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Pi Name: McKinley, Richard Ph.D. Project Title: Effects of Transdermal Vagal Nerve Stimulation (IVNS) on Cognitive Performance Under Sleep Deprivation Siress Stroke Stock on Name: Human Research Program/Discipline- Element/Subdiscipline- Element/Subd	Fiscal Year:	FY 2020	Task Last Updated:	FY 02/10/2020
Division Name: Human Research Program/Discipline: Program/Discipline: Program/Discipline: Litement/Subdiscipline: Joint Agency Name: TechPort: No Human Research Program Elements: Ul HEPH-Human Factors & Behavioral Performance (IRP Rev II) Human Research Program Elements: Ul Human Research Program Risks: Ul Steps/Risk of Performance Decrements and Adverse Health Outcomes Resulting from Sleep Loss, Circadian Despatchment Despatchment Space Biology Element: None Space Biology Element: None Space Biology Special Category: None Space Biology Special Category: None Pl Email: Ichard meknlev Zérus afmul Fax: FY Organization Type: GOVERMENT Phone: 937-938-3598 Organization Type: United States Department of the Air Force Pl Address 1: Wright-Patterson Air Force Base Pl Address 2: 2510 5th St, Bidg 840 Pl Web Page: City: Wright Patterson Air Force Base Pl Address 2: 2510 5th St, Bidg 840 Pl Web Page: City: Wright Patterson Air Force Base Pl Address 3: OII Zip Code: 45433-7951 Congressional District: 10 Comments: Project Type: GROUND Solicitation / Funding Human Research Program: No. of Past Does: No. of Master' Candidates: No. of Master' Candidates: No. of Master' Degrees: No. of Master' Candidates: No. of Master' Degrees: No. of Master' Degrees: No. of Master' Candidates: No. of Master' Degrees: No. of Master' Degr	PI Name:	•		
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Human Research Program Risks: Space Biology Element: None Space Biology Special Category: None PI Email: richard mekinley 2@us.af.mil PI Email: richard mekinley 2@us.af.mil Fax: FY PI Organization Type: GOVERNMENT Organization Name: United States Department of the Air Force PI Address 1: Wright-Patterson Air Force Base PI Address 2: 2510 5th St, Bldg 840 PI Web Page: City: Wright Patterson Afb State: OH Comments: GROUND Solicitation / Funding Health and Performance (FI AGSHIP), Appendix A-Flagslip, Appendix A-Flagslip, Appendix A-Flagslip, Appendix B-Omnibus Start Date: 12/17/2019 Send Date: 12/17/2019 Send Date: No. of PhD Degrees: No. of Master' Degrees: No. of Master' S Candidates: No. of Master' Degrees: No. of Master' Candidates: No. of Bachelor's Candidates: No. of Bachelor's Candidates: No. of Bachelor's Candidates: No. of Master' Degrees: No. of Master' Degrees	Joint Agency Name:		TechPort:	No
Space Biology Element: None None Space Biology Cross-Element Discipline: None PI Email: pichard-mckinlev 2@ns. afmil Piny 1 Organization Name: United Sates Department of the Air Force PI Address 1: Wright-Patterson Air Force Base PI Address 2: 2510 5th St, Bidg 840 PI Weight Patterson Air Force Base PI Address 2: Wright Patterson Air Force Base PI Address 3: Wright Patterson Air Force Base PI Address 4: Wright Patterson Air Force Base PI Address 5: Wright Patterson Air Force Base PI Address 6: United Sates Department of the Air Force PI Address 1: Wright Patterson Air Force Base PI Address 2: 1510 5th St, Bidg 840 PI Weish Page: City: Wright Patterson Air Force Base PI Address 8: Wright Patterson Air Force Base PI Address 9: United Sates Department of the Air Force Wright Patterson Air Force Base PI Address 9: United Sates Department of the Air Force PI Address 1: Wright Patterson Air Force Base PI Address 1: Wright Patterson Air Force Base PI Address 2: 10 5th State: OH Comments: 2018 HERO 80/SC018/N0001-Crew Health and Performance (PLAGSHIP). Appendix B-Omnibus Source OMNIBUS Appendix A-Flagship, Appendix B-Omnibus Appendix B-Omnibus Start Date: 12/17/2019 End Date: 12/15/2020 No. of PhD Degrees: No. of PhD Degrees: No. of Master's Candidates: No. of Master' Degrees: No. of Master's Candidates: No. of Bachelor's Candidates: No. of Bachelor's Candidates: No. of Bachelor's Candidates: Whitmire, Alexandra Whitmire, Alexandra Organization Type: With Mining Alexandra Whitmire, Alexandra Organization Type: W	Human Research Program Elements:	(1) HFBP :Human Factors & Behavioral Performa	nce (IRP Rev H)	
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Objective: To evaluate the efficacy of transdermal vagal nerve stimulation (tVNS) to mitigate the effects of fatigue induced by sleep deprivation on aspects of cognition including attention, arousal, multitasking, and memory in populations of Department of Defense (DoD) subjects.

Primary Objective: Demonstrate a >20% improvement in at least one cognitive skill during sleep deprivation stress when compared to the control population.

Secondary Objective: Assess effects of tVNS on subjective mood.

Methods: This study will utilize a single factor, between subjects, double blinded experimental design. The factor will be "stimulation type" and will be tested at two levels: active and sham. Participants will be randomly assigned to one of two experimental groups (n=20 for each group). Group 1 will receive active tVNS on the skin over the left and right cervical vagus nerve (neck) at 25 Hz for 2 minutes on each side (with a 2 minute break in between) at 1800. Group 2 will receive sham tVNS at 1800 on both the left and right cervical vagus. The sham will be conducted with a separate sham tVNS device provided by the manufacturer. The sham provides similar sensations (e.g., vibrations) without providing stimulation of the nerve.

After consenting to participate in the study, participants will fill out the medical screening questionnaire. Two days prior to their scheduled experimental trial, participants will be given an activity wrist monitor and instructed that their daily schedules should include a minimum of seven hours of sleep per night between the hours of 2300 and 0600. Also during this time participants will receive training on all four performance tasks to be utilized in the study. Participants will be trained to asymptote on the performance tasks to guard against learning effects during experimental testing. Therefore, more training may be administered if necessary. Participants will also become familiarized with the subjective questionnaires at this time.

On the day of their experimental trial, participants will be required to awaken at 0600 and perform their daily activities as normal. They will be instructed to not consume any caffeine or central nervous system (CNS)-altering medications/substances on the experimental test day. Each participant will arrive at the test facility at 1530 hours. Upon arrival, their activity data will be analyzed to ensure that proper sleep cycles were maintained. Starting at 1600 hours, participants will complete one session of the vigilance task (30 mins), one session of the working memory task (20 mins), one session of the psychomotor vigilance test (PVT) task (10 mins), one session of the Multi-attribute task battery (MATB) task (20 mins), and fill out the Profile of Mood States-Brief (POMS-B), Visual Analogue Scale (VAS), and side–effects questionnaire. Afterwards, participants will then be provided a break of approximately 90 minutes where they can talk, watch TV, walk, read, or play video games. The second session will begin at 1900 hours. These procedures will be repeated every three hours with the final session occurring at 1600 the following day (36 hours continuous wakefulness). At 1900, participants will be given active or sham tVNS depending on their experimental group.

Impact: High levels of performance at all times is a requirement for success in both military and space exploration populations. Non-invasive vagal nerve stimulation has been shown to augment cognitive performance such as learning, memory retention, attention, and arousal. The results from this research will help determine the feasibility of tVNS to limit the effects of fatigue stress on NASA and military operators. While there is no substitute for adequate sleep, this may substantially reduce errors and attention lapses caused by increased fatigue when rest is not an option.

Rationale for HRP Directed Research:

Research Impact/Earth Benefits:

Impact: High levels of performance at all times is a requirement for success in both military and space exploration populations. Non-invasive vagal nerve stimulation has been shown to augment cognitive performance such as learning, memory retention, attention, and arousal. The results from this research will help determine the feasibility of tVNS to limit the effects of fatigue stress on NASA and military operators. While there is no substitute for adequate sleep, this may substantially reduce errors and attention lapses caused by increased fatigue when rest is not an option.

Task Progress:

New project for FY2020.

Bibliography Type:

Task Description:

Description: (Last Updated: 07/01/2021)