NeuroData lab

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Outline

- Background
  - **What is heritability?**
  - Graphs, networks, connectomes
  - Where do connectomes come from?
- Problem
  - What are we trying to estimate?
  - Causal models
  - Dcorr
  - Distance functions
- Results
  - Dataset
  - Results 1
  - Results 2

What is heritability?

- Variations in phenotype caused by variations in genotype.

- Example:

Brains as connectomes

(aka networks or graphs)

- Vertex = a region of interest

- Edges = connectivity measure between a pair of vertices

- Diffusion MRI = # of estimated neuronal fibers

Connectome Generation

center

Source:

https://www.biorxiv.org/content/biorxiv/early/2021/11/03/2021.11.01.466686.full.pdf

Overall DAG

Insert dag

Subject specifig DAGs

Insert 4 Dags

Statistical problem

- Want an independence test!

- $H_0 : F(Genome, Connectome) = F(Genome)F(Connectome)$
  $H_A : F(Genome, Connectome) \neq F(Genome)F(Connectome)$

- Test statistic: Distance correlation

Statistical problem

- Want an independence test!

- $H_0 : F(Genome, Connectome | Covariates) = F(Genome | Covariates) F(Connectome | Covariates)$
  $H_A : F(Genome, Connectome | Covariates) \neq F(Genome | Covariates) F(Connectome | Covariates)$

- Test statistic: Conditional distance correlation

Human Connectome Project

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Assumptions

- Only 2 children per family

- Only identical twins, fraternal twins, non-twin siblings

Monozygotic vs Dizygotic

- Assumptions:
  - Controls environment variable

Insert figure

All three groups

- Assumptions:
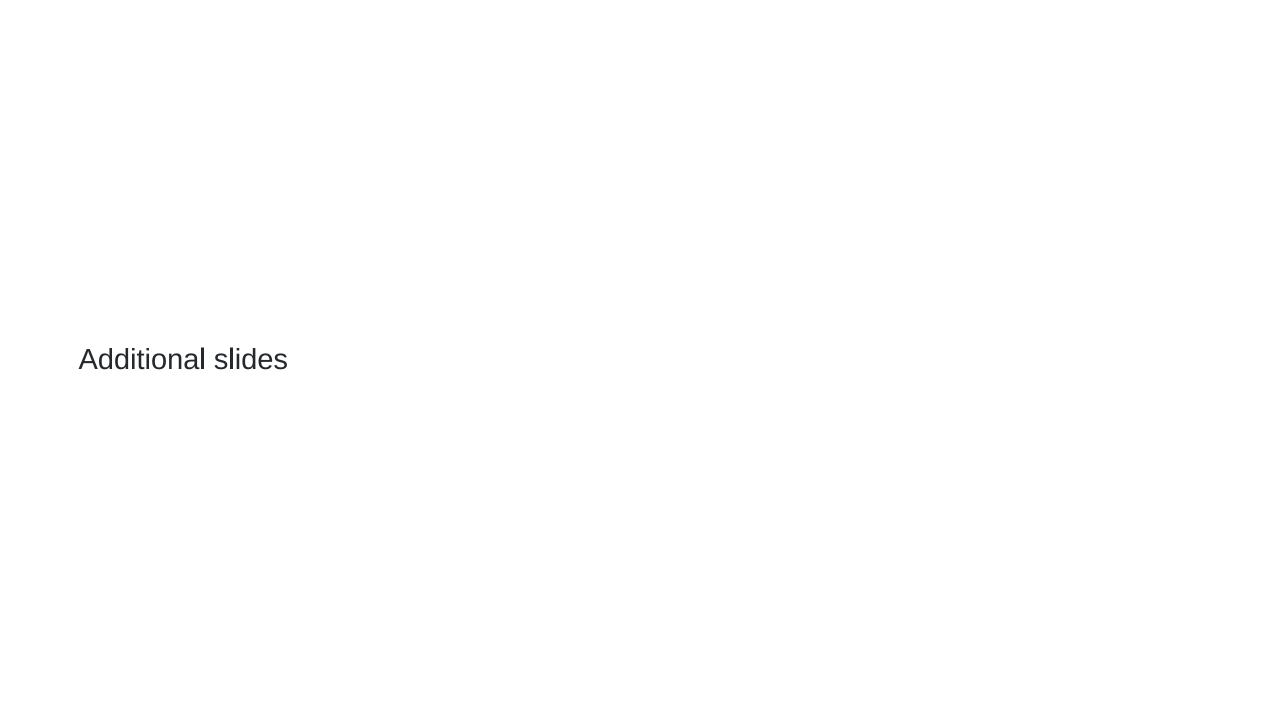 - Add in environmental and genetic variance

Insert figure

Neuroanatomy Mediator

Test the existence of arrow

Conditional Test as causal effect estimator

- Using conditional distance correlation

The End

Additional slides

Information on Distance Correlation

Shortcomings

- Network models

- Problems with connectome estimation.

- dominant genetic effects and epistasis.

- No interaction between environment and genetics

Environemtal effects

- Shared
  - Common experiences of siblings living in the same household.
    - household income, the family's living situation, the dynamics between the parents, food consumed
- Non-shared
  - Everything else
  - Epigenetics
  - Luck
  - schools, peers