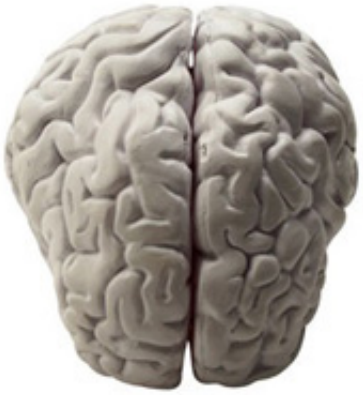
How does the brain create sequences?

January 26 2014



When you learn how to play the piano, first you have to learn notes, scales and chords and only then will you be able to play a piece of music. The same principle applies to speech and to reading, where instead of scales you have to learn the alphabet and the rules of grammar.

But how do separate small elements come together to become a unique and meaningful sequence?

It has been shown that a specific area of the brain, the basal ganglia, is implicated in a mechanism called chunking, which allows the brain to efficiently organise memories and actions. Until now little was known about how this mechanism is implemented in the brain.

In an article published today in *Nature Neuroscience*, neuroscientist Rui Costa, and his postdoctoral fellow, Fatuel Tecuapetla, both working at the Champalimaud Neuroscience Programme (CNP) in Lisbon, Portugal, and Xin Jin, an investigator at the Salk Institute, in San Diego, reveal that neurons in the basal ganglia can signal the concatenation of individual elements into a behavioural sequence.

"We trained mice to perform gradually faster sequences of lever presses, similar to a person who is learning to play a piano piece at an increasingly fast pace." explains Rui Costa. "By recording the neural activity in the basal ganglia during this task we found neurons that seem to treat a whole sequence of actions as a single behaviour."

The basal ganglia encompass two major pathways, the direct and the indirect pathways. The authors found that although activity in these pathways was similar during the initiation of movement, it was rather different during the execution of a behavioural sequence.

"The basal ganglia and these pathways are absolutely crucial for the execution of actions. These circuits are affected in neural disorders, such as Parkinson or Huntington's disease, in which learning of action sequences is impaired", adds Xin Jin.

The work published in this article "is just the beginning of the story", says Rui Costa. The Neurobiology of Action laboratory at the CNP, a group of around 20 researchers headed by Rui Costa, will continue to study the functional organisation of the basal ganglia during learning and execution of action sequences.

More information: Basal ganglia subcircuits distinctively encode the parsing and concatenation of action sequences, DOI: 10.1038/nn.3632

Provided by Champalimaud Neuroscience Programme