Fiscal Year:	FY 2012	**Task Last Updated:**	FY 10/23/2012
PI Name:	Klerman, Elizabeth B. M.D., Ph.D.		
Project Title:	Ultra-Short Light Pulses as Efficient Countermeasures for Circadian Misalignment and Objective Performance and Subjective Alertness Decrements		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Human Factors and Performance Team		
Joint Agency Name:		**TechPort:**	Yes
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		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	02115-5804	**Congressional District:**	8
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2011 Crew Health NNJ11ZSA002NA
Start Date:	08/01/2012	**End Date:**	07/31/2015
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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:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
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COI Name (Institution):	Lockley, Steven (Brigham And Women's Hospital, Inc.) Wang, Wei (Brigham And Women's Hospital, Inc.) Duda, Kevin (Charles Stark Draper Laboratory Inc.)		
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Task Description:	Lighting protocols have been recognized by NSBRI, NASA, and NIH as important countermeasures for circadian rhythm and sleep disruptions and their associated effects on performance and alertness for both crews in space and workers on Earth. The current light-based countermeasures involve one or more hours of bright light exposure. We have recently demonstrated significant circadian phase shifting with an ultra-short 2-minute bright light stimulus. The use of such a short duration stimulus as a countermeasure would significantly preserve the ability to work in the ISS lighting environment and reduce crew resource requirements. We propose to test the relative efficacy of both ultra-short and longer-duration light protocol countermeasures using the newly approved ISS lighting system to induce both adaptive circadian resetting and direct alerting effects. The inpatient experiments will involve healthy volunteers whose circadian rhythms and subjective and objective performance and alertness will be studied before, during and after 2-minute or longer exposures to ISS lighting modes. Objective alertness and performance measures will include the Psychomotor Vigilance Task, the Karolinska Drowsiness Test (an EEG-based measure of alertness), Slow Eye Movements (an EOG-based measure of alertness) and lunar lander simulator flight performance, an operational task-specific measure developed by NSBRI investigators. These studies will further our understanding of the physiologic mechanisms that mediate exposure-duration-dependent and wavelength-dependent effects of photic stimuli on circadian phase and performance. Furthermore, results from these experiments will be added to our validated mathematical models: (i) a model of the effects of light on the human circadian pacemaker, (ii) a linked model of effects of circadian phase and length-of-time awake on objective performance and subjective alertness; and (iii) a linked software application used for determining the optimal timing of light exposure to be employed as a countermeasure for poor performance and alertness as predicted by the other two mathematical models. The experimental and modeling results will have direct Earth-based applications for workers on early-rising, night or rotating schedules, as well as for people experiencing jet lag. The proposed work directly addresses one of the NSBRI NRA research objectives and two NASA Human Research Program IRP Risks. This proposal will also address other NSBRI goals: training of future scientists, collaboration among NSBRI investigators, and a combination of basic science with space-based applications and potential commercial applications. Our specific aims are to (1A) test the phase shifting effect of three different ISS lighting-based protocols compared with a dim light control: (i) continuous General Illumination mode during a 16-hr wake episode; (ii) continuous Phase Shift mode during a 6.5-hr time window centered in a 16-hr wake episode with General Illumination during the rest of the 16-hr wake episode; and (iii) multiple intermittent 2-minute Phase Shift mode exposures within a 6.5-hr time window centered in a 16-hr wake episode with General Illumination during the rest of the 6.5-hr window and during the rest of the 16-hr wake episode; (1B) quantify the relative phase-shifting efficacy of these different lighting conditions; (2) test the melatonin suppression effect of each of the different lighting protocols compared with the dim light control; (3) test the subjective and objective performance and alertness response to each of the different lighting protocols compared with the dim light control; and (4) amend our mathematical model of the effects of light on the human circadian pacemaker and the linked model of the effects of length of time awake and circadian phase on performance and alertness to include the circadian phase-shifting results, the measures from an operationally-relevant task and the direct alerting effects of light.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2012.
Bibliography Type:	Description: (Last Updated: 10/26/2023)