Fiscal Vear:	FY 2008	Task Last Undated:	FY 10/08/2008
PI Name	Dinges David F Ph D	Tush Lust opunteur	1110,00,2000
Project Title:	Countermeasures to Neurobehavioral Deficits from Cumulative Effects of Recovery Sleep Opportunities	e Sleep Deprivation Durin	g Space Flight: Dose-Response
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline Element/Subdiscipline:	NSBRIHuman Factors and Performance Team		
Joint Agency Name:	Т	echPort:	Yes
Human Research Program Elements:	(1) BHP :Behavioral Health & Performance (archival in 2017)		
Human Research Program Risks:	(1) Sleep:Risk of Performance Decrements and Adverse Health Desynchronization, and Work Overload	Outcomes Resulting from	n Sleep Loss, Circadian
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	dinges@pennmedicine.upenn.edu	Fax:	FY
PI Organization Type:	UNIVERSITY	Phone:	215-898-9949
Organization Name:	University of Pennsylvania		
PI Address 1:	Department of Psychiatry		
PI Address 2:	423 Service Dr., 1013 Blockley Hall		
PI Web Page:			
City:	Philadelphia	State:	PA
Zip Code:	19104-4209	Congressional District:	2
Comments:			
Project Type:	GROUND	Solicitation / Funding Source:	2003 Biomedical Research & Countermeasures 03-OBPR-04
Start Date:	06/01/2004	End Date:	05/31/2008
No. of Post Docs:	0	No. of PhD Degrees:	0
No. of PhD Candidates:	2	No. of Master' Degrees:	0
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	18
No. of Bachelor's Candidates:	41	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)		
Grant/Contract No.:	NCC 9-58-HPF00404		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	 (1) The overarching goal of this project is to develop sleep schedule countermeasures to ensure optimal neurocognitive performance capability in astronauts during prolonged space flight. The primary aim is to determine the sleep dose-response effects of an acute change in sleep duration that occurs between two periods of chronic sleep restriction on neurocognitive performance functions, subjective states, and waking and sleep physiology. The optimal performance of astronauts during extended-duration space flight depends heavily on achieving recovery through adequate sleep. There is now extensive evidence that astronaut sleep in space averages 4 to 6.5 hours per day, and when critical operations (e.g., nighttime docking) are scheduled, very little sleep may be obtained during a day prior to the critical event. Ground-based experiments on healthy adults by our laboratory and others have demonstrated that limiting daily sleep duration to less than 7 hours leads to cumulative deficits in neurocognitive performance and alertness. Within 1-2 weeks of sleep restriction at levels experienced by astronauts, performance deficits were serious; impairments on tasks requiring sustained attention, working memory and cognitive throughput reached levels equivalent to those found after 1-2 nights of total sleep loss. The experiment will determine the countermeasure benefits for performance (during critical operations and subsequent days of sleep restriction) from an acute increase in sleep duration (i.e., single night of recovery sleep). In addition, generating sleep dosc-response functions. We will establish sleep dosc-response curves for the immediate and delayed impact on neurobehavioral functions, and recovery sleep on eardroxacutar induces. (2) We are currently in the process of performing performance recovery sleep on estriction is possible within 2 nights. We will investigate the relationship between sleep physiology and performance responses. We will investigate the effects of chronic sleep restriction	
Rationale for HRP Directed Research:		
Research Impact/Earth Benefits:	The primary aim is to determine the sleep dose-response effects of an acute change in sleep duration that occurs between two periods of chronic sleep restriction, on neurocognitive performance functions, subjective states, and waking and sleep physiology. The experiment will determine the countermeasure benefits for performance (during critical operations and subsequent days of sleep restriction) from an acute increase in sleep duration (i.e., single night of recovery sleep). The knowledge gained has the potential to change work scheduling and further understand the effect of sleep lose and recovery on neurobehavioral function in many Earth-based safety-sensitive occupations, such as transportation workers (e.g., truck drivers, train conductors, airline pilots); operators in safety-sensitive industries (e.g., power plant control rooms); and military personnel.	
Task Progress:	Data collection is now complete. Seventy-two subjects completed the 16 day in-laboratory study protocol (for a total of 1152 laboratory days). We are currently in the process of performing analyses on the data collected. Specifically, we are analyzing the neurobehavioral performance changes across the experimental protocol, and the recovery phase. We are in the process of manual scoring and analysis of the polysomnographic and cardiovascular data. Preliminary data suggests that a single sleep period of 8h, 10h or 12h after 5 nights of 4h sleep, provides substantial acute recovery, but not protection against the immediate reappearance of performance deficits when it is followed by 5 additional nights of sleep restriction.	
Bibliography Type:	Description: (Last Updated: 04/24/2024)	
Abstracts for Journals and Proceedings	Avery N, Banks S, Dinges DF. "Change in psychomotor vigilance test lapses predicts change in digit-span memory performance during sleep restriction." Sleep 2007. 21st Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. Sleep. 2007;30 Suppl:A122. , Jun-2007	
Abstracts for Journals and Proceedings	Avinash D, Banks S, Van Dongen H, Dinges DF. "Slow wave dynamics during consecutive weeks of sleep restriction to 4 hours per day." Sleep 2007. 21st Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. Sleep. 2007;30 Suppl:A119. , Jun-2007	
Abstracts for Journals and Proceedings	Banks S, Bergamo C, Dinges DF. "Sleep restriction reduces heart rate variability." Sleep 2007. 21st Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. Sleep. 2007;30 Suppl:A31. , Jun-2007	
Abstracts for Journals and Proceedings	Banks S, Van Dongen H, Dinges DF. "Response to sleep restriction depends upon preexisting sleep debt." Sleep 2007. 21st Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. Sleep. 2007;30 Suppl:A119. , Jun-2007	

Abstracts for Journals and Proceedings	Caruso H, Banks S, Minkel J, Dinges DF. "Executive functioning following five nights of sleep restriction." Sleep 2007. 21st Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. Sleep. 2007;30 Suppl:A120. , Jun-2007
Abstracts for Journals and Proceedings	Erickson J, Banks S, Dinges DF. "Winscat test battery is partially sensitive to chronic sleep restriction." Sleep 2007. 21st Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. Sleep. 2007;30 Suppl:A124. , Jun-2007
Abstracts for Journals and Proceedings	Goel N, Lakhtman L, Basner M, Banks S, Dinges DF. "Neurobehavioral and cognitive differences during total versus partial sleep deprivation." Sleep 2007. 21st Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. Sleep. 2007;30 Suppl:A131., Jun-2007
Abstracts for Journals and Proceedings	Goel N, Lakhtman L, Basner M, Banks S, Dinges DF. "Phenotyping neurobehavioral and cognitive responses to partial sleep deprivation." Sleep 2007. 21st Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. Sleep. 2007;30 Suppl:A130-1., Jun-2007
Abstracts for Journals and Proceedings	Lakhtman L, Banks S, Goel N, Dinges DF. "Synthetic work performance following five nights of sleep restriction." Sleep 2007. 21st Annual Meeting of the Associated Professional Sleep Societies, Minneapolis, MN, June 9-14, 2007. Sleep. 2007;30 Suppl:A120. , Jun-2007
Articles in Peer-reviewed Journals	Banks S, Dinges DF. "Behavioral and physiological consequences of sleep restriction." J Clin Sleep Med. 2007 Aug 15;3(5):519-28. <u>PMID: 17803017</u> , Aug-2007
Awards	Dinges DF. "1st Place Computational Modeling Prize for paper on 'Understanding Decrements in Knowledge Access Resulting from Increased Fatigue', The Cognitive Science Society, July 2007." Jul-2007
Awards	Dinges DF. "Laurence R. Young Space Biomedical Research Award for contributions to human performance in space, April 2008." Apr-2008
Awards	Dinges DF. "NASA Distinguished Public Service Medal, July 2007." Jul-2007
Books/Book Chapters	Mallis MM, Banks S, Dinges DF. "Sleep and circadian control of neurobehavioral functions." in "Neuroergonomics : the brain at work." Ed. R. Parasuraman, M. Rizzo. Oxford ; New York : Oxford University Press, 2007. p. 207-220., Jul-2007