The Effects of Long-Duration Spaceflight on Training Retention and Transfer

Human Research Program - Human Factors and Behavioral Performance

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ABSTRACT

Training our crew members for long duration, exploration-class missions will have to maximize long-term retention and transfer of the trained skills. The expected duration of the missions, our inability to predict all the possible tasks the crew will be called upon to perform, and the low training-to-mission time ratio require that the training be maximally effective such that the skills acquired during training will be retained and will be transferrable across a wide range of specific tasks that are different from the particular tasks used during training. However, to be able to design training that can achieve these ambitious goals, we must first understand the ways in which long-duration spaceflight affects training retention and transfer.

Current theories of training retention and transfer are largely based on experimental studies conducted at university laboratories using undergraduate students as participants. Furthermore, all such studies have been conducted on Earth. We do not know how well the results of these studies predict the performance of crew members. More specifically, we do not know how well the results of these studies predict the performance of crew members in space and especially during long-duration missions. To address this gap in our knowledge, the current on-going study seeks to test the null hypothesis that performance of university undergraduate students on Earth on training retention and transfer tests do in fact predict accurately the performance of crew members during long-duration spaceflights. To test this hypothesis, the study employs a single 16-month long experimental protocol with 3 different participant groups: undergraduate university students, crew members on the ground, and crew members in space. Results from this study will be presented upon its completion. This poster presents results of study trials of the two tasks used in this study: a data entry task and a mapping task.

By researching established training principles, by examining future needs, and by using current practices in spaceflight training as test beds, this research project is mitigating program risks and generating templates and requirements to meet future training needs.

Discussion

A typical high-risk, critical skill trained on the ground and refreshed onboard is cardiopulmonary resuscitation (CPR) (Figures 1 and 2). No data exists to determine how to support maximum retention of this skill, nor of how frequently this skill should be refreshed onboard. The fundamental research in this study is designed to provide data on training requirements that will support retention and transfer of trained skills and that apply not just to a single skill such as CPR but that apply across the entire training continuum (Figure 3) and across the breadth of crew training - from the medical emergency response shown here to system's emergencies, extravehicular activities, robotics operations, ascent/entry, maintenance, and repair.

Figure 1 (left). Photo JSC2010-E-107015 Courtesy of NASA. ISS crew members Satoshi Furukawa, Mike Fossum, and Sergey Volkov train on cardiopulmonary resuscitation (CPR) in a 1-G ground training facility, pushing down onto a dummy strapped onto the crew medical restraint system (CMRS), the gold-colored platform.

Figure 2 (right). Photo ISS034-E-005260 Courtesy of NASA. ISS crew member Oleg Novitskiy demonstrates one method of performing CPR in 0-G onboard the ISS by pushing off the ceiling with his feet and down onto the CMRS.

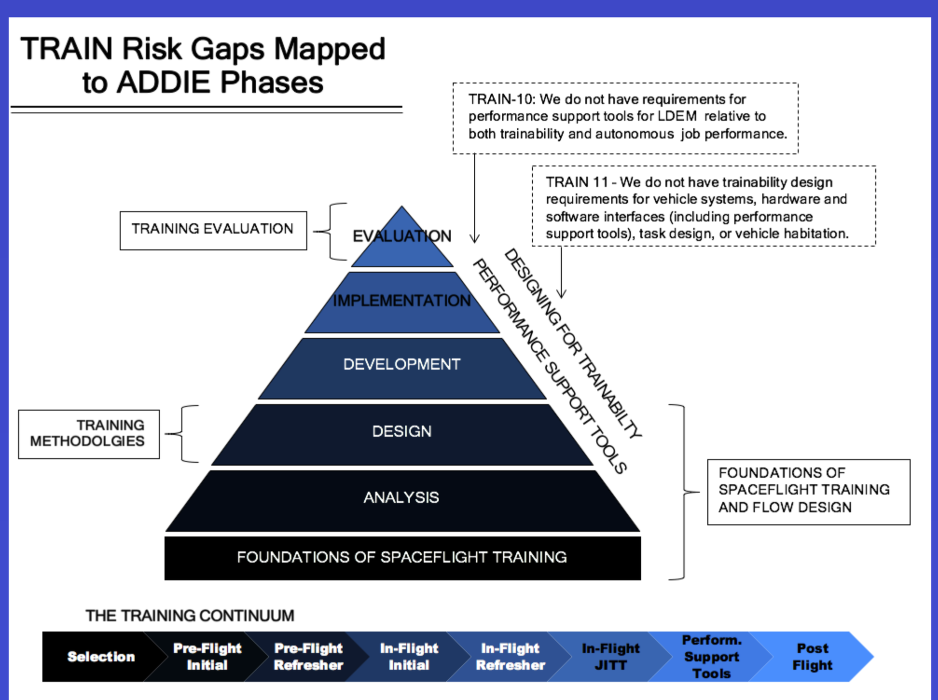
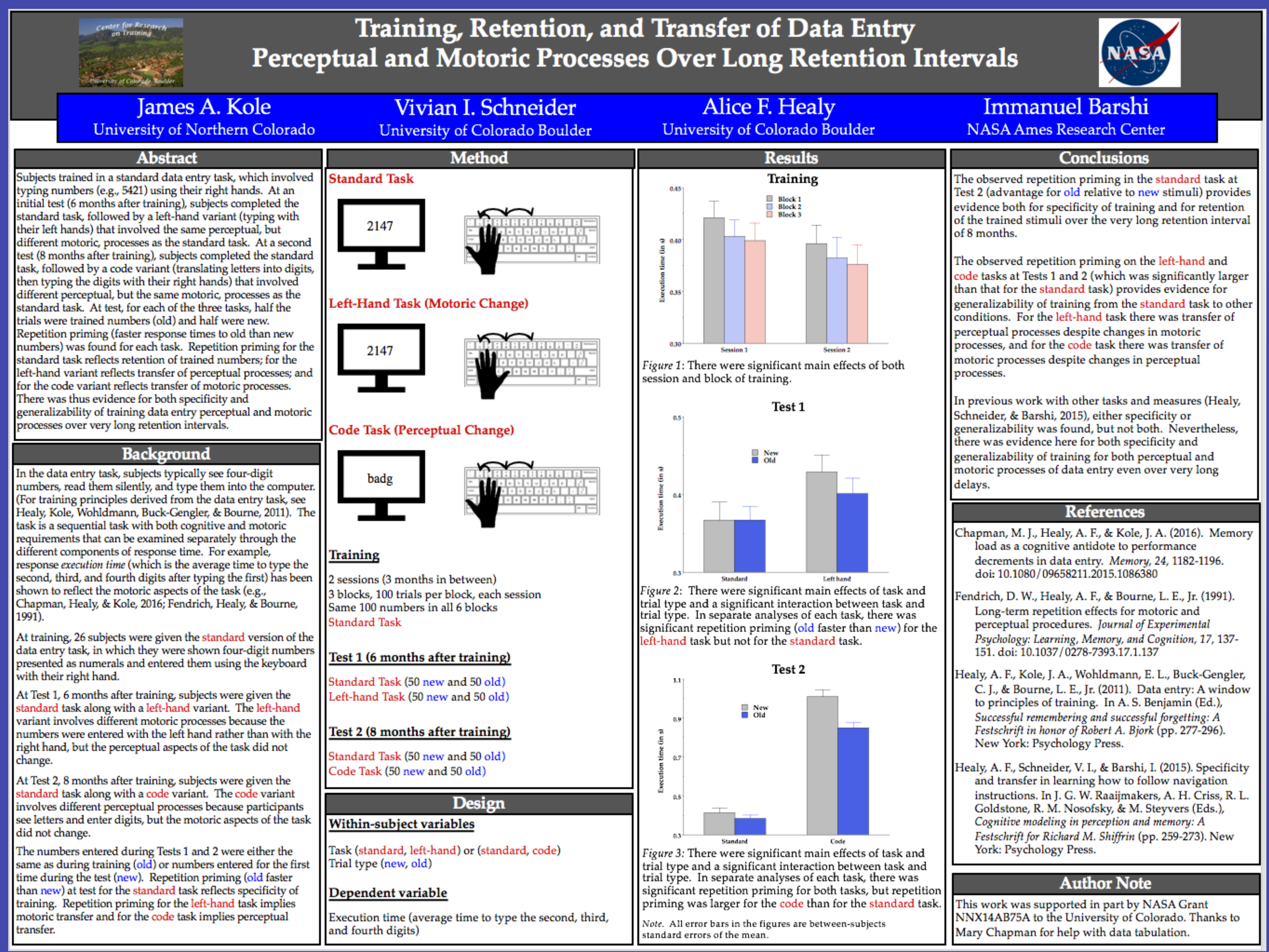
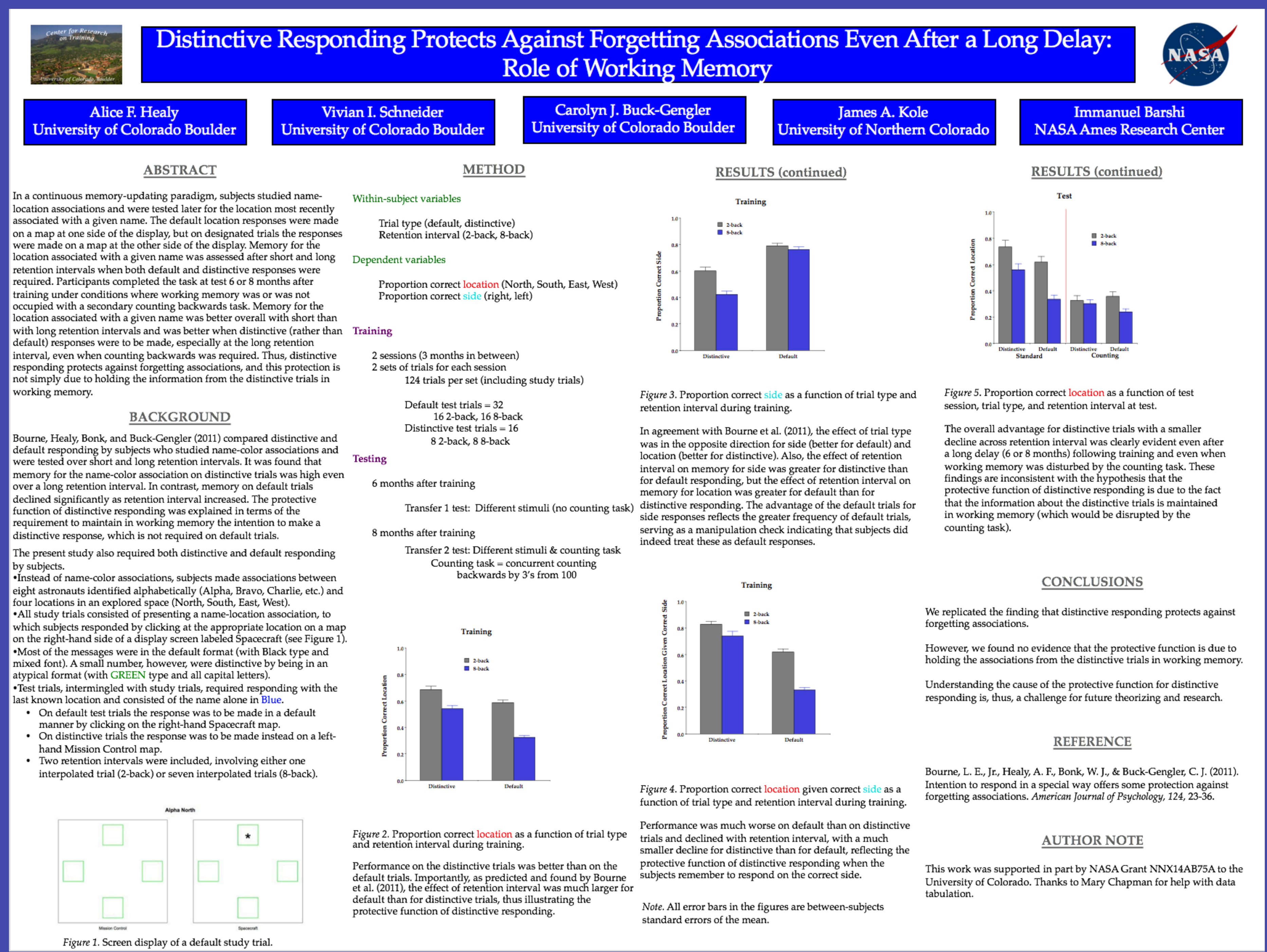


Figure 3. The Risk of Performance Errors Due to Training Deficiencies path to risk reduction aligns with the standard ADDIE (analysis, design, development, implementation, evaluation) model for training design used by NASA's Flight Operations Directorate. The research encompasses the entire training continuum.

Initial Results from University Student Subjects



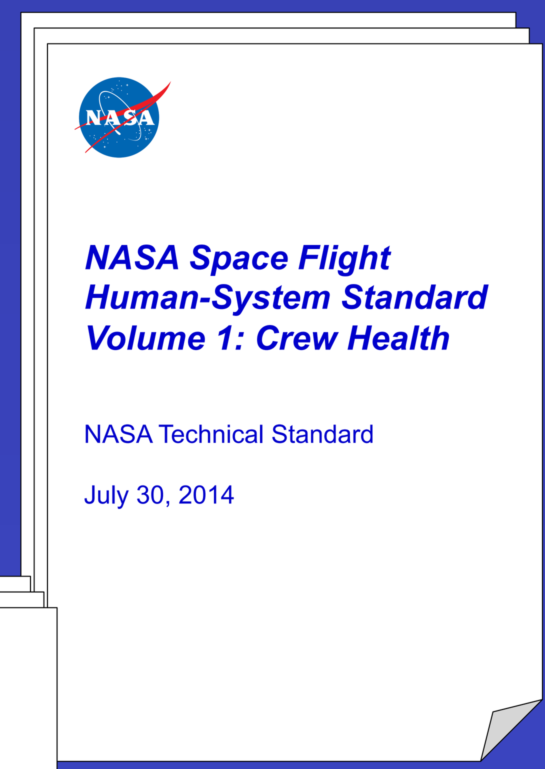


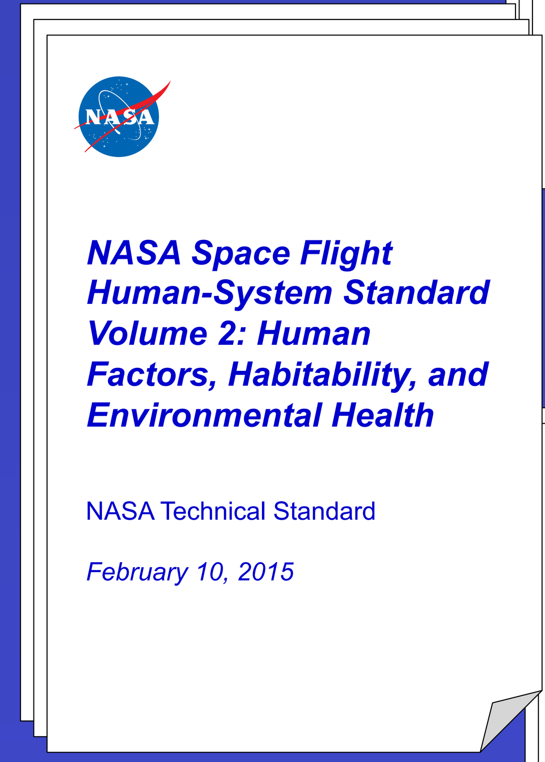
Current State:

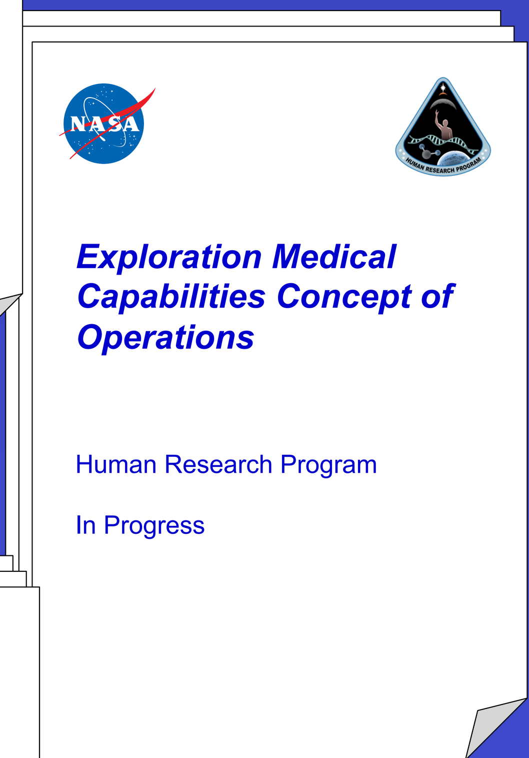
- The study with university students employing the 16-month long experimental protocol has completed data collection. Initial results from university student subjects are displayed in the two insert-posters here.
- *An identical study with crew members on the ground began this year (2018).*
- *An identical study with crew-like participants begins this year (2018).*
- *An identical study with crew members on board the ISS is pending.*

Implications:

Results from this study have direct implications to various NASA requirements and guidance documents such as the ones shown here.







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