <p>Louis, M. R., & Sutton, R. I. (1991). Switching cognitive gears: From habits of mind to active thinking. <i>Human Relations</i>, 44(1), 55-76.</p> <p>Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. <i>Academy of Management Review</i>, 26(3), 356-376.</p> <p>Rotundo, M., & Sackett, P. R. (2002). The relative importance of task, citizenship, and counterproductive performance to global ratings of job performance: A policy-capturing approach. <i>Journal of Applied Psychology</i>, 87(1), 66-80.</p>
Task Progress:	<p>The proposed research program begins to address the performance effects of entrainment to a particular work style and then switching to another style during an operational space flight context. Specifically, we explore what individual attributes make crew members more or less susceptible to entrainment, and what can be done to mitigate the negative effects of entrainment and improve individual and team capabilities to engage in effective task switching. In addressing these questions, the proposed studies also contribute to answering the following identified Integrated Research Plan (IRP) gaps: 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 in the context of jobs that vary in regard to required cognitive, emotional, physical, and social energies. The problem of entrainment may be especially problematic as astronauts shift between individual and crew tasks that may vary significantly in their physical, cognitive, and emotional demands (Smith-Jentsch, 2015). Although individual, job, and organizational attributes foster a base of job engagement (Kahn, 1990), features of the specific tasks that individuals transition between can also foster residual engagement, or the inability to decouple one's energies from previous tasks, which in turn, can hinder effectiveness in subsequent tasks. In other words, lingering engagement in prior tasks after a transition has occurred (i.e., residual engagement) makes it difficult for individuals to mentally, emotionally, or socially disengage and disconnect from their prior task and focus their full attention and energy on the new task. The difficulty in transitioning also creates problems with transitions between tasks, and in turn, hinders effectiveness in subsequent tasks.</p> <p>We are currently conducting ground experiments within HERA (Human Explorations Research Analog) as well as in Arizona State University (ASU) laboratory settings. The findings from these experiments will enhance our understanding of the psychological and interpersonal pathways through which entrainment or residual engagement operates, and individual and task attributes that can mitigate its effects. This could lead to the development of interventions to improve individual and team effectiveness in a variety of organizational contexts including exploration missions.</p> <p>HERA Campaigns: We anticipate testing our hypotheses in four HERA missions (16 participants over a one-year time period). We have currently completed the first wave of the HERA campaign. Prior to analog participation, we collected relevant personality characteristics and demographic information of participants, leveraging pre-existing data on these characteristics where possible. Our objective is to integrate the work of this study as seamlessly as possible into the natural workflow of HERA non-astronaut crew members. To accomplish this, we identified transitions between independent and interdependent tasks that are performed regularly by all crew members and for which performance data is already available. In other words, we did not introduce any new tasks, but rather 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 residual engagement in the tasks. Individuals in HERA mission control recorded notes about crew member task effectiveness. Because the campaign is only recently completed, and we have yet to gain access to performance information for this first wave, we are currently unable to comment on the data findings.</p> <p>ASU Lab Studies: We recruited 363 undergraduates to participate in a lab study in exchange for course credit. 119 of the participants completed a series of online tasks, which they performed independently. The results of these findings show that participants' engagement in the first task predicted their residual engagement during the second task. Further, when participants experienced residual engagement, their engagement and performance levels on the second task suffered. This effect was particularly strong with individuals lower in cognitive ability.</p> <p>The other 244 participants were randomly assigned onto a team of four individuals. Each team completed an interdependent team task, during which time each individual filled a unique role on the team. Following the completion</p>

of the team task, participants transitioned to an individual task. Our preliminary results show that individuals who were engaged in the team task experienced a higher degree of residual engagement during the individual task. Further, residual engagement in the first task (during the second task) resulted in diminished levels of engagement in the second task as well as lower levels of effectiveness in the second task.

Overall, these preliminary findings reveal a better understanding of the transitional process that influences effectiveness in multifaceted work as individuals transition between tasks. Importantly, we find that engagement in a prior task can have both positive and negative consequences on subsequent tasks. On the positive side, individuals who exhibit higher levels of engagement in an initial task are more likely to engage in subsequent tasks, increasing their effectiveness. However, on the negative side we find that engagement in a prior task can also linger after individuals move on to subsequent tasks, negatively impacting subsequent task engagement and effectiveness. Our ongoing research aims at helping NASA leverage the benefits of engaging work during task transitions, while limiting the associated risks.

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).

Kahn, W. A. (1990). Psychological conditions of personal engagement and disengagement at work. *Academy of Management Journal*, 33(4), 692-724.

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