A Novel Database Lookup Method for Deep Brain Stimulation Network Mapping

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1. INTRODUCTION

- **Clinical outcomes** following deep brain stimulation (DBS) to the subthalamic nucleus (STN) **in Parkinson's disease** (PD) can be **predicted based on functional connectivity (FC)** seeding from stimulation sites [1].
- Previously, to do so, optimal connectivity was condensed to a single map, which was then compared with connectivity profiles of patients in other cohorts.

AIM:

- We developed a revised strategy, which stores each patient's **FC profile** and **clinical improvements** in a **look up database** and quantifies **pairwise similarities** to predict unseen patients. Novel patient's FC is compared to each entry in the database. Based on similarities, a weighted average of improvements in database patients is formed to predict outcomes in the unseen patient.

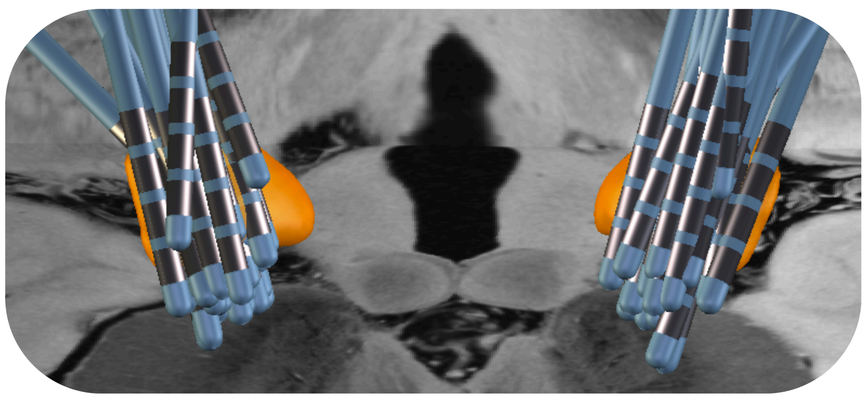
2. METHODS

- **PATIENTS:** 51 PD-STN patients that underwent surgery at Charite Berlin.
- **CLINICAL IMPROVEMENT:** Unified Parkinson's disease rating scale III (UPDRS-III).
- **CONNECTOME:** Normative resting-state connectome calculated from 1,087 scans included in the Human Connectome Project [2].
- **METHODOLOGICAL WORKFLOW:**

(1) DBS electrode placement and stimulation volumes (E-fields) were reconstructed using Lead-DBS software. FC fingerprints were estimated by seeding from E-fields using the normative connectome.

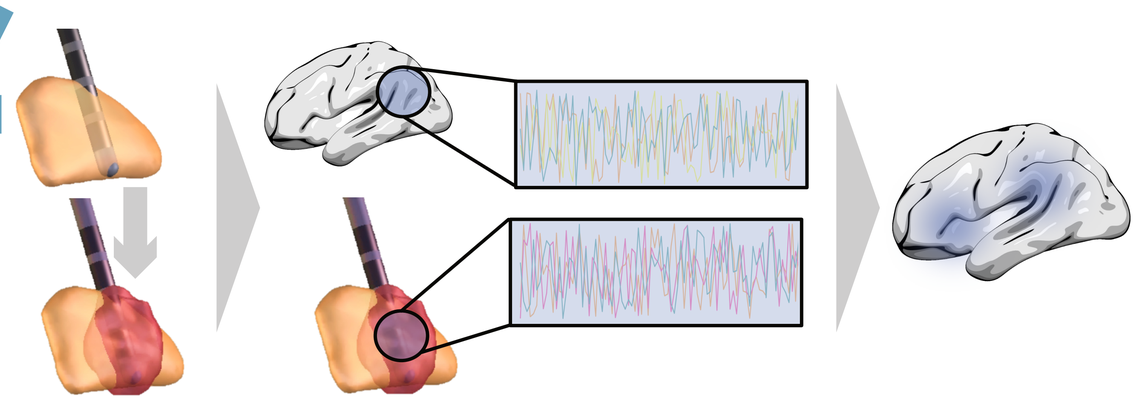
(2) Lookup Database method was used to predict clinical improvement in unseen patients (multiple cross-validation designs).

1.

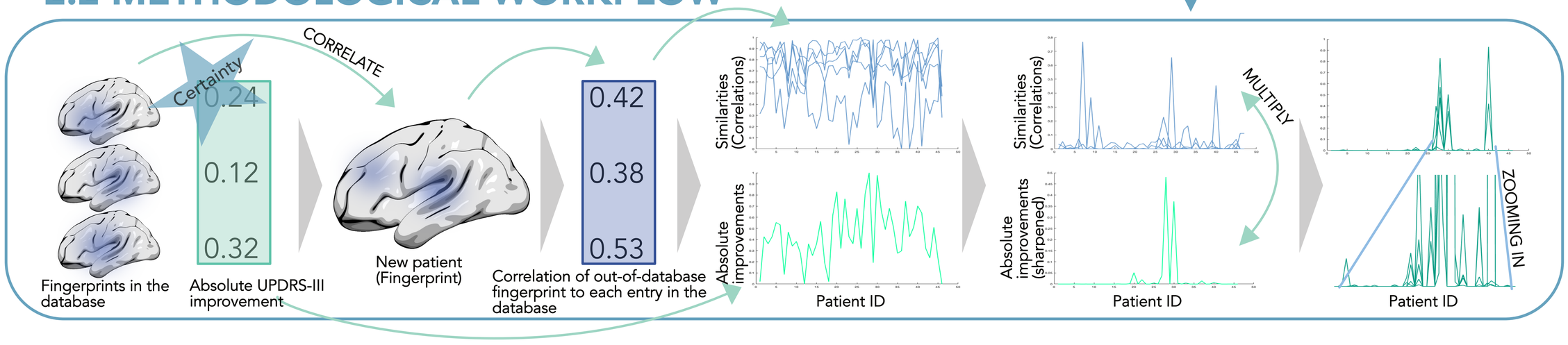


DBS electrode placement in the sample of 51 patients. Electrode reconstructions shown in blue, together with STN (orange) as defined by the DISTAL atlas [3].

2.1

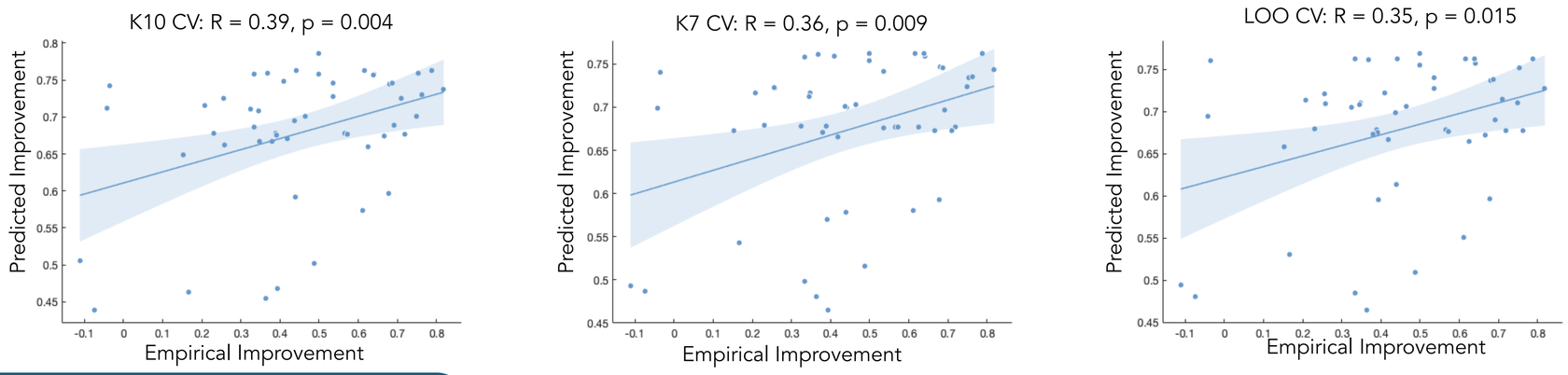


2.2 METHODOLOGICAL WORKFLOW



Database with brain functional connectivities can be used to predict DBS related clinical improvement.

3.



3. RESULTS

- Correlations between **estimated** and **empirical UPDRS-III** improvements for different types of cross-validations were:
  - **K10:** Pearson's R = 0,.39, p = 0.004
  - **K7:** Pearson's R = 0.36, p = 0.009
  - **Leave-one-out:** Pearson's R = 0.35, p = 0.015

Poster PDF & references.

4. CONCLUSIONS

- We introduce a **novel method for DBS network mapping** using a lookup database. Potential advantages include:
  - Model retains **more information** from the original data.
  - **Direct prediction** of clinical response variable.
  - Certainty variable added to account for the **ceiling effect.**

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