Cognitive information differentiates between connectivity and activity across the cortical hierarchy

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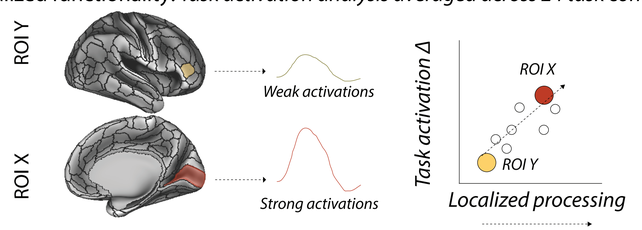
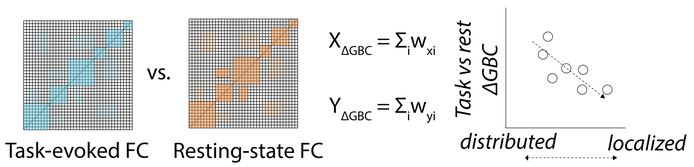
Identifying localized and distributed processes with task activations and functional connectivity (FC) analyses

Localized functionality: *Task activation analysis averaged across 24 task conditions*



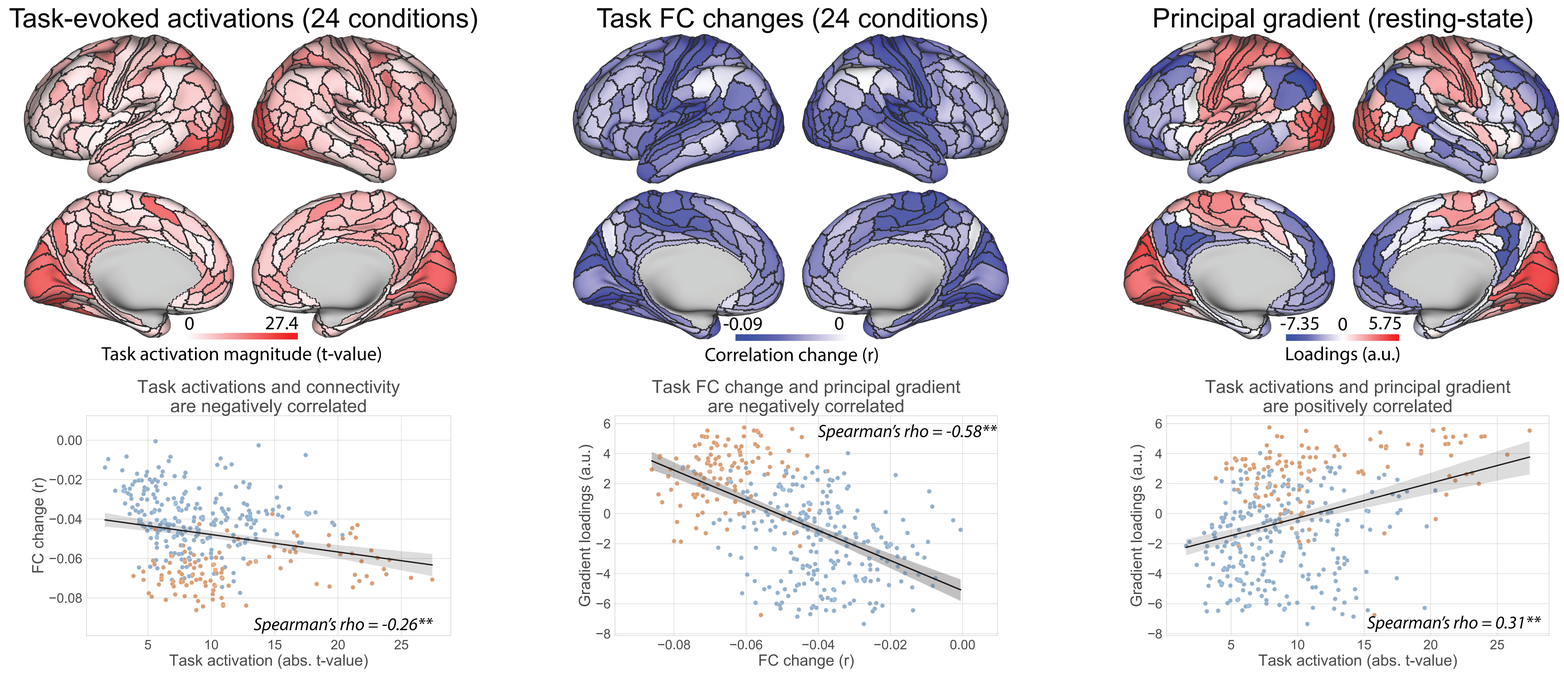
Localized vs distributed functionality: *FC analysis averaged across 24 conditions*



Task-evoked FC | Resting-state FC

Data set: HCP data set, all rest and task data (n=352)
Task activations: The magnitude of task GLM activations averaged across 24 conditions
FC change: Rest to task FC change for each region using timeseries after task regression

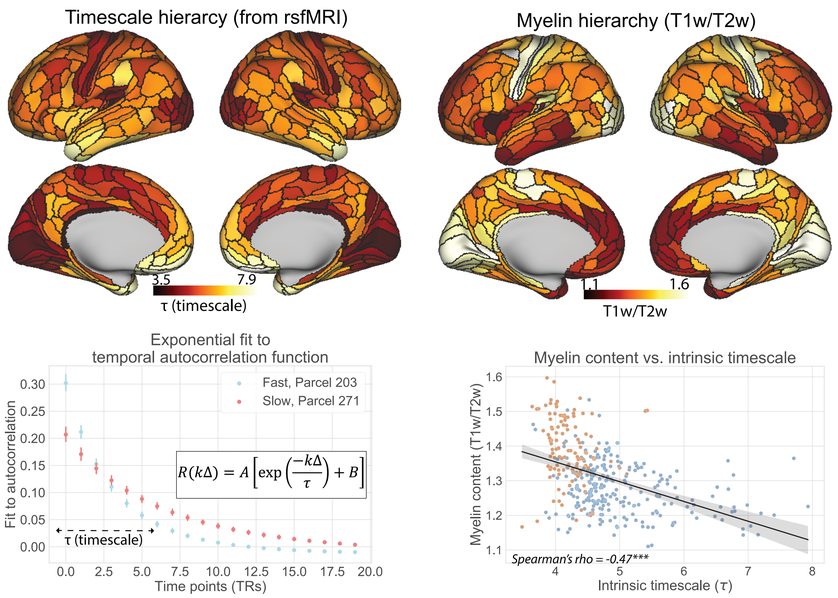
Task activations and FC changes are negatively associated across cortex and related to gradient organization



Hypothesis: Cortical differences in localized and distributed processes are associated with intrinsic hierarchical cortical organization

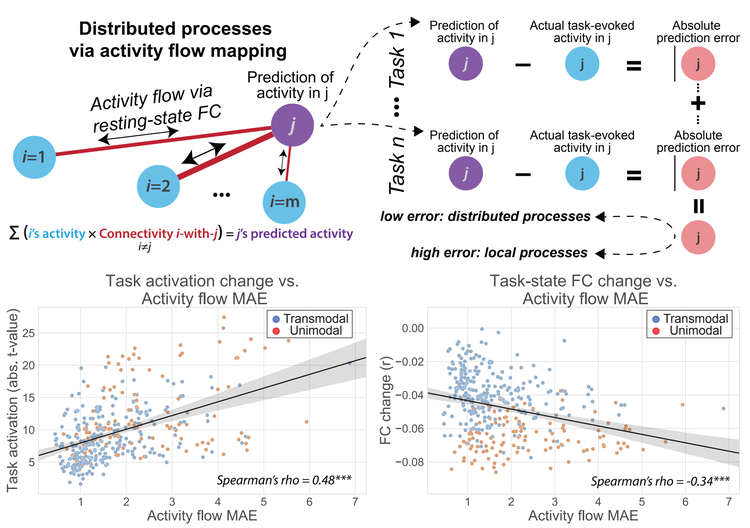
Cortical differences in task-state activations and connectivity profiles are associated with large-scale intrinsic gradients from rsfMRI (Margulies et al. 2016), which reflect hierarchical cortical organization

Task-state dynamics are related to other forms of intrinsic cortical hierarchy



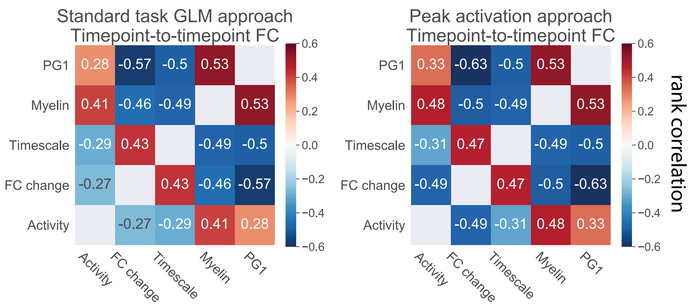
Timescale hierarchy is negatively correlated with anatomical (myelin) hierarchy

Gradients of distributed processes by modeling activity flow across brain areas



- Activity flow mapping tests whether a brain region can be predicted using other brain regions' activity (i.e., from a distributed process) (Cole et al. 2016; Ito et al. 2020)
- Activity flow prediction error is anti-correlated with cortical hierarchy
  - Lower-order unimodal areas are harder to predict with activity flow mapping

Summary of associations between structural, intrinsic, and task-evoked cortical hierarchies



Conclusions (preprint: Ito et al. 2020)

- ***Task-state activation and FC changes are correlated with previously reported measures of cortical hierarchy***:
  - Macroscale gradient organization (rsfMRI; Margulies et al. 2016)
  - Timescale hierarchy (rsfMRI; Murray et al. 2014)
  - Anatomical (myelin) hierarchy (structural MRI; Burt et al. 2018)
- ***These relationships were also observed without task regression*** (non-parametric estimates) of task activations and FC changes
  - Identified peak activations for each task block to identify activations or FC using block-to-block variance (Rissman et al. 2004)

References

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