Does imagery movement share similar neural mechanisms with the actual movement?

Raclette2

slide1: intro & question & hypothesis Nan
slide2: method (task + data analysis outline) Ramy

slide3: **time frequency analysis** (question + results + conclusion) Hanif

slide4: **classifier analysis** + trajectory analysis alpha band (Huayu
slide5: **classifier analysis** + trajectory analysis beta band (Huayu

slide6: general conclusion + (discussion) (Xianhui
slide7: Thank you page

Introduction

- “Imagery”: Imagined motor movement
  - preparation of actual movements
  - learning of complex motor skills.

- Miller et al. (2010):
  - the spatial distribution of activities in the primary motor area for imagery and actual movements overlap in low frequency band (8-32Hz), but does not overlap in high frequency (76-100Hz).

  However, Brinkman et al. (2014)
  - oscillatory power differ in the alpha (8-12 Hz) and beta frequency bands (18-25Hz) over sensorimotor regions during imagery

- Current study:
  - imagery ≈ actual movements？
    - both single-channel level and population level.
  - Hypothesis:
    - alpha band_imagery, beta_actual movement

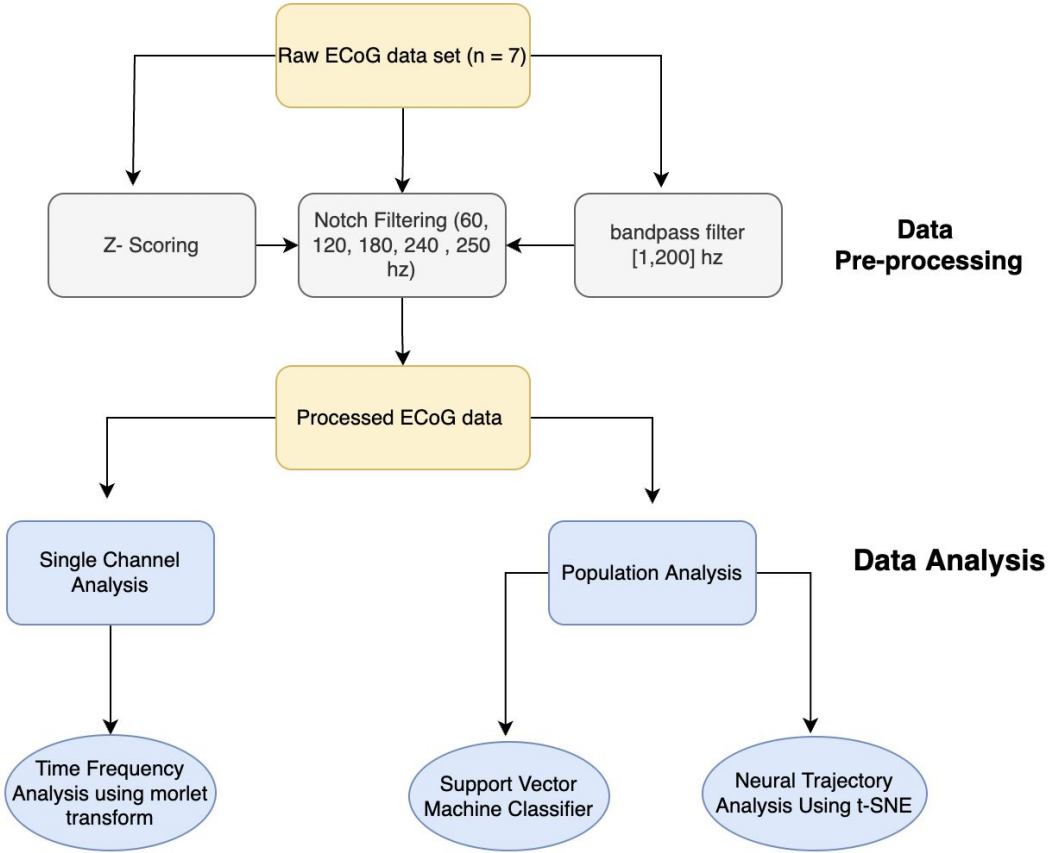
Data (n = 7)

Data Set Contain about the first two tasks:

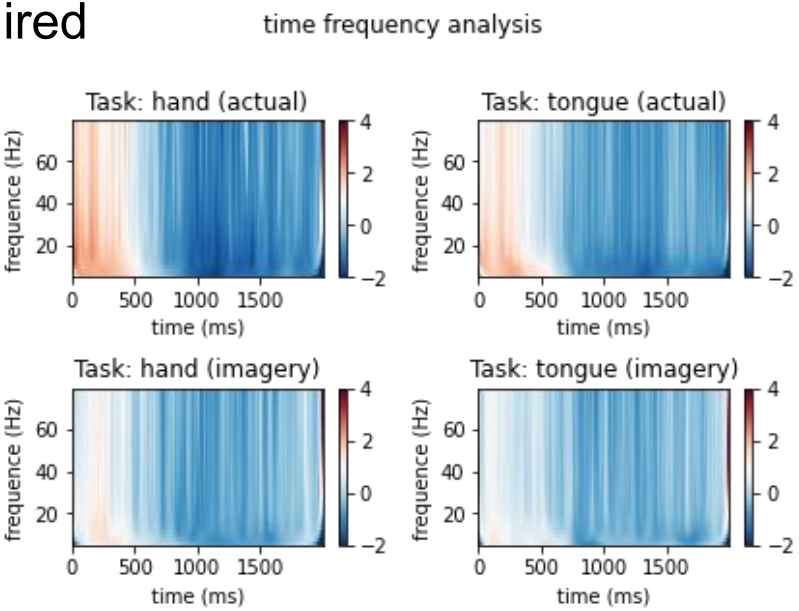
- **Motor Movement**
  - Tongue (30 trials)
    - *opening of mouth with protrusion and retraction of the tongue at ~1-2 Hz*
  - Hand (30 trials)
    - *flexion and extension of all fingers at ~1-2 Hz*
- **Motor Imagery**
  - *The imagery was kinesthetic rather than visual*

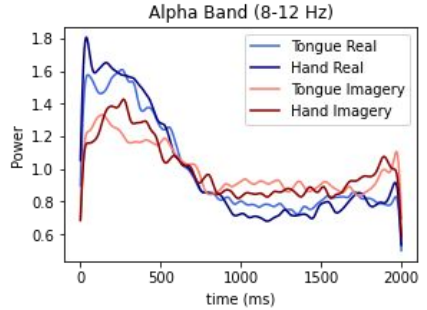
Sample rate is always 1000Hz, and the ECoG data has been notch-filtered at 60, 120, 180, 240 and 250 Hz, followed by z-scoring across time

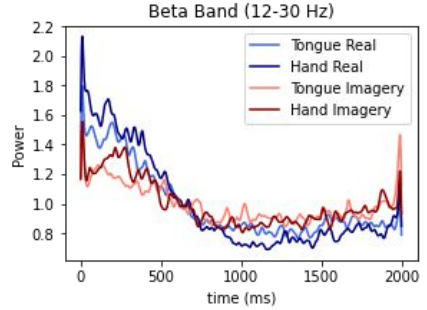
Pipeline

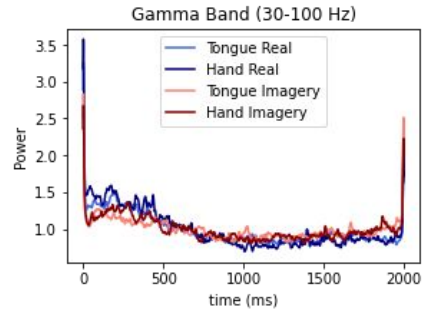

Raw ECoG data set (n = 7)
Z- Scoring
Notch Filtering (60, 120, 180, 240 , 250 hz)
bandpass filter [1,200] hz
Data Pre-processing
Processed ECoG data
Single Channel Analysis
Population Analysis
Data Analysis
Time Frequency Analysis using morlet transform
Support Vector Machine Classifier
Neural Trajectory Analysis Using t-SNE

1. Although imagery and actual movement differ in power change, both of them have similar power change between hand and tongue
2. Further population-level analysis required

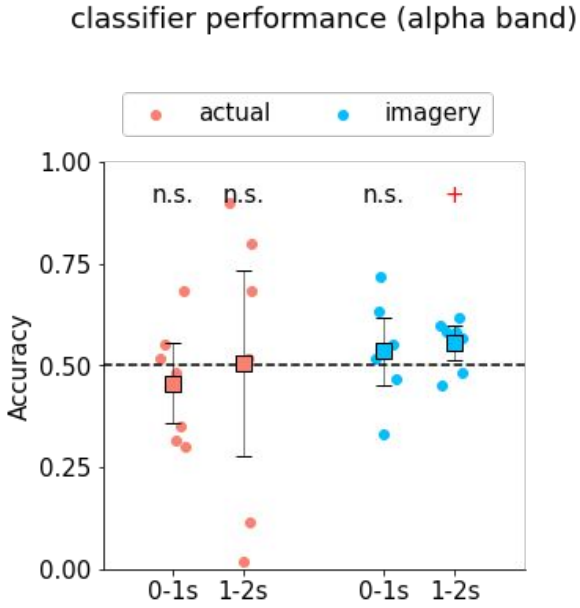


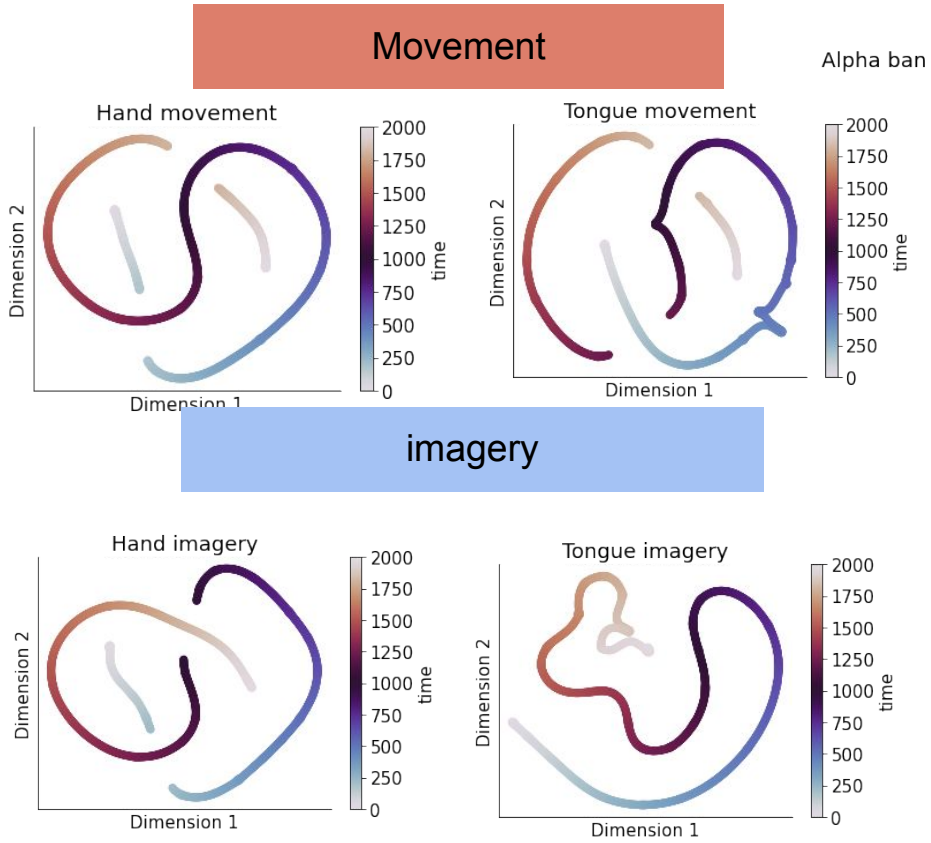




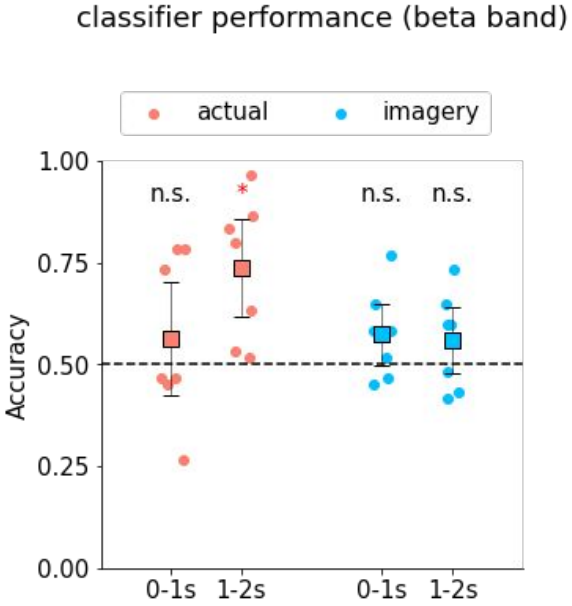


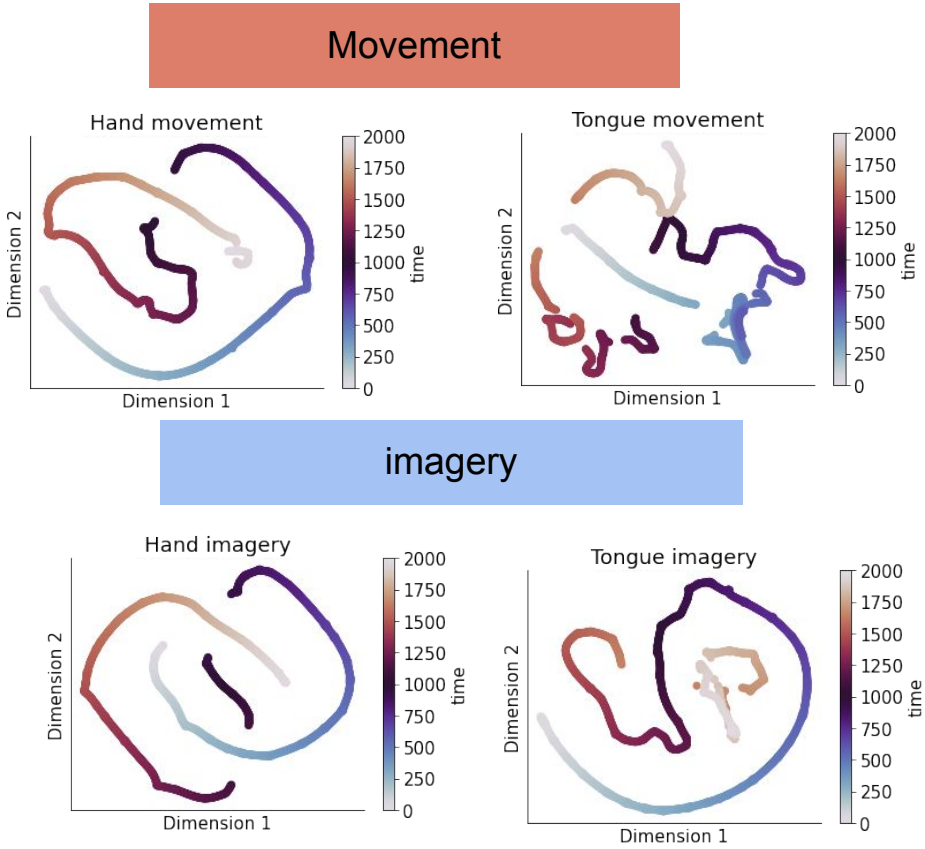
Imagery representation relies on **alpha band** while actual movement does not

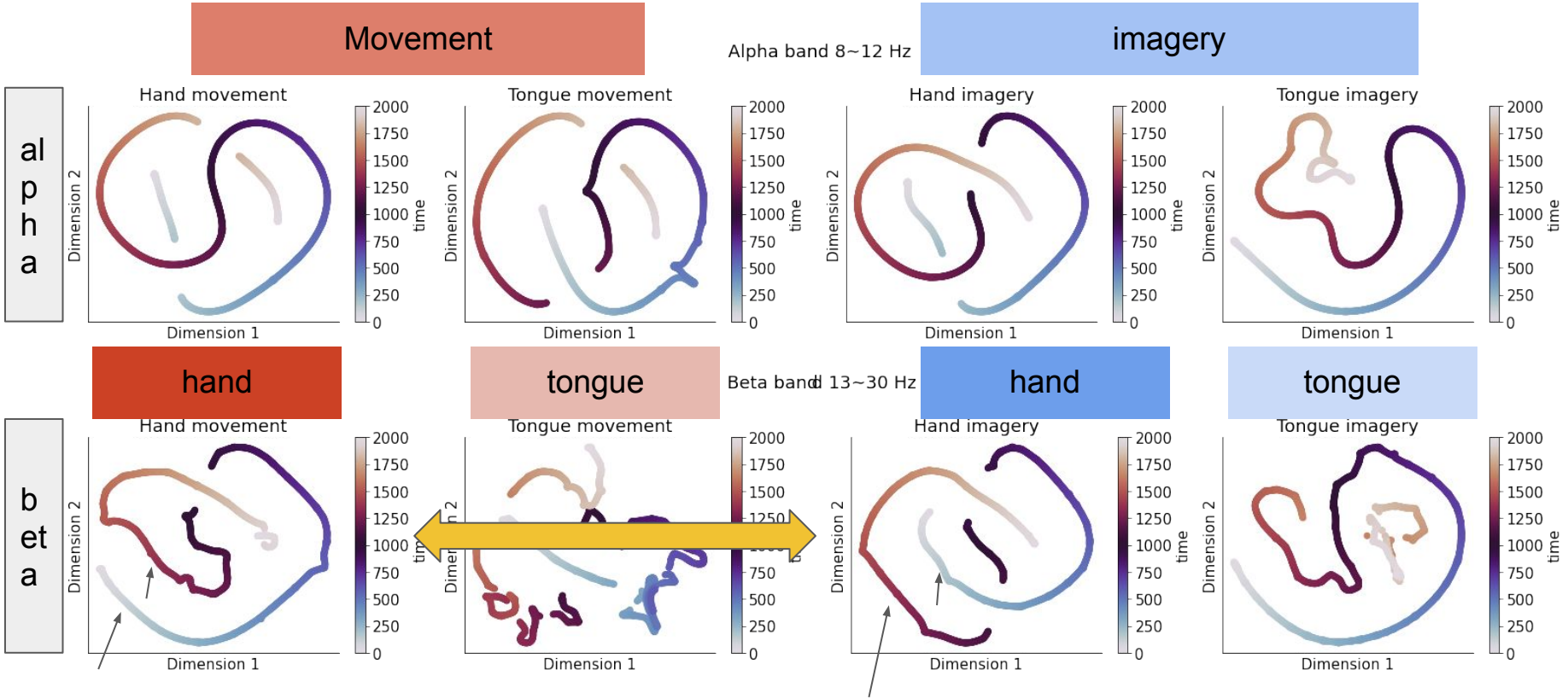




Actual movement representation relies on **beta band** while imagery does not






Movement
Alpha band 8~12 Hz
imagery
alpha
Hand movement
Tongue movement
Hand imagery
Tongue imagery
Dimension 1
Dimension 2
time
2000
1750
1500
1250
1000
750
500
250
0
hand
tongue
Beta band 13~30 Hz
hand
tongue
beta

Conclusion

- Lorem Ipsum Dolor Sit Amet

Thank you!

references

1. Miller, K. J., Schalk, G., Fetz, E. E., Den Nijs, M., Ojemann, J. G., & Rao, R. P. (2010). Cortical activity during motor execution, motor imagery, and imagery-based online feedback. *Proceedings of the National Academy of Sciences*, *107*(9), 4430-4435.
2. Brinkman, L., Stolk, A., Dijkerman, H. C., de Lange, F. P., & Toni, I. (2014). Distinct roles for alpha-and beta-band oscillations during mental simulation of goal-directed actions. *Journal of Neuroscience*, *34*(44), 14783-14792.