The Research Problem

Atypical social behavior in ASD

- communication
- emotional reaction
- behavioral response
The Explanation

Impaired social cognitive processing

► face processing
Face Processing

Figure 1: A copy of Bruce and Young's (1986) face processing model.
The Explanation

Impaired social cognitive processing

► face processing

► Theory of Mind
Theory of Mind
The Explanation

Impaired social cognitive processing

- face processing
- Theory of Mind
- action understanding
Action Understanding
The Social Brain

Mentalizing
Medial prefrontal, Posterior cingulate

Affect
Amygdala, Insula

Biological Form
Lateral fusiform gyrus

Biological Motion
Superior temporal sulcus
The Approach

Examine the recruitment of brain regions
The Improved Approach

Examine connectivity of ROIs

► face processing network
► Theory of Mind network
► action understanding network
Face Processing Network

- **Object recognition**
  - Lateral occipital cortex
  - Inferior ventral temporal cortex

- **Face detection**
  - Superior colliculus
  - Pulvinar
  - Amygdala

- **Face identification**
  - Fusiform gyrus
  - Inferior occipital gyrus

- **Expression**
  - Amygdala
  - Orbitofrontal cortex
  - Sensorimotor cortex

- **Gaze**
  - Superior temporal sulcus
  - Superior temporal gyrus
Theory of Mind Network

- Sensory System
  - Other's state
    - Emotions
    - Motions
    - Intentions
  - Contextual evaluation
  - mPFC
  - OFC

- Cognitive System
  - Other's trait
    - Intentions
    - Prior interaction
    - Social norms
  - Anticipations
  - TPJ
  - STS

- Motor System
  - dIPFC
  - ACC
  - PCC

  - Make decisions
  - Behavior adaptation

- Evidences of impairments
- Few evidences of impairments
- Contradictory evidences
- Evidences of no-impairments
- Few evidences of no-impairments
- Not enough evidences
Action Understanding Network
The Experiment

- Arrow-Object (AO)
- Eyes-Object (EO)
- Eyes-LeftRight (ELR)
- Eyes-OpenClosed (EOC)
- Mouth-OpenClosed (MOC)
The Experiment
Collecting fMRI Data
The fMRI Data

<table>
<thead>
<tr>
<th></th>
<th>EO-AO</th>
<th>EO-ELR</th>
<th>ELR-EOC</th>
<th>EOC-MOC</th>
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<tr>
<td>FACE</td>
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<td><img src="image2.png" alt="Image" /></td>
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Using IMaGES
Independent Multiple-sample Greedy Equivalence Search

http://www.phil.cmu.edu/projects/tetrad/
Extracting the Time Series
Time series to IMaGES graph
The Results

<table>
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<th>NT</th>
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The Results
The Results
The Results

FACE

TOM

ACTION
What was Learned

- face processing: ASD $\approx$ NT
- Theory of Mind: ASD $\neq$ NT
- action understanding: ASD $\neq$ NT when faces involved
- ASD networks less stable than NT
Other Studies Using IMaGES

preference decisions
Other Studies Using IMaGES

preference decisions

language processing
Other Studies Using IMaGES

preference decisions

language processing

cocaine drug usage
Other Studies Using IMaGES

- preference decisions
- language processing
- cocaine drug usage
- female & male orgasm
Wish List

► Metric for graph comparison
 How many edges must differ?
 Role of orientation?

► Means of assessing model validity
 Account for time series variance
 Differentiate models with same GOF
Thanks to my collaborators:

Steve Hanson
Joe Ramsey
Clark Glymour