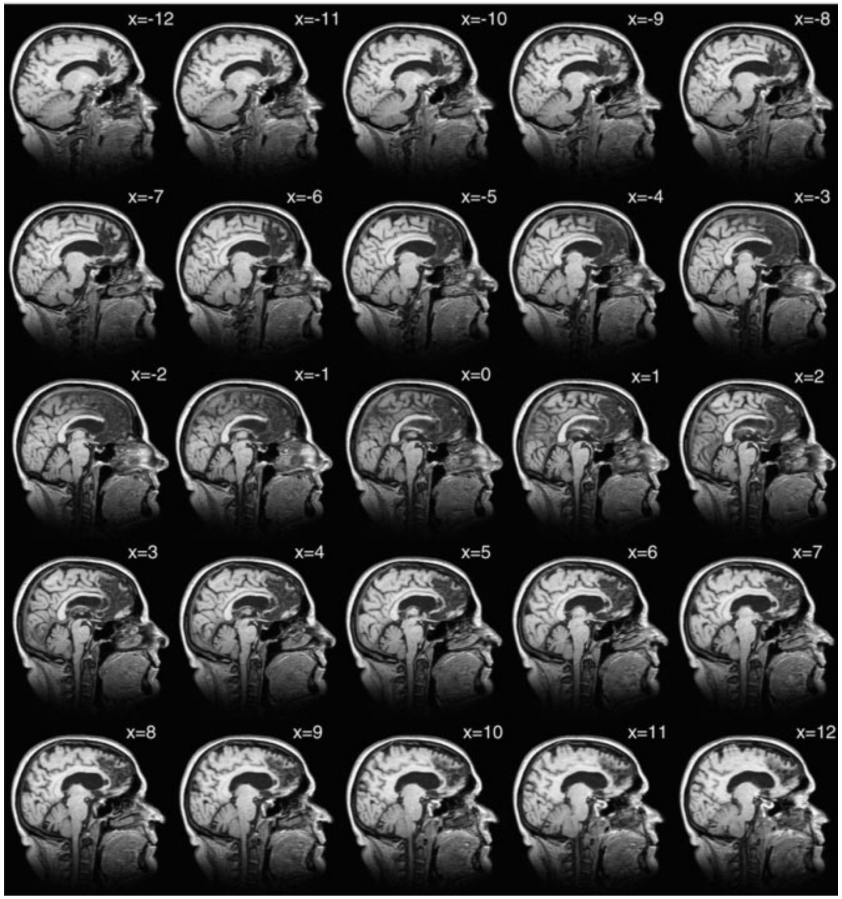
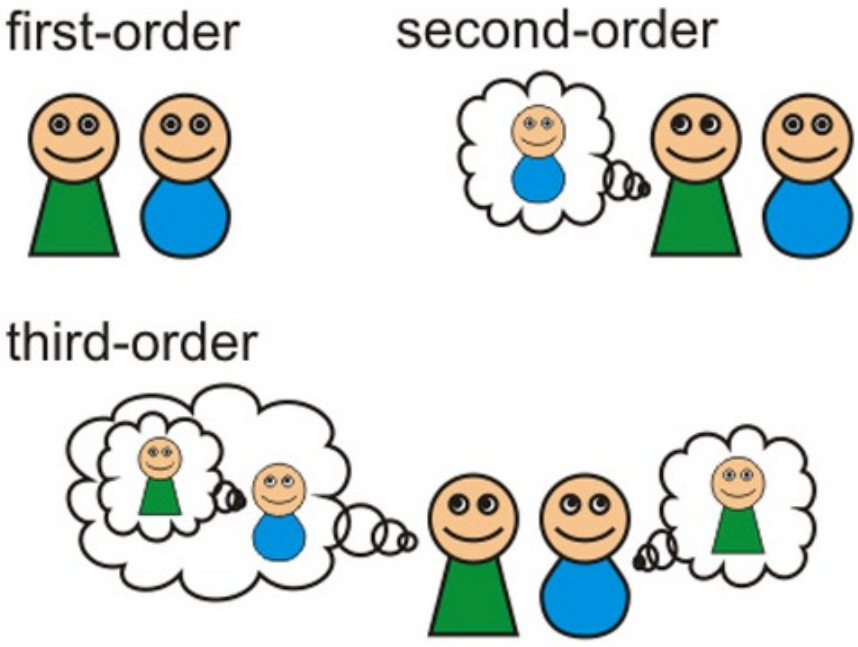
Today's question



An innate, Theory of Mind module?

Mentalizing



Today's docket

1. False-belief understanding

   Theory of Mind, development, theories

2. Brain correlates

   Story comprehension, intention recognition, development, cellular level

3. Neuropsychological evidence

   Patient G.T.

Theory of Mind

- Ability to attribute mental states to ourselves and others, including their goals, preferences, beliefs, and knowledge
- Not to be taken literally as an explicit philosophical theory about the contents of the mind
- Over the years, alternative terms such as ‘mentalizing’ and ‘intentional stance’, have also come into use
- Thought to serve as one of the foundational elements for social interaction
- Traditional test is a false-belief task

People routinely interpret others’ behavior in terms of their mental states

Testing for Theory of Mind

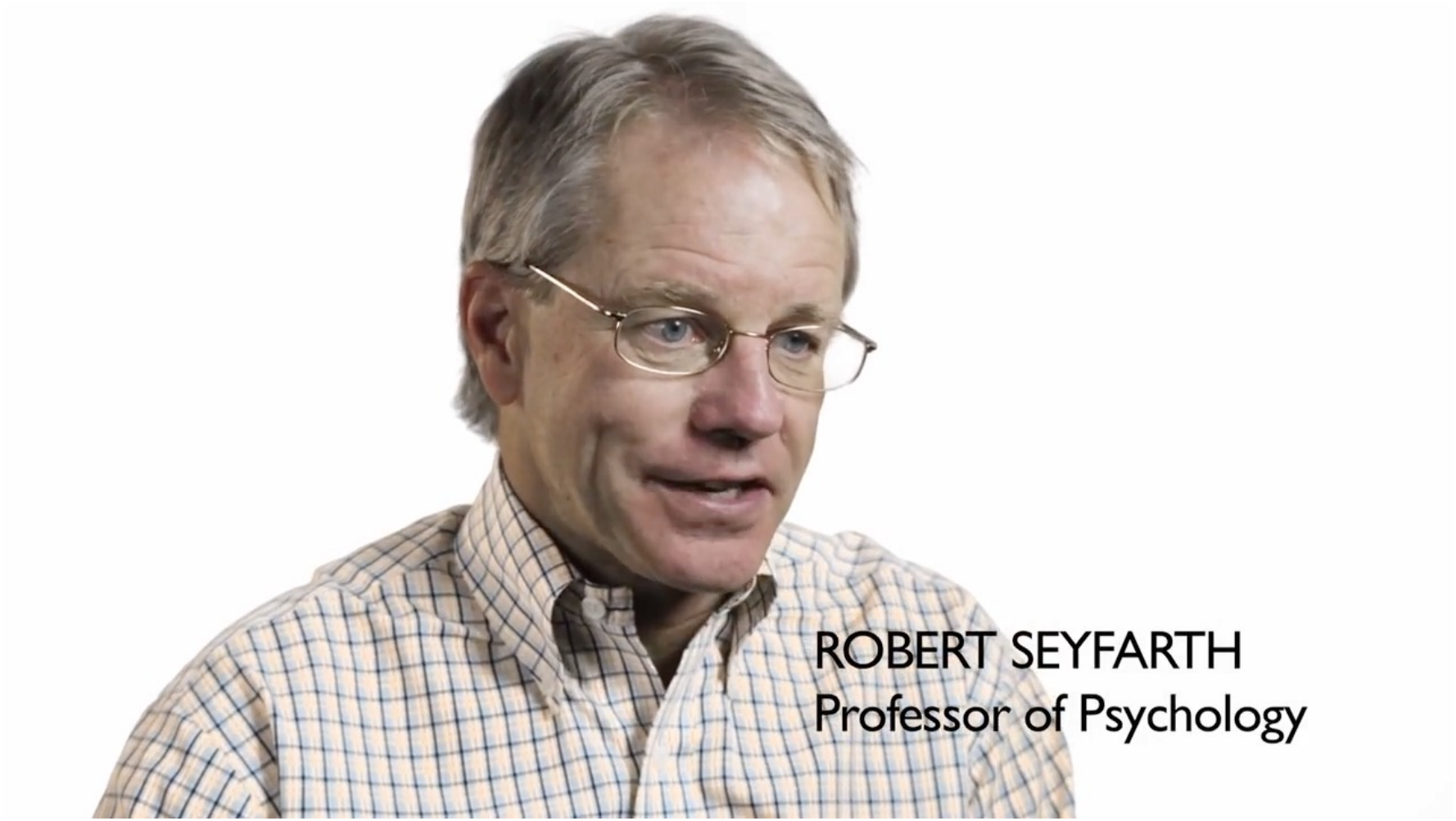
A true belief would not do as a test for the presence of theory of mind, as it would be impossible to decide unequivocally whether the other person behaves in accordance with reality or in accordance with his or her own belief about reality. By contrast, understanding of *another person's wrong belief* requires explicit representation of the wrongness of this person's belief in relation to one's own knowledge.

by **Daniel C. Dennett***

Department of Philosophy Tufts University, Medford, Mass. 02155

***Beliefs about beliefs** [P&W, SR&B].*

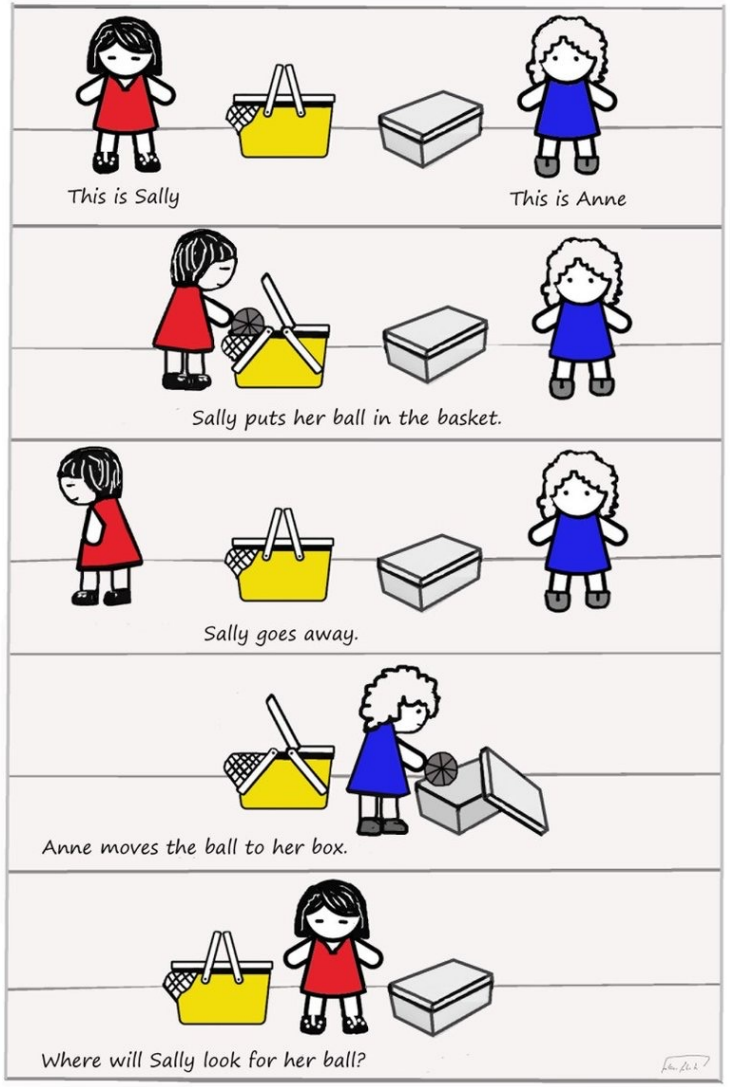
Development



False-belief understanding

DARTMOUTH

Development



Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception

HEINZ WIMMER*
University of Salzburg

JOSEF PERNER
University of Sussex

Number of subjects giving correct answers to 'Belief'-question in Experiment 1

	Number of correct answers		
Age (years)	2	1	0
4–5	4	2	6
6–7	11	0	1
8–9	11	1	0

Children begin to pass false-belief tasks requiring a verbal response around age 4

False-belief understanding

DARTMOUTH

Development

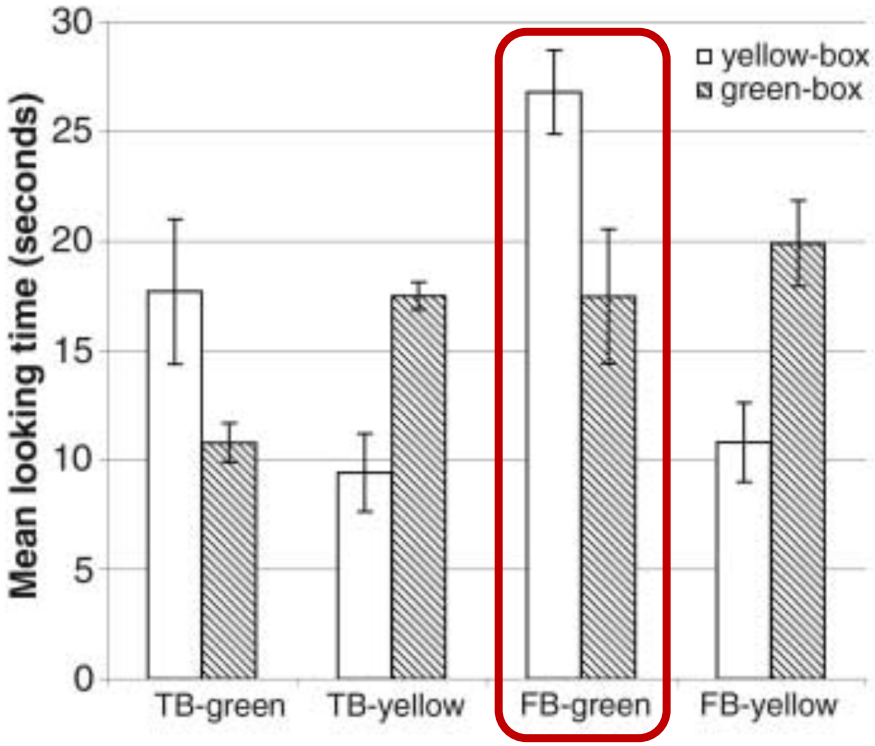
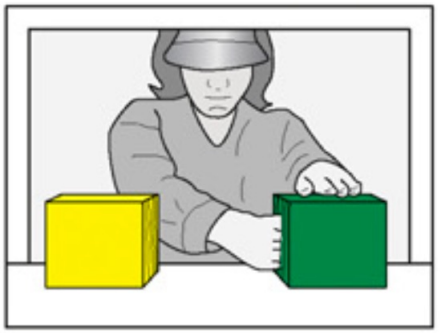
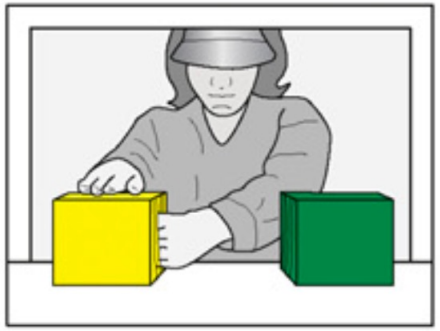


Fig. 4. Mean (±SE) looking times during the test trial (after the actor reached into the green or yellow box) in the four belief conditions.

expected



OR



unexpected

Do 15-Month-Old Infants Understand False Beliefs?

Kristine H. Onishi[1]* and Renée Baillargeon[2]

15 month old infants pass false-belief tasks eliciting an implicit response

Theories of Theory of Mind

- *Modularity* theories postulate that ToM development is driven by an innate neural mechanism dedicated to mental state reasoning
- *Simulation* theories propose that ToM relies upon direct access to one's own psychological states in reasoning about the minds of others
- *Executive* accounts posit that ToM difficulties stem at least in part from challenges in inhibiting one's own perspective
- *Theory theory* postulates that ToM knowledge resides in domain-specific theory-like structures informed by data gleaned from the social world

How and where: Theory-of-mind in the brain

Caitlin E.V. Mahy[a,b,*], Louis J. Moses[a,1], Jennifer H. Pfeifer[a,1]

Today's docket

1. False-belief understanding

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Mentalizing stories

‘A burglar who has just robbed a shop is making his getaway. As he is running home, a policeman on his beat sees him drop his glove. He doesn’t know the man is a burglar, he just wants to tell him he dropped his glove. But when the policeman shouts out to the burglar, “Hey, you! Stop!” The burglar turns round, sees the policeman, and gives himself up. He puts his hands up and admits that he did the break-in at the local shop’.

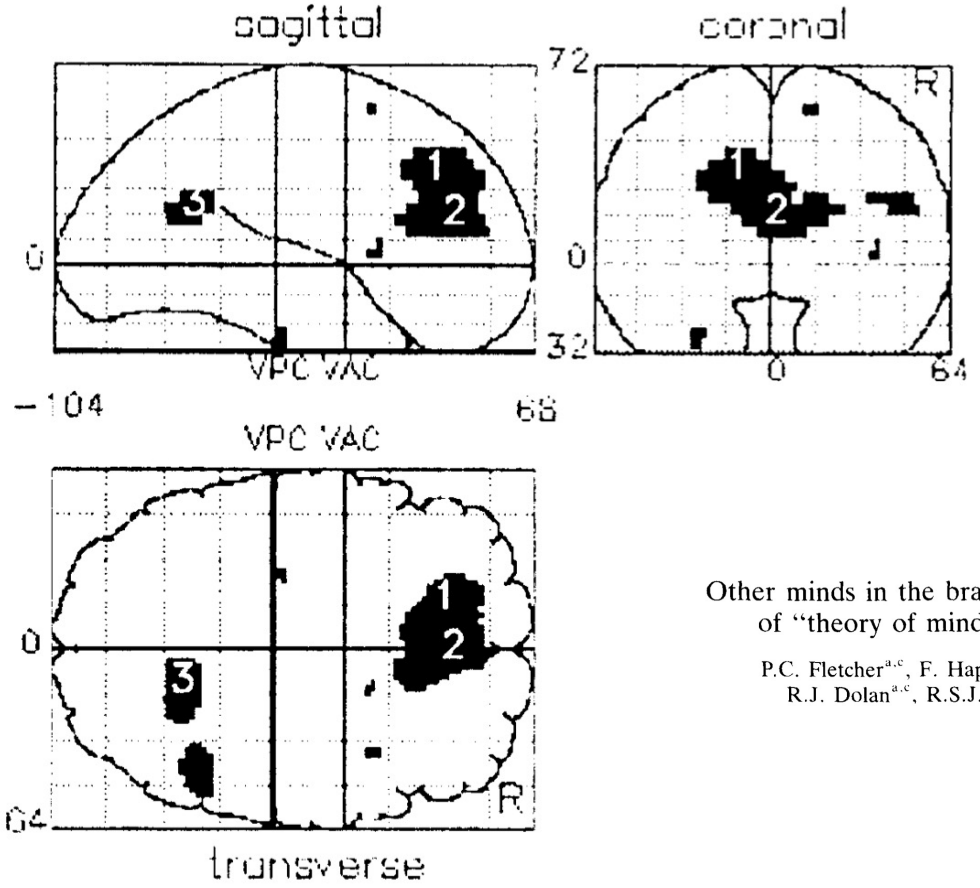
Why did the burglar do that?

Physical stories

‘A burglar is about to break in to a jewelers' shop. He skillfully picks the lock on the shop door. Carefully he crawls under the electronic detector beam. If he breaks this beam it will set off the alarm. Quietly he opens the door of the storeroom and sees the gems glittering. As he reaches out, however, he steps on something soft. He hears a screech and something small and furry runs out past him towards the shop door. Immediately the alarm sounds’.

Why did the alarm go off?

Mentalizing in story comprehension



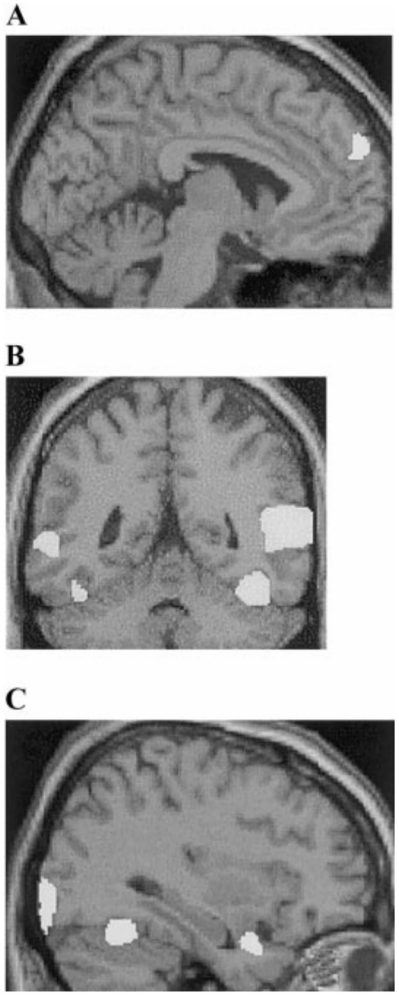
Other minds in the brain: a functional imaging study of "theory of mind" in story comprehension

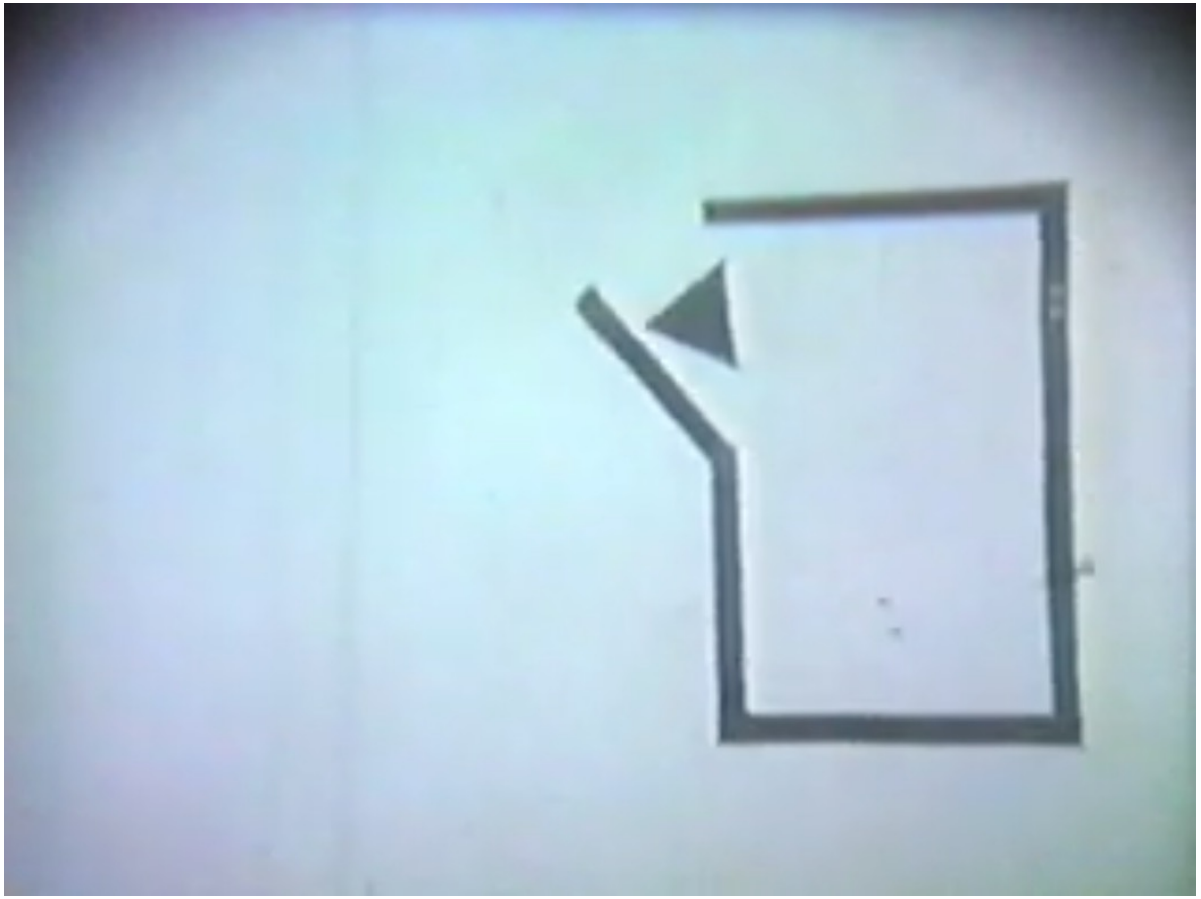
P.C. Fletcher[a,c], F. Happé[b], U. Frith[b,d,*], S.C. Baker[a], R.J. Dolan[a,c], R.S.J. Frackowiak[a], C.D. Frith[a,d,*]

Fig. 3. SPM showing a direct comparison between the theory of mind and the physical task. The main area of difference between the two types of story is the left medial frontal region (1), with a small difference in activation in the anterior (2) and posterior cingulate cortex (3).

Mentalizing increases cerebral blood flow in mPFC and rSTS

Mentalizing in intention recognition





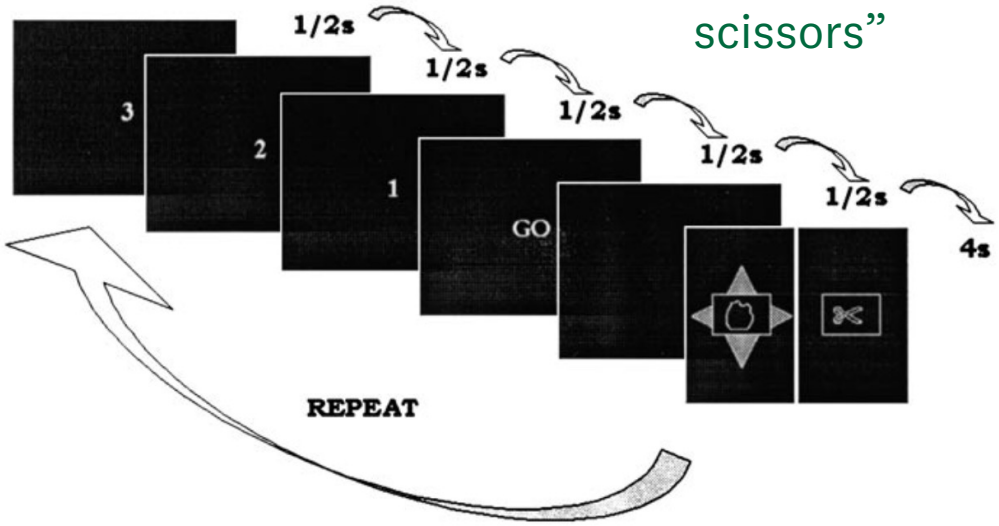
Movement and Mind: A Functional Imaging Study of Perception and Interpretation of Complex Intentional Movement Patterns

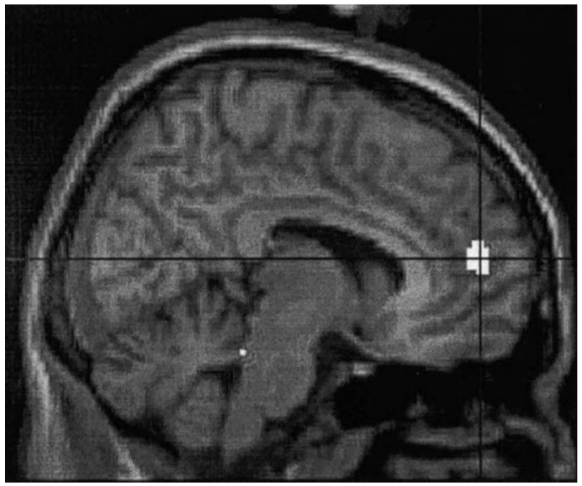
Fulvia Castelli,* Francesca Happé,† Uta Frith,* and Chris Frith‡

Mentalizing increases cerebral blood flow in mPFC, STS, and temporal pole

Mentalizing in a competitive game setting

“stone, paper, scissors”





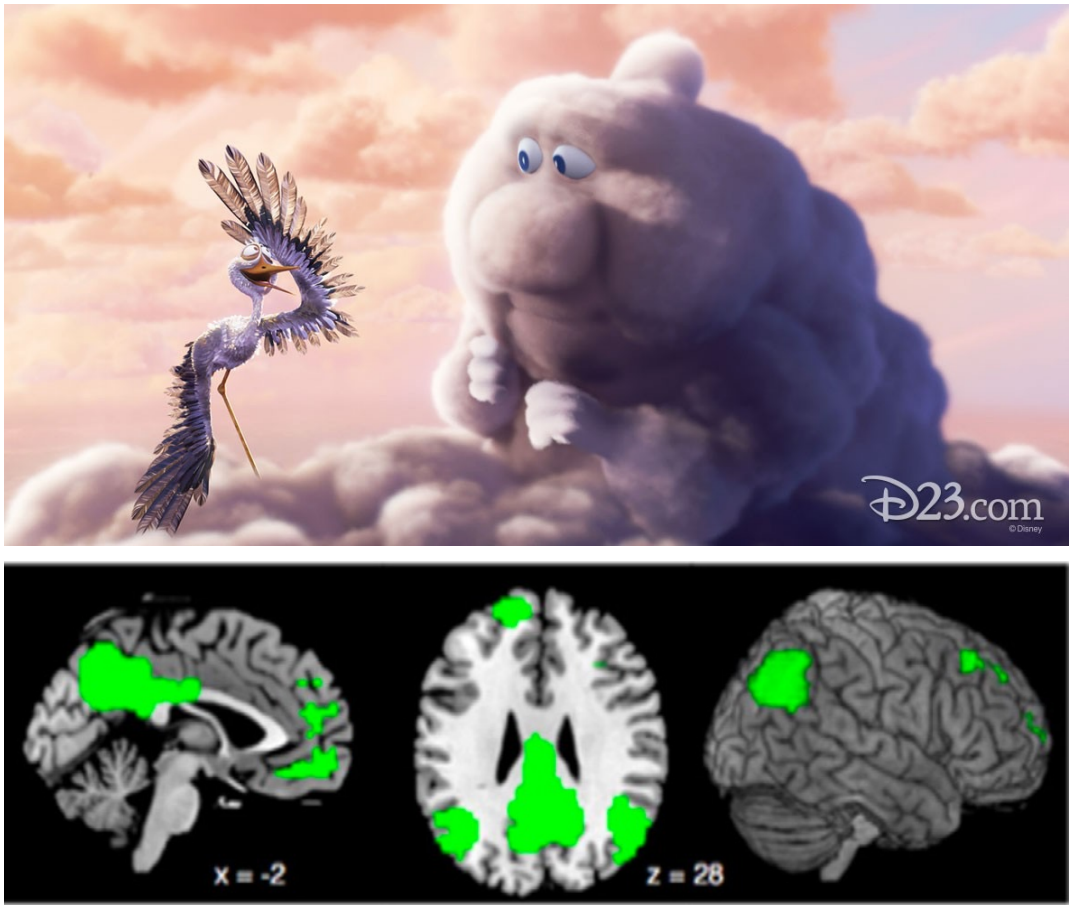
Human > computer

Imaging the Intentional Stance in a Competitive Game

Helen L. Gallagher,* Anthony I. Jack,† Andreas Roepstorff,*‡ and Christopher D. Frith*

Mentalizing increases cerebral blood flow in mPFC

Mentalizing in passive movie watching

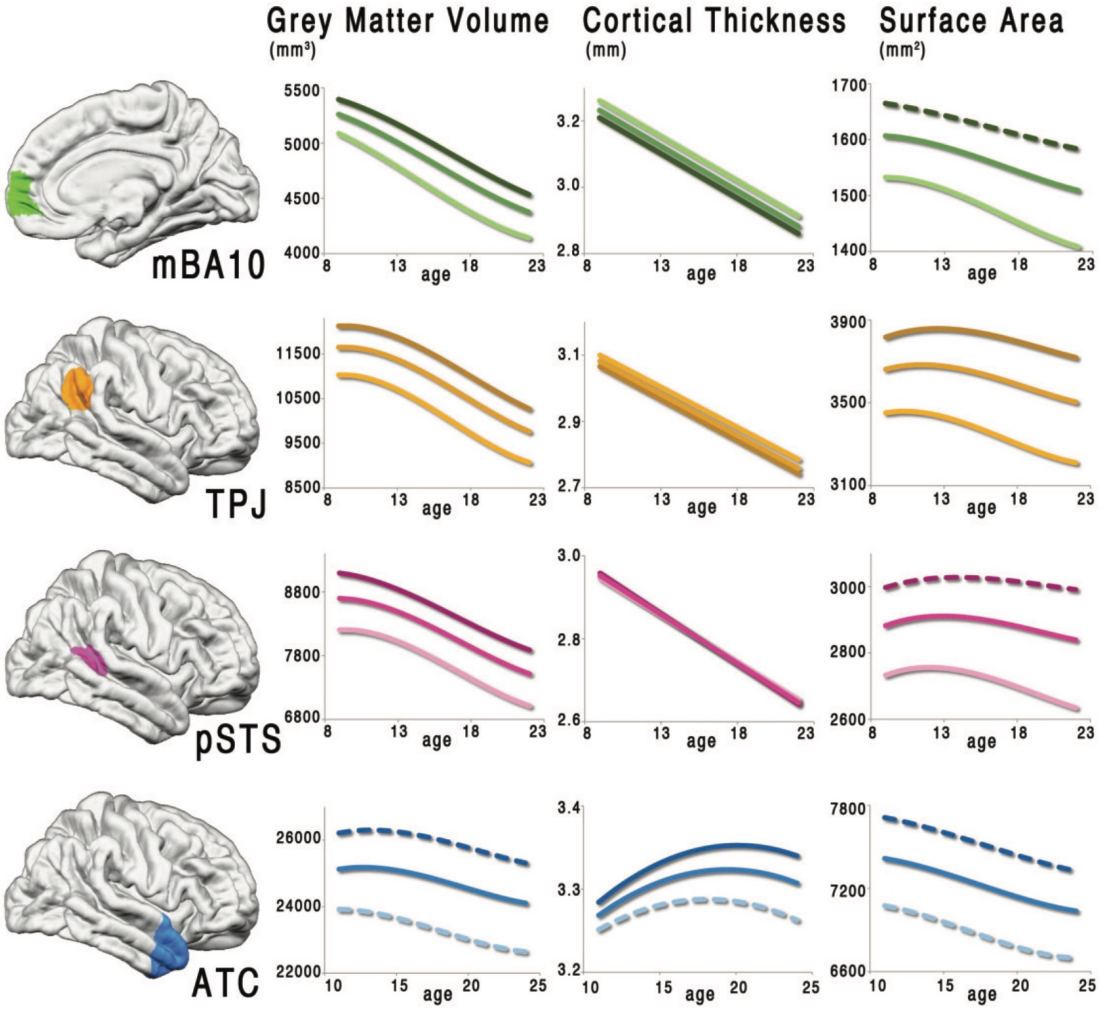


Localizing Pain Matrix and Theory of Mind networks with both verbal and non-verbal stimuli

Nir Jacoby [a,*], Emile Bruneau [a], Jorie Koster-Hale [b], Rebecca Saxe [a]

The “Theory of Mind network”

Development

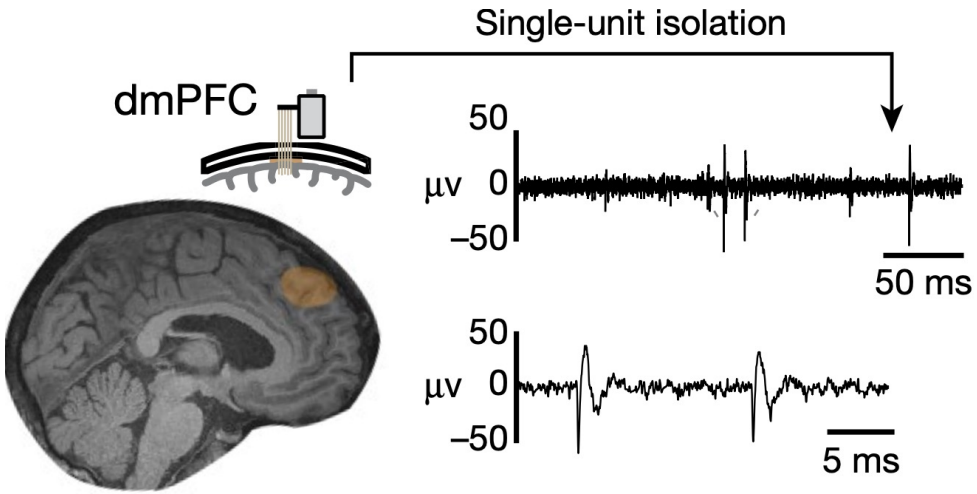


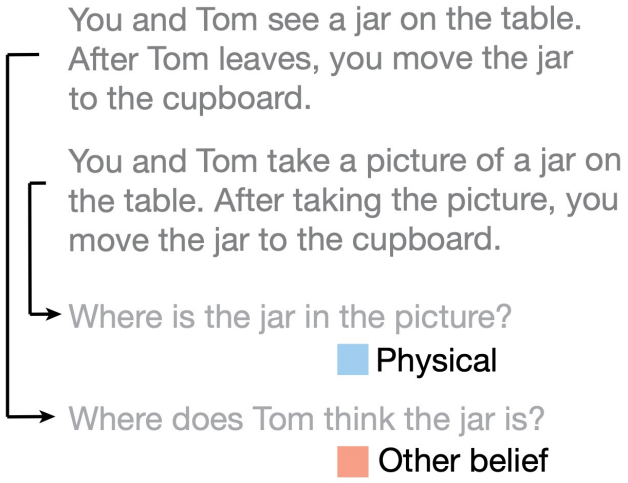
Developmental changes in the structure of the social brain in late childhood and adolescence

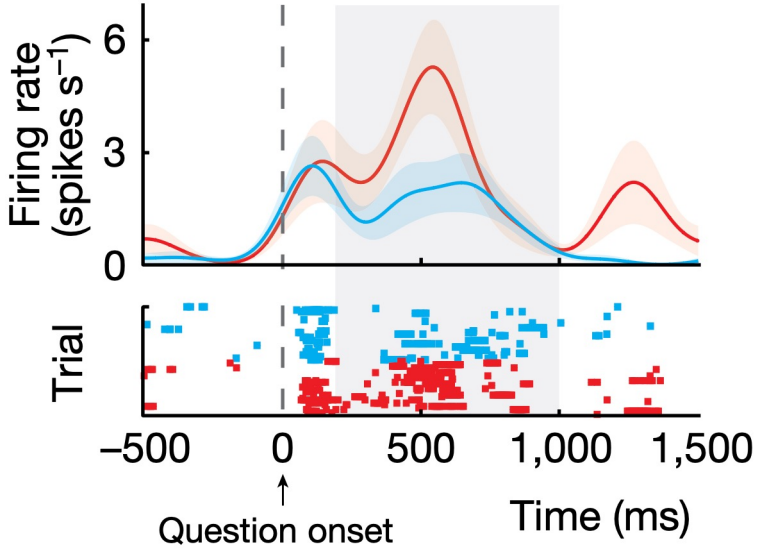
Kathryn L. Mills,[1,2] François Lalonde,[2] Liv S. Clasen,[2] Jay N. Giedd,[2] and Sarah-Jayne Blakemore[1]

Developmental structural changes across the Theory of Mind network

Cellular level







Single-neuronal predictions of others' beliefs in humans

Mohsen Jamali[1], Benjamin L. Grannan[1], Evelina Fedorenko[2], Rebecca Saxe[2], Raymundo Báez-Mendoza[1] & Ziv M. Williams[1,3,4]✉

dmPFC neurons encode information about others' beliefs

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Neuropsychological evidence

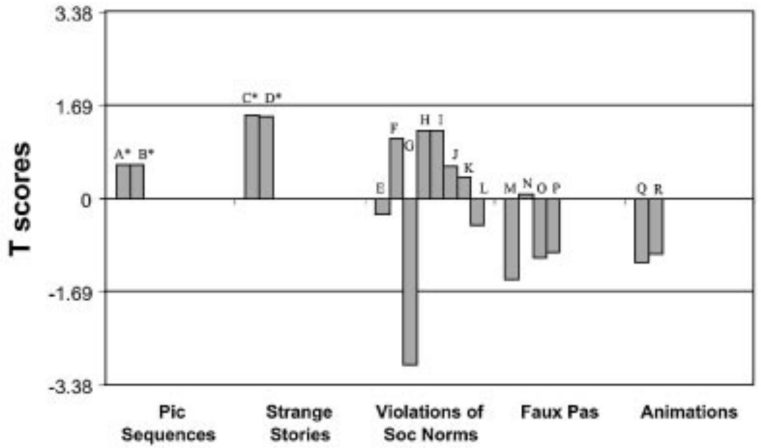
DARTMOUTH

Patient G.T., bilateral mPFC infarction

Fig. 2 Foci of ToM activations from ten different neuroimaging studies rendered onto a normalised version of GT's lesion.

The impact of extensive medial frontal lobe damage on 'Theory of Mind' and cognition

Chris M. Bird,[1] Fulvia Castelli,[1] Omar Malik,[2] Uta Frith[1] and Masud Husain[1,2]



mPFC regions are not necessary for Theory of Mind

Take-home concepts

- Mental state representation emerges at around 15 months (perhaps earlier), followed by explicit access to it around age 5
- Mentalizing reliably activates medial prefrontal cortex. Yet, this region appears not necessary for mentalizing
- The mentalizing network has not been studied in genuinely interactive settings nor is it known how people actually align mental states

  (wait for the Communication module...)

- Dual 2: Social Development