

Fiscal Year:	FY 2009	Task Last Updated:	FY 06/05/2009
PI Name:	Dinges, David F. Ph.D.		
Project Title:	Countermeasures for Performance Deficits from Sleep Loss and Workload in Space Flight		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Human Factors and Performance Team		
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) 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:	GROUND	Solicitation / Funding Source:	2007 Crew Health NNJ07ZSA002N
Start Date:	06/01/2008	End Date:	05/31/2012
No. of Post Docs:	0	No. of PhD Degrees:	0
No. of PhD Candidates:	1	No. of Master' Degrees:	0
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	9
No. of Bachelor's Candidates:	12	Monitoring Center:	NSBRI
Contact Monitor:	Contact Phone:		
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Banks, Siobhan (University of Pennsylvania Health System) Goel, Namni (University of Pennsylvania)		
Grant/Contract No.:	NCC 9-58-HFP01602		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	<p>In order to be able to carry out mission-critical tasks at any time during a mission, astronauts must maintain a high level of performance in the face of demanding workloads and work-rest schedules that result in chronic sleep restriction. The proposed research will use a laboratory-based study to acquire critically-needed information on the effects on performance of high cognitive workload and sleep restriction (Specific Aim 1). We will test the hypothesis that as sleep restriction accumulates, it will potentiate the performance-impairing effects of higher cognitive workload. Another key goal of the study is to provide astronauts with an objective way to identify performance changes and the need for countermeasures for fatigue from sleep restriction and high workload. To this end, the project will complete validation of the sensitivity of the 3-minute PVT SelfTest to high workload and sleep restriction. PVT SelfTest feedback interfaces will also be evaluated, and the task will be tested in analog operations to establish its technical feasibility (Specific Aim 2). Tertiary goals of the project include identification of biobehavioral predictors of differential vulnerability to the cognitive effects of sleep restriction and high workload (Specific Aim 3), and development of individualized biomathematical models that predict performance on the PVT SelfTest during high workload (Specific Aim 4). The project has primary relevance to strategic goals of the NSBRI Human Performance Factors, Sleep and Chronobiology (HPFSC) Team. It addresses a high priority gap identified by the NASA SAT, BHP, and NSBRI HPFSC area, and specifically targets questions 27e,d,f,g in Bioastronautics Roadmap Risk Area 27 (Human Performance Failure Due to Sleep Loss and Circadian Rhythm Problems), questions 26f,g,c,h in Risk Area 26 (Mismatch between Crew Cognitive Capabilities and Task Demands), and question 25d in Risk Area 25 (Human Performance Failure Due to Neurobehavioral Problems). To date N=20 (of the N=80 subjects needed) have completed the laboratory protocol. Data acquisition will continue at this rate in the coming year to ensure the projects end with the required number of subjects needed to evaluate the effects on performance of high cognitive workload and sleep restriction. Data are also being recorded on subjects in the 105-day Russian Chamber Study.</p>
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>The research builds on an extensive body of work we have conducted to help manage the cognitive performance of astronauts in space while they undergo high workload and sleep restriction. The acquisition of critically needed knowledge on how these factors potentiate fatigue effects on performance will help set standards and improve individualized mathematical models that predict countermeasure needs. The continued development of the PVT SelfTest will offer a tool by which astronauts can autonomously assess their performance fitness and make decisions about countermeasures. These deliverables will also have utility in a broad range of Earth-based applications in which sleep restriction and workload have major adverse impacts on human performance (e.g., transportation modes, power plants, military operations).</p>
Task Progress:	<p>The project is on schedule and the study is progressing well. N=20 healthy adults have completed the 11-day experimental protocol (for a total of 220 laboratory days) and we expect to recruit another 20 subject in the coming grant year. The PVT SelfTest is being deployed on ISS for astronaut data acquisition on its feedback utility.</p>
Bibliography Type:	Description: (Last Updated: 04/24/2024)
Articles in Peer-reviewed Journals	<p>Chee MW, Tan JC, Zheng H, Parimal S, Weissman DH, Zagorodnov V, Dinges DF. "Lapsing during sleep deprivation is associated with distributed changes in brain activation." J Neurosci. 2008 May 21;28(21):5519-28. PMID: 18495886, May-2008</p>
Articles in Peer-reviewed Journals	<p>McCauley P, Kalachev LV, Smith AD, Belenky G, Dinges DF, Van Dongen HP. "A new mathematical model for the homeostatic effects of sleep loss on neurobehavioral performance." J Theor Biol. 2009 Jan 21;256(2):227-39. PMID: 18938181, Jan-2009</p>
Articles in Peer-reviewed Journals	<p>Mollicone DJ, Van Dongen HP, Rogers NL, Dinges DF. "Response surface mapping of neurobehavioral performance: testing the feasibility of split sleep schedules for space operations." Acta Astronautica. 2008 Oct-Nov;63(7-10):833-40. PMID: 19194521 http://dx.doi.org/10.1016/j.actaastro.2007.12.005, Oct-2008</p>
Articles in Peer-reviewed Journals	<p>Basner M, Dinges DF. "Dubious bargain: Trading sleep for Leno and Letterman." Sleep. In press, 2009., Jun-2009</p>
Articles in Peer-reviewed Journals	<p>Lim J, Dinges DF. "Sleep deprivation and vigilant attention." Ann N Y Acad Sci. 2008;1129:305-22. PMID: 18591490, Oct-2008</p>
Articles in Peer-reviewed Journals	<p>Rogers NL, Dinges DF. "Interactions of chronic sleep restriction and circadian system in humans." J Sleep Res 2008 Dec;17(4):406-11. PMID: 19090952, Dec-2008</p>
Awards	<p>Dinges DF. "Raymond F. Longacre Award for Outstanding Accomplishment in the Psychological and Psychiatric Aspects of Aerospace Medicine, Aerospace Medical Association, Annual Meeting, Los Angeles, USA, May, 2009." May-2009</p>
Books/Book Chapters	<p>Dinges DF, Rogers NL. "The future of human intelligence: Enhancing cognitive capability in a 24/7 world." in "Extending Intelligence: Enhancement and New Constructs." Ed. P.C. Kyllonen, R.D. Roberts, L. Stankov. New York : Lawrence Erlbaum Associates, 2008, p. 407-430., May-2008</p>
Books/Book Chapters	<p>Ballas CA, Evans DL, Dinges DF. "Psychostimulants and wakefulness-promoting agents." in "Textbook of Psychopharmacology. 4th ed." Ed. A. F. Schatzberg, C. B. Nemeroff. Washington, D.C. : American Psychiatric Pub., 2009., May-2009</p>
Books/Book Chapters	<p>Ballas C, Dinges DF. "Stimulant and wake-promoting substances." in "Encyclopedia of Neuroscience." Ed. L. R. Squire. Boston, MA : Elsevier, 2009. p. 419-424. http://dx.doi.org/10.1016/B978-008045046-9.00051-6, Jan-2009</p>
Books/Book Chapters	<p>Minkel JD, Dinges DF. "Circadian Rhythms in Sleepiness, Alertness, and Performance." in "Encyclopedia of Neuroscience." Ed. L. R. Squire. Boston, MA : Elsevier, 2009. p. 965-970. http://dx.doi.org/10.1016/B978-008045046-9.01622-3, Jan-2009</p>

Books/Book Chapters

Minkel JD, Banks S, Dinges DF. "Sleep Deprivation: Neurobehavioral Changes." in "Encyclopedia of Neuroscience." Ed. L. R. Squire. Boston, MA : Elsevier, 2009. p. 997-1004. <http://dx.doi.org/10.1016/B978-008045046-9.00073-5> , Jan-2009