

An Agenda for Sensorimotor Research in Sub-Orbital Flight

The excitement of space travel will be open to thousands of people by new commercial sub-orbital operations. Experience with changing g levels during space flight and parabolic flight suggests that sensorimotor disruptions are likely in these travelers, including postural stability, eye movements and motor coordination. We believe overcoming these sensorimotor disruptions will require a framework that delineates how approaches should differ from those applied to orbital flight and between sub-orbital passengers and pilots. For example, while most passengers are interested in maximizing enjoyment and flying only once, pilots are interested in maximizing precision and safety, and fly often. Strategies for overcoming disruptions include sensorimotor adaptation, re-adaptation, pre-adaptation, pharmaceuticals and cognitive training. Approaches should also account for differences in frequency of flights and mission objectives when selecting appropriate strategies.

Sensorimotor adaptation is one strategy for overcoming disruptions. However, for it to be effective in sub-orbital flight with periods of reduced and enhanced gravity lasting less than five minutes, it will have to occur quickly. We have performed experiments on sensorimotor adaptation during parabolic flight, in which we tested subjects over four consecutive days of flying. The reflex we tested, the pitch vestibulo-ocular reflex, took a few days during to overcome an initial disruption. This suggests that sensorimotor adaptation will be important for sub-orbital pilots, and that sub-orbital passengers may benefit from previous exposure to parabolic flight. This is supported by our previous work on context-specific adaptation, where we found that g-level dependent sensorimotor adaptation was retained for days and possibly months.

To improve comfort and safety during sub-orbital operations, we recommend using parabolic flight to pre-adapt sub-orbital passengers, and we recommend continued research in this area to understand the best timing for these flights, and the optimal set of tasks for passengers to conduct during altered g levels. We also recommend emphasizing recency of experience for sub-orbital pilots.