The Brain's Neurochemical Achitecture Organizes Long-range Frequency-specific Brain Connectivity

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Mapping Neurotransmitter Influence on Frequency-Defined Neurophysiological Connectivity

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Introduction

The macroscale functionality of the brain does not come from independent regions: it emerges from the integration of functionally connected regions that communicate across time and space which is in turn orchestrated by the microscale molecular processes.

Nonetheless, the interplay between the chemoarchitecture of the cortex and patterns of functional connectivity remains poorly understood.

Materials

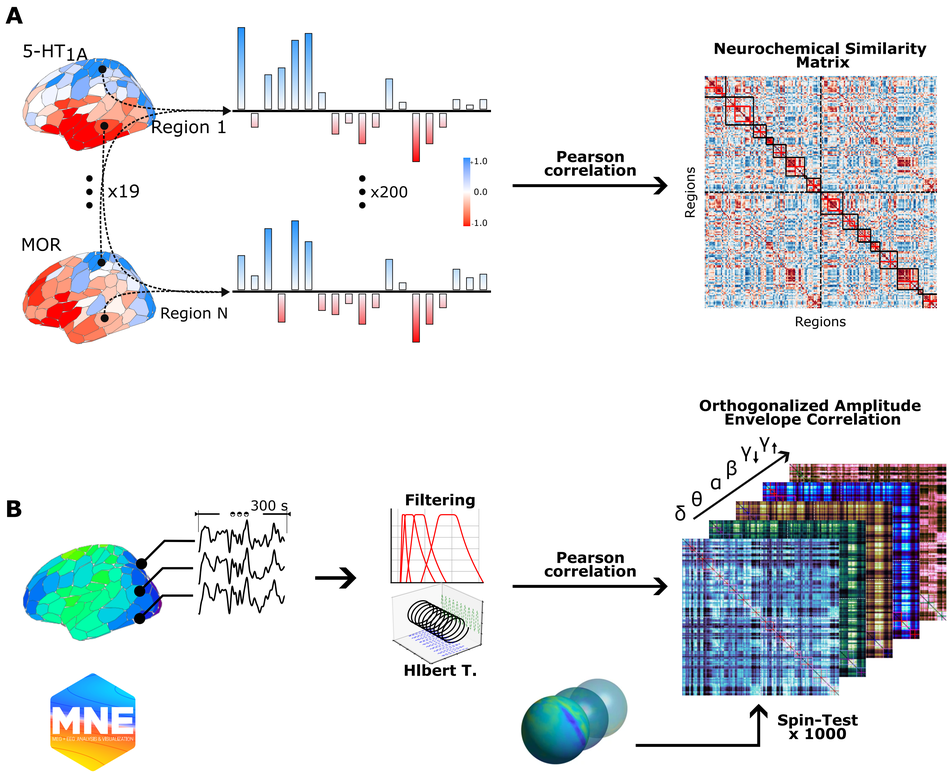
neuromaps

- N ≈1,200
- PET-based Maps
- 19 Neurochem Systems

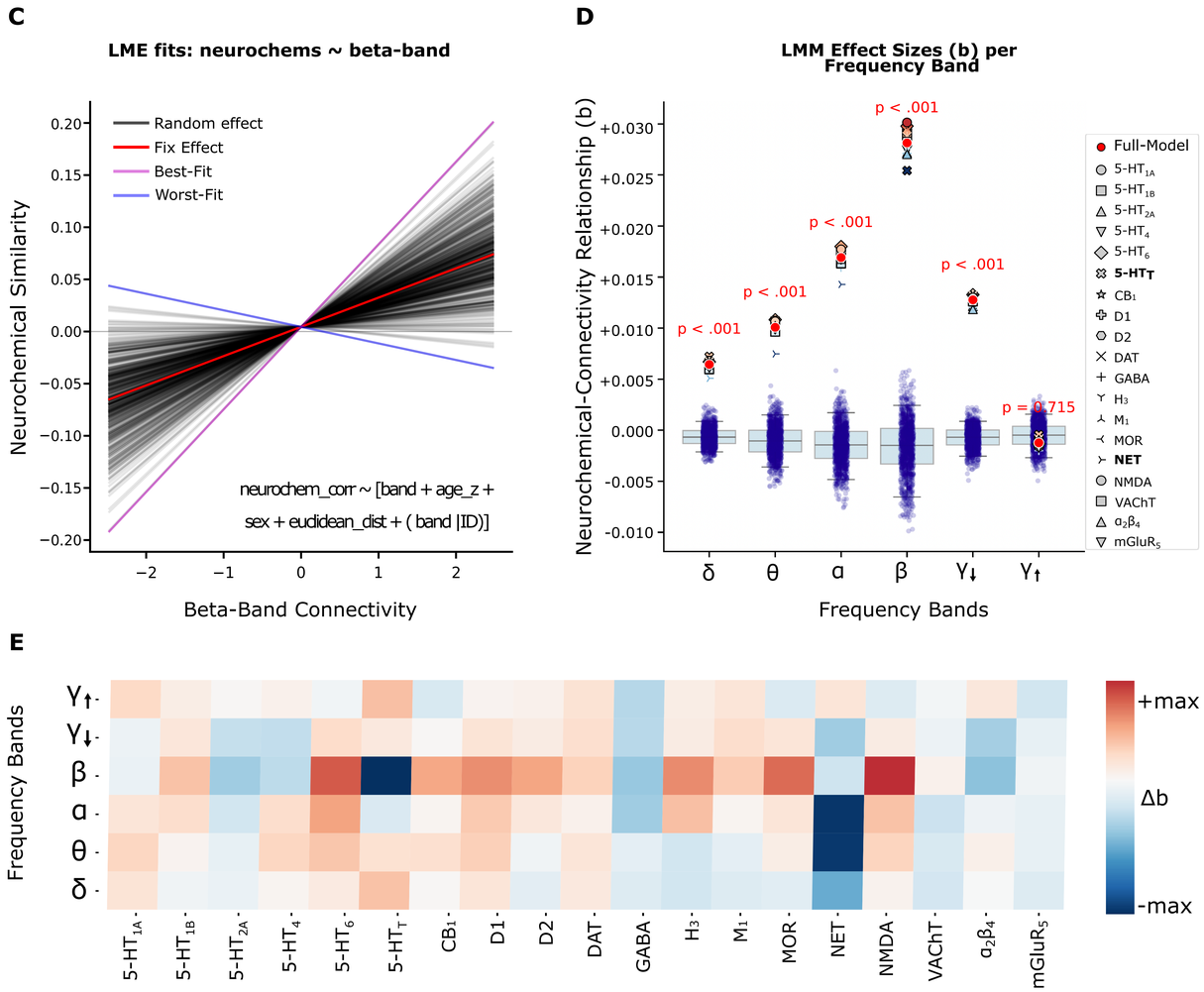
CamCAN

- N = 567
- Task-Free MEG
- T1 MRI

Methods



Results



Conclusions and Future Directions

1. Functional brain connectivity is shaped by the coordinated influence of multiple neurotransmitter systems, working together to support frequency-specific network organization—with the strongest effects observed in the beta band, followed by alpha, low gamma, theta, and delta.

2. Leave-one-out analyses revealed that certain neurotransmitters are critical for maintaining the observed similarity between connectivity and chemoarchitecture. Some systems (i.e., 5-HTT for beta band and NET for theta and alpha bands) highlight the importance of selective neuromodulation.

3. Future directions will investigate moderations by demographics variables (e.g., age and sex) and cognitive functions.