Public Abstract

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Title:Homeostatic Compensation and Neuromodulation Maintain Synchronized Activity in Motor Neurons of the Crustacean Cardiac Ganglion

Behaviors are generated by electrical activity in the nervous system, which must be able to continuously produce reliable behavior over many decades. The timing of neuronal firing is a fundamental feature of the neuronal activity underlying movement. In some cases, synchronized activity across multiple neurons is desirable. Surprisingly, motor neurons can generate virtually identical electrical activity using different combinations of ion channel proteins. This variability can make neurons vulnerable to desynchronization. However, when synchronized activity is disrupted in motor neurons of the cardiac ganglion, the network is able to restore synchrony within 1 hour. Each individual cell contributes to this process by adjusting its membrane ion channels. Further, at the network level communication through gap junctions is increased to help restore synchrony.

Neurons need to be stable over time, but a certain amount of flexibility is necessary. Neuromodulation is able to adjust the electrical excitability of neurons to provide this flexibility. We found that modulating the cardiac ganglion with serotonin had the side-effect of causing desynchronization, but that dopamine is able to prevent this by signaling for gap junctions to increase in strength. This implicates an important role for neuromodulation in maintaining network stability.