

Resting state MEG Analysis

Preprocessing: dimensionality reduction

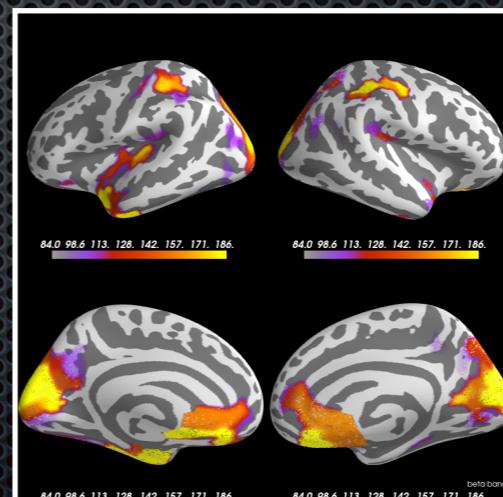
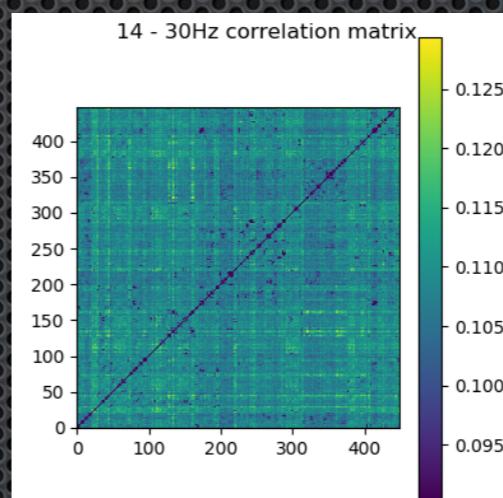
- Traditional five-mins mind wandering plus fixation during MEG recorded at 1KHz with DC-333Hz time-frequency sampling.
- De-noising instrumental/environmental artifact signals using signal space separation with inner basis regularization (SSS 300 sec temporal integration) plus head-movement compensation for time-weighted average HPI head position during MEG recording.
- De-noised data was low-pass filtered at 100Hz and signal space projections of ExG peripheral blink and cardiac signals, as well as ERM noise covariance were computed using PCA.
- Five second epoching with RMS peak-to-peak ML estimation routine to drop noisy trials.
- Quasi-realistic individual 4D models of source space projection using dSPM source imaging pipeline.
- For each subject, within 5 ages (tp), computed 6-levels narrowband AEC, within 450 spatial ROIs.

Data engineering & modelling

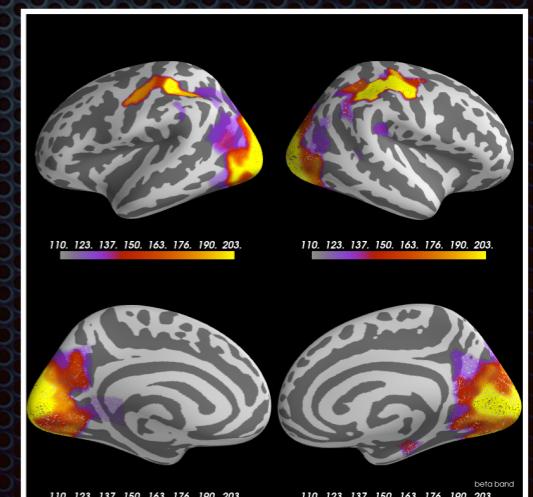
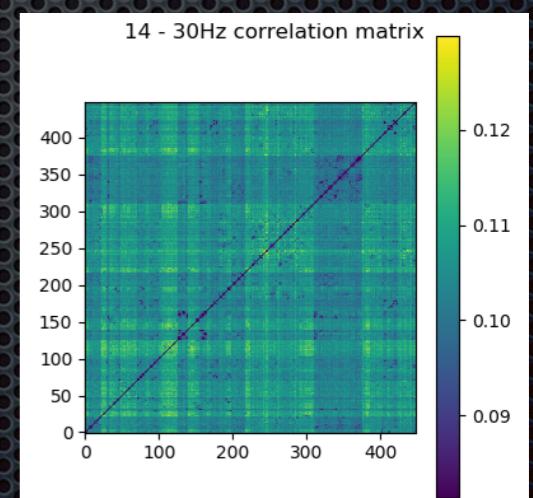
$$Y \sim \alpha_{m \times m} + \theta_{p \times q} + \omega_j + \lambda_{n \times p}$$

- m = space (440 ROIs)
- $p \times q$ = trial x time
- j = network (narrow-band frequency)
- $n \times p$ = subject x score

Nine (n=28)



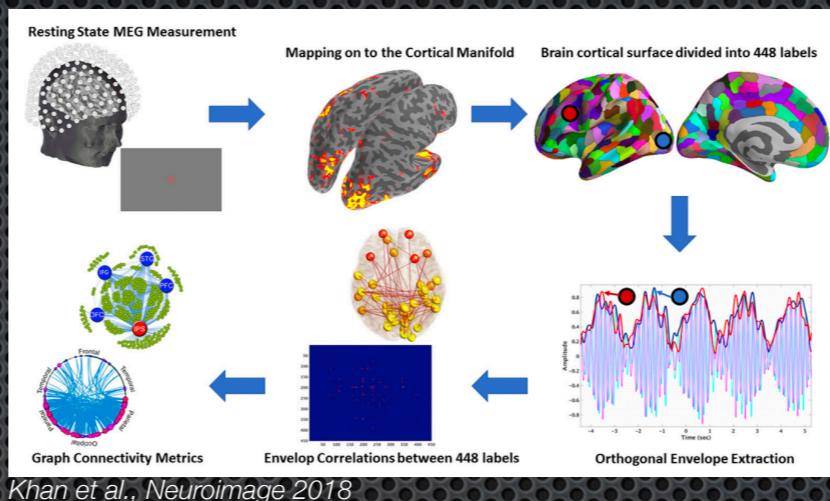
Seventeen (n=32)



Modelling...

$$Y \sim \alpha_{m \times m} + \theta_{p \times q} + \omega_j + \lambda_{n \times p}$$

- m = space (440 ROIs)
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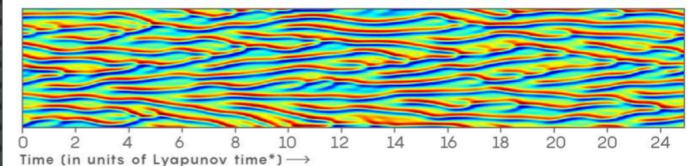
- What can Y represent?
 - Network fc over age time point
 - spatial patterning of temporal-spectral coherence
 - dynamic model of mental state (causal modeling)

Training Computers to Tame Chaos

A machine-learning algorithm has been shown to accurately predict a chaotic system far further into the future than previously possible.

A Chaos Model

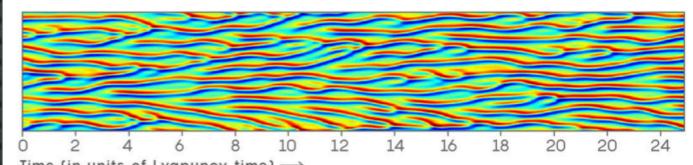
Researchers started with the evolving solution to the Kuramoto-Sivashinsky equation, which models propagating flames:



* Lyapunov time = Length of time before a small difference in the system's initial state begins to diverge exponentially. It typically sets the horizon of predictability, which varies from system to system.

B Machine Learning

After training itself on data from the past evolution of the Kuramoto-Sivashinsky system, the "reservoir computing" algorithm predicts its future evolution:



A - B Do They Match?

Subtracting B from A shows that the algorithm accurately predicts the model out to an impressive 8 Lyapunov times, before chaos ultimately prevails:

