

NxPCM Assessment for Virtual Reality Training

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Study Title: Virtual Reality Training: “Cybersickness” and Effects on Sensorimotor Functions

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Research Gaps

- Gaps associated with this study:
 - None – study was initiated prior to the development of the current knowledge gaps
 - Risk: Risk of Impaired Ability to Maintain Control of Vehicles and Other Complex Systems
- Recommended future studies or gap(s):
 - This study demonstrated the potential for the use of virtual reality environments as a training (pre-flight adaptive) tool and potential countermeasure to decrease Sensorimotor control problems seen during space flight. Although the project recognizes the potential for virtual reality (VR) as an adaptive tool, the overall necessity for such a tool may be of lesser priority than other research given the retirement of the Shuttle. Should HHC decide this area merits further research, we recommend a limited pilot study of 5-10 flight subjects that undergo VR adaptation pre-flight and then again be tested post flight to determine the actual microgravity benefit of using Virtual Reality training to mitigate space flight associated Sensorimotor control deficits.
 - No gaps are recommended to be opened or closed based on this study.

NxPCM Study Summary:

The Virtual Reality (VR) study evaluated the responses of 61 subjects (31 men, 30 women) to two experimental protocols. Experiment 1 was designed to test motion sickness and postural control effects while Experiment 2 evaluated motion sickness, gaze holding, and eye-head-hand coordination effects post VR training. The responses were evaluated using simulator sickness questionnaires (pre and post VR testing), posture testing, eye-head-hand coordination testing, and GAZE holding testing. The researchers determined that immediately following VR exposure subjects reported increase motion sickness symptoms as expected, but recovered rapidly. After repeated VR exposure, most subjects had less symptoms of motion sickness, meaning subjects were better able to adapt to transitions between environments with subsequent exposure. In addition, there was also a trend (not statistically significant) seen between genders where women

had larger decreases in postural stability immediately following exposure, but recovered more quickly to baseline than men. All subjects had decreases in postural stability following VR testing which correlates to the decreases seen in crewmembers post-flight. The evaluation of eye-head-hand coordination and GAZE following VR testing showed decreases in response compared to pre-test measures. Neither improved with subsequent testing, but the researchers feel this may be due to a lack of feedback given during the testing procedure. Overall, the use of VR testing presents a prospect for further evaluation subject to the priorities of the HHC Element.

Researcher's Summary from Final Report:

“Given the evidence for individual's ability to develop dual-adaptive sensorimotor control strategies for transitioning between a variety of altered sensory conditions, it is reasonable to suggest that similar sensorimotor dual-adaptation is possible for transitioning between virtual and normal environments. Implementing dual-adaptation protocols for regular VR users could minimize or eliminate the negative aftereffects of exposure to VR, making utilization of VR safer and more effective. Additionally, motion sickness and disruptions in sensorimotor functions following VR were similar to those observed following space flight, suggesting VR environments can serve as a useful analog for understanding the effects of space flight on Sensorimotor coordination. VR environments offer unique training opportunities, particularly for training astronauts to improve spatial orientation skills in complex space flight environments like the International Space Station, emergency egress training, and dual-adapting them to the novel sensory conditions of microgravity and facilitating rapid re-adaptation upon return to earth. Hence, VR environments may also be employed as a **countermeasure** for the disruptions in Sensorimotor control associated with space flight.”