The Role of Language in Theory of Mind

Gabriel Sevilla
Grammar & Cognition Lab
http://www.grammar.cat/
Introduction to Theory of Mind (ToM)

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Introduction
to
Theory of Mind (ToM)
1. What is ToM?

• **Definition:** Ability to attribute mental states (beliefs, intentions, desires, emotions) to oneself and others.

• **Synonyms:** Mindreading, folk psychology, mentalizing, empathy.

• **Research Domains:** Developmental psychology, comparative psychology, cognitive linguistics, clinical linguistics, philosophy of mind, etc.
1. What is ToM?

First Definition: Premack & Woodruff (1978), “Does the chimpanzee have a theory of mind?”.

“An individual has a theory of mind if he imputes mental states to himself and others. A system of inferences of this kind is properly viewed as a theory because such states are not directly observable, and the system can be used to make predictions about the behavior of others. As to the mental states the chimpanzee may infer, consider those inferred by our own species, for example, purpose or intention, as well as knowledge, belief, thinking, doubt, guessing, pretending, liking, and so forth”.
1. What is ToM?

According to Premack & Woodruff (1978), ToM is:

- **Made of:** Mental states (intentions, beliefs, doubts, etc.).

- **Measured by:** Predicting behavior.

- **Applied to:** Self + others (but measure applies to others).
1. What is ToM?

'Second' Definition: Baron-Cohen, Leslie, Frith (1985), “Does the autistic child have a 'theory of mind'?”.

- **ToM**: Imputing mental states to oneself and others (like Premack & Woodruff 1978).
- Mental states = meta-representations (Leslie 1987) = internal representations (LOT, Fodor).
- Pretend play is also meta-representation. Children from 2 years old.
2. Types of ToM: By Task

1. False Belief Attribution
2. Trait Judgements
3. Social Animations
4. Reading the Mind in the Eyes
5. Rational Actions

(Schaafsma et al. 2015)
False-Belief Attribution Tasks

False-belief attribution: Tests the ability to understand that one's own beliefs may be different from others' beliefs.

• Sally-Anne Test → Baron-Cohen, Leslie & Frith (1985).
• Unexpected Contents Task → Perner et al. (1987).
• Passed by children from 4 years old (de Villiers 2007).
Social Animation Tasks

**Social Animation**: Tests the ability to attribute intentions to physical movements of agents, whether human or not.

- Social Attribution Task (SAT): Heider & Simmel (1944).

Reading the Mind in the Eyes Tasks

1. feeling sorry
2. bored
3. interested
4. joking
2. Types of ToM: By Concept

1. Implicit vs. Explicit
2. Affective vs. Cognitive
3. First-order vs. Second-order
4. Self-oriented vs. Other-oriented
## Implicit ToM vs. Explicit ToM

<table>
<thead>
<tr>
<th>IMPLICIT</th>
<th>EXPLICIT</th>
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<tbody>
<tr>
<td>Automatic</td>
<td>Deliberative</td>
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<tr>
<td>Effortless</td>
<td>Effortful</td>
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<tr>
<td>Innate</td>
<td>Learned</td>
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<tr>
<td>Non-linguistic</td>
<td>Linguistic</td>
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Affective ToM vs. Cognitive ToM

• **Affective ToM**: Emotional “understanding” / involvement. Ex. A chimpanzee showing affection for another chimpanzee.

• **Cognitive ToM**: Perspective taking. Ex. (1) A chimpanzee understanding somebody else's visual perspective.

  Ex. (2) A human being understanding somebody else's epistemic perspective (false belief).

• Affective vs. Cognitive ToM = Affective vs. Cognitive empathy.
Affective ToM (intra-species)
Affective ToM (inter-species)
Cognitive ToM (Visual Perspective)
Cognitive ToM (Epistemic Perspective)

Sally

Sally’s basket

Anne

Anne’s box

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First- vs. Second-Order ToM

Jack: Mental state
Jill: Mindreading
Jack: Embedded mindreading (First recursion)
Self- vs. Other-oriented ToM

- **Self-oriented ToM**: Intra-personal understanding. Ex. Inner speech.

- **Other-oriented ToM**: Inter-personal understanding. Ex. Social relationships.

- Self- vs. Other-oriented ToM → ToM not always social.
3. ToM in the Brain

Meta-analyses for individual task groups

- False Belief vs. photo (n=15)
- Trait Judgments (n=15)
- Strategic Games (n=9)
- Social Animations (n=14)
- Mind in the Eyes (n=10)
- Rational Actions (n=10)

z-values (permutation-based)
3. ToM in the Brain

- Only 2 ROIs (Regions of Interest) for ToM across tasks:
  1. dmPFC : Dorsal Medial Prefrontal Cortex.
  2. TPJp : Temporo-Parietal Junction Posterior.

(Schurz et al. 2014, Schurz & Perner 2015)
3. ToM in the Brain

Connectivity based parcellations of TPJ and mPFC
3. ToM in the Brain

But “ToM Network” overlaps with other brain networks:

1. Autobiographical Memory.
2. Prospection.
4. Default Mode.

(Buckner & Carroll 2007)
3. ToM in the Brain
3. ToM in the Brain

• What does fMRI tell us about ToM?

1. As a concept, ToM needs to be fine-grained + interrelated with other cognitive categories.

2. As a technique, fMRI may not be accurate enough: EEG (brain rhythms) could contribute much.

3. Overall, it is problematic to speak of a “ToM brain network”.

Discussion

on

Theory of Mind (ToM)
4. Questions about ToM

• Methodological questions:

1. Which are the minimal units of ToM?

2. How are these units different and potentially connected?

3. Can we speak of a ToM (cognitive/neural) network?

4. How would a ToM (cognitive/neural) network be different from other networks (autobiographical memory, etc.)?
4. Questions about ToM

• Research domain questions:

1. How does ToM work in human vs. non-human cognition?
2. How does ToM work in neurotypical vs. disordered cognition?
3. How does ToM work in linguistic vs. non-linguistic cognition?

Cross-domain question: could the answer to 3 answer 1 & 2?
5. ToM & Language

- Studies correlating ToM & language:

  1. Astington & Jenkins (1999): Correlation between language & ToM in TD.

  2. Happé (1995a,b): Correlation between language & ToM in ASD.

  3. Fisher et al. (2005): Correlation between grammar & ToM in ASD.

5. ToM & Language


5. Paynter & Peterson (2010): Syntax as predictor of ToM skills in ASD.


7. Durrleman & Franck (2015): Confirm correlation between complement clauses & ToM in ASD.
5. ToM & Language

• How can ToM correlate with language?

1. ToM = explicit ToM.

2. Explicit ToM is tested through false belief (FB) tasks.

3. FB tasks require first- & second-order ToM.

4. First- & second-order ToM are most commonly represented by complement clauses with verbs of cognition.
5. ToM & Language

• Durrleman & Franck (2015) distinguish:

1. Complement clauses (CC) with verbs of perception.
   Ex. Mary *sees* that the boy is playing the piano.

2. CC with verbs of communication.
   Ex. Mary *says* that the boy is playing the piano.

3. CC with verbs of cognition.
   Ex. Mary *thinks* that the boy is playing the piano.
5. ToM & Language

- Durrleman & Franck found that children with ASD:

1. Had no problem with complementation, non-verbal FB & executive functioning.

2. Had problems with verbal FB when involving CC with verbs of communication & cognition, but not verbs of perception.

3. That points to a specific and powerful role of language in ToM.
5. ToM & Language

Nicaraguan Sign Language:

• Pyers & Senghas (2009) ran a false-belief (FB) task with Nicaraguan sign learners of first and second generation.

• Second-generation sign learners, with more developed linguistic skills, had better performance in FB tasks than first-generation sign learners.

• When first-generation sign learners interacted with second-generation members, improving their signing skills, they improved FB task performance.
6. Meta-analyses & Criticisms to ToM


5. Schaafsma et al. (2015): Deconstruction & reconstruction of ToM.
6. Meta-analyses & Criticisms to ToM

• New Approaches:


7. Conclusions

1. ToM is an umbrella term including many different kinds of cognitive abilities.

2. The concept of ToM needs to be deconstructed and reconstructed in order to avoid confusion.

3. Language may be the key in distinguishing: i) human vs. non-human ToM; ii) neurotypical vs. disordered ToM.
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