“Studies in my lab are directed at understanding how different types of spinal cord ‘interneurons’—neurons that bridge communications between sensory and motor neurons—control how we move and how we respond to touch and pain. Knowing more about how these cells develop and function is a critical step in devising new therapies to regenerate and activate circuits in the spinal cord following injury.”

Investigating how movement is controlled lies at the center of our quest for understanding how our nervous system works. We now know that a hierarchy of “motor” networks in the nervous system controls movements. Among these are specialized networks of interneurons in the spinal cord—commonly referred to as central pattern generators (CPGs)—that direct the rhythmic muscle movements that underlie locomotion. These spinal CPGs are engaged and controlled by the brain to produce the coordinated muscle movements that allow us to walk, talk and play an instrument.

Although scientists have known about the locomotor CPG for nearly 100 years, the identity of the neurons that make up the circuitry had remained a mystery. Goulding’s lab, in pioneering efforts to break the molecular code that generates these different interneuron cell types, has begun unraveling the wiring of the spinal cord. Previously, Goulding and his team discovered that a subset of interneurons, called V0 neurons, governs the left-right alternating pattern of activity that is needed for stepping, as opposed to hopping, movements. They have also analyzed the function of other neurons, including V1 neurons that set the pace at which animals walk.

However, identifying the cells that control our ability to flex and extend our limbs has proven more difficult. These have an essential role in movement, as without them we would not be able to bend and stretch our arms and legs. In a recent series of experiments, Goulding’s team identified a second class of inhibitory neuron that cooperates with the V1 neurons to control muscle activity that is needed to move the limbs and walk. Strikingly, they found that the same neurons are present in the spinal cords of swimming vertebrates, leading Goulding to propose that the “walking” CPG is an evolutionary adaptation of the “swimming” CPG circuit. More recently, efforts in the lab have turned to understanding how the spinal CPG is activated both by touch and pain pathways that are important for protective reflexes, and by descending pathways from the brain—knowledge that is essential for developing new treatments for spinal cord injury.

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