Fiscal Year:	FY 2023	**Task Last Updated:**	FY 03/29/2023
PI Name:	Flynn-Evans, Erin E. Ph.D.		
Project Title:	Assessing the Impact of Caffeine and Other Dietary Factors on Crew Performance and Sleep		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	erin.e.flynn-evans@nasa.gov	**Fax:**	FY
PI Organization Type:	NASA CENTER	**Phone:**	650-279-3459
Organization Name:	NASA Ames Research Center		
PI Address 1:	Fatigue Countermeasures Group		
PI Address 2:	Human Systems Integration Division, Code 262-4		
PI Web Page:			
City:	Moffett Field	**State:**	CA
Zip Code:	94035	**Congressional District:**	18
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	Directed Research
Start Date:	04/01/2023	**End Date:**	03/30/2024
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**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:**	
Contact Email:	alexandra.m.whitmire@nasa.gov		
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Smith, Scott Ph.D. (NASA Johnson Space Center) Zwart, Sara Ph.D. (NASA Johnson Space Center) Jansen, Rachel Ph.D. (NASA Ames Research Center) Glaros, Zachary M.S. (NASA Ames Research Center)		
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Statement of the Problem: Humans require 7-8 hours of sleep for adequate cognitive function and behavioral health. Chronic sleep deprivation is associated with progressive performance impairment with each day of insufficient sleep. Astronaut crews have historically averaged around 6 hours of sleep per night, especially during missions that required a high tempo work environment, confined spacecraft without crew quarters, and frequent sleep schedule changes. Each of these situations are likely to occur during Artemis and Mars missions. While such short sleep duration has been shown to reduce crew alertness and performance on the International Space Station (ISS), crewmembers typically perform better than average individuals when they are sleep deprived. It is possible that this better than average performance is due to resilience against the negative impacts of sleep loss. However, it is also possible that astronaut crews self-select countermeasures, such as caffeine, that compensate for the performance decrements that typically accompany sleep loss. Caffeine is the most widely used performance-enhancing drug on Earth. Astronaut crews have access to caffeine in the form of pills and liquid coffee. Numerous studies have confirmed the utility of caffeine as a countermeasure against the effects of sleepiness and neurobehavioral performance. For example, chronic low dose caffeine consumption (0.3 mg/kg/h) can sustain performance over 28 hours of sleep deprivation. While caffeine is clearly a potent countermeasure to improve alertness and performance on a variety of tasks, it also interferes with sleep. This leads to performance deficits on the following day, driving a cycle of caffeine use to counter the effects of caffeine-induced sleep disruption. There are few data available on the use of caffeine by astronauts during spaceflight. In post-flight interviews, 75% of astronauts reported use of alertness medications during their mission, including caffeine pills or modafinil and ISS crewmembers reported using caffeine on more than 90% of days before and during long duration missions, regardless of whether or not they were circadian misaligned. Habitual, rather than strategic, caffeine use and the presumably near-constant presence of such a powerful performance enhancing drug likely masks the true extent of sleepiness due to chronic sleep loss and circadian misalignment during spaceflight and analog missions. We therefore have little information on what would happen to sleepiness and performance in operational settings if caffeine became unavailable during a long-duration mission, and plan for that contingency. Current evidence suggests that the impact would be quite profound. Caffeine availability will be limited during future Artemis and Mars missions. For example, Orion will not have hot water, making liquid coffee unavailable as a countermeasure. Similarly, longer duration missions will be unlikely to have sufficient payload to provide crews continuous access to caffeine. As a result of these mission constraints, it is critical that we 1) determine the prevalence of caffeine use among crews, 2) characterize the impact of caffeine on performance, and 3) characterize the impact of caffeine on sleep. This information will provide us with an understanding of how caffeine is being used inflight to help guide countermeasure use in future missions. Specific Aims: 1) We will characterize the use of caffeine (frequency, timing, dose, proportion of caffeine users) among 21 crewmembers during ISS missions in order to determine how much caffeine would be required to maintain current use; 2) We will evaluate the impact of caffeine use on cognitive performance by comparing performance following caffeine ingestion to performance on days when no caffeine was consumed. We will make these comparisons both between and within individuals to determine how caffeine impacts performance. We will further evaluate whether cognitive dimensions are affected differentially by caffeine (e.g., better reaction time, but with increased impulsivity following caffeine use); 3) We will characterize the impact of caffeine use on sleep duration, latency, and wake after sleep onset on days when caffeine is consumed compared to days when no caffeine was consumed. We will further evaluate the impact of later timing of caffeine consumption on sleep outcomes; and 4) We will conduct exploratory analyses to evaluate links between other dietary factors on sleep, including intake of macronutrients, such as carbohydrates. Research Methods: No new data will be collected as part of this task. We will combine actigraphy, survey, and Cognition test battery data from the Standard Measures protocol with caffeine data from the Medical Evaluation Documents (MED) Volume B (MedB) ISS Food Intake Tracker (FIT) application.
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. The results of this directed task analysis are needed quickly to inform early Artemis missions.
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2023.
Bibliography Type:	Description: (Last Updated: 11/10/2020)