

Muscle 'synergies' may be key to stroke treatment

October 20 2009

Researchers at MIT and San Camillo Hospital in Venice, Italy, have shown that motor impairments in stroke patients can be understood as impairments in specific combinations of muscle activity, known as synergies.

Previous work in animals and humans has shown that groups of muscles tend to be co-activated as a unit in predictable patterns, or synergies, across a wide range of movements. These synergies are thought to represent the fundamental building blocks from which the brain constructs complex movements. The new findings support this concept and also suggest new approaches to the rehabilitation of [stroke](#) patients. Stroke is a leading cause of long-term disability in the United States, with about 700,000 new or recurrent cases each year.

The researchers, led by Emilio Bizzi, an MIT Institute Professor and a member of the McGovern Institute for Brain Research and the Department of [Brain](#) and Cognitive Sciences, used electromyographic (EMG) recording to measure activity in arm and shoulder muscles of eight stroke patients as they performed a variety of reaching movements. The patients had stroke damage in one cortical hemisphere only, so one arm was impaired while the other was largely unaffected.

The researchers used computational methods to identify groups of muscles whose activation was correlated across movements. In seven out of eight patients, these correlations, or synergies, were largely identical between the affected and unaffected arms, even though the actual

movements were very different between the two arms. The results support the view that the synergies are encoded in the brainstem or spinal cord, areas that were unaffected in these patients. "We show that descending neural signals from the motor cortex select, activate and combine a small number of muscle synergies specified by networks in the spinal cord or brainstem," Bizzi explains, "and different movements emerge as these synergies are recruited to various degrees."

The findings suggest a new approach to the rehabilitation of stroke patients. By identifying synergies whose activations are affected following a stroke, it may be possible to develop focused rehabilitation methods that specifically train the impaired synergies. As a first step toward this goal, the researchers plan to monitor a group of stroke patients as they undergo rehabilitation therapy, to determine whether the post-stroke improvements in motor function can be explained as changes in the activation pattern of specific synergies.

More information: Chung VC, Piron L, Agostini M, Silvoni S, Turolla A, Bizzi E. (2009). Stability of muscle synergies for voluntary actions after cortical stroke in humans. *Proceedings of the National Academy of Science (USA)*. Oct 19 2009.

Source: Massachusetts Institute of Technology ([news](#) : [web](#))

Citation: Muscle 'synergies' may be key to stroke treatment (2009, October 20) retrieved 7 May 2024 from <https://medicalxpress.com/news/2009-10-muscle-synergies-key-treatment.html>

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