



IMaGES in the Brain

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CMU – October 2013

The Research Problem

• **Atypical social behavior in ASD**

- ▶ communication
- ▶ emotional reaction
- ▶ behavioral response

The Explanation

Impaired social cognitive processing

▶ **face processing**

Face Processing

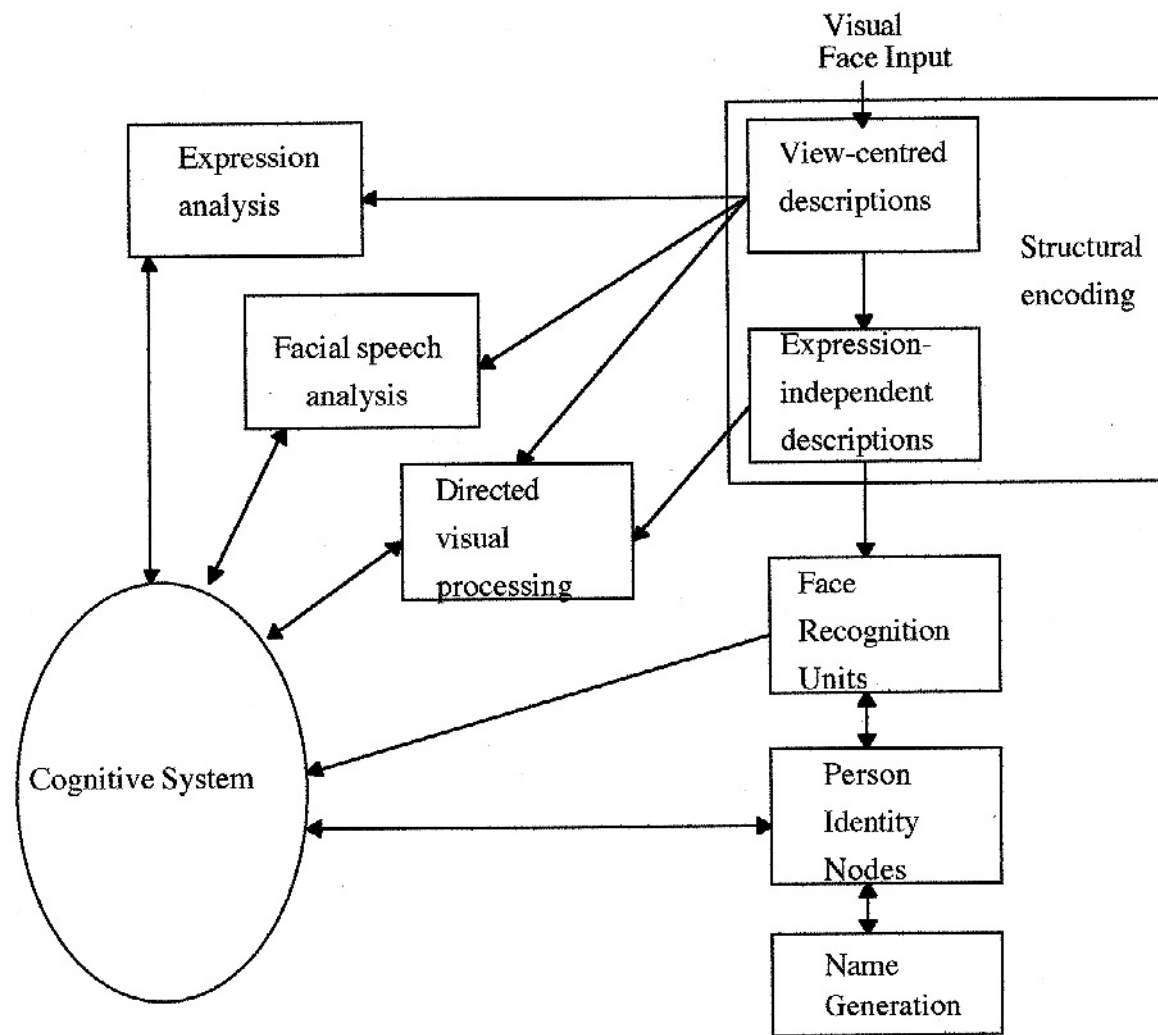


Figure 1: A copy of Bruce and Young's (1986) face processing model.

The Explanation

Impaired social cognitive processing

- ▶ face processing
- ▶ Theory of Mind

Theory of Mind

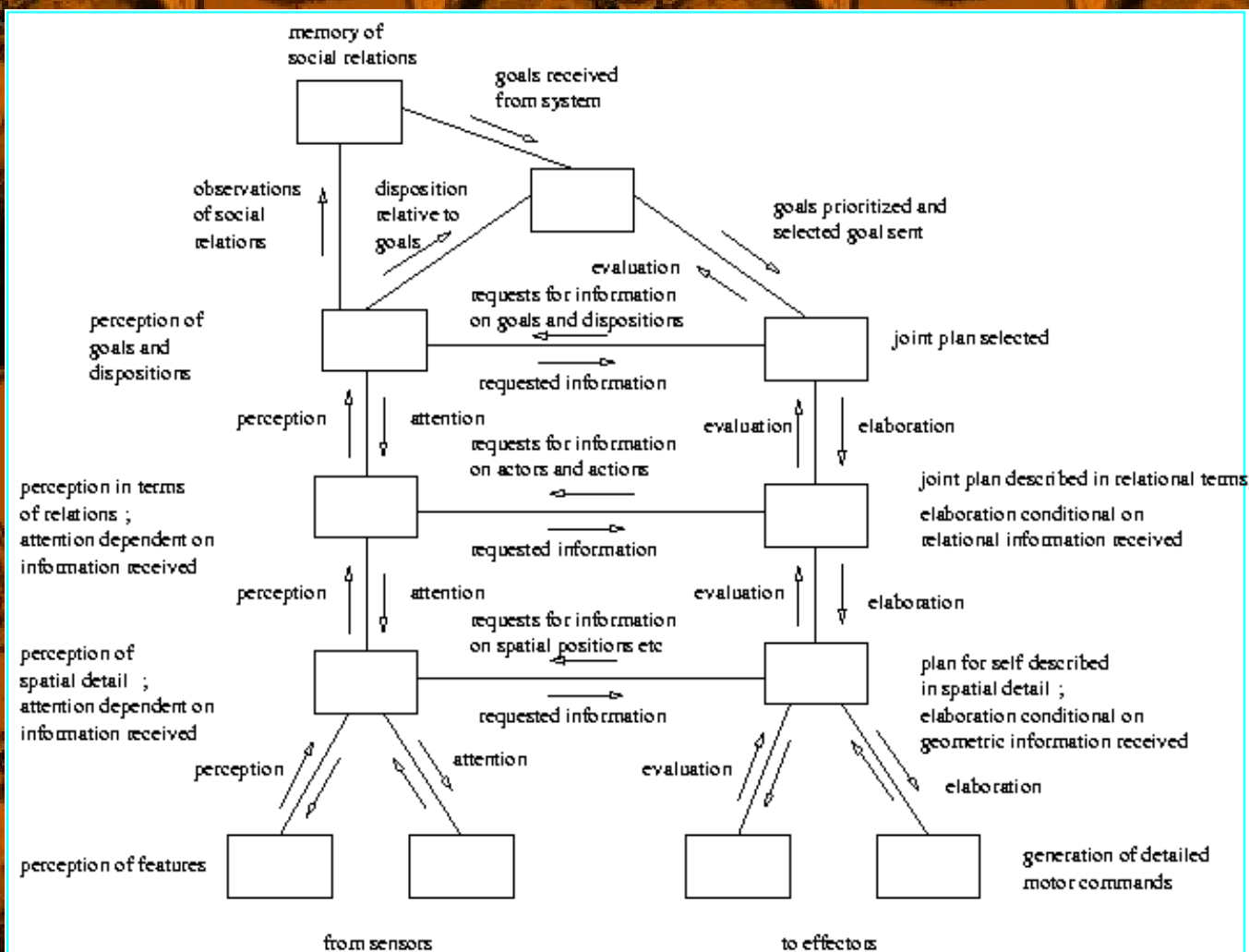


The Explanation

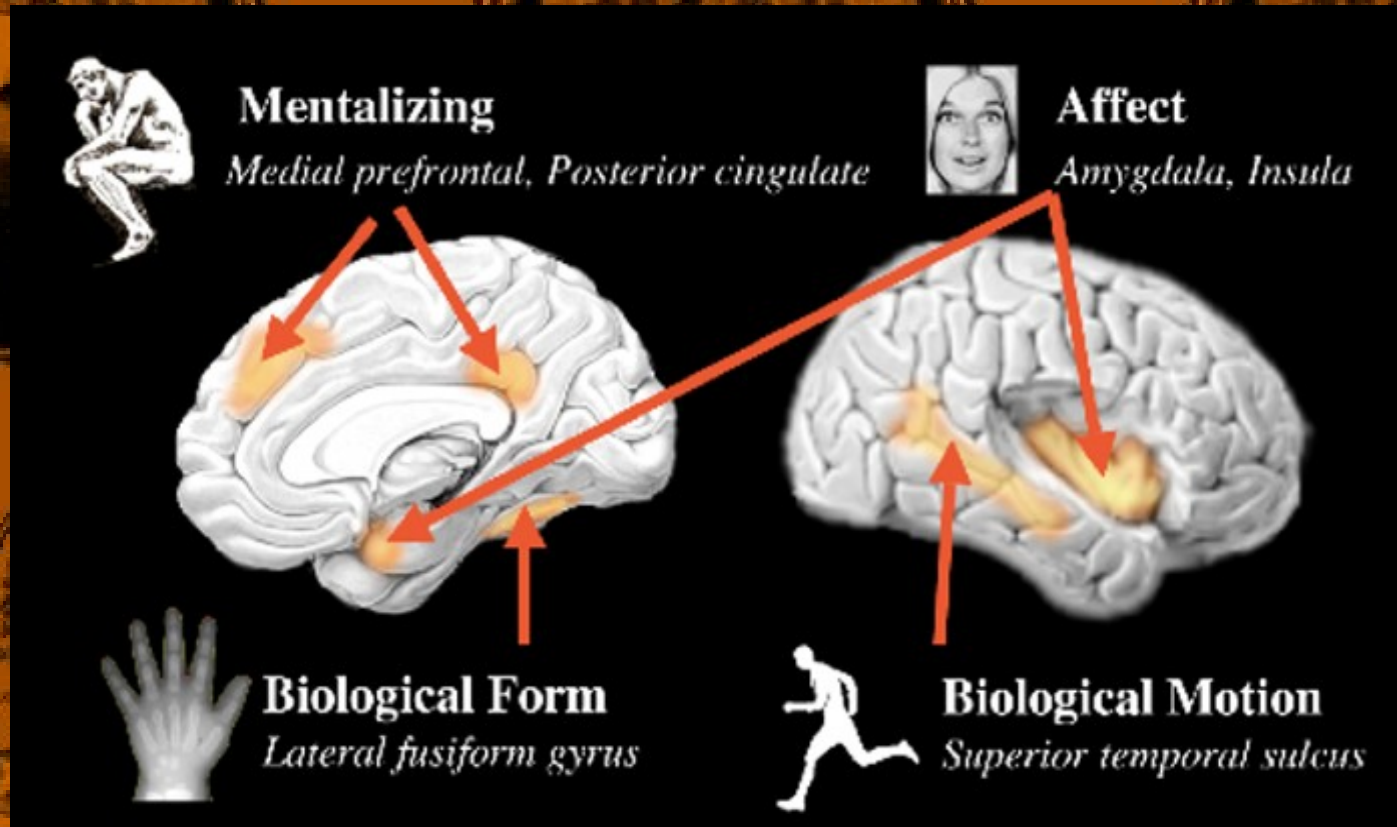
Impaired social cognitive processing

- ▶ face processing
- ▶ Theory of Mind
- ▶ action understanding

Action Understanding

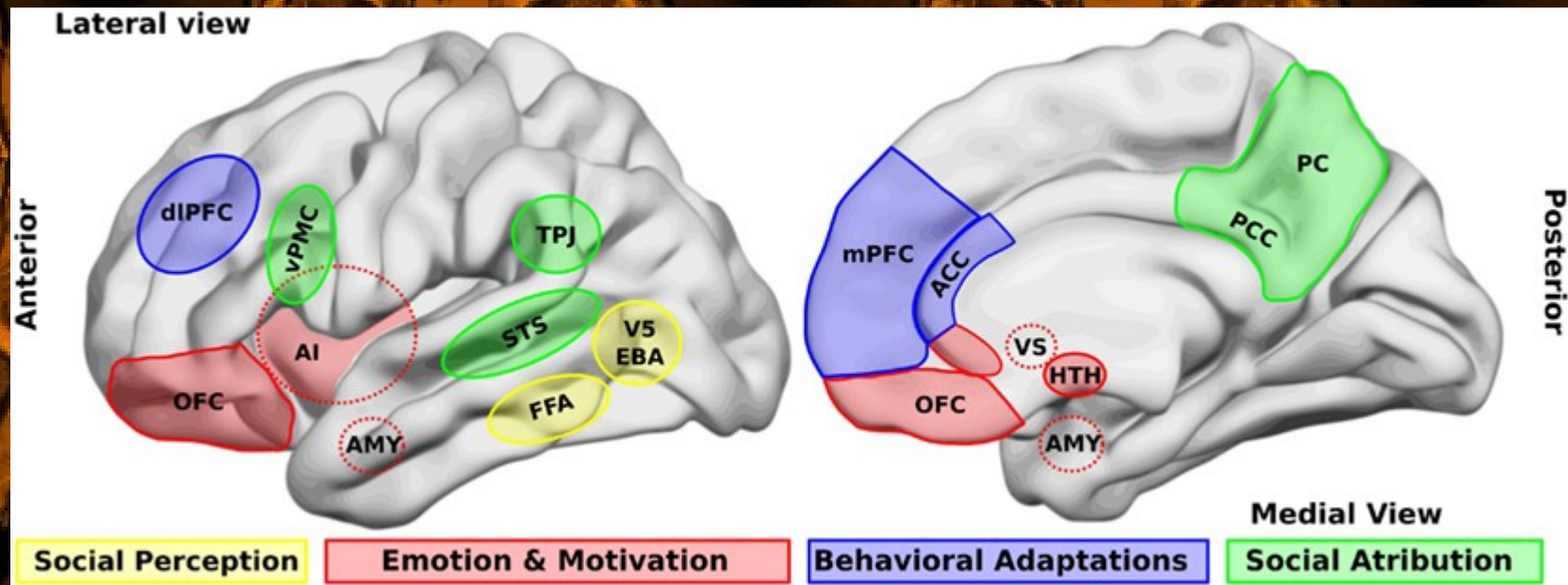


The Social Brain



The Approach

Examine the recruitment of brain regions

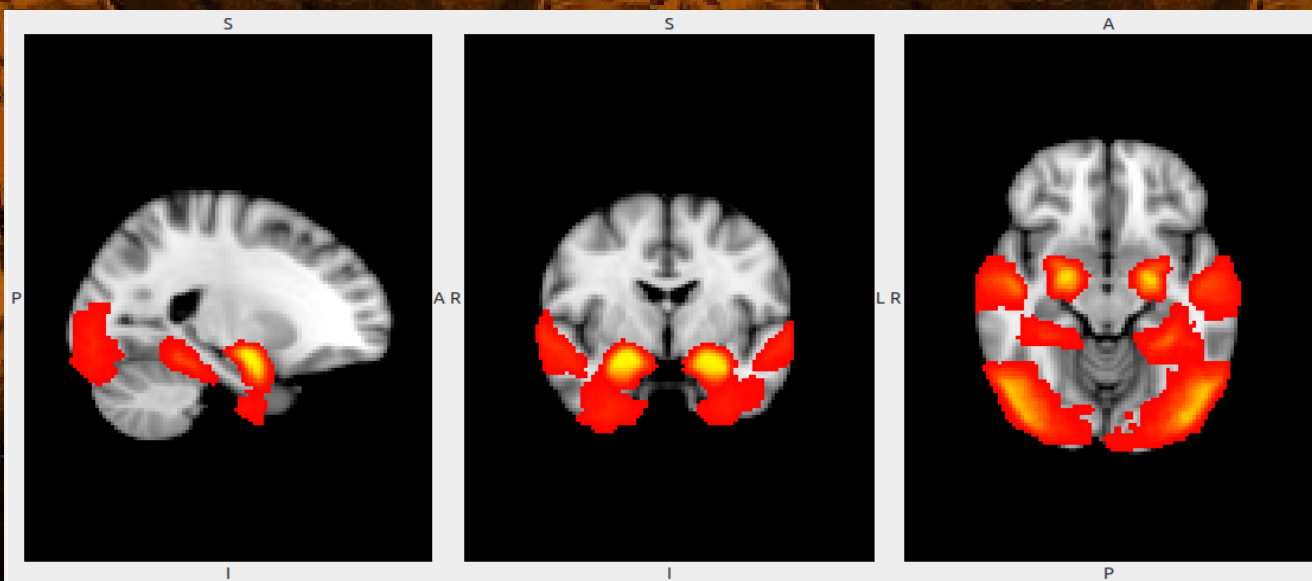
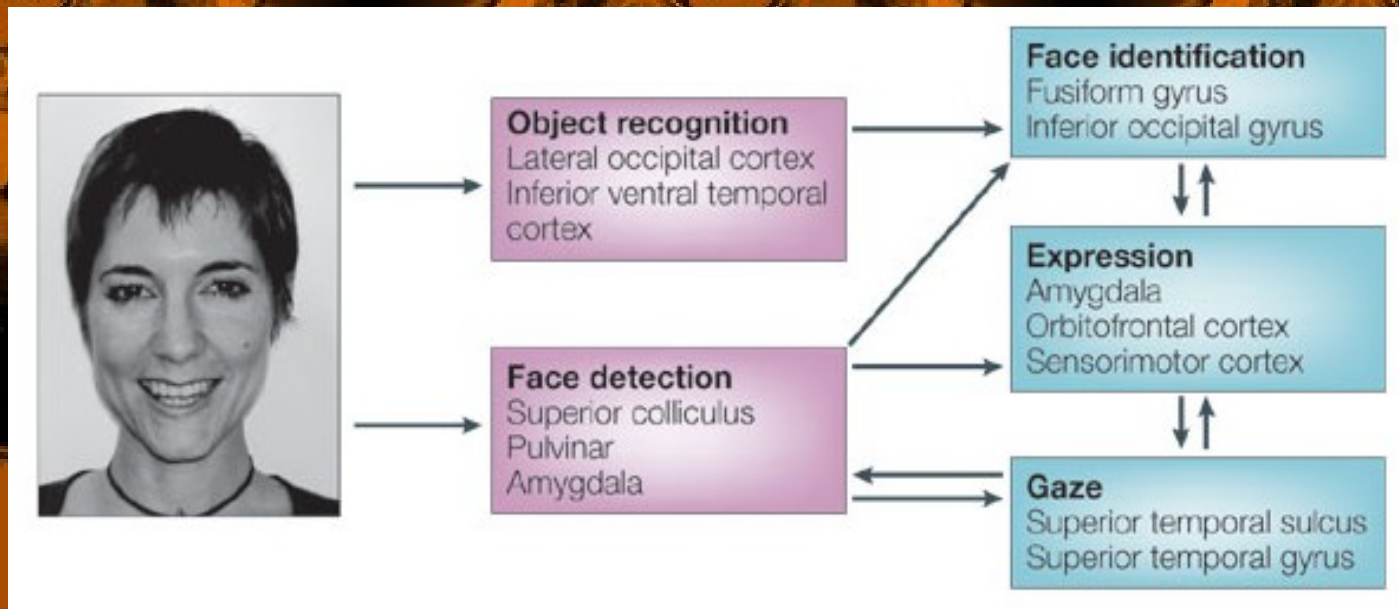


The Improved Approach

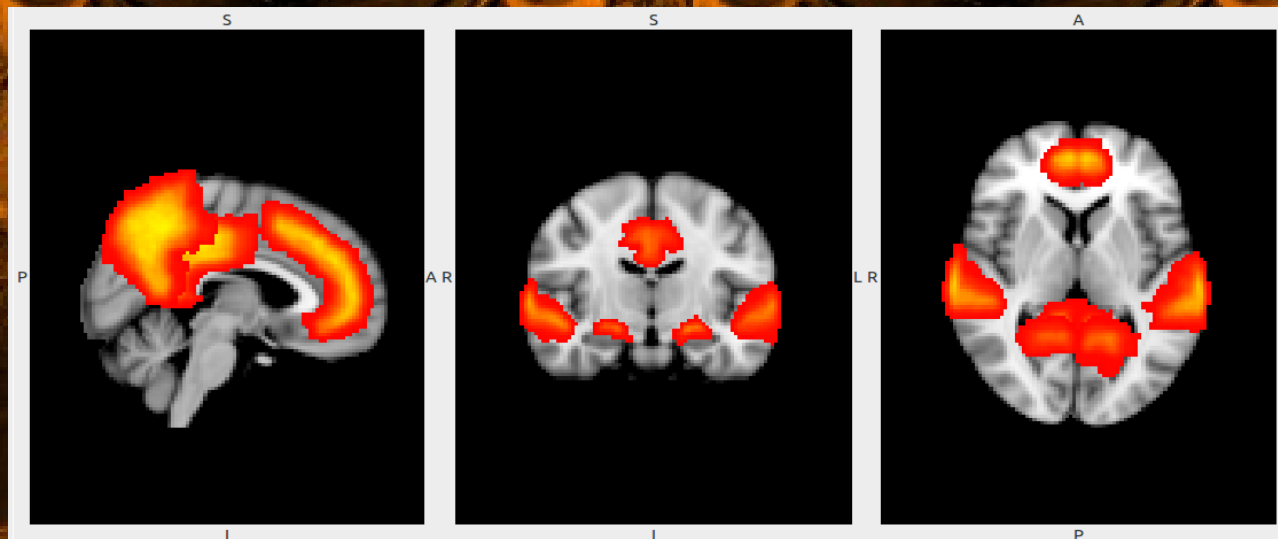
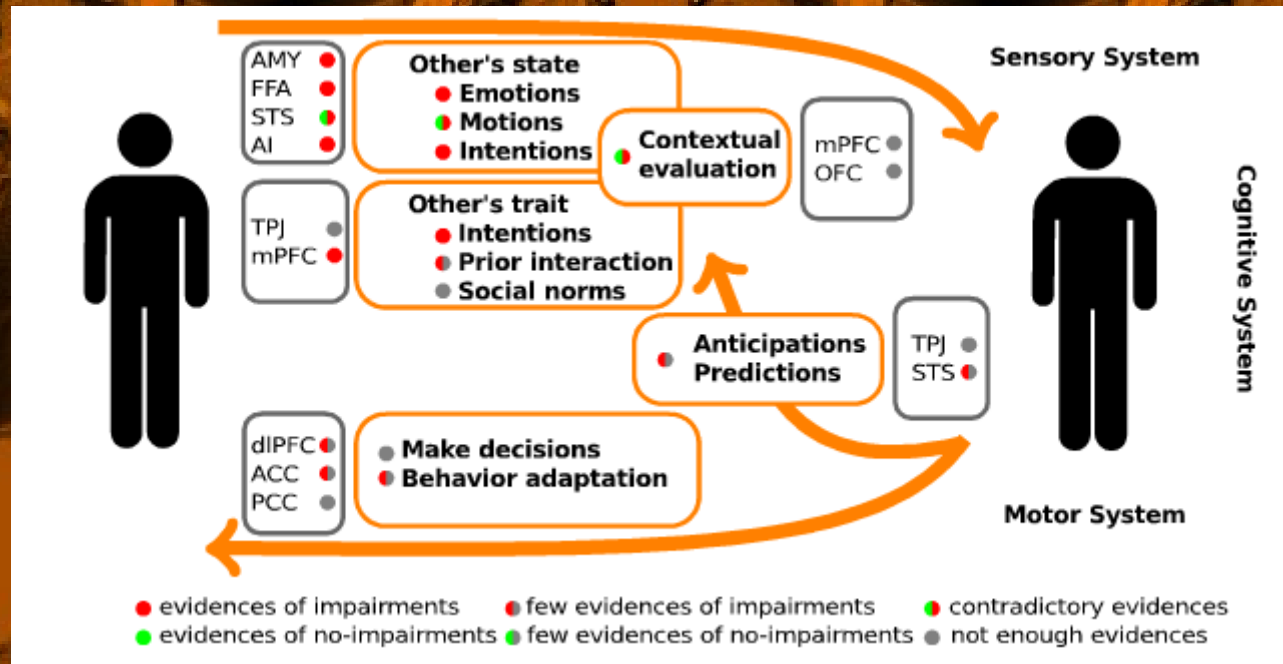
Examine connectivity of ROIs

- ▶ face processing network
- ▶ Theory of Mind network
- ▶ action understanding network

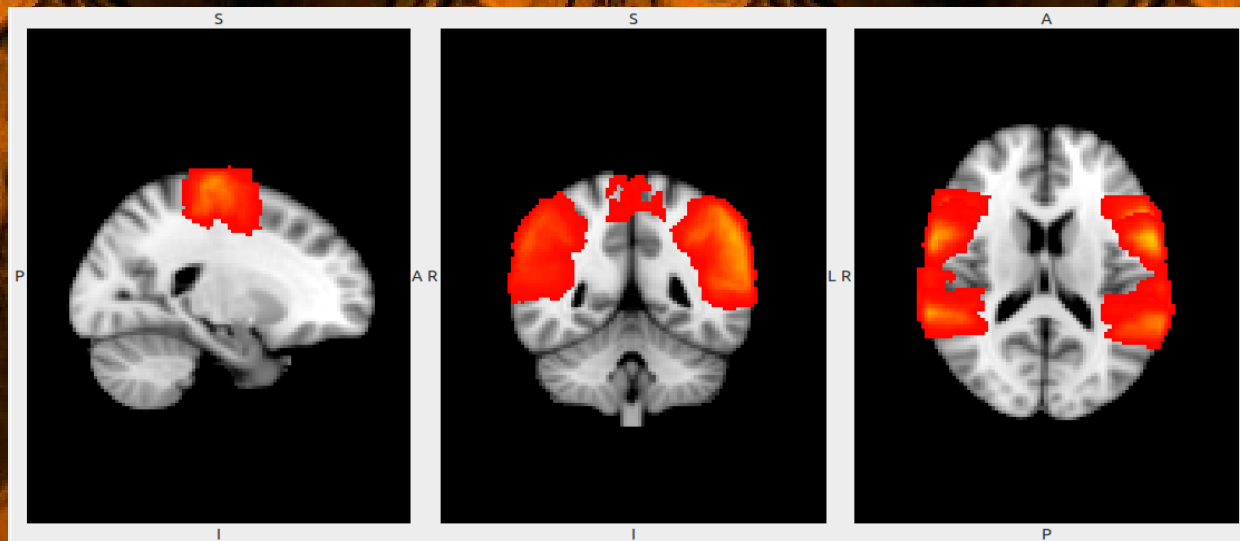
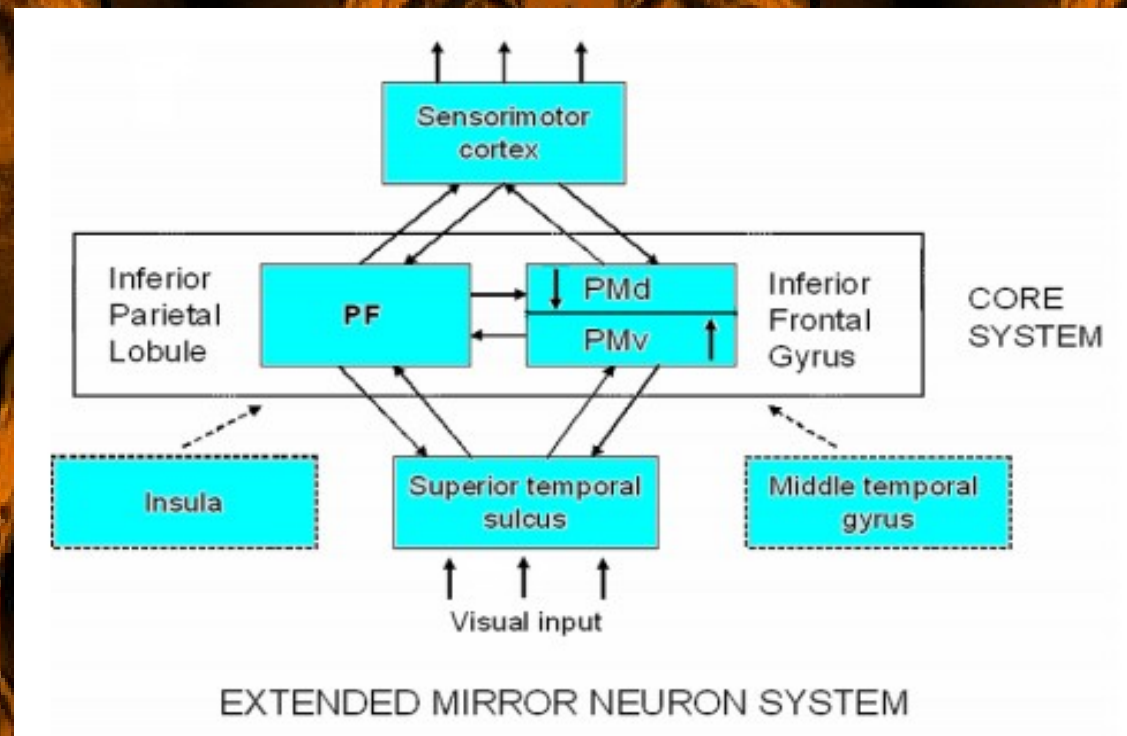
Face Processing Network



Theory of Mind Network

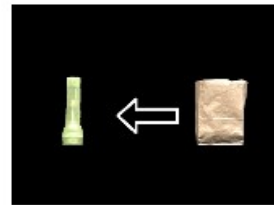


Action Understanding Network



The Experiment

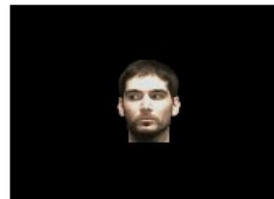
Arrow-Object (AO)



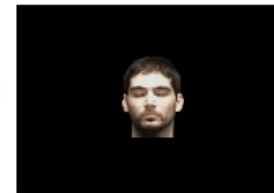
Eyes-Object (EO)



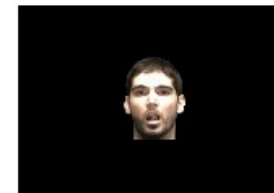
Eyes-LeftRight (ELR)



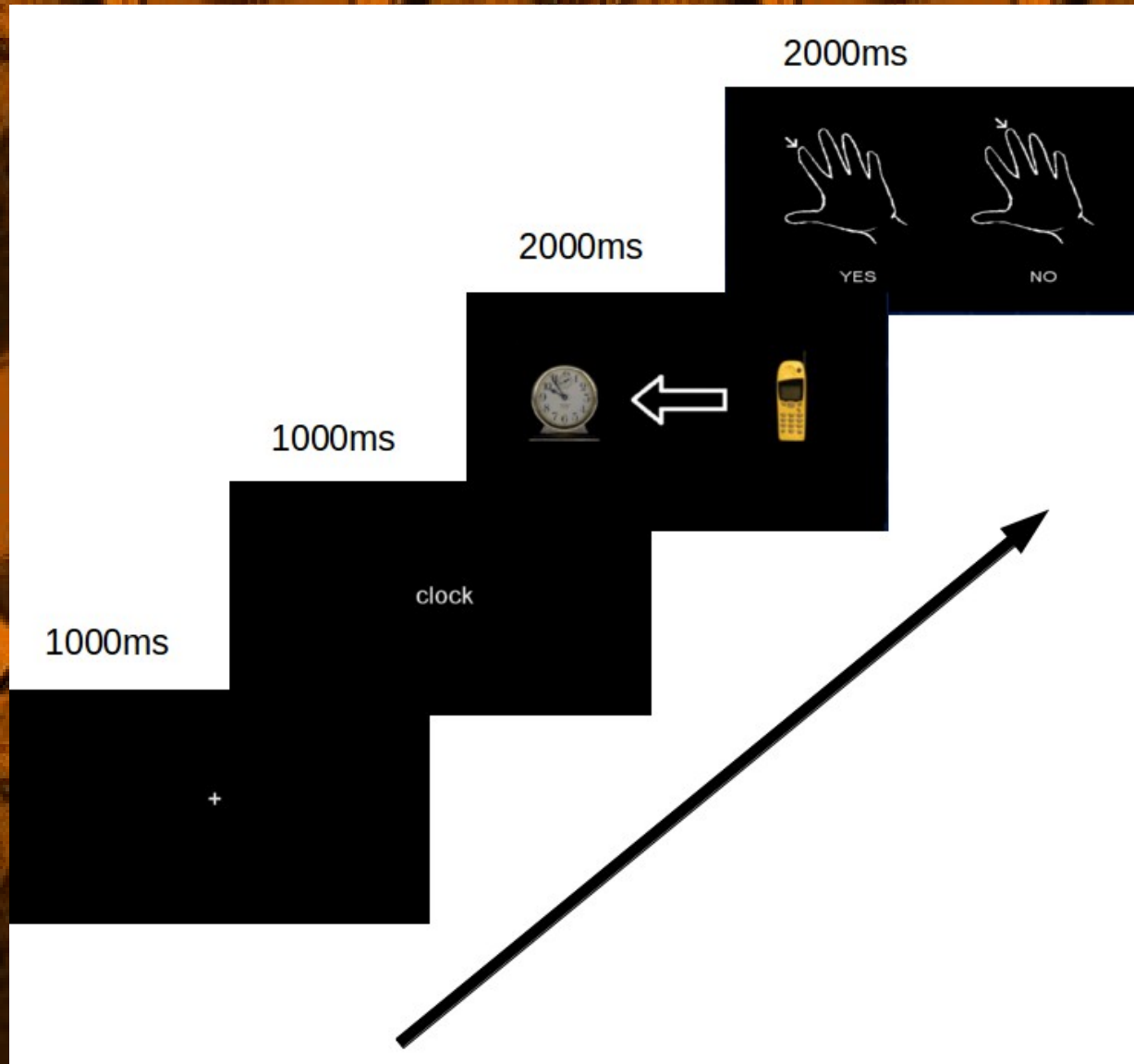
Eyes-OpenClosed (EOC)



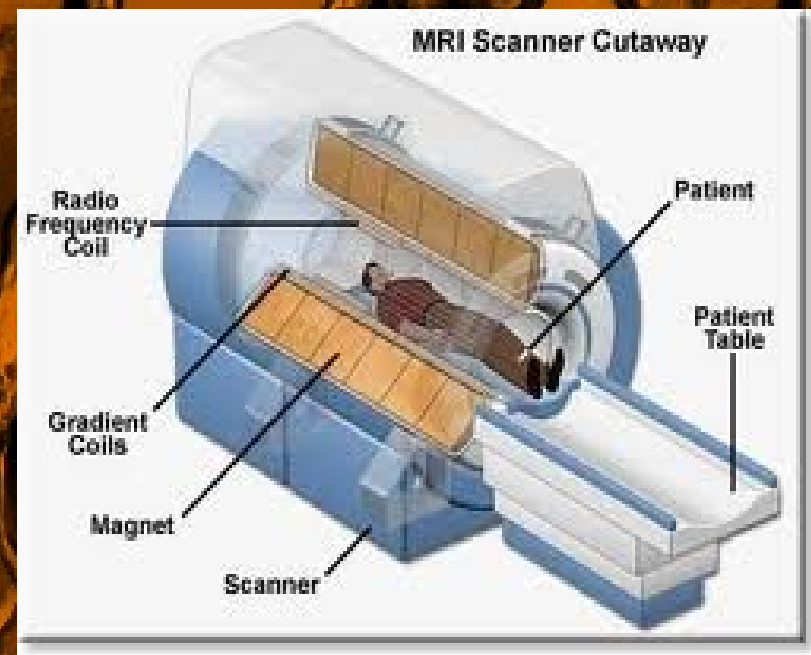
Mouth-OpenClosed (MOC)



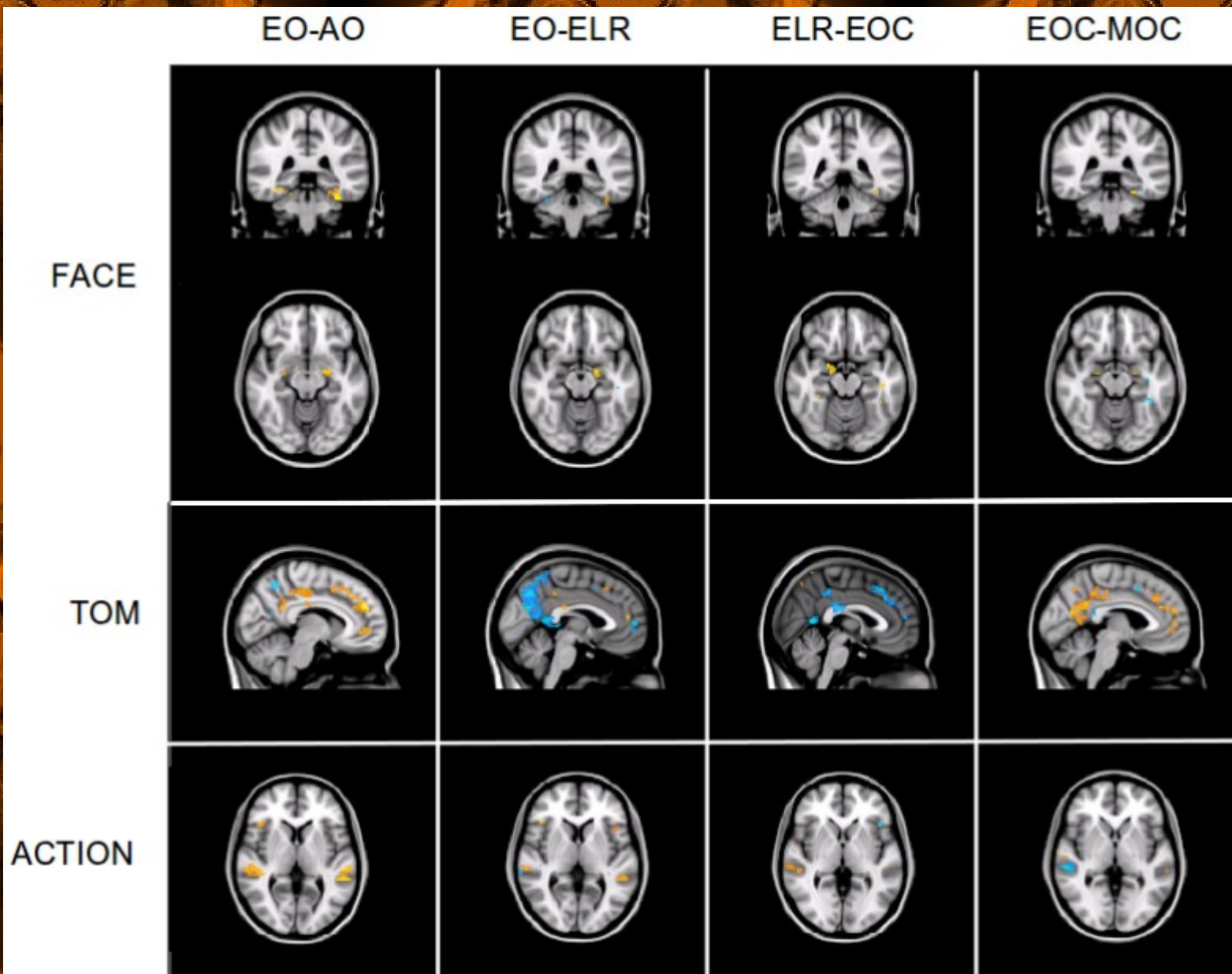
The Experiment



Collecting fMRI Data

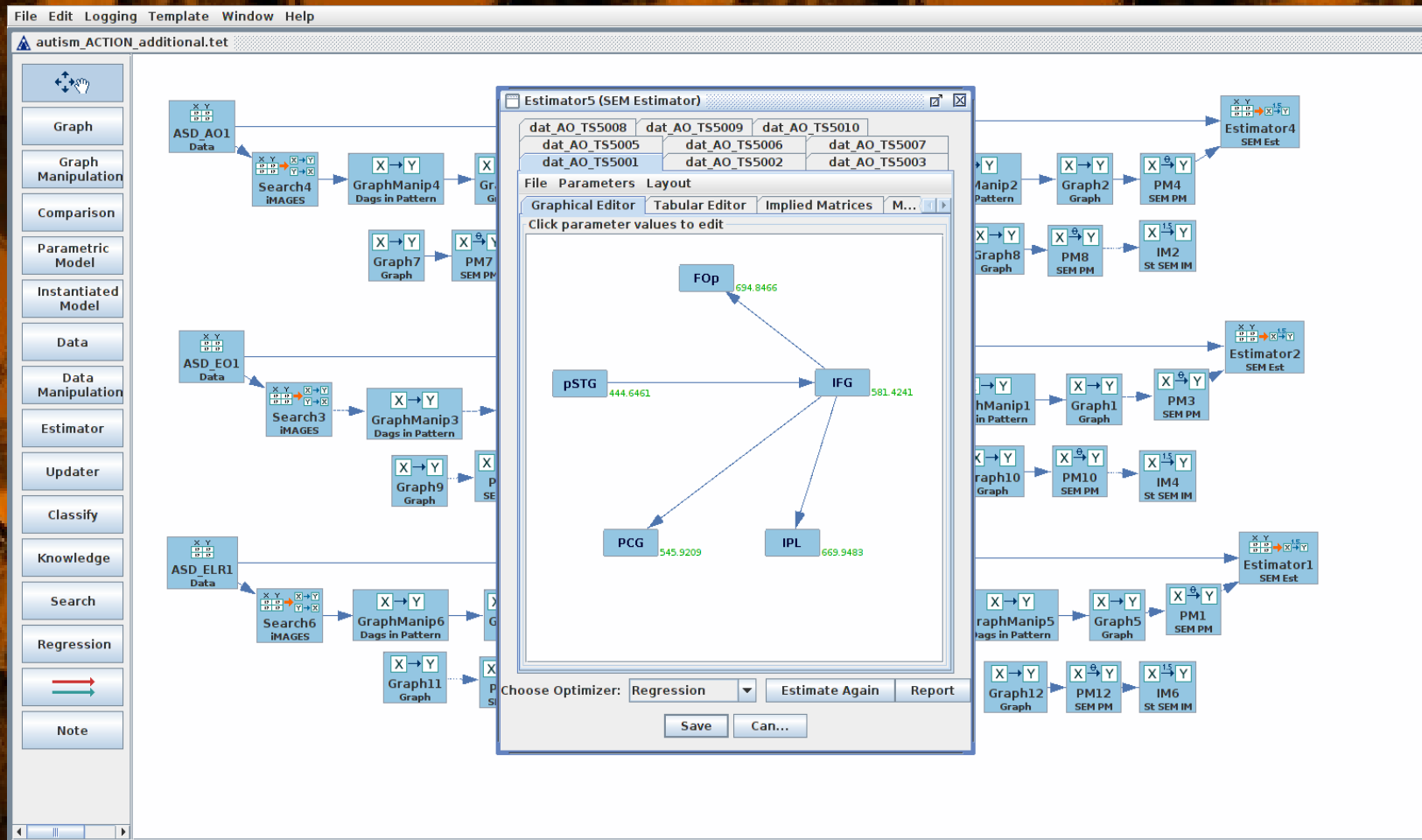


The fMRI Data



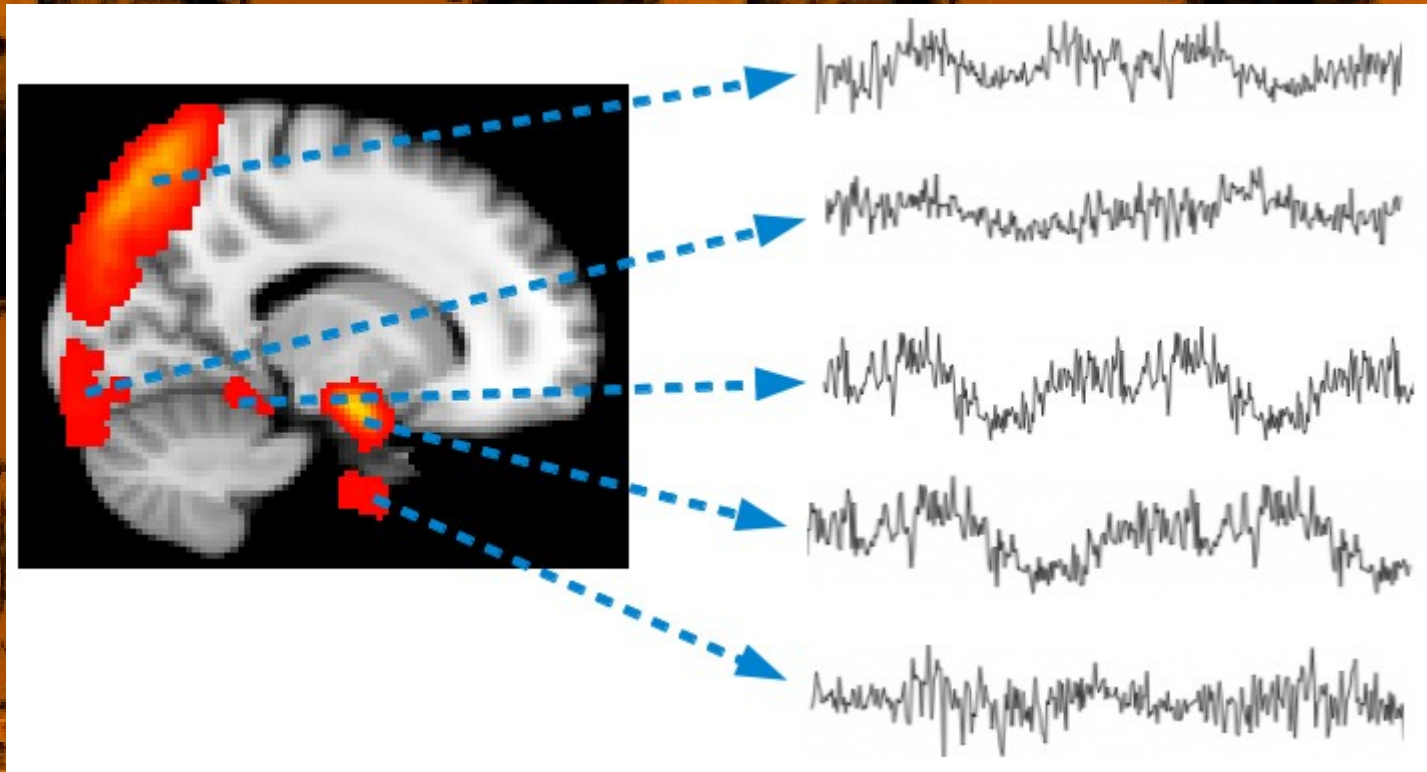
Using IMaGES

Independent Multiple-sample Greedy Equivalence Search

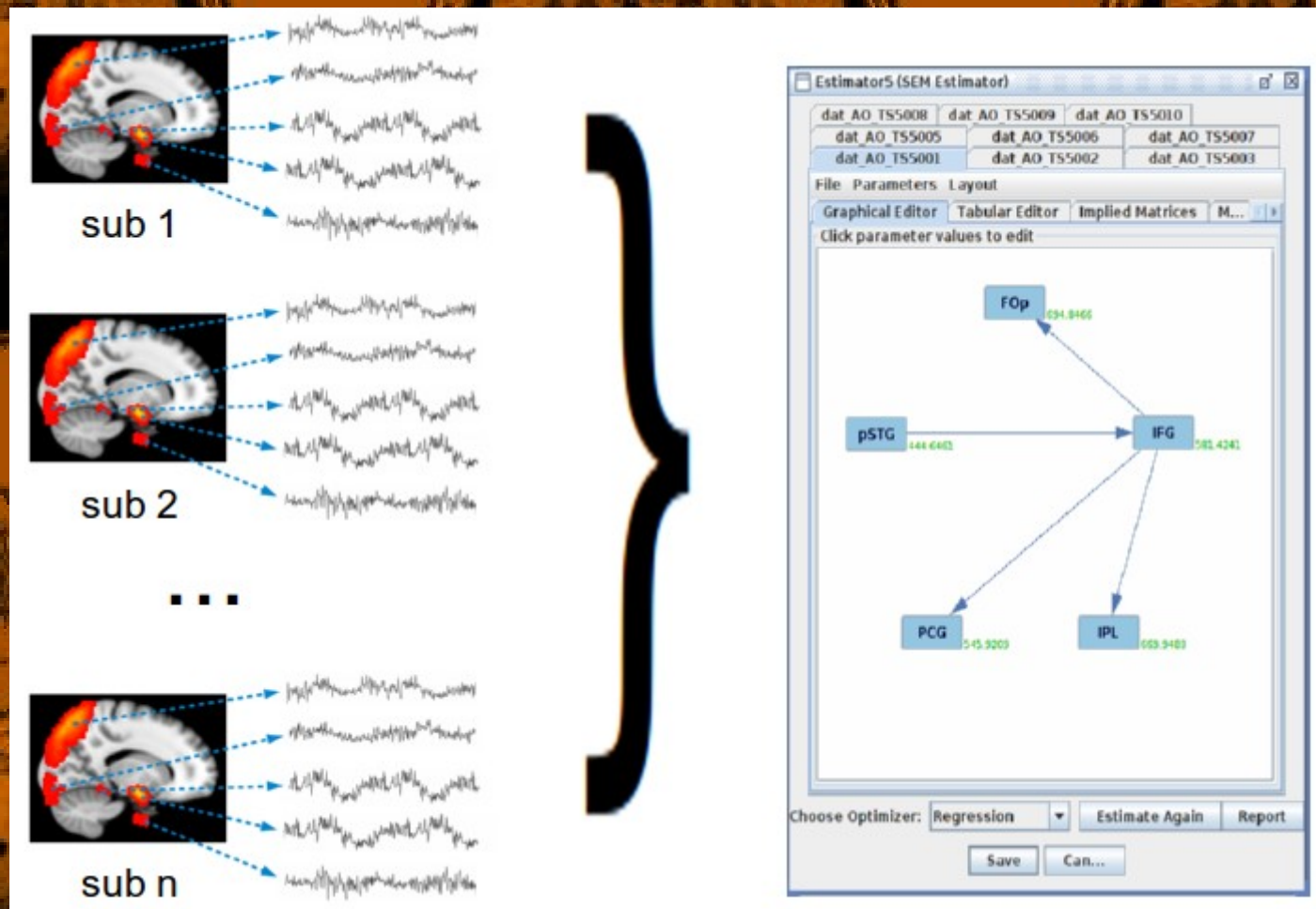


<http://www.phil.cmu.edu/projects/tetrad/>

Extracting the Time Series

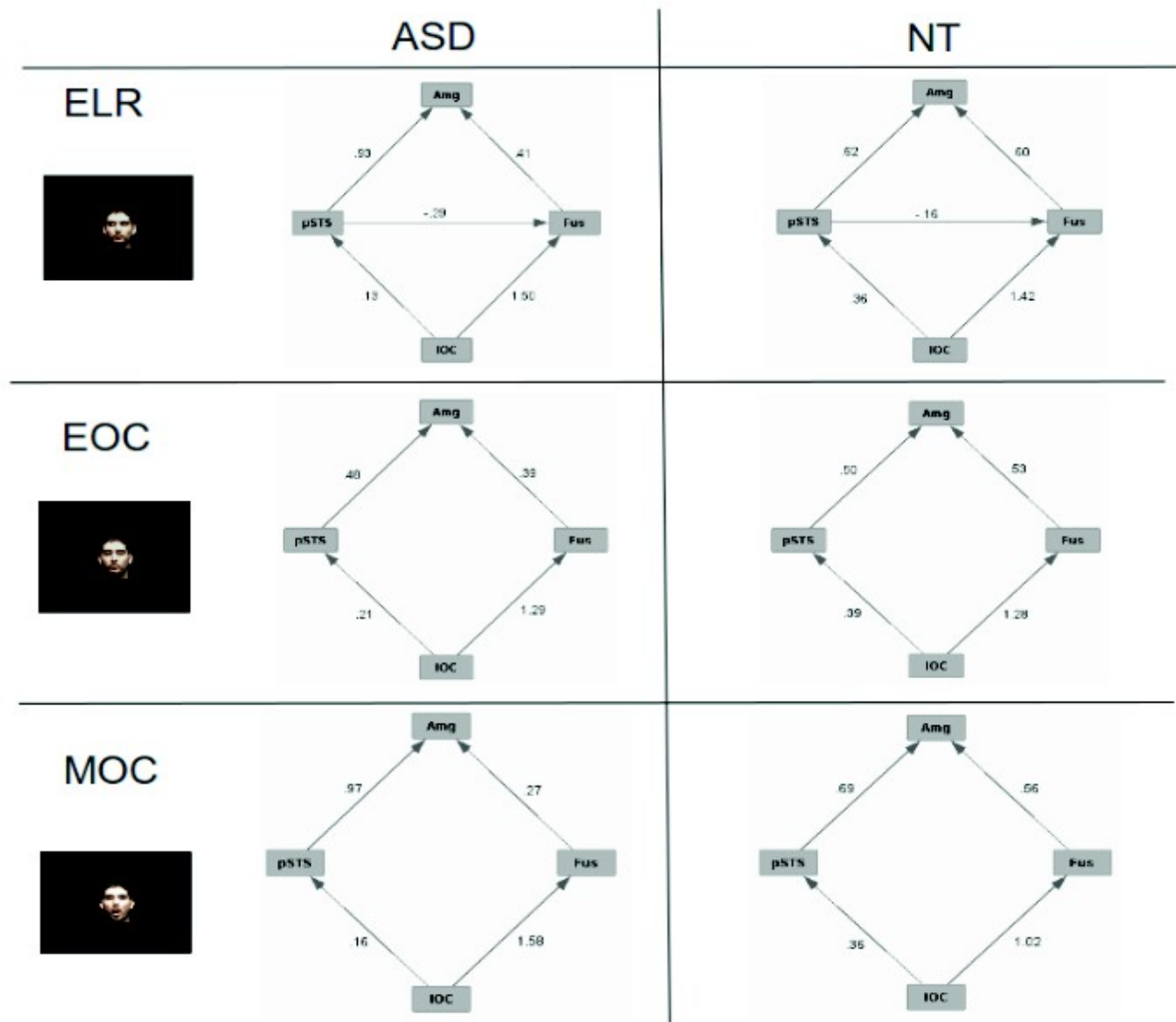


Time series to IMaGES graph



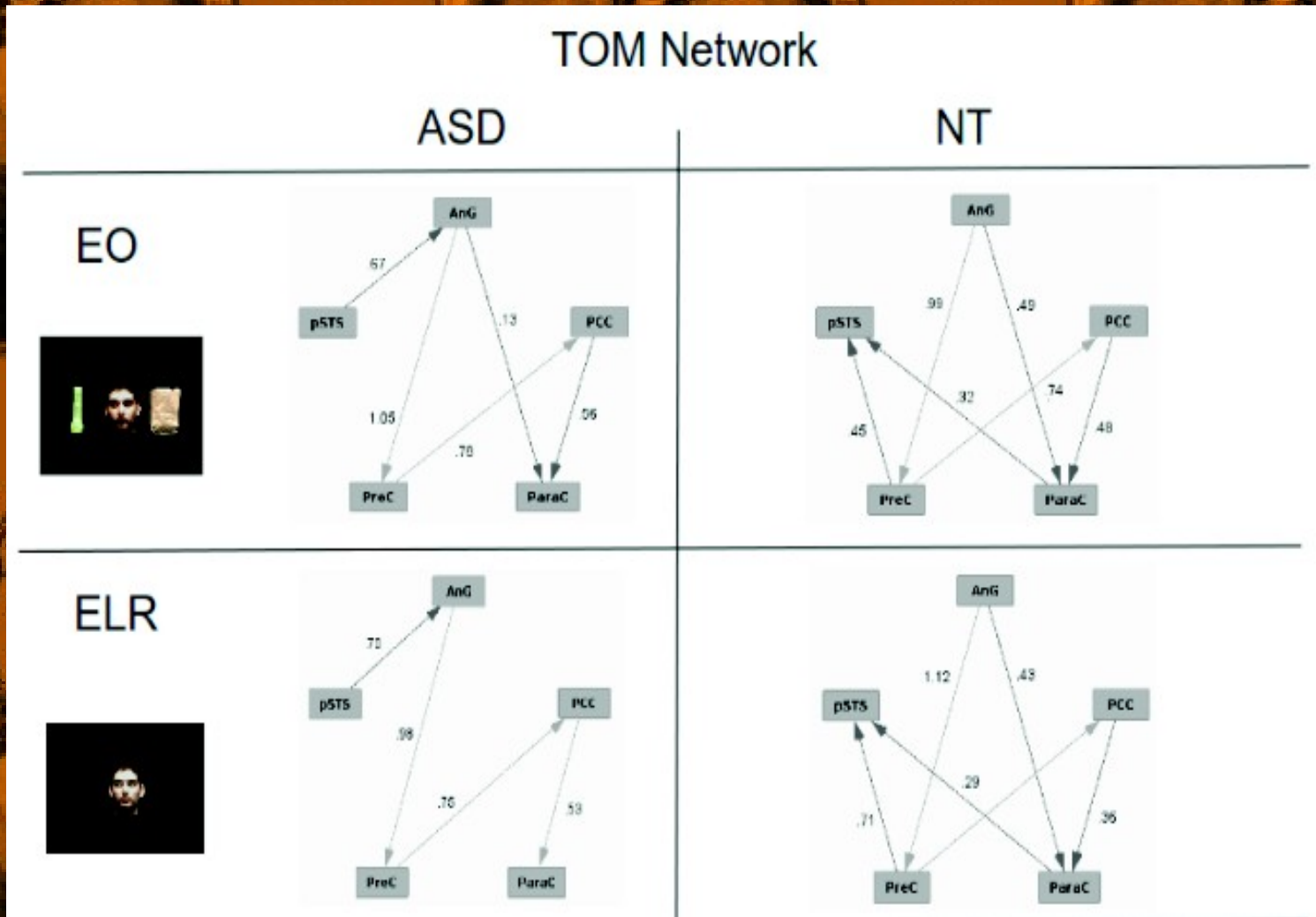
The Results

FACE Network



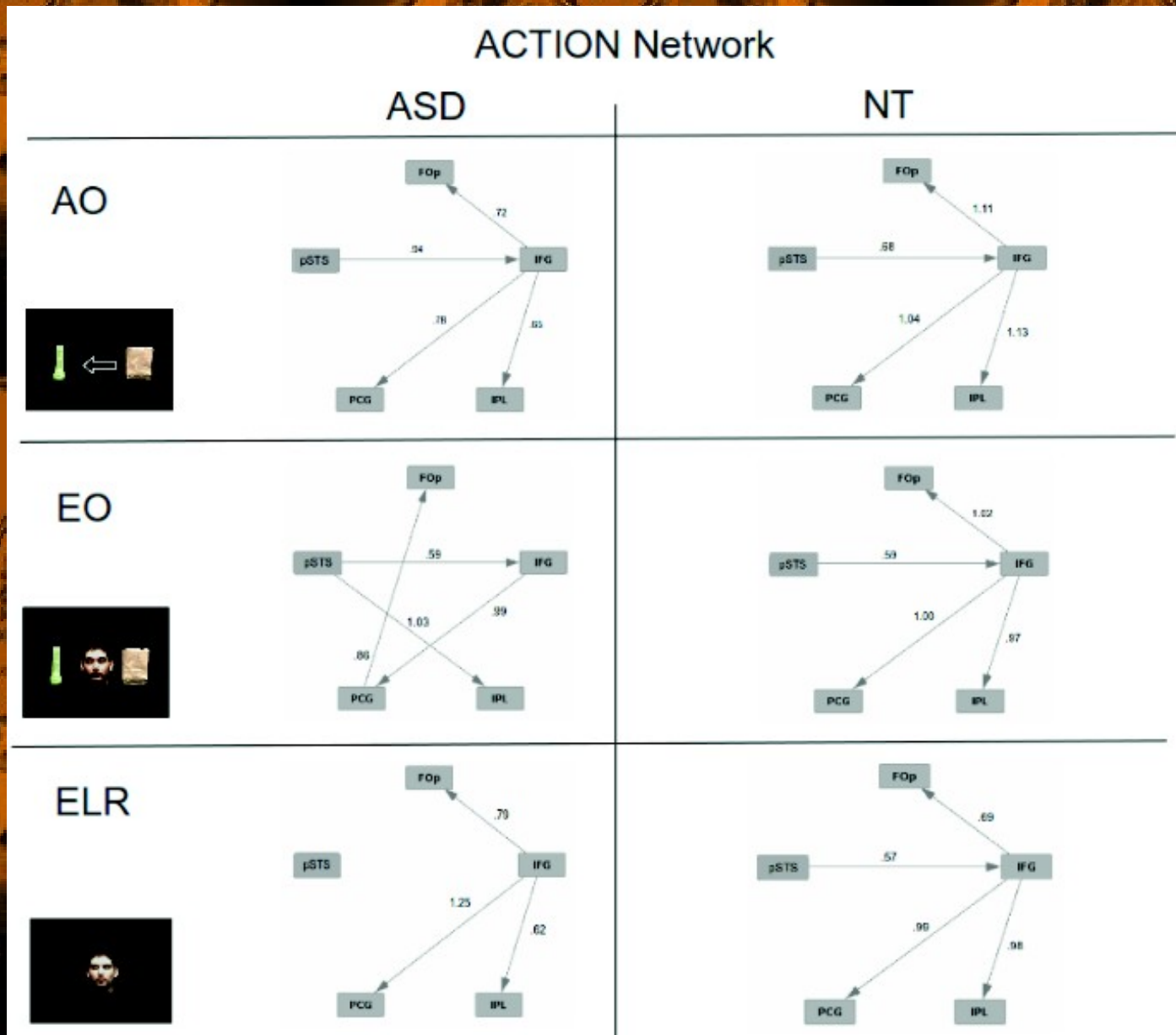
The Results

TOM Network



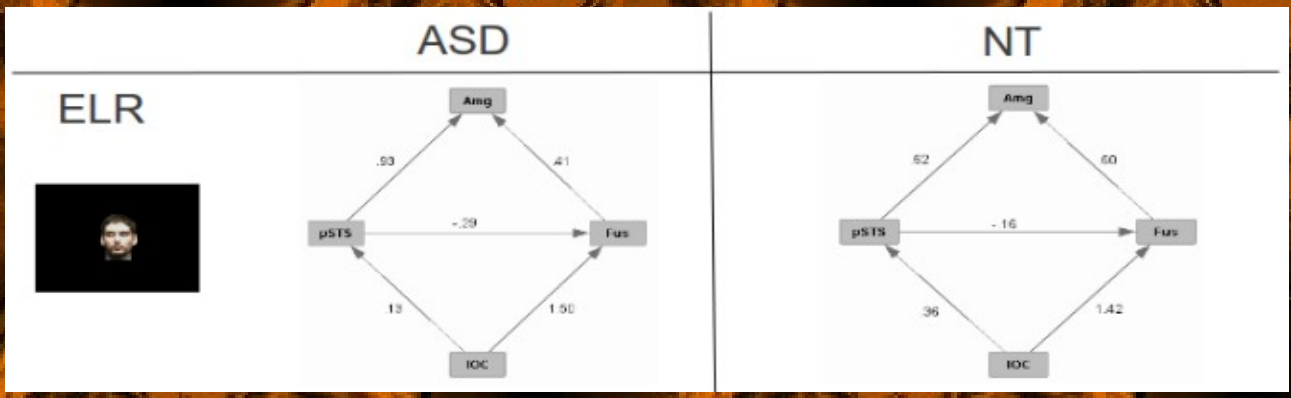
The Results

ACTION Network

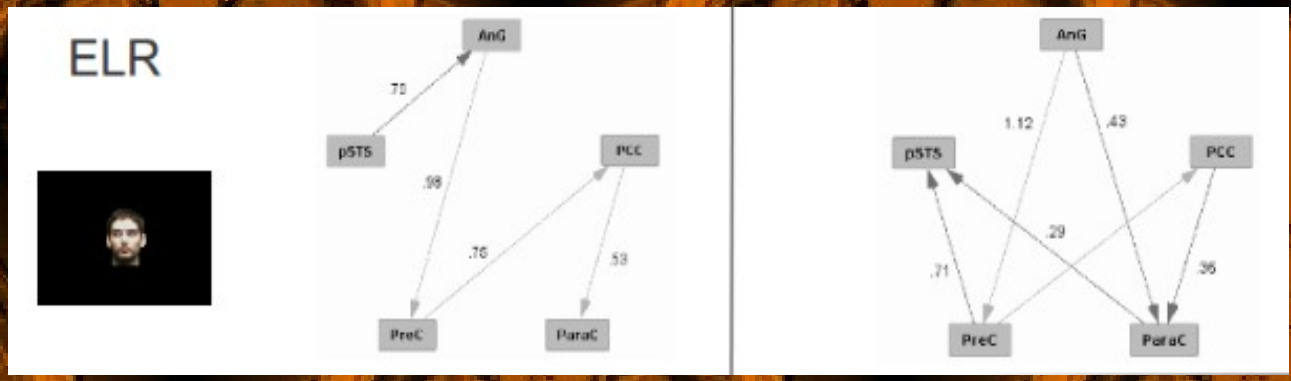


The Results

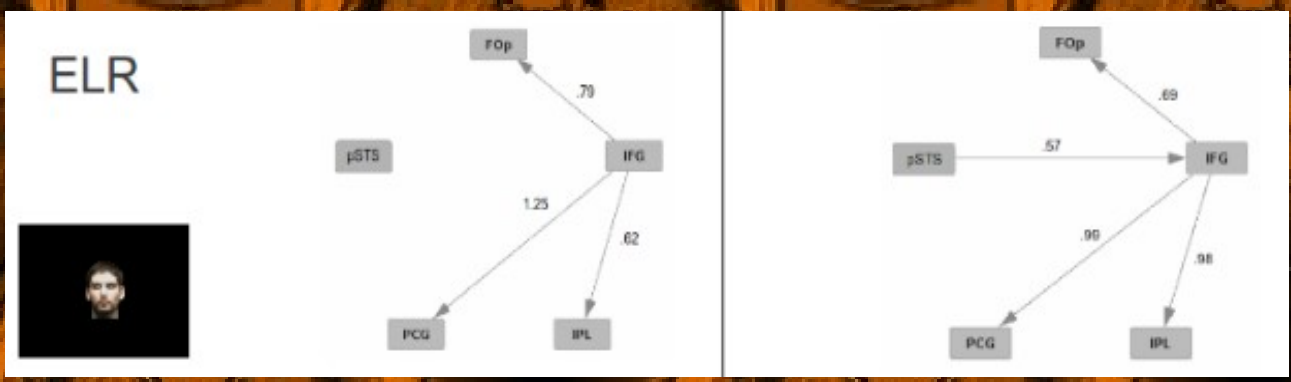
FACE



TOM



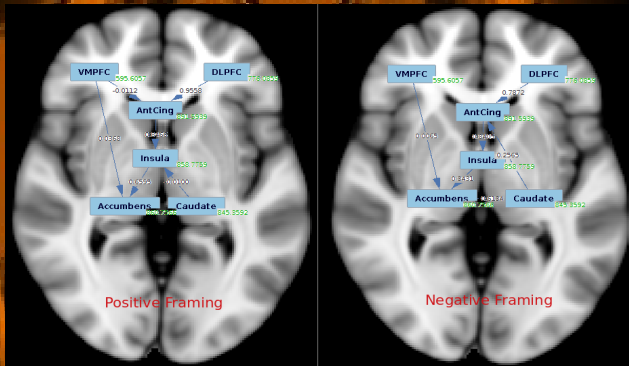
ACTION



What was Learned

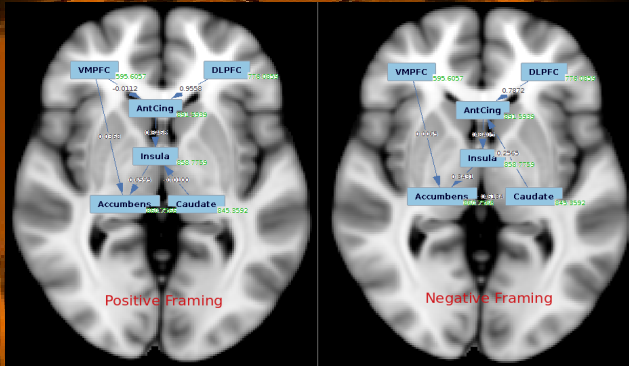
- ▶ face processing: ASD \approx NT
- ▶ Theory of Mind: ASD \neq NT
- ▶ action understanding: ASD \neq NT
when faces involved
- ▶ ASD networks less stable than NT

Other Studies Using IMaGES

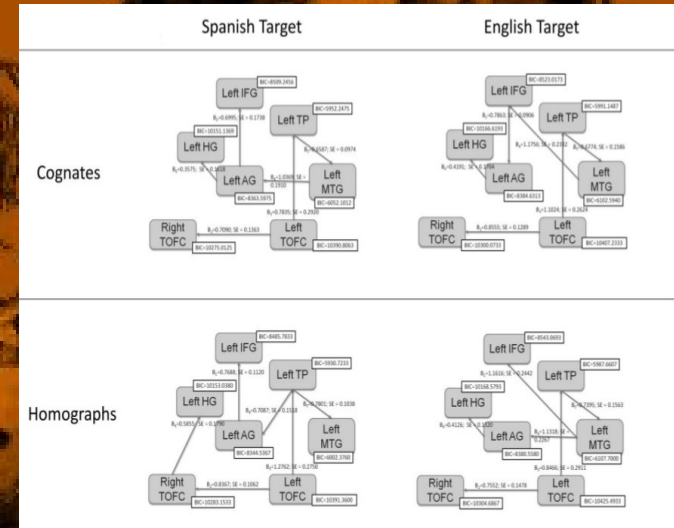


preference decisions

Other Studies Using IMaGES

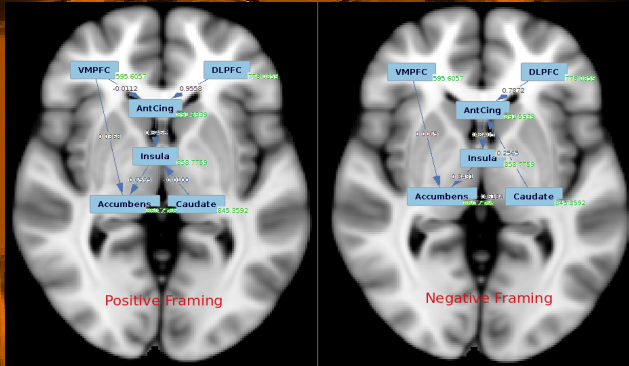


preference decisions

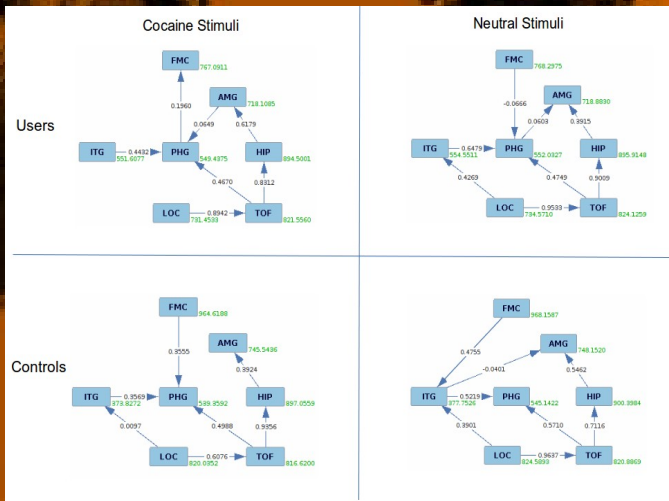


language processing

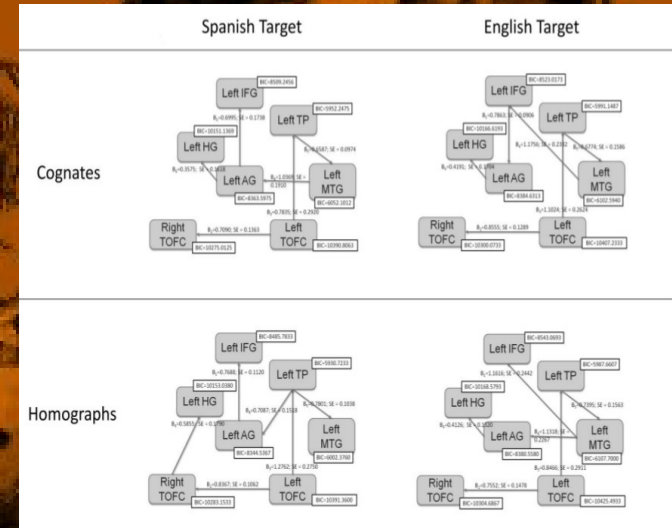
Other Studies Using IMaGES



preference decisions

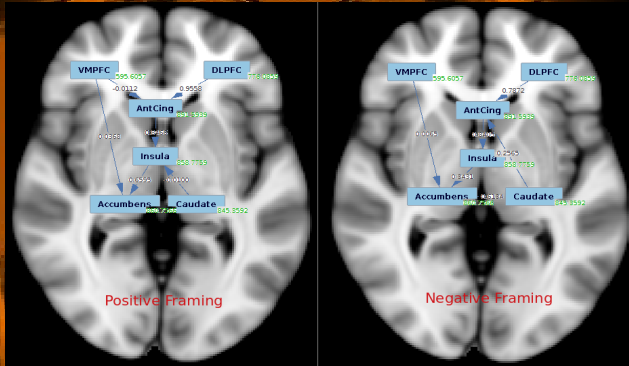


cocaine drug usage



language processing

Other Studies Using IMaGES

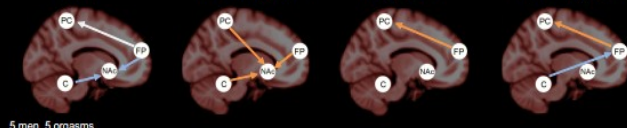


preference decisions



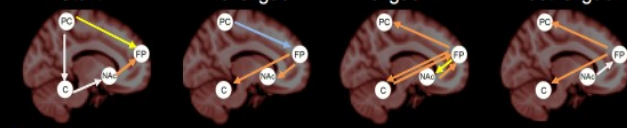
Male Orgasm, Penis Self Stimulation

Start → Pre-Orgasm → Orgasm → Post-Orgasm



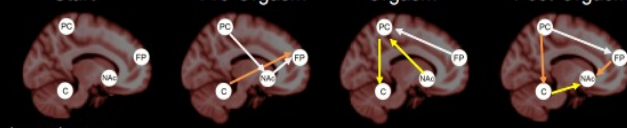
Female Orgasm, Clitoral Self Stimulation

Start → Pre-Orgasm → Orgasm → Post-Orgasm

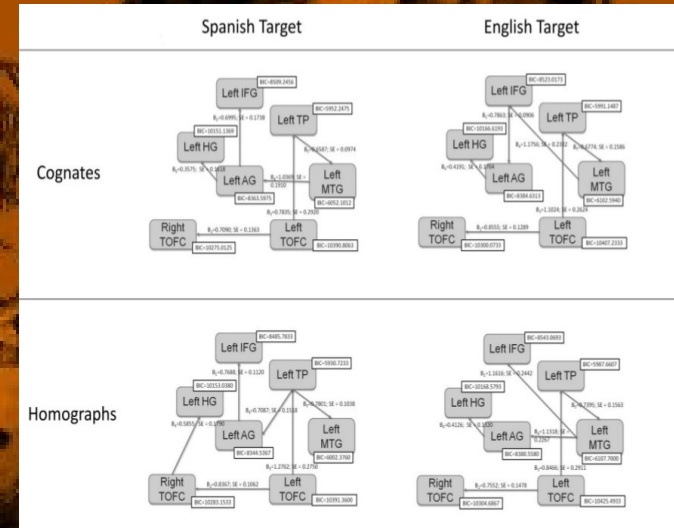


Female Orgasm, Thought-Induced

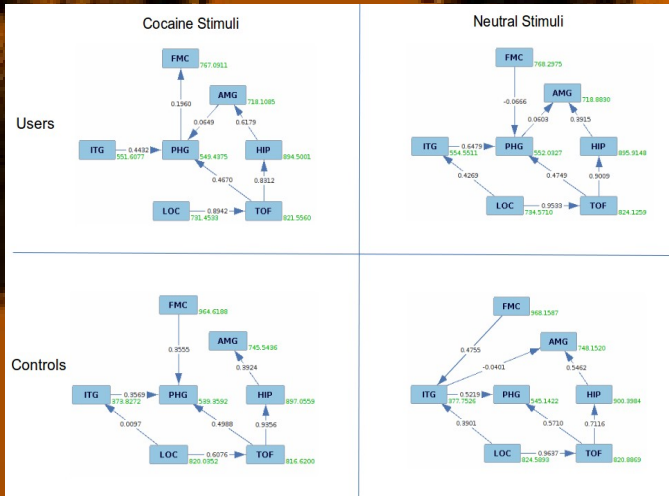
Start → Pre-Orgasm → Orgasm → Post-Orgasm



female & male orgasm



language processing



cocaine drug usage

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

The background of the slide is a repeating pattern of microscopic images of plant tissue, likely showing cross-sections of cells with prominent cell walls and internal structures. The color scheme is a monochromatic orange-brown. Overlaid on this pattern is white text.

Thanks to my collaborators:

Steve Hanson

Joe Ramsey

Clark Glymour