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SPINAL CORD

Speeding up locomotion

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Neural circuits in the spinal cord generate coordinated locomotor movements. To ensure that the appropriate output is generated in a particular context, these circuits undergo continuous adjustments. In a new study, Ausborn *et al.* shed light on the mechanisms that regulate the speed of zebrafish swimming.

Previous studies have shown that changes in locomotor speed require the sequential activation of excitatory V2a premotor interneurons, which are involved in the generation of locomotor rhythm. However, it remained unclear how these cells are recruited to increase swimming frequency. To investigate this issue, the authors used brainstem–spinal cord preparations from zebrafish in which V2a interneurons express green fluorescent protein. They induced swimming-like activity by electrically stimulating descending axons and recorded the activity patterns of V2a interneurons using patch-clamp techniques. They found that although some V2a neurons were not recruited at all (that is, they never fired an action potential), others were transiently recruited and some were continuously recruited during the entire swimming episode. These findings indicate that V2a interneurons have different recruitment thresholds, so some are more likely to fire and to display larger membrane potential changes during swimming than others.

To characterize these V2a subsets further, the authors examined the amplitude of synaptic membrane potential oscillations with increasing swimming frequencies and showed that the number of transiently recruited interneurons increases as the swimming frequency increases. Interestingly, in embryonic and larval zebrafish, the order of V2a interneuron recruitment correlates with their dorsoventral position, whereas in juvenile and adult zebrafish, this topographic order is lost. Furthermore, they found no correlation between the input resistance of V2a interneurons and their recruitment frequency. Instead, the non-topographic, incremental recruitment of these interneurons is determined by their excitatory synaptic currents and their input resistance.

Finally, the authors suggest that the tight temporal relationship between the synaptic inputs of V2a interneurons and the activity of their target motor neurons is indicative of multiple overlapping microcircuits that are composed of topographically organized motor neurons and non-topographically organized V2a interneurons; such microcircuits ensure the execution of contextually appropriate movements.

Together, these findings provide new insights into the recruitment threshold of V2a interneurons during the adjustment of swimming speed and the organization of spinal circuits involved in the generation of coordinated movement.

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THINKSTOCK

ORIGINAL RESEARCH PAPER Ausborn J., Mahmood, R. & El Manira, A. Decoding the rules of recruitment of excitatory interneurons in the adult zebrafish locomotor network. *Proc. Natl Acad. Sci. USA* **109**, E3631–E3639 (2012)