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BEHAVIOUR

Doing the locomotion

Rhythmically firing networks of neurons in the spinal cord, known as central pattern generators (CPGs), drive locomotive behaviours. How these circuits are organized to generate the rhythmic bursts of activity that result in left–right and flexor–extensor muscle coordination is still poorly understood. Two studies in *Neuron* shed new light on the contribution of distinct spinal cord interneuron populations to the production of locomotor activity.

Previous work has shown that two groups of developmentally defined interneurons, V0 and V1 neurons, are involved in the alternating bursts of activity between the motor neurons that innervate the left and right hindlimb muscles, and in the regulation of the speed of locomotor outputs. Now, Crone *et al.* and Zhang *et al.* have helped to expand the picture by reporting a contribution from two other types of interneuron in the ventral spinal cord: V2a and V3 neurons.

Crone *et al.* examined the role of V2a interneurons, which are glutamatergic and project ipsilaterally. Selective ablation of these cells in mice affected the locomotor rhythm, by increasing the variability of both the frequency and the amplitude of the bursts. Moreover, it caused a marked disruption of the left–right alternations in activity bursts and impaired the ability to initiate locomotor-like activity upon brainstem or sensory afferent stimulation. Examination of the V2a projections revealed that these neurons directly contact commissural neurons, including the V0 population; this led the authors to suggest that V2a connections onto V0 neurons are at least partly responsible for securing the left–right phasing of the CPG.

Zhang *et al.* investigated the contribution of V3 interneurons, which are also excitatory but project contralaterally. By genetically decreasing the excitability of the V3 neurons, they found that these cells are essential for producing a stable and robust locomotor rhythm. Inactivation of these neurons also resulted in asymmetrical patterns of left–right activity (without affecting left–right alternation), suggesting that, by acting on contralateral excitatory and inhibitory neurons, V3 cells establish a balance between the motor outputs in both halves of the spinal cord.

These papers highlight the role of excitatory transmission in shaping motor output. Although neither of these interneuron populations seem to be absolutely required for rhythmogenesis, it is possible that the effects of a particular, yet to be defined subpopulation might be masked by compensatory changes. The next step towards understanding the neural correlates of locomotion will be to establish the actual connectivity between interneuron subsets and the individual motor neuron pools that trigger the contraction of particular muscles.

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ORIGINAL RESEARCH PAPERS Crone, S. A. *et al.* Genetic ablation of V2a ipsilateral interneurons disrupts left-right locomotor coordination in mammalian spinal cord. *Neuron* **60**, 70–83 (2008) | Zhang, Y. *et al.* V3 spinal neurons establish a robust and balanced locomotor rhythm during walking. *Neuron* **60**, 84–96 (2008)
FURTHER READING Kiehn, O. Locomotor circuits in the mammalian spinal cord. *Annu. Rev. Neurosci.* **29**, 279–306 (2006) | Lanuza, G. M., Gosgnach, S., Pierani, A., Jessell, T. M. & Goulding, M. Genetic identification of spinal interneurons that coordinate left-right locomotor activity necessary for walking movements. *Neuron* **42**, 375–386 (2004) | Gosgnach, S. *et al.* V1 spinal neurons regulate the speed of vertebrate locomotor outputs. *Nature* **440**, 215–219 (2006)


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