10+ 1 X7	EV 2017		EX 02/05/2010
Fiscal Year:	FY 2017	Task Last Updated:	FY 02/05/2018
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:	NSBRIHuman Factors and Performance Team		
Joint Agency Name:	ï	FechPort:	No
Human Research Program Elements:	(1) HFBP :Human Factors & Behavioral Performance (IRP R	lev H)	
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	ebklerman@hms.harvard.edu	Fax:	FY 617-732-4015
PI Organization Type:	UNIVERSITY	Phone:	617-732-8145
Organization Name:	Brigham and Women's Hospital/Harvard Medical Center		
PI Address 1:	Department of Medicine		
PI Address 2:	Division of Sleep Medicine		
PI Web Page:			
City:	Boston	State:	MA
Zip Code:	02115-5804	Congressional District:	8
Comments:			
Project Type:	Ground	Solicitation / Funding Source:	Directed Research
Start Date:	03/01/2016	End Date:	05/31/2017
No. of Post Docs:	1	No. of PhD Degrees:	0
No. of PhD Candidates:	0	No. of Master' Degrees:	1
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	0
No. of Bachelor's Candidates:	0	Monitoring Center:	NSBRI
Contact Monitor:		Contact Phone:	
Contact Email:			
Flight Program:			
Flight Assignment:	NOTE: End date changed to 5/31/2017 (original end date wa	s 2/28/2017) per NSBRI (Ed.,	, 3/2/17)
Key Personnel Changes/Previous PI:			
COI Name (Institution):			
Grant/Contract No.:	NCC 9-58-HFP00006		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	NOTE: Follow-on as a directed research project to Dr. Klerman's National Space Biomedical Research Institute project "Ultra-Short Light Pulses as Efficient Countermeasures for Circadian Misalignment and Objective Performance and Subjective Alertness Decrements"; project NCC 9-58-HFP02802. Both light and exercise are effective countermeasures for space and ground-based crews for circadian phase resetting, and both affect objective performance, subjective alertness, and sleep. Exercise is crucial for space-based crews for cardiovascular and bone health and those who exercise regularly show improved sleep quantity and quality. Exercise increases physiological arousal and can help promote alertness in the short-term. In previous studies, however, it is unclear to what extent exercise alone was responsible for phase shifting the circadian pacemaker or changes in alertness because subjects were exposed to light levels that are known to phase shift the human circadian pacemaker during the exercise. We tested the combined effects of these two countermeasures to determine whether adding exercise to light stimuli will further improve circadian phase resetting, objective performance, subjective alertness, and sleep. The one-year project included an 8-day inpatient protocol with 8 healthy participants. The protocol included a circadian phase delay, as occurs when traveling from Europe/ western Russia to the US. By combining two countermeasures already used by NASA – exercise and lighting – the results of these studies can be easily translated to operations by NASA on the International Space Station (ISS) or for ground based crews. If there are increased positive responses to the addition of exercise to lighting, then such schedules can be implemented on the ISS without additional equipment or devices. The experimental results will have direct Earth-based applications for workers on early-rising, night, or rotating schedules, as well as for people experincing jet lag. These studies will further our understa
Rationale for HRP Directed Research	:
Research Impact/Earth Benefits:	Light is the major environmental time cue that resets the circadian pacemaker in the mammalian hypothalamus. Light information is captured exclusively by the eyes using specialized cells containing a blue-light sensitive photopigment. Each day the light-dark cycle resets the internal clock, which in turn synchronizes the physiology, psychology, and behavior controlled by the clock. Failure to receive this light-dark information, as experienced for example by totally blind individuals, causes the circadian pacemaker to revert to its endogenous non-24-hour period and possibly become desynchronized from the 24-hour light-dark cycle. Exposure to irregular light-dark cycles, as experienced for example by psychiatric patients with irregular sleep-wake cycles, can also disrupt circadian rhythms. Light also suppresses the hormone melatonin and has a direct arousal effect on the brain, improving alertness and performance. This property of light can be useful as a non-pharmacological treatment in a number of conditions, and if timed appropriately, these direct alerting effects, to help maintain alertness at the correct time and subsequently improve sleep. Scheduled physical activity such as wheel running in hamsters and mice as well as exercise in humans has also been reported to influence the circadian levels, that it may facilitate circadian adaptation to shift work. In addition to exercise being used to shift the circadian phase, objective performance, subjective alertness, and sleep. The results of our experiments may be applicable to conditions such as jet lag, and shift-work or night-work. Millions of workers in the safety, security, transportation, healthcare, and industrial sectors are affected by these conditions such as jet lag, and shift-work or night-work. Millions of workers in the safety, security, transportation, healthcare, and industrial sectors are affected by these conditions safety officers). Attempting to sleep at adverse circadian phases is difficult, resulting in poor sleep efficiency. Similarly, a
Task Progress:	We began our recruitment efforts in May 2016 and we have successfully completed all planned studies. Twenty six participants were consented and screened of whom 9 qualified for the study. Eight participants (4 females) completed the protocol and one male participant was disempanelled due to pre-exisiting medical conditions that were not evident during screening. Ed. note: As this is a follow-on to Dr. Klerman's NSBRI project "Ultra-Short Light Pulses as Efficient Countermeasures for Circadian Misalignment and Objective Performance and Subjective Alertness Decrements"; project NCC 9-58-HFP02802, see that project's reports for publications resulting from this work.
Bibliography Type:	Description: (Last Updated: 06/25/2025)
Articles in Peer-reviewed Journals	Barger LK, Sullivan JP, Blackwell T, O'Brien CS, St Hilaire MA, Rahman SA, Phillips AJK, Qadri S, Wright KP, Segar JL, McGuire JK, Vitiello MV, de la Iglesia HO, Poynter SE, Yu PL, Zee P, Sanderson AL, Halbower AC, Lockley SW, Landrigan CP, Stone KL, Czeisler CA. "Effects on resident work hours, sleep duration and work experience in a Randomized Order Safety Trial Evaluating Resident-physician Schedules (ROSTERS)." Sleep. 2019 Aug 1;42(8):zsz110. <u>https://doi.org/10.1093/sleep/zsz110</u> ; PubMed <u>PMID: 31106381</u> ; PubMed Central <u>PMCID: PMC6685326</u> , Aug-2019