Neural Circuit Unit
Professor Yutaka Yoshida

Abstract

The Neural Circuit Unit is interested in understanding neural circuits to control motor behaviors including locomotion and skilled movements. The Unit primarily focuses on formation, function, and regeneration of motor circuits using a variety of techniques such as optogenetics, electrophysiology, molecular biology, and mouse genetics.

1. Staff

- Yutaka Yoshida, Professor
- Ayako Murayama, Staff Scientist (- March 2024)
- Tomoko Yamanaka, Staff Scientist
- Kumiko Saitou, Postdoctoral Scholar
- Yu Takata, Postdoctoral Scholar
- Lokesh Agrawal, Postdoctoral Scholar (August 2023-)
- Chi Man Tong (December 2023-)
- Ken Matsuura, Research Unit Technician
- Esther Lai, Research Unit Technician
- Tomoe Shimazaki, Research Unit Technician
- Tomoe Owan, Research Unit Administrator

2. Collaborations

2.1 Evolutionarily distinct, species-specific motor circuits

- Description: comparison of mRNAs in neurons within motor circuits between rodents and primates
- Type of collaboration: Joint research
- Researchers:
    - Professor Masahiko Takada, Center for the Evolutionary Origins of Human Behavior, Kyoto University

2.2 To understand how muscles are activated during motor behaviors

- Description: Measuring of muscle activity during motor behaviors
- Type of collaboration: Joint research
- Researchers:
    - Associate Professor Samuel Sober, Emory University

2.3 Analysis of motor circuits

- Description: determination of function of different motor circuits
- Type of collaboration: Joint research
- Researchers:
    - Research Assistant Professor Fumiyasu Imai, Weill Cornell Medicine

2.4 Spinal cord injury

- Description: spinal cord injury
- Type of collaboration: Joint research
- Researchers:
    - Associate Professor George Mentis, Columbia University

2.5 Spinal cord injury

- Description: spinal cord injury
- Type of collaboration: Joint research
- Researchers:
    - Professor John Martin, City of College in New York

2.6 Amyotrophic lateral sclerosis (ALS)

- Description: ALS
- Type of collaboration: Joint research
- Researchers:
    - Associate Professor Neil Shneider, Columbia University

2.7 Friedreich’s ataxia (FRDA)

- Description: FRDA

- Type of collaboration: Joint research
- Researchers:
    - Assistant Professor Joriene C de Nooij, Columbia University

3. Activities and Findings

We have been studying how corticospinal circuits are formed, and how they control skilled motor behaviors. We have shown that plexinA1/A3-semaphorin5A/5B signaling controls axon fasciculation of corticospinal circuits (Gu et al., 2023). We also demonstrate that layer Va neurons are major presynaptic partners of corticospinal neurons (Imai et al., 2024). In addition, we find that modulation of both intrinsic and extrinsic signaling with neuronal modulation promotes motor recovery after spinal cord injury (Takatani et al., 2024).

4. Publications

4.1 Journals

1. Gu Z., Matsuura K., Letelier A, Basista M., Craig C., Imai F, and Yoshida Y. *Axon fasciculation, mediated by transmembrane semaphorins, is critical for the establishment of segmental specificity of corticospinal circuits.* Journal of Neuroscience, 43 (32): 5253-5768 (2023).
2. Nishiyama M., Kalambogias J., Yang E., Lang S., Imai F., de Nooi J.j, and Yoshida Y. *Anatomical and functional analysis of corticospinal tract in FRDA mouse model*. bioRxiv. (2024).
3. Imai F., Matsuura K., Yang E., Klinefelter K., Alexandrou G., Letelier A., Takatani H., Osakada F., and Yoshida Y. *Layer Va neurons, as major pre-synaptic partners of corticospinal neurons, play critical roles in skilled movements.* bioRxiv. (2024).
4. Takatani H., Fujita N., Imai F., and Yoshida Y. *Forelimb motor recovery by modulating extrinsic and intrinsic signaling as well as neuronal activity after the cervical spinal cord injury.* bioRxiv. (2024).
5. Sawada M., Hamaguchi A., Mano N., Yoshida Y., Uemura A., and Sawamoto K. *PlexinD1 signaling controls domain-specific dendritic development in newborn neurons in the postnatal olfactory bulb.* Frontiers in Neuroscience, 17: 1338853 (2023).
6. Upadhyay A., Gradwell M.A., Vajtay T.J., Conner J., Sanyal A.A., Azadegan C., Patel K.R., Thackray J.K., Bohic M., Imai F., Ogundare S.O., Yoshida Y., Abdus-Saboor I., Azim E., Abraira V.E.. *The Dorsal Column Nuclei Scale Mechanical Sensitivity in Naive and Neuropathic Pain States.* bioRxiv [Preprint]. 2024 Apr 25:2024.02.20.581208. doi: 10.1101/2024.02.20.581208. (2024).
7. Khan M. Y., Chen J., Jain V., Agrawal L., Lin C. J., Chen M., The Influence of Surface Modification on the Shortwave Infrared Emission of Rare-Earth-Doped Nanoparticles. Journal of Medical and Biological Engineering (2024)

4.2 Books and other one-time publications

Nothing to report

4.3 Oral and Poster Presentations

1. Saitou K. Yoshida T. Ohki K. Neural activity underlying the local cue detection during visual discrimination in mouse visual cortex, The 46th Annual Meeting of the Japan Neuroscience Society, Sendai, Japan, August 2 (2023)
2. Yoshida Y. *Descending control of skilled motor behaviors*, Symposium to honor the career of Dr. Michael O'Donovan, NIH, USA, November 9-10 (2023)
3. Takata Y., *Morphological characteristics of giant pyramidal cells constituting the corticospinal tract and their effects by CNS injury*, The 28th Annual Conference of the Japanese Association for Basic Physical Therapy, Hiroshima, Japan, December 3 (2023)
4. Yoshida Y. *Descending and ascending motor pathways to control skilled movements*, SALK Institute, USA, January 5 (2024)
5. Yoshida Y. *Descending and ascending motor pathways to control skilled movements*, Cincinnati Children's Hospital Medical Center, USA, January 24 (2024)
6. Agrawal L. *Neural graft technology: a novel way to address the clinical challenges related to the treatment of neural traumas*, International ISN-MLSU First Neurochemistry Research Techniques & Management of Neurological disorders, Mohanlal Sukhadia University, India, January 24 (2024)
7. Tong C., Agrawal L., Yoshida Y. *Personalization of regenerative medicines to address the clinical challenges related to neural traumas*, Kyushu Medical School, Japan, January 30 (2024)
8. Yoshida Y. *Descending motor circuits to control skilled movements in wild-type mice and a mouse model of diseases and injuries*, City of College in New York, USA, February 15 (2024)

5. Intellectual Property Rights and Other Specific Achievements

Nothing to report

6. Meetings and Events

6.1 Sensorimotor circuits for limb control

- Date: March 5 -8, 2024
- Venue: OIST Campus Sydney Brenner Lecture Theater
- Co-organizers: The Institute of All But Cats (IABC)
    - Eiman Azim (Salk)
    - Rui Costa (Columbia University)
    - Tadashi Isa (Kyoto University)
    - Marylka Yoe Uusisaari (OIST)
- Speakers:
    - Turgay Akay (Dalhousie University, Canada)
    - Francisco Alvarez (Emory University, USA)
    - Eiman Azim (Salk, USA)
    - Jay Bikoff (St. Jude Children's Research Hospital, USA)
    - Joriene De Nooij (Columbia University, USA)
    - Graziana Gatto (University Hospital of Cologne, Germany)

- Martyn Goulding (Salk, USA)
- Sten Grillner (Karolinska Institute, Sweden)
- Edmund Hollis (Weill Cornell Medicine, USA)
- Tadashi Isa (Kyoto University, Japan)
- Artur Kania (IRCM, Canada)
- Claudia Kathe (University of Lausanne, Switzerland)
- Ole Kiehn (University of Copenhagen, Denmark) *online
- Ariel Levine (NIH/NINDS, USA)
- John Martin (CUNY, USA)
- Mackenzie Mathis (EPFL, Switzerland) *online
- Masanori Matsuzaki (University of Tokyo, Japan)
- George Z. Mentis (Columbia University, USA)
- Yukio Nishimura (Tokyo Metropolitan of Medical Science, Japan)
- Gerald Pao (OIST)
- Samuel Pfaff (Salk, USA)
- Abigail Person (University of Colorado, USA)
- Andrew Pruszynski (Western University, Canada)
- Vibhu Sahni (Weill Cornell Medicine, USA)
- Kazuhiko Seki (National Institute of Neuroscience, Japan)
- Samuel Sober (Emory University, USA) *online
- Aya Takeoka (NERF/KU Leuven, Belgium)
- Marylka Yoe Uusisaari (OIST)
- Yutaka Yoshida (Burke Neurological Institute/Weill Cornell Medicine and OIST)
- Laskaro Zagoraiou (Biomedical Research Foundation of the Academy of Athens)
- Niccolo Zampieri (Max Delbruck Center, Germany)

7. Other

Nothing to report.