

Isabella P. Fallon PhD – Duke University, Neurobiology

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RESEARCH INTERESTS

My research advances our understanding of the neural mechanisms underlying skilled movements, learning, and decision-making. Combining expertise in neural circuit manipulation, activity monitoring, and continuous behavioral tracking, I have developed a clear and concise model of how circuits embedded within basal ganglia nuclei drive movement and decision-making. In the future, I aim to leverage this understanding to build innovative biomedical devices that restore loss of motor function and improve quality of life.

EDUCATION

Duke University School of Medicine, Durham, North Carolina

Ph.D., Neurobiology, May 2024

- Dissertation Title: Striatal Pathways for Action Counting and Steering
- Advisor: Henry Yin
- Committee: Nicole Calakos, Michael Tadross, and Rebecca Yang

University of Colorado Boulder, Boulder, Colorado

B.A., Psychology and Neuroscience

- Dissertation Title: Evaluating Stressor Controllability Effects in Female Rats
- Advisor: Steven Maier
- Committee: Kathryn Plath, Heidi Day, Michael Baratta

RESEARCH EXPERIENCE

Duke University, Yin Laboratory

Advisor: Henry Yin

Postdoctoral Researcher

2024 – Present

- Conducting cutting-edge research on the neural mechanisms underlying skilled dexterous movements and kinematics.
- Mentoring PhD and undergraduate students on research methodologies and experimental design, and career development.

Duke University School of Medicine, Yin Laboratory

Advisor: Henry Yin

Graduate Student

2019 – 2024

My research focused on the mechanisms by which the nervous system generates action. I focused on the direct and indirect pathways of the Basal Ganglia and how they contribute to decision making, action initiation, kinematics and coordinating sequences of actions. My research identified a novel, simple and descriptive ‘push-pull’ model for striatal circuits that predicts decision making and movement trajectory.

- Designed and programmed a novel operant task to measure decision making and kinematics.
- Used kinematic and operant analysis of rodent behavior to understand task related movements.
- Measured pathway activities using *in-vivo* calcium imaging to analyze their relationship to behavior.
- Manipulated pathway activities with optogenetics to understand their functional contributions.
- Developed a ‘push-pull’ model of how striatal pathways regulate movement trajectory.

**University of Colorado Boulder & UC Denver, Maier
& Greenwood Laboratory**

Advisor: Steven Maier

Professional Research Associate

Spring 2017 – Fall 2019

- I researched the prophylactic effects of exercise on traumatic stress and the related neurobiological mechanisms.

University of Colorado Boulder, Maier Laboratory

Advisor: Steven Maier

Undergraduate Research Assistant

Fall 2014 – Fall 2017

- I researched the neural mechanisms underlying stress resilience. My work identified a key sex difference in stress outcomes and its neurobiological substrate.

Anschutz Medical Campus, Todorovic Laboratory

Advisor: Slobodan Todorovic

Undergraduate Research Assistant

Summer 2016

- My project explored the role of CaV3.2 channels in pain transmission and explored mechanisms of endogenous CaV3.2 channel modulation.

PEER-REVIEWED JOURNAL PUBLICATIONS

1. **Fallon IP**, Fernandez SO, Hong F, Yin HH. Striatal pathways steer forelimb reach extension. (2024). *In preparation*.
2. **Fallon IP**, Dolzani SD, Leslie NR, Amat J, Trahan GD, Laynes RA, Watkins LR, Maier SF, Baratta, MV. Coping with stress promotes long-term resilience through distinct prefrontal circuits. (2024). *In preparation*.
3. **Fallon IP**, Roshchina M, Hong F, Fernandez SO, Ruan S, Yin HH. Striatal pathways for action counting and steering. (2024). *Under review Nature*.
4. Tanner MK, Mellert SM, **Fallon IP**, Baratta MV, Greenwood BN. [Multiple Sex- and Circuit-Specific Mechanisms Underlie Exercise-Induced Stress Resistance](#). (2024). *Exercise and Mental Health*.
5. **Fallon IP**, Hughes RN, Severino FPU, Kim N, Lawry CM, Watson GDR, Roschina M, Yin HH. [The role of the parafascicular thalamic nucleus in action initiation and steering](#). (2023). *Current Biology*.
6. Bakhurin K, Hughes, RN, Jiang Q, **Fallon IP** Yin, HH. [Force tuning explains changes in phasic dopamine signaling during stimulus-reward learning](#). (2023). *Biorxiv*.
7. Zhang J, Hughes RN, Kim N, **Fallon IP**, Bakhurin K, Kim J, Severino FPU, Yin HH. [A one-photon endoscope for simultaneous patterned optogenetic stimulation and calcium imaging in freely behaving mice](#). (2023). *Nature Biomedical Engineering*.
8. Petter EA, **Fallon IP**, Hughes RN, Watson GDR, Meck WH, Ulloa Severino FP, Yin HH. [Elucidating a locus coeruleus-dentate gyrus dopamine pathway for operant reinforcement](#). (2023). *Elife*.
9. Hassell JE, Baratta MV, **Fallon IP**, Siebler PH, Karns BL, Nguyen KT, Gates CA, Fonken LK, Frank MG, Maier SF, Lowry CA. [Immunization with a heat-killed preparation of Mycobacterium vaccae NCTC 11659 enhances auditory-cued fear extinction in a stress-dependent manner](#). (2022). *Brain Behavior and Immunity*.
10. McNulty CJ*, **Fallon IP***, Amat J, Sanchez RJ, Leslie NR, Root DH, Maier SF, Baratta MV. [Elevated prefrontal dopamine interferes with the stress-buffering properties of behavioral control in female rats](#). (2022). *Neuropsychopharmacology*.
11. Watson GDR, Hughes RN, Petter EA, **Fallon IP**, Kim N, Severino FPU, Yin HH. [Thalamic projections to the subthalamic nucleus contribute to movement initiation and rescue of parkinsonian symptoms](#). (2021). *Science Advances*.
12. Frank MG, Baratta MV, Zhang K, **Fallon IP**, Pearson MA, Liu G, Hutchinson MR, Watkins LR, Goldys EM, Maier SF. [Acute stress induces the rapid and transient induction of caspase-1, gasdermin D and release of constitutive IL-1 \$\beta\$ protein in dorsal hippocampus](#). (2020). *Brain Behavior and Immunity*.
13. **Fallon IP**, Tanner MK, Greenwood BN, Baratta MV. (2019). [Sex differences in resilience: experiential](#)

[factors and their mechanisms](#). *European Journal of Neuroscience*.

14. Tanner MK, **Fallon IP**, Baratta MV, Greenwood BN. [Voluntary exercise enables stress resistance in females](#). (2019). *Behavioural Brain Research*, 369.
15. Baratta MV, Leslie NR, **Fallon IP**, Dolzani SD, Chun LE, Tamalunas AM, Watkins LR, Maier SF. (2018). [Behavioural and neural sequelae of stressor exposure are not modulated by controllability in females](#). *European Journal of Neuroscience*.

PEER-REVIEWED CONFERENCE ARTICLES & ABSTRACTS

1. Yin HH, Bakhurin K, **Fallon IP**, O.Jiang, M.Hossain, B.Gutkin. (Fall 2022). Deconstructing the Reward Prediction Error Hypothesis of Dopamine Function. *Society for Neuroscience*, Chicago, Illinois.
2. **Fallon IP**, Roshchina M, Hong F, Vignali C, Fernandez SO Fernandez SO, Yin HH. (Fall 2022). The Role of Striatal Neurons in Counting Behavior. *Society for Neuroscience*, Chicago, Illinois.
3. Hong F, **Fallon IP**, Yin HH. (Fall 2022). Striatal Direct and Indirect Pathway Neurons Play Complementary Roles in Action. *Society for Neuroscience*, Chicago, Illinois.
4. **Fallon IP**, Fernandez SO, Yin HH. (Fall 2022). The striatal indirect pathway resets the neural representation of numerosity. *The Assembly and Function of Neuronal Circuits*, Ascona, Switzerland.
5. **Fallon IP**, Fernandez SO, Yin HH. (Fall 2022). The striatal indirect pathway resets the neural representation of numerosity. *Society for Neuroscience*, San Diego, California.
6. Bakhurin K, Hughes RN, **Fallon IP**, Yin HH. (Fall 2022). Ventral tegmental dopamine neurons signal force vector dynamics during Pavlovian conditioning and performance. *Society for Neuroscience*, San Diego, California.
7. McNulty CJ, **Fallon IP**, Amat J, Sanchez RJ, Root DH, Maier SF, Baratta MV. (Fall 2022). Behavioral control over stress recruits a distinct circuit in females. *Society for Neuroscience*, San Diego, California.
8. Bonar KK, Tanner MK, **Fallon IP**, Baratta MV, Greenwood BN. (Fall, 2019). Exercise effects on activation of dorsal raphe nucleus-projecting neurons during uncontrollable stress. *Front Range Neuroscience Group*, Fort Collins, CO.
9. **Fallon IP**, Fernandez SO, Yin HH. (Fall 2022). The striatal indirect pathway resets the neural representation of numerosity. *The Assembly and Function of Neuronal Circuits*, Monte Verita, Switzerland.
10. **Fallon IP**, Levy ES, Dolzani SD, Leslie NR, Amat J, Trahan GD, Laynes RA, Watkins LR, Baratta MV, Maier SF. (Fall, 2019). Control over stress engages a corticostriatal projection for the production of long-term stress resilience. *Ascona Circuits Meeting*, Monte Verita, Switzerland.
11. **Fallon IP**, Tanner MK, Tamalunas AM, Baratta MV, Greenwood BN (Fall, 2019) Voluntary wheel running prevents the behavioral and neurochemical sequelae of uncontrollable stress in females. *Society for Neuroscience*, Chicago, Illinois.
12. Tanner MK, **Fallon IP**, Baratta MV, Greenwood BN. (Fall, 2018) Wheel running prevents the negative impact of stressor exposure in females. *Front Range Neuroscience Group*, Fort Collins, Colorado.
13. Levy ES, **Fallon IP**, Baratta MV, Leslie NR, Watkins LR, Maier SF. (Fall, 2018). Determining prefrontal projections involved in the production of long-term stress resilience. *Molecular and Cellular Cognition Society*, San Diego, California.
14. Baratta MV, Dolzani SD, **Fallon IP**, Leslie NR, Amat J, Trahan GD, Laynes RA, Watkins LR, Maier SF. (Fall, 2018). Control over stress engages a corticostriatal projection for the production of long-term stress resilience. *Society for Neuroscience*, San Diego, California.
15. **Fallon IP**, Baratta MV, Leslie NR, Dolzani SD, Chun LE, Tamalunas AM, Watkins LR, Maier SF. (Summer, 2018). Behavioral and neural sequelae of stressor exposure are not modulated by controllability in females. *Neurobiology of Stress Workshop*, Banff, Canada.
16. **Fallon IP**, Baratta MV, Leslie NR, Dolzani SD, Chun LE, Tamalunas AM, Watkins LR, Maier SF. (Fall, 2017). Evaluating Stressor Controllability Effects in Female Rats. *Society for Neuroscience*, Washington D.C.

INVITED TALKS

1. “Striatal mechanisms underlying counting behavior”. Seminar series, Duke University School of Medicine, Durham, North Carolina. 2023
2. “Investigating the role of striatal indirect pathway neurons in quantity estimation”. Basal Ganglia

Symposium, Duke University School of Medicine, Durham, North Carolina. 2022

3. **“Control over stress engages a corticostriatal projection for the production of long-term stress resilience”**. Ascona Circuits Meeting, Monte Verita, Switzerland. 2019
4. **“Evaluating Stressor Controllability Effects in Female Rats”**. Rocky Mountain Regional Neuroscience Group, University of Colorado Anschutz Medical Campus, Denver, Colorado.

HONORS & AWARDS

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| Women Who Make a Difference | 2018 |
| Biological Science Initiative Travel Grant (\$800) | 2017 |
| Best Abstract Award, Rock Mountain Regional Neuroscience Group | 2017 |
| Best Undergraduate Thesis in Neuroscience Award (\$1,500) | 2017 |
| Undergraduate Research Opportunities Program Research Assistantship Award (\$1,200) | 2016 |
| Undergraduate Research Opportunities Program Individual Grant (\$1,000) | 2016 |
| Undergraduate Research Opportunities Program- HHMI Research Grant (\$2,000) | 2015 |
| Biological Science Initiative Scholars Program Summer Award Research Grant (\$500) | 2015 |

TEACHING EXPERIENCE

Duke University School of Medicine, NEUROBIO 719 Concepts in Neuroscience II Teaching Assistant to Professor Kevin Franks Spring 2021

- Assisted students in understanding homework material and learning the lectures.
- Graded student assignments.
- Presented students with methods for designing a research proposal.

Duke University School of Medicine, Duke Athletics

Tutor to football and soccer student athletes

Fall 2020- Spring 2021

- Met with students weekly to discuss lecture material.
- Helped students organize their notes and develop strategies for remembering material.
- Educated students on topics including neuroanatomy, neurobiology, neuro-ethics, productivity, and note-taking.

SUPERVISION OF UNDERGRADUATE MENTEES

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| Duke University, URS Assistantship, Sofia O. Fernandez | Spring 2022 – Fall 2024 |
| Duke University, Pierce Hollier | Spring 2021 – Spring 2022 |
| University of Colorado Boulder, UROP Assistantship Emily Levy | Spring 2018 – Fall 2019 |

SUPERVISION OF GRADUATE MENTEES

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| Duke University, Feiyang Hong | Spring 2021 – Present |
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RESEARCH RELATED WORK EXPERIENCE

University of Colorado Boulder, Special Undergraduate Enrichment Programs

Advisory Board Member and Website Manager

2015-2016

- Promote undergraduate research on the CU Boulder campus and facilitate faculty-student partnerships
- Managed the program’s communications using the platform Web Express powered by Drupal.

COMMUNITY SERVICE & LEADERSHIP

Duke University, Nucleate leadership team

Communications team

Fall 2020 – Spring 2024

- It was my job to coordinate communication between local biotech companies, researchers at institutions, students in biomedical PhDs, and the Fuqua School of Business Completed numerous training courses on student support, facilitating group dynamics, fostering interpersonal relationships, and

mandatory reporting as a responsible employee. I also created programs and flyers for nucleate-sponsored events.

PROFESSIONAL DEVELOPMENT

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| The Inaugural Raynor Cerebellum Project Postdoc Summit, Scottsdale, AZ | November 2024 |
| Neurobiology retreat, Wilmington, NC | October 2024 |
| Accelerate to Industry, Durham, NC | May 2023 |
| The responsible scientist II, Duke University, BIOTRAIN 754 | Spring 2023 |
| Responsible conduct in research, Duke University, GS 710A | Fall 2020 |
| Responsible conduct in research, Duke University, GS 714 | Fall 2019 |

TECHNICAL SKILLS

- Laboratory techniques: behavioral testing, optogenetics, chemogenetics, *in-vivo* endoscopic calcium imaging, *in-vivo* fiber photometry, pharmacology, inducible systems for activity-dependent labeling, confocal microscopy, viral-mediated gene delivery, anatomical tract tracing, immunofluorescence
- Software: med-associates programming, Minian (Ca analysis), DeepLabCut (2D&3D pose estimation), MATLAB, all google programs, NeuroExplorer, Adobe illustrator, Adobe Premiere Pro, Adobe Acrobat, GraphPad, ImageJ, Plexon, Python in Jupyter Notebooks.

REFERENCES

Professor Henry Yin
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