“Action is the basic way we interact with the world. My lab is interested in understanding how the brain learns, selects and executes actions. By dissecting the neural circuits and molecular mechanisms underlying the brain’s generation of adaptive behavior, we hope to contribute to the development of more effective therapeutic interventions for neurological diseases, such as Parkinson’s disease and obsessive-compulsive disorder.”

We all explore the world by acting, and learn to repeat actions that lead to happy outcomes and avoid those that lead to unpleasant results. We all balance the cost and the outcome of different possible actions and pick the ones that best match our expectation. How does our brain accomplish such amazing tasks, evaluate situations and direct our behavior according to the ever-changing environment? And why are those extraordinary abilities compromised in different neurological diseases? Studying a series of complex behavioral tasks in mice, Jin’s lab is working to understand how the neurons and molecules in the brain interact to implement the computation, memory and selection of actions.

Numerous motor and mental diseases, including Parkinson’s, Huntington’s, obsessive-compulsive disorder, schizophrenia and depression, have been linked to the dysfunction of circuits composed of basal ganglia, a group of interconnected structures deep in the brain. Jin found that nigral dopaminergic neurons, whose degeneration is responsible for Parkinson’s disease, and the neurons in the striatum, which degenerates in Huntington’s disease, can broadcast the signals selectively for starting or stopping the newly learned action sequences. The finding provides important insights into the action initiation and termination deficits observed in those diseases. His research further demonstrated that learning cognitive actions, such as playing chess or doing math, could involve the same neural circuitry involved in learning motor actions, and that they may share similar molecular mechanisms. This introduces the possibility of studying cognitive action learning and dysfunction in genetic models.

The lab plans to continue exploring the molecular and circuit mechanisms underlying action learning and selection, employing a vast array of cutting-edge genetic, physiological and optical techniques in freely behaving mice. Ultimately, Jin hopes to characterize the fundamental principles of how the brain generates actions from multiple levels of analysis and to develop cures for a wide range of action-related neurological and psychiatric diseases.

For more information, please visit www.salk.edu/faculty/jin