

Bootstrapping attitudes^{*}

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Abstract This paper explores two classic problems at the semantics-pragmatics interface from a learner’s perspective. First, the meaning that speakers convey often goes beyond the literal meaning of the sentences they utter. Second, not all content encoded in utterances has equal standing: some is foregrounded, some backgrounded. Yet a sentence does not formally distinguish what a speaker asserts from what she presupposes or merely implicates. For this reason, the child acquiring a language has a daunting task. She must both extract the literal meaning from the overall message, and separate the background assumptions that are linguistically required from those that are incidental. This paper discusses the ways in which the syntax might guide the child with this daunting task, through a few case studies on children’s acquisition of attitude verbs.

Keywords: acquisition, syntactic bootstrapping, propositional attitudes, pragmatics, implicatures, presuppositions

1 Introduction

Consider how a child might learn the meaning of new words. By hearing the same word in a variety of situations, and by paying attention to what speakers are directing their attention to, the child may eventually successfully associate a word with a particular object or action. However, this strategy can’t work with all word meanings. For instance, attitude verbs, such as *think*, *want*, or *know*, express abstract mental states, which are not associated with physical correlates that the

^{*} This paper reports on the results of a joint project with Jeff Lidz on the acquisition of attitude verbs, supported by NSF grant #BCS-1124338. Many thanks to my collaborators: Jeff Lidz, Shevaun Lewis, Aaron White, Kate Harrigan, Rachel Dudley, Naho Orita, Morgan Moyer, Erin Eaker, and Meredith Rowe, and to our research assistants Sam Blitzstein, Fayna Kostyukovsky, Jessica Lee, Sara McVeigh, Susan Ojo, Anne Ramirez, Ashley Tipton, and Leah Whitehill. For useful feedback and discussion, thanks to Pranav Anand, Jane Grimshaw, John Grinstead, Chris Kennedy, Angelika Kratzer, Keir Moulton, Magda Oiry, Tom Roeper, Florian Schwarz, Jill De Villiers, and Alexander Williams, as well as audiences at UMD, UCL, Jean Nicod, UNC, UCLA, Johns Hopkins, Harvard, UMass, Rutgers, OSU and SALT 24.

learner can use. Gleitman, Cassidy, Nappa, Papafragou & Trueswell (2005) demonstrate that the meaning of such “hard words” can’t be gleaned from the situational context alone. In one study, adult subjects were shown silent videos of parent/child interactions, and had to guess what word had been uttered by the parent at particular points. Subjects were good at guessing verbs that described concrete actions like *hit*. However, they systematically failed when the verb was an attitude verb like *think*. This suggests that the situational context doesn’t carry enough information to help even adults figure out an attitude verb meaning.¹ Yet, children eventually learn these verbs. Gleitman and colleagues argue that the key to learning these “hard words” is paying attention to the syntactic environment in which they occur.

According to the syntactic bootstrapping hypothesis, children learning new words will exploit principled links that exist between a word’s meaning and its syntactic distribution to constrain their hypotheses for that word’s meaning (Landau & Gleitman 1985; Gleitman 1990; Pinker 1989 among others). For attitude meanings, one potentially telling syntactic cue is the selection of a sentential complement (see Fischer, Gleitman & Gleitman 1991; Gleitman et al. 2005, and references therein). Other syntactic properties may further help the child differentiate amongst various attitude meanings (White, Dudley, Hacquard & Lidz 2014).

This learning story assumes that the child is able to correlate syntactic distribution and semantics. However, the semantics is not what the child is directly exposed to. The kinds of meanings children hear are *speaker* meanings, not *literal* meanings: utterances are always uttered in context, and ripe with additional content that speakers convey. Children never have direct access to the semantics: at best, all they have to go by are the correlations between the syntax and the entire message that speakers convey.

This creates two ‘pragmatic’ challenges for the learner. The first challenge is how to extract *literal* meaning from *speaker* meaning. If an expression is routinely used in contexts in which speakers convey the same pragmatic enrichment, might the child lexicalize an enriched meaning? The second challenge comes from the fact that not all content that speakers convey is foregrounded. Speakers utter sentences against a host of background assumptions. How does the child separate those that are linguistically required (such as presuppositions) from those that are merely incidental?

There are of course principled links between semantics and pragmatics, as the former determine and constrain the types of enrichments and presuppositions triggered. But the semantics itself cannot be directly observed. Given that children lack direct access to it, and only ever hear speaker meanings, how do they

¹ Papafragou, Cassidy & Gleitman (2007) show that false belief scenarios help increase the salience of mental state descriptions, but that syntactic information is much more reliable.

untangle semantic and pragmatic contributions? Might they lexicalize an implicature? Might they fail to identify a presupposition trigger?

To address these questions, our research group has been investigating the acquisition of attitude verbs, as they provide a rich terrain for exploration. These verbs are acquired relatively late. They describe mental states that are not directly observable, and thus their acquisition has to rely heavily on the linguistic context. Furthermore, because attitude verbs report speech acts and mental states, they are prone to pragmatic enrichments, as they are often used for indirect speech acts. Finally, some attitude predicates, namely factives (e.g., *know*), are presupposition triggers. By looking at when and how children learn attitude meanings, we can ask what role syntax and pragmatics play in this learning process. This paper reports on our findings, as they pertain to the two pragmatic challenges. Section 2 focuses on the challenge of extracting literal meaning, by looking at the role that speaker meanings play in helping and hindering children's acquisition of the verbs *think* and *want*. Section 3 turns to the challenge of not-at-issue content, by examining children's acquisition of the factive verb *know* and its non-factive cousin, *think*.

2 Untangling speaker and literal meaning: *want* vs. *think*

2.1 *think* and *want* in child language

Children typically seem to understand *want* before *think*, and this asymmetry in acquisition appears to hold for their cross-linguistic counterparts (see for instance Perner, Sprung, Zauner & Haider 2003 for German, and Tardif & Wellman 2000 for Mandarin and Cantonese). Children do not fully master *think* until age four or five, while they appear to reach an adult-like understanding of *want* by age three.

Mistakes with *think* typically arise with sentences that report a false belief. Take the scenario in (1):

- (1) **HIDE AND SEEK SCENARIO:** Swiper is hiding behind the curtain, but his friend Dora wrongly believes that he is behind the chest.

Unlike adults, three year olds typically reject sentences like (2) in such a scenario:

- (2) Dora thinks that Swiper is behind the chest.

However, they do not seem to have the same difficulties with *want*. In a similar scenario, three year olds accept sentences like (3) (Perner et al. 2003; De Villiers 2005; Rakocky, Warneken & Tomasello 2007; Harrigan, Hacquard & Lidz 2014):

- (3) Dora wants Swiper to be behind the chest.

A standard explanation for this asymmetry ties it to conceptual development (e.g., Perner et al. 2003). According to this conceptual hypothesis, the concept of *desire* is acquired prior to the concept of *belief*, which awaits the full development of a *Theory of Mind*, around age four. Prior to this, children are said to be unable to understand that others can have beliefs different from their own, as evidenced by their consistent failure at false belief tasks, such as the “Sally and Anne” test² (Wimmer & Perner 1983; for a meta-analysis see Wellman, Cross & Watson 2001).

However, in the last decade, various infant studies have shown that false belief understanding may be in place very early on, at least when tested via implicit measures (Onishi & Baillargeon 2005; Song, Onishi, Baillargeon & Fischer 2008; Southgate, Senju, & Csibra 2007 among others). If the belief concept is in place in infancy, the difficulty with explicit false belief tasks could be due to additional task demands. Importantly for our purposes, three-year-olds’ difficulty with *think* couldn’t be conceptual.

2.2 Pragmatic hypothesis: speaker meanings and *think*

Through a series of experiments, we explore an alternative line of explanation for children’s difficulty with *think*, namely whether its source might be pragmatic (Lewis, Hacquard & Lidz 2012, 2014; Lewis 2013). Perhaps children acquire the right semantics for *think* early on, and know that people can be mistaken in their beliefs, but this knowledge is obscured by children’s difficulty understanding what *speakers* (as opposed to sentences) mean when using *think*.

Three-year-olds typically reject true sentences like (2) in scenarios where the complement clause is false, seemingly responding to the truth of the complement, rather than to the truth of the entire sentence. Interestingly, even adults sometimes respond to the truth of the complement. Consider the following dialogue (adapted from Simons 2007):

² The “Sally and Anne” test (Baron Cohen, Leslie & Frith 1985) is a modification of Wimmer & Perner 1983, which involves two characters Sally and Anne. Sally hides a toy into her basket and then leaves. While she’s gone, Anne takes the toy and moves it into her box. The child is then asked: “When Sally comes back, where will she look for her toy?” Adults and older children point to the basket, but three-year-olds point to the box. This consistent error has been interpreted as showing that young children are unable to ascribe to Sally the false belief that the toy is still in the basket.

- (4) A: Why isn't John in his office right now?
 B: Mary thinks he's out of town.
 C: No he's not, he's home.

In this dialogue, C is not denying that Mary holds a particular belief, but rather that John is out of town (the complement clause). With this denial, C is not responding to the *literal* meaning of B's utterance, but to its enriched, *speaker* meaning, which amounts to an indirect assertion of the complement clause.

How does this indirect assertion arise? The literal content of B's answer is a mere belief report, which doesn't directly address A's question. However, C assumes that B is cooperative and trying to address A's question. A natural way in which B's utterance addresses A's question is if B endorses this belief, and thus 'proffers' its content. With such "parenthetical" uses of *think* (Urmson 1952; Hooper 1975), the complement clause carries the "main point" of B's utterance (Simons 2007), which C can then respond to. The main clause gets demoted to parenthetical status, and plays an evidential function (indicating the source of evidence for the proffering).³

Adults can thus respond to the content of the complement clause in contexts in which the speaker seems to proffer it (as in (4)). We hypothesize that the reason children respond to the truth of the complement is that they tend to assume such enriched meanings, even in cases where adults do not. Thus, when they hear a sentence like (2), children assume that the speaker intends to proffer the complement clause, and they reject the sentence, if they know the complement to be false. This assumption for enriched meanings might partly be an input effect. Occurrences of *think* with such endorsement uses are common in adult speech (Diessel & Tomassello 2001), and may be reinforced by the fact that many instances of *think* in child-directed speech involve first person subjects.

Assuming that children's errors with *think* are pragmatic rather than conceptual, we predict that their performance should improve in contexts where endorsement enrichments are blocked. This is exactly what we found.

Recall our scenario in (1) where Swiper is hiding behind the curtain, but Dora thinks that he is behind the chest. In such a scenario, three-year-olds reject the sentence in (2), repeated in (5) below, while older children and adults accept it:

³ I will use the term 'speaker endorsement' in this paper for this kind of parenthetical reading. However, the term may be too strong, as the speaker may not "endorse" the complement, but merely put it on the table, without committing to its truth. Angelika Kratzer (p.c.) reports that in German, the dialogue in (4) is felicitous with reportative subjunctive in the complement clause in B's utterance, which creates a distancing effect for the speaker (i.e., lack of commitment). In this case, C can still respond to the complement clause. Even if the speaker is not committed to the truth of the complement, what matters is that a speaker can use such *think* sentences to offer the content of the complement clause for consideration, which her addressee can directly respond to. Thanks to Angelika Kratzer and Mandy Simons for discussion on this point.

(5) Dora thinks that Swiper is behind the chest.

In this context, the entire sentence is true, but the complement is false. According to the conceptual hypothesis, children reject (5) because they are unable to attribute to Dora a false belief. According to the pragmatic hypothesis, they reject (5) because they assume an enriched meaning: a proffering of the complement clause, which they know to be false.

Consider the same false belief scenario where Swiper is behind the curtain, but Dora thinks that he is behind the chest, but now with the target sentence in (6):

(6) Dora thinks that Swiper is behind the curtain.

In this scenario, (6) is false, but the complement is true. Here, the two hypotheses make different predictions. According to the conceptual hypothesis, children should *accept* (6). Given that they are unable to attribute to Dora a false belief, and that the complement is true, they should attribute to Dora the true belief that Swiper is behind the curtain. The pragmatic hypothesis, however, predicts that children should correctly *reject* (6). Indeed, if children understand the belief attribution that *think* expresses, they should reject it, regardless of the truth of the complement. There is no belief to endorse, since the belief attribution is incorrect.

Hence, the conceptual hypothesis predicts that children should reject (5) and accept (6) for the same reason: they can't ascribe to Dora a false belief, so they will reject a *think* sentence when the complement is false, but accept it when the complement is true. The pragmatic hypothesis predicts that children should reject *both* (5) and (6): (5) because of its assumed *speaker meaning*, a proffering of the complement (which is false); (6) because its *literal meaning* is already false.

In Lewis et al. 2014, we tested this contrast with three-year-olds, i.e., children at an age where they typically fail explicit false belief tasks. We found that their responses were highly influenced by the truth of the complement clause when the entire sentence was true (as in (5)): they tended to accept the sentence if the complement was true, to reject it if the complement was false, and to vary when they didn't know whether the complement was true or not. However, when the sentence was false (as in (6)), three-year-olds correctly rejected it, regardless of the truth of the complement (see the results in Figure 1). This is in line with the predictions of the pragmatic hypothesis, but not of the conceptual hypothesis.

Hence, like adults, three-year-olds reject *think* sentences when their literal meaning is false. They further reject *think* sentences when they take the speaker meaning to be false, even in cases where adults do not. We will return to this non-adult-like behavior in section 3, and ask whether it results from having lexicalized an enriched meaning for *think*, or whether it is due to a default pragmatic enrichment.

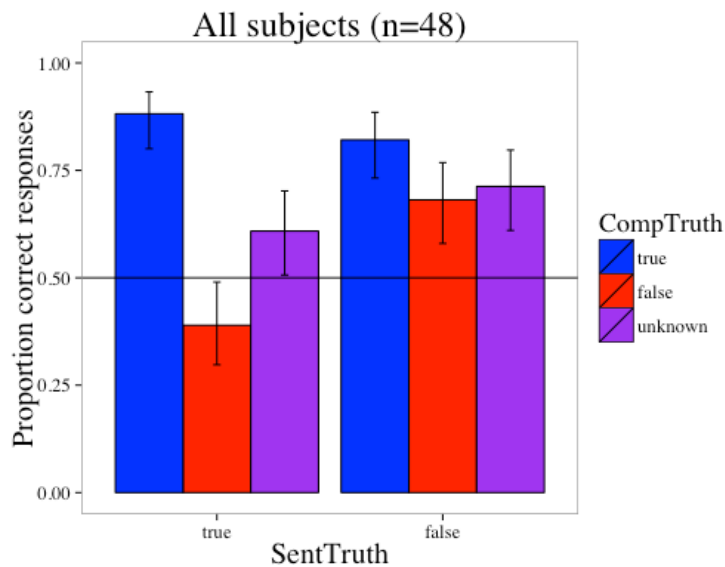


Figure 1 Three-year-olds' performance on true and false *think* sentences, with complement clauses that are true, false or unknown (from Lewis et al. 2014)

To sum up, three-year-olds appear to roughly have the right semantics for *think*. They are able to respond to literal meaning to reject a false *think* sentence. They tend to further reject sentences that are literally true, but where the speaker meaning they assume is false. We now turn to the question of why children appear to be so good with *want*, and do not seem to ever respond to the truth of its complement, as with *think*.

2.3 *think* vs. *want*: semantics, pragmatics, and syntactic bootstrapping

We have argued that what drives children to respond to the complement clause with *think* are the routine 'endorsement' enrichments that speakers implicate when using *think*. As we will see shortly, the reason why endorsement enrichments come about so easily with a verb like *think* is due to its semantics: a verb like *think* expresses a judgment of truth, which can be endorsed by the speaker. This endorsement can be indirect, as in B's utterance in the dialogue in (4), or direct, as in the following examples (see Pesetsky 1992 for the latter test):

- (7) Dora *correctly* thinks that Swiper is behind the curtain.

- (8) Dora thinks that Swiper is behind the curtain, *which is true*.

A verb like *want*, on the other hand, doesn't express a judgment of truth that can be endorsed, as the infelicity of the following counterparts to (7) and (8) illustrate:

- (9) # Dora *correctly* wants Swiper to be behind the curtain.
(10) Dora wants Swiper to be behind the curtain, #*which is true*.

Consider a variant of the dialogue in (4) in (11). Here, the natural way to make sense of B's utterance is not as an endorsement of Mary's judgment. Rather, we assume that Mary is John's boss, or some other authority figure, whose desires amount to commands:

- (11) A: Why isn't John in his office right now?
B: Mary wants him to be out of town.

Thus, while speakers often use *think* sentences to indirectly assert—or 'proffer'—the content of the complement clause, they do not typically do so with *want* sentences: *want* and *think* do not trigger the same kinds of routine pragmatic enrichments. A verb like *think* can have endorsement of truth enrichments and thus be used for indirect assertions. A verb like *want*, on the other hand, isn't typically used for indirect assertions. Instead, it may more easily be used for indirect commands:

- (13) A: Where is John?
B: Mary thinks he's in the kitchen.
Speaker meaning: He's in the kitchen. [indirect assertion]
- (12) A: Where should I put this table?
B: Mary wants it in the kitchen.
Speaker meaning: Put it in the kitchen! [indirect command]

We hypothesize that this difference in typical speaker meanings between *think* and *want* sentences drives children to treat the two verbs differently. But how does this mapping between verb and type of enrichment happen?

First, why do the semantics of *think* and *want* lead to different pragmatic enrichments? Could there be a verb (call it *thinko*), which expresses a belief like *think*, but doesn't lend itself to endorsement enrichments? Could there be a verb (call it *wanto*), which expresses a desire like *want*, but which would lend itself to endorsement enrichments? Why don't *wanto* and *thinko* exist in natural

language?⁴ Second, why don't *wanto* and *thinko* exist in child language? Why don't children ever assume endorsement enrichments with *want*? And given how good they are at accepting *want* sentences with false complements, why do they so systematically respond to the truth of the complement with *think*? How do they get to the right kinds of enrichments, when they haven't yet mastered the embedding verbs that trigger these enrichments?

2.3.1 Representational vs. non-representational attitudes

While attitude verbs come in many flavors, they seem to split into two main classes, based on their semantic and syntactic properties:⁵ those that express a judgment of truth and those that express a preference. The former corresponds to Bolinger's (1968) '*representational*s', i.e., attitudes that convey a 'mental picture' or 'representation' of the world, and Hooper's (1975) '*assertives*', i.e., attitudes that can be used to make indirect assertions:

- (14) a. **Representational attitudes:** *think, know, say, believe, argue, claim...*
 b. **Non-representational attitudes:** *want, wish, demand, order...*

Several semantic and syntactic properties differentiate these two classes, perhaps most famously mood selection in Romance: representational attitudes take indicative complements; non-representational take subjunctive complements (Bolinger 1968; Hooper 1975; Farkas 1985; Giannakidou 1997; Villalta 2008 among others). Furthermore, and as illustrated in the previous section, only representational can have parenthetical uses that allow them to make indirect assertions (Hooper 1975). These parenthetical uses are sometimes accompanied by parenthetical syntax, such as 'slifting' (Ross 1973), or complement preposing (Bolinger 1968; Hooper & Thompson 1973):

- (15) a. John, I think, is home.
 b. # John, I want, is home.

⁴ *Hope* may be a good candidate for *wanto*. Like *want*, it expresses a preference. However, it also expresses doxastic possibility (Portner 1992), and can be used to proffer that the complement clause is a live possibility (Truckenbrodt 2006; Scheffler 2008; Anand & Hacquard 2013):

- (i) A: Where is John?
 B: I hope that he's here/I think that he's here/??I want him to be here.

As for its acquisition, Harrigan, Hacquard & Lidz (*in progress*) find that children are prone to the same errors with *hope* as with *think*, when it takes a finite complement, but respond to *hope* in a more adult-like way, as with *want*, when it takes an infinitival complement.

⁵ We focus here on attitude predicates that select for a sentential complement.

These kinds of differences have led some to propose that while representationalals involve a standard, representational, Hintikkan semantics, non-representationalals are instead inherently comparative, and combine with their complements using a logic of preference (Bolinger 1968; Stalnaker 1984; Heim 1992; Farkas 1985; Villalta 2008; Anand & Hacquard 2013 among others).

There thus seems to be a principled connection between the semantics of various attitude predicates and the types of pragmatic enrichments that they typically trigger. Representational attitudes (like *think*) express a judgment of truth, which can be endorsed by the speaker, resulting in an indirect assertion. Non-representational attitudes express preferences rather than judgments of truth, and thus they don't trigger the same kinds of endorsement of truth enrichments.

Given this principled and systematic connection between attitude meaning and pragmatic enrichment, the learner could in principle reconstruct the underlying semantics from the type of enrichment. But this requires that they have access to the enriched meaning. As discussed in the introduction, because attitude sentences describe mental states that are not observable, the intended meaning can't be gleaned from the situational context alone, and thus the child will need to rely on the syntax for cues. This is, of course, assuming that there is a principled mapping between syntactic distribution and meaning.

We have just seen that certain syntactic properties correlate with the representational/non-representational split, for instance, mood selection in Romance. However, English doesn't have a productive mood distinction that correlates with representationality, and yet English-speaking children differentiate *want* and *think* sentences very early on, as evidenced by the type of errors they make with the latter, but not the former. What's worse, a language like German has a productive use of subjunctive mood in complements of attitude verbs, but it tracks reported speech, as opposed to the representationality split. If there are no universal syntactic reflexes of representationality, and in particular, the *think/want* distinction, how useful can the syntax be in helping the child pick up the meaning of these verbs?

2.3.2 *think* vs. *want*: syntactic bootstrapping

We have seen that *think* and *want* belong to two different semantic classes that lead to different enrichments. Children seem to be tripped up by endorsement enrichments with *think* sentences, given their tendency to respond to the truth of the complement clause. They, however, do not make the same mistakes with *want* sentences, as they never respond to the truth of the complement. Why not? How do they know that *want* doesn't trigger endorsement uses? And why do they so systematically assume that *think* does? It can't be from the meaning of these

verbs, since that's precisely what they are trying to learn. So what gives away *want*'s and *think*'s semantic classes?

Going back to English, the syntactic form of the complements of these verbs seems to provide a rather robust cue: *think* obligatorily takes a finite complement, *want* can only take a non-finite complement:

- (16) Mary thinks that Peter is coming today.
 (17) Mary wants Peter to come today.

If there is a principled link between finiteness of the complement and representationality that learners have access to, it should help them differentiate between these two verbs. However, not all languages show the same finiteness distinction. In German, for instance, both *want* and *think* can take a finite complement:

- (18) Maria denkt, dass Peter heute kommt.
 Maria thinks that Peter today comes
 'Mary thinks that Peter is coming today.'
 (19) Maria will, dass Peter heute kommt.
 Maria wants that Peter today comes
 'Mary wants Peter to come today.'

And yet, children learning German show the same successes and failures with *think* and *want* as their English-speaking counterparts (Perner et al. 2003). This, in fact, is what led Perner et al. to conclude that the asymmetry in acquisition between the two verbs must reflect a conceptual, rather than a linguistic problem, since it seems to be insensitive to language-specific differences. Given the different cross-linguistic selectional profiles of attitude verbs, how does the learner know what to look for in the syntactic input, to narrow down the semantic class that each verb belongs to?

We have seen different reflexes of the representational/preferential split across different languages: e.g., slifting and finiteness of the complement in English, mood of the complement in Romance. While German doesn't exploit finiteness and mood in the same way, it still exhibits syntactic reflexes of representationality. As in English, only representational attitudes allow slifting and complement preposing. Furthermore, representationals optionally allow complements with verb second word order, whereas non-representationals only allow complements with the verb in final position, as was the case in (18) and (19) (Truckenbrodt 2006):

- (20) Maria denkt, Peter kommt heute.
Maria thinks Peter comes today
'Mary thinks that Peter is coming today.'
- (21) * Maria will, Peter kommt heute.
Maria wants Peter comes today
'Mary wants Peter to come today.'

Languages thus seem to syntactically mark the same split, but with different syntactic reflexes. For a syntactic bootstrapping account to get off the ground, there needs to be a way for the child to figure out these language-specific mappings, without having to hardcode them (as children do not know whether they are learning French, English, or any other language). A syntactic bootstrapping account then needs to be abstract enough to be universal, and thus useful for *any* child learning any language. However, a syntactic bootstrapping account will only be useful if it can still lead to language-specific mappings, despite this universality.

Interestingly, while the syntactic reflexes of representationality differ across languages, they all converge in maintaining a distinction in whether the attitude verb allows “main clause syntax” in its complement (Dayal & Grimshaw 2009). Representational attitudes like *think* all allow complement clauses that syntactically resemble (declarative) main clauses, but non-representational attitudes do not. In Romance, representationals take indicative mood, i.e., the mood of declarative main clauses, but non-representationals cannot. In English, representationals take finite complements, just like declarative main clauses, but non-representationals cannot. In German, representationals allow verb second word order, i.e., the word order of declarative main clauses, but non-representationals cannot (as schematized in Table 1).

The syntactic features differentiating main from embedded clauses differ across languages, but within a language, the syntax of main clauses and complement clauses of representational attitudes overlap. To figure out whether a verb has a representational or non-representational semantics, the learner would thus only need to notice whatever syntactic features appear in declarative main clauses, and look for the same features in embedded clauses (for computational modeling evidence that a learner tracking only main clause features would quickly discover the representational/preference split, see White, Hacquard & Lidz, *in progress*).

	<u>main clause</u>	<u>complement of <i>think</i></u>	<u>complement of <i>want</i></u>
English	finite	✓ finite	✗ finite
French	indicative	✓ indicative	✗ indicative
German	Verb 2	✓ Verb 2	✗ Verb 2

Table 1 Syntactic reflexes of representationality

We thus see that the syntax is informative in discerning two semantic classes of attitude verbs. This, we hypothesize, is what allows young children to differentiate *think* and *want* early. But not only does the syntax need to distinguish two classes, it also needs to be informative about what these classes are. If the syntactic reflexes were arbitrary, we might expect all children to differentiate *want* and *think*, but some might attribute to *want* (and its kin) a representational semantics, and to *think* (and its kin) a non-representational semantics. However, this never seems to happen.

This is where the syntax and the pragmatics can be mutually informative about the semantics. The syntactic reflexes are not random. The syntax associated with *assertions* (namely, the syntax of declarative main clauses) is the type of syntax that is found in complements of attitudes that are used for *indirect* assertions (i.e., representational attitudes). Thus, hearing attitude sentences with declarative main clause syntax in the complement might be what leads children to assume that the speaker's message is an indirect assertion.⁶ They can then infer that the embedding verb must be the kind of verb whose semantics lends itself to indirect assertions, that is, one that expresses a judgment of truth that the speaker can endorse, that is, a representational attitude.

To sum up, we have seen that children seem to make categorical distinctions between *think* and *want* early on, given the errors that they make with the former, but not the latter. Three-year-olds reject true *think* sentences, but accept true *want* sentences when the complement is false. We have argued that this type of response is due to a tendency to assume pragmatic endorsement enrichments with *think*, in which the speaker 'proffers'—or indirectly asserts—the complement

⁶ Note that it can't just be that children only pay attention to the complement clause, and assume it is a direct assertion. Our results reported in section 2.2 show that three-year-olds do not ignore *think*, and reject sentences that are false but have a true complement. If children were simply paying attention to the complement clause, they should accept such sentences. Hence, it appears that children keep track of not only the shape of the complement clause, but also the fact that it is an *embedded* clause.

clause. We proposed that three-year-olds do not reject *want* sentences when the complement is false because they do not assume endorsement enrichments with *want*. We have argued that what leads children to assume such different semantics for *think* and *want* is their syntactic distribution: like other representational attitudes, *think* takes complements that allow declarative “main clause syntax”; *want*, like other non-representational attitudes, doesn’t. While children do not have direct access to the semantics they are trying to learn, there are helpful correlations between the syntax and the pragmatics that they can exploit. These correlations, we hypothesize, are key in helping learners make categorical distinction between verbs like *want* and *think*. Even if they haven’t fully grasped the meaning of these verbs, they know what broad semantic class they belong to.

We now turn to a much subtler contrast, that between two verbs within the representational class: *think* and *know*. What role does the syntax and the pragmatics play in helping or hindering the learner in figuring out the semantics of these verbs? In particular, how detectable is *know*’s factivity, and *think*’s non-factivity?

3 Picking up not at issue content: *think* vs. *know*

Think and *know* both express a belief of their subject. *Know* further presupposes that its complement is true. This meaning difference seems relatively subtle, and, the acquisition literature suggests that children do not pick up on it until they are at least four years of age. From a learner’s perspective, our two pragmatic challenges are compounded in figuring out this meaning difference. First, with *know*, the truth of the complement is presupposed, hence, backgrounded. Given that children are only ever exposed to *felicitous* sentences (where the presupposition is supported), they may fail to realize that a felicitous use of *know* requires that the complement be in the common ground. Children may thus miss the presupposition associated with *know*. Second, as we saw in section 2, *think* often comes with endorsement enrichments, in which case the speaker is committed to the truth of the complement, just like with *know*. If *think* and *know* sentences both involve speaker commitment to the truth of the complement, the difference between the two will only amount to whether this commitment is backgrounded (with *know*) or foregrounded (with *think*). When and how do children differentiate *think* and *know*? Do they understand that *think* is non-factive? Do they understand that *know* is factive?

3.1 Factive *think*?

We have seen in section 2 that three-year-olds tend to assume endorsement uses of *think*. Is this due to a default pragmatic preference, where they take the

complement to carry the main point of the utterance by default, or could they possibly have lexicalized an enriched meaning, perhaps a factive *think*?

Factive *think* would require that both the belief attribution and the complement be true for a *think* sentence to be true. But this is precisely what our three year olds seem to expect *think* sentences to require. Recall Lewis et al.'s scenario in (1), repeated in (22):

- (22) **HIDE AND SEEK SCENARIO:** Swiper is hiding behind the curtain, but his friend Dora wrongly believes that he is behind the chest.

In such a scenario, three-year-olds differed from adults in rejecting (23). But like adults, they rejected (6), repeated in (24):

- (23) Dora thinks that Swiper is behind the chest.
 (24) Dora thinks that Swiper is behind the curtain.

Thus, both the complement and the whole sentence have to be true for three-year-olds to accept a *think* sentence, which is consistent with a factive understanding of *think*. To see this, we can replace *think* with *know* in (23) and (24), given the scenario in (22). Our adult judgments with *know* line up with three-year-olds' judgments with *think*. When forced to either accept or reject each of (25) and (26), an adult would reject both:⁷

- (25) Dora knows that Swiper is behind the chest.
 (26) Dora knows that Swiper is behind the curtain.

Could it be that the reason children tend to respond to the truth of the complement with *think* is that they have lexicalized a non-adult-like factive *think*?

3.2 Factive *know*?

Children have been argued not to distinguish *think* and *know* until at least age four (Harris 1975; Johnson & Marastos 1977; Abbeduto & Rosenberg 1985; Moore, Bryant & Furrow 1989 among others). With simple affirmative sentences, this is perhaps unsurprising, given young children's tendency to assume endorsement uses for *think*. To test children's knowledge of *know*'s factivity (and *think*'s non-factivity), we need to look at their understanding of both verbs in embedded contexts, such as under negation. Do children realize that the truth of the complement projects only with *know*?

⁷ It might be possible to accept (25), with stress on *know*, under the interpretation that Dora has a very certain gut feeling about Swiper's location. However, (26) is plainly false.

In Dudley, Orita, Hacquard & Lidz 2015, we tested three-year-olds' understanding of the two verbs with a simple game. Children had to guess where a toy was hidden in one of two boxes (a blue box and a red box), based on clues consisting of sentences containing *think* and *know*, as in (27):

- (27) a. Lambchop thinks that the toy is in the red box.
 b. Lambchop knows that the toy is in the red box.
 c. Lambchop doesn't think that the toy is in the red box.
 d. Lambchop doesn't know that the toy is in the red box.
 e. Lambchop thinks that the toy is not in the red box.
 f. Lambchop knows that the toy is not in the red box.

Our results show that as a group, three-year-olds did differentiate *think* and *know*. While they tended to pick the red box (the box mentioned in the complement clause) after clues like (27a) and (27b), and the blue box after clues like (27e) and (27f), they differed after clues like (27c) and (27d). With *think* under negation (27c), they picked the blue box. With *know* under negation (27d), however, some children picked the red box, while some picked the blue box. See the results in Figure 2: the graph on the left shows children's overall responses for *think* and *know*; the graph on the left zooms in on the condition with *know* under matrix negation, and shows how children were distributed: 13 children always picked the box consistent with a non-factive interpretation, 6 children always picked the box consistent with a factive interpretation, and 9 children picked the box consistent with a factive interpretation one or two out of three times.

To the extent that these results reflect semantic knowledge and are not due to extra linguistic (e.g., processing) factors, they suggest the following for children's early understanding of *think* and *know*. As for *think*, it appears that three-year-olds have a non-factive representation. If they took *think* to be factive, they should assume that the truth of the complement projects, and understand the toy to be in the red box after a clue like (27c), contrary to fact. This suggests that what is responsible for children responding to the truth of the complement in false belief contexts is not a lexicalized factive *think*. Children may still have lexicalized a *veridical think* (where the truth of the complement is asserted, but not presupposed).⁸ Alternatively, they may have an adult-like, non-veridical, non-factive semantics, but assume endorsement uses by default, perhaps because they have difficulty figuring out when beliefs are relevant in context (i.e., when the main clause carries the main point of the utterance; see Lewis 2013).

⁸ See Abrusan 2011 and Anand & Hacquard 2014 for a pragmatic explanation of why such a veridical *think* is not attested in the adult language. If the lack of veridical (as opposed to factive) doxastics in natural language is principled, rather than an accidental lexical gap, then children will either never hypothesize a veridical *think*, or it will eventually be pruned out.

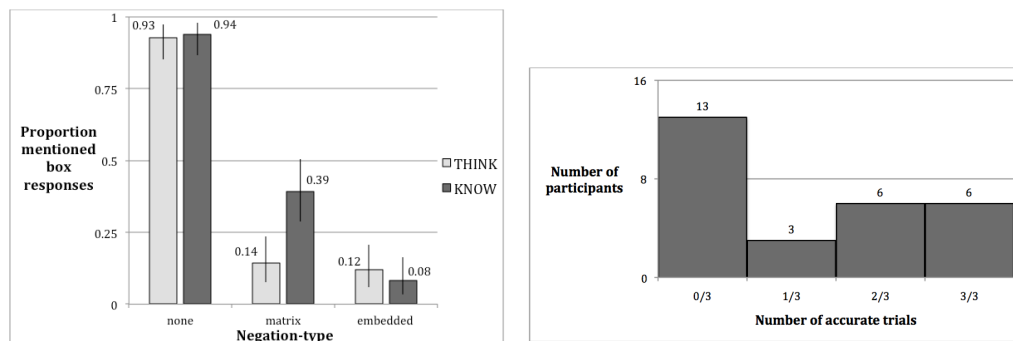


Figure 2 **Left:** Three-year-olds' proportion of responses where they picked the box 'mentioned' in the complement of *think* and *know* sentences with no negation, matrix negation, and negation in the complement. **Right:** Individual accuracy on *know* with matrix negation (from Dudley et al. 2015)

As for *know*, while some three-year-olds already seem to have an adult-like factive understanding, many seem to have instead a non-factive *know*. This raises two related questions. First, what gives away *know*'s factivity and *think*'s non-factivity? And second, given the individual variation we found, why don't all children figure out *know*'s factivity at the same time?

3.3 Bootstrapping factivity?

This section will offer brief speculative remarks on what might give away factivity. There are two potential sources of information for *know*'s factivity and *think*'s non-factivity: the discourse context and the syntactic context in which these verbs occur. As for the first, the learner would have to pick up on differences in the state of the discourse whenever *think p* and *know p* are used: was *p* mentioned before? Does it denote a fact that is salient to both speaker and addressee? Keeping track of such differences in contexts of use might be difficult, especially given children's assumption that the speaker is committed to the truth of *p* with both verbs. Speaker commitment to *p* would not be enough: children would have to pick up on whether *p* consists of new or old information. They would further have to realize that *know p* never occurs in contexts where *p* is false, and infer from this indirect evidence that *p* must be true whenever *know* is used. This may be difficult to notice, and it is thus perhaps not surprising that some children need more time. What might underlie individual variation then,

could be that some three-year-olds have been exposed to more uses of *know* and *think* overall than other three-year-olds, or are better at keeping score of discourse contexts, to be able to pick up on the felicity conditions of each verb.

Because the meaning difference between *think* and *know* is subtle and not directly observable from the situational context, the syntax may here again be helpful. There would have to be principled links between factivity and certain syntactic properties, which the learner would somehow be privy to. A good candidate for such a property might be question-embedding (see Hintikka 1975; Karttunen 1977; Ginzburg 1995; Egré 2007).⁹ While *know* can take an interrogative complement, *think* cannot:

- (28) Dora knows whether Swiper is behind the chest.
(29) * Dora thinks whether Swiper is behind the chest.

If the connection between factivity and question-embedding is indeed principled, the following learning story could explain the pattern of data we have seen. The child would start out with the assumption that both *think* and *know* are representational attitudes, based on the fact that both verbs take complements whose syntax resembles that of declarative main clauses. She would further notice that, unlike *think*, *know* occurs with interrogative complements, and hypothesize that *know* is factive. If this is right, what could explain individual variation might be that the linguistic input children hear varies in quantity and quality from child to child: perhaps three-year-olds who have an adult-like, factive, understanding of *know* have heard more instances of both verbs overall, but more particularly, in crucial syntactic environments (e.g., *know* with an interrogative complement).

Hence, the route to factivity may involve paying close attention to the state of the discourse or the syntactic environments in which these verbs occur, or both. We are currently investigating these two possible routes by looking at possible correlations between input variability and knowledge of factivity (Dudley, Rowe, Hacquard & Lidz, *in progress*).

4 Conclusion

When learning word meanings, children do not have direct access to the semantics: all they ever get exposed to are speaker meanings and syntactic forms. Children somehow have to infer the semantics from both, and figure out what is

⁹ The correlation between factivity and question-embedding is not perfect: communicative verbs like *tell* and *decide* can take questions, but they are not factive; emotive factives like *resent* and *regret* cannot take whether complements, but are factive. For discussion, see Egré (2007) and Spector & Egré (2013).

part of literal meaning, what is enrichment, and what backgrounded assumptions are part of the conventional content associated with an expression.

We have focused here on how children learn the meaning of certain attitude verbs, and examined the syntactic and pragmatic contributors to this learning process. We first turned to the acquisition of the verbs *think* and *want*, which express very different meanings, and which children seem to differentiate early on. We argued that the syntax may help children categorize the two verbs into different classes early on, even when they haven't yet fully mastered these verbs. We then examined children's understanding of the verbs *think* and *know*, whose meaning difference is much more subtle. We found that some, but not all three-year-olds differentiated the two in an adult-like way. For this contrast, the syntactic and the situational cues may not be as reliable or salient as for the *think* vs. *want* distinction, and we speculated that differences in the linguistic input that each child gets exposed to might be at the source of their differing understanding of *know*'s factivity.

We have argued that because children do not get exposed to the semantics directly, they have to reconstruct it by exploiting correlations between syntax and speaker meanings. Specifically, we have hypothesized that the way that syntax helps bootstrap attitude class is by offering parallels between the syntax used for different speech acts, and the syntax found in the complements of attitude verbs used for related indirect speech acts.

Specifically, we saw that representational attitude predicates, like *think*, are often used to express indirect assertions (or 'profferings'), because they express judgments of truth that the speaker can endorse. We proposed that the learner could figure out *think*'s semantic class by matching the syntax of its complement with the syntax typically used for assertions, i.e., the syntax of declarative main clauses. Other classes of attitudes report other kinds of mental states and speech acts: rogatives report questions, desideratives report preferences. Both can be used for indirect speech acts: questions and requests, respectively. It remains to be determined how frequent question and request enrichments are in child-directed speech, and whether and how they might help or hinder the acquisition of these verbs. We have seen that young children seem to be adult-like with *want*, in that they never respond to the truth of the complement. But this is unsurprising, given that *want* is not typically used for indirect assertions. Might they however make other speaker meanings errors, by over-assuming, for instance, that a desire report is an indirect request?

We have argued that for a syntactic bootstrapping account of attitude meanings to be successful, it needs to be abstract enough to be used by learners of various languages, but still lead to language-specific syntax/semantics mappings. The account we have proposed doesn't require hard-coding language-specific information (e.g., finiteness and representationality), but it does require that

learners be equipped with certain expectations, by the time they are learning attitude meanings. Minimally, they would need (i) a basic understanding of speech acts and have picked up on the syntax associated with each in their language (e.g., assertions and the syntax of declarative main clauses); (ii) an understanding that some verbs embed clauses, and that when they do, they report a relation between the subject and some state of affairs, described by the complement; (iii) an expectation that the syntax of the complement will match the syntax of the type of speech act or mental state that the attitude verb reports on (e.g., assertion).

Finally, we hope to have shown that children's pragmatic competence, while not completely adult-like, is quite sophisticated. Since the pioneering work of Noveck (2001), a common assumption in the literature is that children are "bad" at pragmatics.¹⁰ But this presupposes that children have prior, and full access to the literal content that pragmatic inferences are based off, but have trouble computing additional enrichments. However, what children get exposed to are enriched meanings, not literal meanings. We have argued that children can, and in fact, do hypothesize speaker meanings, sometimes to a fault.

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¹⁰ For insightful discussion of children's pragmatic competence and overviews of the literature, see Pouscoulous 2012 and Lewis 2013.

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