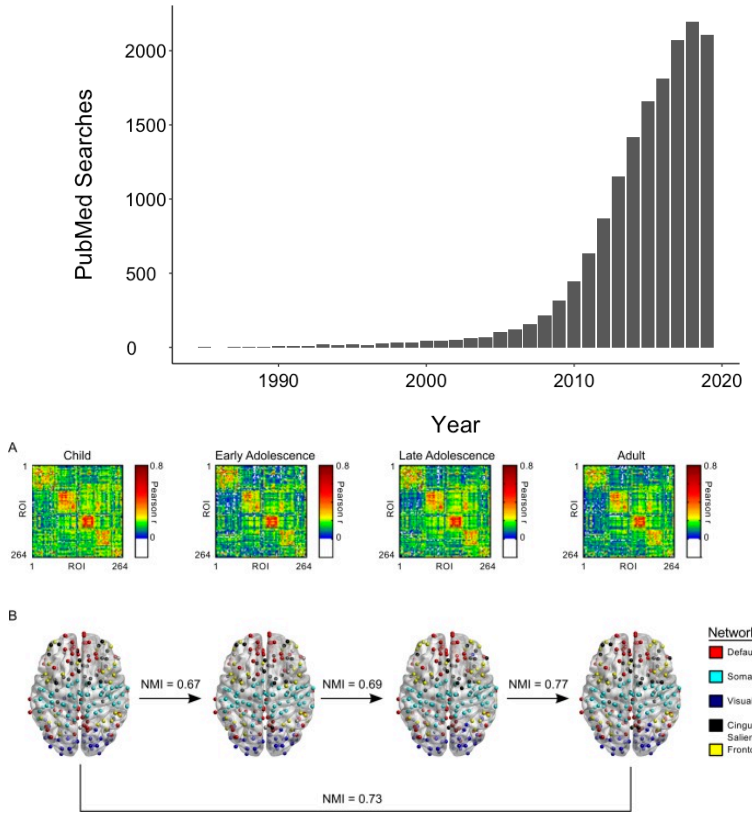
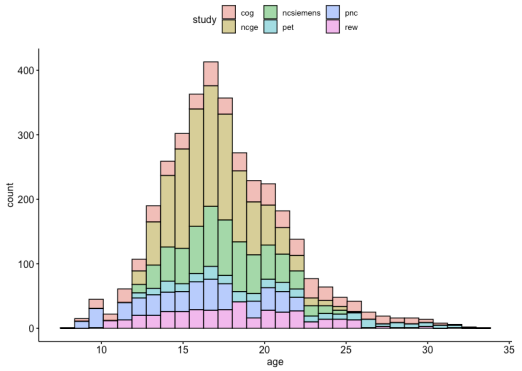
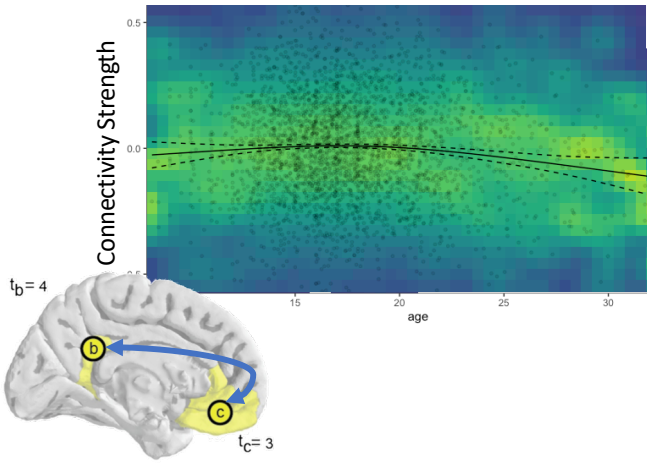
The functional connectome

- Resting state fMRI has become a ubiquitous imaging protocol with thousands of publications per year, allowing the measurement of functional connections at rest quickly, easily, and with minimal invasiveness
- There is particular interest in understanding how these connections (and the networks they comprise) change as the brain matures, since this may convey valuable information regarding the emergence of mental illness
- However, connectivity strength estimates are VERY noisy, are heavily influenced by pre-processing choices, and can vary from site to site
- This has led to a realization that THOUSANDS of scans may be needed to produce reliable results, resulting in a strong interest in open science and big data approaches to developmental neuroimaging



The developmental connectome

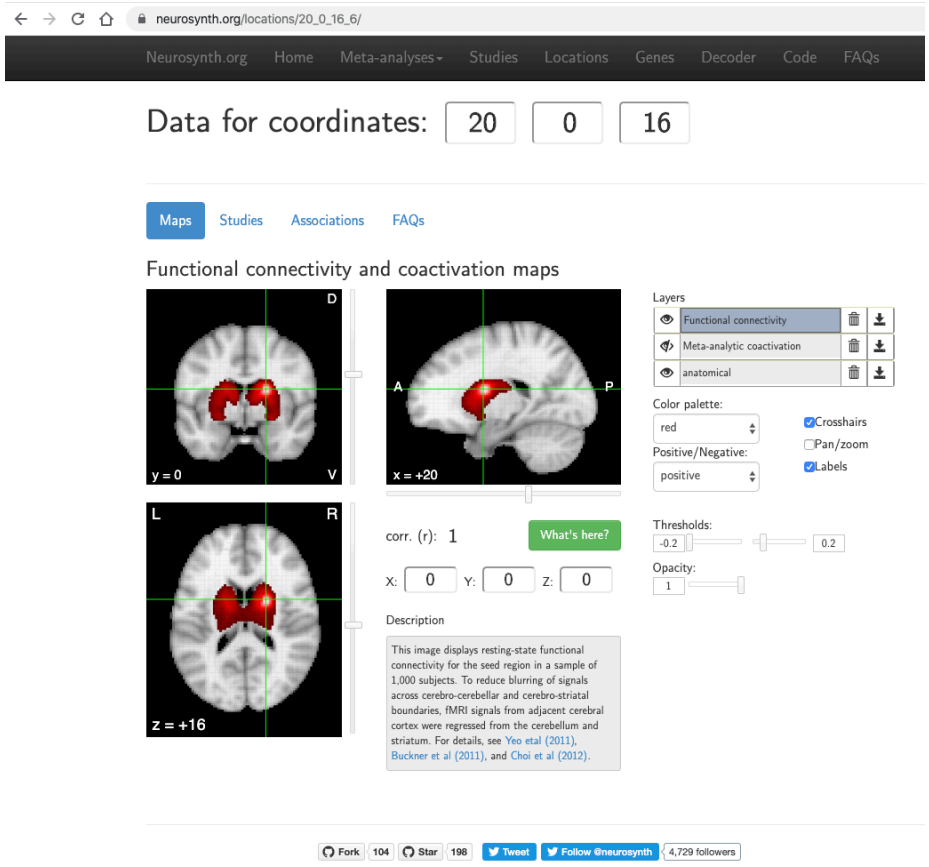




- We have collected data from multiple, longitudinal neuroimaging studies, comprising over 4000 adolescent fMRI scans and applied a standardized, state of the art processing pipeline
- Using the Pittsburgh Supercomputing Cluster, we have used this data to estimate non-linear age trajectories for each of 500k functional connections in the brain (pairwise among >1000 brain regions)
- This data would be valuable to countless research groups
  - Reproducibility: Validation of smaller studies
  - Technical development: Evaluation of new imaging acquisition and processing methods
  - Exploratory: Generation of new hypotheses
- But how do we visualize half a million developmental trajectories?

A web interface for exploring the developmental connectome

- Web portal front-end (a la NeuroSynth) which allows selection of brain regions of interest, tied to a backend database populated with our supercomputer results to pull data, statistical models, and developmental trajectory visualizations



- Interface 1 (region-to-region)
  - Generate a browser-based report for the connection of interest
  - Graphs of connectivity strength vs age
  - Tables reporting statistics (gender difference, effects of artifacts, etc)
  - Allows validation of individual connections to enhance reliability of individual studies

- Interface 2 (whole brain)
  - Brain-based visualization
  - Select a region of the brain, visualize all the other regions it is “connected” to, and whether those connections change with age
  - Facilitates exploratory analyses (given a particular region of interest, where in the brain is there coordinated maturation?)