

COE CST Sixth Annual Technical Meeting

Task 309: Assessment of Physiological Screening Requirements & Training Modalities for Repeated Exposures to Sustained High G Acceleration

James M. Vanderploeg, MD, MPH

Tarah L. Castleberry, DO, MPH

Rahul Suresh, MD, MS

Wilfredo Rodriguez-Jimenez, MD, MS

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Agenda

- Team Members
- Task Description
- Schedule
- Goals
- Results
- Conclusions and Future Work

Team Members

- PI – James Vanderploeg, MD, MPH
- Co-I – Tarah Castleberry, DO, MPH
- Students
 - James Pavela, MD
 - Wilfredo Rodriguez-Jimenez, MD, MS
- Organizations
 - NASTAR – Matching funds
 - UTMB
 - Virgin Galactic

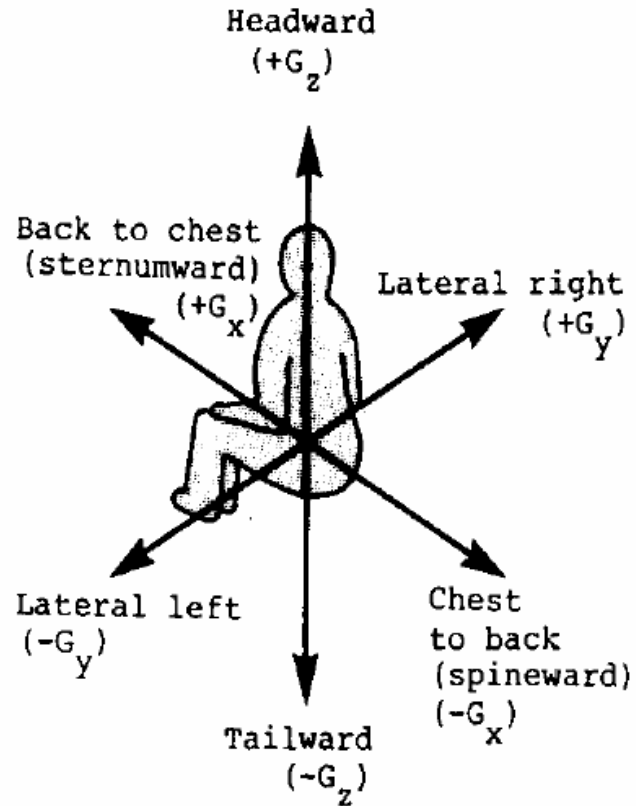
Task Description

- Repeated exposure of the crew to sustained high +Gx and +Gz acceleration in demanding spaceflight profiles is a new and untested paradigm. Identifying the unique physiological challenges, screening and training techniques will enable spaceflight operators to ensure safe operations.

Task Description

- Evaluate:
 1. Physiological responses to repeated exposures to sustained high G acceleration
 2. Effects of training for suborbital spaceflight
- Particular interest in:
 1. Sustained +Gx during launch
 - a. Performance effect?
 - b. Fatigue with repeated exposures?
 2. Response to +Gz exposure after a period of weightlessness
 - a. Is there increased risk of GLOC? (similar to push-pull?)
 - b. Does training improve responses? To what extent?
 - c. Is there fatigue or improved tolerance with repeated exposures?

Acceleration forces



Direction of accelerative force

Vertical

Headward - Eyeballs-down

Tailward - Eyeballs-up

Transverse

Lateral right - Eyeballs-left

Lateral left - Eyeballs-right

Back to chest - Eyeballs-in

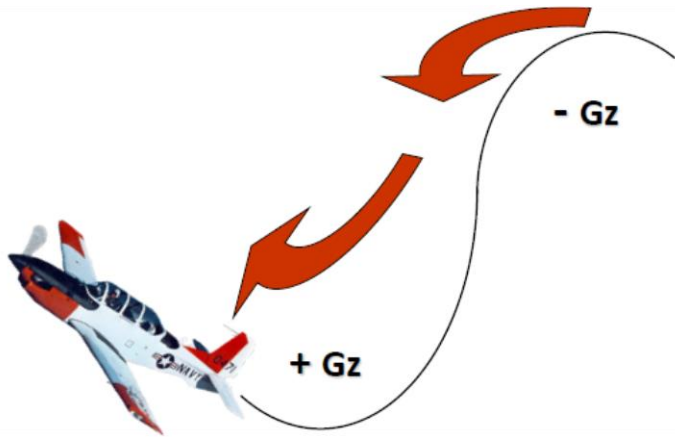
Chest to back - Eyeballs-out

Note:

The accelerative force on the body acts in the same direction as the arrows.

What is known about effects of G?

Gz



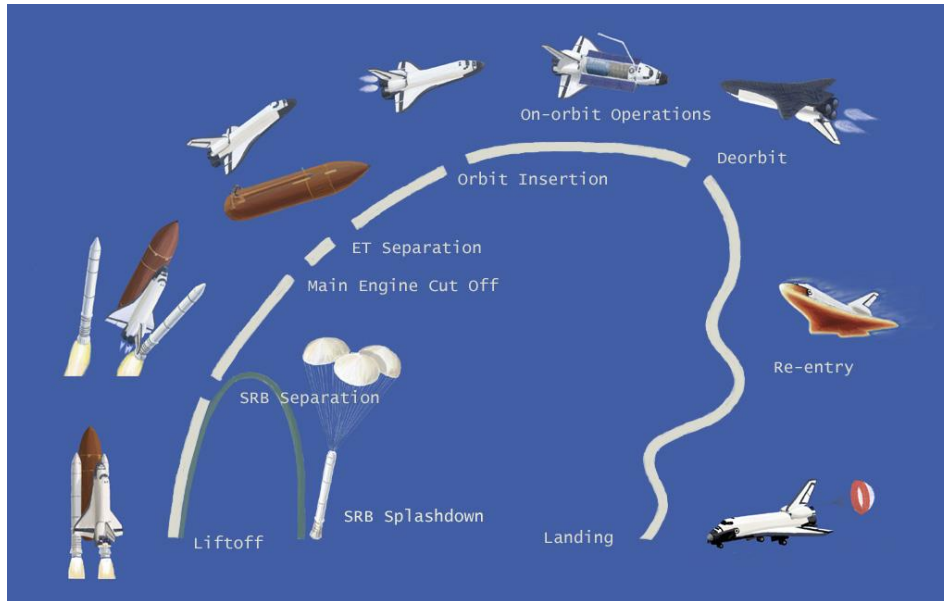
Push-Pull phenomenon =
Decreased tolerance to +Gz after
-Gz exposure

Gx



+Gx with launch profiles –
vibration & +Gx affects
ability to reach
controls/switches

Other knowns

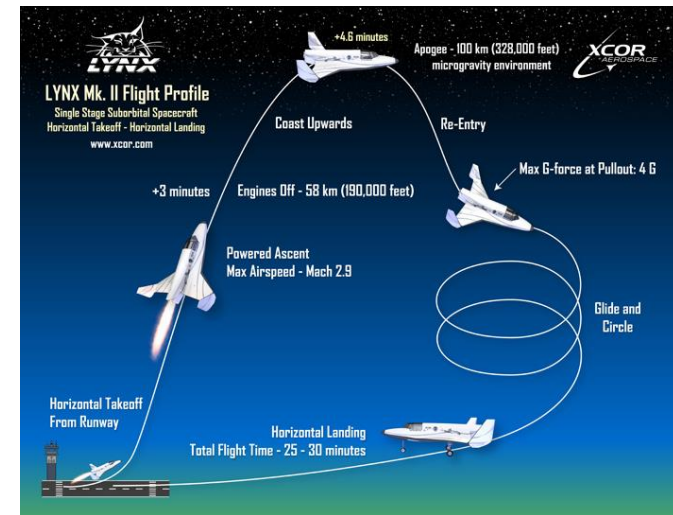
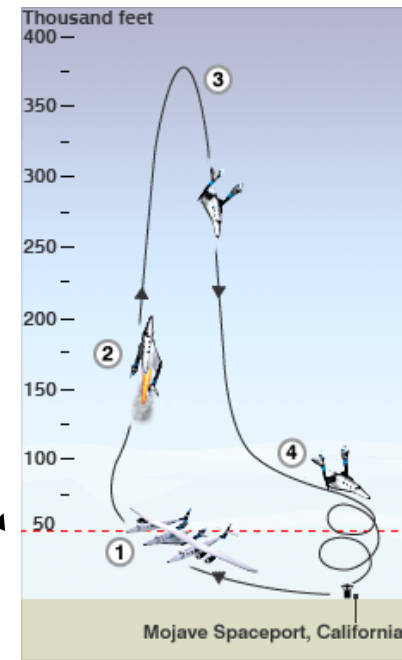


Orbital flight in Shuttle
 ~+3Gx on launch, <+1.5Gz on re-entry;
 decreased G tolerance & orthostatic intolerance
 after sustained weightlessness

Unknown:

- Response after short period of weightlessness
- Repeated exposures

Suborbital flights
 +3-4 Gx on launch
 +4-6 Gz on re-entry



New studies...



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Analog environments & Training



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Goals

- Compare pilot performance and physiological response in aerobatic flights, centrifuge acceleration profiles, and actual spaceflight.
- Develop recommendations for pilot training and medical screening.

- **Relevance to Commercial Space Industry**
 - Data collection and documentation of affects of repeated flights
 - Identification of best training & screening practices

Schedule

- Multiyear project
 - Beginning with data collection on pilots in centrifuge and in aerobatic training aircraft in Fall 2016
 - Plan for data collection on pilots during suborbital spaceflights in 2017 and 2018

Results

- Pending

Conclusions and Future Work

- Pending
- Future – data collection on spaceflight participants

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Project At-A-Glance

- University: The University of Texas Medical Branch
- Principal Investigator: James Vanderploeg, MD
- Co-Investigator: Tarah Castleberry, DO
- Residents: James Pavela, MD; Wilfredo Rodriguez-Jimenez

Relevance to Commercial Spaceflight Industry

- Repeated exposure of the crew to sustained high +Gx and +Gz acceleration in highly demanding spaceflight profiles is a new and untested paradigm. Identifying the unique physiological challenges, screening and training techniques will enable spaceflight operators to ensure safe operations.

Statement of Work

- Compare pilot performance and physiological response in aerobatic flights, centrifuge acceleration profiles, and actual spaceflight.
- Develop recommendations for pilot training and medical screening.



Status

- Collect data on pilots in centrifuge-simulated suborbital flight and aerobatic flight Fall 2016/Spring 2017

Future Work

- Recruit pilots for research study
- Conduct physiological monitoring during spaceflights in 2017/2018