

Fiscal Year:	FY 2015	Task Last Updated:	FY 06/30/2015
PI Name:	Palinkas, Lawrence Ph.D.		
Project Title:	Assessing the Impact of Communication Delay on Behavioral Health and Performance: An Examination of Autonomous Operations Utilizing the International Space Station		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Behavior and performance		
Joint Agency Name:	TechPort:	No	
Human Research Program Elements:	(1) BHP :Behavioral Health & Performance (archival in 2017)		
Human Research Program Risks:	(1) BMed :Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (2) HSIA :Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture (3) 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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Zip Code:	90089-0411	Congressional District:	33
Comments:			
Project Type:	Flight	Solicitation / Funding Source:	Directed Research
Start Date:	09/05/2012	End Date:	09/30/2016
No. of Post Docs:	0	No. of PhD Degrees:	0
No. of PhD Candidates:	0	No. of Master' Degrees:	0
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	0
No. of Bachelor's Candidates:	0	Monitoring Center:	NASA JSC
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Flight Program:	ISS		
Flight Assignment:	ISS NOTE: End date changed to 9/30/2016 per NSSC information (Ed., 7/18/16) NOTE: End date is now 6/30/2016 per NSSC information (Ed., 6/8/15) NOTE: Period of performance corrected to 9/5/2012-9/4/2015 per NSSC information (Ed., 4/4/2013)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Chou, Chih-ping (University of Southern California) Vessey, William Ph.D. (Wyle/NASA Johnson Space Center) Leveton, Lauren (NASA Johnson Space Center)		
Grant/Contract No.:	NNX12AR21A		
Performance Goal No.:			

Performance Goal Text:**Task Description:**

Space crews of exploration missions in the future will need to be more autonomous from mission control and act and operate independently, in part, due to the expectation that communication quality between the ground and exploration crews will be more limited by communication delays and other quality factors than on any mission to date. Communication delays and the impact these delays have on the quality of communications to the crew will create performance decrements if crews are not given adequate training and tools to support more autonomous operations. The proposed research study will examine the impact of implementing an experimental communication delay on the International Space Station (ISS) on individual and team factors and outcomes, including performance and related perceptions of autonomy. To date, very few studies have observed teams in remote environments that perform without communication with management teams (e.g., mission control), and no such studies have been conducted during long-duration expeditions or missions. This study meets the operationally constrained criterion of a Human Research Program (HRP) directed research project (DRP) and is a time-constrained requirement as we will be: 1) utilizing ISS Increment 39/40 to implement this study beginning in Spring of 2014, 2) incorporating the results of this study to identify future near-term research tasks that relate to autonomy and what countermeasures will be needed to adequately prepare for autonomous long duration missions, and 3) guiding future NASA Research Announcement (NRA) calls based on the conclusions that are drawn from this study that will address and close research gaps (including Team Gaps 1, 6, and 7 as well as inform BMed Gaps 1 and 2). Specifically, this study will examine how interdependent teams (such as those with members in the field and at home base) interact and perform tasks with and without delays in communications between the team elements. The tasks to be performed by the teams vary along two dimensions: 1) those that are either critical or not critical ("criticality") and 2) those that are either novel or familiar ("novelty"). Tasks will include variations in both dimensions as it is assumed that highly novel and highly critical tasks are similar to those that a team may encounter during a long duration mission in which they have no prior training but must address. The proposed study will involve the 3 USOS astronaut participants aboard the ISS during Increment 39/40, as well as the CAPCOMs and Flight Directors on duty during the 4 weeks of the increment during which data collection will take place. While this sample should be adequate to demonstrate feasibility of data collection and enable preliminary analyses of study hypotheses, 3-4 additional increments may be required to achieve sufficient power to test all study hypotheses. During the planned 180 days of Increment 39/40, participants will perform 16 tasks, 8 under conditions of no delay in communications, and 8 under conditions of a 10 minute one-way delay. Tasks will be designated by subject matter experts (SMEs) in collaboration with the Mission Operations directorate (MOD) for monitoring based on their level of novelty (high/low) and criticality (high/low).

Rationale for HRP Directed Research:

This research is directed because NASA must define complete scientific activities in a short time and there is insufficient time to issue a solicitation.

Research Impact/Earth Benefits:

- Delays in communications are technically feasible. Audiovisual records of performance under control and delayed conditions are available to provide objective measures of communication and performance. Obtaining post-task information from participants on mood and performance is also feasible.
- However, finding sufficient number of tasks that meet study criteria is a significant challenge to conducting such a study. Data collection will in all likelihood require more increments to achieve adequate sample size. Greater flexibility in study criteria and more time is required to educate potential study participants are needed.
- Study participants were in agreement as to importance of study and there was little difficulty with recruitment of participants. However, MCC concern about impact of study on certain operations, the Astronaut Office concern about astronaut willingness to provide certain types of information in standardized formats, and astronaut concerns about relevance of certain items on questionnaires represent important challenges to conducting a study of this nature. As a result, quantitative data on perceived stress and social support are lacking.
- Communications delay was associated with understanding what was communicated.
- Being understood by others was significantly associated with autonomy, individual and team performance and team well-being.

Task Progress:

- Total communications quality was associated with autonomy, team performance and well-being.
- Crew performance and well-being were associated with communications delay in low critical tasks.
- Autonomy was associated with crew and team performance and crew well-being, but did not mediate the relationship between communications delay and these outcomes.
- Post-flight interviews with astronauts revealed evidence of stress and frustration in completing tasks under conditions of communications delay due to difficulties in getting answers in a timely fashion with certain tasks (Cargo Ops, housekeeping) because it resulted in an additional delay in getting the information needed to complete the task, when one party does not understand and they have to ask questions. Participants also acknowledged impacts on task performance including delays in task completion and anticipated difficulties with completing certain tasks under conditions of communications delay. Behavioral changes that occurred included asking longer and more detailed questions, discussions with other crewmembers before making a call to Mission Control, more interaction between crewmembers because ground personnel could not be used as a crewmate, less interaction of ground would affect mood and feelings of camaraderie, and CAPCOM would slow down pace of communication and make more repeated calls. Other distractions included: location – communication more difficult in some parts of ISS than others, a condition referred to as 'Space brain' – affected comprehension and memory, and other crewmembers yelling down questions during calls.

Bibliography Type:

Description: (Last Updated: 11/13/2019)