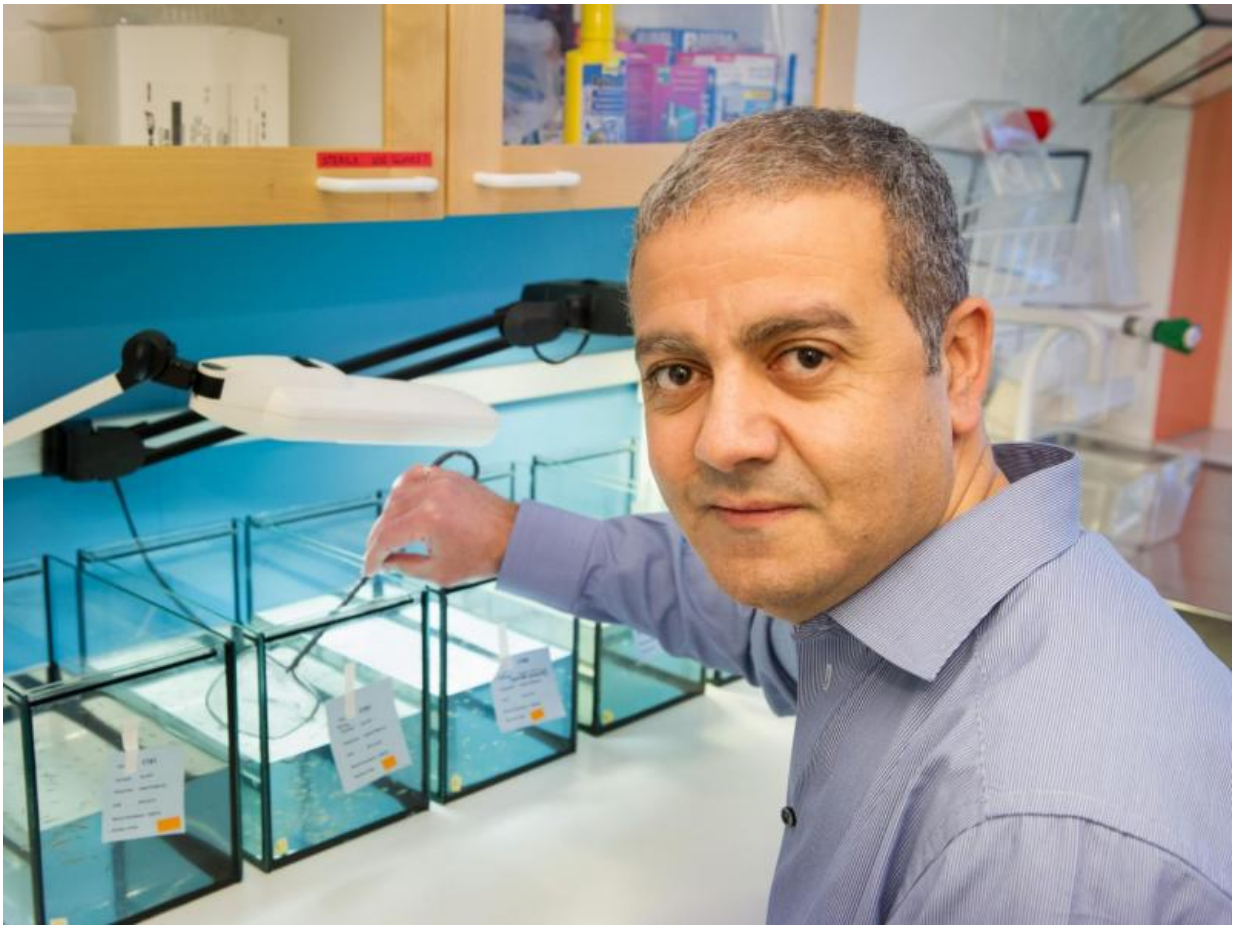
New role for motor neurons discovered

January 13 2016



Dr. Abdel El Manira is a Professor of Neuroscience at Karolinska Institutet in Sweden. Credit: Stefan Zimmerman

A new study presented in the journal *Nature* could change the view of the role of motor neurons. Motor neurons, which extend from the spinal

cord to muscles and other organs, have always been considered passive recipients of signals from interneuronal circuits. Now, however, researchers from Sweden´s Karolinska Institutet have demonstrated a new, direct signalling pathway through which motor neurons influence the locomotor circuits that generate rhythmic movements.

Locomotion is essential to all animals and is based on a carefully balanced interaction between the muscles and the brain. Nerve cells are typically able to both receive and generate electrical impulses, which are then relayed to other nerve cells. The nerve cells that make contact with the muscles are called motor neurons, and for almost a century they have been regarded as passive receivers of the detailed motor programmes generated and elaborated by networks of nerve cells in the spinal cord. According to this model, motor neurons relay the signals faithfully and unidirectionally to the muscles.

"We have now uncovered an unforeseen role of motor neurons in the elaboration of the final program for motor behaviour," says principal investigator Abdel El Manira at Karolinska Institutet's Department of Neuroscience. "Our unexpected findings demonstrate that motor neurons control locomotor circuit function retrogradely via gap junctions, so that motor neurons will directly influence transmitter release and the recruitment of upstream excitatory interneurons."

The study was conducted using zebrafish, a common animal model in neurobiological research because they are transparent and relatively easy to manipulate genetically. Through a combination of different methods, the team has shown that there is a direct link via electrical synapses or gap junctions, between motor neurons and the excitatory interneurons that generate rhythmic swimming motions in the fish. These synapses directly connect two neurons, and enable the transfer of electrical signals between these neurons. With the aid of optogenetics, the researchers selectively silenced the activity of motor neurons and showed that they

have a strong influence on the locomotor circuit function via gap junctions.

"This study represents a paradigm shift that will lead to a major revision of the long held view of the role of motor neurons," says Professor El Manira. "Motor neurons can no longer be considered as merely passive recipients of motor commands - they are an integral component of the circuits generating motor behaviour."

More information: Jianren Song et al. Motor neurons control locomotor circuit function retrogradely via gap junctions, *Nature* (2016). DOI: 10.1038/nature16497

Provided by Karolinska Institutet