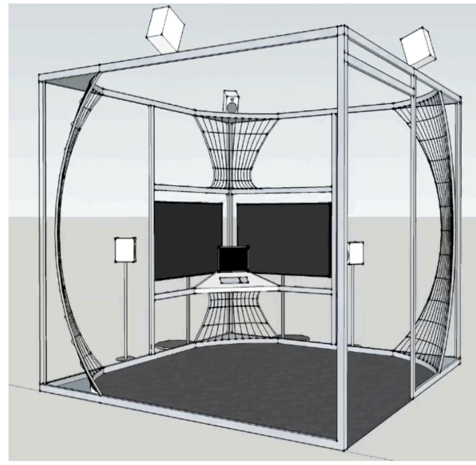
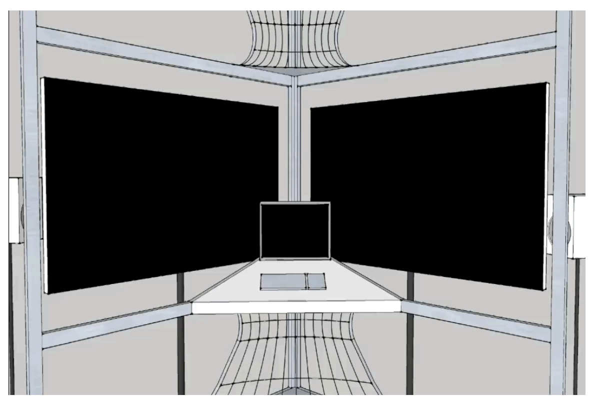
Virtual Space Lab and the first experiment



In the first experiment we employed a "Virtual Space Lab" (VSL) – a mixed reality environment that acted as an experimental testbed. A number of important limitations constrained the design and construction of the VSL. The VSL was constructed in a lab at the Institution of Simulation and Training at the University of Central Florida. It was obviously located on Earth and not moving relative to anything on Earth.

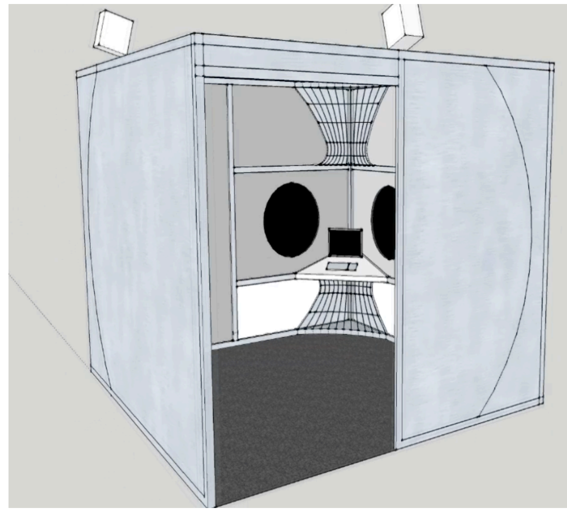
Weightlessness

One clear limitation was that we could not simulate weightlessness in any way that would not interfere with the visuals and the experimental requirements. This was not expected to be a problem for several reasons. First, reports contained in the astronauts' journals suggested that there was little explicit connection between weightlessness and the visual stimuli that generated the experiences in question. Weightlessness is an issue at the beginning of the space journey and is addressed in a pragmatic fashion with the main concern about movement and being able to control action. After a few days, these issues are resolved and there is not much discussion of weightlessness and, with one exception, any mention of weightlessness in connection with the visual experiences at the window. Second, we employed a seated workstation scenario that minimized the difference between the effects of zero-g and one-g. That is, being strapped into a workstation, as astronauts sometimes are, minimizes the different practical effects of zero-g and one-g. In such circumstances, the presence or absence of gravity makes little practical difference. It should be noted, however, that the implicit effects of weightlessness and vestibular modulations on the visual system could not be controlled. It is likely that does have some effect on visual experience simply because of cross-modal connections. Furthermore, there is some evidence that long-term weightlessness does have a negative effect on the visual system (Kramer et al. 2012; Mader et al. 2011). Such long-term effects manifest themselves only after several months in micro-gravity, however.



Earthbound

Another set of limitations involved the narrative (rather than physical) entry into and exit from the simulation. That is, participants knew that they were not leaving earth and that they would not really be in space. Yet, it was thought, a higher level of immersion in the simulation would depend on making the experience as convincing as possible, given certain physical and budgetary limitations. A launch sequence and landing sequence facilitated immersion in the narrative of being in space. Accordingly, we introduced convincing auditory effects to simulate launch – the loud and authentic sound of the space shuttle launch rockets that began after a vocal countdown and eventually cut off to silence, which signaled arrival in space. This was a simple solution that worked quite well, and a number of participants reported a degree of realism connected with the sound, vibrations, and a feeling that they were taking off. The landing sequence, which was less important, involved a series of radioed announcements.



Physical placement

The physical size and location of the VSL also required some problem solving involving lab space and noise levels. The interior of the VSL was modeled on a workstation on the ISS, which allowed access to a console of computer equipment and windows. In the VSL we wanted to limit any distraction from the window visuals, so we minimized the complexity of the console area and provided only a desktop computer monitor, kept completely dark during the time the windows were open, and a desktop mouse.

Workstation in the ISS.

Inside the VSL

Portal view of earth

Inside the VSL

Events in the first experiment

As each participant prepared for the experiment, a space-flight narrative was initiated, explaining that he or she would be involved in a simulated space flight. The narrative continued as the participant was "suited up" i.e., connected to the physiosiological and neurophysiological instruments with a detailed explanation of the devices (ECG, EEG, fNIR). Once the participant was connected, a 5-minute resting baseline was executed, requiring the participant to remain still and quiet while gazing at the blank monitor. The launch sequence then began ending with silence when the participant "escaped the earth's atmosphere." Then one of the two portals opened, presenting one of four dynamic space views. Each one lasted for 12 minutes.

a) Earth (including the image discussed above)
b) Deep space (stars and gassy formations)
c) Earth with object (the passing appearance the ISS)
d) Deep space with object (the passing appearance of the moon)

This was a 2 (Earth or Deep Space) x 2 (object or no object) mixed design with repeated measures on the first variable. Each participant received two experimental conditions in a counter-balanced order.

The astronaut texts indicate that experiences of AWCH occurred when viewing earth or deep space, but astronauts' missions occurred in different space vehicles, some of which allowed viewing of the ISS; others were in the ISS. The experimental design was intended to enable investigation of AWCH experiencers compared to AWCH non-experiencers by maximizing the opportunity to induce those experiences with different space views that map to those reported by astronauts.