"Mirror neurons in the infant brain are formed by the interactions between self and other."

M. Iacoboni

SELF AND OTHER

J. A. Pineda

COGS171

UCSD

What is the SELF?

- There are multiple attributes of SELF –including competing attributes any one of which can dominate.
- These ordinarily converge in varying proportion on what we recognize as who we are. Each of these has a distinctive evolutionary history and mechanism of expression.
- Each may have its own proximate mechanism of expression, often involving a shared ensemble of causes

SELVES

- **CONSISTENT SELF**
  - **personality is consistent across the lifespan - Kagan**
- **THE AUTOMATIC SELF**
  - **most of our functions are autonomic –even our insights**
- **TENTATIVE SELF**
  - **neural activity precedes and prepares voluntary action –Libet**
- **TASTEFUL SELF**
  - **Right frontotemporal dementia can involve a dramatic change in taste: religious, political, even food and clothing. –Lee *et al.* 2001**
- **NARRATIVE SELF**
  - **a left hemisphere "interpreter" integrates past and current experiences into a sense that we have control over ourselves -- Gazzaniga**

SELVES

- **ACTIVE SELF**
  - **You are what you do, *then* conduct post hoc rationalizations to minimize cognitive dissonance**
- **SOCIALLY CONSTRUCTED SELF**
  - **My cortices mirror yours –about 15%**
- **CREATIVE / EXTRASOMATORY SELF**
  - **Corporealization of the psyche; reafference; art**
- **RESONANT SELF**
  - **Consciousness arises from coordination different parts of the brain –Crick & Koch, Llinas**
- **CURIOUS SELF**
  - **Novelty is pleasurable, it makes my synapses tingle**

The POST-HOC SELF

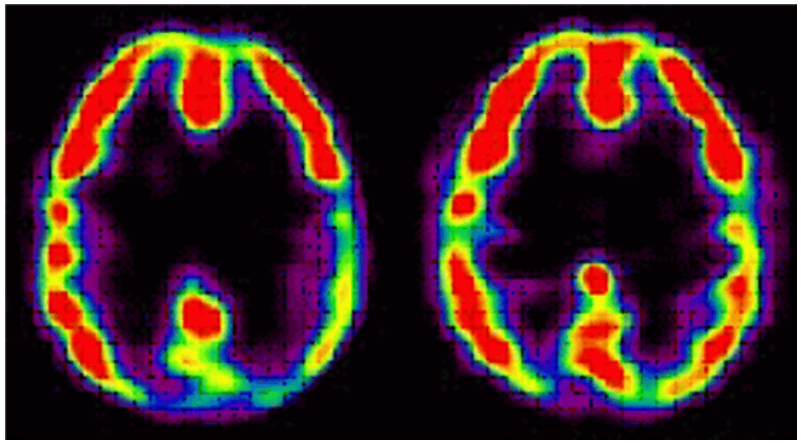
Even when we think we are in control . . .

We are generally acting several hundred milliseconds after we act (a lifetime in terms of survival of the quickest –as in catching prey or evading predators)

"cognitions" are frequently after-the-fact rationalizations of phenomena which take place in non-verbal parts of the brain. The frontal and temporal "interpreter," then confabulates an "explanation." –Gazzaniga in *Nature's Mind*

THE SPIRITUAL SELF

"As long as our brain is wired as it is God will not go away."



Left: the brain of an experienced Tibetan meditator shows decreased activity in the parietal lobe (on the right side) when he meditates. **Right**: the same person's brain during normal activity

Mirror Neurons

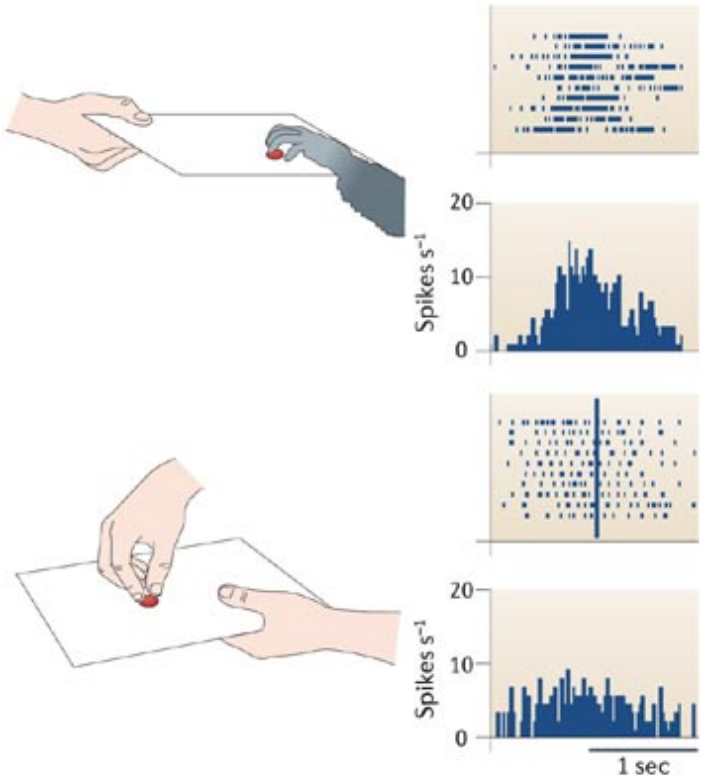
- Facilitate social behavior
  - Imitation
  - Intentions
  - Language
  - Emotions

  Who ‘owns’ the behavior/ action?

  How does the brain code for ‘agency’?

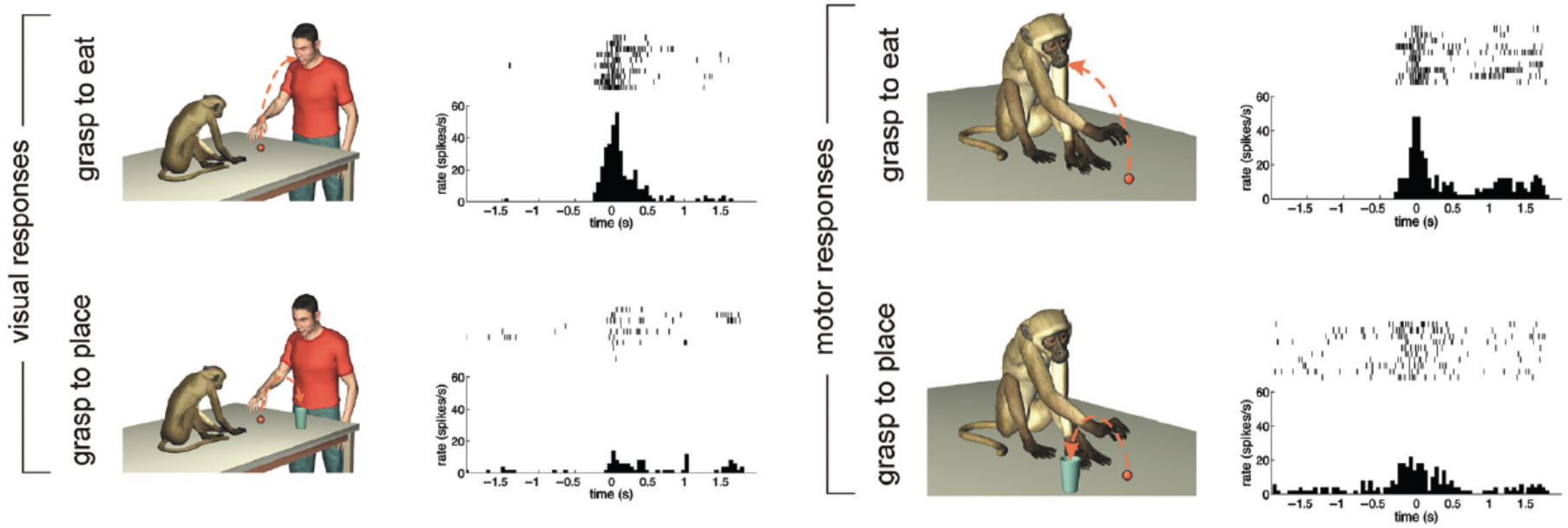
Neural Indices of Interdependence

- Firing rate
  - Not the same for self execution and other execution
    - Self activity > other activity



The Role of Context

- Mirror neuron firing is modulated by the context in which an action is observed
  - Fogassi et al., 2005 showed that different populations of parietal mirror neurons fire when a monkey grasps an object that is subsequently eaten and when it grasps an object that is subsequently placed in a container.

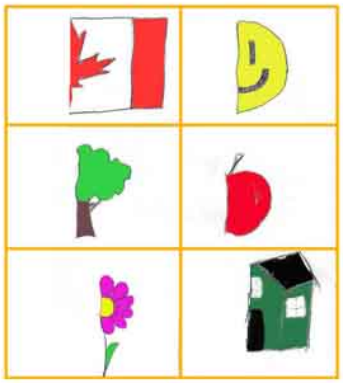


The Role of Parietal Areas

- The RH parietal operculum, which receives sensory information from the hands shows higher activity during imitation than during execution of action
  - No mirror neurons in that area
  - Does not activate to observation of action

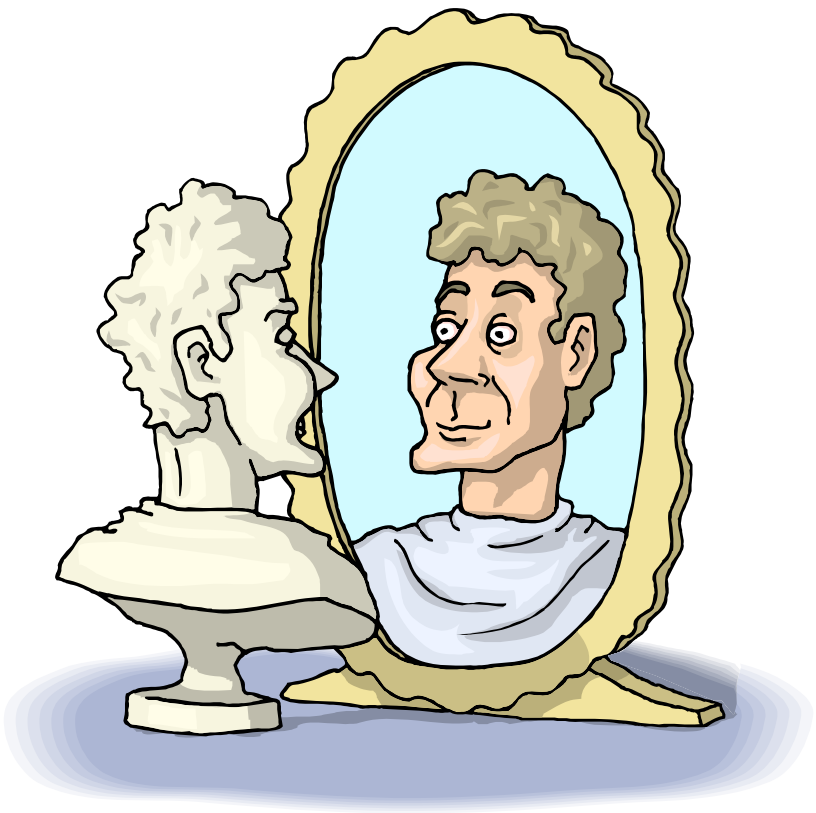
RH Parietal Lesions

- Affects body 'awareness'
  - Hemineglect
  - Denial of problem
  - Unable to recognize own body parts



Therefore, parietal areas reaffirm a sense of ownership of our limbs and our actions

Phenomenology of Self



- Some philosophers argue that we cannot separate self/other
  - They are co-constituted
- mirror neurons help build a sense of self (self recognition) and then help distinguish self/other (imitation)

What is Self-Recognition

- The Mirror (real ones) Test
  - Developed by Gordon Gallup in the late 60s
    - An objective measure of chimp's behavior
    - A red mark on chimps forehead
    - Animal touches own forehead rather than the mirror image → self awareness
    - Control test: chimps who were unfamiliar with mirrors did not react to the red mark on forehead.
  - orangutans, dolphins, elephants, and pigeons pass test; monkeys and gorillas fail it

Human Infants

- Infants around 1 year of age fail the test
- At the end of the second year, they begin to pass it
  - Joint attention??
  - Embarrassment

Explanations of Mirror Test

- Isolation inhibits development of self-recognition
- Rich social context facilitates it
  - Rich and long mother-infant interactions

What's the difference between these environments?

the presence of others…

fMRI Study of Self-Recognition

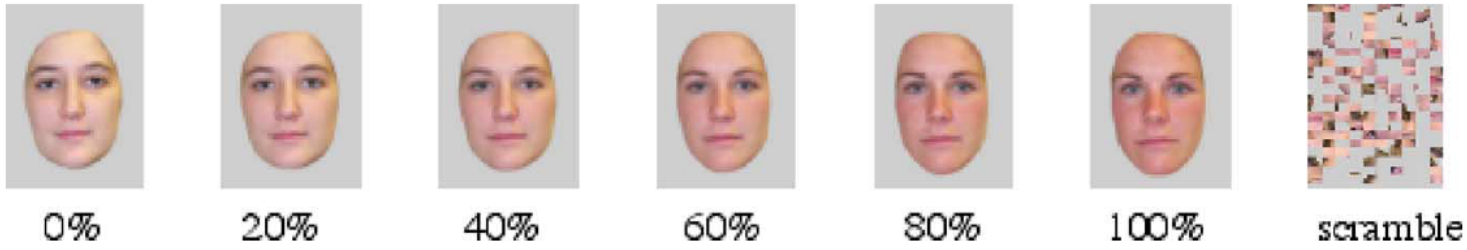
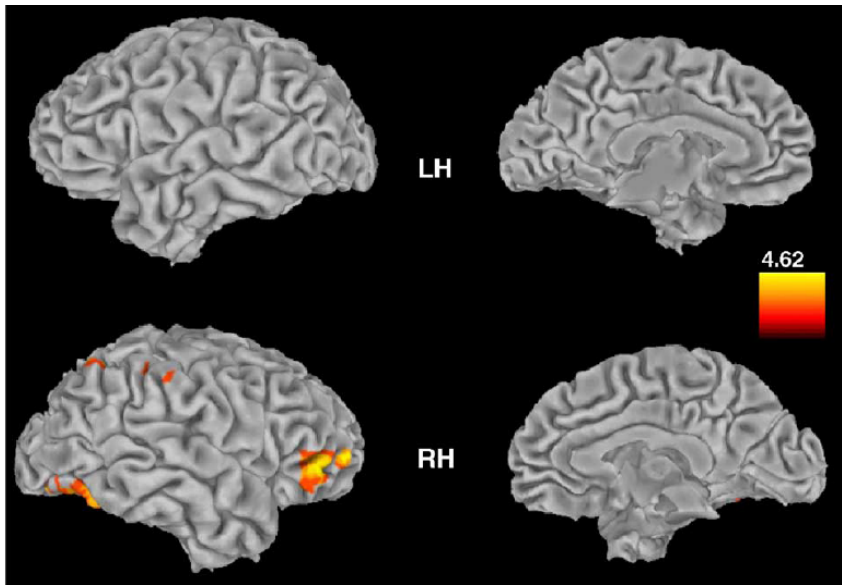


Fig. 1. Examples of stimuli. For each individual subject, an image of the subject was digitally morphed into an image of a highly familiar other in 20% increments.

Uddin et al., 2005



Self-face recognition activates a frontoparietal "mirror" network in the right hemisphere

Self-Recognition: Faces and Voices

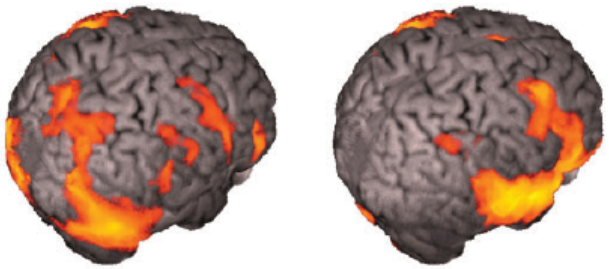


Fig. 1 Viewing pictures and hearing voices compared with resting baseline.

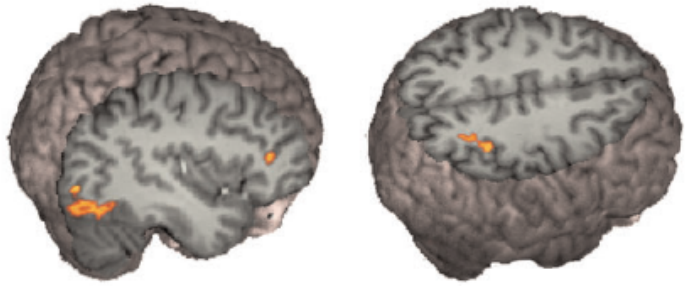
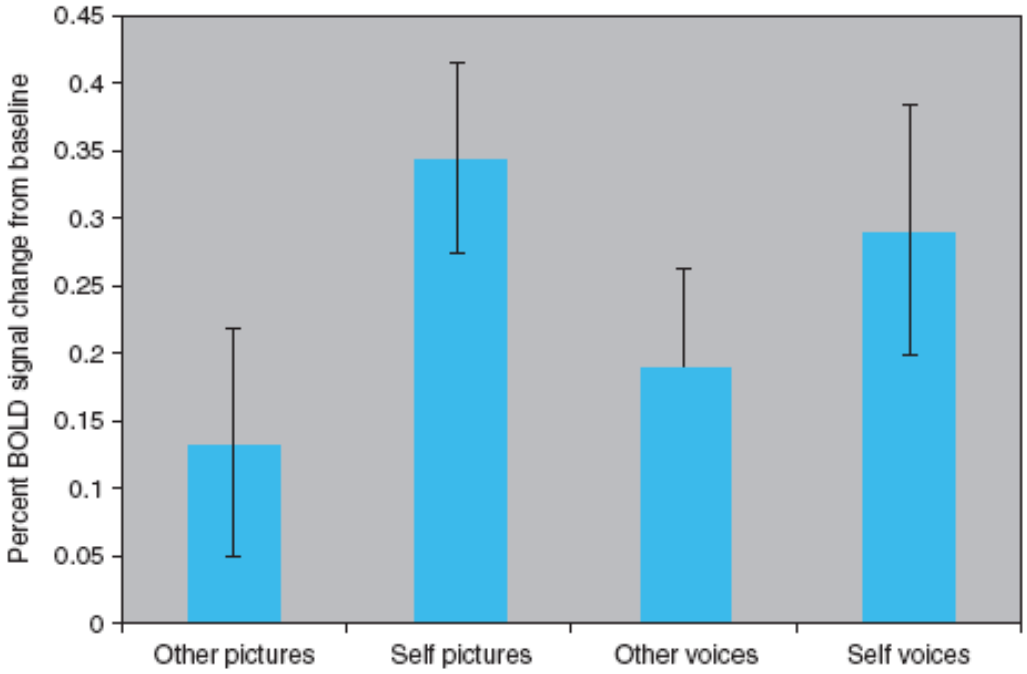


Fig. 2 Faces, self minus other. Seeing one's own face produced greater signal compared with viewing a friend's face in the IFG, the inferior parietal lobe and the inferior occipital gyrus on the right side.

Fig. 3 Voices, self minus other. Hearing one's own voice compared with a friend's voice produced greater signal in the right IFG.

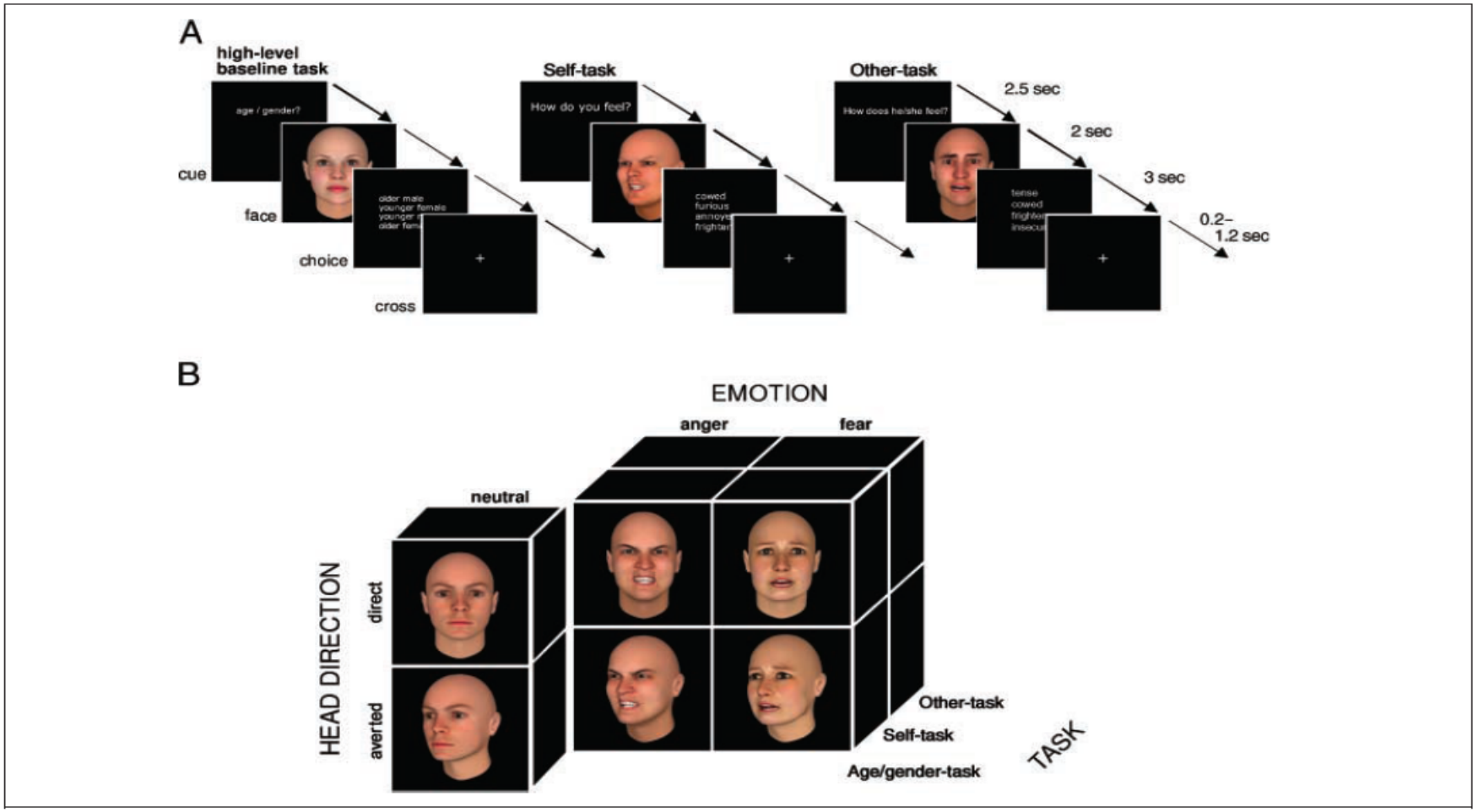
Kaplan et al., SCAN, 2008

Signal Changes in Prefrontal Cortex

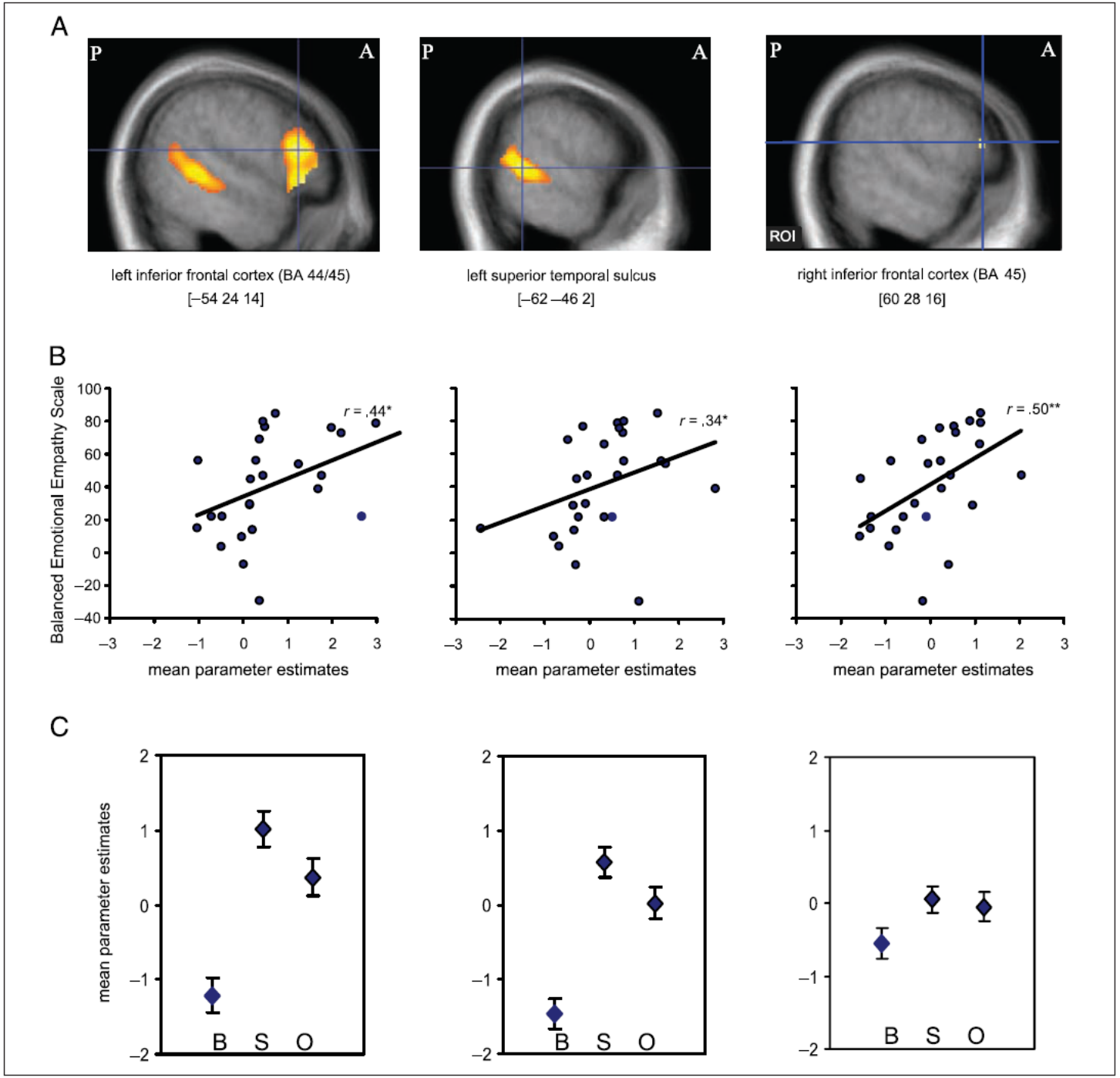


Prefrontal ROI

An fMRI Study of Empathy



Schulte-Ruther et al., 2007


A
P
A
left inferior frontal cortex (BA 44/45)
[–54 24 14]
P
A
left superior temporal sulcus
[–62 –46 2]
P
A
ROI
right inferior frontal cortex (BA 45)
[60 28 16]
B
Balanced Emotional Empathy Scale
r = ,44*
r = ,34*
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mean parameter estimates
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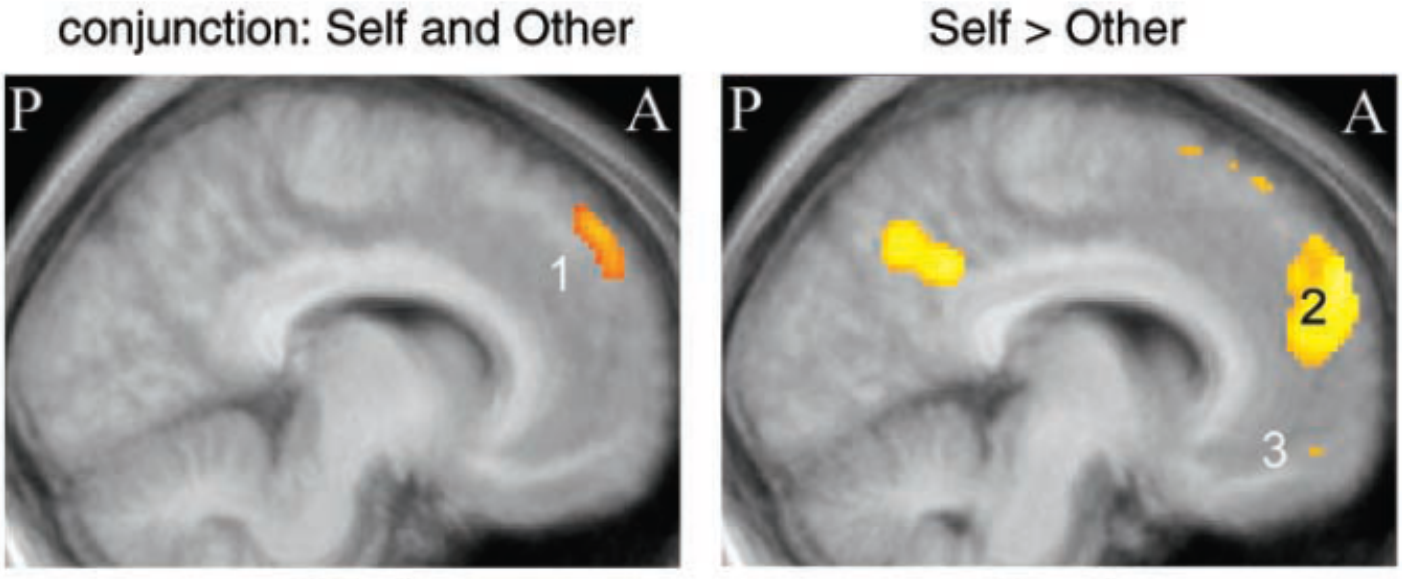
Similarities-Differences Between Self and Other



Medial prefrontal cortex

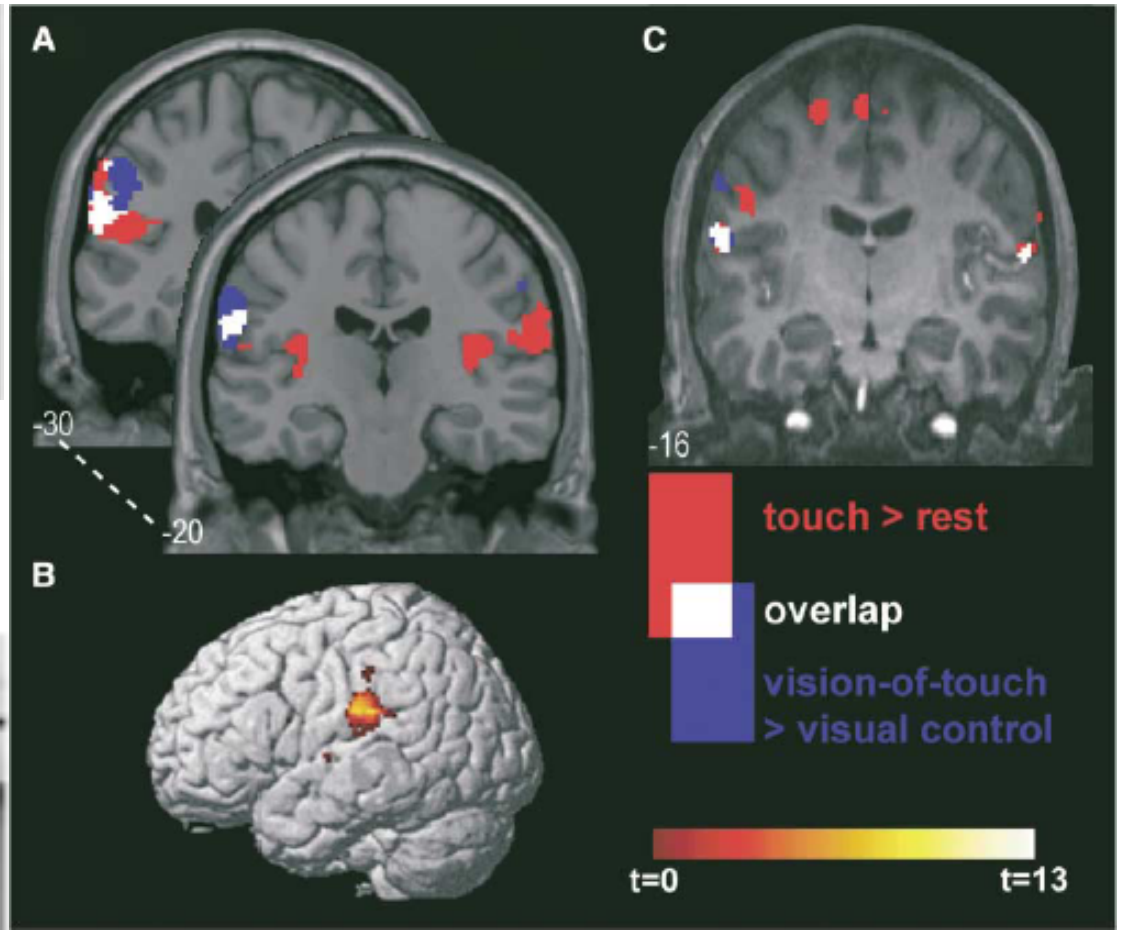
An alternative hypothesis:

"Feeling" someone else's feelings…

1. Being touched:

2. A video of someone else being touched

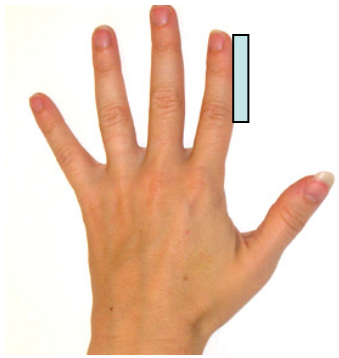
Brain response:



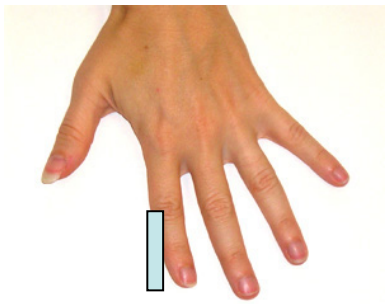
An alternative hypothesis:

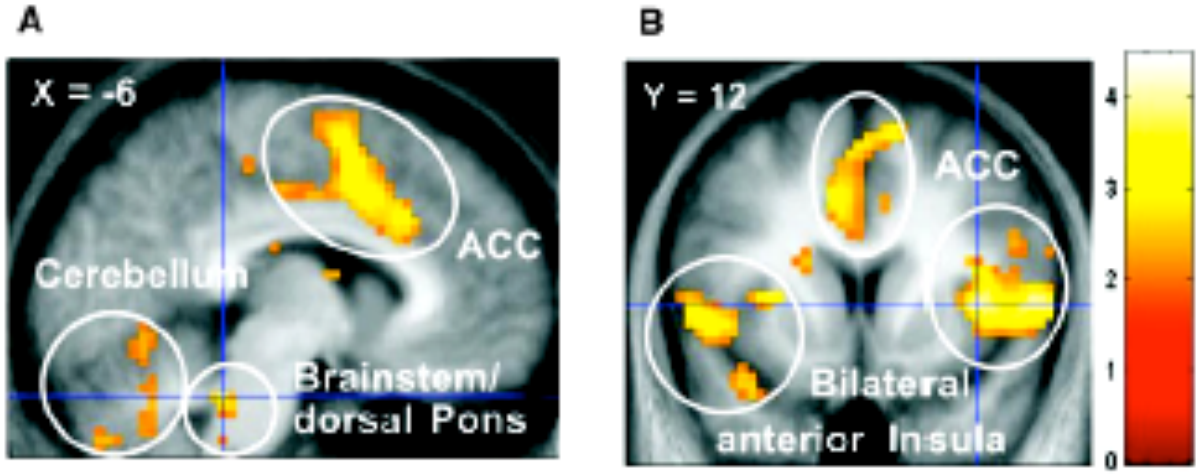
"Feeling" someone else's pain…

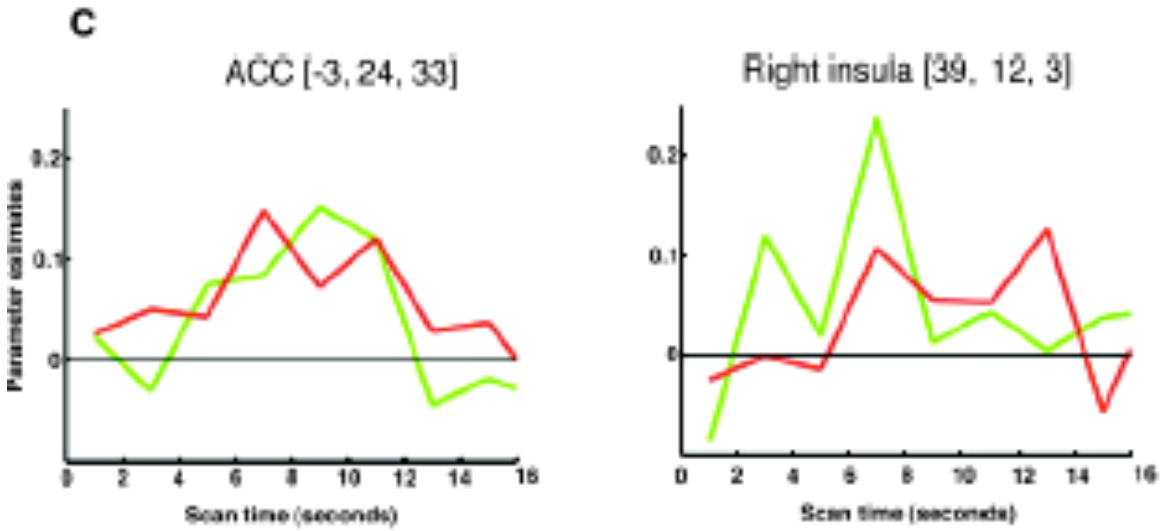
Own pain:



Significant other's pain:







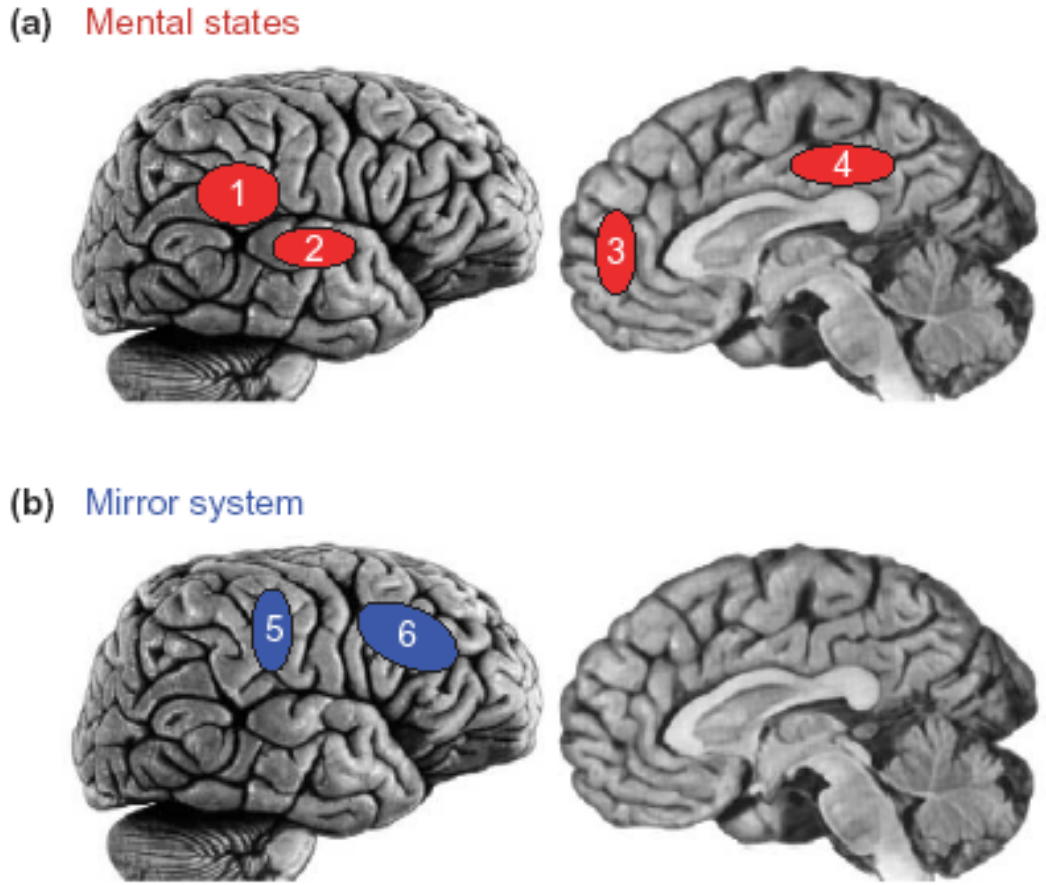
An alternative hypothesis:

Do we use "mirror neurons," instead of an intuitive theory, to understand other minds?

An argument from neuroscience:

A group of brain regions involved in "Theory of Mind"

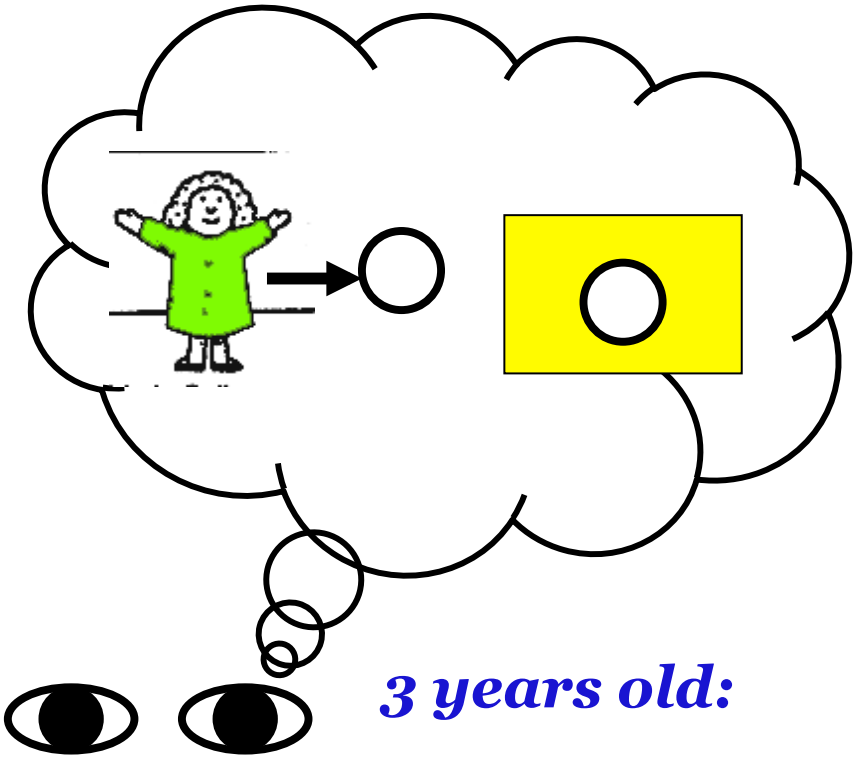
Anatomically and functionally distinct from the "Mirror system"

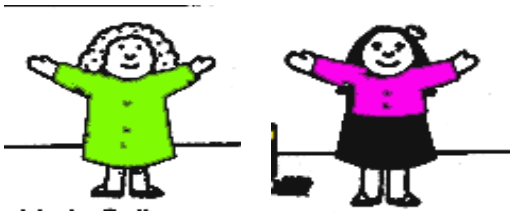


Going beyond the information given

So where does the concept of "belief" come from?

"Theory of Mind"





Sally **Anne**

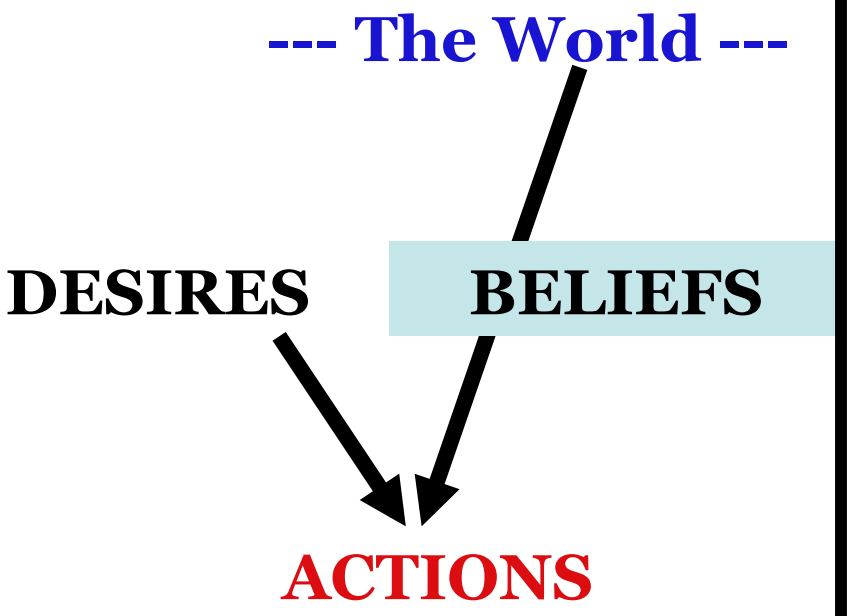
3 years old:

"In the box."

Where will Sally look for her ball?

Going beyond the information given

An intuitive Theory?



Non-Theory alternative?

Is there any alternative hypothesis?

“Cells that read minds”?

"Mirror neurons allow us to grasp the minds of others not through conceptual reasoning but through direct simulation. By feeling, not by thinking."