

Yiyao Zhang

CONTACT INFORMATION

Post Doctoral Researcher
Neuroscience Institute
NYU Langone Medical Center
550 First Avenue, New York, NY 10016

E-mail: Yiyao.Zhang@nyulangone.org
E-mail: yiyaozhang2018@gmail.com
Phone: +1 551 2085630

RESEARCH INTERESTS

The modulation of neural networks plays a pivotal role in shaping our understanding of learning and memory functions, with potential implications for treating a spectrum of brain disorders, including epilepsy, Alzheimer's disease, autism spectrum disorders, and dementia. While previous *in vitro* research has offered valuable insights into the receptors and mechanisms through which neuromodulators influence individual neurons and circuits, their effects on neural networks in free-moving animals during various behavioral states, and their contribution to the development of brain disorders remain largely unexplored. My research is dedicated to unraveling the intricate relationship between neuromodulators and memory function within the hippocampus, both in healthy conditions and under pathological circumstances. I focus primarily on two key neuromodulators, acetylcholine and oxytocin, employing state-of-the-art techniques such as large-scale electrodes including tetrodes, silicon probes, and neuropixel arrays. Additionally, I utilize fiber photometry to observe real-time fluctuations in neuromodulator concentrations at the millisecond scale. This multidimensional approach enables me to uncover critical correlations between neuromodulator activity and the states of neural networks, such as excitation-inhibition balance and synaptic transmission. I also explore the causal relationships between neuromodulators and neural activity by using innovative methods like optogenetics, chemogenetics, and pharmacology. The ultimate aim of my research is to shed light on the intricate connection between neuromodulators and the dynamic states of neural networks, with a particular focus on their potential role in the onset and progression of brain disorders such as epilepsy, Alzheimer's disease, autism, and dementia

EXPERTISE

Large-scale *in-vivo* Electrophysiology recording (tetrode, silicon probes, neuropixel), Optogenetics (Optetrode), Fiber photometry, Neuropharmacology (Intra-brain micro-injection), Behavior.

ACADEMIC EXPERIENCE

NYU Langone Health Neuroscience Institute, New York, NY, USA
Postdoctoral Researcher since July 2018 (**Buzsaki Lab**)

EDUCATION

ECNU, East China Normal University, Shanghai, China

Ph.D., Key Laboratory of Brain Functional Genomics, Ministry of Education / Shanghai Key Laboratory of Brain Functional Genomics, July 2012 to January 2018

- Thesis Title: *Septo-hippocampal Cholinergic Projection Regulate Neural Activity of Hippocampus*
- Advisors: Prof. Dr. Longnian Lin
- Area of Study: large-scale *in-vivo* Electrophysiological neuron activity recording, Optogenetics, Neuropharmacology (Intra-brain micro-infusion), central cholinergic neuromodulation, learning and memory, hippocampus, medial septum.

ECNU, East China Normal University, Shanghai, China

B.Sc., School of Life Sciences, September 2008 to June 2012.

JOURNAL PUBLICATIONS

- [1] **Zhang, Y.***, Karadas, M, Liu, J., Gu, X., Yulong Li, Y., Tsien M., R, Buzsaki, G, Interaction of acetylcholine and oxytocin neuromodulation in the hippocampus. *Under revision of Neuron*.

- [2] **Zhang, Y.***, Cao, L*., Varga, V., Jing M., Karadas, M. Yulong Li, Y., Buzsaki, G, Cholinergic suppression of hippocampal sharp wave ripples impairs working memory. *PNAS*. doi:10.1073/pnas.2016432118
- [3] Ma, X.* , **Zhang, Y.***, Wang, L., Li, N., Barkai, E., Zhang, X., Lin, L. and Xu, J., 2020. The firing of theta state-related septal cholinergic neurons disrupt hippocampal ripple oscillations via muscarinic receptors. *Journal of Neuroscience*, 40(18), pp.3591-3603. doi:10.1523/JNEUROSCI.1568-19.2020
- [4] Zhang, X., Dong, S., Ji, H., **Zhang, Y.***, Yuan, Y*.. Transcranial ultrasound sound stimulation at the peak-phase of theta-cycles in the hippocampus improve memory performance. *NeuroImage*, volume 283, 1 December 2023, 120423. doi:https://doi.org/10.1016/j.neuroimage.2023.120423 .
- [5] Soula, M., Martín-Ávila, A., **Zhang, Y.**, Dhingra, A., Nitzan, N., Sadowski, M.J., Gan, W.B., Buzsáki, G. Forty-hertz light stimulation does not entrain native gamma oscillations or affect Alzheimer’s pathology, *Nature Neuroscience*. doi:https://doi.org/10.1038/s41593-023-01270-2 , citations 19.
- [6] Valtcheva, S., Issa, H.A., Bair-Marshall, C.J., Martin, K.A., Jung K., **Zhang, Y.**, Kwon HB, Froemke RC. Neural circuitry for maternal oxytocin release induced by infant cries. *Nature*, 2023 Sep;621(7980):788-795 doi: 10.1038/s41586-023-06540-4
- [7] Varga, V., Petersen, P., Zutshi, I., Huszar, R., **Zhang, Y.**, Buzsaki, G. Place field-memory field unity of hippocampal neurons. *Cell Reports*, Under review
- [8] Yuan, Y., Zhang, K., **Zhang, Y.**, Yan, J., Wang, Z., Wang, X., Liu, M., Li, X., The Effect of Low-Intensity Transcranial Ultrasound Stimulation on Neural Oscillation and Hemodynamics in the Mouse Visual Cortex Depends on Anesthesia Level and Ultrasound Intensity," *IEEE Transactions on Biomedical Engineering*, 2021 May;68(5):1619-1626. doi:10.1109/TBME.2021.3050797
- [9] Wang X., **Zhang, Y.**, Kaiqing Zhang, Yi Yuan, Influence of behavioral state on the neuromodulatory effect of low-intensity transcranial ultrasound stimulation on hippocampal CA1 in mouse. *NeuroImage*, 2021 Nov 1;241:118441, 34339832 (2021). doi:10.1016/j.neuroimage.2021.118441
- [10] Ma, X., Zhang, Y., Wang, L., Lin, L., Multi-channel in vivo recording technique: microdrive array fabrication and electrode implantation in mice. *Sheng li xue bao : [Acta Physiologica Sinica]*, 01 Dec 2013, 65(6):637-646.

CONFERENCE PUBLICATIONS

- [1] **Zhang, Y.**, Cao, L., Buzsaki G., Cholinergic dynamic in hippocampus. Society of Neuroscience, session 158.08/V13 (2019).
- [2] **Zhang, Y.**, Liu J., Tsien R., Buzsaki G., In-vivo Oxytocin Modulation of Neural Network in Dorsal Hippocampus. Society of Neuroscience, Session 407 - Hippocampal Physiology III, (2022).

AWARDS

The national innovation program of college students

Scholarship for innovation project 101026922, 2009–2010

- Thesis: Resveratrol effect on improving Rat’s in-vitro spontaneous hypertension

Plexon outstanding publication award 2021 recipient

- The Firing of Theta State-Related Septal Cholinergic Neurons Disrupt Hippocampal Ripple Oscillations via Muscarinic Receptors

U19 travel award for SFN2022

- *In-vivo* oxytocin modulation of neural network in dorsal the hippocampus

ACNP travel award for ACNP 61st annual meeting, 2022

- Neuromodulation of acetylcholine and oxytocin on the hippocampus

2023 NARSAD Young Investigator Grant recipient

- Impaired Cholinergic Regulation of Hippocampal Pyramidal cell-Interneuron Interactions May Underly IEDs Mechanism and depression symptoms. Jan 1st, 2024 - Jan 1st, 2026

U19 travel award for SFN2023

- *In-vivo* Interaction of acetylcholine and oxytocin neuromodulation in the hippocampus

TEACHING AND
MENTORING
EXPERIENCE

TAL Education Group, Shanghai, China

- Mathematics teaching
- ✓ 2015–2018 : Mathematical Olympiad and thinking training (age 10-12)

NYU undergraduates mentoring, NY, USA

- Sarah Marn 2019-2020
- Xinyi Gu 2022-present

Graduates mentoring, Yanshan University, Qinhuangdao, China

- Co-advising graduates (Master and Ph.D students) with Prof. Dr. Yi Yuan.

TALK/EVENTS

ACNP2022, Invited talk

- Topic: Broadcasting Cholinergic Control of Memory Across Time: How Slow Can You Go?

Alpha-Omega Company, online

- Topic: Genetic Voltage-indicator *Challenge or Best Partner?*

Joint Neuroscience Colloquium

- Co-host: Learning and Exploiting Sensory Statistics in Decision Making, Athena Akrami, PhD.

Buzsaki lab tour

- Co-organize lab and science tour for NYU undergraduates and NYC high-school students.

COMPUTER SKILLS

- **Programming Language:** MATLAB, Python.
- **Scientific Tools:** Adobes, Autodesk360, Graphpad.