

Is it a word or pseudo word?

Optimized extraction of cortico-subthalamic interactions as biomarker of lexical decisions in Parkinsonian patients

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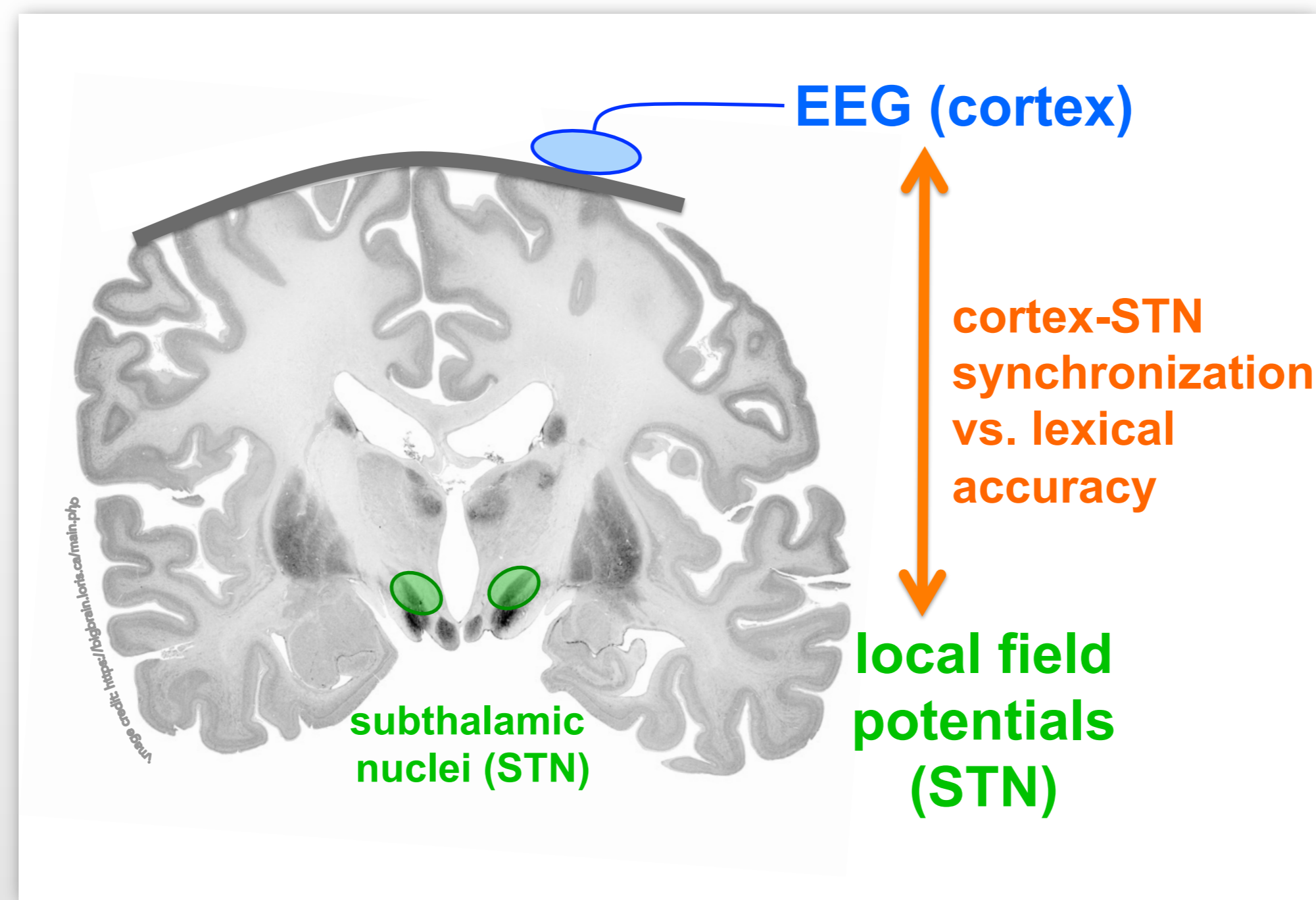


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Background and research questions

- neural **synchronization** between **cortex** and **subthalamic nucleus (STN)** in Parkinson's disease (PD) was shown to relate to movement performance [1]
- question (1): Does cortico-subthalamic coherence also relate to **cognitive aspects of task performance**, e.g., language-related?
- question (2): How to **circumvent challenges** of "standard" coherence studies, i.e., efficiently handling **multi-channel** recordings and avoiding artifacts due to **volume conduction**?



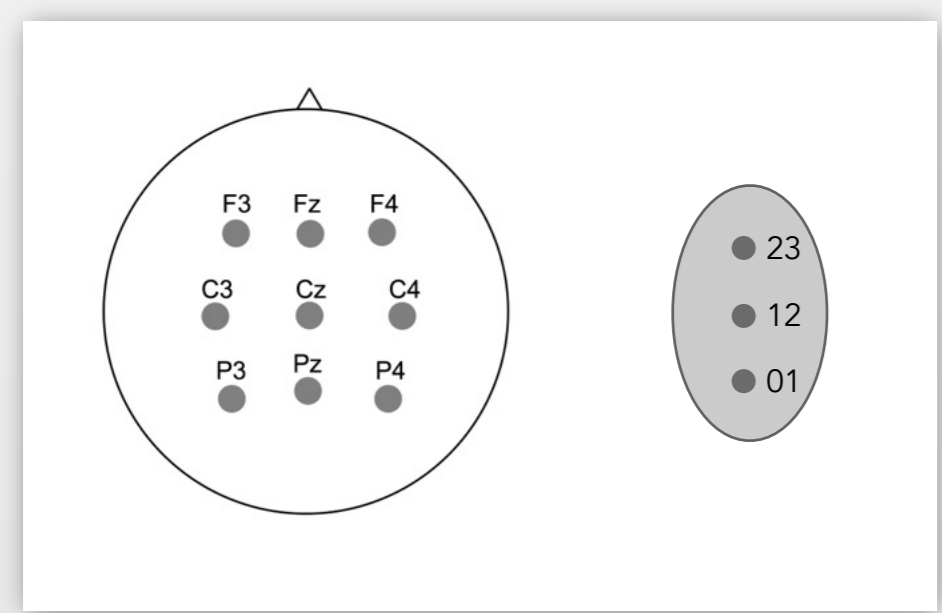
Patients and recordings

- patients with severe idiopathic PD (n=8; 5 males)
- surgery for deep brain stimulation
- mean age 54 years
- simultaneous **EEG-LFP** recordings (analysis: 9 EEG channels, 3 LFP channels per side: 01, 12, 23)
- OFF stimulation, **ON levodopa**
- lexical decision task** (6 min) [2]: button press if genuine word (noun vs. pseudo noun)

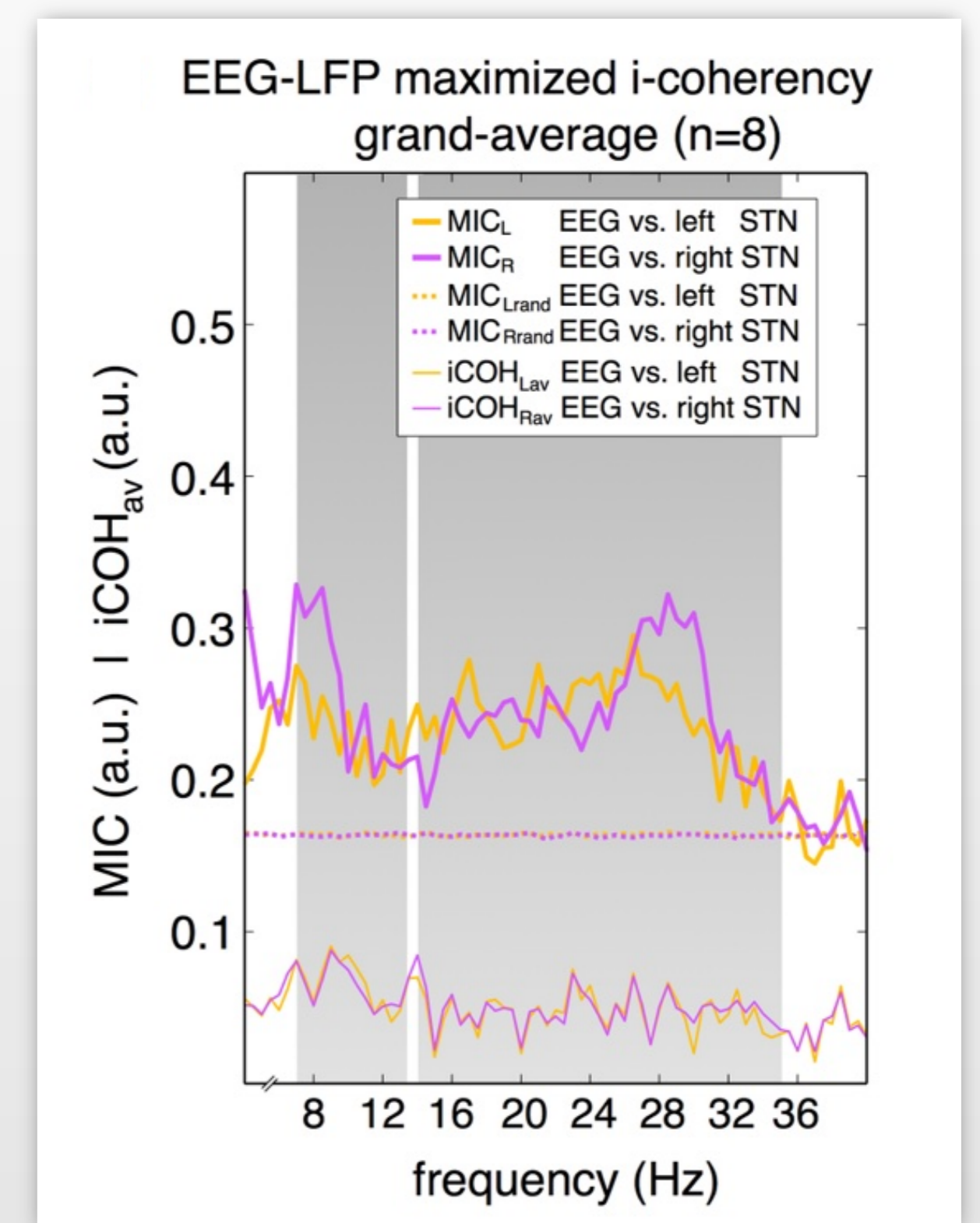
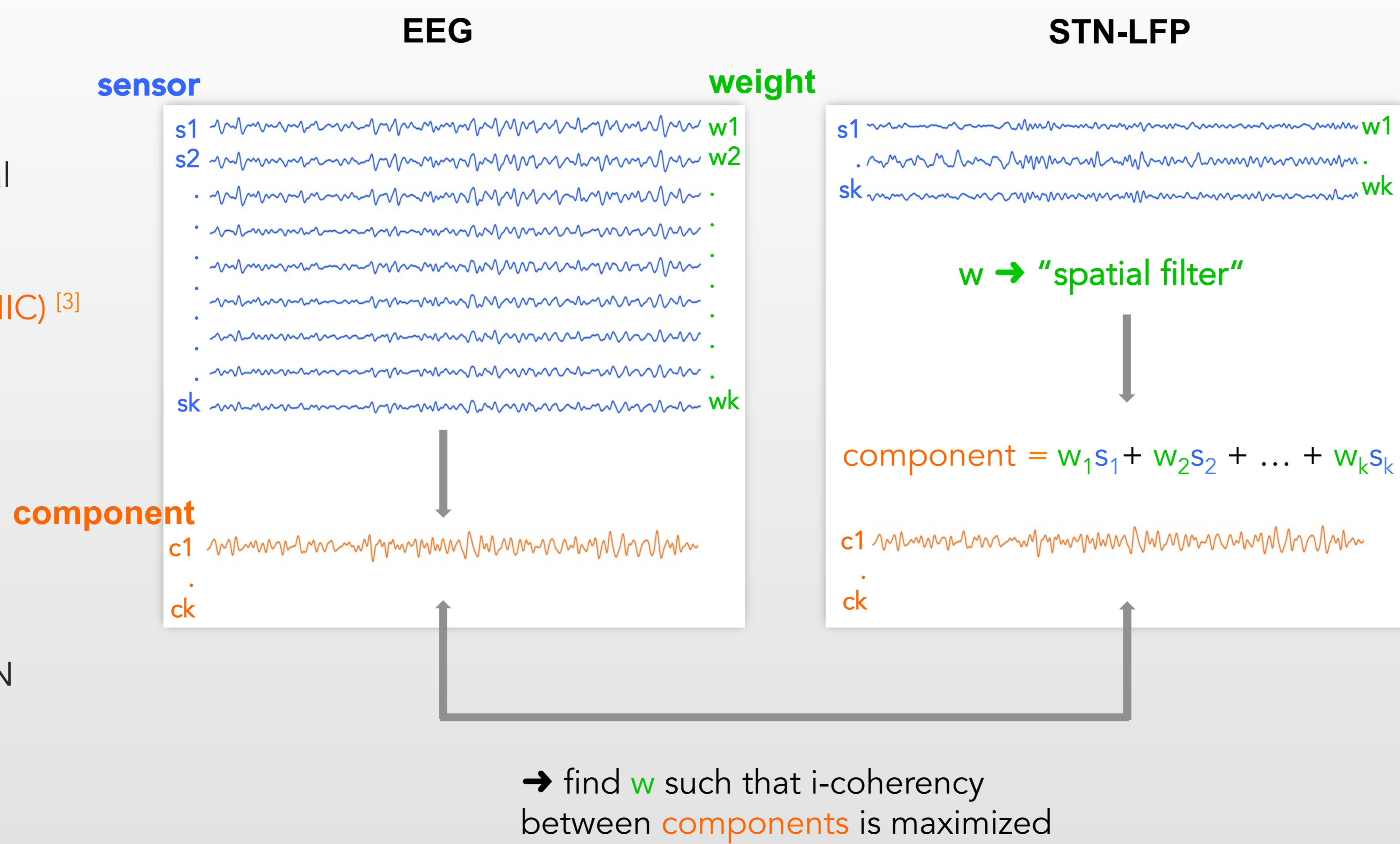
Methods: overcoming the "many-channel challenge" by multivariate extraction of cortico-subthalamic interactions [3,4]

multivariate spatial decomposition:

- extract time-lagged neural synchronization between 2 data spaces
- maximized i-coherency (MIC)** [3]

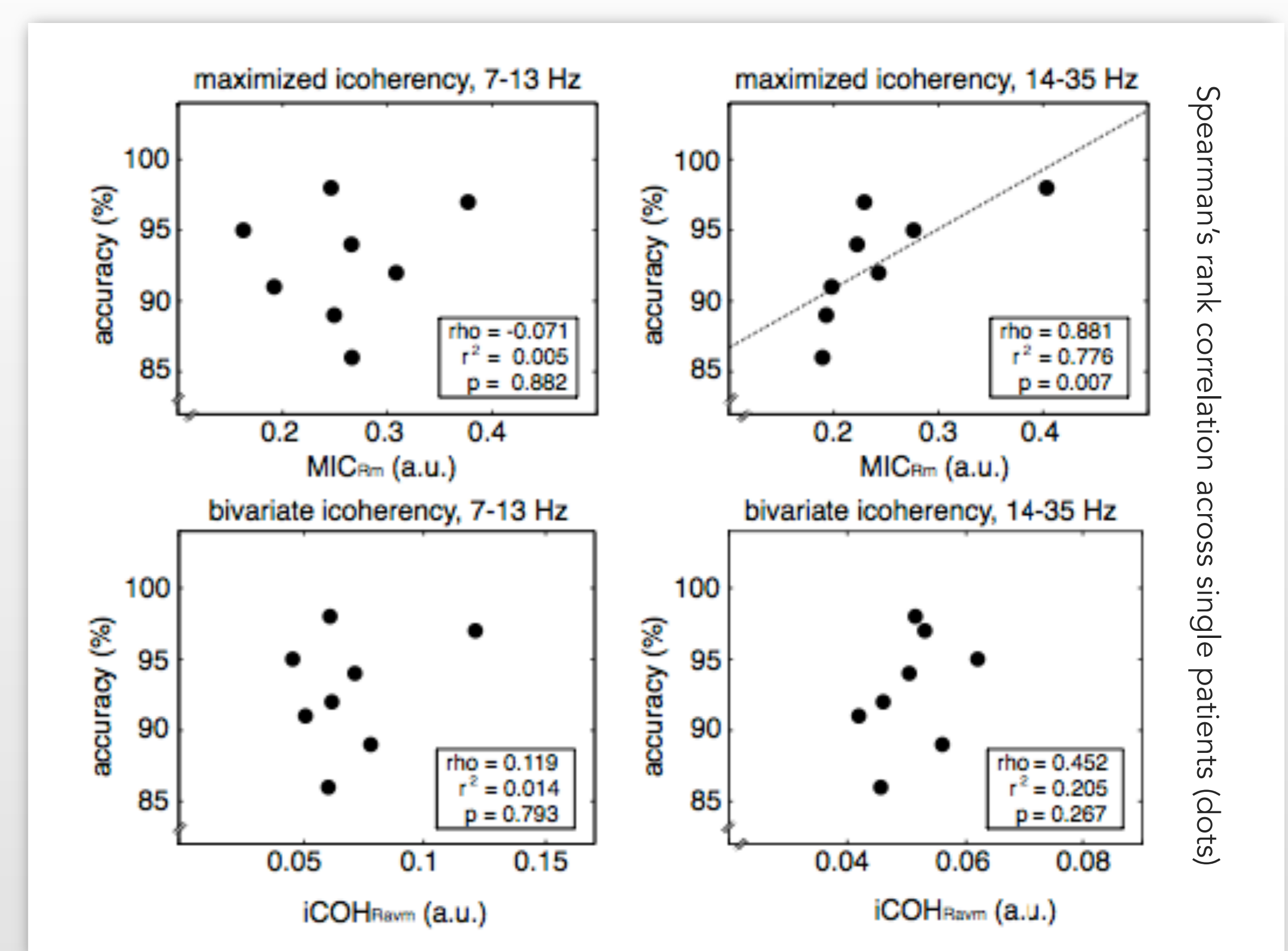
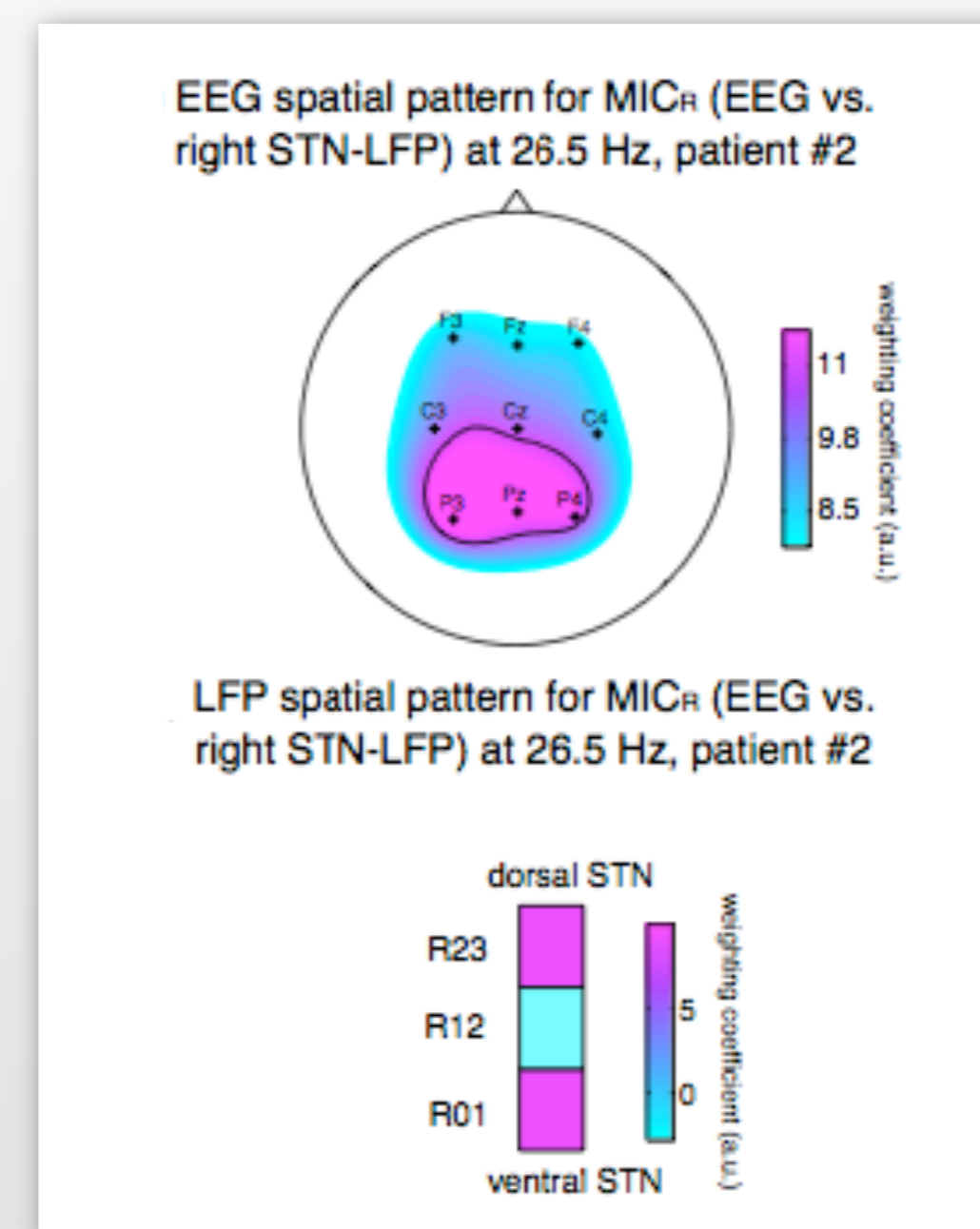
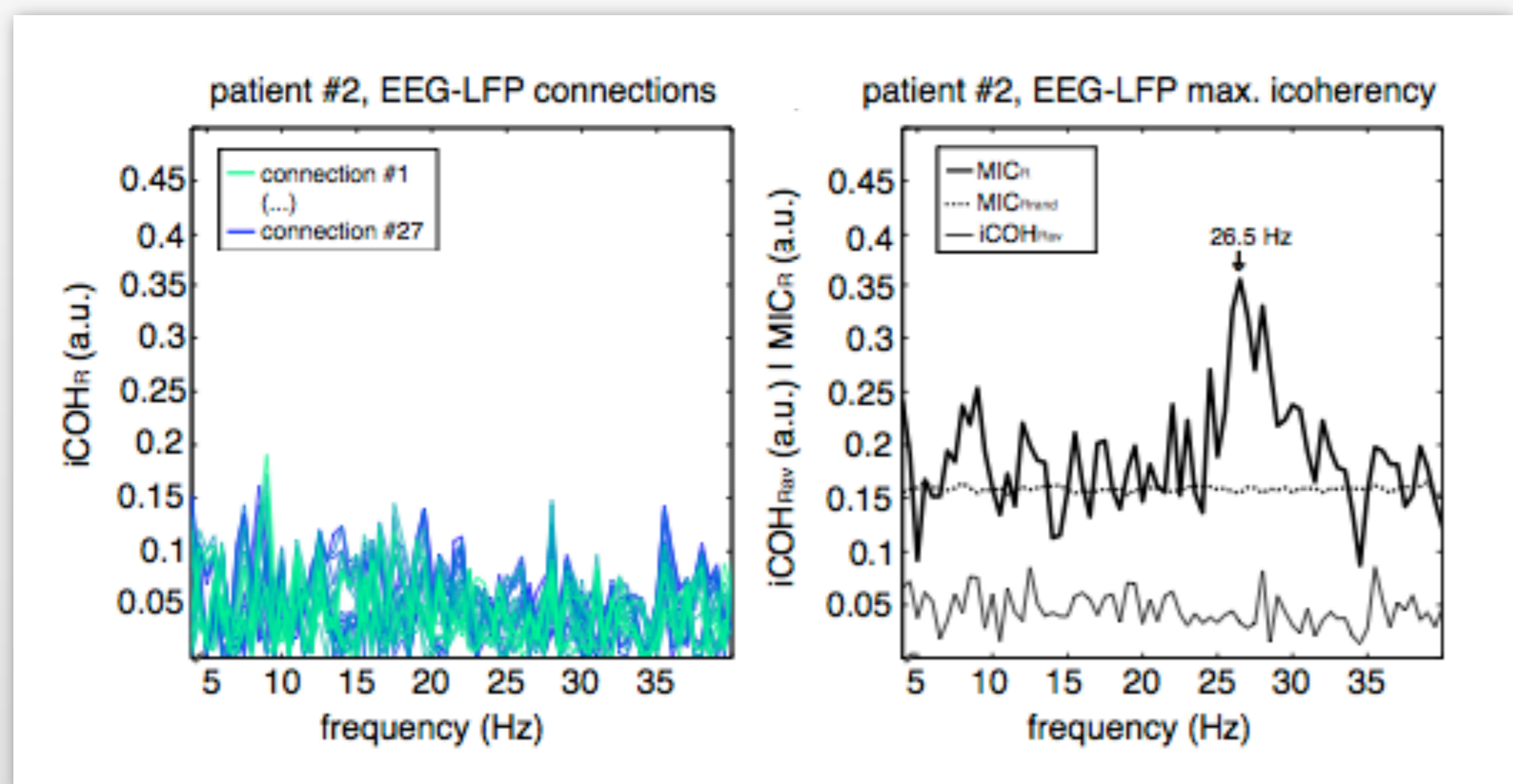


example: EEG vs. right STN = 27 connections → virtual channel



Results: accuracy in lexical decisions correlates with maximized cortico-subthalamic synchronization [4]

- 14-35 Hz oscillations; no correlation between MIC and reaction times or UPDRS, respectively



Summary of results

- increased **cortico-subthalamic** time-lagged **neural synchronization** (14-35 Hz) relates to increased accuracy in **lexical decisions**
- extracted by **multivariate, maximized i-coherency** [3] considering all sensors simultaneously; not significant with the "standard" bivariate i-coherency
- results **not affected by volume conduction** artifacts

Conclusions

- novel finding: **cortico-subthalamic synchronization** relates to **cognitive aspects of task performance**, beyond the motor domain
- relevance of **cortex-STN interactions** for accuracy of **lexical decisions**
- multivariate methods** useful for extracting clinically relevant neural oscillations from multi-channel recordings (beneficial signal-to-noise ratio)

References

- Hirschmann et al. (NeuroImage, 2013)
- Ehlen et al. (PloS One, 2013)
- Ewald et al. (NeuroImage, 2012)
- Hohlefeld et al. (under revision)

Acknowledgements

We thank Dr. Lea K. Engberding-Krugel for her help with the data recordings, and we acknowledge DBS surgery performed by Dr. Gerd-Helge Schneider. The research was supported by the German Research Foundation (DFG) grant no. KFO 247, in addition to SFB 936/Z3 and BMBF (031A130).

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