

“Theory of Mind” as a mechanism of selective attention

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Why is this included under Evolution?

The adaptive problems posed by social life are complex and demand cognitive specializations for navigating the social world.

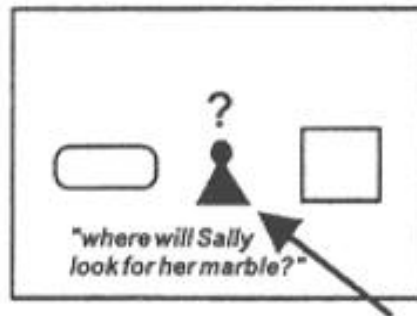
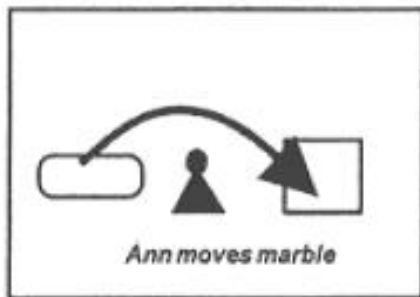
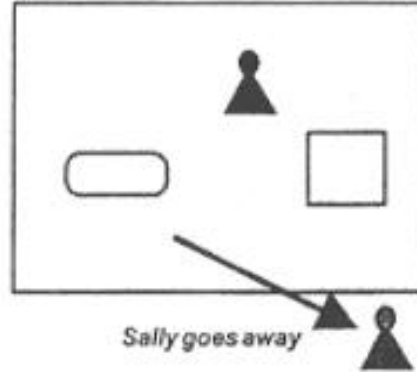
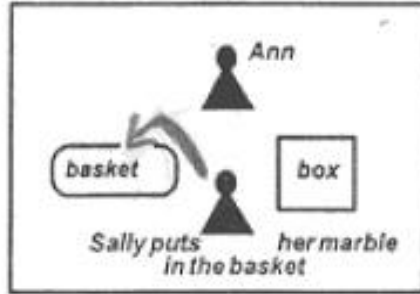
Cognitive adaptations in the human brain.

Evidence for domain-specific mechanisms specialized for reasoning about the contents of other minds and about cooperation.

Theory of mind

- David Premack and Guy Woodruff (1978) – The capacity to attend to mental state properties and adapt to environment.
- Showed that their chimp, Sarah inferred the "intentions" and "motivations" of a man to predict his actions.
- Developmental Psychology - what human children know about the minds of others, and, when.
- Still a lack of consensus as to the relation of this ability to other cognitive faculties, the underlying mechanisms at work, and even its ontogenetic course.
- Autism

Standard false-belief task



Sally's desire for the marble
– true

Sally's belief concerning the
location of the marble – false
(from the attributer's point of
view)

Standard False-belief task

- ✱ Normal children solve after their 4th birthday.
- ✱ Autistic children fail despite mental ages
>>4yrs
- ✱ Children with Down Syndrome can succeed.

How does the young brain attend to mental states?

Mother's behavior:
talking to a banana...



Infer mental state:
mother **PRETENDS**
(of) the banana (that)
"it is a telephone"

- M-representation and the *Theory of mind Mechanism* (ToMM)
 - a) Agent involved – mother
 - b) Attitude – pretends true
 - c) Aspect of the world that anchors the attitude –banana
 - d) Content of the agent's attitude – “it is a telephone”

ToMM – “a specialized component of social intelligence providing the time-pressured, on-line intentional interpretations of behavior that are necessary for an agent to take part effectively in conversations and other real-time social interactions”

Properties:

- ✍ mechanism of selective attention.
- ✍ operates post-perceptually.
- ✍ domain-specific.
- ✍ subject to dissociable damage.
- ✍ employs the M-representational system.
- ✍ damaged in Autism (Kanner’s syndrome – infantile autism).

Triad of impairments in Autism:

1. social incompetence
2. poor verbal and non-verbal communication skills
3. lack of pretend play

Investigating ToMM:

Standard false-belief test (Sally and Ann) on normal children (4yrs), Down (10yrs) and Autistic (12yrs) children.

Qns:

- | | |
|---|---|
| a. In the beginning where did Sally put the marble? | 85% of normal and Down Syndrome children – predicted right. |
| b. Where is the marble now? | |
| c. Where will Sally look for her marble? | Only 20% autistic children predicted correctly. |

Why?

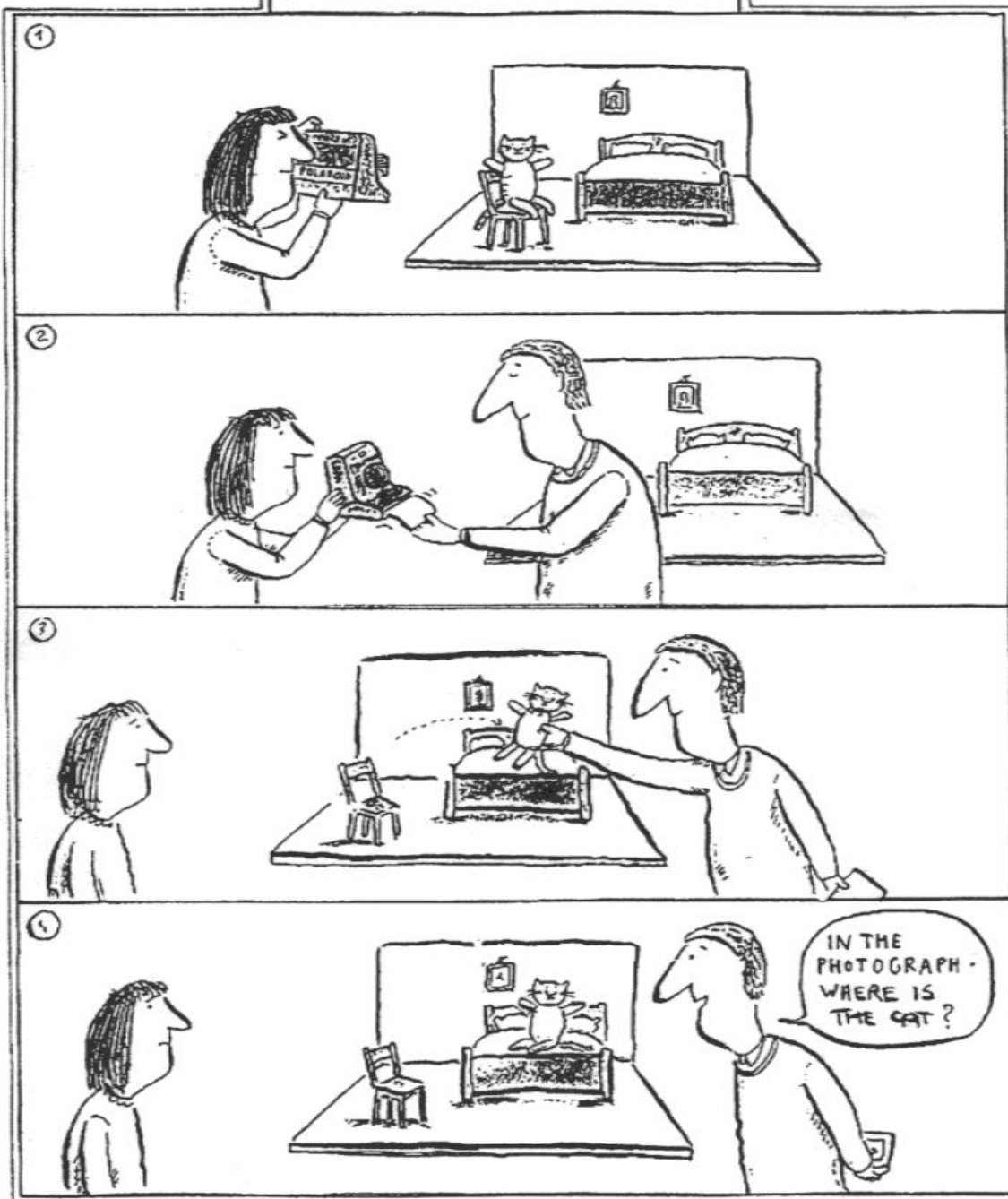
Due to any non-specific impairments – working memory, poor executive function, abstract reasoning?

The answer – “photograph task” by Zaitchik.

Without engaging mental state concepts.

Here Sally’s belief is replaced by a photograph. A mental representation is replaced by a public representation.

PICTURE TASK



Results were similar to the false-belief task:

3-yr-olds failed, but 4-yr-olds passed.

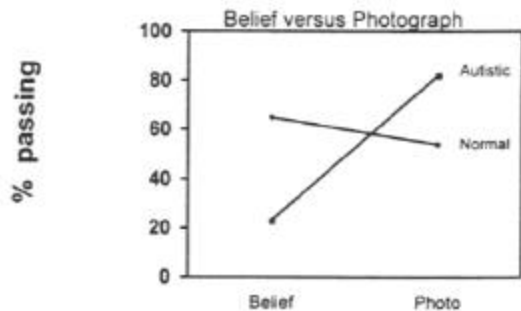
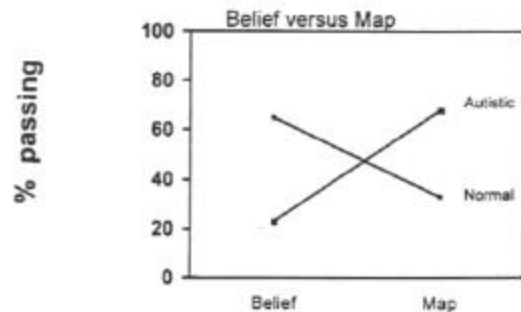
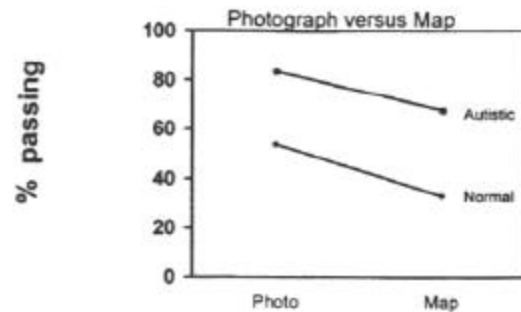
Leslie and Thaiss's (1992) test on 4-yr-olds and autistic children:

- Standard false-belief test and the photograph test.
- 4-yr-olds fine, but children who passed only one, passed the false-belief test!!
- Autistic children – bad in false belief, but near-perfect performance in photograph test

something in the normal young brain compensates for invisibility of belief.

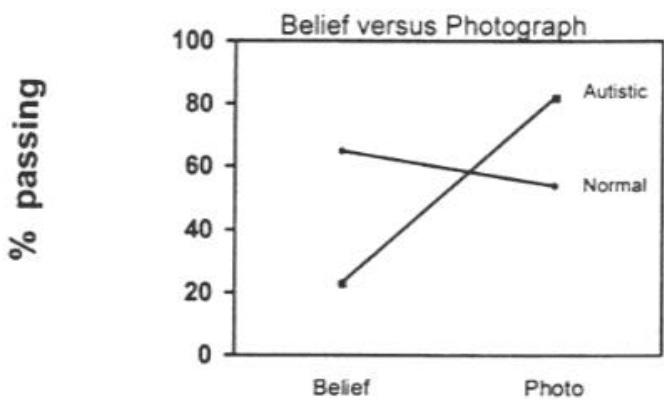
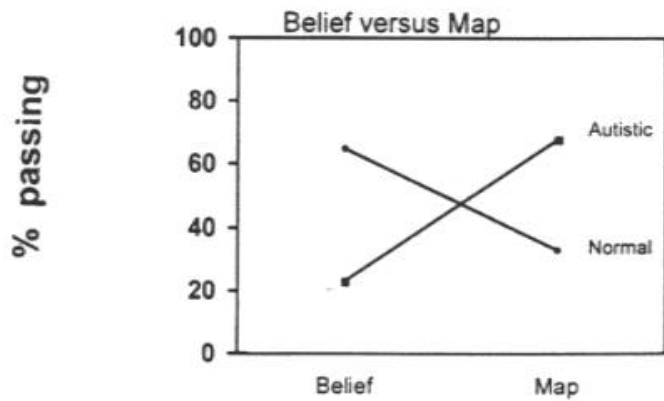
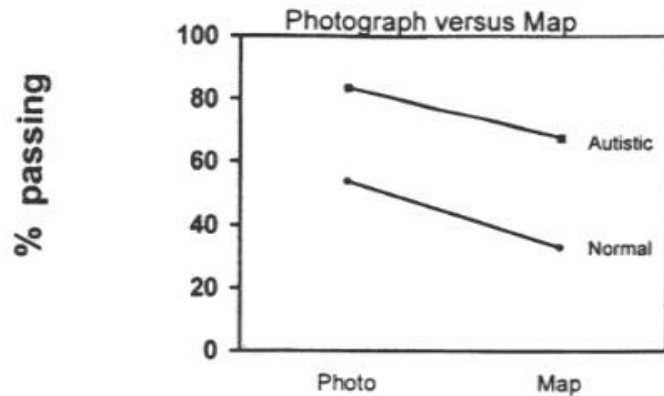
Role of ToMM as a mechanism that directs attention to otherwise unattendable mental states and thus promotes learning.

Children were further studied using maps instead of the photograph.



So, poor performance in autistics NOT due to:

- i. WM deficits, poor executive function or poor abstract reasoning.
- ii. Impaired event memory, mental imagery or attention.

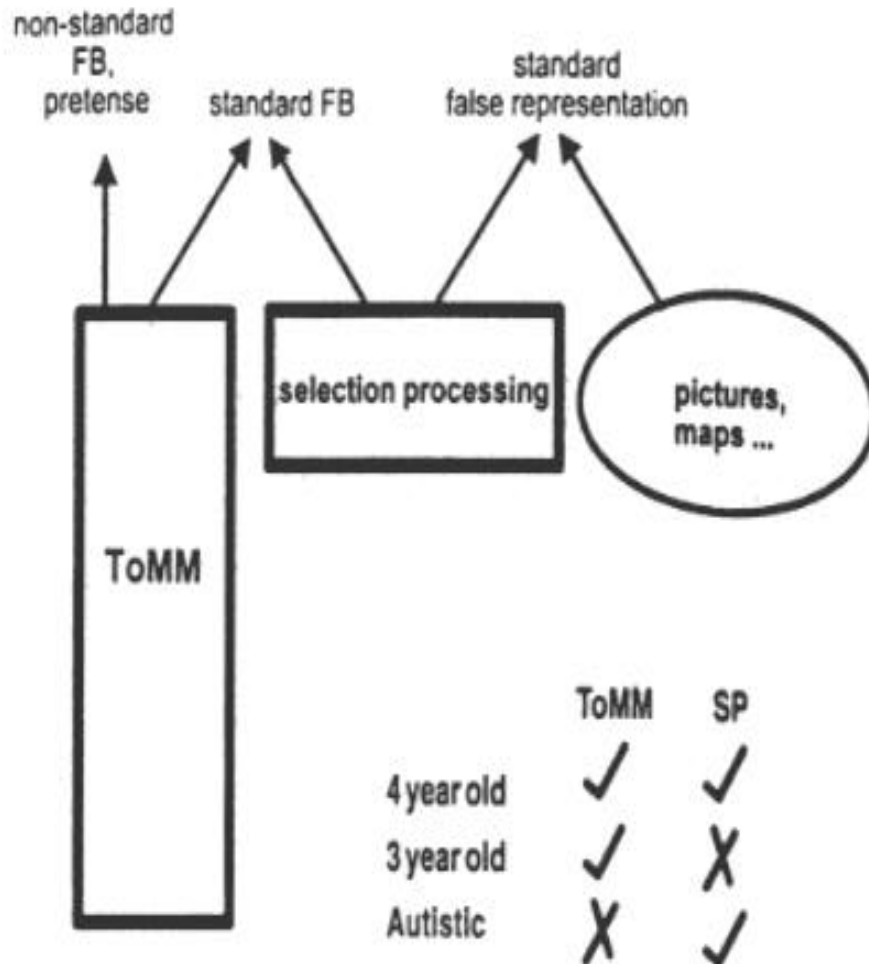


Note: Autistic children possess the general problem solving resources required by the false-belief task, but are impaired in a specific representational competence (ToMM).

Arguments:

- ✚ ToMM by default attributes a belief with a content that reflects current reality.
- ✚ To succeed in a false-belief task, this default attribution must be **INHIBITED** and an alternative non-factual content for the belief be selected. This is called Selection Processing (SP).

ToMM-SP model of “theory of mind development.



Note: Some tasks such as recognizing pretense and modified false-belief tasks, which require only ToMM, can be done by 3 yr-olds and not autistic kids.

Important findings summarized:

category	Std. False-belief task	Photograph task
Normal 4yr-olds	++	+
Non-autism, but MR (10 yrs)	+	
Autism (12 yrs)	-	++
Normal 3 yr old	-	no data; but since task needs SP -

Do autistic and normal 3 yr-olds
fail the standard false-belief task
for the same reason?

Roth and Leslie using a modified false-belief task found that

3-yr-olds can succeed in false-belief tests.

➤ Older autistic Ss did not

➤ The modified test was easier than the standard one for 3 yr-olds, but not for autistic Ss.

➤ SP demands were a limiting factor for 3 yr-olds and not autistic Ss.

So, these groups fail for different reasons.

Modifications of the standard task which help 3 yr-olds.

■ “Where will Sally *first* look for her marble?”
(problems)

■ Sally does not go away but watches Ann as she moves the marble (Sally has seen the move, Sally’s belief is true. Hence called **Standard true-belief condition**).

Responses to "Look first" Question

False Belief versus True Belief at 3 yrs 10 mths

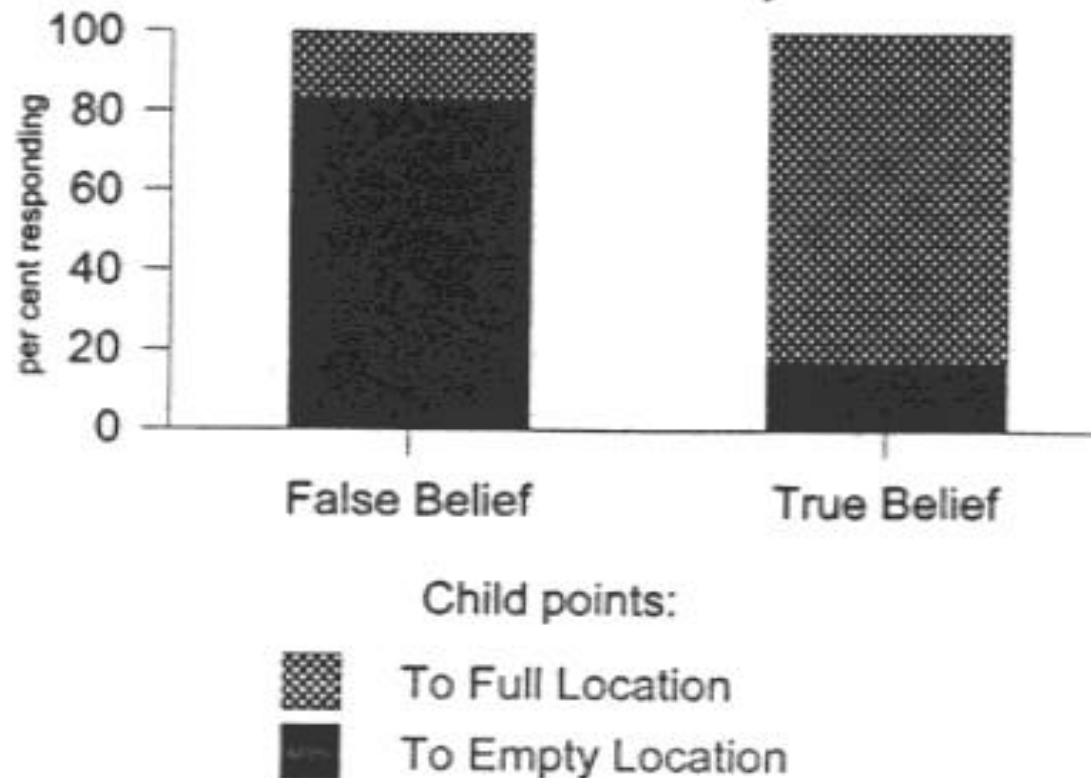


FIGURE 85.6 Three-year-old children respond correctly to a "look first" prediction question in both false-belief and true-belief tasks, although correct responses are opposite in the two tasks. The "look first" modification therefore helps 3-year-old children to calculate belief. (After Surian and Leslie, 1999.)

How does this look “first question” help?

The question increases the salience of the first location as the possible content of Sally’s belief. ✍

This salience of the non-factual content relative to the default, reduces the need for inhibition ✍

less load on SP.

Does this look first question help autistic children too?

Surian and Leslie (1999) found that they do NOT.

Conclusion: Normally developing children's performance on false-belief problems is limited by processing resources rather than by an inability to represent belief states in others. The resources become sufficient by the age of 4.

Saw earlier:

Default belief attributions have to be inhibited to solve a false-belief problem and this may be a problem for 3 yr olds!

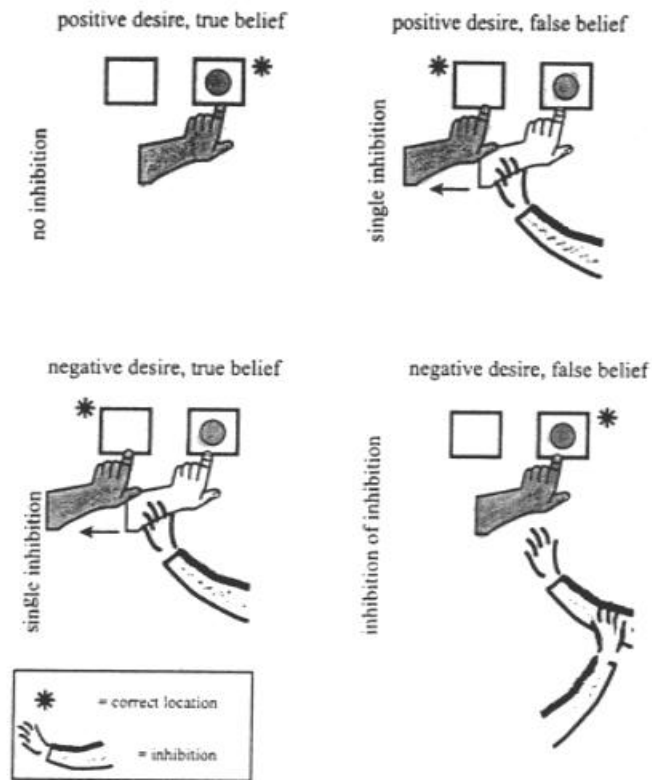
BUT,

why does belief attribution have a default bias?

Model of SP in belief-desire reasoning

Inhibitory processing in belief tasks

Inhibition of inhibition



(1,1) = Sally watches Ann move the marble. Sally wants it

(1,2) = standard false-belief task – Ann manipulates without Sally's knowledge. Sally wants it.

(2,1) = Sally watches Ann, but doesn't want the marble

(2,2) = Ann manipulates without Sally's knowledge and Sally doesn't want the marble

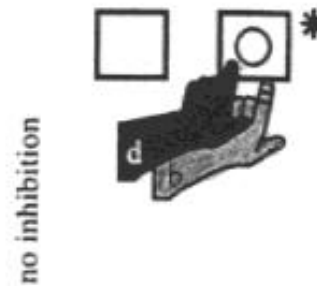
Alternate model of inhibitory processing in belief-desire reasoning

- Based on **IOR**
- **belief calculated first** and desire targets identified relative to belief.

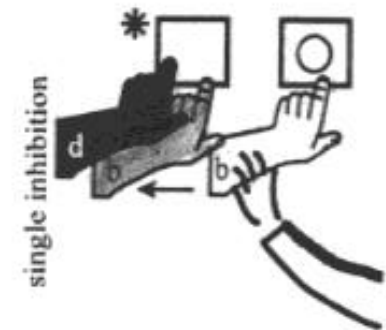
- (1,1) = Sally watches Ann move the marble. Sally wants it
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- (2,1) = Sally watches Ann, but doesn’t want the marble
- (2,2) = Ann manipulates without Sally’s knowledge and Sally doesn’t want the marble

Inhibitory processing in belief tasks:
return to inhibited target

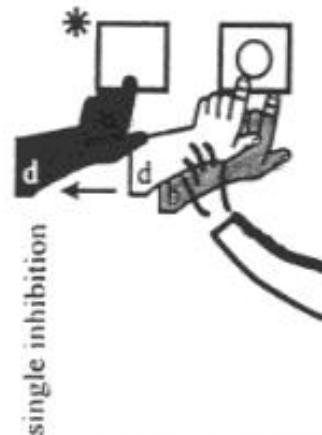
positive desire, true belief



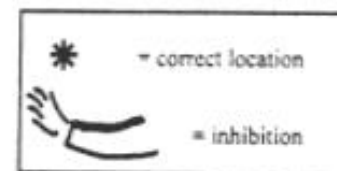
positive desire, false belief



negative desire, true belief



negative desire, false belief



Conclusion:

- Theory of mind is analyzed as a selective attention mechanism.
- Mental state concepts allow the brain to selectively attend to corresponding mental state properties and thus permit learning those properties.
- Autistic children are impaired in this mechanism.