INCREASING COGNITIVE ABILITY/RESERVE USING SOFTWARE – PILOT (ICARUS-PILOT)

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BACKGROUND

This research study was competitively awarded under the 2022 JSC Innovation Charge Account (ICA) program administered by NASA Johnson Space Center's Joint Technology Working Group. Study period of performance was May through September 2022, with a maximum allowed procurement budget of $10K. The study sought to quantify and assess the potential benefit of using commercial-off-the-shelf (COTS) cognitive training software to improve cognitive performance in an astronaut-like terrestrial population.

METHODS

Five volunteer research participants were recruited from the JSC employee population to mimic certain demographic characteristics of the NASA astronaut population (age, education/discipline). Participant cognitive performance was assessed before and after executing eighteen sessions of remote cognitive training executed nominally three times per week using six exercises within an adaptive app-based COTS software package (BrainHQ, Posit Science) on study-provided tablets. Pre- and post-training cognitive performance was measured using internal assessments in BrainHQ as well as Cognition Test Battery (CTB) version ISS B01 v3 (3.0.9-201710021500), an independent software test developed specifically for NASA and used currently in research studies on astronauts. BrainHQ exercises were posited to map well or partially to several CTB sub-tests. Participants provided feedback on their study experience formally via semi-structured interview at the conclusion of testing and informally throughout the study if they encountered issues.

RESULTS

The enrolled ICARUS-Pilot study participants generally matched Artemis crew demographic characteristics. Four of five participants have completed study training and assessment activities as of the writing of this abstract. These test participants complied well with desired training session frequency and duration yielding an average cumulative active training duration of 15 hours over an average of 45 days; participants showed 78% average improvement in metric performance for the six trained exercises, with an associated overall 33%ile ranking increase against performance of the entire BrainHQ subscribing population for internal pre/post assessment, agreeing with post-study survey self-reported performance increases. CTB overall feedback scoring, not corrected for learning effects, showed an average of 19% performance improvement across its 10 performance measures over the training period for the completed participants. Detailed analyses will be conducted once participant data collection for the study is complete and the resulting dataset is fully populated.

DISCUSSION

These preliminary results provide a positive trend for the effectiveness of the training approach, but further analysis will be needed to establish significance, investigate far transfer, and suggest the needed participant pool size for subsequent efforts to achieve statistically significant outcomes given similar results.

The pilot study has already been helpful by allowing the study team to learn a great deal about the capabilities and limitations of the COTS software package that will be reflected in future proposals along with revised timelines for study execution and test participant management. From participant feedback, one common thread regarding the COTS training was that it felt overly repetitive – future proposals should reassess overall training duration, available levels for each trained exercise, and the behavior of the BrainHQ internal scheduler in determining which exercises should be trained and for how long.

If the final analysis of this feasibility study ultimately supports it, the study team will recommend further investigation to fully evaluate this potential countermeasure and optimize its implementation. Future proposals would cite this feasibility study's outcome and would seek to refine the training protocol and obtain statistically significant results for cognitive performance increases as well as retention data.