

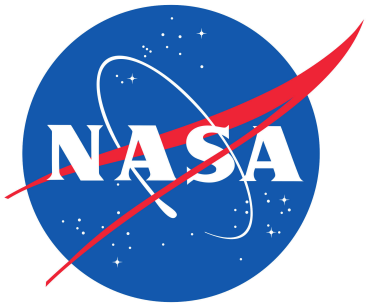
Effects of altered gravity on the central nervous system of *Drosophila melanogaster*

Siddhita Mhatre

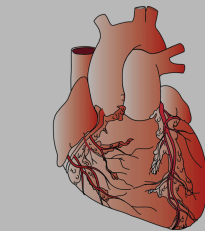
Janani Iyer

Bhattacharya Lab

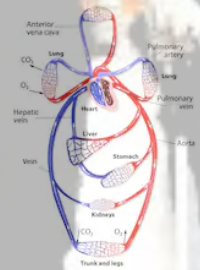
NASA Ames Research Center



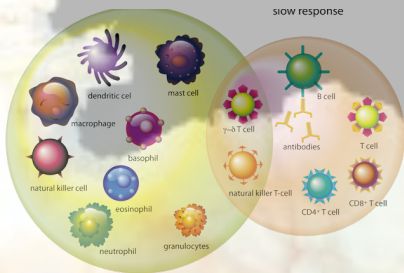
Physiological response to spaceflight



Cardiovascular deconditioning



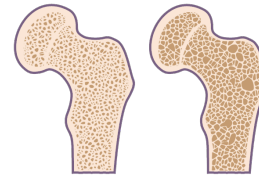
Fluidic shift



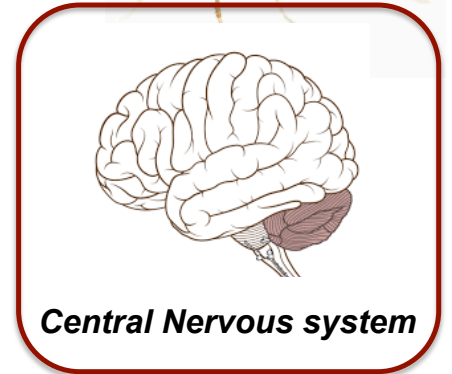
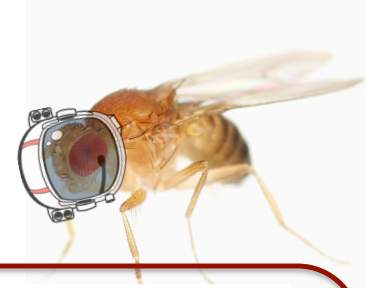
Maladaptive immune system



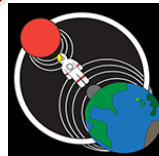
Muscle atrophy



Bone loss



Central Nervous system



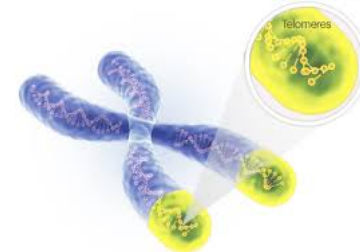
Microgravity (Lack of gravity)



Radiation



Social Isolation



Genetic changes - Telomeres

Multi-use Variable-g Platform (MVP) Validation



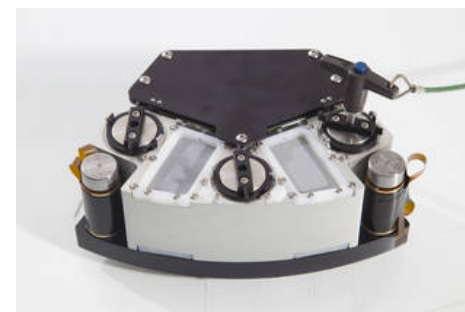
MVP-Fly-01 experiment on SpaceX CRS-14:

Launched on: 4/2/18

Returned on: 5/5/18 (33 days)

Ground control dates: 5/27/18 – 6/29/18

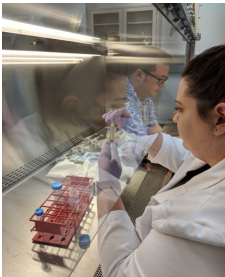
- Optimized for life/physical science research in microgravity
- 2 independent centrifuges (each can spin up to 2g)
- Controls temperature, relative humidity
- Cycles fresh cabin air into habitat
- Telemetry/real-time video & other data; ground commanding
- Reusable/reconfigurable MVP facility
- Up to 12 simultaneous experiment modules



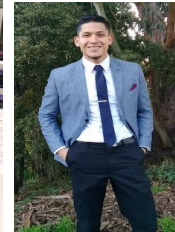
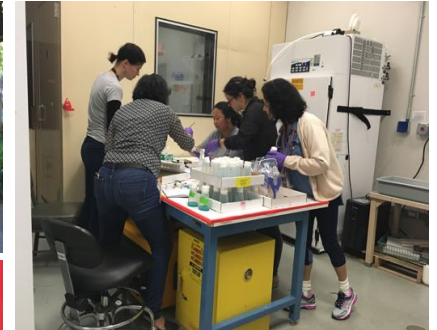
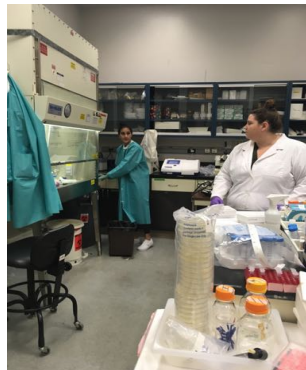
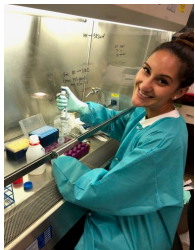
Credits: Techshot Inc.



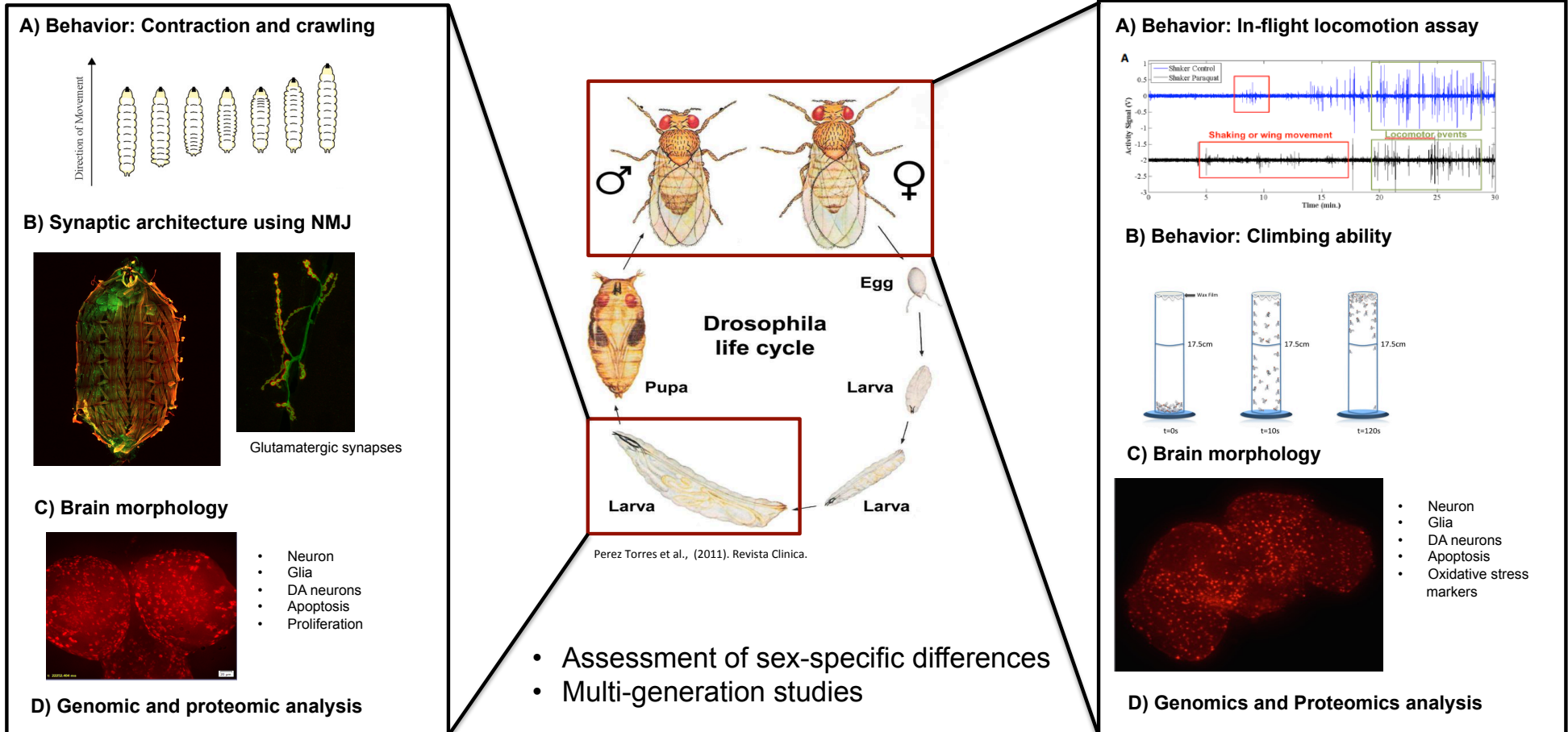
LARGE SAMPLE NUMBERS RETRIEVED POST-FLIGHT



- 1,160 total Micro-g adult flies: 506 males, 654 females
- 1,076 total Space 1g adult flies: 517 males, 559 females
(+ thousands more larvae and eggs in each case)
- 883 total asynchronous ground flies: 362 males, 521 females

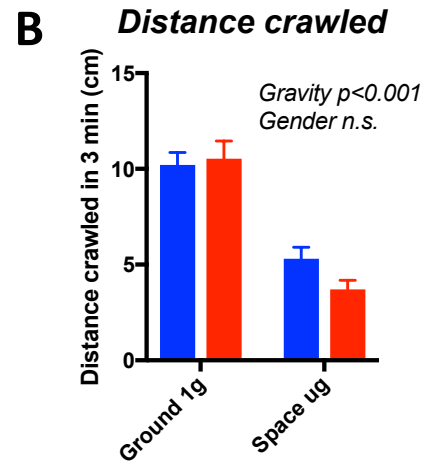
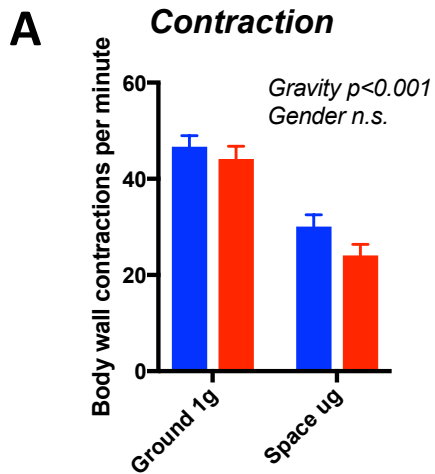
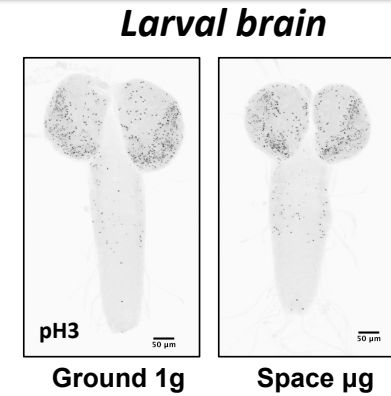
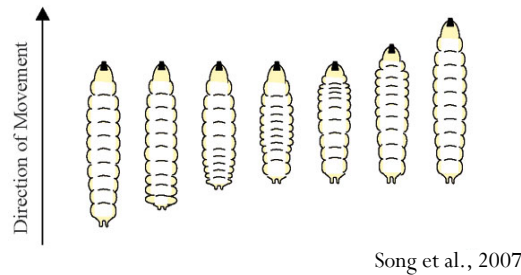


Measuring neurobehavioral health of the flies

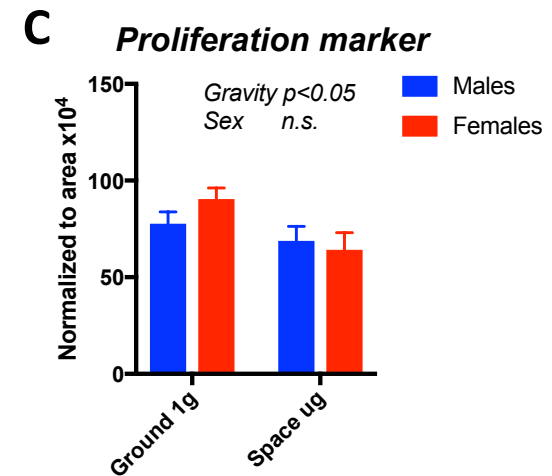


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Behavioral and brain morphology defects in spaceflight larvae suggest neurological impairments

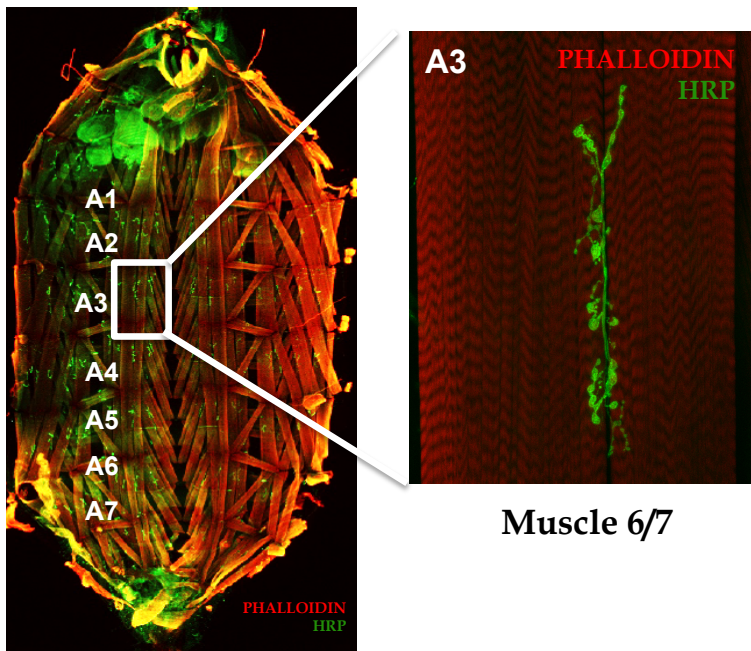


■ Males
■ Females



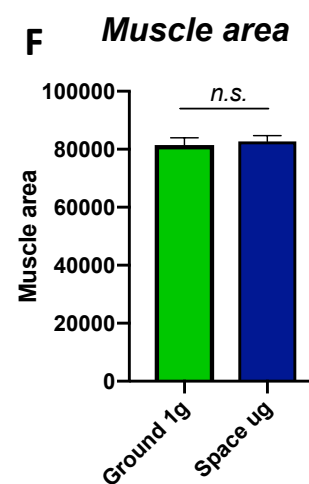
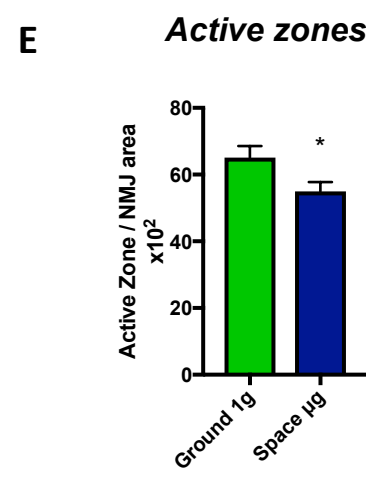
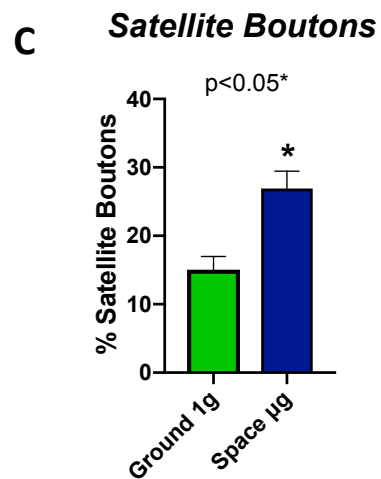
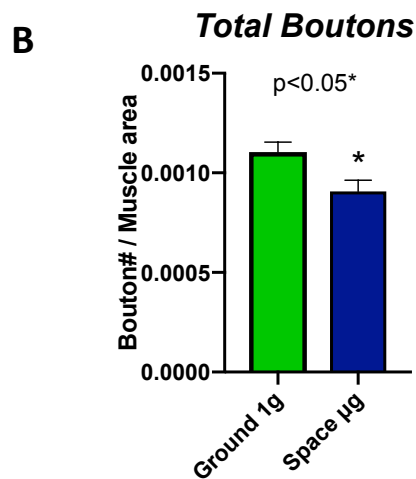
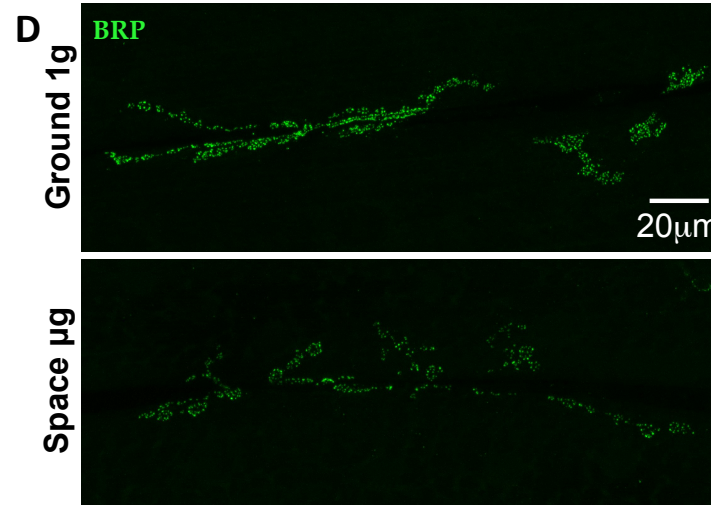
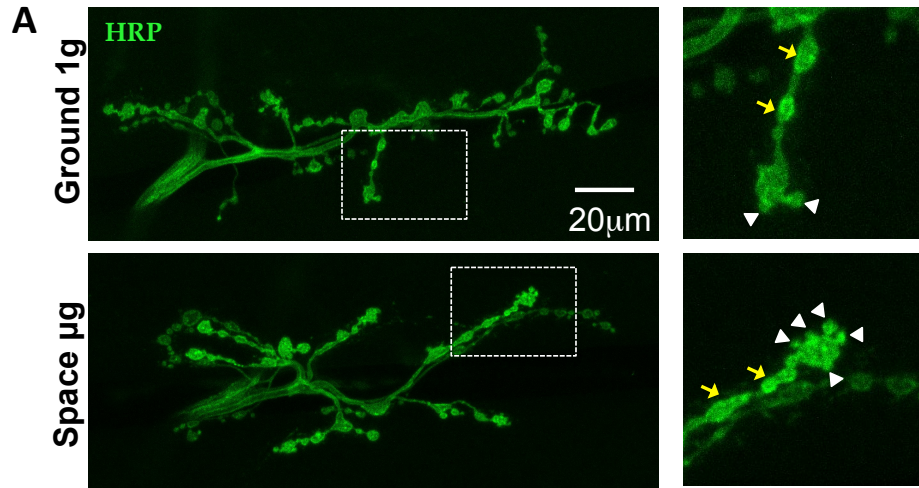
Janani Iyer, Siddhita Mhatre, Jhony Zavaleta

Synaptic abnormalities in spaceflight larvae



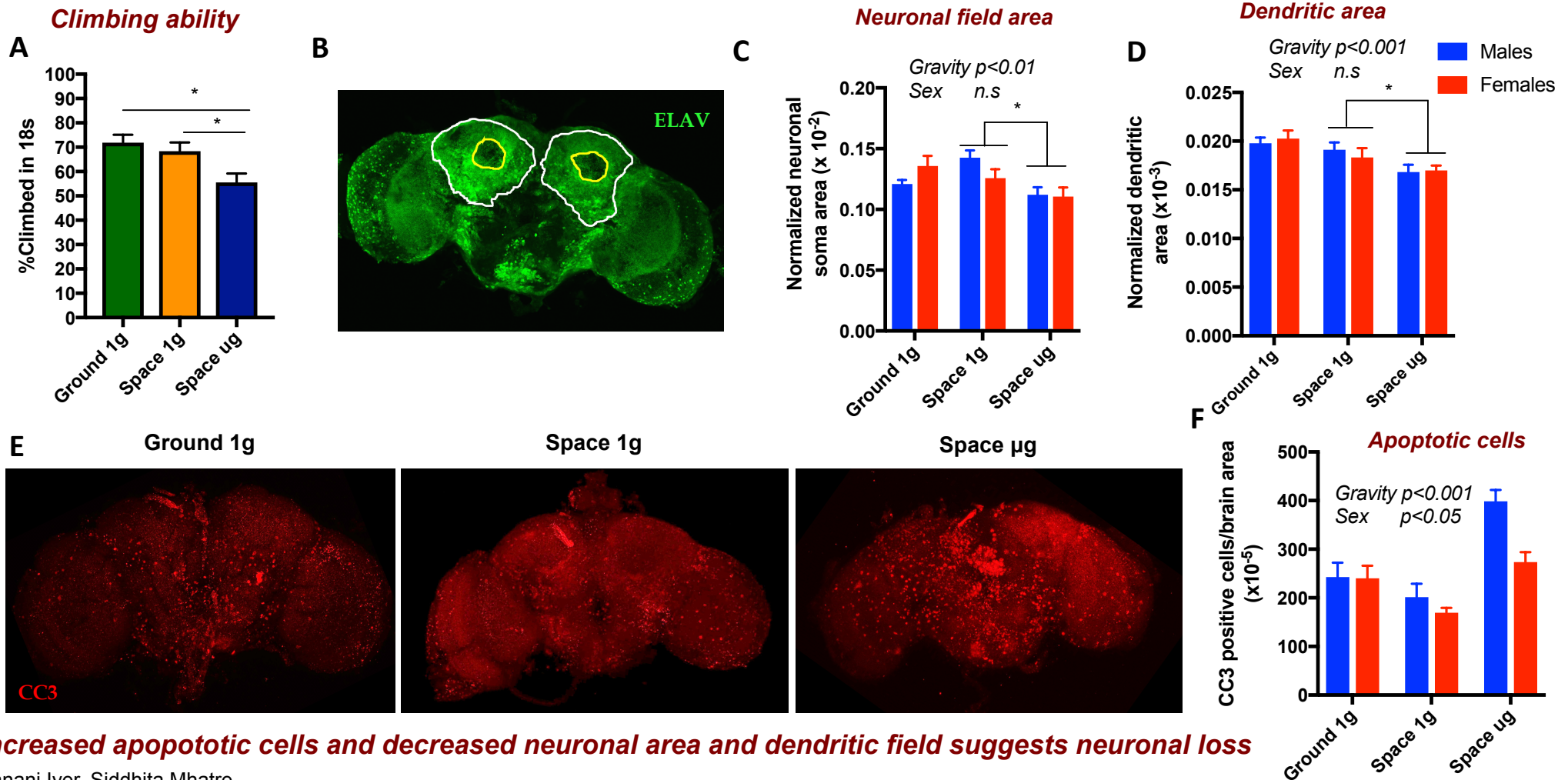
Muscle 6/7

Synaptic abnormalities in spaceflight larvae



Decreased total number of boutons and active zones while increased number of satellite boutons in spaceflight larvae suggests decreased synaptic transmission

Neuronal loss in spaceflight condition: Adult flies



Increased apoptotic cells and decreased neuronal area and dendritic field suggests neuronal loss

Janani Iyer, Siddhita Mhatre

Summary and Future Directions

- Validation spaceflight mission for *Drosophila* MVP hardware → Successful
- Novel study assessing spaceflight effect on nervous system
- Behavioral deficits in larvae and adults correlates with observed morphological defects
- Adult fly brain results suggest **gravity as a major factor** in neuronal deficits in spaceflight
- Results from this mission would help in shaping hypothesis for future missions and ground based studies
- On going: Ground acclimatization and multi-generational studies along with genomic and proteomic analysis on spaceflight larvae and adult flies

This study will help elucidate the underlying anatomical, functional and molecular changes in the nervous system resulting from spaceflight, which in future will help identify putative gene pathways for countermeasure studies

Principal Investigator:

Sharmila Bhattacharya

Scientists:

Janani Iyer

Rachel R. Gilbert

Amber M. Paul

Egle Cekanaviciute

Christina Cheung

Medaya Torres



Collaborators:

Karen Occor, SBPMDI

Rolf Bodmer, SBPMDI

Subha Govind, CUNY

Marta Wayne, U. Florida

Ground based Hypergravity studies

Spaceflight Immune studies

Students :

Matthew Rudolph & Patrick Cherubin (KSC), Ivy Fernandes, Jhony Zavaleta

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THANK YOU!!

