Fiscal Year:	FY 2009	**Task Last Updated:**	FY 05/30/2009
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:**	07/31/2013
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:	Shea, Cami1e	**Contact Phone:**	281-244-2017
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Flight Program:	ISS		
Flight Assignment:	ISS 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):			
Grant/Contract No.:	NNX08AY09G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The Psychomotor Vigilance (PVT) Self Test (operational name on ISS is Reaction Self Test) is intended to provide astronauts with objective feedback on neurobehavioral changes in vigilant attention, psychomotor speed, state stability, and impulsivity while on ISS missions. The PVT Self Test is ideal for repeated use in spaceflight because unlike other cognitive tests, it is very brief (3-minute) while being free of learning effects and aptitude differences that make interpretation of other cognitive measures difficult. The PVT Self Test on the International Space Station can aid astronauts to objectively identify when their performance capability is degraded by various fatigue-related conditions that can occur as a result of ISS operations and time in space (e.g., acute and chronic sleep restriction, sleep shifts, extravehicular activity [EVA], and residual sedation from sleep medications). The following are the objectives (specific aims) of the project: 1) To evaluate the extent to which PVT Self Test performance of astronauts is sensitive to fatigue from sleep loss and circadian disruption during ISS missions. This will include the following conditions evaluated individually and in aggregate: i) extended wake duration between 16 hours; ii) sleep restriction defined as total sleep time >0 and <6 hours per 24-hour period; and iii) circadian perturbation associated with night work and slam shifting. 2) To evaluate the extent to which PVT Self Test performance of astronauts is sensitive to fatigue from work intensity during ISS missions. This will include the following conditions evaluated individually and in aggregate: i) extend work durations up to 16 hours per day; ii) more than 6 consecutive work days without a day off for rest; and iii) work requiring extravehicular activity (EVA). 3) To evaluate the extent to which PVT Self Test performance of astronauts declines with time in mission. 4) To explore the extent to which PVT Self Test performance of astronauts will be sensitive to the carry-over effects of medications for sleep (e.g., zolpidem, ramelteon, etc.) on ISS. 5) To evaluate the extent to which PVT Self Test performance feedback (via a graphical interface) is perceived by ISS astronauts as a useful tool for assessing performance capability. This will be addressed throughout the mission by astronaut ratings.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The PI developed the original 10-minute Psychomotor Vigilance Test (PVT), which the Reaction Self Test was derived from, 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. The PVT SelfTest (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, etc.).
Task Progress:	During the current reporting period, we interacted with International Space Station Medical Project (ISSMP) personal to specify the system-level requirements for integrating experiment unique software into the Human Research Facility (HRF) computers and Station Support Computers (SSC). We completed internal quality assurance engineering documentation that specified the user requirements and system requirements for the PVT Self Test Software. We worked with ISSMP to identify data management procedures including data acquisition, storage, and transfer procedures to achieve a highly reliable and redundant experimental data acquisition plan. Unit-level system requirements testing related to data management procedures specifying expected functionality and input/output verification data was executed. We completed and received approval for the Experimental Document (ED) detailing data acquisition time points and protocol logistic for pre-flight, post-flight and in-flight study phases (approved 28 October 2008). To complete the user interface, a series of PVT Self Test interface prototypes were developed to rapidly evaluate design choices for the SelfTest feedback screens and user input. At each iterative design step, prototypes were presented to astronauts that participated in NEEMO 9, 12, 13 (N=6 astronauts participated in the design process). A beta version of the PVT SelfTest was developed with a full user interface and PVT metrics analysis algorithm. Unit-level system requirements testing of the user interface and PVT metrics analysis algorithm was conducted using a comprehensive test plan to verify that input/output data matched specified expected functionality. We completed the ISS Display and Graphics Commonality Standard (IDGCS) and the Payload Display Review Team (PDRT) review process that included multiple interface design iterations and documentation (approved 8 April 2009). We completed and received approval for the Version Description Document (VDD) that specifies software components as well as installation, configuration, operation, maintenance, update, and removal procedures (approved 16 March 2009). Comprehensive whole-system verification of the PVT SelfTest was performed by using an ISSMP IBM A31P laptop (replica of HRF laptop). The replica computer contained the same hardware and operating system build as the operational version on the ISS. Verification tests were performed according to a test plan containing tasks which will exercise the limits of performance of the PVT SelfTest software. The PVT Self Test software uses precise timing measurements in the response time measurement algorithm. Calibration of the system timing was conducted on the HRF replica to ensure timing precision. Additional testing conducted by NASA and ISSMP of the PVT SelfTest software on HRF and SSC computer systems resulted in additional iterations of the PVT SelfTest Software. We made Informed Consent Briefing (ICB) presentations to N=10 astronauts. Informed consent was provided by 6 astronauts and 4 consent forms are still pending as of this report submission. We provided Baseline Data Collection (BDC) familiarization sessions with 6 astronauts on the specific procedures to use the PVT SelfTest. We began baseline data acquisition on 6 astronauts.
Bibliography Type:	Description: (Last Updated: 04/24/2024)
Abstracts for Journals and Proceedings	Mollicone D, Basner M, Mott C, Ecker A, Dinges DF. "A Novel PVT Self-Test to Enhance Fatigue Mitigation Strategies in Space." Presented at the the Aerospace Medical Association's 80th Annual Scientific Meeting, Los Angeles, CA, May 4-7 2009. Aviation, Space, and Environmental Medicine 2009 Mar;80(3):224. , Mar-2009
Articles in Peer-reviewed Journals	Lim J, Dinges DF. "Sleep deprivation and vigilant attention." Annals of the New York Academy of Sciences, 2008;1129:305-22. http://dx.doi.org/10.1196/annals.1417.002 ; PubMed PMID: 18591490 (Molecular and Biophysical Mechanisms of Arousal, Alertness, and Attention) , Sep-2008

Awards	Dinges DF. "2009 Raymond F. Longacre Award for Outstanding Accomplishment in the Psychological and Psychiatric Aspects of Aerospace Medicine, Aerospace Medical Association, May 2009." May-2009