Finish attachment and Representational theory of mind

Today

- Explain the evidence that a fully representational theory of mind first emerges at 4 (Wellman)
- Explain the evidence that it is present in infancy (Onishi & Baillargeon)
- Finish attachment
- Theory of mind

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Theory of Mind (ToM):

The ability to understand that others have beliefs, desires and intentions that are different from one's own. (David Premack and G. Woodruff, 1978)

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Is physics sufficient to predict or explain behavior?

- what do you see here?
- nope ...

**slide from *www.mit.edu/~jbt/9.iap/*

Going beyond the information given

For understanding other minds:

(a domain of mostly invisible entities!)

~~**What we see:**~~ ~~A "biological" motion~~ **FICTION**

What we *understand:*

A hand *reaching* for a bottle

His intention: to drink the liquid

He believes the liquid is poison

He wants to die

Etc.

False Beliefs

He believes Juliet is dead

Slide courtesy of Rebecca Saxe. Used with permission.

Theory of how theory of mind develops, circa 2005

- Animate/inanimate distinctions, understanding goals (by 6 months)
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- Mirror self-recognition (12-18 months)
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- Faux pas, humor, irony, ambiguity, source memory … lifespan development.

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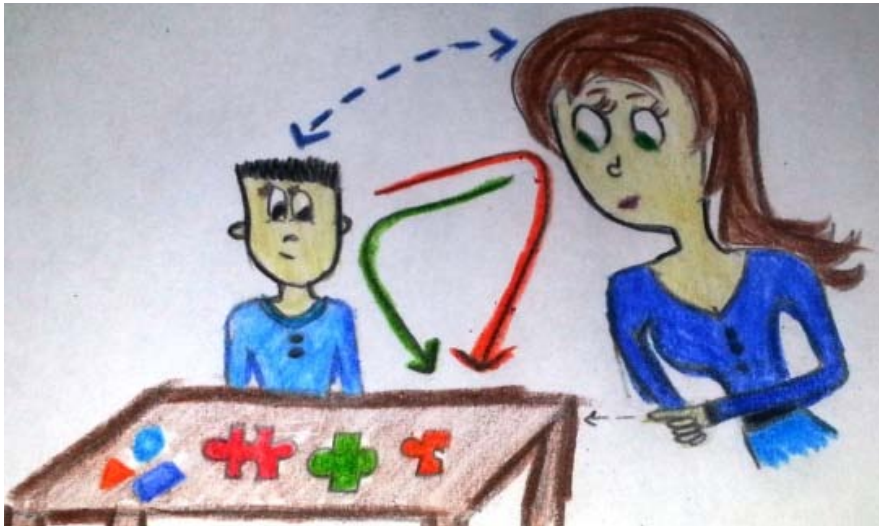
Joint attention

- what joint attention is not
  - However, babies may selectively attend to these ostensive cues early in life and use them to guide learning.
- what joint attention is
- also in humans
  - "Pedagogical stance"
  - Interpret information followed by pedagogical cues as generalizable and informative about non-obvious properties.

Joint Attention

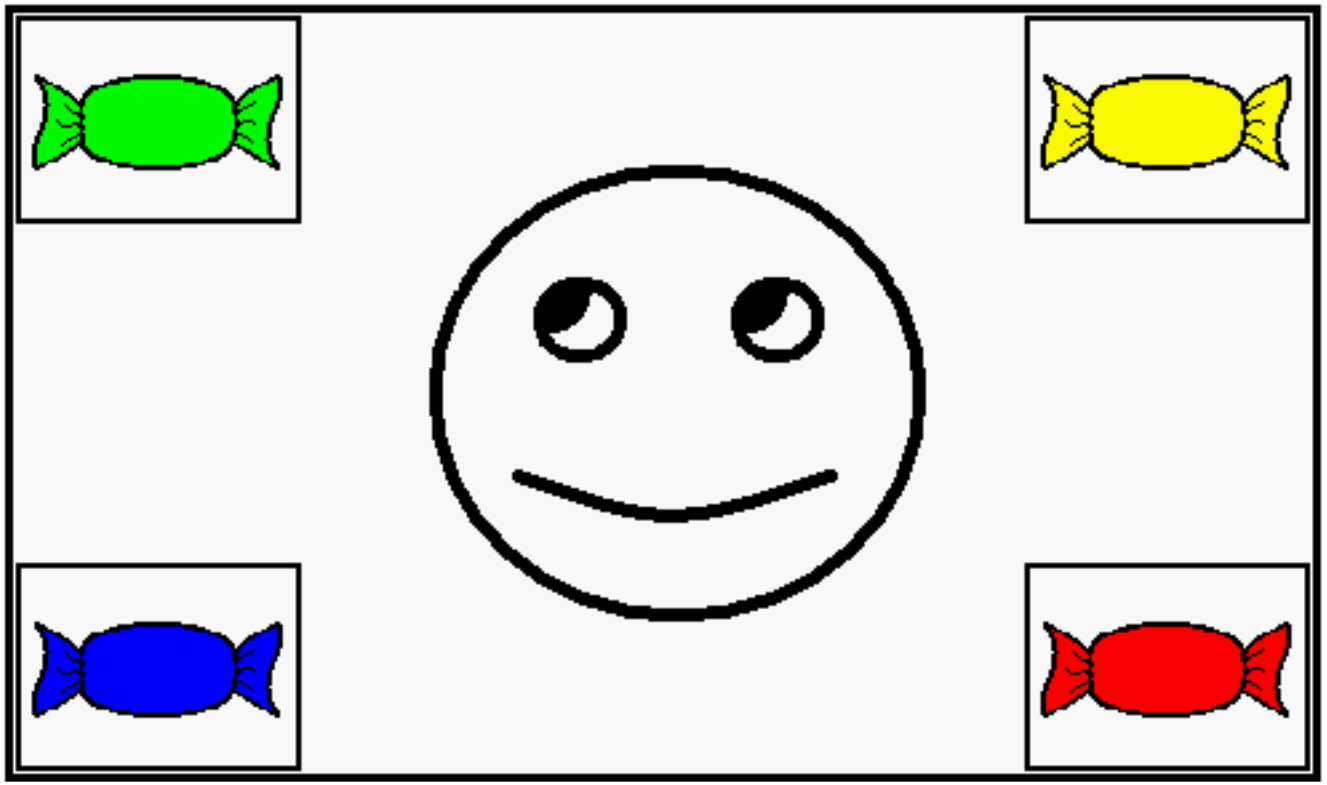


Ten-month-old revolution

- the ability to follow the gaze and attention of another
- understanding the referential function of pointing or showing
- the coordination of these processes

Figures removed due to copyright restrictions. Beier, Jonathan S., and Elizabeth S. Spelke. "Infants' Developing Understanding of Social Gaze." *Child Development* 83, no. 2 (2012): 486–96.

Beier & Spelke, 2012



However, infants do not seem to treat gaze as goal-directed until 12 months (Brune & Woodward, 2007)

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Differences in desires

And develops (or not) through the lifespan: “How could you possibly have liked that movie/party/meal/haircut ...”

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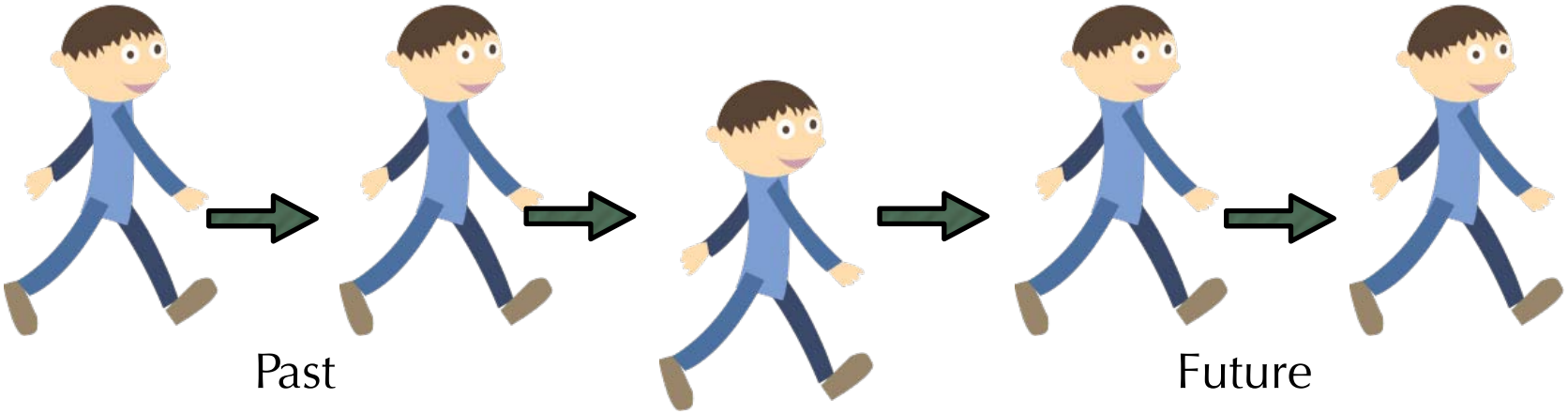
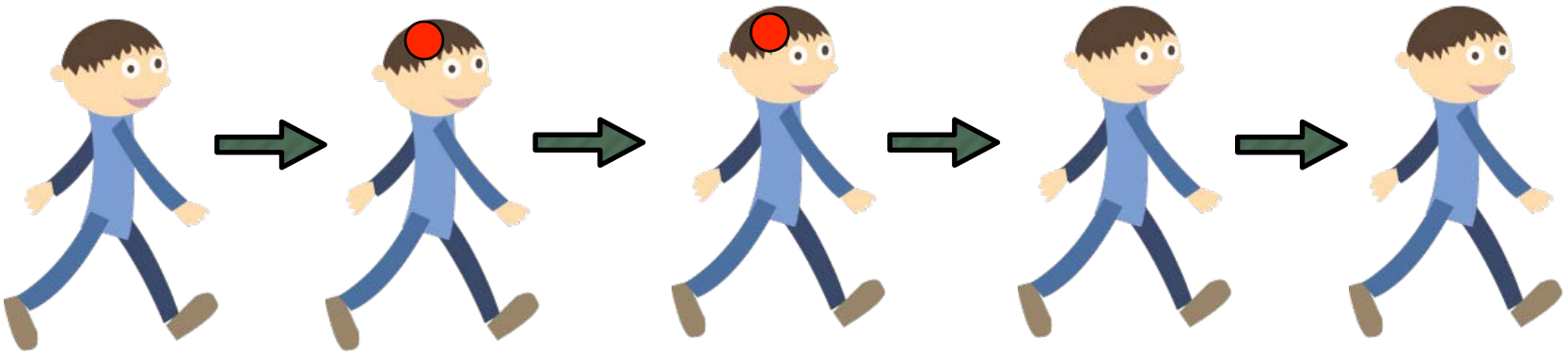
Autobiographical memory

- The fully-developed human sense of self is **temporally extended**



Autobiographical memory

- Videotaped session playing game with experimenter who surreptitiously places sticker on kid's forehead
- Two minutes later, kid (w/ sticker still on head) is invited to watch video of game with experimenter, including part where sticker is placed on head
- Even amongst the youngest age group, the majority could identify themselves in video...
- But, were they able to use this information to infer that the sticker was **still** on their head?
  - –2 year olds: none
  - –3 year olds: 25% did
  - –4 year olds: 75% did



Autobiographical memory

- Do you know why cat's have whiskers?
- How long have you known why cats have whiskers?

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Representational theory of mind

- The true test of mental state understanding is understanding that mental states can differ from reality. They do not just 'copy' the world.
- This is important because if you ask about a true belief (i.e., "is water wet?") children could respond correctly even if didn't know anything about others' minds, by answering according to what they know
- Daniel Dennett's thought experiment: an entity understands other minds if it understands that beliefs can be false.

**idea from *acdrupal.evergreen.edu/files/languageandplace/ToM4.ppt*

Representational theory of mind

- Mental states are interesting because their truth value can be independent of the truth of the world:
  - "John believes its' raining" can be true even if the proposition "it's raining" is false.
  - "Snow White believes the woman selling apples is kind" can be true and "Snow White believes her step mother is kind" can be false, even if her step mother is the woman seling. apples

Representational theory of mind

- But don't toddlers understand this? They understand that there can be gaps between mental states and reality. They do not confuse pretense and reality.

- However, pretending it's a telephone means you **don't really** think it's a telephone.
- And **it really isn't** a telephone.
- Mental state and world are congruent.

Image: Flickr. Ben Lerchin CC BY-NC-SA.

- Believing it's a telephone means you **do really** think it's a telephone.
- And **it really isn't** a telephone.
- Mental state and world are incongruent.

Representational theory of mind

- Also there is a phenomenological marker to pretense.
- You can tell when you or someone else is “pretending”. (Even children use exaggerated gestures and voice patterns).
- You don’t confuse the “pretend” world with the “real world” (neither do children).

Image: Flickr. Ben Lerchin CC BY-NC-SA.

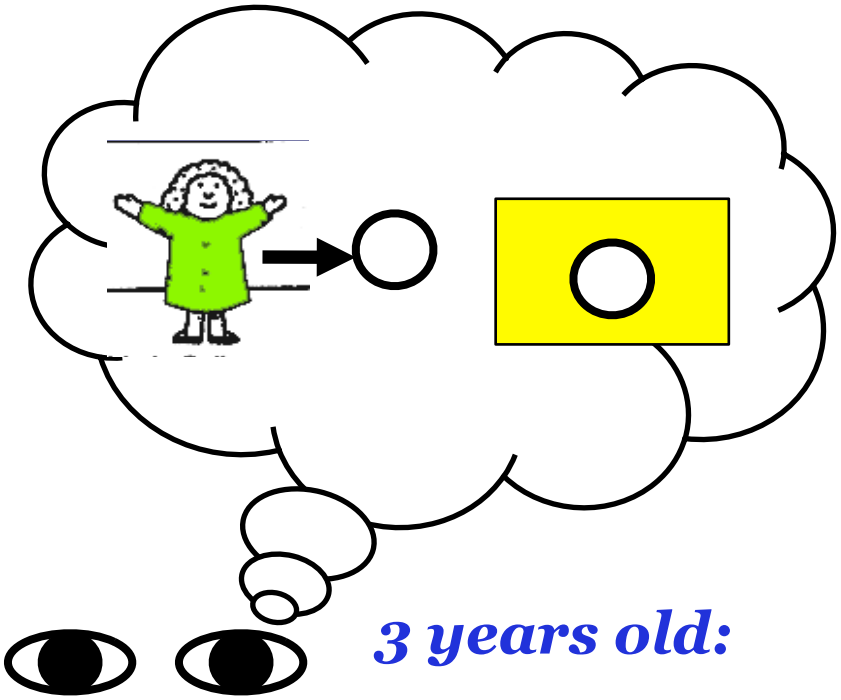
- But it doesn’t ‘feel like anything’ to have a false belief.
- Which of your beliefs are false right now?

Representational theory of mind

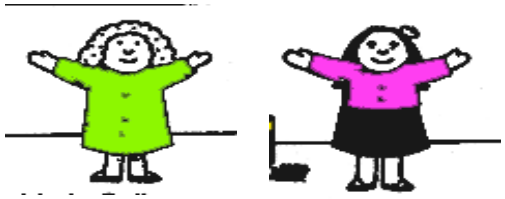
- So what develops?
  - Understanding the mental/physical distinction?
    - Thoughts in the mind are not equivalent to things in the world
  - Understanding that mental states cause actions?
    - We act consistent with our beliefs to fulfill our desires.
  - Understanding that the mind represents (and thus can mis-represent) reality.
    - Our beliefs can be false.

**slide from *www.mit.edu/~jbt/9.iap/*

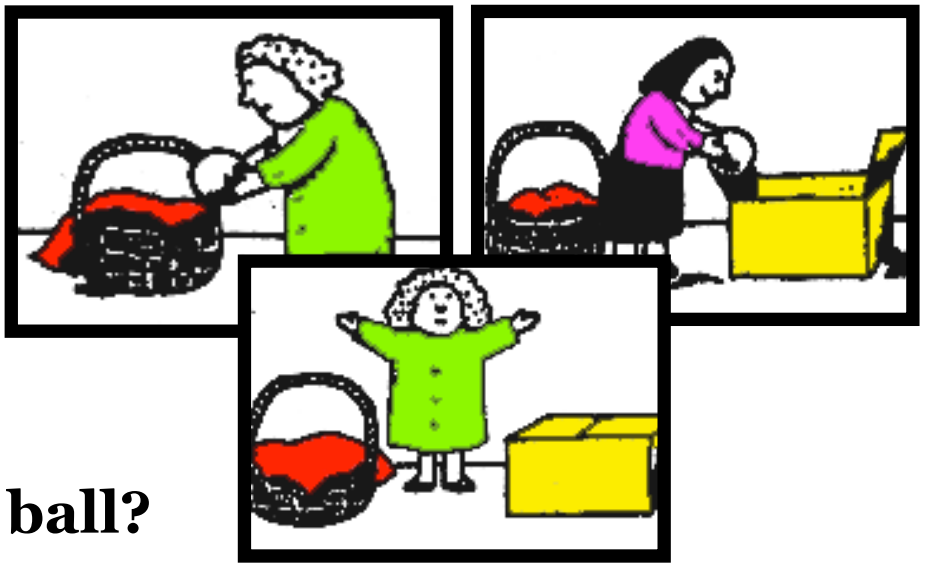
Unexpected transfer task



3 years old:



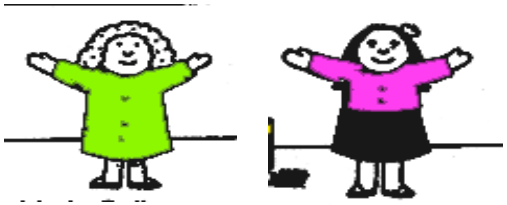
Sally **Anne**

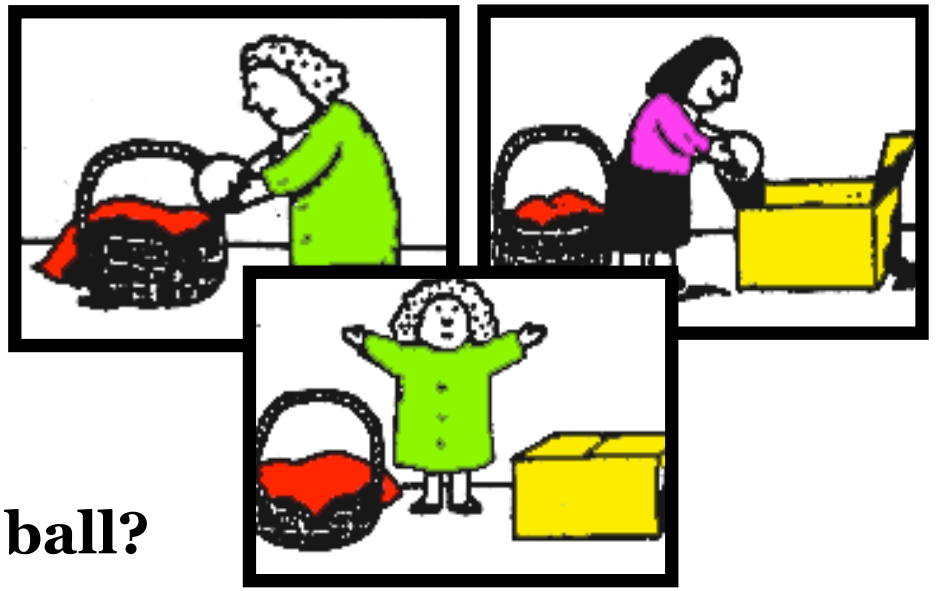


Where will Sally look for her ball?

**slide from *www.mit.edu/~jbt/9.iap/*

Unexpected transfer task





5 years old:

"In the basket."

Where will Sally look for her ball?

Wellman et al's (2001) meta-analysis

- 77 articles, 178 studies, 591 conditions.
- Many factors influence FB task performance.
- Better performance if:
  - 1) deception as motive for change
  - 2) children carry out transformation themselves
  - 3) inhibitory control demands are reduced
  - 4) emphasis on time frame - where will he look *first*?

- But – basic development trend still observed
-

Representational theory of mind

- So why do five-year-olds succeed? (i.e., what supports theory of mind reasoning)
- And why do three-year-olds fail? (what changes?)

Why do we five-year-olds succeed?

- Theory theory: causal attribution of unobserved variables (thoughts, beliefs, desires, and intentions) to both self and others, to explain observable behavior (Premack & Woodruff, 1978).

- Simulation theory: we have first-hand access to own beliefs and can use knowledge of our own mental states in similar situations to explain the actions of others.

Representational theory of mind

- Developmental evidence against simulation theory … No "first-person privilege"
- Smarties/pencils
- Do you want to look in the box or feel what's in the box? (Hard/soft cat v. red/ green ball)

slide from *www.mit.edu/~jbt/9.iap/9.94.Saxe.ppt***

Understanding states that one has *never* experienced: Kelli

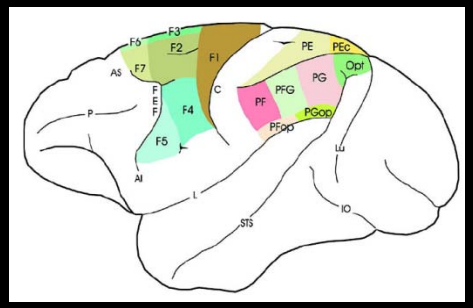
When Kelli was 4.5 years old:

Can you hide the car, so Mommy won't see it?

A congenitally blind adult defines "to notice":

"To see something that comes into your view. But not only to see it, but to perceive it and understand it. You could sit on this rocking chair and not notice the colour of it at all"

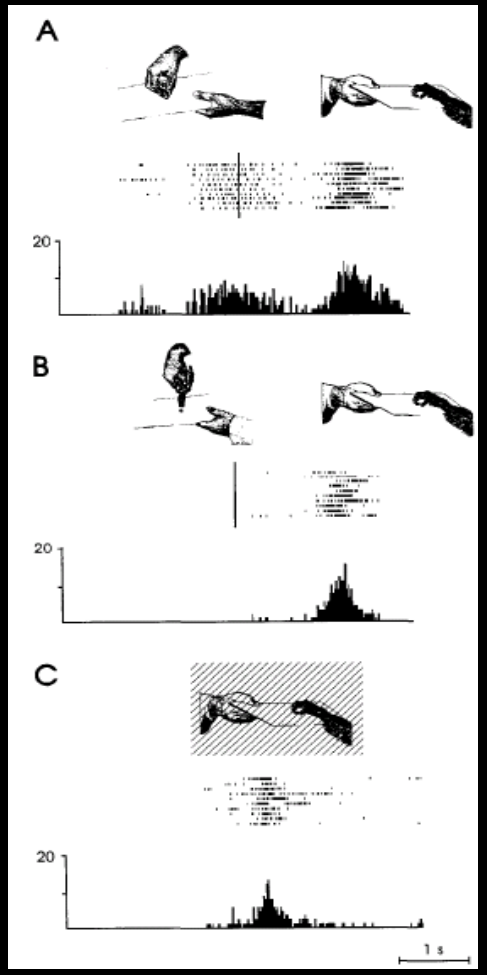
Discovery of "mirror neurons"

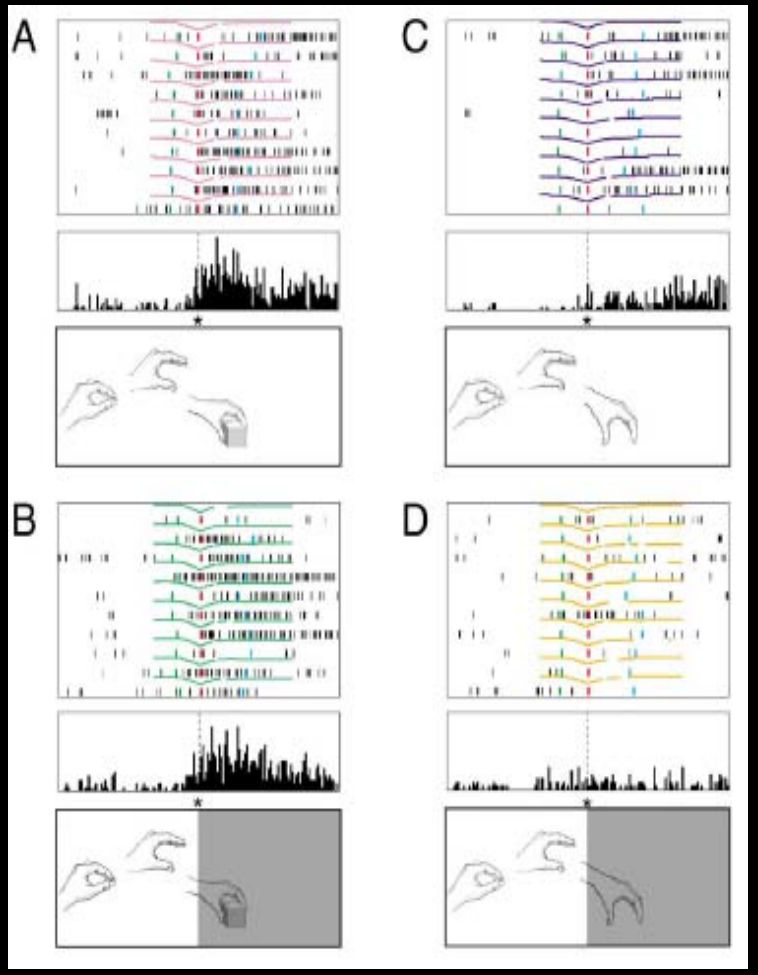


- In monkeys, the ventral premotor cortex (F5) contains mirror neurons

These neurons fire when:

(1)the monkey performs a specific action
(2)the monkey sees another performing the action





Rizzolatti et al (1996)
Umilta et al. (2001)

Monkey See

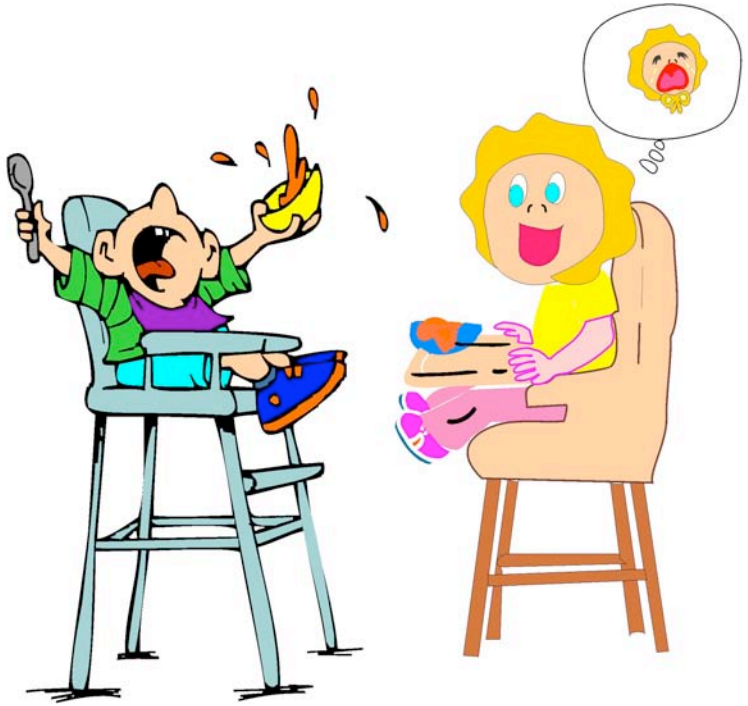
Image: OpenClipArt. Public Domain.

Neurons Do

Rizzolatti (2002) recorded from the ventral premotor area of the frontal lobes of monkeys and found that certain cells will fire when a monkey performs a single, highly specific action with its hand: pulling, pushing, tugging, grasping, picking up and putting a peanut in the mouth etc. Different neurons fire in response to different actions.

MIRROR NEURONS

Rizzolatti found that any given mirror neuron will also fire when the monkey in question observes another monkey (or even the experimenter) performing the same action.

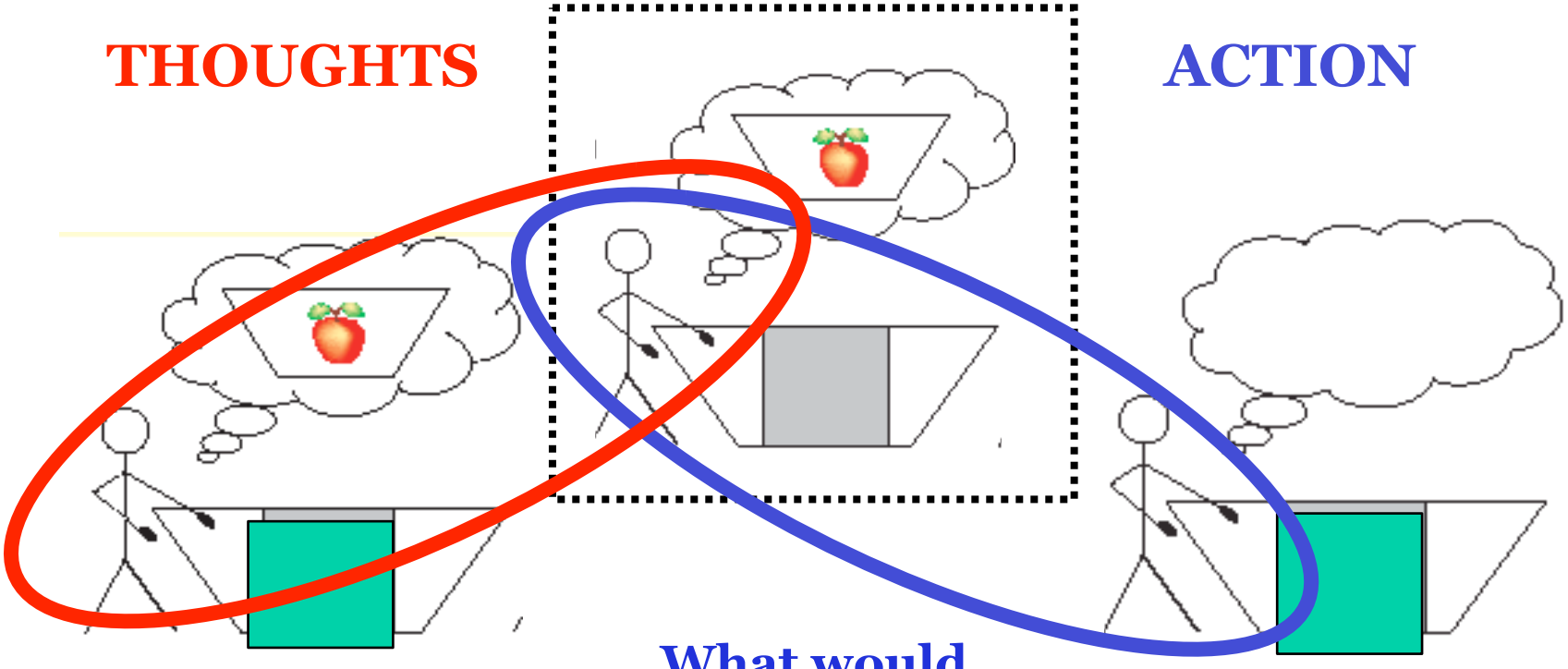


Anytime you watch someone else doing something the corresponding mirror neuron might fire in your brain, thereby allowing you to "read" off another's intentions, and thus to develop a sophisticated "theory of other minds."

Mirror neurons (Rebecca Saxe:

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

Thought experiment:



Why do three-year-olds fail?

- Competence deficit: most beliefs (e.g., that you have two feet, ten fingers, etc.) are true. It takes a lot of evidence to infer that people can represent states of the world that are not true.
- Performance deficit: it is hard for children to inhibit their own knowledge of the world to respond to the knowledge of others (or even their own past knowledge).

Study 1: Onishi & Baillargeon (2005)

- Violation-of-Expectation Paradigm
  - Infants tend to look longer at the outcome that is novel/ unexpected
  - Familiarization trials (same for all conditions)
  - 4 conditions (TB/FB) x 2 endings (Test trials)
- In this study, infants were familiarized to...

1. Hiding

Figures removed due to copyright restrictions.
Figure 1 . Onishi, Kristine H. and Renée Baillargeon. "Do 15-Month-Old Infants Understand False Beliefs?" *Science* 308, no. 5719 (2005): 255-8.

2. Retrieval

Study 1: Onishi & Baillargeon (2005)

- TB-green: the woman has a True Belief that the watermelon is in the green (darker) box.

- FB-green: the woman has a False Belief that the watermelon is in the green(darker) box.

Figures removed due to copyright restrictions.
Figures 2AC, 3, and 4 . Onishi, Kristine H. and Renée Baillargeon. "Do 15-Month-Old Infants Understand False Beliefs?" *Science* 308, no. 5719 (2005): 255-8.

Study 1: Onishi & Baillargeon (2005)

- TB-yellow: the woman has a True Belief that the watermelon is in the yellow box.

- FB-yellow: the woman has a False Belief that the watermelon is in the yellow box.

Figures removed due to copyright restrictions.
Figures 2BD, 3, and 4 . Onishi, Kristine H. and Renée Baillargeon. "Do 15-Month-Old Infants Understand False Beliefs?" *Science* 308, no. 5719 (2005): 255-8.

How to interpret the results?

- Rich account – infants understand that beliefs can mediate behaviors and can expect an agent's behavior based on the content of her beliefs
  - She *thinks* that the watermelon is in the green box, so she'll reach for the green box even though it's really in the yellow box..

- Lean account – infants only attribute knowledge/ ignorance, and apply a simple behavior rule (ignorance leads to error).
  - The watermelon is now in the yellow box, but she didn't *see* this; so she'll search for the other location (green box)

i.e., see Perner & Ruffman (2005) , *Science*

Southgate, Senju & Csibra

- false belief task

If just ignorance vs. knowledge, children should have judged at chance (there is no ball there). Instead, specifically predicted she would look where she 'believed' ball was.

Why do infants succeed, three-year-olds fail, and five-year-olds succeed?

- Implicit versus explicit knowledge?
  - Except if an experimenter puts object A in box A and object B in box B and leaves, and then the objects are switched, and she comes back and asks for the "sefo" that she put in box A, children hand her the object in box B. (Southgate, Chevallier, Csibra, 2010)
- Performance/competence distinction
  - But not altogether satisfying ... stay tuned.

Why do three-year-olds fail? But two-year-olds and babies succeed?

- Competence deficit: most beliefs (e.g., that you have two feet, ten fingers, etc.) are true. It takes a lot of evidence to infer that people can represent states of the world that are not true.
- Performance deficit: it is hard for children to inhibit their own knowledge of the world to respond to the knowledge of others (or even their own past knowledge).
- NOTE: No one current account explains all the data (recall that three-year-olds don't merely fail to inhibit their own true knowledge, they confabulate explanations for their own and others' behavior ...)
- Stay tuned ...

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- Autobiographical memory (around 3)
- Understand differences in beliefs (by 7 months?)
- Faux pas, humor, irony, ambiguity, source memory … lifespan development.

Call & Tomasello, Trends in Cognitive Sciences, 2008

Table 2. Studies on chimpanzees' and human infants' understanding of perception and knowledge

Studies	References	
	Chimpanzees	Infants
Gaze following		
1. Follow gaze to distant locations behind self	[42–44]	[45]
2. Follow gaze on the basis of both face and eye direction	[46]	[46,47]
3. Check back with gazer if nothing relevant at the target location	[48,49]	[50]
4. Stop looking after a few trials if nothing relevant at the target location	[51]	
5. Ignore distracting objects on the way to the target location	[52]	[53]
6. Move to the side of opaque barriers to view the target location	[42,49,52]	[54]
7. Understand that gaze stops at an opaque barrier - unless it has a window in it	[55]	[56]
Gestural communication		
8. Use visual gestures mostly when conspecifics or E are oriented to them	[6,14,57,58]	[6]
9. Position oneself to gesture in front of others	[59,60]	[61]
10. Both face and eye orientation of recipient determine gesture production	[62]	[6]
Food competition		
11. Pick the food that the E is not looking at	[26]	
12. Pick the food that a dominant individual or E cannot see because of barrier	[26,63,64]	[65]
13. Visually conceal approach to food (using barrier)	[26,27]	
14. Auditorially conceal approach to food (choosing silent door)	[27]	
15. Take food that a dominant individual did not see being hidden	[15]	[66]
16. Understand that if competitor picks first, he will have chosen the food he saw (not food he did not see) being hidden	[a]	[a]

[a](J. Kaminski *et al.*, personal communication).
Gaps in the table indicate no information available.

Call & Tomasello, Trends in Cognitive Sciences, 2008

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Studies	References	
	Chimpanzees	Infants
Getting/finding food		
1. Leave earlier and beg more intensely from an E who is unwilling as opposed to unable to deliver food (behavior similar in the two cases)	[31]	[32]
2. Select the box acted on intentionally versus accidentally (behavior similar in the two cases)	[33]	[33]
3. Leave earlier when E is playing with as opposed to trying to open a box with food (behavior identical in the two cases)	[a]	
Reacting to a partner's actions		
4. Give the object that the E is trying to reach	[34,35]	[34]
5. Take the food that a competitor is trying to reach	[36]	
6. Anticipate where E is going based on potential goals available	[a]	
7. When food is stolen retaliate against thief, not against innocent receiver of stolen food	[37]	
Imitation		
8. Produce target action based on observing a failed attempt	[38,39]	[40]
9. Copy intentional actions more often than accidental actions	[38]	[41]
10. Selectively copy freely chosen acts but not those forced by circumstances	[28]	[29]

[a](D. Buttelmann *et al.*, personal communication).
Gaps in the table indicate no information available.

9.85 Infant and Early Childhood Cognition
Fall 2012