

Children's Attitude Problems: Bootstrapping Verb Meaning from Syntax and Pragmatics

Valentine Hacquard and Jeffrey Lidz
University of Maryland, College Park

How do children learn the meanings of propositional attitude verbs? We argue that children use information contained in both syntactic distribution and pragmatic function to zero in on the appropriate meanings. Specifically, we identify a potentially universal link between semantic subclasses of attitude verbs, their syntactic distribution and the kinds of indirect speech acts they can be used to perform. As a result, children can use the syntax as evidence about the meaning, which in turn constrains the kinds of pragmatic enrichments they do and do not make in understanding these verbs in conversation.

1. Introduction

This paper explores the role of syntax and pragmatics in word learning, by focusing on how children acquire the meaning of so-called attitude verbs, verbs that express mental states or “attitudes” of individuals towards particular states of affairs, such as *think*, *want*, or *hope*.

The problem of word learning in general has received a mountain of attention, much of it motivated by puzzles of induction. As Quine (1960) famously observed, the extralinguistic environment accompanying the use of a word leaves open the particular concepts in the mind of the speaker that condition that use. A situation in which a speaker uses a word to refer to a rabbit might be identical to one in which he intended to refer to the rabbit's fur, the speed at which it is moving, or to the memory of a delicious stew. Moreover, even if a learner can pinpoint precisely the part of the world being picked out by a novel word, recognizing, for example, that the speaker was referring to the rabbit, this reference would be consistent with a broad range of concepts with overlapping extensions (e.g., rabbits or black holes, rabbits with more than one ear, things physically identical to rabbits, etc.; Goodman 1955). Linguists and cognitive scientists have responded to these philosophical problems by noting that word learners can draw on perceptual, conceptual and linguistic abilities that lead them to parse the world into the same pieces and to relate those pieces to the same concepts as the speakers producing those words (Gleitman 1990, Spelke 1990, Markman 1990, Waxman & Lidz 2006, Carey 2010). Moreover, these conceptual burdens may be significantly reduced by learners' ability to track the goals and intentions of their interlocutors (Baldwin 1991, Bloom 2001, Clark & Amaral 2010).

Despite these constraining capacities, attitude verbs pose a significant challenge for any theory of word learning. These verbs describe abstract mental states that do not leave reliable correlates in the physical world, providing little evidence for learners to recognize that they are being referred to (Landau & Gleitman 1985). And, although children may have a rich capacity to see people's actions in terms of their beliefs, desires, goals and intentions (Gergely *et al.* 1995, Woodward 1998, Onishi & Baillargeon 2005, Southgate *et al.* 2007, Kovacs *et al.* 2010, among others), this ability is distinct from the recognition that those mental states make likely word meanings (Papafragou *et al.* 2007).

The problem of recognizing that a word picks out a mental state is highlighted by results from the human simulation paradigm (Gillette *et al.* 1999). Adult subjects were shown silenced videos of mother-child interactions, with a tone occurring when a particular word was used, and were asked to guess what word was uttered there. Participants were able to recover nouns more easily than verbs. But for our purposes, a key finding is that concrete verbs such as *push* were identified more frequently than abstract verbs like *think* and *want*. Indeed, participants almost never correctly identified attitude verbs, suggesting that the meaning of these words is not easily gleaned from paying attention solely to what speakers are attending to in the **situational context** in which they speak (Gillette *et al.* 1999; Snedeker & Gleitman 2004; Gleitman *et al.* 2005). This is not to say that the situational context doesn't play a role: certain situations make attitudes more salient and encourage speakers to use mental state vocabulary: Papafragou *et al.* (2007) show that scenes in which a character has a false (as opposed to a true) belief prompt speakers to use words like *think* more often. Yet the bulk of children's exposure to mental state vocabulary does not occur in such informative contexts; most instances of *think* in child-directed speech do not report false beliefs (Shatz *et al.*, 1983, Bloom *et al.* 1989, Diessel & Tomasello 2001, Dudley *et al.*, 2016, a.o.). Hence the child may need more reliable cues to figure out attitude meanings, in particular, from the **linguistic context** in which these words occur.

One aspect of a word's linguistic context is its **lexical context**, namely the set of words that occur in the same sentence. Lexical information can be quite useful in learning the meaning of verbs like *eat* or *drink*, which co-occur with noun phrase arguments from a very narrow semantic range (namely edibles and drinkables; Resnik 1996). It is however much less clear that lexical context is informative at all as to attitude meanings, given that attitude verbs (e.g., *want*) impose few restrictions on the semantic range of noun phrase arguments (Resnik 1996, White 2015).

Syntactic context may be especially useful if the syntactic distribution of a word correlates with its semantic class. Gleitman and colleagues propose that **syntactic cues** play a critical role in children's acquisition of abstract words like attitude verbs (which they refer to as "hard words"). Supporting evidence for this proposal comes from adult experiments, in which subjects systematically hypothesize attitude meanings for nonce verbs that appear with a sentential complement (Gillette *et al.* 1999). Given how much better adults fare with syntactic cues, compared to situational cues, **syntactic bootstrapping** (i.e., using a word's syntactic distribution to infer its meaning) seems like our best bet for how children acquire attitude meanings. This bet is made good, however, only if children are sensitive to such distributional cues, if these distributional cues are connected to meaning differences in principled ways, and if children are somehow privy to these connections.

While the syntactic bootstrapping hypothesis for word learning was originally proposed specifically for abstract terms like attitude verbs, most of the studies testing this hypothesis have focused on simple transitive and intransitive verbs (e.g., Landau & Gleitman 1985; Pinker 1989; Naigles 1990, 1996; Naigles & Kako 1993; Lidz *et al.* 2003; Yuan & Fisher 2009), or on whether attitude verbs as a class can be differentiated from other verbs (Gleitman 1990; Fisher *et al.* 1991; Lidz *et al.* 2004, Gleitman *et al.* 2005; Fisher *et al.* 2006; 2009). From this body of work, we have good reason to believe that children do pay attention to syntactic distribution when learning new words, and specifically, that a verb's selection of a sentential complement provides good evidence that this verb expresses some attitude meaning. It is however much less clear whether further syntactic differences help the child differentiate *among* attitude meanings.

Are semantic differences between verbs like *think* and *want* reflected in their syntactic distribution? And can children use such distributional information to infer the right meanings?

As we will see, children differentiate *think* and *want* very early on, even before they have fully mastered their meaning and use. This differentiation is evidenced by their systematic comprehension errors with *think*, but not *want* sentences. This differential treatment suggests that something cues children in early that *think* and *want* belong to different semantic classes. As we have just seen, it is unlikely that this something resides in the situational or lexical contexts. Syntactic distribution presents a more promising avenue, given that it clearly differentiates verbs like *think* and *want*. In English, *think* and *want* differ in the finiteness of their complement. *Think* takes a finite complement, *want* takes a nonfinite complement:

- (1) Mom thinks that Andy is going to bed.
- (2) Mom wants Andy to go to bed.

However, the few previous studies testing children's sensitivity to this contrast have been largely inconclusive (Asplin 2002; Johnson *et al.* 2002). It is thus unclear that children make use of the syntax when learning finer-grained distinctions among attitude meanings, presenting a challenge to syntactic bootstrapping theories.

Even if children can be shown to be sensitive to finiteness as a cue to attitude verb meaning, a prior challenge to children's sensitivity to such a cue is whether it even tracks something semantically principled. Indeed, not all languages show the same finiteness contrast between verbs like *think* and *want*. In German, for instance, both *think* and *want* take finite complements for the counterparts of (1) and (2). And yet German-speaking children seem to differentiate *think* and *want* in the exact same ways as English-speaking children (Perner *et al.* 2003). Thus, the viability of a syntactic bootstrapping account for attitude verb meanings depends on whether we can find (i) principled mappings between attitude verb meanings and their syntactic distribution in each language; (ii) a way for children to figure out these language-specific mappings. In this paper, we propose such an account, and present some initial evidence for children's sensitivity to syntactic distribution in attitude verb learning.

We will argue that syntactic cues work in conjunction with another key aspect of the linguistic environment particularly relevant to attitude verb learning, namely the *pragmatic context* in which these verbs are used. One challenge to word learning that is perhaps less often discussed, comes from the distinction between *sentence meanings* and *speaker meanings* (Searle 1969, Austin 1975, Grice 1975). Sentences are used to achieve conversational goals, so often what gets communicated is not merely the literal meaning of the words, but something richer. Thus, even if children can perceive the point of a speaker's utterance, they still lack a direct access to the literal sentence meaning, and hence to the meanings of specific lexical items. As a consequence, learners have to extract the literal meaning from the enriched meaning conveyed by an utterance.

In the case of attitude verbs, this problem is acute. Because attitude verbs describe speech acts and mental states, they are often used by speakers to perform indirect speech acts in which the literal content of the attitude report only plays a minor role in the speaker meaning. Specifically,

a sentence that is literally about the thoughts or desires of the speaker or the hearer can be used to indirectly describe or demand a situation that satisfies these attitudes. When a parent says, “I want you to go to bed,” she is telling the child to go to bed. The point of the utterance is not an attitude ascription. And these uses are the dominant uses in speech to children (Shatz *et al.*, 1983, Bloom *et al.* 1989, a.o.). Such pragmatic enrichments present yet a further challenge to the acquisition of attitude verbs: how do children manage to extract their literal meaning, given that this literal meaning is clouded by the speaker meaning?

But perhaps these pragmatic enrichments are not just a curse, but a blessing. Might they not, in fact, provide useful cues as to literal content? As we said, attitude reports are routinely used to perform indirect speech acts:

- | | | |
|-----|---------------------------------------|-----------------------------|
| (3) | I want you to go to your room. | <i>Go to your room!</i> |
| (4) | I think Mary’s in her room. | <i>Mary is in her room.</i> |

(3) is literally a desire report, but it can easily be used as an indirect request. (4) is literally a belief report; however it can easily be used to indirectly make a proposal as to Mary’s location. The kinds of indirect speech acts that attitude verbs are routinely used for depend on the kinds of literal meanings these verbs express: desire reports are easily used to make indirect requests and belief reports typically make indirect assertions. For Searle (1975), this is because the literal content of (3)-(4) express the sincerity condition of the indirect speech acts being performed: to make a request, one has to want that request to be fulfilled; to make an assertion, one has to believe its content.

If a child were somehow privy to the intended speech act a speaker conveys with an attitude report, might this not provide clues as to its literal meaning? A request is an expression of a preference, hence a verb used to make a request may express a preference; an assertion is an expression of a judgment of truth, hence a verb used to perform an assertion may express a judgment of truth. But how would such **pragmatic bootstrapping** work? How can the learner figure out the intended speaker meaning if she does not yet understand the literal meaning?

For pragmatic bootstrapping to get off the ground, children would have to be sensitive to the intended force of speakers’ utterances, even if they don’t fully understand their content, and figure out whether the utterance was intended as a request or as an assertion. The existing literature suggests that this is a viable possibility. From infancy, children are remarkably sensitive to the goals (referential and other) of the people around them (Baldwin 1991, Gergely *et al.* 1995, Woodward 1998, Bloom 2001, Csibra *et al.* 2003, Halberda 2006). Children are notably very good at understanding indirect speech acts like requests, regardless of the form of the utterances used to perform such requests (Shatz 1978, Spekman and Roth 1985).

Hence, if children are good at understanding the intended speech acts behind speakers’ utterances, they may be able to use cues from the intended indirect speech act to recover the meaning of the direct speech act. But might this not backfire? *Think* sentences are often used for indirect assertions. However, they can also be used to perform indirect requests. A sentence like (5) can be used to send one’s child to bed. If a child were to rely on the force of the indirect

speech act (request) to recover the meaning of the direct speech act, might she hypothesize a desire meaning for *think*?

(5) I think it's time for bed.

Here we propose that the syntax acts as a crucial filter. The challenges to the syntactic bootstrapping and the pragmatic bootstrapping hypotheses resolve each other by being mutually constraining: the syntax helps the learner parse the pragmatic context, the pragmatics, in turn, helps the learner make use of the syntactic distribution.

In a nutshell, attitude verbs split into two main semantic classes: attitudes that express judgments of truth (e.g., *think, say*), what Bolinger (1968) called the “representational”, as they represent a picture of the world, and attitudes that express preferences (e.g., *want*), the “non-representational”. We will refer to the latter as preferentials in order to make the meaning more transparent. Because of their semantics, representational and preferential are conventionally used for different indirect speech acts: representational express judgments of truth and are used to indirectly assert, via an implicit endorsement of these judgments of truth. Preferential express preferences and are used to indirectly request, via an implicit endorsement of these preferences.

Interestingly, syntax seems to track this split in representationality (Bolinger 1968, Hooper 1975, Farkas 1985, Giannakidou 1997, Villalta 2008, Anand & Hacquard 2013, among others) in a way that is robust to cross-linguistic variation: representational take complements with the syntactic hallmarks of assertions, i.e., complements that resemble declarative main clauses (Dayal & Grimshaw 2009, Hacquard 2014). In English for instance, representational *think* and *say* take finite complements, just like declarative main clauses. Preferential do not: their complements do not resemble declarative main clauses, but rather imperative clauses (nonfinite clauses in English).

Assuming that attitude verbs' syntactic selection is principled in the ways just proposed, it could prove quite useful to the learner. The learner might observe that a certain attitude verb embeds complements that resemble assertions, by noticing syntactic hallmarks of declarative main clauses. From this she might infer that with this attitude report, the speaker intends to indirectly *assert* the content of the complement (indirectly, because the complement clause is still embedded). She might further infer that the embedding verb's semantics must lend itself to such indirect assertions, i.e., that it is a verb that expresses some kind of truth judgment (e.g., a belief), i.e., that is representational. This proposal provides a way to resolve the cross-linguistic challenge to the syntactic bootstrapping hypothesis: the learner only needs to track syntactic hallmarks of declarative main clauses, and not language-specific features such as finiteness.

To sum up, we propose that what allows the child to infer the lexical semantics of attitude verbs—to which she is never directly exposed—is the exploitation of correlations between the syntax (what syntactic complements appear in attitude reports) and the pragmatics (how these attitude reports are used by speakers). We will refer to this proposal as the **pragmatic syntactic bootstrapping hypothesis**.

We will develop this hypothesis by focusing on the long noted asymmetry in children's acquisition of the verbs *think* and *want*. Children seem to understand *want* in an adult-like way by age three. However, they struggle with *think* until well into their fourth birthday (Johnson & Maratsos 1977, de Villiers 1995, 2005, de Villiers & de Villiers 2000, Perner *et al.* 2003, Sowalsky *et al.* 2009, Lewis *et al.* 2012, *to appear*, Lewis 2013, a.o.), and consistently give non-adult-like responses to *think* sentences used to report a false belief.

We will argue that this asymmetry is due to a pragmatic difference in how these verbs are used, a difference that leads children astray in standard tasks that test their understanding of *think*. This is in contrast to the traditional view according to which the asymmetry reflects an asymmetry in the development of the concepts expressed (*belief* vs. *desire*) (Wellman & Bartsch 1988; Wellman & Wooley 1990, Perner 1991a; 1991b; Bartsch & Wellman 1995; Repacholi & Gopnik 1997; Perner *et al.* 2003; 2005, Perner & Ruffman 2005). According to our proposal, children's errors with *think* need not reflect a non-adult-like conceptual or even semantic representation.

This paper is organized as follows. In section 2, we look into more detail at the asymmetry in children's understanding of *think* and *want*. In section 3, we argue that this asymmetry has a pragmatic basis. In section 4, we explain the link between the syntactic distribution of attitude verbs and the kinds of pragmatic enrichments (and errors) such verbs invite. In section 5, we provide evidence that syntactic distribution is predictive of attitude meanings and that children use such cues when hypothesizing attitude meanings. We conclude in section 6.

2. Asymmetry in the acquisition of *want* and *think*

The developmental literature argues that children master *want* before they master *think*. This is based on a seemingly robust asymmetry in three- and four-year-olds' comprehension of *think* and *want* sentences. Children make consistent mistakes with *think*, when it is used to report a false belief. Consider the following scenario (adapted from Perner *et al.* 2003), in which Andy is watching TV, but his mother falsely believes that he is going to bed. In such a scenario, three-year-olds typically reject the true sentence in (6):

(6) Mom thinks that Andy is going to bed.

However, children do not make the same kinds of mistakes with *want*. Given a variant of the scenario where Andy is watching TV but his mother wants him to go to bed, three-year-olds have no trouble accepting sentences like (7). This asymmetry in acquisition holds for the German counterparts of *want* and *think* (Perner *et al.* 2003), and other languages (e.g., Mandarin and Cantonese; Tardif & Wellman 2000):

(7) Mom wants Andy to go to bed.

While the asymmetry is robust throughout the experiments in which it has been tested, the tasks comparing children's understanding of *want* and *think* do not always involve the same

processing demands. *Think* is typically tested in false belief contexts, where the reported belief conflicts both with reality, and with the child's own beliefs. In (6), Mom's belief conflicts with the reality set up by the scenario (Andy is actually watching TV); and given that the child knows what Andy is actually doing, her own beliefs naturally line up with reality. Thus, in order to assess the sentence in (6), the child has to hold in memory and process a belief that conflicts both with reality and with her own beliefs.

The same types of conflict are not always present when testing *want*. Consider the sentence in (8), given a scenario where Andy is currently watching TV. In listening to the story, the child doesn't necessarily have any desires about what Andy does. Thus the reported desire doesn't conflict with the child's desires in the same way as the reported belief in (6) conflicts with her beliefs. Moreover, strictly speaking, the desire reported in (7) does not conflict with reality either. This is due to the fact that when *want* takes a complement with an eventive predicate like 'go to bed', it is future-oriented. The sentence in (7) describes a desire for an event to occur at a time that *follows* the wanting time. Note that the future-orientedness of *want* holds even in German, where *want* takes a present tensed finite complement. In (8a), unlike in (8b), the complement is most naturally interpreted at a time that follows the attitude time:

- (8) a. Was will die Mutter, dass Andreas tut? Perner *et al.* (2003)
What wants the mother, that Andy does?
What does Mom want Andy to do?
- b. Was denkt die Mutter, dass Andreas tut?
What thinks the mother, that Andy does?
What does Mom think Andy is doing?

Thus (8b) asks about a *belief* that conflicts with reality, but (8a) asks about a desire that doesn't necessarily conflict with reality. Could children's relative ease with *want* in studies like Perner *et al.*'s, be an artifact, due to differences in processing demands, when compared to *think*? Does children's performance with *want* decline when it is used to report a truly counterfactual desire or a desire that conflicts with the child's own desires? Here the literature is mixed, but overall, it suggests that children do much better than with *think* sentences used to report false beliefs.

Moore *et al.* (1995) tested three year olds' understanding of *want* sentences used to report a desire that conflicts with their own by setting up a game, in which the child competes with a puppet for different color cards. Less than half of the children passed the task. Rakoczy *et al.*'s (2007) improved on Moore *et al.*'s methodology. Children's performance improved, but it only hovered around 50%. However, the game was still fairly complex for preschoolers, and failures may have been due to a lack of understanding of the rules of the game and to the small number of critical trials.

In Harrigan *et al.* (2016a), we build on Moore *et al.* (1995) and Rakoczy *et al.* (2007), and set up a competitive game with the child and a puppet, Froggy. The game consists of flipping cards of different colors, with various colors leading to a positive outcome for either Froggy, the child, both, or neither. For instance, when the card is green, Froggy gets to stamp his paper, but when it is pink, the child gets to stamp. A second puppet utters target sentences like the ones in (9):

- (9) a. Froggy wants the card to be green.
b. Froggy wants the card to be pink.

Children received extensive training on the game to ensure that they understood its rules, before they were tested on target sentences. Three-year-olds' performance was adult-like: they readily accepted sentences like (9a) when the reported desire conflicted with their own, and rejected sentences like (9b), despite their own desire for the card to be pink.

We also tested children's understanding of truly counterfactual desires. In a representative story, Megan and her mother are in a grocery store. Megan's mother wants her to stay in the grocery cart, but Megan gets out to find cereal while her mother is not looking. In such scenarios, three-year-olds accepted (10a) and rejected (10b):

- (10) a. Mom wants Megan to be sitting in the grocery cart right now.
b. Mom wants Megan to be getting cereal right now.

These experiments confirm that three-year-olds' have an adult-like understanding of *want*. They further suggest that whatever difficulty three-year-olds have with *think*, it cannot solely be due to the processing demands of assessing a mental state that conflicts with reality, or with the child's own mental state. The asymmetry in acquisition of *think* and *want* thus seems to hold robustly.

What is the nature of this asymmetry? The traditional explanation is that it reflects an asymmetry in the acquisition of the concepts these verbs express. We review this conceptual hypothesis next, and then show that it cannot be right. Instead we argue that children's difficulty with *think* sentences is essentially pragmatic.

3. Explaining the *think/want* asymmetry

3.1. Conceptual hypothesis

Young children's comprehension difficulty with *think*, and their relative ease with *want*, is often tied to conceptual development in the psychology literature. Children's failures with *think* are taken to reflect their inability to ascribe beliefs, and in particular, false beliefs, to others. Their success with *want*, on the other hand, is taken to show that the desire concept develops earlier (for an overview, see Steglich-Petersen & Michael 2015).

The thesis that children initially lack a *theory of mind* that allows them to attribute false beliefs to others has received considerable experimental support, independent of their performance with *think* sentences (for a meta-analysis of over 150 studies, see Wellman, Cross & Watson 2001). In a typical "change of location" false belief task (Wimmer & Perner 1983; Baron Cohen *et al.* 1985), a character (Sally) has a false belief about an object's location (her ball). Sally hides her ball in a basket and then leaves the scene. While she is gone, her friend Anne takes the ball and moves it into her box. The child is then asked: "When Sally comes back, where will she look for

her ball?” Adults and older children point to the basket, but three-year-olds consistently point to the box. This type of error is taken to show that young children are unable to ascribe to Sally the false belief that her ball is still in the basket. Thus, independently of their understanding of the verb *think*, young children seem to be unable to reason about false belief, but they do much better on tasks testing their understanding of unfulfilled desires.

If children acquire the belief concept after the desire concept, as evidenced by their differing performance on false belief and unfulfilled desire tasks, it is not surprising that they have more difficulty with a verb that expresses belief than with a verb that expresses desire. The asymmetry in acquisition of *think* and *want* would thus reflect an asymmetry in the acquisition of the concepts these verbs express.

There are, however, reasons to doubt the conceptual hypothesis. In the past ten years, various infant studies have provided more and more evidence that false belief understanding may be in place very early on (Onishi & Baillargeon 2005; Song *et al.* 2008; Southgate *et al.* 2007 among others). Using implicit measures such as looking time, these studies show that infants are surprised when actors perform actions that are inconsistent with their beliefs, whether these beliefs are *true* or *false*.

There is still no consensus on how to reconcile the results from these infant studies with older children’s consistent failure at explicit false belief tasks (for overviews from various perspectives, see Apperly and Butterfill 2009, Perner and Roesler 2012, Carruthers 2013). Some argue that success on these implicit tasks does not require a full-fledged false belief understanding, but merely low-level expectations about how agents behave (e.g., Perner & Ruffman 2005). Others take infant studies to show that the concept is in place early on, with failures at explicit false belief tasks due to additional task demands (e.g., Leslie 1994). One possibility is that children’s failures are not due to a lack of competence, but performance, with children reading more into the task, and specifically, the goals and desires of the experimenters in asking where certain characters think an object is located (Hansen 2010, Rubio-Fernandez & Geurts 2012, Helming, *et al.* 2014, Westra & Carruthers 2016). This last hypothesis is appealing because it can make sense of the apparent discrepancy between the results from infant studies and those from explicit false belief tasks, and doesn’t require a categorical change in conceptual understanding. Regardless of which hypothesis is ultimately correct, there are reasons to doubt that children lack the concept of belief at age three, though they seem to have difficulty in deploying it in explicit tasks.

Before we turn to our own account, we briefly discuss Jill De Villiers’ intriguing hypothesis for children’s difficulty with *think* and the more general connection between linguistic and conceptual development. De Villiers (De Villiers 1995, de Villiers & de Villiers 2000) argues that children initially lack the ability to encode false belief. What gives them the “scaffolding for false-belief representation” is the special syntax associated with verbs like *think*, namely, the structural means to embed a finite sentential complement, whose truth can differ from the truth of the sentence in which it is embedded. According to this view, children initially lack both the concept of false belief, and the syntax and semantics of *think* sentences. Their linguistic abilities develop first, with the acquisition of the syntax of finite complementation, which, in turn, allows them to represent a belief whose content can be false. A verb like *want* is acquired sooner,

because the syntax it projects is different (it does not take finite complements) and acquired earlier.

Two main issues arise with De Villiers' proposal, however. First, the results of the infant studies here again undermine the thesis that children develop the false belief concept around age four. If false belief understanding is in place early, then practice with attitude verbs may help *deploy* this concept in explicit false belief tasks, but it does not *enable* false belief representation. Second, as Perner *et al.* (2003) argue, De Villiers' hypothesis makes wrong predictions for German-speaking children. As seen in (8), both *want* and *think* in German take finite complements. If children initially lack finite complementation, we would expect German-speaking children to perform equally bad at *want* as *think*, contrary to fact. In response to this challenge, De Villiers revised her proposal in semantic terms (De Villiers 2005, 2007): *think* and *want* take semantically (if not syntactically) different types of complement: "realis" complements for *think*, whose "truth can be evaluated", "irrealis" complements for *want*, whose "truth cannot be evaluated". In this updated version, realis complements provide the scaffolding for false belief representation.

We agree with De Villiers that *think* and *want* differ semantically in that the former expresses a judgment of truth but not the latter. However, we will argue that children's difficulty with *think* is not due to its *syntax* or *semantics*, but to the kinds of *pragmatic* enrichments that verbs that express judgments of truth trigger. We will present evidence that when we control for pragmatic enrichments, three year olds in fact display an adult-like understanding of *think* sentences, even in false belief contexts.

3.2. Pragmatic root of the *think/want* asymmetry

Through a series of experiments, we investigate the possibility that children's difficulty with *think* is pragmatic (Lewis *et al.* 2012, *to appear*). Specifically, we propose that children acquire the right semantics for *think* early on, and know that people can be mistaken in their beliefs, but that this knowledge is obscured by their difficulty understanding what *speakers* mean when using *think*.

The literal meaning of a *think* sentence is a mere belief report. This literal meaning is seen clearly in contexts in which we are reasoning about the motivations behind someone's actions:

- (11) a. Why is Max opening the cupboard?
b. He thinks that there's chocolate in there.

In certain contexts, however, speakers use *think* sentences to convey more than a belief ascription: they use them to proffer the content of the complement clause. To see how this kind of pragmatic enrichment works, consider the following dialogue from Simons (2007):

- (12) A: Why isn't Louise coming to our meetings these days?
B: Henry thinks that she's left town.

The literal content of B's answer is a mere belief report, which doesn't directly address A's question. Why, then, is it an appropriate thing for B to say? Assuming that B is cooperative, a natural way in which B's utterance addresses A's question is if B endorses this belief, and thus 'proffers' or indirectly asserts its content. With such "parenthetical" uses of *think* (Urmson 1952), the complement clause carries the "main point" of B's utterance (Simons 2007). The main clause gets demoted to parenthetical status, and plays an evidential function (indicating the source of evidence for the proffering).

For Hooper (1975), in a situation like (12), the complement is "asserted", but as Simons (2007) points out, these parenthetical uses, unlike real assertions, do not require the full commitment of the speaker. For Simons, with parenthetical uses, the complement carries the main point of the utterance, but it doesn't require speaker endorsement. If B fully endorsed Henry's belief, B should have uttered the complement clause *tout court*. By using an attitude report, B thus implicates some hedging. But even if B has doubts as to Henry's being right, she is still offering the possibility that Louise is out of town (in Henry's name, as it were). We will call this pragmatic enrichment a "proffering" or "indirect assertion" of the complement: it is not a direct assertion, and it may not be fully endorsed by the speaker, but it is nonetheless put forward by the speaker as a possible answer to the question under discussion.

Consider now a third party, C, listening in to the conversation in (12). Upon hearing B's utterance, C can intervene as follows:

- (13) C: No she's not, she's home.

With this denial, C is not responding to the *literal* meaning of B's utterance, but to the indirect proffering of the complement clause (the *speaker* meaning): C is not denying that Henry holds a particular belief (the literal content of B's utterance), but rather that Louise is out of town (the content of the complement clause). This kind of denial is what we hypothesize underlies children's rejection of *think* sentences in scenarios where they know the complement clause to be false: their rejection is a rejection of what they take to be the speaker meaning.

To see this, recall that children's errors with *think* typically arise in false belief contexts. In a scenario where Andy is watching TV, but his mother falsely believes that he is in bed, young children tend to reject a sentence like (14):

- (14) Mom thinks that Andy is in bed.

Suppose that children take the question under discussion to be what Andy is doing. In this context, an utterance of (14) would amount to an indirect assertion that Andy is in bed. Because they know that Andy is in fact watching TV, they should reject what they take to be a false speaker meaning, the same way C rejects B's utterance in (13). Under this view, children's rejection of *think* sentences is a response that is itself adult-like. What isn't adult-like is the use of this rejection in contexts in which the intended speaker meaning is merely the literal meaning, and not an indirect assertion of the complement. We now turn to experimental evidence in support of this proposal.

We hypothesize that the reason children respond to the truth of the complement is that they tend to assume indirect assertion uses, even in cases where adults do not. When they hear a sentence like (14), they assume that the speaker indirectly asserts the complement, and reject the sentence, if they know the complement to be false. If children's errors with *think* are pragmatic rather than conceptual, their performance should improve via contextual manipulation. This is exactly what we find.

In Lewis *et al.* (2012), we manipulate the salience of belief to help children overcome their tendency to assume indirect assertion uses. Four-year-old children watch hide and seek stories where one character hides, and either *one* or *two* other characters look for him. In the *one*-seeker false belief condition, Swiper is hiding behind the curtain, but Dora thinks that he is behind the chest. Children then have to judge whether the sentence in (15) is true. In the corresponding *two*-seeker condition, another character, Boots, is also looking for Swiper, but he thinks that Swiper is behind the curtain. Because Dora and Swiper have conflicting beliefs about the same situation, this scenario highlights the salience of the beliefs each have, and helps prevent indirect assertion interpretations of the target sentence. Our results show that while four year olds tended to reject (15) in the *one*-seeker condition, their performance significantly improved in the *two*-seeker condition:

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

In Lewis *et al.*, *to appear*, we further test whether three year olds can respond to the falsity of a *think* sentence in a false belief context, where the *literal* meaning of the *think* sentence is false, but the complement clause is true. In a typical false belief scenario, 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 (15), while older children and adults accept it. In this context, the entire sentence is true, but the complement is false. According to the conceptual hypothesis, children reject (15) because they are unable to attribute to Dora a false belief. According to the pragmatic hypothesis, they reject (15) because they assume an indirect assertion of the complement, which they know to be false. The crucial manipulation is a change in the target sentence. In the same false belief scenario where Swiper is behind the curtain and Dora thinks that he is behind the chest, children have to assess the target sentence in (16):

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

In this scenario, (16) is false, but the complement is true. Here, the two hypotheses make different predictions. According to the conceptual hypothesis, children should *accept* (16). 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* (16): if children have access to the literal meaning of *think*, they should reject (16) regardless of the truth of its complement.

The conceptual hypothesis thus predicts that children should reject (16) and accept (17) for the same reason: they can't ascribe to Dora a false belief, so they reject a *think* sentence when the complement is false, but accept it when it is true. The pragmatic hypothesis predicts that children should reject *both* (15) and (16): (15) because of its assumed *speaker meaning*, a proffering of the complement (which is false); (16) because its *literal meaning* is false.

Our results support the pragmatic hypothesis over the conceptual hypothesis: children's responses were highly influenced by the truth of the complement when the entire sentence was true (as in (15)): they tended to accept the sentence if the complement was true, reject it if the complement was false, and vary when they didn't know whether the complement was true or not. However, when the sentence was false (as in (16)), they correctly rejected it, regardless of the truth of the complement. Thus, 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.

To sum up, three-year-olds appear to roughly have the right semantics for *think* (or at the very least, they know that it belongs to the class of representationals),¹ they are able to respond to the literal meaning of a *think* sentence, and reject it if it is false. They tend to further reject sentences that are literally true, but where the speaker meaning they assume is false.

Our pragmatic account, according to which children's errors with *think* sentences arise from their over-assuming assertive uses, is reminiscent of Diessel & Tomassello's (2001) proposal that children's initial understanding of *think* is as an illocutionary force marker. However, it crucially differs in that it allows children's knowledge to be continuous with adults' in a way that Diessel & Tomasello's does not. Furthermore, our results show that three year olds do in fact have access to the literal meaning of *think* sentences used to report a false belief.

Having now shown that children do have the right semantics for *think*, but pragmatics interferes, we ask why children do not make these kinds of pragmatic errors with *want*. Given its meaning in the adult grammar, *want* doesn't lend itself as easily to indirect assertion uses. But how could children know this *a priori*, before they have fully mastered either verb? Why don't they hypothesize a meaning for *want* that would lend itself to routine indirect assertions? We hypothesize that syntax here acts as a filter, and constrains children's hypothesis space for these verbs meanings.

4. The pragmatic syntactic bootstrapping hypothesis for attitude verbs

Three year olds consistently differ in their mastery of *think* and *want*: while they seem adult-like with *want*, they make consistent mistakes with *think*. According to the traditional view, the

source of children's difficulty with *think* is conceptual; according to our hypothesis, it is pragmatic. Whatever the source may be however, it is clear that children treat the two verbs differently, even before they have fully mastered at least one of these words. What gives rise to this early differential treatment of the two verbs? What gets them to attribute to *think* a different semantics than to *want*, one that leads them to reject *think* sentences when the complement is false?

One attractive hypothesis is that syntax provides initial cues that these verbs belong to different semantic classes. According to standard characterizations of the syntactic bootstrapping hypothesis, there are principled links between a word's meaning and its syntactic distribution, which learners exploit in word learning. However, attitude verbs present an immediate challenge to this view. What are these syntax/meaning mappings that learners are privy to, given that these mappings differ from one language to the next? How can they be universal in a way that makes them available to children early, and yet language-specific enough, so as to give rise to the right language-specific mappings?

As sketched in the introduction, we propose that the way children acquire the lexical semantics of attitude verbs and categorize them into different semantic classes is by exploiting correlations between the syntactic shape and the pragmatic uses of attitude reports. In this section, we develop this hypothesis. We first discuss the semantics of attitude reports and their subcategorization behavior in different languages, and then turn to their pragmatic uses. We then explain how syntax and pragmatics can work in tandem to help children figuring out attitude verb meanings.

4.1. *want* and *think*: semantics and syntactic subcategorization

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

- (17) a. **Representational attitudes:** *think, know, say, believe...*
b. **Preferential attitudes:** *want, wish, demand, order...*

That representationals like *think*, but not preferentials like *want*, deal in matters of truth is evidenced by the following contrast (Pestovsky 1992):

- (18) Mom thinks that Andy is going to bed, *which is true*.
(19) Mom wants Andy to be going to bed, *#which is true*.

Syntactic subcategorization seems to track this split in representationality, as has been most extensively argued in the formal linguistic literature on mood selection in Romance languages. In

Romance languages like French, representationals take complements with indicative mood, while preferentials take complements with subjunctive mood (Bolinger 1968; Hooper 1975; Farkas 1985; Villalta 2008, among others):

- (20) Maman pense que Andy est au lit.
Mommy thinks that Andy is-IND in bed.
- (21) Maman veut que Andy soit au lit.
Mommy wants that Andy is-SUBJ in bed.

English doesn't use mood productively. Instead, it tracks representationality in two ways: via (i) the finiteness of its complement: representationals tend to take finite complements, preferentials, nonfinite complements; (ii) "Sentence-lifting" ("slifting"; Ross 1973), where the main clause is inserted inside the complement, as in (22), and complement preposing, where the main clause follows the complement, as in (23), which are possible only with representationals (Bolinger 1968; Hooper 1975):²

- (22) a. John, I think, is home.
b. #John, I want, is home.
- (23) a. John is home, I think.
b. #John is home, I want/#John to be home, I want.

German presents an interesting case. While the use of mood is more productive than in English, it doesn't track representationality as in Romance. Rather, subjunctive mood is used to indicate reported speech. Moreover, German differs from English in that it does not use finiteness to mark representationality. Yet, German still tracks representational syntactically in at least two ways: via (i) slifting/preposing; (ii) word order differences in the complement. German is a verb final language. In embedded clauses the verb typically appears at the end:

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

However, representationals (26), unlike preferentials (27), optionally allow the verb of the embedded clause to appear in the clause's second position (so-called "verb second"), the word order found in main clauses (28) (Truckenbrodt 2006, Scheffler 2008):

- (26) Maria denkt, Peter kommt heute.
Maria thinks Peter comes today
'Mary thinks that Peter is coming today.'

- (27) * Maria will, Peter kommt heute.
 Maria wants Peter comes today
 ‘Mary wants Peter to come today.’
- (28) a. Peter kommt heute.
 Peter comes today
 b. *Peter heute kommt.
 Peter today comes
 ‘Peter comes today.’

We thus see that in languages like English, French and German, representationality is marked syntactically, in ways that could potentially help the learner. However, the way it is tracked seems to be language-specific: mood in Romance; finiteness and slifting in English; word order in German. If there are no universal syntactic reflexes of representationality, how useful can syntax be in helping the child pick up meaning differences between verbs like *think* and *want*? At most, it might help children realize that the verbs belong to different semantic classes. But how do they figure out what the correct semantic class is? Can syntactic distribution do more than cluster attitude verbs in different classes? Can it provide cues as to particular semantic classes? To address this question, we first turn to the pragmatic uses of attitude reports.

4.2. *want* and *think*: pragmatic uses

Attitude verbs split into two main classes: verbs that express truth judgments (representationals) and verbs that express preferences (preferentials). This split leads to different routine pragmatic enrichments. Because preferentials express preferences, speakers can easily use them to make indirect requests, by implicitly endorsing the expressed preference:

- (29) a. I want you to clean your room.
 b. Dad wants you to clean your room.
 c. Speaker meaning: *Clean your room!* [indirect request]

Because representationals express truth judgments, speakers can easily use them to indirectly assert the complement, by implicitly endorsing the expressed truth judgment:

- (30) a. I think Mary is in her room.
 b. Dad said that Mary is in her room.
 c. Speaker meaning: *Mary is (perhaps) in her room.* [indirect assertion]

Indirect assertion uses of *think* are rampant in speech to children: most *think* sentences children hear are with first person subjects in the present tense (Bloom *et al.* 1989, Dudley *et al.* 2016, a.o.), as in (31). In such cases, the main point of the speaker’s utterance (her “primary speech act” in Searle’s terms) is the proffering of the complement, rather than a mere belief report. The frequency of such uses may contribute to children assuming indirect assertions by default.

- (31) Child: What is this?
Mother: I think it's mustard.

Want doesn't express a judgment of truth that can be endorsed, as the infelicity (indicated with #) of the following sentences illustrates:

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

This is why indirect assertion uses are less readily available with *want*. They are not, however, impossible. Consider a variant of the Simons dialogue in (34):

- (34) A: Why isn't Louise coming to our meetings these days?
B: Henry wants her to be out of town.

We can make sense of B's utterance in response to A's question by making additional assumptions about why Henry's desires might be relevant to Louise's whereabouts. We might assume that Henry is Louise's boss, whose desires amount to commands, which Louise tends to obey. However, if Henry has no authority on Louise and his desires no bearing on her actions, B's utterance seems inappropriate (in contrast, B's utterance in (12) is appropriate even if Henry's beliefs have no bearing on Louise's actions).

Thus, while speakers often use *think* to indirectly assert the complement, they do not typically do so with *want*. Yet, it is always possible to use a *want* sentence to convey that the complement is true, as in the boss scenario in (34). Similarly, it is possible to use *think* to make indirect requests, as in (35), where the mother is asking her child to stop pulling on her hair:

- (35) I don't think you should use Mommy's hair to hold yourself up.

While such uses may be less routine, they raise an important asterisk as to the usefulness of indirect speech act cues to attitude meanings. To the extent that pragmatic bootstrapping can help, it needs to be constrained, to prevent children from hypothesizing desire meanings for verbs like *think* and belief meanings for verbs like *want*, in cases where these verbs are used for indirect requests and assertions, respectively. We will argue next that pragmatic bootstrapping is constrained by the syntax, and that pragmatics, in turn, guides syntactic bootstrapping.

4.3. The pragmatic syntactic bootstrapping hypothesis for attitude verbs

We have seen that *think* and *want* belong to two different semantic classes that are routinely used to perform different indirect speech acts: assertions and requests. We hypothesized that children’s errors with *think* are caused by their assuming indirect assertion uses, which leads them to respond to the truth (or rather falsity) of the complement, even in cases when adults do not. Children, however, do not make the same mistake with *want*: they never reject a *want* sentence because they know the complement to be false. Why not? Why don’t they assume indirect assertions with *want*? Why do they so systematically assume them with *think*? What gives away *want*’s and *think*’s semantic classes?

We saw that syntax may provide robust cues: in English, *think* takes finite complements, *want* nonfinite complements. A principled link between finiteness and representationality could help children categorize these two verbs. However, not all languages show the same finiteness distinction. In German, both *want* and *think* take finite complements. And yet children learning German show the same successes and failures with *want* and *think* as their English-speaking peers (Perner *et al.* 2003). This, in fact, is what led Perner and colleagues to conclude that the asymmetry in acquisition between the two verbs must reflect a conceptual rather than a linguistic problem, since, they argue, children’s comprehension of the two verbs is insensitive to language-specific differences. Given the varying cross-linguistic subcategorization profiles of attitude verbs, how does the learner know what to look for in the syntactic input, to figure out the semantic class that each verb belongs to?

We have seen different reflexes of representationality across languages: mood in Romance, finiteness in English, word order in German. Languages thus mark the same split syntactically, but with different syntactic reflexes. Children do not know what language they are learning, so how do they arrive at the correct language-specific mappings? A syntactic bootstrapping account needs to be abstract enough to be universal, and yet useful for any child learning any language. And it will only be useful if it can lead to language-specific mappings, despite this universality.

While the syntactic reflexes of representationality differ across languages, they converge in maintaining a distinction in whether the attitude verb allows declarative “main clause syntax” in its complement (Dayal & Grimshaw 2009). Representational verbs all take complement clauses that syntactically resemble declarative main clauses, but preferentials do not. In Romance, representational verbs take indicative complements, the mood of declarative main clauses. In English, they take finite complements, just like declarative main clauses. In German they allow verb second word order, just like declarative main clauses (see Table 1). The syntactic features differentiating main from embedded clauses thus differ across languages, but within a language, the syntax of declarative main clauses and that of the complements of representational verbs overlap.

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

Table 1 Syntactic reflexes of representationality

At this abstract level, the syntax distinguishes two classes of attitude verbs in the same way: representationals take complements with declarative syntax, preferentials do not. Paying attention to main clause syntax could thus help the learner differentiate *think* and *want* (and their French and German counterparts) early. But not only does it allow children to bin the verbs in different classes, main clause syntax could in fact be informative as to what the class is, given its connection to speech acts.

This is how: the syntactic reflexes are not random. The syntax associated with *assertions* (*declarative* main clauses) is the type of syntax found in complements of attitudes used for *indirect* assertions (i.e., representational attitudes). Thus, hearing attitude reports with declarative syntax in the complement might lead children to hypothesize that the speaker's message is an indirect assertion. This in turn might lead them to infer that the embedding verb is a kind of verb whose semantics lends itself to indirect assertions, i.e., one that expresses a truth judgment that the speaker can endorse, i.e., that it is a representational attitude.³

To sum up, we see that children make categorical distinctions between *think* and *want* early on, with systematic errors 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 argued that this is due to a tendency to assume indirect assertions of the complement with *think*. Three-year-olds do not reject *want* sentences when the complement is false because they do not assume indirect assertions with *want*. What leads children to assume such different semantics for *think* and *want* is their syntactic distribution: like other representationals, *think* takes complements that allow declarative syntax, *want*, like other preferentials, does not. While children do not have direct access to the underlying semantics, there are helpful correlations between syntax (clause type) and pragmatics (speech acts) that they can exploit, and give them a way into the broad semantic class each verb belongs to.

5. Evidence for pragmatic syntactic bootstrapping

For syntactic bootstrapping to work for attitude verbs, subclasses of attitude verbs must, in fact, have different syntactic distributions. In addition to differences in distribution, it must be that these differences can be linked to cross-linguistically stable properties, so that it is possible for learners to link the distributional differences to those aspects of meaning that explain them. Finally, it must be shown not only that the preconditions for syntactic bootstrapping are met, but also that learners are sensitive to the relevant distributional features and use them to make inferences about meaning. This is what we show in the next sections.

5.1. Predicting representationality from syntactic (main clause) features

In White *et al.* (2014, 2016a), we test whether subclasses of attitude verbs reliably show different distributional signatures. We collect two kinds of judgment data: first, syntactic acceptability judgments for a set of 30 attitude verbs in 19 syntactic environments, which we use to identify subclasses of verbs based on the similarity of judgments across all 19 environments. We find that the acceptability judgments are predictive of semantic subclasses of verbs, as identified by the linguistics literature (e.g., the representationality split). Second, we collect semantic similarity

judgments in sets of 3 for all 30 verbs. Again, we find that verbs can be classified along several meaning dimensions and that these dimensions are like those identified by prior linguistics literature. Finally, we show that the verb similarities identified in the semantic similarity task are highly predictive of the similarities identified in the syntactic acceptability judgment task. Together, these results indicate that attitude verbs with similar meanings show similar syntactic distributions. This result establishes the first condition on the syntactic bootstrapping hypothesis, namely that verb meaning is predictive of syntactic distribution.

In White *et al.* (2016b), we address the subsequent question of whether the semantic classes of attitude verbs are linked to cross-linguistically stable properties of syntactic distribution, focusing on the role of main-clause features as a cue to representationality. As discussed above, although languages differ in the particular features that distinguish the representational and preferential classes, there is a higher order generalization that links these classes to the syntax. Specifically, verbs from the representational class take complement clauses that have syntactic features of declarative main clauses. Our model proceeds in two steps. First, it identifies the morphosyntactic features of main clauses. In English, these features include the lack of a complementizer, the presence of subject/verb agreement, an obligatory overt subject, among others. The model then uses these features inside a complement clause to serve as the surface cues to the embedding verb's status as representational or preferential. So, by identifying the main clause features, the learner can use their presence or absence in complement clauses as a cue to an attitude verb's semantic class. Crucially, this model does not rely on specific morphosyntactic properties being connected with representationality. Rather, it has a more abstract expectation about verb classes, whose expression can be discovered depending on the surface features of the language being acquired. We show that this model figures out the representationality split in English. We are currently testing the viability of the model on Mandarin, a language with much sparser morphosyntactic cues (Huang *et al.*, *in prep*).

5.2. Sensitivity to syntactic cues in children's attitude verb learning

We now turn to the question of whether actual learners take main clause syntax as evidence for representational meanings. We present initial evidence that children do use syntactic cues like finiteness when figuring out the meanings of unfamiliar (*hope*) and novel attitude verbs.

So far, we have been assuming that attitudes either belong to the representational or the preferential class. This is however not quite accurate. A few verbs (*hope*, *fear*, *worry*...) share semantic and syntactic properties with both representationals and preferentials. Like *want*, *hope* clearly expresses a preference. However, *hope* further expresses doxastic possibility (Portner 1992, Scheffler 2008, Anand & Hacquard 2013), as illustrated by the following contrast:

- (36) a. Dora knows that it's not raining, #but she hopes that it is.
b. Dora knows that it's not raining, but she wants it to be.

(36a) seems contradictory in a way that (36b) isn't. This is because *hope* (but not *want*) conveys that the hoper believes that the complement is a live possibility. If Dora knows that it is not

raining, she cannot believe that it is possibly raining. Because *hope* expresses a doxastic possibility for its subject, a *hope* report can be used to indirectly proffer this possibility (Scheffler 2008):

(37) A: Where is John?

B: I hope that he's here/I think that he's here/??I want him to be here.

Hence, *hope* shares semantic features with both *want* (desire) and *think* (belief). Interestingly, it also shares syntactic features with both. In English, *hope* can take both finite and nonfinite complements. In German, it allows verb second word order in its complement. In Romance, it can take either subjunctive or indicative complements (Farkas 1985). Given that *hope* can appear with both finite and nonfinite complements, we can ask whether complement type influences children's interpretation of *hope* sentences. We predict that children should initially tend to assume indirect assertion uses with *hope* when it takes a finite complement, but not when it takes a nonfinite complement.

We test this hypothesis in a series of experiments probing four year olds' understanding of *hope* (Harrigan *et al.* 2015, 2016b). *Hope* is relatively uncommon in child-directed speech; it should thus be familiar enough to four year olds to know that it is an attitude verb, but perhaps not familiar enough for them to be sure about its meaning. We set up a game where both the beliefs and desires of a puppet, Froggy, are salient, and test whether the syntactic shape of the complement influences children's interpretation of *hope*.

In our game, the child and one experimenter are behind an occluder, while Froggy is on the other side. In front of the child is a box with 40 wooden hearts and stars, which are either red or yellow. Color is predictive of shape: 15 of the hearts are red, 5 are yellow, and 15 of the stars are yellow, 5 are red. The child and the experimenter pull shapes out of the box to show Froggy, and every time the shape is a heart, the child gives Froggy a sticker. Froggy likes getting stickers, therefore his desire on every trial is that the shape be a heart. On each trial, before Froggy sees what the shape is, the child and the experimenter show him a "clue," which is ambiguous as to shape but not color, by inserting a point (of the heart or of the star) through an opening in the occluder (see Figure 1). Thus, on every trial, Froggy has both a desire about shape (he always wants the shape to be a heart), and a belief about shape (when it is red, he always guesses that it's a heart and when it is yellow, that it's a star). Another puppet, Booboo, whom the child is told is "silly and wants to learn how to play the game, but often gets things mixed up," utters test sentences about what Froggy wants (38), thinks (39), or hopes (40)-(41). The child's task is to say whether Booboo is right.

(38) Froggy wants it to be a heart/star!

(39) Froggy thinks that it's a heart/star!

(40) Froggy hopes to get a heart/star!

(41) Froggy hopes that it's a heart/star!

Our results replicate the traditional split in performance with *think* and *want*. Children correctly judge *want* sentences even when the reported desire conflicts with reality. With *think*, they tend to make false belief errors, and reject *think* sentences that report beliefs that conflict with reality. Crucially, children’s responses to *hope* sentences differ significantly, based on the syntactic frame in which they are presented. With a finite complement, their responses pattern with the responses to *think* sentences, showing the same kinds of false belief errors. However, with a nonfinite complement, their responses pattern with the responses to *want* sentences.

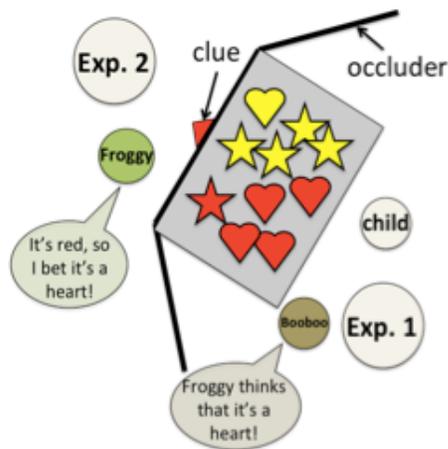


Figure 1: Set-up for task testing children’s comprehension of *think*, *want* and *hope* (from Harrigan *et al.* 2016b).

These results reveal that children use complement syntax to identify aspects of an attitude verb’s meaning: four year olds treat *hope* as a desire verb when it takes a nonfinite complement, and as a belief verb when it takes a finite complement, as signaled by their false belief errors with the latter. One potential concern with this finding is that it depends on children’s performance with a real verb (though one that they likely have very little experience with) and that it uses the false belief error as evidence of the verb’s representationality.

To get a more direct demonstration of the role of syntax in learning attitude meanings, in Lidz *et al.* (*to appear*), we test four year olds’ understanding of a *novel* attitude verb, in an experiment building on Asplin (2002)⁴. In a representative story, Dad (the DISCOVERER) leaves chicken legs on the kitchen table and goes to work. Fido (the ACTOR) arrives hungry but can’t find any food. Jimmy (the ENTICER) arrives and ENTICES Fido to eat the chicken legs, puts them in Fido’s bowl and leaves. Fido decides to eat the chicken. When Dad returns, he finds his chicken legs gone and chicken bones in Fido’s bowl, thereby DISCOVERING that Fido ate his chicken. The enticer has a desire (for Fido to eat the chicken), while the discoverer has a belief (that Fido ate the chicken). After each story, two puppets deliver test sentences as descriptions of the story using the same novel verb and complement syntax (finite vs. nonfinite), but with different subjects:

- (42) FINITE CONDITION
Puppet 1: *Dad* gorped that Fido ate the chicken.

- Puppet 2: *Jimmy* gorped that Fido ate the chicken.
(43) NONFINITE CONDITION
Puppet 1: *Dad* gorped Fido to eat the chicken
Puppet 2: *Jimmy* gorped that Fido ate the chicken.

Recall that verbs that express preferences (e.g., enticings) take nonfinite complements, while verbs that express beliefs (e.g., discoveries) take finite complements. If children are sensitive to this mapping, they should pick the discoverer when they hear a sentence with a finite complement, but the enticer when they hear a sentence with a nonfinite complement. This is what we find. In the finite condition, children were significantly more likely to pick the puppet that mentioned the discoverer, but in the nonfinite condition, they were significantly more likely to pick the one that mentioned the enticer.

6. Conclusions and implications

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. We have focused here on how children learn the meaning of *think* and *want*, two verbs that children seem to differentiate early on, even before they have fully mastered their meaning, and examined the syntactic and pragmatic contributors to this learning process.

We have argued that because children do not get exposed to the semantics directly, they have to reconstruct it by exploiting correlations between syntactic distribution 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 representationals, like *think*, are often used for indirect assertions 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. This is illustrated in figure 2. The observable features of the language and context appear below the dotted line and the linking between semantics, syntax and pragmatics appears above the dotted line. The learner uses observations about the use of a sentence in order to infer its semantic properties.

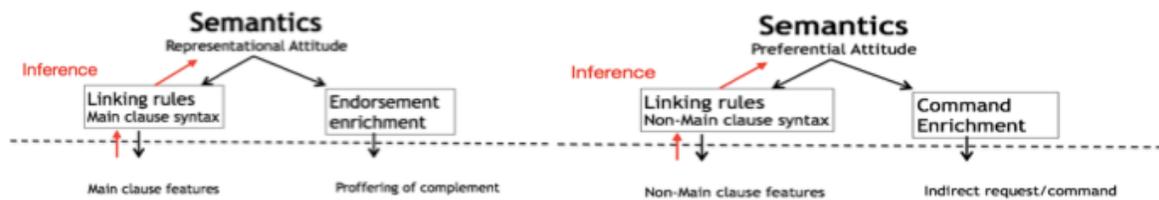


Figure 2: Pragmatic syntactic bootstrapping for representationals (*think*) and preferentials (*want*)

Preferentials like *want* report preferences, and are often used for indirect requests. We have seen that young children seem adult-like with *want*, in that they never respond to the falsity of the complement. This, we argued, is because *want* is not typically used for indirect assertions, and children are cued to this from the fact that *want* doesn't take complements with declarative main clause syntax. But might they not make other speaker meanings errors, by over-assuming, for instance, that a desire report is an indirect request? We leave this intriguing possibility for future research.

We have argued that for syntactic bootstrapping to work for attitude meanings, it needs to be abstract enough to be used by learners of various languages, but still lead to language-specific syntax/semantics mappings. The pragmatic syntactic bootstrapping hypothesis we have proposed doesn't require hard-coding language-specific information, such as finiteness, but it does require that learners be equipped with certain expectations by the time they are learning attitude meanings. Minimally, they would need an understanding that (i) 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; (ii) certain types of clauses are strongly associated with certain types of speech acts (e.g., declarative clauses with assertions); (iii) speech acts can be indirect and attitude reports are well suited for this; (iv) the type of clause that an attitude verb combines with is predictive of its meaning, in matching the clause type of the canonical speech act the verb easily lends itself to.

We have focused on a handful of languages here, both because their syntax and semantics and their acquisition have been extensively studied. Other languages, however, may not mark representationality in such explicit ways. Do children learning such languages show the same acquisitional profile as their English learning peers? Note that even in a language like Mandarin, which does not seem to mark overtly (and perhaps even covertly) mood or finiteness, there may still be syntactic differences that might cue in the learner as to their semantics, for instance in whether attitudes allow aspect markers and overt subjects in their complement (Huang *et al.*, in prep). But it remains to be determined whether such cues are sufficient, and how children acquire attitude verbs in such languages.

Finally, we have argued that children's pragmatic competence, while not completely adult-like, is quite sophisticated. If our proposal is on the right track, children's errors with *think* arise from children reading too much into the intentions of a speaker in using a *think* sentence, namely, in assuming that the speaker is "proffering" the content of the complement. This pragmatic overdrive seems to go counter to the conventional wisdom, according to which children tend to

be hyper literal and unable to compute enriched meanings. This conventional wisdom is motivated by the literature on scalar implicatures, starting with Noveck's (2001) pioneering study, which shows that with scalar expressions, children tend to respond to literal meaning and fail to compute an enriched meaning. The question in that literature is how children get from literal to enriched meaning. The question we addressed here is the converse: given that what children are ever exposed to are speaker meanings, and given that expressions like attitude verbs are routinely used in enriched contexts, how do children extract their literal content? Our results suggest that children have an early appreciation that literal and speaker meanings do not always align. Children can, and in fact, do hypothesize speaker meanings, but they have trouble figuring out when speaker meanings are merely literal meanings. If this is correct, children's difficulty with scalar implicatures cannot be due to an inability to assume speaker meanings that go beyond literal meaning. Instead, it might stem from difficulty figuring out what alternatives are relevant in a given context (see Lewis 2013, Pouscoulous 2012 and references therein). Our results thus add to the growing body of literature that argues that young children's pragmatic abilities have been underestimated: children's pragmatic sophistication is present early on, and is in fact necessary to get attitude verb learning off the ground.

References

- Anand, P. and V. Hacquard (2013) Epistemics and attitudes. *Semantics and Pragmatics* 6(8), 1-59.
- Apperly, I., & Butterfill, S. A. (2009) Do humans have two systems to track beliefs and belief-like states? *Psychological Review*, 116(4), 953-970.
- Asplin, K. (2002) Can complement frames help children learn the meaning of abstract verbs? PhD. Thesis, University of Massachusetts, Amherst.
- Austin, J.L. (1975) How to do things with words. *Oxford University Press*.
- Baldwin, D. (1991) Infants' contribution to the achievement of joint reference. *Child Development* 62, 875-890.
- Baron Cohen, S., A. Leslie, and U. Frith (1985) Does the autistic child have a "theory of mind"? *Cognition* 21, 37-46.
- Bartsch K. & H.M. Wellman (1995) *Children talk about the mind*. New York: Oxford University Press.
- Bloom, P. (2001) *How children learn the meaning of words*. MIT Press.
- Bloom, L., Rispoli, M., Gartner, B., & Hafitz, J. (1989) Acquisition of complementation. *Journal of Child Language*, 16, 101-120.
- Bolinger, D. (1968) *Aspects of Language*. New York: Harcourt, Brace, and World.
- Carey, S. (2010) Beyond Fast Mapping. *Language Learning and Development* 6(3), 184-205.
- Carruthers, P. (2013) Mindreading in infancy. *Mind and Language* 28, 141-172.
- Csibra, G., S. Biro, O. Koos, & G. Gergely (2003) One-year-old infants use teleological representations of actions productively. *Cognitive Science* 27, 111-133.
- Clark, E. V., & Amaral, P. M. (2010) Children build on pragmatic information in language acquisition. *Language & Linguistics Compass* 4(7), 445-457.
- Dayal, V. and J. Grimshaw (2009) Subordination at the interface: A quasi-subordination hypothesis. Ms., Rutgers.
- de Villiers, J.G. and P.A. de Villiers (2000) Linguistic Determinism and the Understanding of False Beliefs, In P. Mitchell and K. Riggs (eds.) *Children's Reasoning and the Mind*. Hove:

- Psychology Press.
- de Villiers, J.G. and J. Pyers (2002) Complements to Cognition: A Longitudinal Study of the Relationship between Complex Syntax and False-Belief Understanding, *Cognitive Development* 17, 1037-1060.
- De Villiers, J.G. (2005) Can language acquisition give children a point of view? In J. Astington, & J. Baird (eds.) *Why Language Matters for Theory of Mind*. New York: Oxford University Press, 186-219.
- de Villiers, J.G. (2007) The interface of language and theory of mind. *Lingua*, 117, 1858-1878.
- Diessel, H. and M. Tomasello (2001) The acquisition of finite complement clauses in English: A corpus-based analysis. *Cognitive Linguistics* 12(2), 97-142.
- Dudley, R., N. Orita, V. Hacquard, and J. Lidz (2015) In F. Schwarz (ed.) *Experimental Perspective on Presuppositions*. Studies in Theoretical Psycholinguistics Series. Springer.
- Dudley, R., M. Rowe, V. Hacquard, and J. Lidz (2016) Acquiring the factivity of *know*. Article submitted for publication.
- Farkas, D. (1985) *Intensional Descriptions and the Romance Subjunctive Mood*. New York: Garland.
- Fisher, C. H. Gleitman and L.R. Gleitman (1991) On the semantic content of subcategorization frames. *Cognitive Psychology* 23, 331-392.
- Fisher, C., Hall, D. G., Rakowitz, S., & Gleitman, L. (1994) When it is better to receive than to give: Syntactic and conceptual constraints on vocabulary growth. *Lingua*, 92, 333-375.
- Fisher, C. (1996) Structural limits on verb mapping: The role of analogy in children's interpretation of sentences. *Cognitive Psychology*, 31, 41-81.
- Fisher, C. (2002) Structural limits on verb mapping: the role of abstract structure in 2.5-year-olds' interpretations of novel verbs. *Developmental Science*, 5(1), 55-64.
- Fisher, C., Klinger, S. L., Song, H. (2006) What does syntax say about space? 26-month-olds use sentence structure in learning spatial terms. *Cognition* 2006, 101, B19-B29.
- Fisher, C., Y. Gertner, R.M. Scott, and S. Yuan (2009) Syntactic bootstrapping. *Wiley Interdisciplinary Reviews: Cognitive Science* 1: 143-149.
- Gergely, G., Z. Nadasdy, G. Csibra & S. Biro (1995) Taking the intentional stance at 12 months of age. *Cognition*, 56, 165-193.
- Giannakidou, A. (1997) *The landscape of polarity items*. PhD. thesis, University of Groningen, The Netherlands.
- Gillette, J., H. Gleitman, L. Gleitman and A. Lederer (1999) Human simulations of vocabulary learning. *Cognition*, 73, 135-176.
- Gleitman, L. (1990) The structural sources of verb meanings. *Language Acquisition* 1(1), 3-55.
- Gleitman, L., K. Cassidy, R. Nappa, A. Papafragou, and J. Trueswell (2005) Hard words. *Language Learning and Development* 1(1), 23-64.
- Goodman 1955
- Grice, H.P. (1975) Logic and Conversation. In P. Cole and J. Morgan (eds.) *Syntax and Semantics*, vol.3, Academic Press.
- Hacquard, V. (2014) Bootstrapping attitudes. In *Proceedings of SALT 24*.
- Halberda, J. (2006) Is this a dax which I see before me? Use of the logical argument disjunctive syllogism supports word-learning in children and adults. *Cognitive Psychology*, 53(4), 310-344.
- Harrigan, K., V. Hacquard, and J. Lidz (2016a) Three-year-olds' understanding of desire reports is robust to conflict. Article submitted for publication.

- Harrigan, K., V. Hacquard, and J. Lidz (2016b) Syntactic bootstrapping and the acquisition of attitude verbs: *think*, *want* and *hope*. In K. Kim *et al.* (eds.) *Proceedings of WCCFL 33*, 196-206.
- Harrigan, K., V. Hacquard, and J. Lidz (2016) Hope for syntactic bootstrapping. Article submitted for publication.
- Hintikka, J. (1969) Semantics for propositional attitudes. Springer Netherlands, 87-111.
- Heim, I. (1992) Presupposition projection and the semantics of attitude verbs. *Journal of Semantics* 9, 183-221.
- Hansen, M. B. (2010) If you know something, say something: young children's problem with false beliefs. *Frontiers in Psychology*, 1(23).
- Helming, K. A., Strickland, B., & Jacob, P. (2014) Making sense of early false-belief understanding. *Trends in Cognitive Sciences*.
- Hooper, J. B. (1975) On assertive predicates. In J. Kimball (ed.) *Syntax and Semantics* 4, 91-124.
- Huang, N., C.-H. Liao, A. White, V. Hacquard and J. Lidz (in prep). Syntactic bootstrapping and attitude predicates in Mandarin Chinese. UMD.
- Johnson, C. and M. Maratsos (1977) Early comprehension of mental verbs: *think* and *know*. *Child Development*, 1743-1747.
- Johnson, V. J de Villiers, K. D'Amato, C. Deschamps & S. Huneke (2002) 'Can syntax give you complements? Poster presented at the IASCL/SCRLD meeting, Madison, WI.
- Landau, B. and L. Gleitman (1985) *Language and Experience. Evidence from the blind child*. Cambridge, MA: Harvard University Press.
- Leslie, A.M. (1994) Pretending and believing: Issues in the theory of ToMM. *Cognition*, 50, 211-38.
- Lewis, S. (2013) Pragmatic enrichment in language processing and development. PhD. thesis, University of Maryland, College Park.
- Lewis, S., V. Hacquard, and J. Lidz (2012) The semantics and pragmatics of belief reports in preschoolers. In A. Chereches (ed.) *Proceedings of SALT 22*, 247-267. Ithaca, NY: CLC.
- Lewis, S., V. Hacquard, and J. Lidz (2016) "Think" pragmatically: Children's interpretation of belief reports. To appear in *Language Learning and Development*.
- Lidz, J., L. Gleitman & H. Gleitman (2003) Understanding how input matters: Verb learning and the footprint of universal grammar. *Cognition*.
- Lidz, J., Dudley, R., and V. Hacquard (2017) Children use syntax of complements to determine meaning of novel attitude verbs. To appear in *Proceedings of BUCLD 41*.
- Markman, E. M. (1990). Constraints children place on word meanings. *Cognitive Science*, 14, 154-173.
- Moore, C., Jarrold, C., Russell, J., Lumb, A., Sapp, F., MacCallum, F. (1995) Conflicting desire and the child's theory of mind. *Cognitive Development*, 10, 467-482.
- Naigles, L. (1990) Children use syntax to learn verb meanings. *Journal of child language*, 17(02), 357-374.
- Naigles, L.R. (1996) The use of multiple frames in verb learning via syntactic bootstrapping. *Cognition*, 58(2).
- Naigles, L.R. and E. Kako (1993) First Contact in Verb Acquisition: Defining a Role for Syntax. *Child Development* 64, 1665-1687.
- Noveck, I. (2001) When children are more logical than adults: experimental investigations of scalar implicatures. *Cognition* 78, 165-188.

- Onishi, K., and R. Baillargeon (2005) Do 15-month-old infants understand false belief? *Science* 308, 255-258.
- Papafragou, A., K. Cassidy, and L. Gleitman (2007) When we think about thinking: The acquisition of belief verbs. *Cognition* 105, 125-165.
- Perner, J. (1991a) Understanding the representational mind. Cambridge, MA: MIT Press.
- Perner, J. (1991b) On representing that: The asymmetry between belief and desire in 38 children's theory of mind. In D. Frye, & C. Moore (eds.), *Children's theories of mind: Mental states and social understanding*. Hillsdale, NJ: Lawrence Erlbaum, 139-56.
- Perner, J., & Ruffman, T. (2005) Infants' insight into the mind: How Deep? *Science* 308, 214-216.
- Perner, J., M. Sprung, P. Zauner, and H. Haider (2003) 'Want that' is understood well before 'say that', 'think that', and false belief: a test of de Villiers's linguistic determinism on German-speaking children. *Child Development* 74, 179-188.
- Perner, J., Zauner, P., & Sprung, M. (2005) What does "that" have to do with point of view? Conflicting desires and "want" in German. In J.W. Astington, & J. Baird (eds.), *Why language matters for theory of mind*. New York, NY: Oxford University Press, 220-44.
- Perner, J., & Roessler, J. (2012) From infants' to children's appreciation of beliefs. *Trends in Cognitive Sciences*, 16(10), 519-525.
- Pesetsky, D. (1992) Zero syntax II: An essay on infinitives. Ms., MIT.
- Pinker, S. (1989) *Learnability and Cognition*. MIT Press.
- Portner, P. (1992) *Situation theory and the semantics of propositional expressions*. PhD. thesis. UMass Amherst.
- Pouscoulous, N. (2012) Early pragmatics with words. In F. Liedtke and C. Schulze (eds.) *Beyond the Words. Content, Context, and Inference*. Mouton Series in Pragmatics (MSP). De Gruyter Mouton, 149-172.
- Quine, W.V.O. (1951) Two dogmas of empiricism. *Philosophical Review* 60(1): 20-43.
- Rakoczy, H., F. Warneken, and M. Tomasello (2007) 'This way!', 'No! That way!'—3 year olds know that two people can have mutually incompatible desires. *Cognitive Development* 22, 47-68.
- Repacholi, B. M., & Gopnik, A. (1997) Early reasoning about desires: Evidence from 14- and 18-month-olds. *Developmental Psychology*, 33(1), 12–21.
- Resnik, P. (1996) Selectional constraints: An information-theoretic model and its computational realization. *Cognition* 61.1, 127-159.
- Rubio-Fernández, P., & Geurts, B. (2013) How to pass the false-belief task before your fourth birthday. *Psychological Science*, 24(1), 27-33.
- Scheffler, T. (2008) *Semantic Operators in Different Dimensions*. PhD. thesis, UPenn.
- Searle, J.R. (1969) *Speech acts: An essay in the philosophy of language*. Vol. 626. Cambridge University Press.
- Searle, J.R. (1975) *Indirect speech acts. Expression and Meaning: Studies in the Theory of Speech Acts*, Cambridge: Cambridge University Press
- Shatz, M. (1978) On the development of communicative understandings: an early strategy for interpreting and responding to messages. *Cognitive Psychology* 10, 271-301.
- Shatz, M., H. Wellman and S. Silber (1983) The acquisition of mental verbs: a systematic investigation of the first reference to mental state. *Cognition* 14: 301-321.
- Simons, M. (2007) Observations on embedding verbs, evidentiality, and presupposition. *Lingua* 117(6), 1034-1056.

- Snedeker, J. & L. Gleitman (2004) Why it is hard to label our concepts. In S. Waxman & G. Hall (eds) *Weaving a Lexicon*. MIT Press.
- Song, H., K. Onishi, R. Baillargeon, and C. Fisher (2008) Can an agent's false belief be corrected by an appropriate communication? *Psychological reasoning in 18-month-old infants. Cognition* 109, 295-315.
- Southgate, V., A. Senju, and G. Csibra (2007) Action anticipation through attribution of false belief by 2-year-olds. *Psychological Science* 18(7), 587-592.
- Sowalsky, E., Hacquard, V., & Roeper, T. (2009) Is PP opacity on the path to false belief? In J. Crawford, K. Otaki, & M. Takahashi (eds.), *Generative Approaches to Language Acquisition North America (GALANA) 3*. Somerville, MA: Cascadilla Proceedings Project, 263-261.
- Spekman, N. J., & Roth, F. P. (1985) Preschool children's comprehension and production of directive forms. *Journal of Psycholinguistic Research*, 14(3), 331-349.
- Spelke, E. S. (1990) Principles of object perception. *Cognitive science*, 14(1), 29-56.
- Stalnaker, R. (1984) *Inquiry*, Cambridge, MA: The MIT Press.
- Steglich-Petersen, A., & Michael, J. (2015) Why Desire Reasoning is Developmentally Prior to Belief Reasoning. *Mind & Language*.
- Tardif, T. and H. Wellman (2000) Acquisition of mental state language in Mandarin and Cantonese-speaking children. *Developmental Psychology* 36(1), 25-43.
- Truckenbrodt, H. (2006) On the semantic motivation of syntactic verb movement to C in German. *Theoretical Linguistics* 32, 257-306.
- Urmson, J. O. (1952) Parenthetical Verbs. *Mind*, New Series 61(244), 480-496.
- Villalta, E. (2008) Mood and gradability: an investigation of the subjunctive mood in Spanish. *Linguistics and Philosophy* 31, 467-522.
- Waxman, S.R. and J. Lidz (2006) Early Word Learning, in D. Kuhn & R. Siegler (eds). *Handbook of Child Psychology: Cognition, Perception and Language* (6th Edition). John Wiley & Sons: NY, 299-335.
- Wellman, H.M., & Bartsch, K. (1988) Young children's reasoning about beliefs. *Cognition* 30, 239-77.
- Wellman, H.M., & Woolley, J.D. (1990) From simple desires to ordinary beliefs: The early development of everyday psychology. *Cognition* 35, 245-75.
- Wellman, H., D. Cross, and J. Watson (2001) Meta-analysis of theory-of-mind development: the truth about false belief. *Child Development* 72, 655-684.
- Westra, E. and P. Carruthers (2017) Pragmatic development explains the theory of mind scale. *Cognition* 157.
- White, A. S. (2015) *Information and incrementality in syntactic bootstrapping*. Doctoral Dissertation, University of Maryland.
- White, A. S., R. Dudley, V. Hacquard, and J. Lidz (2014) Discovering classes of attitude verbs using subcategorization frame distributions. In H. Hsin-Lun, E. Poole and A. Rysling (eds.) *Proceedings of NELS 43*. Amherst, MA: GLSA University of UMass Amherst.
- White, A. S., V. Hacquard, and J. Lidz (2016a) Semantic information and the syntax of propositional attitude verbs. To appear in *Cognitive Science*.
- White, A. S., V. Hacquard, and J. Lidz (2016b) Main clause syntax and the labeling problem in syntactic bootstrapping. To appear in K. Syrett and S. Arunachalam (eds.) *Semantics in Acquisition*. Trends in Language Acquisition Research (TiLAR). Amsterdam: John Benjamins Publishing Company.

- Wimmer, H. and J. Perner (1983) Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition* 13, 103-128.
- Woodward, A. L. (1998) Infants selectively encode the goal object of an actor's reach. *Cognition*, 69, 1-34.
- Yuan, S., & Fisher, C. (2009) "Really? She blicked the baby?" Two-year-olds learn combinatorial facts about verbs by listening. *Psychological Science*, 20(5), 619-626.

Acknowledgements: This research was supported by NSF grant #BCS-1124338. We are grateful to our collaborators Shevaun Lewis, Aaron White, Kate Harrigan, Rachel Dudley, Naho Orita, Morgan Moyer, and Meredith Rowe, and to our research assistants. For useful feedback and discussion, thanks to Pranav Anand, Erin Eaker, Jane Grimshaw, John Grinstead, Chris Kennedy, Angelika Kratzer, Keir Moulton, Magda Oiry, Paul Pietroski, Tom Roeper, Florian Schwarz, Jill De Villiers, Evan Westra, and especially Alexander Williams.

¹These results are compatible with children having a "factive" semantics for *think*, such that the speaker would be presupposing the truth of the complement (as with factive *know*). However, see Dudley *et al.* (2015) for evidence that three year olds treat *think* and *know* differently under negation, and Hacquard (2014) for discussion.

²While slifting/preposing are less prevalent in French, they are sensitive to the representationality split:

- (i) a. Jean est à la maison, je pense.
Jean is home, I think.
- b. *Jean {est/soit} à la maison, je veux.
Jean (is-IND/is-SUBJ) home, I want.

³It can't be that children only pay attention to the complement and assume that it is indirectly asserted. As we saw in section 3.2, three-year-olds do not ignore *think*: they *reject* false sentences that have a *true* complement. It thus appears that children keep track not only of the shape of the complement, but also of the fact that it is *embedded*.

⁴Asplin's results were largely inconclusive, but methodological issues may be at play.