Novel technique localizes fMRI dynamic functional connectivity state transitions

Spencer Brown, OMS-2; Dan Selski, PhD

Introduction

Functional MRI (fMRI) is an imaging modality for the analysis of region-specific neural activity level. Dynamic functional connectivity studies change in brain state over time; these brain states change at discrete state transitions. Current methods for evaluating state transitions include Sliding Windows and Hidden Markov Models, although challenges exist with both methods. The primary aim of this work is to develop a novel method which has innovative potential to improve precise localization of state transitions and advance clinical utility of fMRI.

Methods

3 Tesla fMRI scans were obtained from the Human Connectome Project motor task dataset ($n = 18$). Healthy participants were asked to switch between various motor or resting tasks three seconds after an anticipatory visual cue. Following preprocessing, two half-gaussian kernels were used to approximate adjacent subnetwork pairs over time. Euclidean distance (L2) was calculated between adjacent network pairs. The chi-squared test then evaluated the offset between L2 peaks and cue time.

Results

Following preprocessing and analysis, the stated method revealed marked peaks in L2 distance which synchronized to changes in motor task. Chi-squared confirmed this synchronization ($p < 0.001$), supporting that L2 peaks represent state transitions.

Conclusions

A novel technique for identifying brain state transitions has herein been introduced with the ability to successfully identify precise state transitions. L2 peaks preferentially occurred with changes in motor task, rather than the anticipatory visual cue, which suggests that state transitions are associated more with active task change than task anticipation.

Funding

The authors have no funding to disclose.