Exploring the surprising role of motor system neurons

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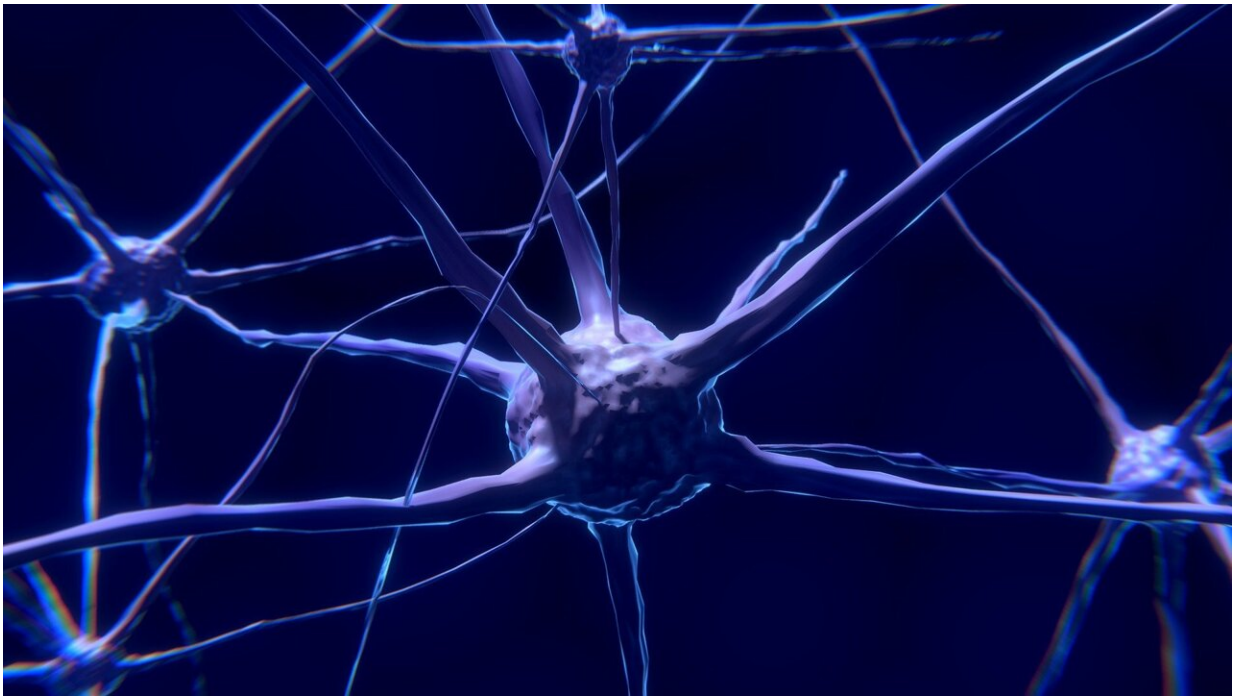

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Motor system neurons not only control movement, but stimulate it. This is the surprising discovery made by the UCLouvain Cognition and Action Laboratory.

Have you ever made a decision too quickly, resulting in a poor choice? The answer is certainly yes: the propensity to make good choices

systematically decreases as the speed at which decisions are made increases. What explains this? The "speed-accuracy trade-off," which is universal in the animal kingdom.

There's no escaping this trade-off, but it's possible to voluntarily regulate it according to the context, by favoring either decision-making speed (to the detriment of the propensity to make good choices) or caution (to the detriment of decision-making speed).

Uninvolved muscles

In a recent study published in *PLOS Biology*, researchers from the Cognition and Actions Lab (UCLouvain Institute of Neuroscience, IoNS) made a surprising discovery. Dr. Gérard Derosière and Prof. Julie Duqué, in collaboration with Dr. David Thura (INSERM, Lyon) and Prof. Paul Cisek (University of Montreal), demonstrated that the activity of neurons projecting to the muscles involved in the execution of a chosen action was strongly amplified when subjects favored quick decisions.

More important, they discovered that this amplification is present in other groups of neurons that project to muscles that are not at all involved in the execution of the chosen action.

Another discovery was that the activity of a third type of neuron is rapidly reduced during the decision, which not only allows us to decide quickly but also to contract specific muscles quickly and thus move more quickly.

The motor system is involved in our choices

"We've succeeded in demonstrating that motor system neurons not only

control movement but also incite action," explains FNRS scientific collaborator Dr. Derosière. "While decision-making is commonly associated with the brain's prefrontal structures, located just above the eyes, our work shows the importance of the motor system in the speed of our choices and in impulsivity."

Recent research on decision-making seemed to suggest that rapidly made choices were based on global changes in the activity of these neurons. However, this hypothesis remained speculative and it remained unclear how decision speed was regulated, because the tools used by scientists did not, until now, allow the activity of these neurons to be recorded accurately.

The UCLouvain team had the idea of using an existing tool, transcranial magnetic stimulation, to establish more precise measurements. The subject is asked to perform a task that requires decision-making; at the same time, neurons in the motor cortex are stimulated and potentials in several muscles (up to nine!) are measured.

A first

"Typically, transcranial magnetic stimulation is used to measure potentials in a single muscle," explains Dr. Derosière. "Here, we stimulated several locations within the skull, which enabled us to measure potentials in many muscles and to establish a detailed map of changes in neuron activity with very good spatial resolution." The result: the researchers were able to demonstrate, for the first time, an amplification of motor cortex activity in a context of impulsivity, but also an amplification of the potentials in the legs of a subject who moves his hands, even though his lower limbs perform no movement!

Addiction

What's the point of this research? Thanks to this study, we know that motor system neurons are directly involved in the regulation of decision speed in healthy subjects. But in addicts (alcoholics, for example), this regulation is disrupted: they decide impulsively and make bad choices. Studying the motor system's role in this context makes sense in the light of this discovery.

More information: Gerard Derosiere et al, Hasty sensorimotor decisions rely on an overlap of broad and selective changes in motor activity, *PLOS Biology* (2022). DOI: 10.1371/journal.pbio.3001598

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