Fiscal Year:	FY 2020	**Task Last Updated:**	FY 07/03/2021
PI Name:	Binsted, Kim Ph.D.		
Project Title:	Using Analog Missions to Develop Effective Team Composition Strategies for Long Duration Space Exploration		
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) **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:	96822-2217	**Congressional District:**	1
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2014-15 HERO NNJ14ZSA001N-Crew Health (FLAGSHIP & NSBRI)
Start Date:	07/01/2015	**End Date:**	07/01/2020
No. of Post Docs:		**No. of PhD Degrees:**	1
No. of PhD Candidates:	2	**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:			
Flight Assignment:	NOTE: Extended to 7/01/2020 per NSSC information (Ed., 1/29/2020) NOTE: Extended to 12/31/2019 per NSSC information (Ed., 7/23/19) NOTE: Extended to 7/31/2019 per J. Garrett/JSC (Ed., 12/21/18) NOTE: Extended to 12/31/2018 per NSSC information (Ed., 8/24/17) NOTE: Element change to Human Factors & Behavioral Performance; previously Behavioral Health & Performance (Ed., 1/17/17)		
Key Personnel Changes/Previous PI:			

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Grant/Contract No.:	NNX15AN05G
Performance Goal No.:	
Performance Goal Text:	
Task Description:	Astronaut crews for long-duration multi-national missions will endure many physical challenges and psychological stressors, some largely predictable in type and timing and others unpredictable. Crews are likely to be diverse with respect to educational background, skill set, ethnicity, gender, leadership/followership styles, etc., yet they must form a cohesive team, and continue to function together at a high level of objective performance and remain responsive to mission support over the duration of the mission. Crew cohesion will be more fragile at times of high stress and fatigue, yet those are the times when performance must be unimpaired if the crew is to succeed. Adding to the challenge, the pool from which crews must be selected may be significantly constrained by other factors, such as past radiation exposure. For these reasons, it is essential that we understand how best to compose and support crews for long-duration space missions, and that we develop a set of validated tools to this end. In order to enable and advance long duration human space exploration, we are investigating individual and crew characteristics that may affect crew function and performance, by measuring both characteristics and performance on a range of simulated missions in analog environments. Based on the correlations found, we will develop a predictive model of the relationship between crew composition and performance. We will validate and enhance this model via data collected on two 8-month Hawai'i Space Exploration Analog and Simulation (HI-SEAS) missions, and use the results to provide NASA with a set of tools to optimize its crew composition strategies. Ed. note December 2018: Project has been rescoped and the specific aims of the re-scoped study are: * Aim 1: Collect, develop, and verify a set of individual, dyad, and crew characteristics that are expected (based on past investigations) to be relevant to crew composition. * Aim 2: Identify correlations, if any, between those characteristics and crew function/performance, using data from a series of simulated missions of various lengths at analog sites. * Aim 3: Build a predictive model based on these correlations. * Aim 4: Validate that model over two eight-month simulated missions at the HI-SEAS analog. Ed. note: The second of these was disrupted in the second week of isolation, and was unable to be completed. For this reason, this grant was rescoped to include data from NNX13AM78G. * Aim 5: Develop a set of tools (e.g., rubric, implemented model, best practices) NASA can use to optimize crew composition.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The objective of this investigation is to provide data and recommendations to inform crew composition for long-duration space missions, and to enable the implementation of countermeasures for problems related to crew behavioral health and performance. This research addresses the following gaps, identified in the Human Research Roadmap : - Team Gap 101: We need to understand the key threats, indicators, and evolution of the team throughout its life cycle for shifting autonomy and interface with automation in increasingly earth independent, long duration exploration missions. - Team Gap 102: We need to identify a set of quantifiable and validated measures, based on 5-12 key indicators of mission-relevant and identified spaceflight acceptable thresholds (or ranges) of team function, to effectively monitor and measure team health and performance of integrated NASA and commercial/private crews, during shifting autonomy in increasingly Earth independent, long duration exploration missions. - Team Gap 103: We need to identify psychological and psychosocial factors, measures, and combinations thereof for use in selecting individuals and composing highly effective crews most likely to maintain team function during shifting autonomy in increasingly earth independent, long duration exploration missions. This research also addresses behavioral health and performance issues in similar situations on Earth (e.g., small groups isolated during a pandemic).

Task Progress:	Our goal in designing HI-SEAS (Hawaii Space Exploration Analog and Simulation) mission conditions is to mimic the surface-exploration phase of a long-duration space mission as closely as practical. Of course, there are many aspects of HI-SEAS that are low fidelity: we do not attempt to simulate microgravity or a thin atmosphere, for example. Our focus is on those aspects of a mission that are most relevant to our research questions. In particular: Isolation: HI-SEAS crewmembers do not have any in-person interactions outside the crew for the duration of the mission. Exchange of items (e.g., samples, food) is done via a resupply container, which is out of sight of the habitat. The only exception is for essential medical care that cannot be provided remotely. Communication: The time it takes for light to travel between Earth and Mars is between four and 24 minutes, depending on the relative positions of the planets. For this reason, all communications between HI-SEAS crewmembers and non-crewmembers are delayed by twenty minutes. In order to avoid confounding our duration-related sub-studies, we do not vary this latency over the course of the mission. This latency prevents the crew from having any real-time interactions with anyone else, or from using interactive websites. The only exception is for necessary functions (e.g., banking) that would typically be handled by a family member or assistant during a real mission. Resource utilization: Habitat sensors allow us to track the use of critical resources, most notably power and water. The primary source of power is solar energy, which is stored in a large battery bank. There is also a back-up propane generator, which is typically only used in case of unusual weather (e.g., a string of cloudy days) or a malfunction of some kind. Water is delivered approximately once a month. Crewmembers are restricted to eight minutes of shower time per person per week. Crews have shown a competitive streak in trying to reduce water use as much as possible. Food: All food is shelf-stable, and dried or freeze-dried food is preferred over canned food if available, to reduce mass. There is a small refrigerator for storing leftovers. The crew can grow food (typically leafy vegetables and sprouts), which makes more of a psychological than nutritional contribution to their diet. Food is resupplied every two months. EVAs (Extravehicular activities): Barring emergencies, the crew can only leave the habitat in an EVA suit under an EVA plan that has been approved by mission support. EVA suits are not true life-support equipment, but instead mimic the bulk, awkwardness, vision limitation, etc. of a real EVA suit. Mission Support: There are two tiers of mission support (aka ground control). Tier 1 is on duty from 8am to 8pm Hawaii time, and is staffed by volunteers from around the world. They approve routine requests, receive crew reports, provide news, research crew questions, and so on. Tier 2 is staffed by the research team, and is available 24/7 to respond to emergencies and to make decisions on issues not sufficiently defined in the mission rules. Medical/psychological care: Crews are monitored remotely by a physician and clinical psychologist for the duration of the mission. Care is provided remotely if possible, in person if necessary (very rarely). This team has the final say on whether it is necessary to remove a crewmember from the mission for their own safety. This has happened twice. Training/debrief periods: Crew arrive in Hawaii about one week prior to the start of their mission. During this time they are trained in mission protocols, and get a crash course in field geology. After the mission, they remain in state for a week of debriefing and post-mission research. The ability to select crewmembers to meet research needs and isolate them in a managed simulation performing under specific mission profiles makes HI-SEAS ideal for detailed studies in space-flight crew dynamics, behaviors, roles, and performance, especially for long-duration missions. As of September 2020, five long-duration missions (two four-month missions, two eight-month, and one twelve-month) have been completed at HI-SEAS. This report focusses on Missions 2-5. The resulting data encompass a total of 15.75 person-years of working and living in the HI-SEAS isolated and confined mission environment.
Bibliography Type:	Description: (Last Updated: 09/09/2022)
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