

I. Linking Function to *Structure* in the Human Brain

The last 15 years of fMRI research have discovered a stunning degree of functional organization in the human brain, including a number of highly specialized regions that can be found in the same place in all normal subjects. BUT:

- 1. Almost nothing is known about the relationship between this functional organization and the underlying anatomy/biology. Do functionally distinct cortical regions have distinct
cytoarchitecture?
connectivity?
circuitry?**

Needed: new methods for human neuroanatomy, including

- discovering connectivity between and within cortical areas!**
- registering fine-grained anatomy with function within individuals**

Kanwisher, MIT

II. *Origins* of Functional Organization in the Human Brain

- 2. How does all this functional organization in cortex arise in development?
High-level cognitive specializations may develop later, & may involve different mechanisms from development of e.g. V1 & M1.**

Challenge: to collect spatially resolved brain data from kids < 7 y.o.

Possible Avenues:

- **technical advances in pediatric fMRI:
specialized MR coils for kids (> higher SNR > shorter scans)
on-line motion correction methods**
- **proxy measures:
ERP markers (if correlated w/ cortical structure in adults)
cytoarchitectonic markers (in younger sleeping children)**
- **macaque models
scanning baby monkeys (Kourtzi)
manipulate experience etc.**

III. Linking Function to *Behavior* in the Human Brain

3. What is the relationship between brain activation & behavior?

- what matters is not *activation* but *information* in brain responses.

New machine-learning classification methods, along with higher-resolution scanning methods, are proving useful in discovering what information is represented in each region.

- **much of the observed cortical activity and information may not be related to behavior. How can we determine which aspects of the cortical response are on the causal chain leading to behavior and which are epiphenomenal?**

i.e., which neural codes are read out behaviorally?

and, how does readout change with task and expertise?

Needed: new methods for inferring the causal role of cortical responses in behavior.