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Spinal Circuit Plasticity for Movement Adaptation

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Motor circuit plasticity lasts into adulthood, enabling us to learn new motor skills, retain learned skills, and regain motor functions following traumatic injury. Remarkable progress has been made using circuit mapping, manipulation, and genetics to identify cell types and circuits in the brain and the spinal cord responsible for movement generation. However, mechanisms remain largely unknown as to how repeated training alters neural connectivity and functions at the level of a single neuron, a circuit, or dynamics across multiple circuits. I will introduce the neural basis of circuit plasticity in which somatosensory dissemination and integration drive spinal learning mechanisms. Using high-density spinal electrophysiological recording in awake, behaving mice and optical tagging of genetically defined spinal inhibitory neurons, we found that gating and dissemination of somatosensory information are critical in this spinal learning paradigm. Interestingly, temporally specific silencing of these neurons impaired learning but did not affect retaining learned behavior. Instead, we found another distinct inhibitory population to be responsible for retention. Together, our work began to reveal the identities of spinal neurons and principles of spinal motor memory encoding. The knowledge gained will provide critical insights into how movement automaticity is achieved in health and recovery after spinal cord injury, where the spinal cord needs to learn to generate movements with severely limited brain input.

References:

Lavaud S, Bichara C, D’Andola M, Yeh S, Takeoka A. (2024) Two inhibitory neuronal classes govern acquisition and recall of spinal sensorimotor adaptation. *Science 384,*194-201.