ADHD fMRI Classification

Week 3

Amy Ko

The Goal

- Classify ADHD brains from normal brains
  - Subtypes: hyperactive, inattentive, or both
- Given: 776 resting-state fMRI scans (ages 7-21)
  - 491 normal brains
  - 285 ADHD brains
  - Additional information: age, gender, diagnosis, handedness, IQ, medication status

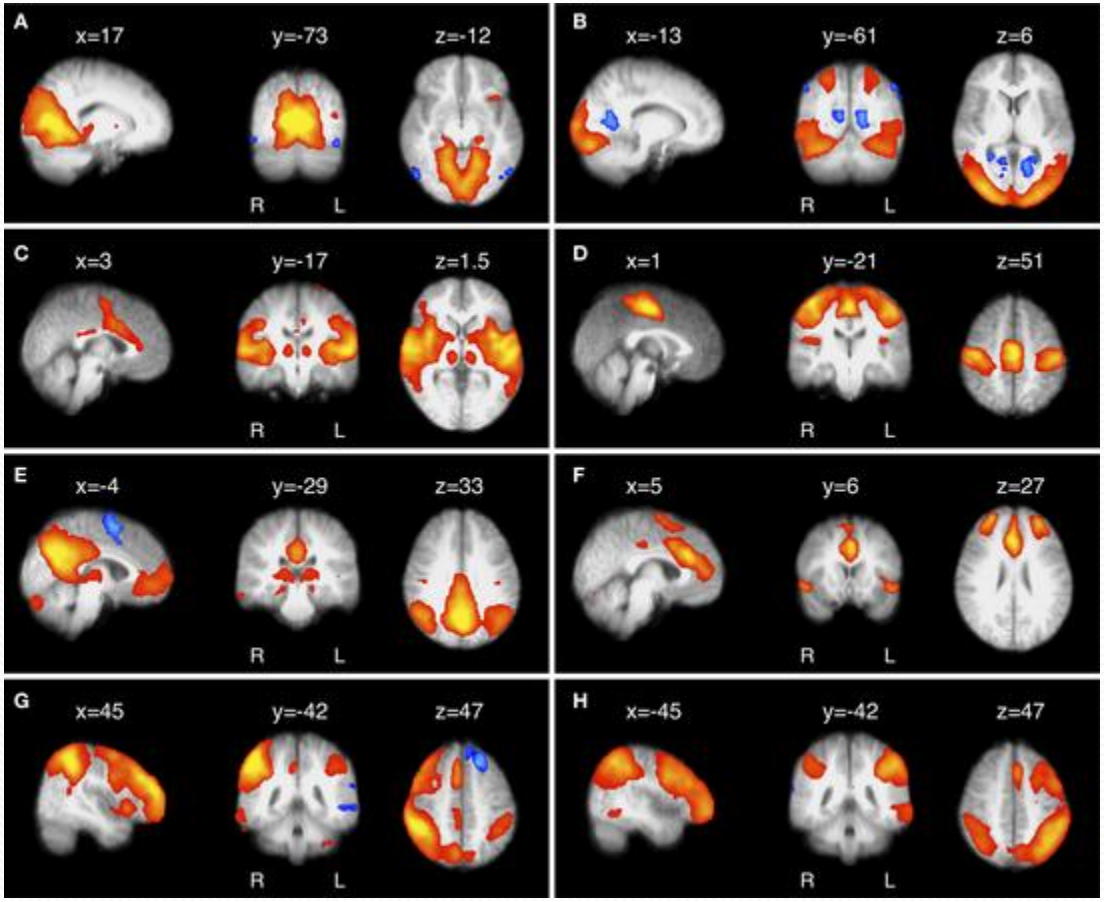
Neurophysiology Behind ADHD

- Default-Mode Network
  - A group of brain regions that are active during rest
  - Antiphasic relationship with regions involved in cognitive tasks
- ADHD → abnormalities in these connections
  - Weaker functional connection between dACC and DMN
  - Weak connections within DMN components themselves

Our Approach

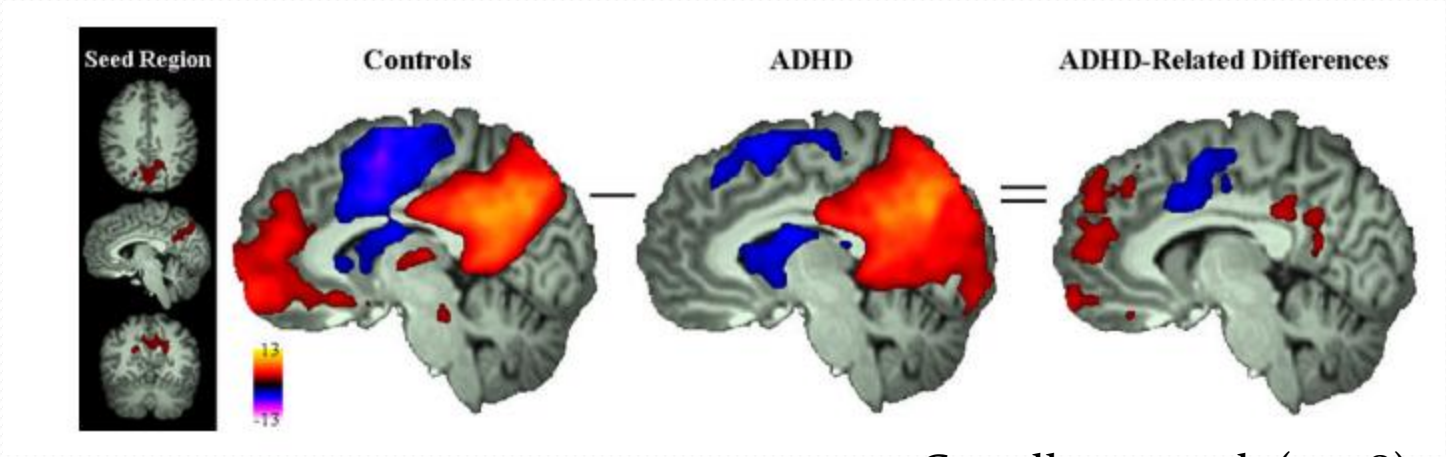
- General Linear Model
  - Each voxel's time series is a linear combination of signals from many different resting-state networks (aka seed regions)
  - The seed regions can be obtained from
    - Previous studies in neuroscience
    - Independent component analysis

Seed Regions



Our Approach

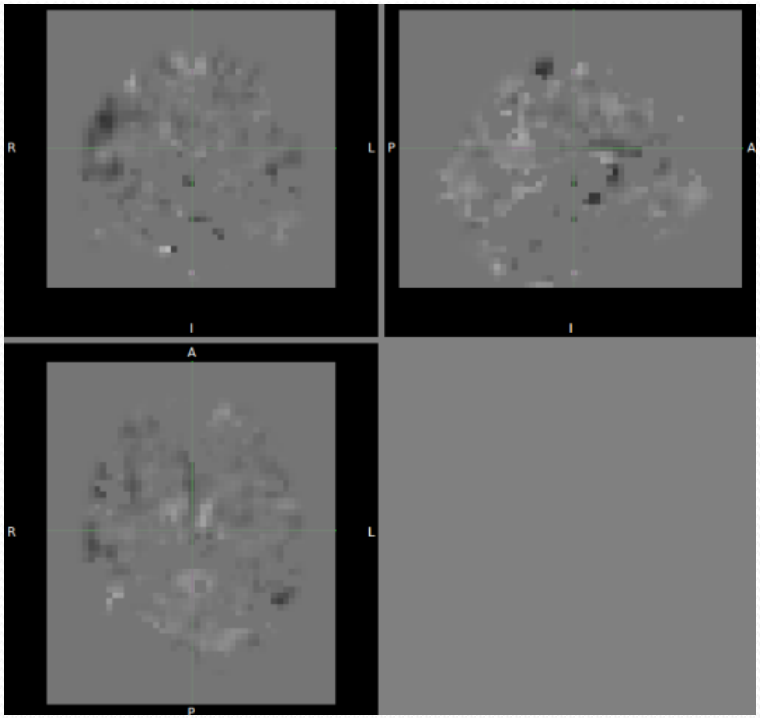
- $y(t) = a1*x1(t) + a2*x2(t) + \ldots + an*xn(t) + \text{corrections}$
  - y = time series of a test voxel
  - x = average time series of the seed regions ("models")
  - a = coefficients
- Compare the coefficients of ADHD and normal brains



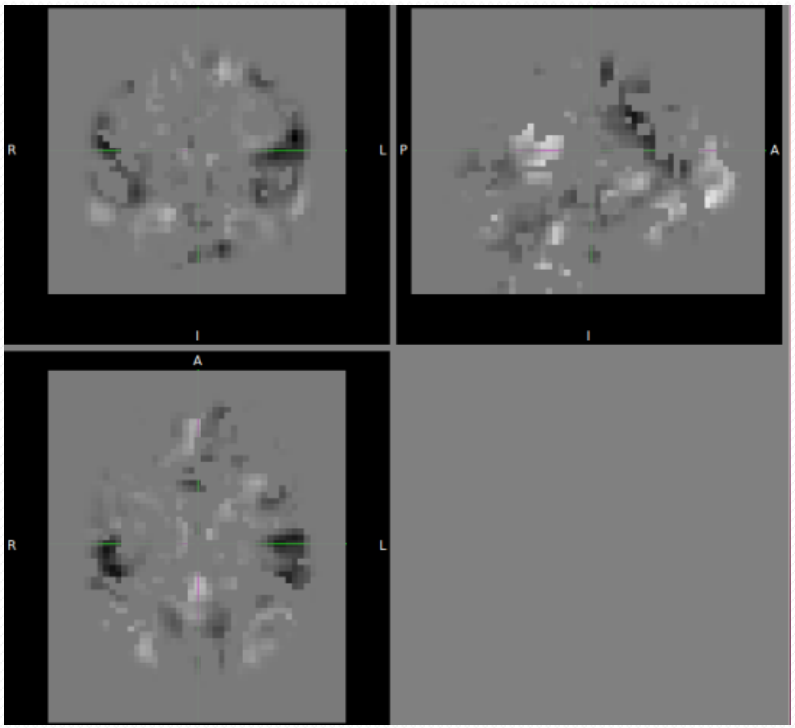
Castellanos et al. (2008)

Our Approach

Normal



ADHD



Next Step

- Explore other brain features
  - More activities in primary and secondary sensory cortices (Tian et al. 2008)
  - Regional homogeneity
    - Cohesiveness of a specified network
    - Decreased regional homogeneity in the frontal-striatal-cerebellar circuits, but increased regional homogeneity mainly in the occipital cortex (Cao et al. 2006)
    - Decreased functional connectivity between precuneus and other DMN components (Uddin et al. 2008)
    - Kendall's coefficient of concordance (Zhu et al. 2007)