A deep brain-computer interface enables patients with Parkinson’s disease to self-regulate pathological oscillations through neurofeedback

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Disclosures

None
Introduction

- Parkinsonian motor symptoms have been linked to increased deep brain $\beta$-oscillatory activity (13–35 Hz).
- $\beta$-activity can be reduced through dopaminergic treatment and deep-brain stimulation (DBS).

- Neurofeedback has been proven to enable the self-regulation of brain activity:
  - EEG-neurofeedback for cortical oscillatory activity
  - real-time fMRI for the deep brain BOLD-signal

- Is the self-regulation of deep brain oscillatory activity through neurofeedback possible?
- Can patients with PD use DBS-electrode guided neurofeedback to self-regulate pathological $\beta$-oscillations?
Methods

- The leads of subthalamic DBS electrodes were connected to an amplifier prior to internalisation.
- $\beta$-activity was extracted in real-time and visualised on a computer screen to provide neurofeedback.
- Patients were tasked to reduce $\beta$-oscillations.
Results

- All patients in this study ($n = 8$) were able to reduce ongoing $\beta$-activity within as little as 6 minutes of neurofeedback training ($p < 0.001$) as compared to their resting $\beta$-activity.

- Control over deep brain $\beta$-activity gradually improved with training time.

- Control over deep brain $\beta$-activity was even possible after removing visual neurofeedback (i.e., deploying the previously learnt mental strategies only) ($p < 0.05$).
Discussion

- Proof-of-principle that ongoing deep-brain electrical activity can be self-regulated through neurofeedback
- PD patients can significantly reduce pathological deep-brain $\beta$-activity.

- Outlook: Can the $\beta$-reduction through DBS-electrode guided neurofeedback
  - improve Parkinsonian motor symptoms?
  - reduce the need for dopaminergic medication or stimulation?
Summary Points

- Neurofeedback is an endogenous method to control ongoing deep brain oscillatory activity.

- Our deep brain-computer interface enabled patients with PD to reduce pathological deep brain $\beta$-oscillations through DBS-electrode guided neurofeedback.