thermosensory neuron during aging and lays the foundation for future exploration of molecular underpinnings of such age-dependent changes in the sensory system. (supported by National Health Research Institutes, NHRI-EX106-10529NI and the Ministry of Science and Technology, MOST 104-2320-B-002-058-MY3)

721C Identification and analysis of multifunctional neurons in a *C. elegans* thermotaxis behavior. *M. Ikeda*, S. Nakano, A. Giles, I. Mori Neuroscience Institute and Group of Molecular Neurobiology, Graduate School of Science, Nagoya University, Nagoya.

Neurons in *C. elegans* are multifunctional and can encode multiple behavioral outputs. However, how a set of neurons in a circuitry regulate multiple outputs still remains poorly understood. To challenge this problem, targeting the whole functional neural circuits from controllable sensory input to behavioral outputs would be an essential approach, in which worms' behaviors that are resulted as circuit outputs can be subdivided into appropriate and analyzable behavioral elements.

Here, we combined high-throughput behavior analysis and comprehensive genetic cell ablations to identify a set of neurons that regulates multiple outputs during thermotaxis behavior: the migration of worms toward their past cultivation temperature on a thermal gradient. By using the Multi-Worm Tracker with a custom-built program, we defined and automatically detected subdivided behavioral elements, such as "omega turns," "reversal turns" and "curves." We successfully identified several elements that were regulated during the thermotaxis. We then performed computer simulations and confirmed that the behavioral elements we identified were sufficient to reproduce the actual thermotaxis behavior. The simulations also demonstrated that "curves" and "reversal turns" drove worms to the cultivation temperature most powerfully among any other behavioral elements. To identify the neurons regulating the "curve" and the "reversal turn" behaviors, respectively, we genetically ablated individual neurons including thermosensory neurons such as AFD, AWC and ASI, and a series of interneurons, which are predicted to mediate information between these thermosensory neurons and motor neurons, which had been previously shown to regulate steering behaviors or backward locomotion. Our analyses showed that AFD, AIB and AIZ regulate both "curves" and "reversal turns", and that each of these two behavioral elements recruits distinct sets of additional neurons for their regulation. Interestingly, different sets of neurons were employed to regulate even the same behavioral element, "curve," depending on whether worms were located in above or below the cultivation temperature on the thermal gradient.

Currently, we are constructing mathematical models of the neural circuits, and searching the parameters of the models, which reproduce experimental data. We so far obtained the several optimized parameter sets, which are probably grasping the properties of actual neural circuits. To confirm the validity of the models, monitoring the actual neuronal activities of freely moving worms is underway. Quantitative analysis of the obtained models will shed light on the mechanisms how neurons and neural circuits generate multiple outputs.

722A A low cost bio-imaging system incorporating machine learning algorithms for automatic analysis of animal behavior. *Adam Iliff*, Apurva Virkud, Shawn Xu Life Sciences Institute, University of Michigan, Ann Arbor, MI.

The overall goal of this project is to develop an imaging system with machine learning capabilities to aid in the study of how genes and neural circuits give rise to animal behavior. Our secondary mission was to create a complete imaging system that was low enough in cost for labs to use many devices in parallel, or for high school and college classrooms to be able to conduct imaging-based biological experiments. Imaging equipment has increased in quality and decreased in cost to a point in which we were able to build an ultra-low-cost imaging system for recording animal behavior which could accomplish our objectives. Specifically, the system is optimized for recording locomotion of the genetic model organism *C. elegans* on a near-flat translucent surface. We utilized the free programming language Python with machine learning packages to incorporate automatic analysis of the recorded videos. Several machine learning algorithms for classifying and annotating animal behavior were tested against the performance of human experts, and the top performing algorithms are implemented in the final software. This system has the potential to save researchers time and money and allow them to quickly determine how manipulating genes and neural circuits alters animal behavior. Future plans include adapting the system for other organisms and more complex behaviors.

723B Mechanosensory experience determines nociceptive and proprioceptive behavioral plasticity. *Sharon Inberg*, Yael Iosilevskii , Benjamin Podbilewicz Department of Biology, Technion- Israel Institute of Technology, Haifa, IL.

We are interested in how animals adjust their innate behavioral outputs in response to sensory experience. *C. elegans* has the ability to undergo molecular, cellular and behavioral plasticity. Our sensory experience paradigm involves comparing isolated worms, to those that were grown in crowded conditions. We found that animals grown in isolation exhibit a change in the arborized dendritic structure of the PVD nociceptor neuron. To test behavioral consequences of mechanosensory isolation we used two assays to measure the response to high threshold mechanosensory stimulation and proprioception. We found that isolation induced a decrease in response to harsh touch that was gentle touch-independent, since *mec-4* touch-insensitive worms show the same isolation-induced reduction in response to harsh touch. The reduction in the responsiveness was also demonstrated by optogenetic stimulation of the PVD, where isolated worms exhibit reduced responsiveness. These findings suggest that the presynaptic activities of the PVD are responsible for the experience induced behavioral plasticity. To reveal the mechanisms mediating these behavioral changes we used mutants for a family of voltage independent sodium channels (D*egenerins). We tested mutations on different degenerins for isolation-induced behavioral plasticity and three were found to have reproducible effects: asic-1, mec-10*, and *degt-1.* Most of the combinations of these three genes failed to induce the behavioral plasticity for the response to harsh touch following isolation, indicating that degenerins are important for the experience induced plasticity in response to harsh touch. In parallel to the nociceptive changes following isolation, a change in