Dynamic functional connectivity

Dynamic functional connectivity (DFC) refers to the observed phenomenon that functional connectivity changes over a short time. Dynamic functional connectivity is a recent expansion on traditional functional connectivity analysis which typically assumes that functional networks are static in time. DFC is related to a variety of different neurological disorders, and has been suggested to be a more accurate representation of functional brain networks. The primary tool for analyzing DFC is fMRI, but DFC has also been observed with several other mediums. DFC is a recent development within the field of functional neuroimaging whose discovery was motivated by the observation of temporal variability in the rising field of steady state connectivity research.

Dynamic functional connectivity (DFC) aims to maximize resolvable information from functional brain scans by considering temporal changes in network structure. Recent work has demonstrated that static, i.e. time-invariant resting-state and task-based FC predicts individual differences in behavior, including attention.

Ching Fong et al. showed that DFC predicts attention performance across individuals. Sliding-window FC matrices were generated from fMRI data collected during rest and attention task performance by calculating Pearson's r between every pair of nodes of a whole-brain atlas within overlapping 10-60s time segments. Next, variance in r values across windows was taken to quantify temporal variability in the strength of each connection, resulting in a DFC connectome for each individual. In a leave-one-subject-out-cross-validation approach, partial-least-square-regression (PLSR) models were then trained to predict attention task performance from DFC matrices. Predicted and observed attention scores were significantly correlated, indicating successful out-of-sample predictions across rest and task conditions. Combining DFC and static FC features numerically improves predictions over either model alone, but the improvement was not statistically significant. Moreover, dynamic and combined models generalized to two independent data sets (participants performing the Attention Network Task and the stop-signal task). Edges with significant PLSR coefficients concentrated in visual, motor, and executive-control brain networks; moreover, most of these coefficients were negative. Thus, better attention may rely on more stable, i.e. less variable, information flow between brain regions [1].

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Ching Fong A, Yoo K, Rosenberg M, Zhang S, Chiang-Shan RL, Scheinost D, Constable RT, Chun M. Dynamic functional connectivity during task performance and rest predicts individual differences in attention across studies. Neuroimage. 2018 Dec 3. pii: S1053-8119(18)32138-4. doi: 10.1016/j.neuroimage.2018.11.057. [Epub ahead of print] PubMed PMID: 30521950.