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
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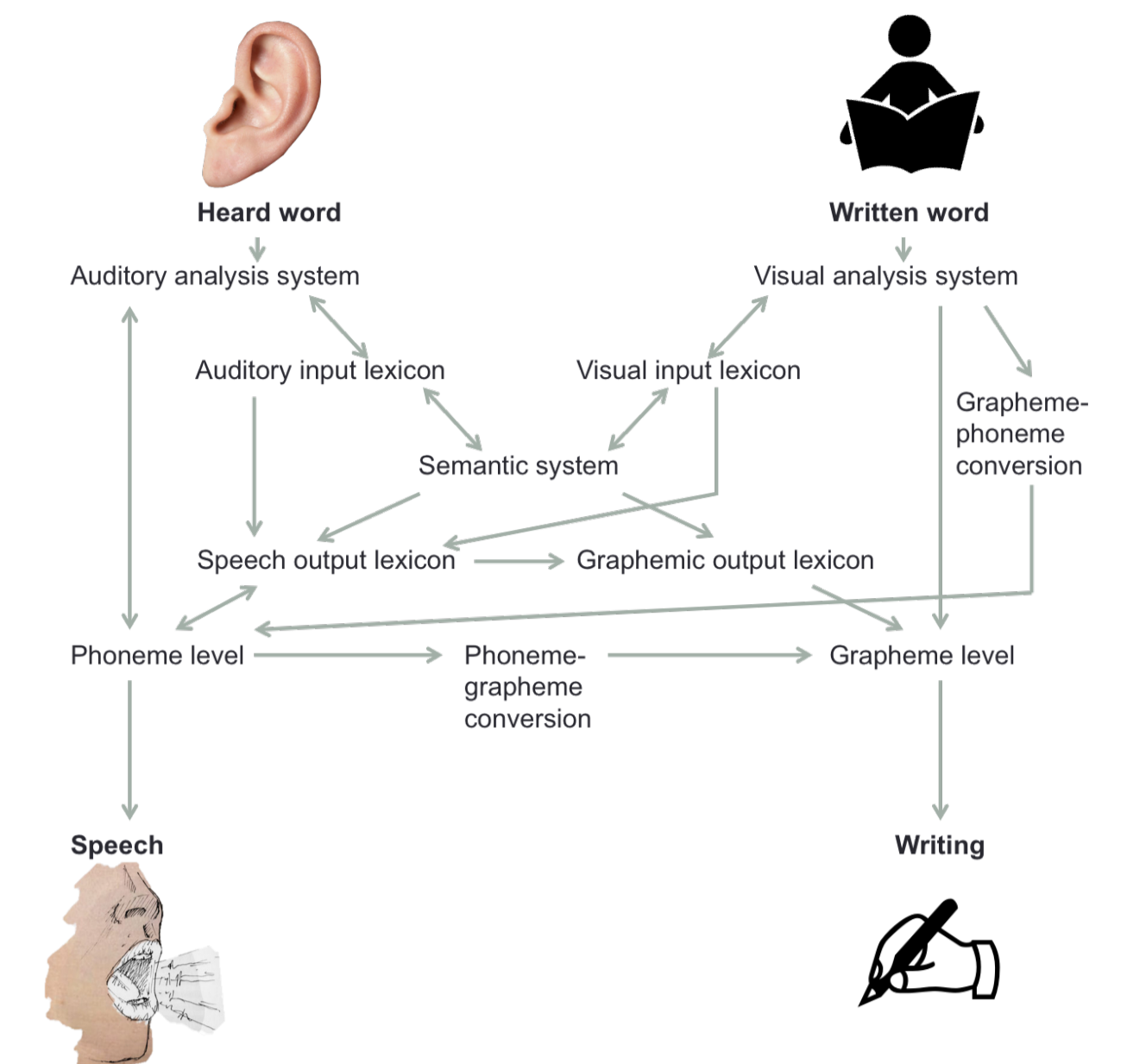
# Subcortical involvement in body and mental action verb processing: an electrophysiological registration study

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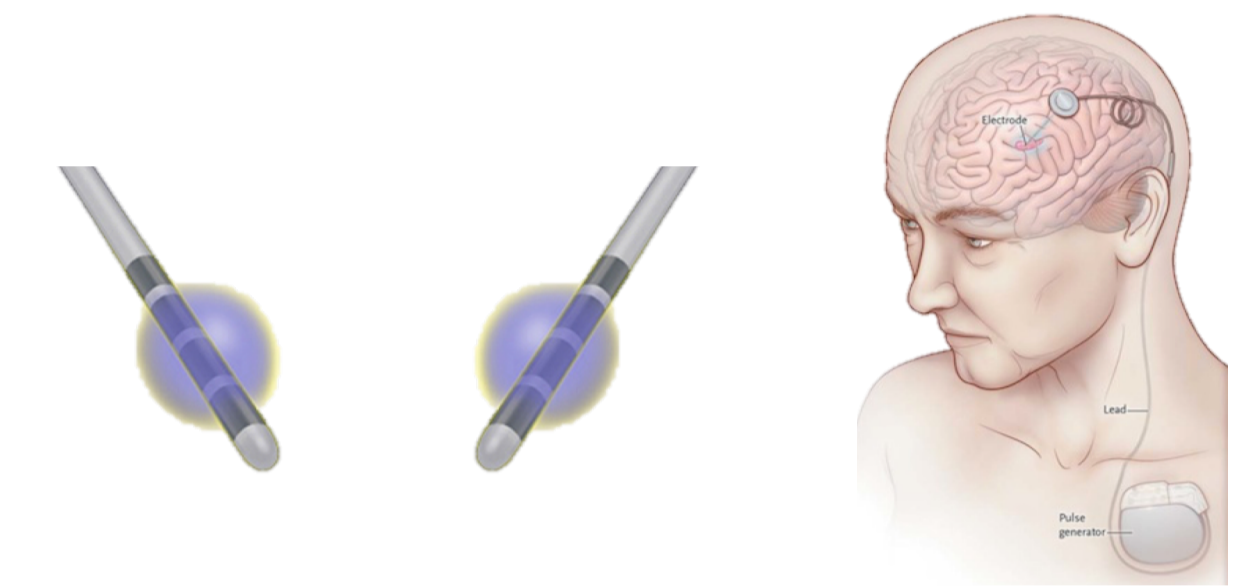
## INTRODUCTION

- The overarching goal of the research group is to investigate **the role of the subcortical nuclei** in language processing.
- Language perception, comprehension and production consist of several different steps, including **the semantic system** (Ellis & Young, 1996).
- Electrophysiological registration (EEG)** has been primarily done at the level of the cortex. It is unclear if semantic related event-related potentials can be elicited in the main subcortical nuclei.
- Semantic processing can be modified by lesions or Deep Brain Stimulation (DBS) in the subcortical nuclei. To what extent, for which demands and how these nuclei are related to each other in the **temporal processing** of semantics is not known yet.
- The current study aims to explore the temporal interaction between the subthalamic nucleus (STN), pedunculopontine nucleus (PPN) and the thalamus during semantic processing through **direct registration** of electrophysiological signals in these deep brain nuclei.
- Direct registration of language elicited EEG in the deep brain nuclei is only possible in patients recruited for **deep brain stimulation** as a treatment for their illness and in the short period after the operation during which the electrode leads are still externalized.



## METHODOLOGY

- Deep Brain Stimulation (DBS) neurosurgical procedure:
  - Implantation of electrodes in target site based on stereotactic procedures.
  - DBS electrode leads stay **externalized for 1 week** during which electrophysiological registration is possible.
- Recording through **quadripolar** electrodes while the externalized leads were connected to the registration device (Neurosoft) using an in-house made interface. Data was collected using a 32 channel SynAmp (Neuroscan) amplifier.
- Signal processing, analysis** and **source localization** were performed in BrainVision Analyzer 2.
- Population:
  - 18 patients with **STN** stimulation for Parkinson's disease (age 45-71; 8 male, 10 female).
  - 2 patients with **thalamic VIM** (ventrointermediate nucleus) stimulation for essential tremor (age 56-73; 1 male, 1 female).
  - 1 patient with **PPN** stimulation for Parkinson's disease (age 50; male).
- Paradigm:
  - Silent reading task consisting of 30 **body action verbs** (e.g. to throw, to point, to wave) and 30 **mental action verbs** (e.g. to think, to develop, to succeed).
  - Testing both with (ON) and without (OFF) **dopaminergic medication** in case of Parkinson's disease.

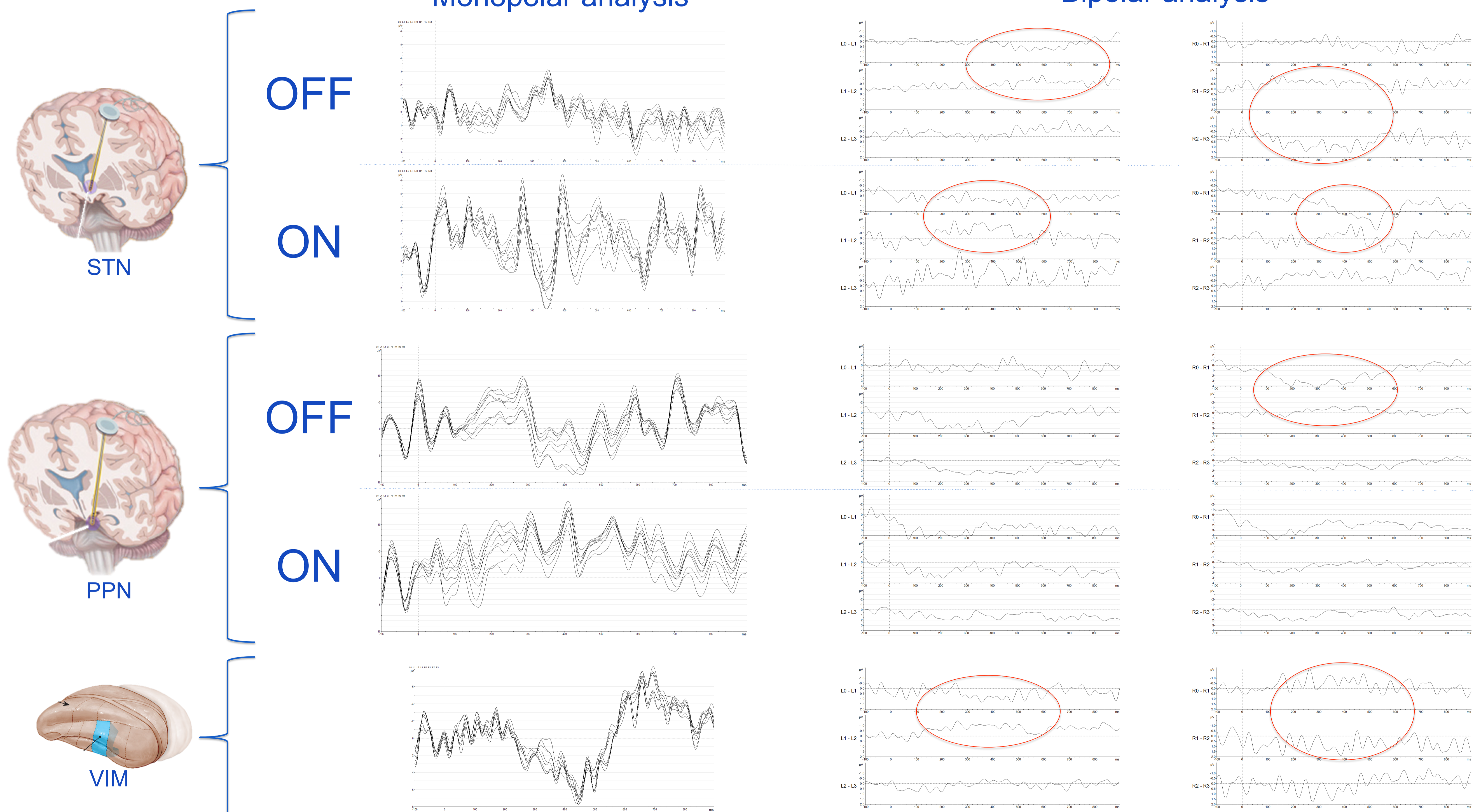


## RESULTS

### Difference waves: Body action verbs – Mental action verbs

#### Monopolar analysis

#### Bipolar analysis



## DISCUSSION

- Subthalamic nucleus:**
  - Right hemisphere : early semantic processing (100-500ms).
    - cfr. P400cz reflects integration into a sequential representation (Dien et al., 2010).
  - Left hemisphere : late semantic processing (500-700ms).
    - cfr. N600 reflects explicit interpretation of stimulus semantics (Cummings et al., 2006).
- Pedunculopontine nucleus:**
  - Right hemisphere : activation (250-450ms).
    - Decision making (Gut et al., 2016).
  - Left hemisphere : no activation was found.
- Thalamus (ventrointermediate nucleus):**
  - Bilateral : Semantic processing (200-500ms).
    - cfr. N400 reflects established meaningful, but not necessarily lexico-semantic representations (Cummings et al., 2006).
- Cortical ERP studies** (Dien et al., 2003 and 2010; Cummings et al., 2006):
  - Semantic evidence for visually presented sentences:
    - N400 (N400pz and P400cz).
    - P600oz and N600.
- Intracranial ERP study** (McCarthy et al., 1995):
  - Semantic evidence for visually presented sentences:
    - Hippocampal area (400ms).
    - Anterior to hippocampal area (500-600ms).

## CONCLUSION

- Subthalamic nucleus : **partial participation** in semantic processing.
- Thalamus (VIM) : **full participation** in semantic processing.
- Pedunculopontine nucleus : **decision making** during semantic processing.

Scan to see abstract 46:

