

Zirong Gu, Ph.D.

Associate Research Scientist

Zuckerman Mind Brain Behavior Institute, Columbia University

Jerome L. Greene Science Center

3227 Broadway, L3-003

New York, NY 10027

Tel: 513-442-6423

Email: zg2284@columbia.edu

Education/Training

2001-2005 **B.S.** Nanjing Agricultural University (NJAU), China
2005-2008 **M.S.** Graduate School of Chinese Academy of Sciences, China
2008-2015 **Ph.D.**, Cincinnati Children's Hospital Medical Center
2015 **Visiting Scientist** The City University of New York
2015-2017 **Post-doctoral Fellow** Cincinnati Children's Hospital Medical Center
2017-present **Post-doctoral Fellow** Zuckerman Mind Brain Behavior Institute, Columbia University

Honors

2002-2003 Second Award, the Excellent Student Scholarship, NJAU, China
2002-2003 Wenshi Corporation Scholarship, NJAU, China
2002-2003 Second Award, National Undergraduate Mathematical Contest in Modeling, China
2003-2004 Third Award, the Excellent Student Scholarship, NJAU
2010 2th Prize of Research Image Competition, the Annual Developmental Mechanisms, Organogenesis and Stem Cells Retreat, Cincinnati Children's Hospital Medical Center
2011 Outstanding 4th year poster, Molecular & Developmental Biology Graduate Program, 18th Annual Graduate Student Symposium
2012 Outstanding Poster Presentation, Graduate Poster Forum 2012, University of Cincinnati
2012 2th Prize of Poster Competition, the Annual Developmental Mechanisms, Organogenesis and Stem Cells Retreat, Cincinnati Children's Hospital Medical Center
2012 3th Place of Presentation Prize, 50th Annual Midwest Developmental Biology Meeting, Cincinnati, Ohio
2012 Richard A. Akeson Travel fellowship, Cincinnati Children's Hospital Research Foundation
2013 Graduate Summer Undergraduate Mentor Award, Graduate School at the University of Cincinnati
2013 Richard A. Akeson Travel fellowship, Cincinnati Children's Hospital Research Foundation
2013 Outstanding Poster Presentation, Graduate Poster Forum 2013, University of Cincinnati
2014 Richard A. Akeson Travel fellowship, Cincinnati Children's Hospital Research Foundation
2014 The Swartz Foundation Travel Fellowship for 79th Cold Spring Harbor Laboratory Symposium: Cognition
2023 SFN Plexon Presenter Award

Research Grant and Fellowships

- 1) 2019-2022** NARSAD Young Investigator Award, Brain & Behavior Research Foundation
Title: Basal Ganglia output circuits for habitual and goal-directed action control in healthy and Sapap3 knockout OCD mouse model; \$70,000
Role: PI and Key Personnel
- 2) 2020-Present** K99/R00, 1 K99 NS119788-01, Pathway to Independence Award, NINDS
Title: Action-specific dissecting of basal ganglia: from the classical model to diverse action-specific subcircuits; \$997,884
Role: PI and Key Personnel
- 3) 2020-2021** Parkinson's Foundation Summer Student Fellowship
Title: Anatomical and functional characterization of external globus pallidus subpopulations support locomotion and learned action
Role: Mentor and Key Personnel

Publications

1) Fukuda T, Takeda S, Xu R, Ochi H, Sunamura S, Sato T, Shibata S, Yoshida Y, **Gu Z**, Kimura A, Ma C, Xu C, Bando W, Fujita K, Shinomiya K, Hirai T, Asou Y, Enomoto M, Okano H, Okawa A, Itoh H. Sema3A regulates bone-mass accrual through sensory innervations. **Nature**. 2013 May 23;497(7450):490-3. PMID: 23644455.

2) **Gu Z**, Imai F, Kim IJ, Fujita H, Katayama Ki, Mori K, Yoshihara Y, Yoshida Y. Expression of the immunoglobulin superfamily cell adhesion molecules in the developing spinal cord and dorsal root ganglion. **PLoS One**. 2015;10(3):e0121550. PubMed PMID: 25826454

3) **Gu Z**, Serradj N, Ueno M, Liang M, Li J, Baccei ML, Martin JH, Yoshida Y. Skilled Movements Require Non-apoptotic Bax/Bak Pathway-Mediated Corticospinal Circuit Reorganization. **Neuron**. 2017 May 3;94(3):626-641.e4. PubMed PMID: 28472660

4) **Gu Z**, Kalambogias J, Yoshioka S, Han W, Li Z, Kawasaki YI, Pochareddy S, Li Z, Liu F, Xu X, Wijeratne HRS, Ueno M, Blatz E, Salomone J, Kumanogoh A, Rasin MR, Gebelein B, Weirauch MT, Sestan N, Martin JH, Yoshida Y. Control of species-dependent cortico-motoneuronal connections underlying manual dexterity. **Science**. 2017 Jul 28;357(6349):400-404. PubMed PMID: 28751609

5) Ueno M, Nakamura Y, Li J, **Gu Z**, Niehaus J, Maezawa M, Crone SA, Goulding M, Baccei ML, Yoshida Y. Corticospinal Circuits from the Sensory and Motor Cortices Differentially Regulate Skilled Movements through Distinct Spinal Interneurons. **Cell Rep**. 2018 May 1;23(5):1286-1300.e7. PubMed PMID: 29719245

6) **Gu Z**, Ueno M, Klinefelter K, Mamidi M, Yagi T, Yoshida Y. Skilled Movements in Mice Require Inhibition of Corticospinal Axon Collateral Formation in the Spinal Cord by Semaphorin Signaling. **J Neurosci**. 2019 Nov 6;39(45):8885-8899. PubMed PMID: 31537704

7) **Gu Z**, Koppel N, Kalambogias J, Alexandrou G, Li J, Simon DJ, Tessier-Lavigne M, Baccei ML, Martin JH, Yoshida Y. Semaphorin-mediated corticospinal axon elimination depends on activity-induced, Bax/Bak-caspase pathway. **J Neurosci**. 2020 May;3190-18.2020. PubMed PMID: 32471877

8) Ueno M, Nakamura Y, Hiroshi N, Jesse K. N, Mari M, **Gu Z**, Atsushi K, Hirohide T, Qing Richard L, Masahiko T, Yoshida Y. Olig2 induces semaphorin expression after spinal cord injury to limit axonal growth of injured neurons. **Cerebral Cortex** 2020 June; DOI: 10.1093/cercor/bhaa142; PMID: 32564090

9) **Gu Z**, Matsuura K, Letelier A, Basista M, Craig C, Imai F, Yoshida Y. Axon fasciculation, mediated by transmembrane semaphorins, is critical for the establishment of segmental specificity of corticospinal circuits. **J Neurosci**. 2023 June 21; JN-RM-0073-22; DOI: <https://doi.org/10.1523/JNEUROSCI.0073-22>; PMID: 37344234

Manuscripts under revision

1) Jung K, Krüssel S, An M, Schappaugh N, **Gu Z**, Costa M. R, Kwon H. Dopamine-mediated cellular programming of heuristic decisions. **Nature Neuroscience** 2023 (under revision)

Manuscripts in preparation

1) **Gu Z**, Tang J., Mendelsohn A., Vicente M., Nikoobakht L., Rosenberg S., Li J., Chakravarthy A., Hammond L., Peterka S. D., Costa M. R. Direct projections from the external globus pallidus to thalamus and brainstem differentially impact behavior. (in preparation)

2) **Gu Z**, Nikoobakht L., Li J., Hammond L., Costa M. R. Organization of basal ganglia outputs revealed by brain-wide mapping of GPe, GPi and SNr. (in preparation)

3) **Gu Z**, Nikoobakht L., Li J., Hammond L., Costa M. R. Granular circuit configuration of external globus pallidus to thalamus and brainstem revealed by brain-wide mapping and single nucleus RNA sequencing. (in preparation)

Invited Presentation

2023 SfN's annual meeting, Washington, DC. Nanosymposium on Basal Ganglia: Structure and Function

2023 Indiana University

2023 UT Southwestern Medical Center

2023 Texas A&M University
2023 Tulane University
2023 Ohio State University
2023 University of Maryland
2023 University of South Dakota
2023 Alfred Benzon Symposium no. 67th, Copenhagen: Bringing Circuit for Movement Together
2023 Loma Linda University
2023 Loyola University Chicago
2023 University at Buffalo, The State University of New York
2023 Binghamton University, The State University of New York, Department of Psychology
2023 Binghamton University, The State University of New York, Department of Biomedical Engineering
2023 Mayo Clinic, Rochester
2023 Stony Brook University, The State University of New York
2023 The University of Texas at Dallas
2022 The University of Texas Health Science Center at San Antonio
2022 Basal Ganglia (GRS) Gordon Research Seminar
2021 Plexon Neuroscience Data Blitz
2017 Harvard University, Department of Chemistry & Chemical Biology
2017 Harvard University, Department of Organismic and Evolutionary Biology
2017 Rockefeller University
2017 Columbia University
2016 The Salk Institute for Biological Studies
2016 Stanford University, Department of Biology
2016 Stanford University, CNC Program
2016 University of California, Berkeley
2016 The Stowers Institute for Medical Research
2012 50th Annual Midwest Developmental Biology Meeting

Conference Proceedings

- 1) **Zirong Gu**, Yonghua Sun, Jan Bogerd, and Zuoyan Zhu (2008) *Nuclear Receptor Subfamily 6 Group A Member 1a (nr6a1a)* Acts Downstream of RA signaling to Mediate Neural Crest Development in Zebrafish. 8th International Meeting on Zebrafish Development and Genetics, June 26th - 30th 2008, Madison, Wisconsin, USA (Poster)
- 2) **Zirong Gu**, Yutaka Yoshida (2010) Distinct roles of transmembrane and secreted semaphorins in the patterning of corticospinal circuits. The Annual Developmental Mechanisms, Organogenesis and Stem Cells Retreat, Cincinnati Children's Hospital Medical Center (April 7th - 8th, 2010) (Poster)
- 3) **Zirong Gu**, Yuka I. Karasawa, Nenad Sestan, Yutaka Yoshida (2011) Regulation of corticospinal axonal trajectories by semaphorin signaling. The EMBO Conference Series on the Assembly and Function of Neuronal Circuits, September 25th - 30th 2011, Monte Verità, Ascona, Switzerland (Poster)
- 4) **Zirong Gu**, Yutaka Yoshida (2010) The connectivity and specificity of corticospinal circuits revealed by trans-synaptic virus tracing. The Annual Developmental Mechanisms, Organogenesis and Stem Cells Retreat, Cincinnati Children's Hospital Medical Center (April 12th - 13th, 2012) (Poster)
- 5) **Zirong Gu**, Yutaka Yoshida (2012) The connectivity and specificity of corticospinal circuits revealed by trans-synaptic virus tracing. 50th Annual Midwest Developmental Biology Meeting, May 11th - 12th 2012, Cincinnati, Ohio, USA (Presentation)
- 6) **Zirong Gu**, Yutaka Yoshida (2012) The connectivity and specificity of corticospinal circuits revealed by trans-synaptic virus tracing. 2012 Cold Spring Harbor Laboratory Meeting on Axon guidance, Synapse Formation and Regeneration, September 18th - 22th 2012, NY, USA (Poster)
- 7) **Zirong Gu**, Yuka I. Karasawa, Nenad Sestan, Yutaka Yoshida (2012) Regulation of corticospinal axon guidance/elimination by semaphorin6D-plexinA1 signaling. SfN's annual neuroscience meeting, October 13th - 17th 2012, New Orleans, LA, USA (Presentation)

- 8) Zirong Gu, Yutaka Yoshida (2013)** Nonapoptotic activation of Bax-Caspase-3 pathway drives the reorganization of corticospinal circuits. Cold Spring Harbor Laboratory Meeting on Wiring the Brain, July 18th - 22th 2013, NY, USA (Poster)
- 9) Zirong Gu, Masaki Ueno, Yuka I. Karasawa, Nenad Sestan, Yutaka Yoshida (2013)** Proper neural circuit formation and skilled motor behavior require *Sema6D-plexinA1* signaling-mediated axon pruning of corticospinal neurons. The EMBO Conference Series on the Assembly and Function of Neuronal Circuits, September 29th - October 4th 2013, Monte Verità, Ascona, Switzerland (Poster)
- 10) Zirong Gu, Masaki Ueno, Yuka I. Karasawa, Nenad Sestan, Yutaka Yoshida (2013)** Proper neural circuit formation and skilled motor behaviour require *Sema6D-plexinA1* signaling-mediated axon pruning of corticospinal neurons. The Networked Brain, Sfn Satellite Meeting, Cell Symposia, November 7th - 8th 2013, San Diego, USA (Poster)
- 11) Zirong Gu, Yutaka Yoshida (2014)** Regulation of synaptic refinement of cortico-muscle circuitry by neuronal activity-driven non-apoptotic Bax-caspase pathway. Genetic Manipulation of Neuronal Activity III, Janelia Farm Research Campus, Howard Hughes Medical Institute, May 18th - 21st 2014, Ashburn, VA, USA (Short talk)
- 12) Zirong Gu, John Kalamboglas, Masaki Ueno, Yuka I. Karasawa, Wenqi Han, Emily Blatz, Mishi Liang, Matthew Weirauch, Nenad Sestan, John H. Martin, Yutaka Yoshida (2014)** Construction of species-specific corticospinal circuit by differential activation of *Sema6D/PlexA1*-mediated axon pruning. 79th Cold Spring Harbor Laboratory Symposium: Cognition, May 28th – June 2th 2014, NY, USA (Poster)
- 13) Zirong Gu, Najet Sarrad, Masaki Ueno, Mishi Liang, Jie Li, Mark Baccei, John H. Martin, Yutaka Yoshida (2015)** Coordinating flexor and extensor muscle activity requires Bax/Bak-caspase-dependent synaptic refinement of corticospinal circuits underlying skilled movements. Cold Spring Harbor Laboratory Meeting on Wiring the Brain, March 24th - 28th 2015, NY, USA (Presentation)
- 14) Zirong Gu, Najet Sarrad, Masaki Ueno, Mishi Liang, Jie Li, Mark Baccei, John H. Martin, Yutaka Yoshida (2015)** Skilled grasping requires non-apoptotic Bax/Bak-mediated corticospinal circuit refinement. Meeting on Rhythmic Motor Circuits, Northwestern University, October 16th 2015, Chicago, IL, USA (Poster)
- 15) Zirong Gu, Najet Sarrad, Masaki Ueno, Mishi Liang, Jie Li, Mark Baccei, John H. Martin, Yutaka Yoshida (2015)** Skilled grasping requires non-apoptotic Bax/Bak-mediated corticospinal circuit refinement. Sfn's annual neuroscience meeting, October 17th – 21st 2015, Chicago, IL, USA (Poster)
- 16) Zirong Gu, John Kalamboglas, Masaki Ueno, Yuka I. Karasawa, Wenqi Han, Emily Blatz, Mishi Liang, Matthew Weirauch, Nenad Sestan, John H. Martin, Yutaka Yoshida (2016)** Cortico-motoneuronal connections and manual dexterity in mice. Molecular & Cellular Neurobiology, Gordon Research Conference, June 12th – 17th 2016, Hong Kong, China (Poster)
- 17) Zirong Gu, John Kalamboglas, Masaki Ueno, Yuka I. Karasawa, Wenqi Han, Emily Blatz, Mishi Liang, Matthew Weirauch, Nenad Sestan, John H. Martin, Yutaka Yoshida (2016)** Cortico-motoneuronal connections and manual dexterity in mice. Neural Development, Gordon Research Conference, July 31st – August 5th 2016, Newport, RI, USA (Poster)
- 18) John Kalamboglas, Zirong Gu, John H. Martin, Yutaka Yoshida (2016)** Leveraging activity and guidance to promote sprouting of direct connections between corticospinal tract axons and spinal motoneurons in *PlexinA1* knockout mice. Sfn's annual neuroscience meeting, November 12th – 16th 2016, San Diego, CA, USA (Poster)
- 19) Zirong Gu, Ananya Chakravarthy, Jonathan Tang, Luke Hammond, Darcy Peterka, Rui Costa.** Direct projections from the external globus pallidus to thalamus and brainstem differentially impact behavior. November 12th 2021, Plexon Neuroscience Data Blitz (Presentation)
- 20) Zirong Gu, Ananya Chakravarthy, Jonathan Tang, Luke Hammond, Darcy Peterka, Rui Costa.** Direct projections from the external globus pallidus to thalamus and brainstem differentially impact behavior. Basal Ganglia (GRS) Gordon Research Seminar, March 19th – 20th 2022, Ventura, CA, USA (Presentation and Poster)

21) Zirong Gu, Ananya Chakravarthy, Jonathan Tang, Luke Hammond, Darcy Peterka, Rui Costa. Direct projections from the external globus pallidus to thalamus and brainstem differentially impact behavior. Basal Ganglia (GRS) Gordon Research Conference, March 20th – 25th 2022, Ventura, CA, USA (Poster)

22) Zirong Gu, ET Thomas, Alana Mendelsohn, Laudan Nikoobakht, Jace Li, Luke Hammond, Kimberly Smith, Bosiljka Tasic, and Rui M. Costa. Granular circuit configuration of direct parallel striatopallidal projections to thalamus and brainstem revealed by brain-wide mapping and single nucleus RNA sequencing. SfN's annual neuroscience meeting, November 11st – 15th 2023, Washington, D.C., USA (Poster)

23) Zirong Gu, Jonathan Tang; Alana Mendelsohn, Mafalda Vicente, Laudan Nikoobakht, Sofia Rosenberg, Jace Li, Ananya Chakravarth, Luke Hammond, Eric Thomas, Kimberly Smith, Bosiljka Tasic, Darcy Peterka, and Rui Costa. Direct striatopallidal pathways to thalamus and brainstem via the external globus pallidus differentially impact behavior. SfN's annual neuroscience meeting, November 11st – 15th 2023, Washington, D.C., USA (Invited talk)

Teaching and Mentoring Experience

2022 Mentor, E. E. Just Scholars Program funded by United Negro College Fund

2018 Costa laboratory, Zuckerman Mind Brain behavior institute supervised undergraduate students

2010-2016 Teaching assistant, Advanced Developmental Biology, Cincinnati Children's/UC

2010-2017 Yoshida laboratory, Cincinnati Children's Hospital Medical Center supervised undergraduate students

2012-2013 Cincinnati Children's Hospital/UC College of Medicine Biomedical Research Mentoring Program

2013 University of Cincinnati, Graduate Summer Undergraduate Mentoring Program