Functional connectivity differences between ECoG signals during motor movement vs. motor imagery

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Miller & Pearson Background

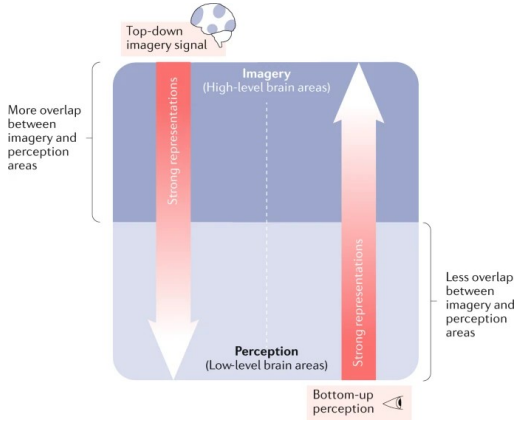
Miller et al. (2010)

- Motor movement vs, motor imagery for hand and tongue movement

- Role of primary motor area (M1) in motor imagery
- Motor imagery mimics the spatial distribution of activity during actual motor movement.

Pearson (2019)

- Mental imagery and stimuli-induced visual perception follow different direction along the visual pathways



- Their representations in the lower-level brain regions convey more differences.

Hypotheses & Core Idea of Method

Hypothesis 1: Functional connectivity, will differ significantly between motor movement and motor imagery.

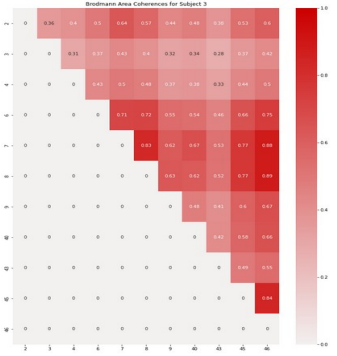
Main Method: Correlation coefficient matrix in frequency

Hypothesis 2: Functional connectivity differences between *compressed* ECoG signals during motor movement vs. motor imagery will decrease.

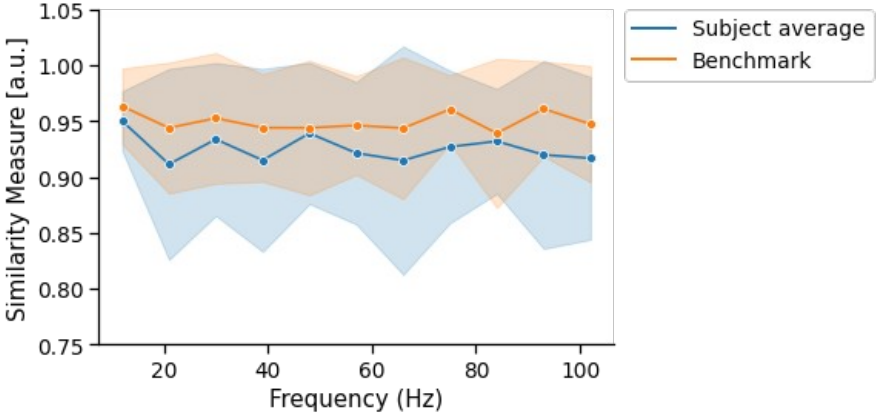
Main Method: Principal Component Analysis

Methods & Result of Coherence

- For each subject and for different frequency bands, for the real movement and motor imagery cases
- Similarity between real movement and imagery



Similarity of functional connectivity during imagery and real movement



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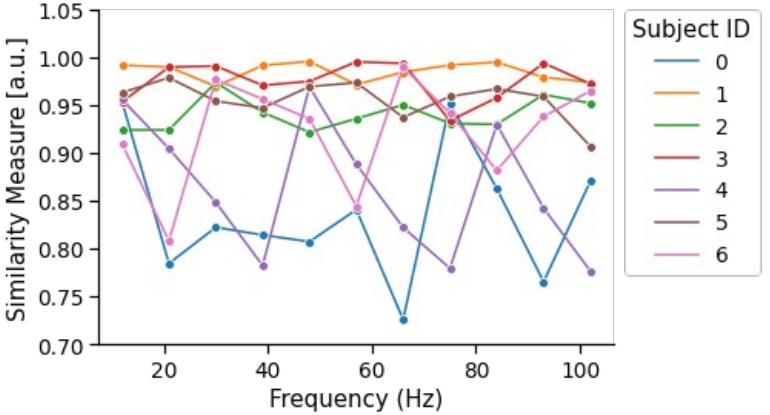
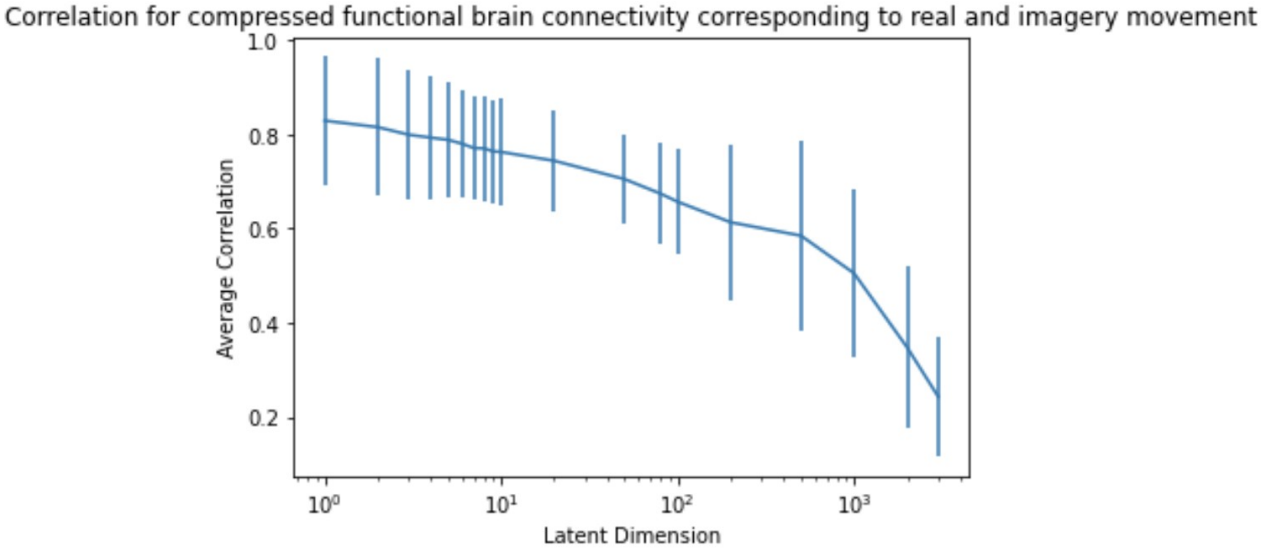
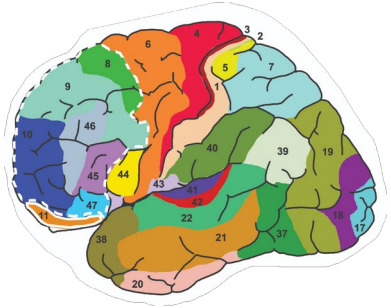


Hypothesis 2: Analysis with PCA

“Functional connectivity differences between *compressed* ECoG signals during motor movement vs. motor imagery will decrease.”



Result: Correlation of Brodmann areas



Brain's 52
Brodmann Areas

Brodmann Area #

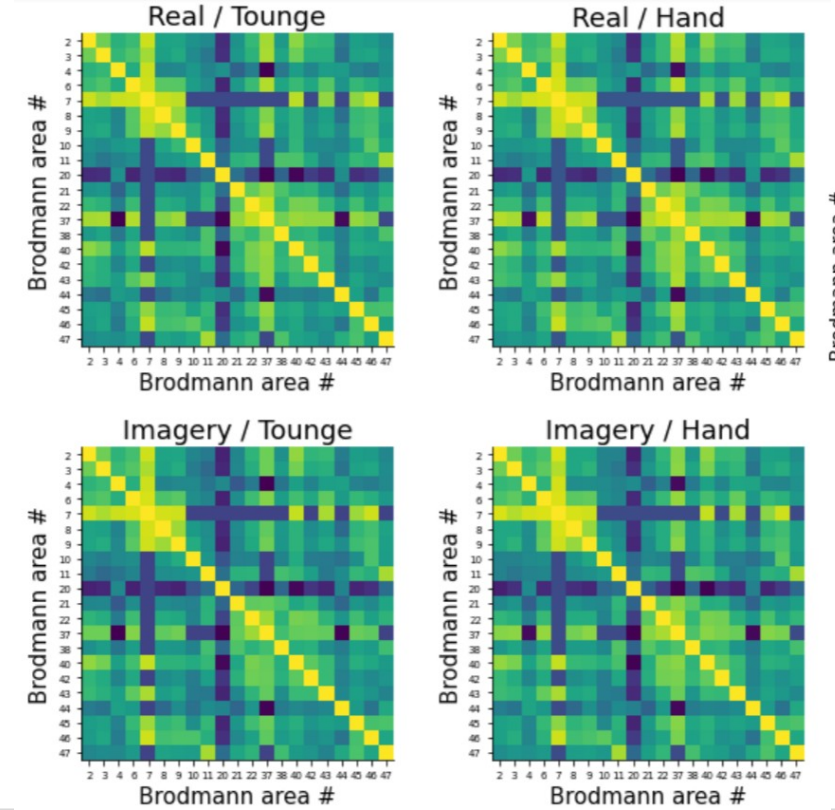
BA 1

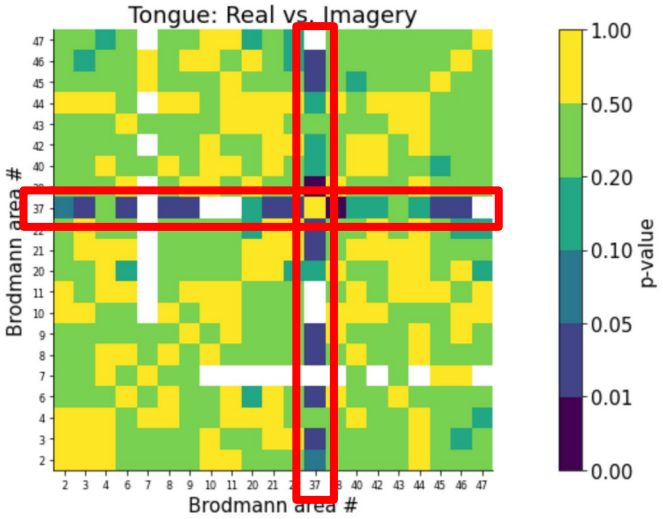
BA 2

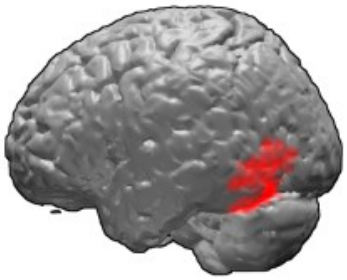
BA 3

BA 52

Result: Correlation of Brodmann areas







Brodmann Area 37:
Face Recognition

Significant?

That's unlikely :)

Conclusion

Hypothesis 1:

a) Subject average [0.97-0.94] vs benchmark [0.95-0.91] off by 0.03

- High similarity between 4/7 subjects [0.93-1]

b) P-value was only low in brodmann area no. 37 but is not present in all subject´s data

Hypothesis 2:

2) Functional connectivity differences between *compressed* ECoG signals during motor movement vs. motor imagery will decrease [from 0.8 to 0.3]

Open Questions

- Considers only hand and tongue movements of epileptic patients. Similar studies on healthy patients and other body-parts?

- Brodmann Area 37: Only area that meaningfully differentiates between real and imaginary movements

- Hand and tongue not differentiated.