icassp 2022
Singapore, China, Virtual
22-27 MAY 2022
ICASSP 2022
SINGAPORE

MUSIC IDENTIFICATION USING BRAIN RESPONSES TO INITIAL SNIPPETS

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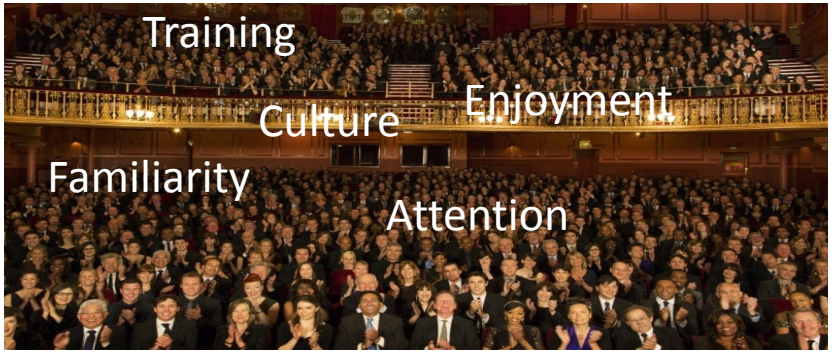
Attributes of Naturalistic Music

- Repetitive Musical Patterns - Beat, timber
- Patterns enable effortless song recognition
- Subjectivity of Musical Listening

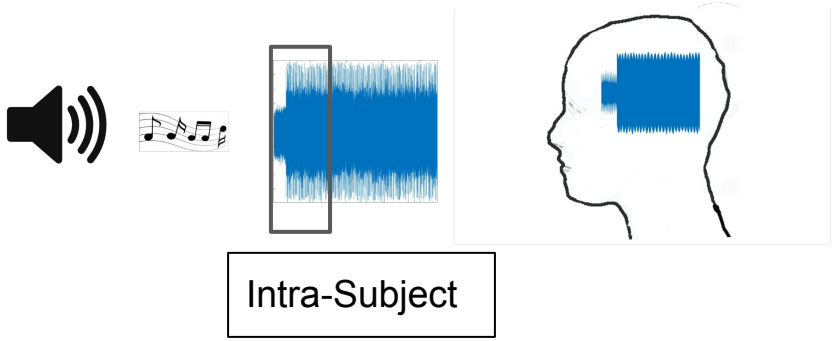
https://www.ncpamumbai.com/soi/

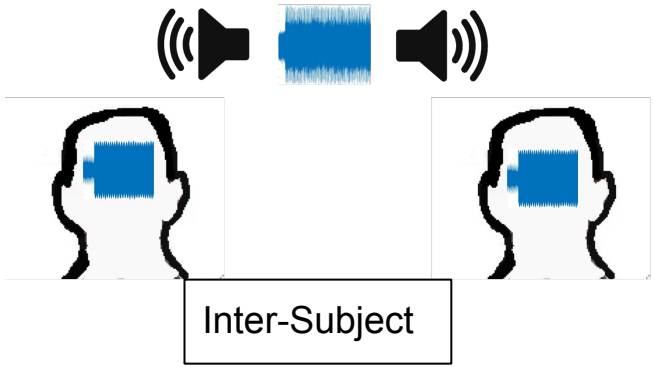


https://www.inc.com/andrew-griffiths/do-you-want-to-capture-every-audience-you-stand-in-front-of.html

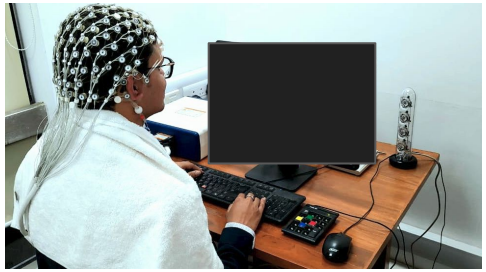
Research Questions

- Is there a significant correlation among a person's neural responses across the duration of a song?
- Are the neural signatures embedded in the initial segments retained throughout the song?
- Are neural signatures associated with a song listener specific or independent?





EEG Datasets



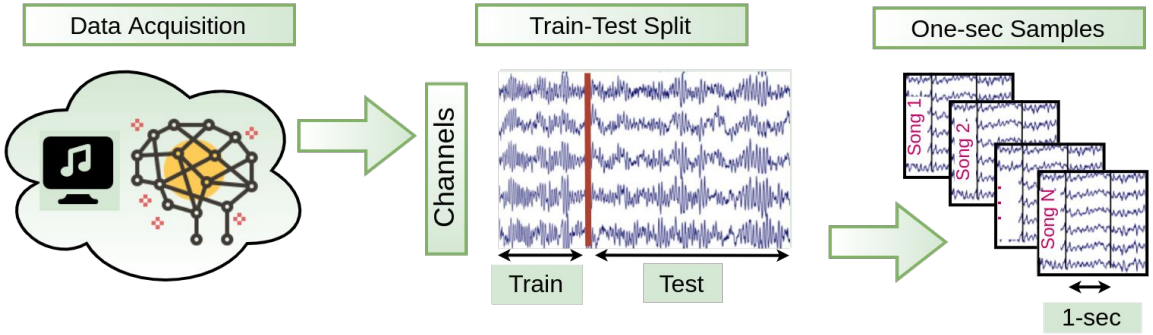
NMED-T

- 20 Participants (Mean Age 23 Years)
- 125 Hz
- 125 Channels
- 10 Naturalistic Songs
- Range : 4.5 - 5 Minutes

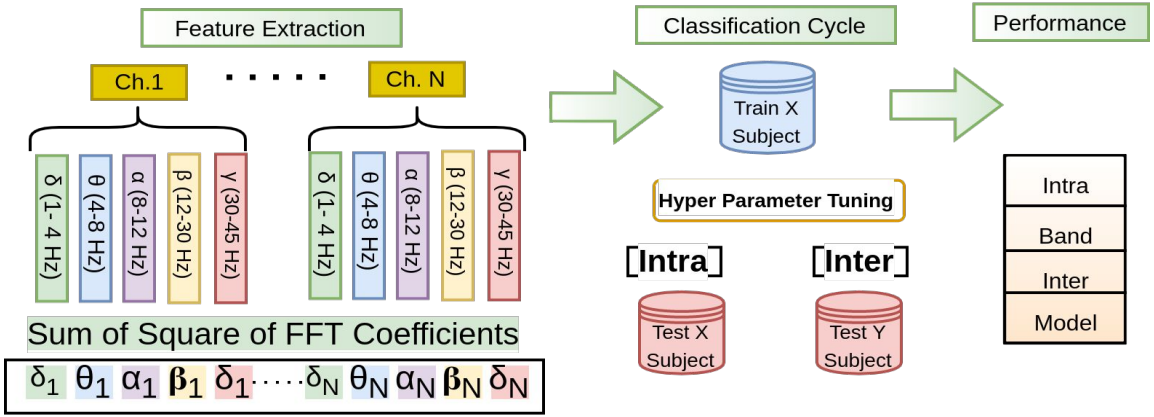
Musin-G

- 20 Participants (Mean Age 23.5 Years)
- 250 Hz
- 128 Channels
- 12 Naturalistic Songs
- Range: 1.5 - 2 Minutes

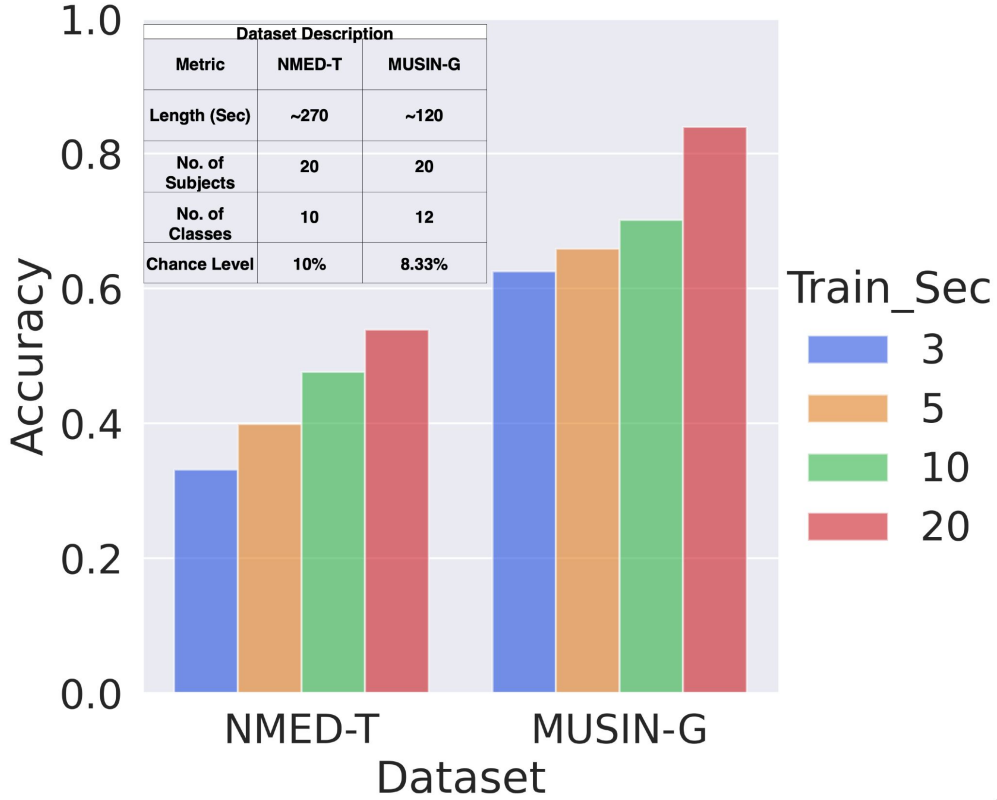
Proposed Approach



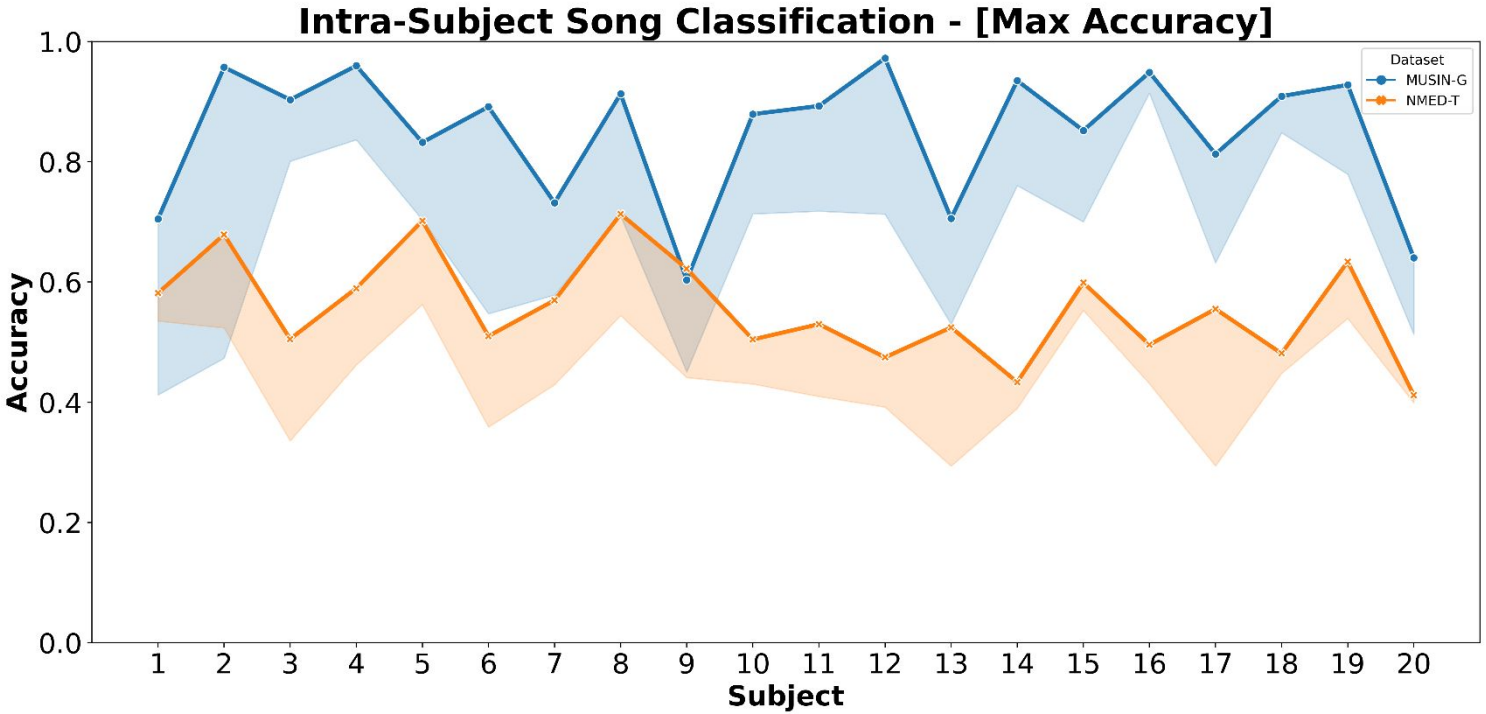
*** Train data consist of initial 3, 5, 10, 20 seconds**



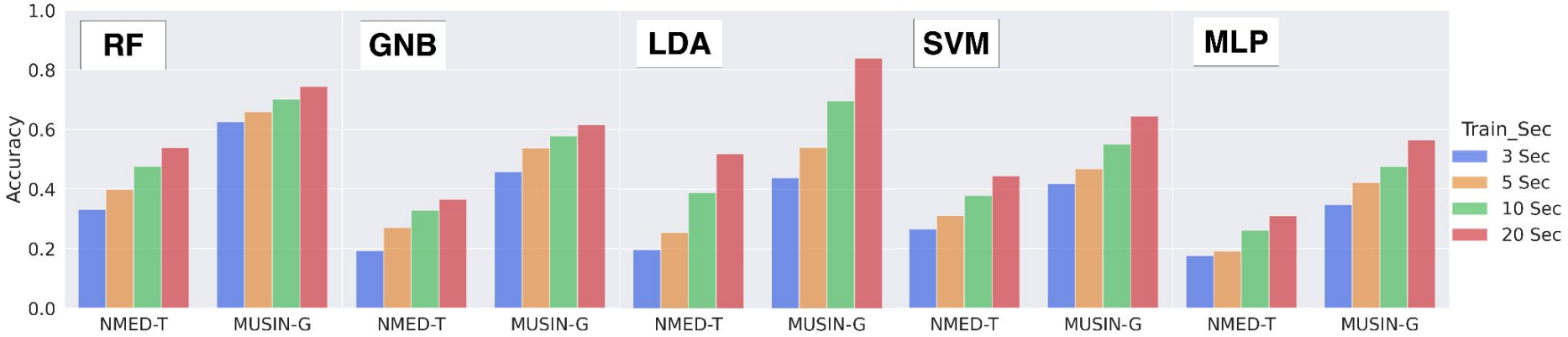
Mean Accuracy Participants for Four Training Windows



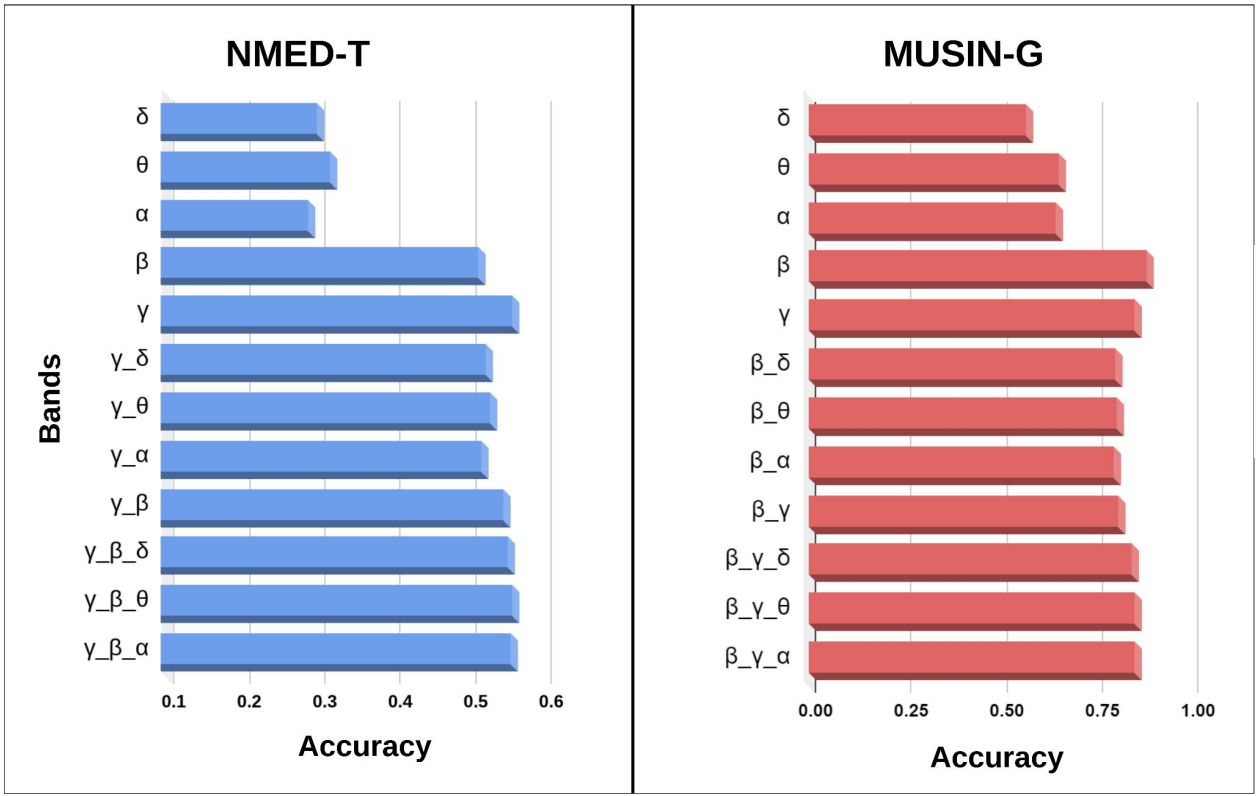
Subject-wise Performance on 20s of Training Data.



ML-based Intra-Subject Song Prediction

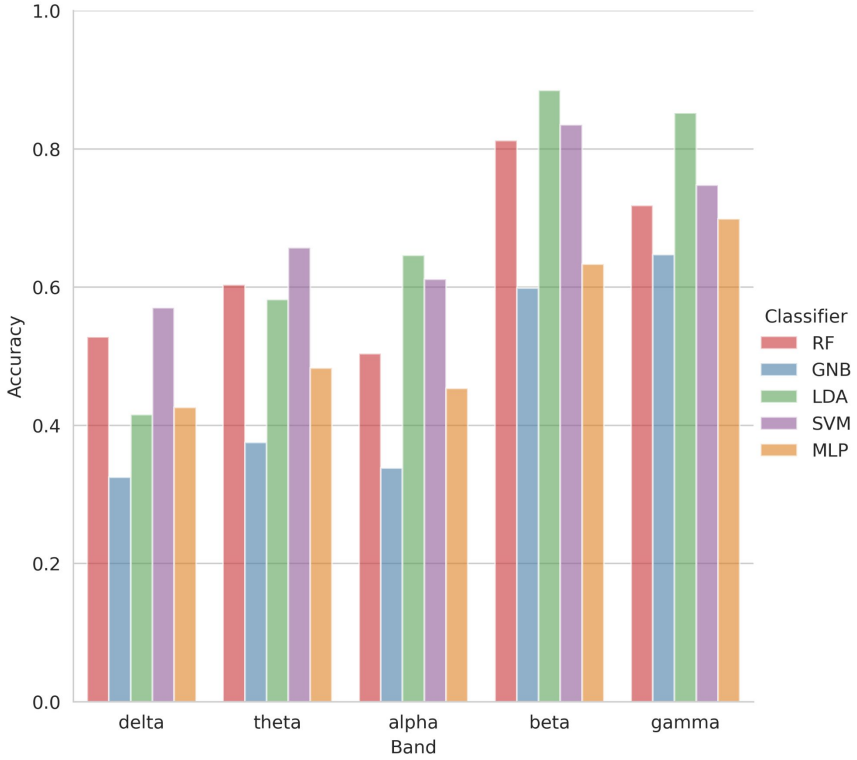


Performance of Frequency Bands

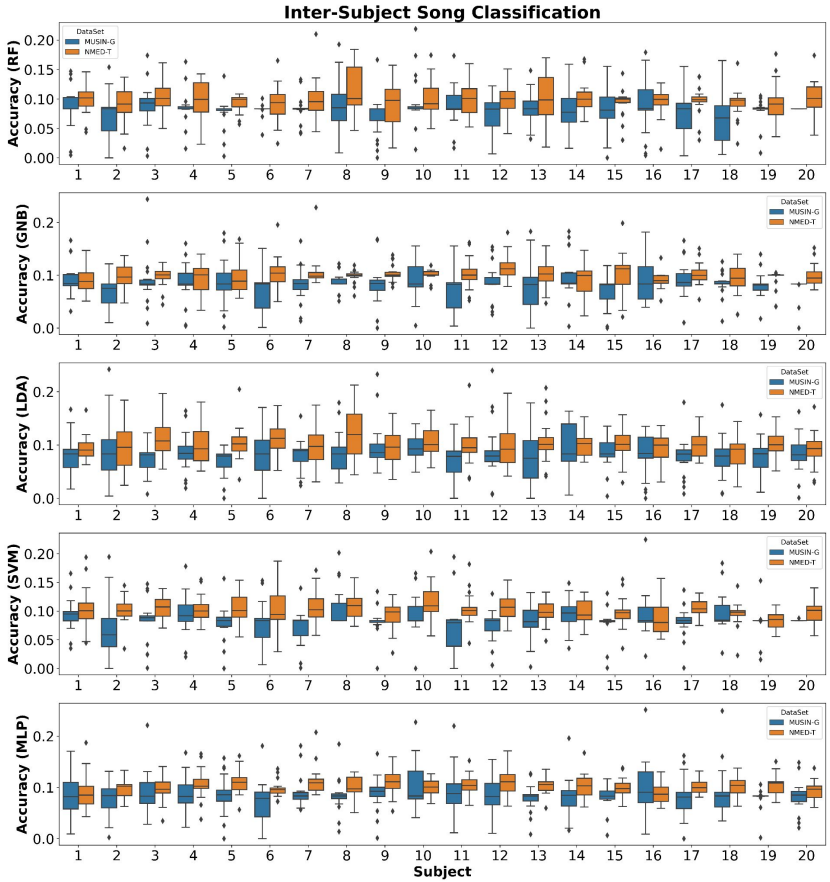


Band	RF	GNB	LDA	SVM	MLP
δ (1-4 Hz)	0.3	0.23	0.34	0.34	0.26
θ (4-8 Hz)	0.29	0.22	0.38	0.36	0.26
α (8-12 Hz)	0.25	0.18	0.37	0.34	0.24
β (12-30 Hz)	0.52	0.39	**0.61**	0.58	0.44
γ (30-40 Hz)	0.59	0.47	**0.65**	0.59	0.47
ALL-Bands	0.6	0.41	0.6	0.52	0.38

ML-based Intra-subject Song Prediction



Subject-independent Song Identification



Conclusion

- Small segments capturing initial brain responses enable sufficient learning of EEG signatures in the spectral domain
- Higher frequency bands, namely β and γ neural oscillations provide the most discriminating features.
- For intra-subject song prediction, we achieve a maximum accuracy of 65% using γ features in NMED-T
- The β band achieves 88% accuracy for MUSIN-G.
- Prediction accuracy drops significantly in inter-subject song classification, suggesting a weak correlation in brain responses among subjects.
- Identifying neural correlates underlying naturalistic musical signature irrespective of individual experiences.

Reference

1. Images - [Research Questions : Intra- and Inter-Subject]

   Predicting Neural Resonance in Naturalistic Scenarios: A Computational Framework to Establish Neural Marker to Observe Internal and External Entrainment. Pankaj Pandey, Derek Lomas, Krishna Prasad Miyapuram, MindBrainBody Symposium, 2022. (https://www.cbs.mpg.de/1922154/c14_pande)

2. NMED-T - (https://exhibits.stanford.edu/data/catalog/jn859kj8079)
3. Musin-G - (https://openneuro.org/datasets/ds003774/versions/1.0.0)

Thank You