Contribution ID: **41** Type: **Poster**

State dependent shifts in large scale functional topographies

Monday 27 October 2025 17:30 (1h 30m)

Naturalistic stimuli, such as movie-watching, amplify behaviorally relevant brain networks and sensory-driven cortical hierarchies (1). However, the large-scale organizational principles that govern how functional connectivity (FC) reconfigures in such contexts remain incompletely understood. Here, we leveraged ultra-high-field (7T) fMRI data from the Human Connectome Project (HCP) (2) and the Precision NeuroImaging (PNI) datasets (3) to investigate how FC changes between rest and movie-watching, and how these differences relate to cortical hierarchy and geodesic distance (GD).

We first analyzed resting-state and movie-watching 7T fMRI data from 93 healthy adults in the HCP dataset. Using the Glasser 360-region atlas, whole-cortex FC matrices were computed for each condition (Figure 1A), and state-dependent differences were quantified using the movie–rest difference (MRD) for each cortical parcel. We selected three representative regions of interest (ROIs) spanning major cortical networks, including V1 (visual), MIP (dorsal attention), and 31pv (default mode). For each ROI, we assessed how MRD varied across the cortex using a linear mixed model and examined its relationship to cortical distance and functional hierarchy (4, 5).

Spearman correlation analysis revealed high similarity in FC between rest and movie states for the ROIs V1 (rho = 0.77, pspin < 0.001), MIP (rho = 0.89, pspin < 0.001), and 31pv (rho = 0.86, pspin < 0.001). However, MRD showed state-dependent variation that was modulated by the hierarchical level of the seed ROI (Figure 1B). In unimodal regions such as V1 and MIP, MRD decreased with geodesic distance (slopeV1 = −0.06, slopeMIP = −0.034; Figure 1C), indicating stronger reconfiguration in nearby areas. In contrast, transmodal ROIs such as 31pv in the default mode network showed increasing MRD with distance (slope31pv = 0.045,), suggesting broader, long-range reorganization. These spatial associations persisted after controlling for differences in FC amplitude between states. Overall, the slope of the MRD–GD relationship scaled with hierarchical position, with more transmodal regions exhibiting flatter or positive slopes, and more sensory–like regions showing steeper negative gradients. In addition, we examined whether MRD patterns reflected underlying cytoarchitectural features using the principal gradient of the BigBrain histological atlas (6, 7). We observed modest correlations between MRD and BigBrain principal gradient in unimodal regions (V1: rho = −0.36, pspin < 0.001; MIP: rho = −0.23, pspin = 0.011), but no significant association in transmodal areas (31pv), suggesting structure–function coupling is strongest at lower hierarchical levels. Finally, we conducted a replication analysis using data from PNI dataset (3) and observed consistent results.

Together, these findings highlight that naturalistic stimulation induces spatially structured and hierarchy-dependent reconfiguration of functional networks. FC changes are most tightly constrained by geodesic and cytoarchitectural gradients in unimodal cortex, but become increasingly distributed and decoupled in higher-order regions (8, 9). Our results support emerging models of large-scale cortical organization and underscore the importance of spatial and hierarchical context in interpreting dynamic functional connectivity.

Primary author: WANG, Yezhou (McGill university)

Co-authors: EVANS, Alan C. (McGill University); Mr NGO, Alexander (McGill University); BERNHARDT, Boris C. (McGill University); CABALO, Donna Gift (McGill University); Dr LEPPERT, Ilana (McGill University); ROYER, Jessica; DEKRAKER, Jordan (McGill University); SMITH, Meaghan (McGill University); RO-

DRIGUEZ-CRUCES, Raul (McGill University); VALK, Sofie (Max Planck Institute for Human Cognitive and Brain Sciences, Leipzig, Germany); Dr VANDERWAL, Tamara (University of British Columbia); HWANG, Youngeun (McGill University)

Presenter: WANG, Yezhou (McGill university)

Session Classification: Poster Session