### [25] PHYSIOLOGICAL EFFECTS OF CENTRIFUGE-SIMULATED SUBORBITAL SPACEFLIGHT

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*(Original Research)*

**INTRODUCTION:** Evidence suggests that the +Gx and +Gz acceleration experienced during suborbital spaceflight launch and re-entry may have meaningful effects on respiratory and cardiovascular physiology. The specific acceleration profile experienced by occupants depends on several factors including the spacecraft and launch platform, the flight trajectory and seat orientation. The use of airline-style cabin pressurisation may further influence physiological effects. This study aimed to investigate the physiological effects of relevant suborbital G profiles in healthy volunteers across a wide range of ages. **METHODS:** The study included 24 participants aged 32-80 years. Three suborbital flight profiles were studied on a centrifuge: vertical rocket-launched capsule with supine seat; air-launched spaceplane with seat reclined supine for re-entry; and air-launched spaceplane seated upright for re-entry. Profiles were conducted breathing air and breathing 15% oxygen to simulate a cabin pressure altitude of 8,000 ft. Arterial oxygen saturation ($SpO_2$), ventilation, respiratory gases, ECG and blood pressure were measured continuously, and subjective data were captured by a symptom questionnaire. **RESULTS:** G exposures were well tolerated overall, although participants commonly reported experiencing short periods of breathlessness and 'unpleasant' chest heaviness at peak G. $SpO_2$ fell with all profiles during both launch and re-entry phases. On average, minimum $SpO_2$ for each profile and phase was 90-94% while breathing air and 84-88% while breathing 15% oxygen. However, there was wide variation between individuals and profiles, and a fifth of participants desaturated to $SpO_2 < 80\%$ at some point. The lowest recorded value for $SpO_2$ was 69%. **DISCUSSION:** Centrifuge-simulated suborbital launch and re-entry is associated with distinct physiological effects including a variable degree of transient hypoxaemia. These effects may warrant consideration as part of the approach to medical fitness standards and guidance for crew and for prospective passengers, especially those who are considered susceptible due to medical status or age. Actual suborbital flights include an intervening microgravity phase, and in-flight measurements are required to determine the additional effects of these dynamic high/zero/high-G profiles.

**Learning Objectives**

1. Understand how high-G acceleration varies across different suborbital launch and re-entry profiles, and how cabin pressure conditions may also vary across suborbital platforms.
2. Understand the physiological effects associated with suborbital G profiles when simulated on a centrifuge, and the effect of simultaneously simulating cabin pressure conditions.

### [26] AN OPERATIONAL SCALE MODEL SHORT-ARM HUMAN CENTRIFUGE AS A CUBESAT PAYLOAD

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*(Education - Tutorial/Review)*

**INTRODUCTION:** Microgravity has been studied as one of the influential factors affecting astronaut health during space travel. With plans of long-term spaceflights, and the Moon and Mars as the next steps in human deep space exploration, missions could span from a few days to months. This imposes a wide variation to mission architecture and planning for commercial enterprises and national agencies as the spacecraft need to be equipped to protect astronauts against the effects of prolonged durations in microgravity. In the extreme, these could lead to potentially life-threatening physiological responses inflight and during return to Earth or other large gravitational bodies. **TOPIC:** Our team at Simon Fraser University's Aerospace Physiology Laboratory is currently in the process of designing a compact short-arm human centrifuge designed to be installed in a variety of spacecraft, using a minimal space allocation. To more thoroughly test the centrifuge prototype, we have proposed to implement a miniature version of this device as the payload of a CubeSat, a classification of Nanosatellites. **APPLICATION:** The CubeSat would use a single reaction wheel as an analog for the centrifuge. The reaction wheel would be used in combination with a series of magnetorquers to learn about how to cancel the torque effects of the centrifuge in a power-efficient manner. Although the centrifuge will primarily produce torques in a single axis any variations in loading or vibrations in the motor will cause minor torques off-axis. These will need to be actively monitored and cancelled in order to prevent unwanted rotation of the spacecraft. Using the information from the in-orbit testing, we will incorporate modifications to our subject-run studies on Earth using our ground-based centrifuge. This will enable us to more thoroughly develop and study countermeasures for space applications and will result in a more in-depth understanding of human physiological responses to artificial gravity in a microgravity environment.

**Learning Objectives**

1. The participants will be able to understand the importance of modelling human physiology innovation prior to prototyping and running human performance research.
2. Participants will learn about scaled, on-orbit testing of aerospace physiology equipment and its importance in mitigating risk in human performance research.

***Monday, 05/23/2022*** ***2:00 PM***
***Tuscany F***

### [S-07]: PANEL: MEETING MENTAL HEALTH CHALLENGES IN AVIATION: THE ROLE OF EMPLOYEE SUPPORT GROUPS

*Sponsored by the AsMA Aviation Mental Health Working Group*

**Chair: Quay Snyder**
**Co-Chairs: Kris Belland, David Scroeder**



***PANEL OVERVIEW:*** *Mental health of aviation professionals is critical to safe operations and personal mental wellness. Barriers to seeking mental health assistance include aviation personality types, implications on medical certification for seeking help, lack of resources and work-related scheduling challenges among others. Studies show that although aviation workers have significant mental health stressors and varying levels of distress, relatively few seek professional help. The evolution of aviation peer support programs has removed many barriers to seeking mental health support. Peer support can be very effective in resolving many mental health issues that arise. This panel will explore the research in to the magnitude of mental health challenges in aviation professionals and establishment of programs to address these challenges. Programs include assistance with mental health professionals, those exclusively administered with peers, those utilizing union-based Employee Assistance Programs and military mental health programs.*

### [27] ROLES AND RESPONSIBILITIES OF PILOT SUPPORT GROUPS

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*(Education - Program/Process Review)*

**BACKGROUND:** Aviation is one of the operational settings where human factors and/or mental illness can impair mental acuity, performance,