Understanding *desire* and *belief* reports

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3/16/12

*University of British Columbia Colloquium*
Early understanding of attitude verbs

How do children represent the meaning of attitude verbs?
Early understanding of attitude verbs

Puzzle 1: Young children seem to consistently misinterpret *think* sentences.
Early understanding of attitude verbs

- Boots is really under the bed.
- Swiper thinks he’s behind the door.

(1) Swiper *thinks* that Boots is behind the door.
   - Adults and 5-year-old children: True
   - 3-year-old kids: False
Early understanding of attitude verbs

Puzzle 1:

• Why do young children consistently respond to the truth of the complement clause with a verb like *think*?

• Is the difficulty *conceptual* or *linguistic* in nature?
Early understanding of attitude verbs

Puzzle 2:

Young children do not seem to have the same difficulties with want sentences.

They understand that (2) can be true in situations where Boots is not behind the door:

(2) Swiper wants Boots to hide behind the door.
Early understanding of attitude verbs

Puzzle 2: Why is there a difference in the acquisition of verbs like *think* and verbs like *want*?

*Is the asymmetry *conceptual* or *linguistic* in nature?*
The Conceptual Development Theory

Children’s initial difficulty with verbs like *think* is conceptual:

• Young children lack the ability to attribute (false) beliefs to others until a fundamental change in their *theory of mind* around age 4.

• **Evidence:** 3-year-olds consistently fail ‘False Belief’ tasks.
False Belief Understanding

Change of Location Task
(Wimmer & Perner 1983)

- Where will Sally look for her ball?
  - Adults and 5-year-olds: *in the basket*
  - 3-year-olds: *in the box*

Baron-Cohen, Leslie & Frith (1986)
The Conceptual Development Theory

• If children are unable to attribute (false) beliefs to others, then it’s not surprising they should have difficulties with verbs expressing such beliefs:

(3) Sally thinks that the ball is in the basket

• Answer to puzzle 1:
  young children’s difficulty with think due to difficulty attributing (false) beliefs to others.
The Conceptual Development Theory

• While children struggle with the concept of BELIEF well into their 5\textsuperscript{th} year, the concept of DESIRE develops much earlier.

• **Answer to puzzle 2:**
  If linguistic development tracks conceptual development, we expect the \textit{want}>\textit{think} asymmetry.
The Conceptual Development Theory

• Development of linguistic understanding derives from changes in conceptual resources.

• As new conceptual resources become available, they can be utilized for representing the relevant verb meanings:
  
  – **think** awaits False Belief understanding (≈Age 4)
  – **want** > **think**
Problems with the Conceptual Development Theory

– 15-month olds can pass non-verbal FB tasks.

suggesting that children have false belief understanding very early on.
(If so, errors with think can’t be blamed on conceptual immaturity)

Onishi&Baillargeon 2005, Song, et al. 2008, Southgate et al. 2011, Kovacs et al. 2010...
Non-verbal False Belief Tasks

- 15-month-olds
- Looking time indicates surprisal when actor’s reach is incompatible with what her belief should be

Onishi & Baillargeon 2005
Problems with the Conceptual Development Theory

– Success at traditional FB tasks follows mastering attitude verbs’ sentential complements

De Villiers’ Linguistic Determinism: Mastering attitude verbs’ sentential complementation is prerequisite for being able to reason about false beliefs.
Attitude Verbs before False Belief

• Longitudinal study of 3-5 year olds over 1 year period

**Complement Comprehension Task:**

The mom said that she bought apples. But look! She really bought oranges!

*What did the mom say she bought?*

- **3-year olds:** oranges
- **5-year olds:** apples

• Children generally succeed on FB tasks only *after* succeeding on Complement Comprehension Task

de Villiers & Pyers (2002)
Problems with the Conceptual Development Theory

– Training on sentential complementation improves performance on FB tasks
Training on comprehension of complements of attitude verbs, but not relative clauses, improved performance on FB tasks.

Hale & Tager-Flusberg (2003)
Problems with the Conceptual Development Theory

So when *do* children have False Belief understanding?

– **Non verbal tasks**: by 7 months.
– **Sally-Anne task**: around age 4.
Problems with the Conceptual Development Theory

So when *do* children have False Belief understanding?

- Maybe non verbal tasks don’t quite test FB.
Problems with the Conceptual Development Theory

So when do children have False Belief understanding?

Or:

• Maybe difficulty with Sally-Anne task not conceptual, but due to excessive task demands: linguistic, computational, executive functions, e.g., inhibiting own knowledge...

• And maybe mastering attitude verbs play facilitative role in passing Sally-Anne FB tasks.
Problems with the Conceptual Development Theory

Both the infant results, and the attitude/FB task correlation cast doubt on the hypothesis that the acquisition of attitude verbs awaits development of the concepts these verbs express.
Linguistic Account

If children already have the *BELIEF* concept, why do they have difficulties with verbs like *think*? And why not with verbs like *want*?

**Goal:** provide an alternative account for our two puzzles that doesn’t rely on conceptual development.
Linguistic Account: *think*

**Puzzle 1:** Why do children consistently respond to the truth of the complement clause with *think*?
Linguistic Account: *think*

Even adults sometimes respond to the truth of the complement clause.

A: Why is John not coming to our meetings?  
B: Mary thinks that he’s in Miami.  
C: Nuh-huh. He’s in Boston.

C is not denying that Mary is in a particular belief state, but is denying the proposition expressed by the *complement clause*. 
Linguistic Account: *think*

This happens because in B’s utterance, *think* receives a *parenthetical* interpretation: (Urmson 1952, Hooper 1975, Rooryck 2001...)

B: (Mary thinks that) John is in Miami

- The embedded clause is the ‘**main point**’ of B’s utterance (Simons 2007).
- The main clause serves an *evidential* function (Rooryck 2001, Simons 2007)
Linguistic Account: \textit{think}

(Mary thinks that) John is in Miami

\textit{“Assertion”}: ‘John is in Miami’

\textit{Source of evidence}: Mary’s belief

\textit{Quechua reportative evidential} -si (Faller 2002)

(4) Marya-qa yachay wasi-pi-s ka-sha-n
Marya-top know house-loc-\textit{report} be-prog-3

\textit{“Assertion”}: ‘Marya is at school’

\textit{Source of evidence}: hearsay
Linguistic Account: *think*

*How do parenthetical interpretations arise?*

**Parenthetical syntax:**

(5) John is in Miami, I think. (*preposing*)
(6) John, I think, is in Miami. (*slifting*)

But parenthetical interpretations arise even without parenthetical syntax.
Linguistic Account: *think*

Pragmatic account for parenthetical interpretation:
(Simons 2007)

**A:** Why is John not coming to our meetings?

**B:** Mary thinks that he’s in Miami.

B’s answer doesn’t directly answer A’s question.
Reasoning that B is cooperative, B’s addressee searches for an answer that does, and finds it in complement clause.

(Further inference from the fact B didn’t use complement clause directly that B doesn’t fully endorse it).
Linguistic Account: \textit{think}

Back to our question:

A: Where is Boots?
B: (Swiper thinks that) Boots is under the bed.

If B’s utterance is a response to the question \textit{Where is Boots?}, it’s easy to get a parenthetical interpretation.
Linguistic Account: *think*

Even if this question is not explicit, it can be implicitly set up by the context...
Linguistic Account: *think*

Common assumption in theories of communication: every assertion is understood as an answer to a question: the **Question under Discussion (QuD)** (Roberts 1996)

**QuD:** Where is Boots?

**Target:** (Swiper thinks that) Boots is under the bed.

If the QuD is *where is Boots*? we expect parenthetical interpretations for target sentence.
Linguistic Account: *think*

*Parenthetical hypothesis:*
Children overgenerate parenthetical interpretations, where adults get regular interpretations.
Linguistic Account: *think*

Evidence from Production data:
Children’s first uses of attitude verbs are formulaic, and serve discourse functions.

Schatz et al 1983, Diessel&Tomassello 2001
Linguistic Account: *think*

Parenthetical hypothesis (Option 1):

- Children only have access to parenthetical interpretations. They start out with **non adult semantics** for *think* as evidentials/discourse markers.

- Why? Maybe because they don’t have the conceptual resources for the real thing (ToM)

Linguistic Account: *think*

Parenthetical hypothesis (Option 2):

- Children have access to both interpretations: they start out with **adult-like semantics** for *think*.

- But: **pragmatic difficulty** accommodating a different QuD (or realizing that a mental state makes a good QuD).
Linguistic Account: *think*

Preliminary support for Hypothesis 2:

• Corpus data: Utterance by a 3-year-old (Schatz et al 1983):

(7) Before I thought this was a crocodile. Now I know it’s an alligator.
Linguistic Account: *think*

**Preliminary support for Hypothesis 2:**

Independent evidence for QuD affecting children’s semantic behavior with quantifier scope:

 Children have difficulty with *inverse scope*:

(8) John didn’t loose some pizzas.

  Adults:  *some* ⇒ *not*  
  4 year olds:  *not* ⇒ *some*  

Default preference for surface scope.

Musolino&Lidz 2006; Gualmini et al 2007; Viau et al 2010
Linguistic Account: *think*

**Preliminary support for Hypothesis 2:**

This difficulty with *inverse scope* disappears when target sentence with inverse scope addresses QuD *directly.*

(8) John didn’t loose some pizzas. *some>*not
(9) John didn’t deliver some pizzas. *vsome>*not

**QuD:** *Did John deliver all the pizzas?*

Gualmini et al 2007
Linguistic Account: *think*

Prediction Hypothesis 2:

We should be able to improve children’s performance on *think* sentences by contextual manipulation.
Experiments 1 & 2

• Manipulation to test whether we can improve children’s performance: 1 (Exp. 1) vs. 2 seekers (Exp. 2) in a hide/seek game.

• 2 seekers with conflicting beliefs about the same situation, to maximize relevance of belief.

Lewis, et al., in progress.
Experiments 1 & 2: Design

Truth value judgment task

Factors:

- **Verb**: say vs. think vs. according to
  
  (between subjects)

- **Child knowledge**: ignorance vs. knowledge

- **Target response**: True vs. false

- **Age**: 3, 4, 5 years
Swiper thinks that Boots is under the bed.
Swiper said that Boots is under the bed.
According to Swiper, Boots in under the bed.
1 seeker experiment: Predictions

• Predicate type:
  – replicate previous result from literature that say think?
  – Replicate previous result according to think?

• Ignorance vs. knowledge: if children’s difficulty with think is inhibiting their own knowledge, they should do better in the ignorance condition.
1 seeker experiment: Results
(4 year olds)

Accuracy by Condition

- According to (n=11)
- Say (n=12)
- Think (n=14)

Knowledge vs. Ignorance
1 seeker experiment: Results
(4 year olds)

Accuracy by Belief Type
(knowledge condition)

According to (n=11)
say (n=12)
think (n=14)
1 seeker experiment: Results

• Say>think>according to

• True Belief> False Belief

• Is ignorance bliss?

Not really. Accuracy is ~50%. If children’s difficulty with think is suppressing their own knowledge, we would have expected 100% accuracy.

If instead, children are responding to truth of embedded clause, we except guessing behavior.
2 seekers experiment: Predictions

• **If children have non adult semantics** (only access to parenthetical interpretation), we do not expect an improvement.

• **If children have adult semantics**, but overgenerate parenthetical interpretations for pragmatic reasons, having 2 seekers should improve their performance by making the belief state more relevant.
2 seekers experiment: Results

**Experiment 1:**
Accuracy by Belief Type (think)

**Experiment 2:**
Accuracy by Belief Type (think)

- Knowledge
- Ignorance

- True Belief
- False Belief
2 seekers experiment: Results

- Children’s performance improves significantly, for both FB and ignorance conditions.
- This is unexpected if children do not have access to standard use of think, or simply ignore matrix.
- But it’s consistent with the parenthetical hypothesis, where children’s difficulty is essentially pragmatic.
Linguistic Account: *think*

To sum up:
Children who seem non-adult-like *can* access regular interpretation of *think*.

This suggests:

- They may learn the right semantics from start:
  - They know that *think p* can be true when *p* is false
  - They know that *think* can have parenthetical interpretations.
- They have relevant BELIEF concept in place
Linguistic Account: *think vs. want*

Hypothesis:

- Children have the right semantics for *want* from the start.
- Because *want* cannot get parenthetical interpretations, they never make the same ‘mistakes’ with *want* as they do with *think*.

A: Where is John?

B: #Mary wants him to be in Miami.
Linguistic Account: *think* vs. *want*

Why not?

*think* = *think* but with no parenthetical interpretation
*want* = *want* but with parenthetical interpretation

• Why don’t *think* and *want* exist in natural language?

• Why don’t *think* and *want* exist in *child* language?
Why don’t think* and want* exist in natural language?

Roughly:

- Parentheticals can only occur with attitudes that express a judgment of truth.
- There are two semantic classes of attitude verbs:
  - Attitudes that express a judgment of truth (think)
  - Attitudes that express a preference for a state of affairs (want)

Linguistic Account: *think* vs. *want*

Why don’t *think* and *want* exist in *child* language?

- How do children know that *think* can have parenthetical readings but that *want* cannot?

  From their ‘meaning’?

- But the meaning is precisely what they’re trying to learn. What constrains their logical space of possibilities so that they never consider *think* or *want*?

  ...Swiper BLABLA that Boots is under the bed...
  ...Swiper BLABLA Boots to be under the bed...
Linguistic Account: *think* vs. *want*

As they’re learning the meaning of *want* and *think*, children somehow know what semantic class they belong to: *preference-based* or *judgment of truth*.

What clues them in?

...Swiper BLABLA *that* Boots *is* under the bed...
...Swiper BLABLA Boots *to be* under the bed...

Morpho-syntactic cue: finiteness?
Linguistic Account: *think* vs. *want*

– The syntactic property of *Finiteness* is relatively easy to observe, compared to the particular attitude one bears to a proposition.

– Once the syntactic properties are identified, they can provide evidence to the learner about the semantic properties (Gleitman 1990, Pinker 1989, Lidz 2006).
Syntactic cues: Issues

English-, German-, and Mandarin-, Cantonese-speaking children understand verbs of desire before verbs of belief.

- Even when there are no finiteness differences between the two classes, there is an asymmetry in acquisition.
- Perner et al: Asymmetry due to *conceptual* differences.

Perner, Sprung, Zauner & Haider 2003; Tardif & Wellman 2000
Syntactic cues: Issues

Finiteness is just one of the cues.

Several phenomena split the attitude pie in the same two halves:

- Parenthetical uses and parenthetical syntax (*slifting, preposing...*):

  (8) John is in Boston, Mary thinks.
  #John to be in Boston, Mary wants.
  #John is in Boston, Mary wants.
Syntactic cues: Issues

Finiteness is just one of the cues.

Several phenomena split the attitude pie in the same two halves:

- Mood selection in Romance

  (9) Jean veut que Marie soit en France
  Jean wants that Marie be-SUBJ in France

  (10) Jean pense que Marie est en France
  Jean wants that Marie be-IND in France
Syntactic cues: Issues

Finiteness is just one of the cues.

Several phenomena split the attitude pie in the same two halves:

- Licensing of epistemic modals

  (11) John thinks that Mary has to be the murderer. (Vepis)
  (12) John wants Mary to have to be the murderer. (*epis)

(Anand&Hacquard 2009)
Syntactic cues: Issues

Finiteness is just one of the cues.

Several phenomena split the attitude pie in the same two halves:

- Degree modification (Villalta 2000, 2008)

  (13) María desea *enormemente* que Rafael venga.
  María wants *enormously* that Rafael comes-subj

  (14) *Alberto dijo enormemente que tenía hambre.*
  Alberto says *enormously* that he is-ind hungry
**Syntactic cues: Issues**

2 classes of attitudes:

1. express a judgment of truth (*think*)
2. express a preference for state of affairs (*want*)

<table>
<thead>
<tr>
<th></th>
<th>Mood</th>
<th>Parenth.</th>
<th>Epistemics</th>
<th>Degree-mod</th>
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<td><em>Desire verbs</em></td>
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<td>No</td>
<td>Yes</td>
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<tr>
<td><em>Belief verbs</em></td>
<td>Indicative</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

Several morpho-syntactic cues could give away a verb’s semantic class.
Syntactic cues: Issues

German: \textit{V2 complementation correlates with parentheticality}

(15) Maria denkt, dass Peter heute noch kommt.

(16) Maria will, dass Peter heute noch kommt.

\textit{Maria thinks/wants that Peter today still comes}

(17) Maria denkt, Peter \textit{kommt} heute noch.

(18) *Maria will, Peter \textit{kommt} heute noch.

\textit{Maria thinks/*wants that Peter \textit{comes} today still}

Truckenbrodt (2006), Scheffler (2008)
Syntactic cues: Issues

But it remains to be determined whether children are sensitive to any of these cues when acquiring the meaning of attitude verbs...
Conclusions

We started out with 2 puzzles:

**Puzzle 1:** Why do young children consistently respond to the truth of the complement clause with a verb like *think*?

**Puzzle 2:** Why do young children not make similar mistakes with verbs like *want*?
Conclusions

**Cognitive hypothesis:**
Linguistic dev. tracks conceptual development: DESIRE>BELIEF hence *want>* *think*

**Linguistic Hypothesis:**
Children learn correct meaning of attitude verbs from the start.
Difficulties with *think* due to pragmatic difficulty figuring out proper use of parentheticals.
Conclusions

• Preliminary results support the linguistic hypothesis: children seem to have the right semantics for \textit{think} (at age 4).

• If so, then they must have the appropriate conceptual resources: one must understand \textit{(false) beliefs}, in order to understand \textit{(false) belief reports}.

• \textit{Tentatively}: children don’t have the same difficulties with \textit{want} as with \textit{think} because they know \textit{want} belongs to the semantic class of attitudes that cannot have parenthetical uses (possibly clued in by syntax).
In Progress...

Can **3-year-olds** show adult-like understanding of *think*?

[video]

Lewis et al, *in progress*
In Progress...

Do children’s adult-like responses with want truly reflect an adult semantic representation?

Harrigan et al, *in progress*
In Progress...

Which syntactic cues are relevant for determining an attitude verb’s semantic class?

White et al, in progress
In Progress...

Can children use syntactic cues to hone in on attitude verb’s semantic class?

Dudley et al, in progress
Thank you!

This material is based upon work supported by the NSF (grant # BCS-1124338), and UMD ADVANCE.

Project collaborators:
   Jeff Lidz, Shevaun Lewis, Aaron White, Kate Harrigan, Rachel Dudley, Erin Eaker, Naho Orita.

Research assistants:
   Fayna Kostyukovsky, Sam Blitzstein, Leah Whitehill, Jessica Lee.

Many thanks to:
   Tom Roeper, Jill de Villiers, Pranav Anand, Jane Grimshaw as well as audiences at UMD, UCL, Jean Nicod and Johns Hopkins.