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| **Fiscal Year:** | FY 2022 | **Task Last Updated:** | FY 08/31/2022 |
| **PI Name:** | McLaughlin, Anne Ph.D. | | |
| **Project Title:** | Cognitive Aid Design Using Augmented Reality to Support Attention | | |
| **Division Name:** | Human Research | | |
| **Program/Discipline:** | | | |
| **Program/Discipline--Element/Subdiscipline:** | | | |
| **Joint Agency Name:** | | **TechPort:** | Yes |
| **Human Research Program Elements:** | (1) **HFBP**:Human Factors & Behavioral Performance (IRP Rev H) | | |
| **Human Research Program Risks:** | None | | |
| **Space Biology Element:** | None | | |
| **Space Biology Cross-Element Discipline:** | None | | |
| **Space Biology Special Category:** | None | | |
| **PI Email:** | anne_mclaughlin@ncsu.edu | **Fax:** | FY |
| **PI Organization Type:** | UNIVERSITY | **Phone:** | 919-513-2434 |
| **Organization Name:** | North Carolina State University | | |
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| **City:** | Raleigh | **State:** | NC |
| **Zip Code:** | 27695-7650 | **Congressional District:** | 4 |
| **Comments:** | | | |
| **Project Type:** | Ground | **Solicitation / Funding Source:** | 2019 HERO 80JSC019N0001-FLAGSHIP & OMNIBUS: Human Research Program Crew Health. Appendix A&B |
| **Start Date:** | 08/20/2020 | **End Date:** | 02/28/2023 |
| **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:** | 0 |
| **No. of Bachelor's Candidates:** | 0 | **Monitoring Center:** | NASA JSC |
| **Contact Monitor:** | Whitmire, Alexandra | **Contact Phone:** | |
| **Contact Email:** | alexandra.m.whitmire@nasa.gov | | |
| **Flight Program:** | | | |
| **Flight Assignment:** | NOTE: End date changed to 02/28/2023 per NSSC information (Ed., 8/25/22)<br>NOTE: End date changed to 08/19/2022 per L. Barnes-Moten/JSC and NSSC information (Ed., 8/2/21) | | |
| **Key Personnel Changes/Previous PI:** | No changes | | |
| **COI Name (Institution):** | Byrne, Vicky M.S. ( KBR/NASA Johnson Space Center )<br>Coleman, Maribeth Ph.D. ( Georgia Tech Research Corporation ) | | |
| **Grant/Contract No.:** | 80NSSC20K1715 | | |
| **Performance Goal No.:** | | | |
| **Performance Goal Text:** | | | |

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| **Task Description:** | We propose to research and develop a cognitive aid to support performance of rare tasks, tasks that cannot be trained at length prior to flight, and any task that would be adversely affected by distraction or attention overload. Many of these tasks are complex, occur in cramped or filled environments, and require detection of patterns, incorporation of feedback into the next steps of the task, and high focus of attention. A preliminary list of these tasks across the 12 phases of an expedition to Mars can be found in the 2018 NASA final report by Stuster, Adolf, Byrne, and Greene. Some previously developed cognitive aids have incorporated augmented reality elements (such as the NASA supported IDEAS (Integrated Display and Environmental Awareness System) and NASA Sidekick)). Cognitive aids with augmented reality elements support attention by adding to the environment: this includes alarms, screen movement, highlighting, and other attention-capture methods. We focus our study and development of novel augmented reality incorporated into a cognitive aid: de-emphasis of auditory and visual clutter and distractions. The term for this type of aid is Diminished Reality (DR). This form of aid targets the cognitive processes most likely to be affected by long-term spaceflight: difficulty focusing, inhibiting distractors, and locating spatial information crucial to the task. DR displays and interaction techniques will be developed by Human–computer interaction (HCI) researchers and graduate students in human factors psychology. Prototypes will be tested with human subjects on the complex task of setting up novel medical equipment, an appropriately complex task listed in the 2018 Mars Expedition Task List. An advanced prototype will be user-tested by space-knowledgeable individuals at Johnson Space Center. Deliverables will include a prototype of the aid and generalized principles and guidelines for future incorporation of de-emphasis augmentations into cognitive aids.<br>Stuster, J, Adolf J, Byrne V, Greene M. (2018). Human exploration of Mars: Preliminary lists of crew tasks. NASA/CR-2018-220043. https:// |
| **Rationale for HRP Directed Research:** | |
| **Research Impact/Earth Benefits:** | This work will benefit the field of psychology by adding to the literature on the impact of stressors, interruptions, and distractions on human performance of complex, novel tasks. This work will benefit the field of computing by investigating these effects in the new technology of "diminished reality" (DR). Similar to augmented reality, DR uses computers and displays to change the appearance of the physical world. In DR, this means by altering or removing objects or sounds. This alteration occurs with various diminishment methods, from outright erasure to desaturation to blurring or to semi-transparency. Auditory stimuli are treated similarly, ranging from silence to diminishment of volume or changes in the spatial nature of the audio. The outcomes of our research will be to inform the design of DR technologies so that they may support work in space or on the ground -- anywhere that diminishment of distraction is desirable. |
| **Task Progress:** | Progress was made in three key areas: protocol development, software development, and participant recruitment.<br>In the area of protocol development, we finalized the measures we planned to use in the experiments and studies. These were all put into electronic formats to allow for distance testing. The measures included tests of situational awareness and other questionnaires. We also developed the performance assessment protocol for when participants complete the ventilator assembly task in virtual reality (VR). Last, we finalized the protocol for experimenter interactions with participants during the study, both in their formal interactions and how the experimenter is allowed to react when implementing the "Wizard of Oz" control of the VR environment.<br><br>In the area of software development, we added flexible networking capabilities to the VR environment, created the experimenter interface to control interactions in the VR environment, and tested the methods of visual and auditory diminishment. We developed the automated counterbalance scheme for participants and tested all software on a variety of Android phones.<br><br>In the area of participant recruitment, we gained Institutional Review Board (IRB) approval for recruiting graduate students at North Carolina State University (NC State) and are in the process of gaining IRB approval to run participants associated with NASA Johnson Space Center (JSC) in Houston. |
| **Bibliography Type:** | Description: (Last Updated: 07/10/2023) |
| **Abstracts for Journals and Proceedings** | Murph I, Richardson K, McLaughlin AC. "Methods of training to overcome distraction via diminished reality." To be presented at the 66th International Annual Meeting of the Human Factors and Ergonomics Society, Atlanta, GA, October 10-14, 2022.<br>Abstracts. 66th International Annual Meeting of the Human Factors and Ergonomics Society, Atlanta, GA, October 10-14, 2022. , Oct-2022 |
| **Articles in Peer-reviewed Journals** | Richardson K, McLaughlin AC, McDonald M, Crowston A. "The effects of diminished reality on the detection of and response to notifications." Proceedings of the Human Factors and Ergonomics Society Annual Meeting. 2021 Nov 12;65(1):159-163. http://dx.doi.org/10.1177/1071181321651236 , Nov-2021 |
| **Articles in Peer-reviewed Journals** | Murph I, McDonald M, Richardson K, Wilkinson M, Robertson S, Karunakaran A, Gandy Coleman M, Byrne V, McLaughlin AC. "Diminishing reality: Potential benefits and risks." Proceedings of the Human Factors and Ergonomics Society Annual Meeting. 2021 Nov 12;65(1):164-8. http://dx.doi.org/10.1177/1071181321651103 , Nov-2021 |