Language and the Mind
LING240
Summer Session II, 2005

Lecture #11
Theory of Mind

- Sarah thought *that Hoggle had betrayed her*.
- The embedded proposition encodes the contents of Sarah's mind.
- The 'truth value' of the embedded proposition cannot be evaluated with respect to this world. It must be evaluated with respect to Sarah's mental world.
- What if a child didn't know this?

If you can correctly evaluate the truth of sentences like these, what do you know?

- Syntactic Knowledge: you know that some verbs can take sentential complements
- Social Cognitive Knowledge: you know that other people can have a false belief
- Bridge: you know that there is a connection between this syntactic form and the expression of potentially false beliefs

How is this knowledge acquired?
Possibility #1: Concepts Before Knowledge

- Usual direction of effect between the developmentof concepts and the language that encodes them is that the concept develops before the corresponding terms

- Syntactic Knowledge: you know that some verbs can take sentential complements
- Social Cognitive Knowledge: you know that other people can have a false belief
- Bridge: you know that there is a connection between this syntactic form and the expression of potentially false beliefs

How is this knowledge acquired?
Possibility #2: Language Before Concepts

- The ability to represent and explain the beliefs,desires, intentions, etc. of others may rely on the ability to represent the syntax of complement clauses.

- Syntactic Knowledge: you know that some verbs can take sentential complements
- Social Cognitive Knowledge: you know that other people can have a false belief
- Bridge: you know that there is a connection between this syntactic form and the expression of potentially false beliefs

Neo-Whorfian: Language as Toolkit

- Language does not simply allow us to communicate complex and novel ideas
- Language allows us to represent complex and novel ideas, i.e., language as an enabler for thought

A Leeetle Problem…

How do you measure children's understanding that other people can have false beliefs?

(abstracted away from their linguistic ability to represent false beliefs)

False Belief Task

- The child is introduced to two puppets, Sir Didymus and Ambrosius. While playing, Sir Didymus puts a marble into a basket and then goes outside (the puppet disappears under the table, for example). When Sir Didymus is not around, naughty Ambrosius changes the location of the marble. He takes it out of the basket and puts it in a box. Some time later Sir Didymus comes back and wants to play with his marble. Children are then asked the critical question:Where will Sir Didymus look for his marble?

- 3-year olds typically fail
- 4-5 year olds typically succeed
- Key problem in autism

If we're looking for a language connection…

- At what age do children start talking about thoughts/beliefs?
- At what age do children first begin to use sentential complements?

Early Language Lacks Mental Verbs

- 2-year olds
  - Talk a lot!
  - ... about what they did, what they want
  - ... about what other do
  - ... possibly about what others say
  - not about what others think

Early Language Development: Understanding Sentential Complements of Communication Verbs

- "Sir Didymus said he bought peaches. But look! He really bought oranges."
- "What did Sir Didymus say he bought?"
- 3-year olds: oranges
- 4-year olds: peaches

Appearance of *Mental* Verbs

The appearance of mental verbs like *think & know* is early (3 years) but often commonly used phrases (easily memorized)

(ex: "I don't know" or "I think I can".)

There are sporadic *real* uses.

The breakthrough

- At around four years of age, children understand that mental verbs can take a whole sentence in their scope (a complement)

ex: Sir Didymus thought that the shampoo was the toothpaste.

- And the embedded sentence can be FALSE from the child's Point of View, but TRUE for Sir Didymus.
- Once the child has this capacity, he can represent two worlds: his own, and someone else's mental world.

The Connection

- Use of mental verbs with sentential complements occurs at roughly the same time that children are able to pass false belief tasks.
- But does using mental verbs a results of understanding the concept OR does understanding the concept a result of using mental verbs?

A longitudinal study with typically developing children

- De Villiers & Pyers, 2002
- Main research question: Does the emergence of false-belief understanding depend on the child's mastery of the grammar (syntax and semantics) of sentential complements?
- 28 children, age 3–5 tested 4 times each over the course of 1 year
- Test battery included a variety of language tests and a variety of false belief tasks questions

False-belief tasks: Unexpected Contents Task

- Child is given a familiar container (band-aid box, playdoh box)
- Child opens container and finds something unexpected
- False belief question: Child is told that a classmate (Sarah) will be brought in, and is asked "What will Sarah think is in the box?"
- Control question: Child is asked "Before, when you were sitting over there, what did you think was in the box?
- 3-year-olds typically answer incorrectly to BOTH questions

False-belief tasks: Unseen Displacement

- **Story**: This boy Bobby and his daddy bought a nice cake for after dinner. But Bobby wanted to go out to play so he put the cake away until after dinner. He put it in this cupboard for later. Then he went out to play. Then the daddy thought, "Oh no, the frosting on the cake might melt!" So he took the cake out of the cupboard and put it in the refrigerator so the frosting wouldn't melt. Then he went out to get some tomatoes for dinner.
- **Memory check questions**: Where did Bobby put the cake? Where is it now?
- **False-belief question (prediction):** Now Bobby is tired of playing and he's coming home. He remembers where he put the cake. When he comes in the kitchen, where will Bobby first look for the cake?
- **Explanation question (justified prediction):** Why will he look there?

False-belief tasks: Explanation of Action

- **Setup**: Child is shown a puppet which is then put to sleep out of sight. While puppet is sleeping, the child is shown a familiar box (e.g. egg carton), and the contents are removed and hidden in a neutral box. Puppet is then brought back. Child is then told that the puppet likes to eat eggs when he wakes up. The puppet then picks up the egg carton and tries to get it open.
- **False-belief Question 1**: Why is he looking in there?
- **False-belief Question 2**: Why isn't he looking in the other box?

Language tasks:
Memory for complements in described mistakes

- **Method**: Child views pictures of stories in which a character is described as making a mistake, telling a lie, or having a false belief. Child has to report the content of the mistake. Both mental state and communication verbs used.
- **Example 1**: He thought he found his ring (second picture), but it was really a bottle cap. What did he think? (pointing back to the first picture)
- **Example 2**: She said she found a monster under her chair, but (second picture) it was really the neighbor's dog. What did she say? (pointing back to first picture)
- **Important**: This task does not require the child to "read" the character's state of mind, but merely to represent it by holding the sentence in mind and then repeating the relevant part back.

Language Tasks: Spontaneous Speech

- Collected while children talked during the test sessions, playedc omputer games with the experimenters, and after watching silent videos
- Analyze for BROAD measures of language development
  - –Mean length of utterance (MLU)
  - –IPSYN: total score (test indicating the range and complexity of grammatical forms used)
  - –Just the score for sentence types (of any kind)
  - –Just the score for complex sentences (of any kind)
  - –Complex sentence score MINUS sentence complement score
- Analyze for TARGETED measures of language development
  - **–The total score for just sentence complements**

Language Tasks:
Medial Answers to Wh-Questions

- **Story**: This little girl went shopping one afternoon but she was very late going home. She went a short way home over a fence but she ripped her dress on the wire. That night when she was in bed she told her mom, "Look, I ripped my dress this afternoon!"
- **Question**: When did the girl say what she ripped?
- **Right answer**: The answer to the short distance question (When did she say it?)
- **Wrong answer**: The answer to the long distance question (When did she rip it?)
- **Medial answer**: (What did she rip?)

Correlations of language measures with false-belief measures (Round 2)

	Prediction	Justified Prediction	Unexpected Contents	Explanation of Action
Memory for Complements/ mental	**.419 ($P < .03$)**	**.418 ($P < .03$)**	**.548 ($P < .003$)**	**.391 ($P < .04$)**
Memory for Complements/ communication	.366 ($P < .06$)	**.484 ($P < .01$)**	**.420 ($P < .03$)**	**.433 ($P < .02$)**
IPSYN comps	.232 (ns)	**.417 ($P < .03$)**	**.394 ($P < .04$)**	**.512 ($P < .005$)**
Correct wh-questions	.238 (ns)	.260 (ns)	.224 (ns)	.096 (ns)
IPSYN complex	.101 (ns)	.356 (ns)	.349 (ns)	.315 (ns)
IPSYN SS	.226 (ns)	**.457 ($P < .02$)**	.160 (ns)	.321 (ns)
IPSYN no comps	.190 (ns)	**.402 ($P < .05$)**	.059 (ns)	.210 (ns)
IPSYN general	.153 (ns)	.237 (ns)	.142 (ns)	.143 (ns)
MLU	.182 (ns)	**.419 ($P < .03$)**	.326 (ns)	.046 (ns)

Sentential Complement Language Measures

Correlations of language measures with false-belief measures (Round 2)

	Prediction	Justified Prediction	Unexpected Contents	Explanation of Action
Memory for Complements/ mental	**.419 ($P < .03$)**	**.418 ($P < .03$)**	**.548 ($P < .003$)**	**.391 ($P < .04$)**
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General Language Measures

So this tells us that there's a definite connection…but which causes which?

Contingency tables of passing Memory for Sentential Complements (syntax) and False Belief (FB)

	Fail Syntax	Pass Syntax
Fail FB	1	13
Pass FB	5	10

Criteria for passing FB: 5/6 right

Criteria for passing Syntax: 10/12 right

Contingency tables of passing Memory for Sentential Complements (syntax) and False Belief (FB)

	Fail Syntax	Pass Syntax
Fail FB	1	**13**
Pass FB	5	10

Pass Syntax *before* pass False Belief.
Syntax --> False Belief Concept

Contingency tables of passing Memory for Sentential Complements (syntax) and False Belief (FB)

	Fail Syntax	Pass Syntax
Fail FB	1	13
Pass FB	**5**	10

Explaining Exceptions: "In every case, children who passed false beliefs gave us evidence that they had productive command of complementation"

Another test of correlation

- Using statistics (multiple regression), you can ask: what predicts what?
- **Statistical Question**: Do language measures (general or specific) at Round 2 predict false belief results at Round 3?
- **Answer**:
  - General language measures do not
  - IPSYN sentential complements do not
  - Wh-questions do not
  - **Memory for sentential complements does**

Important Comparison

- The converse does not hold:

  Statistical Question: Do false belief results at Round 2 predict Memory for Sentential Complements or spontaneous use of Sentential Complements (IPSYN) at Round 3?

  Answer: NO

An intriguing twist…

- The crucial component of memory for complements that makes it a significant predictor of false belief performance is the communication verbs, not the mental verbs!

So how do children learn the connection between sentential complements of verbs and the expression of potentially false beliefs?

- Difficult to observe: someone else's thoughts
- Easier to observe: what people say
  - "She said that she washed her hands"
- Children will sometimes hear sentences like this in a context where there is overt evidence to suggest that the embedded proposition is false.
- Children can use evidence from verbs like <u>say</u> to generalize to verbs like <u>think</u> and <u>believe</u>

Sarah <u>thought</u> *that Hoggle had betrayed her.*

- Syntactic Knowledge: you know that some verbs can take sentential complements
- Bridge: you know from hearing communication verbs and from observing the world while hearing them that there is a connection between this syntactic form and the expression of potentially false propositions
- Having learned this connection from communication verbs, you then generalize that since mental verbs also take sentential complements, their sentential complements must also potentially be false.
- Social Cognitive Result: Therefore you can contemplate other (mental) worlds.

Main Empirical Finding

- Mastery of sentential complement structures is the best predictor of false-belief performance, and this is NOT just a function of higher overall language ability

Conclusions

- Results do not prove, but are compatible with these claims:
- "**The child needs the full syntax of mental verbs plus sentential complements in order to represent in his own mind the belief states of other people**, not simply to encode them for reporting them in speech"
- The language paves the way for reasoning about others' mental states: False Belief understanding.
- **Language in this domain seems to drive Theory of Mind rather then vice versa**.
- Question :What predictions do these claims make?

Testing the Connection in Other Ways and in Other Populations

- What if you train children on communication verbs that take sentential complements? Do they improve on false belief tasks?
- Test development in deaf children who are language-delayed vs. not
- Test false belief understanding in non-humans

Hale & Tager-Flusburg (2003)

Subjects:

- 72 children recruited from preschools, all native speakers of English from diverse racial and socio-economic backgrounds
- 12 children were eliminated after pretests
- Remaining children were all between 36 and 58 months (3 and 4 years 8 months)

- The remaining 60 children were randomly split into three groups
  - False Belief Group (FB)
  - Sentential Complements Group (SC)
  - Relative Clauses Group (RC)
- Children attended two training sessions within one week of each other with four trials at each session

False Belief Group (FB)

- In each trial, an experimenter enacted a location change story
- Children were asked to predict where the main character would look for the object
- Incorrect responses were given corrective feedback and a re-enactment
- Correct responses were confirmed

(Note: No mental state verbs were used)

Sentential Complements Group (SC)

- In each trial, children were told a story where a boy did some action to a Sesame Street character and said that he did it to another
- Children were asked what the boy said
- Incorrect responses were given corrective feedback and a re-enactment
- Correct responses were confirmed

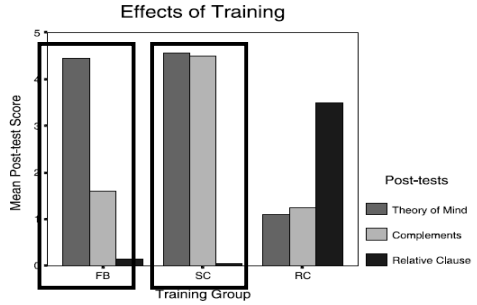
Relative Clauses Group (RC)

- In each trial, a scene was acted out with identical twins and a Sesame Street character. The character carried out differentactions to each twin.
- Children were asked which twin received a specific action - "The one that…"
- Incorrect responses were given corrective feedback and a re-enactment
- Correct responses were confirmed

Post Tests

- Children were post-tested 3-5 days after their last training session

- **Theory of Mind**
  - Children given a location change false-belief task, an unexpected contents false-belief task, and an appearance-reality task
  - Children were asked two questions about each task
  - The location change task also included a justification task which was scored separately
- **Sententical Complements**
  - Children were told 6 stories in which one character tells Mickey Mouse one thing but does something else
  - Children were asked what the character said
- **Relative Clauses**
  - Children told 6 stories accompanied by drawings where Minnie Mouse does different actions to two nearly identical objects
  - Children asked which object Minnie did one of the actions to



It really does seem that sentential complement use enables theory of mind performance

...but training in false-belief task *also* works (language use not necessary, just extraordinarily helpful)

de Villiers & de Villiers (2003): deaf children

- Subjects: 4 - 8 year olds

86 deaf children
- oral only educational settings
- hearing teachers

90 deaf children
- intensive ASL (signing) educational settings
- deaf teachers

Why deaf children?

- Comparison between groups with:
  - different time courses in language development
  - normal overall cognitive profile
    (good non-verbal IQ, social skills, hearing loss was pre-lingual)
- ASL-Deaf-of-Deaf children
  - early natural language input
  - fluent complex ASL by 4-5 years
- ASL-Deaf-of-Hearing children / oral deaf children
  - language delayed

The Study Details

Evaluated three aspects of language:
- vocabulary development
- general syntactic comprehension
- processing/production of complement clauses

Methods
- High-verbal tasks
- Low-verbal tasks
- Spoken language assessments
- ASL production assessments

High-verbal tasks

- Picture supported unseen-object-location-change stories
  Child's task: explain where/why an uninformed character would look for a moved object
- Familiar containers with unexpected contents
  Child's task: recall their own false belief as well as a friend's false belief

Low-verbal tasks

Sticker-hiding game
Child's task: decide whose advice to take, a puppet with a blindfold and a puppet without one

What face? game
Child's task: Shown pictures of something being placed in a box that is surprising. (Keys in a crayola box.) The children were supposed to pick whether there would be a surprised or unsurprised face.

Spoken language assessments

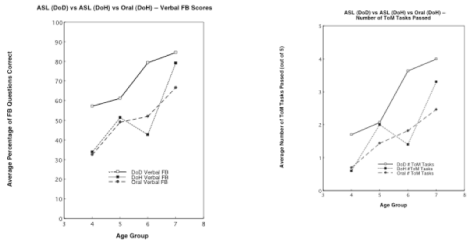
- Short videotape clips
  Child's task: describe character's actions and motivations (points given based on sophistication of answer)
- Silent videotaped cartoons
  Child's task: repeat what a character thought/said in the video

ASL production assessments

- Short videotape clips
  Child's task: produce ASL sentences relating to the characters involved (points given based on sophistication of answer)

Results

Figure 2. Comparison on various measures of ToM reasoning between three groups of deaf children varying in language background.
(from de Villiers, de Villiers, Schick & Hoffmeister, 2001).



Summary

- Oral deaf children with normal IQ, and active social intelligence are significantly delayed in both standard verbal false belief tasks and verbal theory of mind tasks.
- Performance on both verbal and non-verbal tasks are delayed to the same degree.
- Both verbal false belief reasoning and non-verbal theory of mind reasoning in deaf children are best predicted by sentential complement production with verbs of communication or mental state, not just by general language ability.

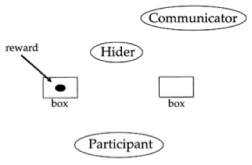
What about non-humans? Call & Tomasello (1999)

- "A Non-Verbal False Belief Task: The Performance of Children and Great Apes"



How do you do a test for children & apes?

- Variation of traditional hiding/finding game
- Main Test:
  Communicator watches the Hider hide a reward in one of two containers and then leaves the room. The Hider switches the containers. The communicator returns and indicates which container has the reward. Participants are asked to locate the reward.



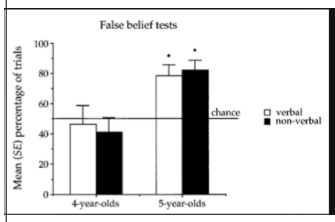
- Note: Many more trials with apes than with children

Control Tests

Check competency in skills needed to successfully perform the task
(other than understanding of false belief)

- **Understanding of Indication Method-** Behind barrier, Communicator watches Hider place reward in bucket. Communicator indicates bucket to participants
- **Visible Displacement** - Communicator indicates reward's location. Hider opens the container and moves the reward.
- **Invisible Displacement** – Same as visible but containers are switched and participants do not see the object
- **Ignoring Communicator** - Hider hides reward. Communicator leaves. Hider switches buckets. Communicator returns and indicates bucket with reward (the wrong container)
- At the end of each test, participants are asked to choose the bucket containing the reward

Results with Children



Consequences-validates nonverbal task as indicator of understanding of false belief

Results with Apes

Chimps notably perform BELOW chance

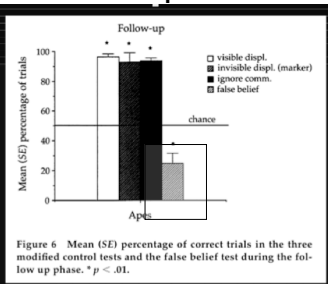


Figure 6 Mean (*SE*) percentage of correct trials in the three modified control tests and the false belief test during the follow up phase. * $p < .01$.

Apes can't do it, even when you do everything to give them a fair chance…

So sentential complements are extraordinarily helpful…but are they the only thing?

ELSEVIER
Cognitive Development 17 (2002) 1451–1472
COGNITIVE DEVELOPMENT

Theory of mind finds its Piagetian *perspective*: why alternative naming comes with understanding belief

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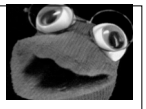
Name/Name (Synonym)
Man/Guy

Name/Name (Category)
Owl/Animal

Color/Name
White/Owl

Color/Color
Blue/Yellow

"Say something different" Task



- Make sure children know critical words (man, guy)
- Production Task: Puppet gives one word for a picture (guy), child must tell the puppet what the other word is (man). Later, vice-versa.
- Judgment Task: Child gives one word for the picture (guy), puppet gives either the other word (man), the same word (guy), or something else (woman). Child has to say whether puppet followed the instructions

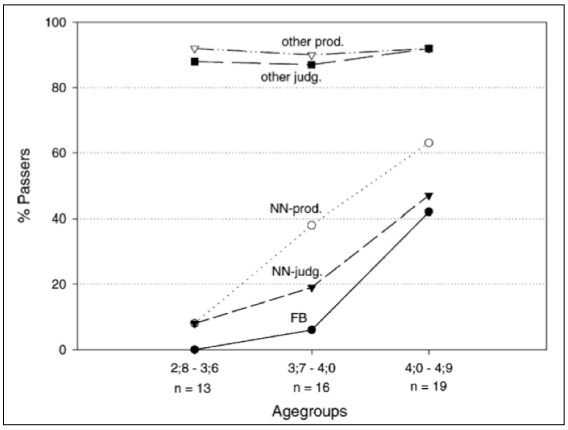


Table 1
Results from experiments by Stummer and from the experiment reported here

Tasks	Stummer (1997) (3.0–6.1, $n = 36$)	Stummer (2001) (3.4–4.9, $n = 40$)	Present experiment (2.8–4.9, $n = 2 \times 24$)	
			Production	Judgement
Correlations [with age and verbal intelligence partialled out]				
FB × synonyms	.64** [.45**]	–	.66** [.62**]	.72** [.72**]
FB × categories	.59** [.42*]	.77** [.65**]	.53** [.25]	.60** [.32]
FB × colour/name	.38* [.32]	.37* [.20]	.13 [−.10]	.17 [−.22]
FB × part/name	–	–	.11 [.27]	.15 [.24]
FB × colour/colour	–	–	.17 [.19]	.17 [−.08]
FB × part/part	–	–	.15 [.18]	.15 [.32]

Summary of Findings

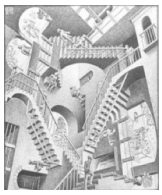
- Ability to simultaneously consider multiple names for a single object is strongly correlated with performance on False Belief tasks while FB performance is not correlated with the ability to simultaneously consider multiple colors of an object, or to simultaneously consider a color and a name of an object

Neo-Whorfian: Language as Toolkit

- Extraordinarily helpful but not necessarily critical features for Theory of Mind Understanding:
  - Sentential Complements
  - Alternative Names for Objects

What does the ability to produce sentential complements have in common with the ability to do the name-name task?

Both require the use to represent an object or event from multiple perspectives simulateously



But don't kids learn synonyms before age 4?

- **Switch perspectives**: Take different perspectives at different times
- **Confront perspectives**: Represent two perspectives simultaneously

Cognitive Determinism

- "Our claim is that the ability to confront different perspectives emerges around 4 years and underlies the co-emergence of success on the False Belief and the Name-Name tasks" - Perner, Stummer, Sprung, & Doherty (2002)