

6 February 2026

Brain network identified for effective treatment of Parkinson's disease

Deep brain stimulation is a key procedure in the treatment of Parkinson's disease. Researchers have now identified the optimal target network in the human brain / publication in 'Brain'

Deep brain stimulation (DBS) improves motor symptoms of Parkinson's disease by modulating a specific brain network that is mainly active in the fast beta frequency range (20 to 35 Hz). This conclusion was reached by an interdisciplinary team of neuroscientists and clinicians from the University Hospitals of Cologne and Düsseldorf, Harvard Medical School and Charité Berlin. The study 'The Deep Brain Stimulation Response Network in Parkinson's Disease Operates in the High Beta Band' in the journal *Brain* is the first to bridge the gap between two ways of analyzing DBS response that were previously widely separate: electrophysiology and brain imaging.

"For the first time, we were able to characterize the DBS response network in Parkinson's disease in terms of space and time, simultaneously," says Professor Dr Andreas Horn from the University of Cologne, who led the study and specializes in computational neurology. "We show that Parkinson's disease can best be treated if we stimulate a very precisely defined network. This network operates synchronized within a specific frequency band, and offers an explanation for how well patients respond to deep brain stimulation."

Deep brain stimulation of the subthalamic nucleus is an established treatment method for alleviating motor symptoms in people with Parkinson's disease by delivering small electric pulses to deep regions of the brain. Whereas previous imaging studies have shown where in the brain the stimulation works best, and electrophysiological studies described the frequency of the underlying signals, no

study has yet been able to capture both dimensions simultaneously in space and time.

The research team analysed data from a large multi-centre cohort with one hundred brain hemispheres from fifty patients. Using brain signals that were simultaneously recorded via the implanted DBS electrode and magnetoencephalography (MEG), the scientists mapped the functional connectivity between the deep and superficial areas of the brain.

The study showed that the relevant network between the subthalamic nucleus and frontal brain regions largely communicates at a comparatively fast frequency (20–35 Hz). The strength of this connection explains how well the motor symptoms of individual patients improved after electrode implantation.

"These results suggest that a certain rhythm of the brain acts as a communication channel between the subthalamic nucleus and the cerebral cortex and may mediate the therapeutic effects of deep brain stimulation," explains Dr Bahne Bahners, first author of the study, who works at Düsseldorf University Hospital. "By stimulating regions that are connected to the identified network, we will probably be able to adjust DBS settings more precisely in the future, especially in patients who have not yet benefited optimally from deep brain stimulation."

In the future, the researchers plan to take a closer look at the causal effects of deep brain stimulation on brain networks. Studies to this effect are currently being conducted.

The study was largely funded by the Professor Klaus Thiemann Foundation.

Media Contact:

Professor Dr Andreas Horn

Institute for Network Stimulation

+49 221 470 2309

andreas.horn@uni-koeln.de



Press and Communications Team:

Dr Anna Euteneuer

+49 221 470 1700

a.euteneuer@verw.uni-koeln.de

Publication and video:

<https://academic.oup.com/brain/article-lookup/doi/10.1093/brain/awaf445>

<https://youtu.be/ZrREFuDI-as>

Press Spokesperson: Dr Elisabeth Hoffmann – e.hoffmann@verw.uni-koeln.de