Training commercial astronauts for spaceflight: Space motion sickness, disorientation, and altered force environments

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Summary
We have developed a protocol for several crucial aspects of commercial astronaut training. Our protocol includes, but is not limited to, training in motion sickness, spatial disorientation and spatial illusions awareness and adaptation; artificial gravity exposure and adaptation; and specific mission task preparation. Three categories of training protocol are being proposed, based on the needs of clients and launch providers.

Introduction
Prospective scientist-astronauts are training to operate research payloads as flight crew on upcoming suborbital spaceflights. Given the expense and importance of ensuring all payload objectives are met, these astronauts must maximize their physiological adaptability and mission task performance efficiency despite the potentially debilitating effects of microgravity.

Space motion sickness (MS) is a major impediment in flight [1]. Its adverse effects are particularly disruptive in the early stages of missions, before adaptation has taken place. Suborbital spaceflights will last only a few minutes, during which the majority of astronauts may become motion sick to the point of discomfort or worse [2]. Knowing one's MS sensitivity, recognizing one's own symptoms, and using non-pharmaceutical countermeasures can mean the difference between failure and success in operating a scientific payload.

Disorientation, movement errors, and spatial illusions constitute another set of challenges when operating in a microgravity environment [3,4,5,6]. Artificial gravity/rotating environments present their own challenges because of the unusual forces affecting bodies in motion [7]. Adaptation takes place over time with repeated exposure and movement, but the very process of acquisition of adaptation is not self-evident and requires training.

Training Protocol Overview
The AGSOL has 40-years of experience in studying human factors, spatial orientation, and space motion sickness in spaceflight and parabolic flight, as well as in a variety of altered gravity environments such as rotating rooms and motion platforms. With our A4H partners, we are developing classroom and practical training for research and payload tasks in the following three categories:

A. General spaceflight human factors and awareness training: 1-2 days long, this protocol will help participants acquire awareness of their MS and disorientation susceptibilities.
B. Expanded spaceflight preparation training: 1-2 weeks long, this protocol will help un-medicated participants acquire MS adaptation that could last up to several months.
C. Specific mission task preparation: Participants will be trained to execute tasks specific to their mission in environments mimicking spaceflight.

Conclusion
Other organizations offer excellent training in zero-gravity exposure, high-G centrifugation, high altitude (low oxygen) exposure, and survival training. However, no one currently offers training specifically targeted to mission task performance through motion sickness and disorientation adaptation. Implementation of this training protocol will ensure that private astronauts' flight preparation is comprehensive and maximizes the success of their research missions, comfort, and safety requirements.

References
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