

# Esther Putman

Doctoral Student, Aerospace Engineering Sciences

Bioastronautics

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## Research Interests

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Spaceflight physiology, neurovestibular adaptations to spaceflight, virtual reality, astronaut training, aerospace medicine, space life and physical sciences, human factors, spacesuit design, emergency medical procedures for space missions.

## Education

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Ph.D., Aerospace Engineering, University of Colorado Boulder. Expected May 2024

Dissertation work: *Multi-environment adaptive virtual reality training as a potential countermeasure to spaceflight-associated neuroplasticity.*

M.S., Aerospace Engineering, University of Colorado Boulder. May 2021

Thesis: *Operational Performance in Functional Mobility and Manual Control Tasks Using Galvanic Vestibular Stimulation.* Advisor: Dr. Torin Clark

M.S., Engineering Management, University of Colorado Boulder. May 2021

B.S., Biology, University of Kentucky, May 2019 (Magna Cum Laude, Departmental Honors, Lewis Honors College)

B.S., Neuroscience, University of Kentucky, May 2019 (Magna Cum Laude, Departmental Honors, Lewis Honors College)

Senior Capstones: (1) Exploring the role of hands-on STEM exposure on student confidence pursuing STEM careers

(2) Investigating bacterial virulence in microgravity environments on board the International Space Station

## Experience

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Space Medicine Associate Engineering Intern | SpaceX | Fall 2022

- Hardware qualification and battery validation of research hardware for the Polaris Dawn mission.
- Trained crew on the performance of research activities for their upcoming flight.
- Created mathematical models of physiological changes in support of operational planning for mission safety.
- Supported testing and validation of the mission's cabin pressure profile for assessment of risk of decompression sickness.
- Initiated creation of a Request for Proposal system for future solicitations of research

Graduate Research Assistant | University of Colorado Boulder | 2019-present

- Research areas: VR astronaut training, estimating trust through psycho and neurophysiological signals, improving human performance with galvanic vestibular stimulation.

- Created spaceflight mission-relevant training scenarios in VR using Unity to improve skill retention for long duration exploration missions.
- Assessed neurophysiology during VR training using EEG and fNIRs.
- Developed novel training algorithm in Python for adaptive difficulty adjustment increasing user engagement and training impact.
- Responsible for IRB approval, human subjects testing, technical writing, and communicating project status with NASA stakeholders.

#### Biological Systems Engineering Intern | Space Tango, Lexington, KY | 2016-2019

- Collaborated on the development, turnover, and integration of over 50 payloads for life and physical sciences research on the International Space Station.
- Responsible for requirements creation and validation for hardware that interfaced with biological materials.
- Customer-facing role developing experiment plans and shaping proposals to facilitate NASA requirement compliance and hardware integration.
- Translated student payload proposals into actionable research plans.
- Communicated experimental design practices and scientific value of payloads to internal and external stakeholders through written and verbal mediums.

#### Space Systems Intern- Brooke Owens Fellow | Vulcan, Seattle, WA | May-August 2018

- Utilized satellite Earth observations to assist development of modeling and prediction algorithms addressing large-scale global issues like illegal blast fishing, elephant poaching, and coral reef conservation.
- Connected AI teams with training data sets from open-source satellite imagery identified and cataloged by my research of primary symptoms.
- Explored the experience of women in STEM to inform gender-inclusive hiring practices.

#### NASA Space Life Sciences Training Program Researcher | NASA Ames Research Center | June-August 2017

- Analyzed biomarkers of cellular senescence in bone marrow stem cells to explore mechanisms of astronaut bone density loss.
- Responsible for animal handling and dissection as well as data collection using cell culturing, flow cytometry, histology, and micro-CT.
- Selected for poster and lightning talk at 2017 American Society for Gravitational and Space Research Conference.
- Team project: Coordinated bacterial payload piggy-back missions on stratospheric weather balloon launches in the path of the 2017 solar eclipse. SOP creation and project management to study survivability in a Martian analog environment.

#### Research Assistant | Sander's Brown Center on Aging, Lexington, KY | 2014-2017

- Researched traumatic brain injury, Alzheimer's, and vascular dementia through confocal microscopy and immunohistochemistry.
- Responsible for fluorescent staining, imaging, and analysis of 40µm coronal mouse brain sections.
- Selected as 2015 IES Brain Research Foundation Fellow.

## Peer Reviewed Journal Publications

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- Putman, E. J.**, Galvan-Garza, R. C., & Clark, T. K. (2021). The Effect of Noisy Galvanic Vestibular Stimulation on Learning of Functional Mobility and Manual Control Nulling Sensorimotor Tasks. *Frontiers in Human Neuroscience*, 15.
- Furman, J. L., Sompol, P., Kraner, S. D., Pleiss, M. M., **Putman, E. J.**, Dunkerson, J., ... & Norris, C. M. (2016). Blockade of astrocytic calcineurin/NFAT signaling helps to normalize hippocampal synaptic function and plasticity in a rat model of traumatic brain injury. *Journal of Neuroscience*, 36(5), 1502-1515

## Conference Papers

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- Putman, E.J.**, Boppana, A., Clark, T.K., Anderson, A.P. "Adaptive Training Using Virtual Reality for Entry, Descent, and Landing During Long Duration Exploration Missions". International Astronautical Congress, 2022.

## Presentations and Posters

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1. **Putman, E.J.**, Boppana, A., Peterson, B., Clark, T.K., Anderson, A.P. "Immersive and Adaptive Training with Virtual Reality for Long Duration Exploration Missions". NASA Human Research Program Investigators Workshop (Feb 2023). Poster.
2. **Putman, E.J.**, Boppana, A., Clark, T.K., Anderson, A.P. "Adaptive Training Using Virtual Reality for Entry, Descent, and Landing During Long Duration Exploration Missions". International Astronautical Congress. (Sep 2022) Paris, France. Abstract and presentation.
3. **Putman, E.**, Boppana, A., Clark, T.K., Anderson, A.P. "Multi-Environment Adaptive Virtual Reality Training as a Potential Countermeasure for Spaceflight Associated Neuroplasticity". NASA Human Research Program Investigators Workshop. (Feb 2022) Virtual, Poster
4. Boppana, A., **Putman, E.**, Clark, T.K., Anderson, A.P. "Dynamic Virtual Reality Training Algorithm for Long Duration Exploration Missions". NASA Human Research Program Investigators Workshop. (Feb 2022) Virtual, Poster
5. Anderson, A.P., Boppana, A., **Putman, E.**, Lewis, Q., Peterson, B. Clark, T.K. "TRINITY: Multi-environment Virtual Trainer for Long Duration Exploration Missions". NSAA Human Research Program Investigators Workshop. (Feb 2022) Virtual, Poster
6. Galvan-Garza, R.C., **Putman, E.**, Clark, T.K., Ziegler, M. "Galvanic Vestibular Stimulation for Training" Neuroergonomics Conference. (Sep 2021) Munich, Germany, Abstract and Presentation
7. **Putman, E.**, Galvan-Garza, R.C., Clark, T.K. "Investigating the Role of Galvanic Vestibular Stimulation on Operational Performance in Manual Control and Functional Mobility Tasks". NASA Human Research Program Investigators Workshop. (Feb 2021) Virtual, Poster

8. **Putman, E.** "Bacterial Virulence in Spaceflight Environments: Utilizing Autonomous CubeLabs to Facilitate Research on the International Space Station." Astronaut Scholarship Program Technical Session (Aug 2018), Washington DC, Talk
9. **Putman, E.**, Cheng-Campbell, M., Stimpel, O., Almeida, E., Blaber, E. "The role of CDKN1a/p21 in cellular senescence of bone marrow stem cells under spaceflight stressors." American Society for Gravitational and Space Research Annual Conference (Oct 2017), Seattle, WA, Poster and Lightning Talk.
10. **Putman, E.** et.al, "NFAT 4 is upregulated in astrocytes in traumatic brain injury model". Showcase of Undergraduate Research (Apr 2017), Lexington KY, Poster
11. Putman, E. "Intracranial pressure and cognition in microgravity: physiological barriers of long duration space flight." Scholars in Biology Research Showcase (Nov 2015), Lexington KY, Poster
12. **Putman, E.**, et. al "NFAT 4 is upregulated in astrocytes in traumatic brain injury model" Irene and Eric Simon Brain Research Fellowship Lunch and Learn (Nov 2015), New York City NY, Talk
13. **Putman, E.**, et. al, "Investigating the role of NFAT 4 in inflammatory process of astrocyte activation." Bluegrass Society for Neuroscience Spring Neuroscience Day (Apr 2015), Lexington KY, Poster
14. **Putman, E.**, et. al, "Investigating the role of NFAT 4 in inflammatory process of astrocyte activation." Marksbury Symposium Poster Presentation (Nov 2014), Lexington KY, Poster

## Teaching Experience

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Graduate Teaching Fellow- University of Colorado Boulder

Linear Control Systems Engineering (Fall '19)

Introduction to Humans in Aviation (Spring '20, Summer '20, Fall '20, Fall '21)

Human Factors Engineering (Spring '20, Summer '20, Spring '21, Spring '22)

## Volunteer Positions

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Student Board President- American Society for Gravitational and Space Research

- Led projects in education outreach, political advocacy, conference events, and social media presence.
- Organized STEM outreach event for 800 middle school students at the 2019 International Astronautical Congress.
- Conducted research and content creation as well as event organization and planning to support annual Washington, D.C. trip advocating for ISS research funding.

Education Outreach and Political Action Officer- American Society for Gravitational and Space Research

- Created space life sciences curriculum targeted for middle school science students.

- Assisted CASIS in US Science and Engineering Festival hands-on STEM event.
- Spoke to congressional representatives in support of ISS research funding.

### **Outreach Experience**

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2022 Invited Speaker- Lafayette High School Upcoming Stem Scholars Club  
 2022 Invited Speaker- Women of Aeronautics and Astronautics CU Chapter  
 2022 Guest lecturer on developing for HoloLens in Unity for CU Boulder NASA Suits Challenge Club  
 2021 Meet a Scientist Volunteer at Boulder Public Library- AR with Google Cardboard demonstration  
 2020 Invited Speaker- Lafayette High School Upcoming Stem Scholars Club  
 2019 International Astronautical Congress STEM Days Presenter: Hands on experiments about science on ISS  
 2019 Kentucky Aerospace Discovery Day Volunteer  
 2019 Space Trek Space Science Camp for Girls- Invited Speaker  
 2019 Invited Speaker- Girl Scout's Engineering Lock-in  
 2019 University of Kentucky Engineering Day Volunteer  
 2019 Kentucky Science Center Girl's STEM Club Volunteer- Chemical Engineering Demonstrations  
 2019 STEM Exposure in the Classroom, Student Teacher  
 2019 American Society for Gravitational and Space Research Advocacy on the Hill  
 2018 Neuroscience in the Classroom, Student Teacher  
 2018 American Society for Gravitational and Space Research Advocacy on the Hill  
 2018 US Science and Engineering Festival Presenter with Center for Advancement of science in space.  
 2017 Kentucky Aerospace Day at the Capitol  
 2016-2018 Higher Orbits Suborbital Advisory board member and volunteer/speaker for "Go for Launch" camps.

### **Grants and Fellowships**

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2022 Future Space Leaders Foundation Fellow  
 2020 National Science Foundation Graduate Research Fellow  
 2018 Brooke Owens Fellow  
 2016 Chellgren Research Fellow  
 2015 BS/MD Accelerated Pre-Medical Program  
 2015 IES Brain Research Foundation Fellow

### **Honors and Awards**

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2018 Women in Aerospace Foundation Scholar  
 2018 AIAA Diversity Scholar  
 2018 Astronaut Scholar  
 2015-2019 Otis A. Singletary Scholar

2015-2019 T.W. Lewis Honors College

2015 Writing, Rhetoric, and Digital Studies Excellence in Composition Award

### **Media**

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Behind the Blue podcast: *"UK Senior Esther Putman Connects the Arts and Aerospace as She Reaches for the Stars"*. December 2018

Ampersand Magazine *"Reaching for the Stars: Biology senior Esther Putman has combined her love of biology, astronomy and engineering to follow her dream of a career in aerospace medicine."* April 2019

UKNow: *"UK Senior Wins Astronaut Scholarship, Brooke Owens Fellowship"*. Oct. 2018

### **Additional Certifications and Experience**

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1. Basic Life Support (CPR and AED) Certified, American Heart Association (2020)
2. University of Kentucky Resident Advisor (2016-2017)