Zachary T. Pennington, PhD

Department of Neuroscience
Mount Sinai School of Medicine
Website: ZachPenn.github.io

Current Position

2023 – present **Instructor, Icahn School of Medicine at Mount Sinai**
Laboratory of Dr. Denise Cai

Education & Training

2018 – 2022 **Icahn School of Medicine at Mount Sinai**
Postdoctoral Fellowship, Department of Neuroscience
Laboratory of Dr. Denise Cai

2018 **UCLA**
PhD, Behavioral Neuroscience and Quantitative Psychology
Advisor: Dr. Michael Fanselow

2010 **UCLA**
BA, Psychology
Advisor: Dr. J. David Jentsch

2008 **Pasadena City College**
AA, Psychology

Grants & Fellowships

Current Funding:

2023 – 2028 **NIMH K99/R00 Pathway to Independence Award** - $999,000
"Disentangling the consequences of trauma"

2023 – 2025 **Behavior Brain Research Foundation, Young Investigator Award** - $70,000
"Contributions of the anterior hypothalamic nucleus to post-trauma stress sensitization"

2024 – 2025 **Postdoc Innovator Award, Mount Sinai Friedman Brain Institute** - $25,000
"Contributions of GABAergic neurons in the anterior hypothalamic nucleus to defensive behavior"

2023 – 2025 **NIMH R56 (Co-Investigator)** – $783,000
"Fear and anxiety circuit mechanisms in anterior hypothalamic nucleus"

Fellowships, Awards and Honors

2024	ACNP Travel Award
2024 – 2025	Postdoc Innovator Award, Mount Sinai Friedman Brain Institute
2023 – 2028	NIMH K99/R00 Pathway to Independence Award
2023 – 2025	Behavior & Brain Research Foundation, Young Investigator Award
2022	McKnight Foundation Doupe Fellow
2022	Mount Sinai Neuroscience Outstanding Citizen Award
2018 – 2019	NIDA T32 Postdoctoral Fellowship, Mount Sinai
2017 – 2018	UCLA Dissertation Year Fellowship
2017	UCLA Teaching Practicum Program Fellow
2016	UCLA Teaching Practicum Program Fellow
2015 – 2017	NIMH F31 Fellowship
2015	UCLA Brain Research Institute, Society for Neuroscience Travel Award
2012 – 2014	NIDA T32 Predoctoral Fellowship, UCLA
2012	Travel Award to attend the BBC Translational Addiction conference
2012	UCLA Graduate Summer Research Mentorship Fellowship
2008	Opal Jones Trust Scholarship in Psychology, Pasadena City College
2008	Valedictorian of Pasadena City College

Diversity, Equity, and Inclusion:

At each step in the academic ladder, from elementary school onwards, individuals from underrepresented groups face substantial hurdles that impede their ability to thrive. These hurdles produce great harm, both for the individual and society at large. We must make sweeping changes to improve upon the situation. As a person that struggled with mental illness, a high-school dropout, and a community college graduate, I am where I am today because people saw my potential and mentored me. I am committed to extending the same caring hand to those from non-traditional and under-represented backgrounds. As a graduate student, I tutored homeless youth and served as a mentor for the UCLA Psychology Undergraduate Research Journal. As a postdoctoral fellow, I have helped acquire diversity supplements to support undergraduates from underrepresented backgrounds and have mentored these students in preparation for graduate school. As chair of the Neuroscience Postdoctoral Association, I co-led the development of a fellowship to help graduate students from underrepresented backgrounds secure postdoc positions, and am helping to develop youth outreach activities. Throughout my career, I hope to improve upward mobility at all stages of education and to promote an inclusive environment.

Publications:

Preprints:

1. Dong Z, Feng Y, Diego K, Baggettaa A, Sweis BM, **Pennington ZT**, Lamsifer SI, Zaki Y, Sangiuliano F, Philipsberg PA, Morales-Rodriguez, Kircher D, Slesinger P, Shuman T, Aharoni D, Cai CJ (2024). Simultaneous dual-color calcium imaging in freely-behaving mice. *BioRxiv*, 2024.07.03.601770.
   https://www.biorxiv.org/content/10.1101/2024.07.03.601770v1

Research Reports:

2. **Pennington ZT**, LaBanca A, Sompolpong P, Christenson Wick Z, Feng Y, Dong Z, Francisco TR, Chen L, Fulton SL, Maze I, Shuman T, Cai DJ (*in press*). Dissociable contributions of the amygdala and ventral hippocampus to stress-induced changes in defensive behavior. *Cell Reports.*
   https://www.biorxiv.org/content/10.1101/2023.02.27.530077v2

   This work forms the basis of my K99/R00 award aimed at understanding the non-associative consequences of trauma on fear and anxiety-related behaviors. My future lab will seek to define microcircuits governing these trauma-induced changes in defensive behavior.

3. Zaki, Y, **Pennington ZT**, Morales-Rodriguez D, Francisco TR, LaBanca AR, Dong Z, Carrillo Segura S, Silva AJ, Shuman T, Fenton A, Rajan K, Cai DJ (*in press*). Aversive experience drives offline ensemble reactivation to link memories across days. *Nature*.

4. Feng Y, Diego KS, Dong Z, Christenson Wick Z, Page-Harley L, Page-Harley, V, Schnipper J, Lamsifer SI, **Pennington ZT**, Vetere LM, Philipsberg PA, Soler I, Jurkowski A, Rosado CJ, Khan NN, Cai DJ, Shuman, T (*in press*). Distinct changes to hippocampal and medial entorhinal circuits emerge across the progression of cognitive deficits in epilepsy. *Cell Reports.*

5. Dong Z, Mau W, Feng Y, **Pennington ZT**, Chen L, Zaki Y, Rajan K, Shuman T, Aharoni D, Cai DJ (2022). Minian, an open-source miniscope analysis pipeline. *eLife*: 11:e70661.

6. **Pennington ZT**, Diego KS, Francisco TR, LaBanca AR, Lamsifer SI, Liobimova O, Shuman T, Cai DJ (2021). ezTrack – A step by step by step guide to behavior tracking. *Current Protocols in Neuroscience*, 1(10): e255.

   I guided a team of undergraduates as they wrote the initial draft of this manuscript, as well as subsequent revisions.

7. Blaze J, Navickas A, Phillips HL, Heissel S, Plaza-Jennings A, Miglani A, Asgharian H, Foo M, Katanski CD, Watkins CP, **Pennington ZT**, Javidfar B, Espeso-Gil S, Rostandy B, Alwaseem H, Hahn CG, Molina H, Cai DJ, Pan T, Yao WD, Goodarzi H, Haghighi F, Akbarian S (2021). Neuronal Nsun2 deficiency produces tRNA epitranscriptomic alterations and proteomic shifts impacting synaptic signaling and behavior. *Nature Communications*, 12(1): 4913.

8. Lichtenberg NT, Sepe-Forrest L, **Pennington ZT**, Lamparelli AC, Greenfield VY, Wassum KM (2021). The medial orbitofrontal cortex → basolateral amygdala circuit regulates the influence of reward cues on adaptive behavior and choice. *Journal of Neuroscience*, 41(34): 7267-7277.

9. Rajbhandari AK, Octeau JC, Gonzalez S, **Pennington ZT**, Mohamed F, Trott J, Chavez J, Ngyuen E, Keces N, Hong WZ, Heve RL, Waschek J, Khakh BS, Fanselow MS (2021). A basomedial amygdala to intercalated cells microcircuit expressing PACAP and its receptor PAC1 regulates contextual fear. *Journal of Neuroscience*, 41(15): 3446-61.

10. Shuman T, Aharoni D, Cai DJ, Lee CR, Chavlis S, Page-Harley L, Vetere LM, Feng Y, Yang CY, Mollinedo-Gajate I, Chen L, **Pennington ZT**, Taxidis J, Flores SE, Cheng K, Javaherian M, Kaba CC, Rao N, La-Vu M, Pandi I, Shtrahman M, Bakhurin KI, Masmanidis SC, Khakh BS, Poirazi P, Silva AJ, Golshani P (2020). Breakdown of spatial coding and neural synchronization in pilocarpine-treated epileptic mice. *Nature Neuroscience,* 23(2): 229-238.

11. **Pennington ZT**, Trott JM, Rajbhandari AK, Li K, Walwyn WM, Evans CJ, Fanselow MS (2020). Chronic opioid pretreatment potentiates the sensitization of fear learning by trauma. *Neuropsychopharmacology,* 45(3): 482-490.

This paper demonstrates the ability of chronic opioid administration to potentiate aversive learning in a withdrawal-independent and anxiety-independent manner. This provides a novel mechanism that could potentially contribute to the high comorbidity between opioid use disorder and PTSD. Future work from my lab will seek to define the circuit and pharmacological mechanisms underlying this change, as well as the extent to which it is an opioid-specific phenomena.

12. **Pennington ZT**, Dong Z, Feng Y, Vetere LM, Page-Harley L, Shuman T, Cai DJ (*2019*). ezTrack: An open-source video analysis pipeline for the investigation of animal behavior. *Scientific Reports,* 9(1): 19979.

This paper documents and validates the open-source behavioral tracking software I developed during my postdoc. This software is used across 6 continents and has been cited over 100 times since 2019. In my future lab I plan to extend this software's capabilities to benefit the broader research community.

13. Kosarussavadi S*, **Pennington ZT***, Covel C, Schlinger BA (2017). Across sex and age: Learning and memory and patterns of avian hippocampal gene expression. *Behavioral Neuroscience, 131(6): 483-491. *Joint first authors*

14. **Pennington ZT**, Anderson AS, Fanselow MS (2017). The ventromedial prefrontal cortex in a model of traumatic stress: Fear inhibition or contextual processing? *Learning & Memory*, 24(9): 400-406.

15. Lichtenberg NT, **Pennington ZT**, Holley SM**,** Greenfield VY, Cepeda C, Levine MS, Wassum KM (2017). Basolateral amygdala to orbitofrontal cortex projections enable cue-triggered reward expectations. Journal of Neuroscience, 37(35): 8374-8384.

16. James AS, **Pennington ZT**, Tran P, Jentsch JD (2015). Compromised NMDA/glutamate receptor expression in dopaminergic neurons impairs instrumental learning, but not Pavlovian goal-tracking or sign-tracking. *eNeuro,* 2(3): e0040-14.

Reviews:

17. Fanselow MS, **Pennington ZT** (2018). A return to the dark ages of psychiatry with a two-system framework for the study of fear. *Behaviour Research and Therapy*, 100:24-29.

This review, in addition to an accompanying commentary (Fanselow & Pennington, 2017), argues against a perspective piece suggesting that fear could not be studied in non-human animals. If true, such a perspective would have sweeping implications for biomedical research on fear and anxiety disorders. As faculty, I hope to not only produce novel biological insights into the mechanisms of behavior, but influence how we translate these findings to medical conditions in humans.

18. Jentsch JD, Ashenhurst JR, Cervantes MC, Groman SM, James AS, **Pennington ZT** (2014). Dissecting Impulsivity and its relationship to addictions. *Annals of the New York Academy of Sciences, 1327*(1): 1-26.

19. Jentsch JD, **Pennington ZT** (2014). Reward, interrupted: inhibitory control and its relevance to addictions. *Neuropharmacology,* 76B: 479-486.

Commentaries:

20. **Pennington ZT**, Cai DJ (2021). Propanolol inhibits reactivation of fear memory. *Biological Psychiatry,* 89(12):1111-12.

21. **Pennington ZT**, Fanselow MS (2018). Indirect targeting of sub-superficial brain structures with transcranial magnetic stimulation reveals a promising way forward in the treatment of fear. *Biological Psychiatry*, 84(2): 80-81.

22. Fanselow MS, **Pennington ZT** (2017). The Danger of LeDoux & Pine's Two System Framework for Fear. *American Journal of Psychiatry*, 174(11): 1120-1121.

Invited Talks:

2024	Hypothalamus Gordon Research Conference (Lewiston, ME)
2024	Neurobiology of Stress Conference (Boston, MA)
2024	UCLA Behavioral Neuroscience Seminar (Los Angeles, CA)
2024	CU Boulder Behavioral Neuroscience Seminar (Boulder, CO)
2024	Yale Division of Molecular Psychiatry Seminar Series (New Haven, CT)
2023	ACNP Meeting (Tampa, FL)
2023	Pavlovian Society Meeting (Austin, TX)
2022	UT Southwestern, El Paso. Learning Technology Seminar Series (Virtual)

Professional Activities and Service

2022 – present **Co-Director, Mount Sinai Emerging Scholars Program**

2022 – present **Founder/Organizer, Faculty Search Support Group**

- *Organized mock chalk-talk session with faculty and trainees.*
- *Organized application review session with faculty input.*
- *Coordinated postdocs being able to attend departmental chalk-talks.*

2024 **Organizer, Symposium on Diversity, Inclusion and Training** (Departments of Pharmacological Sciences and Neuroscience)

2023 **Instructor, Cold Spring Harbor Laboratories** (Cold Spring Harbor, NY):
Imaging Structure and Function in the Nervous System

2021 – present **Founder/Organizer, Sinai Anxiety Fear and Trauma Journal Club**

- *Multi-lab journal club designed to facilitate collaboration amongst labs and safe place for trainees to refine their science and presentation skills.*

2021 – 2022 **Chair, Mount Sinai Neuroscience Postdoctoral Association**

- *Helped orchestrate multiple career panels for postdocs.*
- *Created grant-writing resources to help postdocs identify and secure funding.*
- *Organized job-search support group for postdocs going on faculty search.*
- *Hosted socials to facilitate sense of welcome amongst postdoc community.*

2021 **Instructor, UCLA** (Los Angeles, CA):
Virtual Miniscope Workshop

2019 **Instructor, CAJAL Advanced Neuroscience Training Programme:**
Principles and implementation of Miniscope imaging and analysis.

2019 – present **Committee Member, Mount Sinai Neuroscience Postdoctoral Association**

2018 – 2021 **Committee Member, Mount Sinai Neuroscience Seminars**

2015 – 2017 **Graduate Student Mentor, UCLA *Undergraduate Research Journal of Psychology***

Teaching

Academic Courses

2022 – present **Invited Lecturer at Mount Sinai**

Courses:

- *Neuro Core Unit 3, Behavioral and Cognitive Neuroscience*
- *Techniques and Approaches in Neuroscience*

2016 – 2017 **Instructor at UCLA**
Average Overall Rating: 8.4/9 (N = 70)
Courses:
- *Psych 15, Introductory Psychobiology (2 school quarters)*

2012 – 2018 **Teaching Assistant at UCLA**
Average Overall Rating: 8/9 (N = 291)
Courses:
- *Psychology 110, Fundamentals of Learning (1 school quarter)*
- *Psychology 115, Principles of Behavioral Neuroscience (3 school quarters)*
- *Psychology 116, Behavioral Neuroscience Laboratory (6 school quarters)*
- *Neuroscience M101L, Neuroscience Laboratory (1 school quarter)*

Workshops

2023 **Instructor, Cold Spring Harbor Laboratories** (Cold Spring Harbor, NY):
Imaging Structure and Function in the Nervous System

2021 **Instructor, UCLA** (Los Angeles, CA):
Virtual Miniscope Workshop

2019 **Instructor, CAJAL Advanced Neuroscience Training Programme** (Bordeaux, France):
Principles and implementation of Miniscope imaging and analysis.

Research Advising

Research Mentor at Icahn School of Medicine at Mount Sinai

2024 – Present Afra Mahmud, Undergraduate Research in Cai Lab

2024 - Present Madeline Bacon, Research Associate in Cai Lab
- *Author on Pennington et al. Cell Reports, 2024*

2023 - 2024 Shereen Abdel-Raheim, Undergraduate in Cai Lab
- *Author on Pennington et al. Cell Reports, 2024*
- *First author poster presentation at Mount Sinai Neuroscience Retreat 2024*
- *Poster presenter at SFN 2023*
- *Next Position: Applying for Clinical Psychology PhD*

2022 - 2024 Patlapa Sompolpong, Research Associate in Cai Lab
- *Author on Pennington et al. Cell Reports, 2024*
- *First author poster presentation at SFN 2023*
- *Poster presenter at SFN 2022*
- *Next Position: Neuroscience PhD, Emory University*

2020-2022 Alexa LaBanca, Research Associate in Cai Lab

- *Author on Pennington et al. Cell Reports, 2024*
- *Author on Pennington et al. Current Protocols in Neuroscience, 2021*
- *First author poster presentations at SFN 2021, SFN 2022, Mount Sinai Neuroscience Retreat 2021, Mount Sinai Neuroscience Retreat 2022*
- *Next Position: Neuroscience PhD, Mount Sinai School of Medicine*

2019-2021 Taylor Francisco, Neuroscience and Behavior Student at Columbia

- *Author on Pennington et al. Cell Reports, 2024*
- *Author on Pennington et al. Current Protocols in Neuroscience, 2021*
- *First author poster presentation at SACNAS 2021.*
- *NIMH Diversity Supplement Awardee*
- *Next Position: Data Science MA, Columbia University*

2021 Keziah Diego, Research Associate in Shuman Lab

- *Author on Pennington et al. Current Protocols in Neuroscience, 2021*
- *Next Position: MD, U Chicago*

2021 Sophia Lamsifer, Research Associate in Shuman Lab

- *Author on Pennington et al. Current Protocols in Neuroscience, 2021*
- *Next Position: MD, Yale School of Medicine*

2021 Olga Liobimova, Undergraduate Researcher in Shuman Lab

- *Author on Pennington et al. Current Protocols in Neuroscience, 2021*

Senior Thesis Mentor at UCLA

2018-2018 Kevin Li, Psychobiology

- *Author on Pennington et al. Neuropsychopharmacology, 2020*
- *First author poster presentation at UCLA Psychology Undergraduate Research Conference 2018*
- *Next Position: MD, UCSF Medical School*

2017-2018 Dimyana Hana, Neuroscience

- *First author poster presentation at UCLA Neuroscience Undergraduate Research Conference 2018*
- *Next Position: Brand Strategist & Content Creator*

2015-2016 Austin Anderson, Psychobiology

- *Author on Pennington et al. Learning & Memory, 2017*
- *First author poster presentation at UCLA Psychology Undergraduate Research Conference 2016*
- *Next Position: DO, Arizona College of Osteopathic Medicine*

2013-2014 Patricia Stan, Neuroscience

- *First author poster presentation at UCLA Psychology Undergraduate Research Conference 2014*
- *Next Position: Neuroscience PhD, University of Pittsburgh*

2012-2013 Kyra Phillips, Psychology

- *First author poster presentation at UCLA Psychology Undergraduate Research Conference 2013*
- *Next Position: Psychobiology PhD, University of Michigan Ann Arbor*

2012-2013 Taylor Clark, Psychology

- *First author poster presentation at UCLA Psychology Undergraduate Research Conference 2013*
- *Next Position: Neuroscience PhD, UT Austin*

Press and Media

2021 Neuropsychopharmacology Press Release

2017 Society for Neuroscience Press Release

Reviewer:

Journal Review:

Neuropsychopharmacology, Reviewer (since 2021)

Biological Psychiatry, Reviewer (since 2023)

Journal of Neuroscience, Reviewer (since 2023)

Science Advances, Reviewer (since 2024)

References:

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