Fiscal Year:	FY 2018	**Task Last Updated:**	FY 03/29/2018
PI Name:	Dinges, David F. Ph.D.		
Project Title:	Psychomotor Vigilance Test (PVT) on ISS		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Behavior and performance		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) **BMed**:Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (2) **Sleep**:Risk of Performance Decrements and Adverse Health Outcomes Resulting from Sleep Loss, Circadian Desynchronization, and Work Overload		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	19104-4209	**Congressional District:**	2
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	Directed Research
Start Date:	08/01/2008	**End Date:**	12/31/2017
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 is now 12/31/2017 per K. Ohnesorge/JSC HRP (Ed., 3/9/17) NOTE: Element change to Human Factors & Behavioral Performance; previously Behavioral Health & Performance (Ed., 1/18/17) NOTE: End date is now 3/31/2017 per NSSC information (Ed., 5/5/14) NOTE: End date is now 7/31/2014 per PI (Ed., 5/3/2013) NOTE: start/end dates changed per J. Dardano/JSC --previously 4/30/2008-8/31/2013 (4/16/2009)		
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Basner, Mathias M.D., Ph.D. (University of Pennsylvania School of Medicine)		
Grant/Contract No.:	NNX08AY09G		
Performance Goal No.:			

Performance Goal Text:	
Task Description:	The Psychomotor Vigilance (PVT) Self Test (operational name on International Space Station (ISS) is Reaction Self Test (RST)) is intended to provide astronauts in spaceflight with objective feedback on neurobehavioral changes in vigilant attention, psychomotor speed, state stability, and impulsivity while on ISS missions, as well as recording their subjective ratings of workload, sleep timing and quality, tiredness, fatigue, and stress. The PVT Self Test is suited for repeated use in spaceflight because unlike other cognitive tests, it is very brief (less than 5 minutes) while being free of learning effects and aptitude differences that make interpretation of other cognitive measures difficult. Our initial Reaction Self Test study evaluated 24 astronauts, before, during, and after 6-month missions on the International Space Station (ISS). A total of 2,856 RST evaluations were obtained from 21 astronauts participating in 6-month ISS missions. To determine whether there were continuing changes in Reaction Self Test outcomes for ISS missions greater than 6-month duration, a study was conducted on the RST outcomes of N=2 participants in the initial 1-year mission (i.e., one US astronaut and one Russian cosmonaut). The following are the objectives (specific aims) of the project for the 1-year mission. The US astronaut and Russian cosmonaut were evaluated within the 1-year mission, and relative to data from the N=21 astronauts in 6-month missions. 1) Evaluate whether there were changes in sleep duration and/or sleep quality within the 1-year mission (i.e., first 6 months compared to the second 6 months of the 1-year mission), and differences in these outcomes between the 1-year and 6-month missions. 2) Evaluate whether there were changes in psychomotor speed, performance lapses, and premature responses on the Brief Psychomotor Vigilance Test (PVT-B) within the 1-year mission (i.e., first 6 months compared to the second 6 months of the 1-year mission), and differences in these outcomes between the 1-year and 6-month missions. 3) Evaluate whether there were changes in subjective ratings of sleepiness, fatigue, tiredness, physical exhaustion, workload, and stress within the 1-year mission (i.e., first 6 months compared to the second 6 months of the 1-year mission), and differences in these outcomes between the 1-year and 6-month missions. 4) To investigate changes in the intake of caffeine and medications within the 1-year mission (i.e., first 6 months compared to the second 6 months of the 1-year mission), and differences in these outcomes between the 1-year and 6-month missions.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The Principal Investigator (PI) developed the original 10-minute Psychomotor Vigilance Test (PVT), from which the Reaction Self Test was derived, to measure changes in psychomotor speed, lapses of attention, wake state instability, and impulsivity induced by fatigue and other performance-degrading factors commonly found in operational environments. Based on research supported by federal and non-US federal agencies, as well as the pharmaceutical industry, the 10-minute PVT has been extensively validated in laboratory studies, simulators, and operational environments to be sensitive to a variety of performance-degrading fatigue-related factors. There are currently more than 200 published peer-review papers on the sensitivity of the 10-min. PVT to fatigue-related factors. The Reaction Self Test is a 3-minute PVT Self Test that contains special timing and algorithm characteristics and that has been validated against the 10-minute PVT. The 3-minute Reaction Self Test will have utility in a wide array of safety-sensitive environments on Earth. Potentially any occupation in which alertness and fatigue management are essential to prevent errors on critical tasks will benefit from adaptations of the PVT SelfTest technology (e.g., certain military personnel, airport security screeners, physicians on night shifts and prolonged call).
Task Progress:	Data obtained from the RST project included: Time in Bed, Total Sleep Time, Poor Sleep Quality, Sleepiness, Tiredness, Fatigue, Physical Exhaustion, Stress, Workload, Caffeine Consumption, PVT Response Speed, PVT Lapses, PVT Premature Responses, and PVT Performance Score. No medications were reported by either astronaut. Linear mixed effect models with random subject effect were created using SAS version 9.3 and adjusted only for administration time (morning/evening). The five groups that were compared were: N=21 astronauts with valid data from the PVT on ISS 6-month mission, first 6 months of data from astronaut Y, second 6 months of data from astronaut Y, first 6 months of data from astronaut Z, and second 6 months of data from astronaut Z. Paired t-tests were used to compare the first and second 6-month periods for astronaut Y and to compare the first and second 6-month periods for astronaut Z. Independent t-tests were used to compare data from N=21 astronauts on the 6-month mission with the first and second 6-month periods for astronaut Y, and to compare data from N=21 astronauts from the 6-month mission with the first and second 6-month periods for astronaut Z. Astronaut Y had no significant changes from the first 6 months to the second 6 months in the following in-flight VAS scales: Time in Bed (TIB), Total Sleep Time (TST), Poor Sleep Quality, Sleepiness, Tiredness, Fatigue, Physical Exhaustion, and Workload. Astronaut Y did, however, have a significant increase in subjective Stress ratings from the first 6 months to the second 6 months in-flight. Relative to PVT-B performance, Astronaut Y had no significant changes from the first to the second 6 months of the 1-year mission in PVT Response Speed or PVT Premature Responses. However, Astronaut Y did have significantly more PVT Lapses in the second 6 months of the mission. Moreover, Astronaut Y had significantly more PVT Lapses in both six month periods of the 1-year mission relative to the N=21 astronauts who undertook 6-month ISS missions. Therefore, Astronaut Y had a lower overall PVT-B Performance Score than the N=21 astronauts from the 6-month mission. Astronaut Z had no significant changes from the first 6 months to the second 6 months in the following in-flight VAS scales: TST, Poor Sleep Quality, Tiredness, and Fatigue. Astronaut Z did, however, have a significant decrease in TIB, increase in Sleepiness, increase in Physical Exhaustion, decrease in Stress, increase in Workload, and decrease in Caffeine Consumption in the second 6 months relative to the first 6 months. Relative to PVT-B Performance, Astronaut Z had no significant changes from the first 6 months to the second 6 months of the 1-year mission in PVT Response Speed or PVT Premature Responses. However, Astronaut Z did have

	significantly less PVT Premature Responses in the second 6 months of the mission. Therefore, Astronaut Z had a significant increase in PVT Performance Score in the second 6 months relative to the first 6 months of the mission. The PVT-B Performance Score of Astronaut Y was more adversely affected by Slam shifts during the first 6 months of the mission than was PVT-B Performance of Astronaut Z.
Bibliography Type:	Description: (Last Updated: 04/24/2024)
Articles in Peer-reviewed Journals	Jones CW, Basner M, Mollicone DJ, Mott CM, Dinges DF. "Sleep deficiency in spaceflight is associated with degraded neurobehavioral functions and elevated stress in astronauts on six-month missions aboard the International Space Station." Sleep. 2022 Mar 14;45(3):zsac006. https://doi.org/10.1093/sleep/zsac006 ; PMID: 35023565; PMCID: PMC8919197 , Mar-2022