Why study brains?

Why are we, NSF, and the public so interested in brains?

Why did we have the Decade of the Brain, not the Decade of the Liver, Kidney, or Pancreas?

The really exciting thing about brains is that *they produce thought and behavior.*

The ultimate goal of neuroscience is not simply to explain how ion channels, synapses, and neurons work, but *how all of this machinery creates thought and behavior.*

The study of cognition in humans and other animals lies at the very core of neuroscience. You could call this enterprise…..

The Human Cognome Project

A broad-based effort to characterize our cognitive repertoire

- not just an inventory of mental processes, but
- an algorithm-level understanding of the *representations and computations* that constitute these cognitive processes
- including which of these cognitive processes may be uniquely human
- as well as which processes we share with other species,

comparative cognome projects for
e.g. macaques, mice, fruit flies.

How can this research program proceed,
in a fashion that is integrated with the rest of neuroscience?

What is the functional organization of the mind and

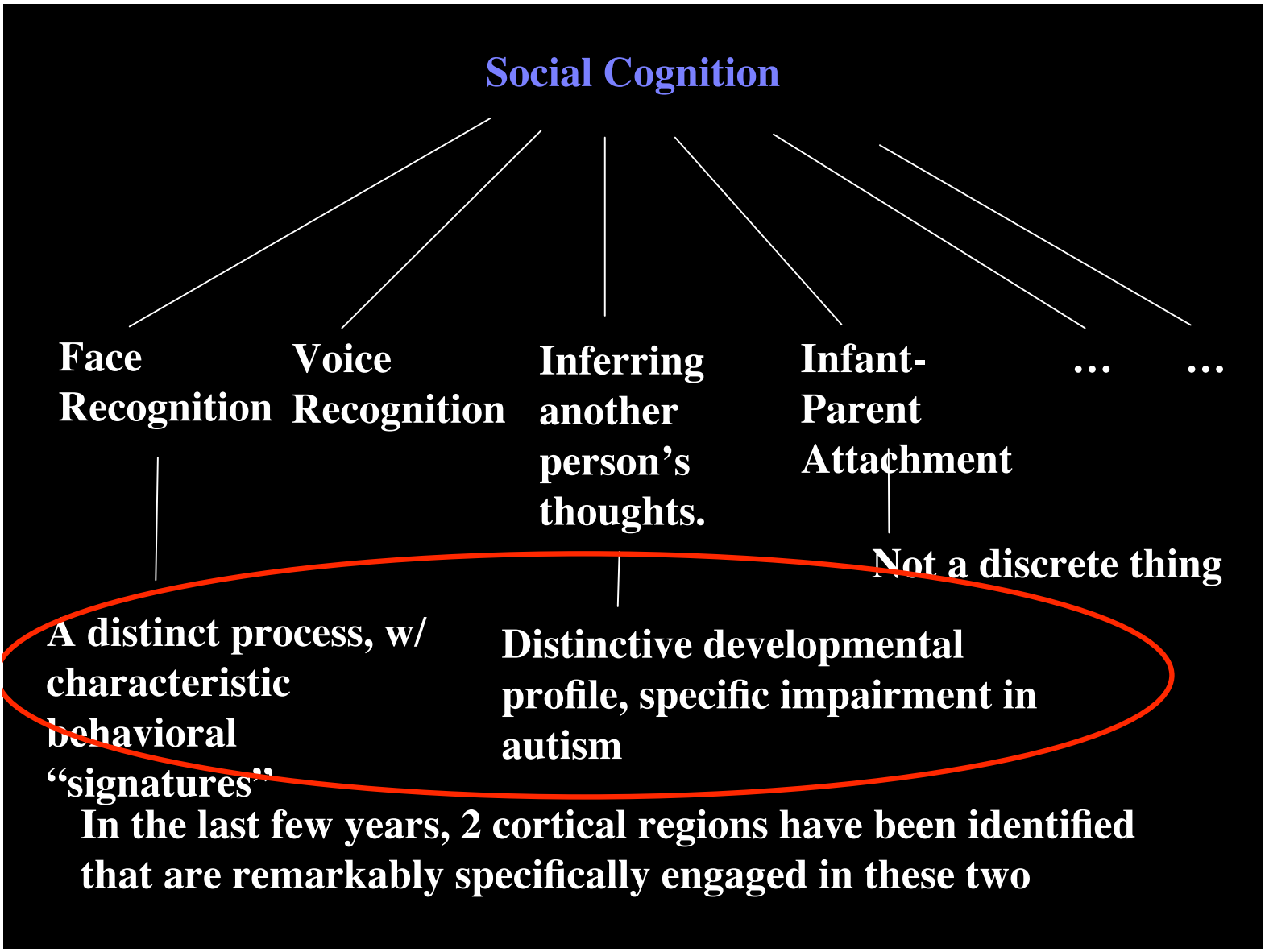
To what extent is the mind/brain composed of

-discrete components that carry out specific cognitive functions
e.g. face recognition, syntax, or representing number

- general-purpose mechanisms that cut across domains

How this research program proceeds:

- investigation of core cognitive abilities (The Cognome)
- the cognome provides the hypothesis space for brain investigations (e.g. fMRI)
- for each core cognitive ability: is this function implemented in
  - specialized brain region/s dedicated to that function only?
  - distributed network of brain regions each of which may conduct multiple cognitive operations


Social Cognition
Face Recognition
Voice Recognition
Inferring another person's thoughts.
Infant-Parent Attachment
…
…
Not a discrete thing
A distinct process, w/ characteristic behavioral "signatures"
Distinctive developmental profile, specific impairment in autism
In the last few years, 2 cortical regions have been identified that are remarkably specifically engaged in these two

A Rich Landscape of Exciting New Questions

• understanding how the different components of the system interact
    at both levels, cognition & brain

• how are the components connected
        connectivity of human brain largely unknown
        animal models can help (e.g., Tsao, face areas in macaques)

• how does cognitive and neural structure arise in development?
        roles of learning and genes in constructing these components
• how does cognitive and neural structure arise evolutionarily?
        comparative approaches are key here

Explaining the Brain Basis of Cognition: A Twenty Year Perspective

- navigation/spatial cognition
- speech perception
- multisensory integration
- sensorimotor integration
  e.g., visually-guided action
- face recognition
- reading
- number

Tools for the Future

- Methods for scanning of younger kids

- Methods to better map anatomical connectivity in the human brain

- Methods for getting and integrating brain data from humans with high spatial and temporal resolution

- Watching small brains work
  e.g. mapping from gene to network to complex behavior

- New methods of analyzing and integrating large data sets from multiple methods

- Expanding the scale of investigation from the mid-level scale