

# Under pressure: acute emotional reactivity reflected in Subthalamic Beta Oscillations in Parkinson's Disease

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## Introduction

Acute and chronic stress can significantly impact motor behavior in Parkinson's disease (PD) [1]. Chronic local field potentials (LFP) recordings from Deep Brain Stimulation (DBS) patients provide valuable insights into the neurophysiological underpinnings of motor, cognitive, and emotional functions. While STN theta-alpha activity has been linked to neuropsychiatric symptoms like anxiety and depression [2][3], the effects of acute emotional stress on STN beta-band (13-30 Hz) activity remain largely unexplored.

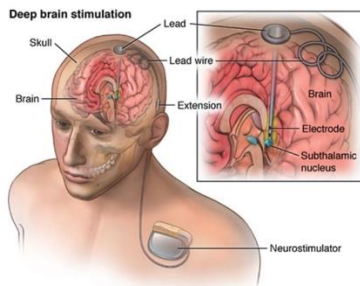


Figure 1. Schematic representation of DBS

## Case report

We present a 51-year-old male with advanced Parkinson's disease (PD), implanted with bilateral STN-DBS and a sensing-enabled system. In March 2025, the patient underwent one month of remote LFP recording to optimize adaptive DBS (aDBS) programming. Following beta peak frequency selection and testing, aDBS was activated. After one month, the patient reported subjective improvements in motor and non-motor symptoms, confirmed by clinical scales. Chronic BrainSense™ data showed effective beta-band modulation, with 40% of LFP activity within the therapeutic range. A day-by-day analysis revealed a recurring increase in bilateral beta-band activity between 7-10 pm, coinciding with the patient providing care to a severely ill family member, a known source of psychological stress.

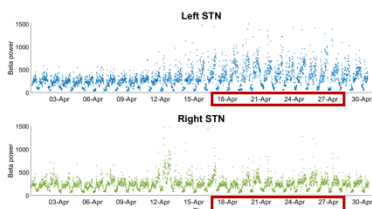


Figure 2. LFP from left and right STN during chronic recordings. The red boxes underline the days in which the stressor event occurred.

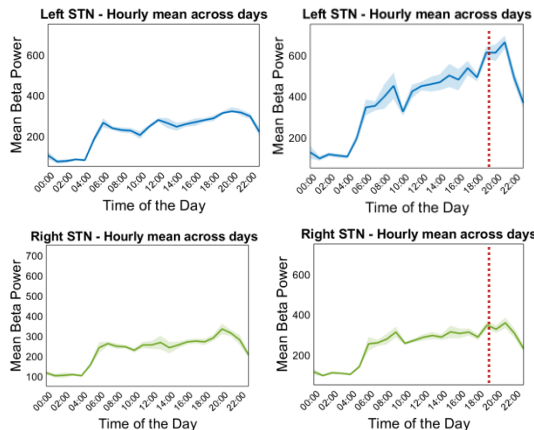


Figure 4. Left and right STN mean hourly beta power oscillations during a stress-free period and under emotional stress.

## Conclusions

This case report suggests that acute emotional stress may modulate neurophysiological beta-band activity in PD patients. It underscores the potential of chronic LFP monitoring in DBS-treated PD patients as a window into the interplay between emotional stress and motor circuit dynamics. These observations support the hypothesis that emotional states may modulate electrophysiological signals and might therefore be relevant for adaptive DBS programming.

### References

- [1] R. L. Blake, M. R. MacAskill, R. Shorran, E. T. J. Anderson, «Stress-evoking emotional stimuli exaggerate deficits in motor function in Parkinson's disease», *Neuropsychologia*, vol. 112, pp. 66-76, apr. 2018, doi: 10.1016/j.neuropsychologia.2018.03.006.
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- [3] E. Bemasoni et al., «Neurophysiological gradient in the Parkinsonian subthalamic nucleus as a marker for motor symptoms and apathy», *Npj Park. Dis.*, vol. 11, fasc. 1, pp. 1-11, gen. 2025, doi: 10.1038/s41531-024-00848-2.



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