VIRTUAL REALITY AS A MEDIUM FOR SENSORIMOTOR ADAPTATION TRAINING AND SPACEFLIGHT COUNTERMEASURES

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Astronauts experience a profound sensorimotor adaptation during transition to and from the microgravity environment of space. With the upcoming shift to extra-long duration missions (upwards of 1 year) aboard the International Space Station, the immediate risks to astronauts during these transitory periods become more important than ever to understand and prepare for. Recent advances in virtual reality technology enable everyday adoption of these tools for entertainment and use in training. Embedding an individual in a virtual environment (VE) allows the ability to change the perception of visual flow, elicit automatic motor behavior and produce sensorimotor adaptation, not unlike those required during long duration microgravity exposure. The overall goal of this study is to determine the feasibility of present head mounted display technology (HMD) to produce reliable visual flow information and the expected adaptation associated with virtual environment manipulation to be used in future sensorimotor adaptability countermeasures. To further understand the influence of visual flow on gait adaptation during treadmill walking, a series of discordant visual flow manipulations in a virtual environment are proposed. Six healthy participants (3 male and 3 female) will observe visual flow information via HMD (Oculus Rift DK2) while walking on an instrumented treadmill at their preferred walking speed. Participants will be immersed in a series of VE's resembling infinite hallways with different visual characteristics: an office hallway, a hallway with pillars and the hallway of a fictional spacecraft. Participants will perform three trials of 10 min. each, which include walking on the treadmill while receiving congruent or incongruent visual information via the HMD. In the first trial, participants will experience congruent visual information (baseline) where the hallway is perceived to move at the same rate as their walking speed. The final two trials will be randomized among participants where the hallway is perceived to move at either half (0.5x) or twice (2.0x) their preferred walking speed. Participants will remain on the treadmill between trials and will not be warned of the upcoming change to visual flow to minimize preparatory adjustments. Stride length, step frequency and dual-support time will be quantified during each trial. We hypothesize that participants will experience a rapid modification in gait performance during periods of adaptive change, expressed as a decrease in step length, an increase in step frequency and an increase in dual-support time, followed by a period of adaptation where these movement parameters will return to near-baseline levels. As stride length, step frequency and dual support times return to baseline values, an adaptation time constant will be derived to establish individual time-to-adapt (TTA). HMD technology represents a paradigm shift in sensorimotor adaptation training where gait adaptability can be stressed using off-the-shelf consumer products and minimal experimental equipment, allowing for greater training flexibility in astronaut and terrestrial applications alike.