

Discovering the factivity of *know**

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Abstract How do children discover which linguistic expressions are associated with presuppositions? Do they take a direct strategy of tracking whether linguistic expressions are associated with particular speaker presuppositions? This strategy may fail children who are trying to learn about the presuppositions of so-called “soft” presupposition triggers, which can be readily used even when the relevant would-be presupposed content is not part of the common ground. We present a corpus study with the soft trigger *know* and the related, but non-presuppositional *think*. We find that a direct learning strategy would indeed run into problems for such a soft trigger given the nature and availability of evidence in children’s linguistic input.

Keywords: presuppositions, soft triggers, factivity, veridicality, attitude verbs

1 Introduction

How do children discover which linguistic expressions are associated with presuppositions? The acquisition literature typically focuses on when children master presupposition triggers (Falmagne, Gonsalves & Bennett-Lau 1994; Berger & Höhle 2012; Jasbi 2015; among many others), and remains mostly silent on how children might achieve this (see Schulz 2003 for a notable exception). In the formal semantics

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literature, when the “how” question is broached, the assumption is that children figure out presupposed content by directly tracking what speakers presuppose when using presupposition triggers (see for instance [Matthewson 2006](#)). But this assumption seems to under-appreciate the difficulty of identifying triggers for several reasons, not the least of which is that some triggers (Abusch’s “soft triggers”) are often used when the presupposition that they would typically trigger is not common knowledge.

In this paper, we focus on the soft trigger *know*, which as a **factive** verb is taken to presuppose that the proposition expressed by its complement is true ([Kiparsky & Kiparsky 1970](#); [Stalnaker 1974](#)). We ask whether there is enough evidence in children’s linguistic input to identify its presupposition using such a direct strategy. We focus on *know* because it is particularly frequent in speech to children ([MacWhinney 2000](#)) as compared to other presupposition triggers. In addition, there is another high frequency attitude verb which is closely related to *know* but is non-factive, and can serve as a comparison case: *think*. We ask whether children can track speaker presuppositions in order to figure out that *know* is factive but that *think* is not. Our results suggest that an acquisition route which relies on tracking whether uses of *know* presuppose or entail its complement may fail, as they are relatively indistinguishable from uses of *think* in this respect. We briefly point to alternative routes to figuring out the factivity contrast, which rely on more indirect cues, such as the syntactic distribution of these two verbs (syntactic bootstrapping) and the kinds of indirect speech acts these verbs are typically used for (pragmatic bootstrapping).

2 Acquiring presupposition triggers

The most direct avenue to discover which words trigger presuppositions would be to track the background assumptions that a speaker makes when using a presupposition trigger:

- (1) Pay attention to everything that speakers presuppose and notice that whenever expression *X* is used, *p* is always common knowledge. Conclude that *p* is a presupposition triggered by *X*.

This is essentially an extension of the associationist view of how the mapping problem is solved for non-presupposed content (e.g., learning that *apple* means APPLE). While this direct strategy is the most straightforward in principle, it could prove particularly challenging for presupposed content. For one, presuppositions are — by their nature — backgrounded: they might thus fly under the learners’ radar. Furthermore, speakers make many presuppositions when they speak that are not conventionally associated with any particular expression ([Stalnaker 1974](#)). Soft triggers present a further challenge for this strategy, in that their presuppositions

seem to be easily defeasible. If speakers fail to consistently presuppose the relevant presupposition, children may need to rely on other routes to identify the trigger.

3 Factivity: semantic and pragmatic background

3.1 Theories of presupposition triggering

The literature on presupposition triggering asks how different expressions get to be associated with their presuppositions, and two main types of accounts have emerged. Semantic accounts, following Strawson (1950) and Frege (1948), define presuppositions according to patterns of entailment. For example, if a sentence presupposes p , then the question of the sentence's truth can only arise if p is true. Adopting this perspective, authors such as Karttunen (1974), Heim (1983), and Van der Sandt (1992) treat presuppositions as constraints imposed on the conversational context that are arbitrarily specified in the lexicon. In contrast, pragmatic accounts of presupposition treat them as constraints on what the speaker can do with a presupposition trigger and the conditions that must be met in order to felicitously and successfully utter sentences with this trigger (Stalnaker 1974; Kempson 1975; Wilson 1975; Boër & Lycan 1976; Karttunen & Peters 1977; Levinson 1983; Chierchia & McConnell-Ginet 2000; Kadmon 2001; Simons 2001, 2003; Abrusán 2011).

These two types of accounts are not mutually exclusive because accepting one type of account for a particular trigger does not preclude accepting the alternative for other triggers. While the original Stalnakerian view leaves open the possibility that all presupposition triggering is pragmatic, Stalnaker himself admits that some presuppositions may need to be arbitrarily specified in the lexicon and the recent pragmatic accounts of presuppositions all concern soft triggers, and aim at capturing the ease with which their presuppositions can be canceled, in comparison with those of hard triggers. One prominent view for hard triggers is that the presupposed content is anaphoric. Hence presuppositions may form a heterogeneous class (although see Abrusán 2016).

3.2 Cognitive vs. emotive factives

Factives can be roughly divided into two classes: cognitive factives and emotive factives. Cognitive factives (e.g., *realize*, *discover*, *forget*) take true complements, and the truth of the complement is furthermore typically presupposed ((Kiparsky & Kiparsky 1970). Cognitive factives are a prime example of soft triggers, given that their presuppositions are easily defeasible (see 2 from Karttunen 1971).

(2) If I **realize** later that I have not told the truth, I will confess it to everyone.

Emotive factives (e.g., *regret*, *hate*, *be happy*) have an additional entailment that the subject has an emotional attitude towards that complement. Emotive factives background not only the truth of their complement, like cognitive factives, but also that their subject believes the complement to be true (3).

- (3) John hates that it is raining.

While cognitive factives are generally assumed to be soft triggers, the status of emotive factives is more controversial. [Abbott \(2006\)](#) assumes that they are hard triggers, while [Simons \(2007\)](#) and [Abrusán \(2011\)](#), take all factives are soft triggers.

The status of *know* is also controversial. Its presupposition seems less easily cancelable than that of cognitive factives (compare 4 to 2 and ??).

- (4) If I **know** later that I have not told the truth, I will confess it to everyone.

Yet its presupposition is often not contextually-supported (5), at least in naturalistic speech between adults. Utterances of *x knows p* can be used when the addressee has no reason to take the truth of the complement for granted: discourse initial uses of *x knows p* are felicitous and the majority of uses of *x knows p* in speech between adults are, in fact, “informative” in that they provide hearers with new information ([Spencer 2003](#)). Second, [Simons \(2007\)](#) shows that the complement of *know* can provide content which addresses the QUD (6). And lastly, *p* does not always project out of family-of-sentences contexts with *x knows p*, as in examples provided by [Beaver \(2010\)](#), including (7).

- (5) a. Did you **know** that John won the lottery? (uttered discourse initially)
 b. No, I didn't. That's amazing!
- (6) a. Where was Louise yesterday?
 b. I **know** from Henry that she was in Princeton. (from [Simons 2007](#))
- (7) ... I haven't tried this with wombats though, and if anyone discovers that the method is also wombat-proof, I'd really like to **know**. ([Beaver, 2010](#), ex. 32)

To make matters even more difficult for the language-learning child, the cluster of properties in (5-7) might make *know* seem no different from a non-factive verb like *think* — at least with respect to its status as a presupposition trigger. To compare with *know*, *think* can also be used to provide new information (8), to address the QUD (9), and the complement of *think* can even appear to project, even when the complement of *know* does not (see 10 modified slightly from [Simons, Beaver, Roberts & Tonhauser 2017](#)).

- (8) I **think** that Mary won the lottery! (uttered discourse initially)
- (9) a. Where's Mary?

b. I **think** she's at home.

(10) Q: Why is it taking Phil so long to get back here?

A: He doesn't **know** that the car's parked in the garage!

A': He doesn't **think** that the car's parked in the garage!

3.3 Theories of factivity

Any account of cognitive factives must capture the ease with which their presuppositions are canceled. For semantic accounts, where presuppositions are conventionally associated with the factive trigger, this would mean that the presuppositions are often accommodated locally (Heim 1983). For pragmatic accounts, cancellation is expected because presuppositions are conversationally derived.

Several pragmatic accounts of factivity (Stalnaker 1974; Simons 2001) propose that factive sentences like (11) have (at least) two relevant entailments: a doxastic entailment (*x believes p*) that is typically foregrounded (12a) and a veridical entailment (*p*) which is typically backgrounded (12b).

(11) John knows that Mary is home.

(12) a. John has the belief that Mary is home.

b. Mary is home.

For Stalnaker (1974), both of these entailments cannot be put forward at once given that they are independent of each other, so — to be orderly — one of the entailments gets backgrounded. Following Stalnaker, several authors have tried to provide accounts for why *p* gets backgrounded (Simons 2001; Abusch 2002, 2010; Abrusán 2011; Tonhauser, Beaver, Roberts & Simons 2013; Simons et al. 2017, among others). Abrusán (2011) argues for a default grammatical main point: any entailment about the running time of the main event is “main point”, while other entailments get backgrounded, unless they are targeted by the QUD or focus. For Abusch (2002, 2010), *be aware* and *know* evoke the lexical alternative *be unaware*. Since both alternatives entail *p*, it follows that *p* is true, under the defeasible assumption that at least one of the alternatives is true. Simons et al. (2017) propose a similar account that derives the relevant alternatives pragmatically instead of lexically.

If pragmatic accounts are on the right track, they provide a potentially easier avenue for the learnability problem as compared to semantic accounts: all that the child would need to figure out is that *x knows p* both entails *x believes p* and *p*, and could then rely on some principled pragmatic reasoning to figure out that — all else equal — *p* typically gets backgrounded. The learnability challenge would then be to figure out the (non-)veridicality of the verbs — that *x knows p* entails *p*, but that *x thinks p* doesn't. As we will see, the actual exposure that children receive with *know* and *think* shows that even this is not trivial.

4 Corpus study

4.1 Hypotheses

In acquiring a word like *know* and its non-factive counterpart *think*, the child faces a complex task. Children must determine that *know* both entails and backgrounds the truth of its complement, while *think* does not. The earliest that some children have been found to reliably differentiate *know* and *think* in terms of their (non-)factivity is 3 years of age, but many children do not reliably distinguish the verbs until they are over 4 years old (Dudley, Orita, Hacquard & Lidz 2015; Hacquard, Dudley, Baron & Lidz 2016; among others). How do children figure out the two differences between *know* and *think*, namely that *know* is both veridical and factive while *think* is neither, even at such young ages?

One avenue would be to try and directly observe the status of the verbs' complements within a discourse, as discussed in (13) and (14).

- (13) **discourse status cues to (non-)veridicality:** Pay attention to everything that speakers say in using *know* and *think*, as well as what is true in the context of utterance. Observe that *p* is always true when *x knows p* is uttered, but not necessarily when *x thinks p* is uttered. Conclude that *know* entails the truth of its complement and that *think* does not.
- (14) **discourse status cues to (non-)factivity:** Pay attention to everything that speakers presuppose in using *know* and *think*. Notice that whenever *x knows p* is used, *p* is always common knowledge but not whenever *x thinks p* is uttered. Conclude that *p* is a presupposition triggered by *x knows p* but not *x thinks p*.

Laying out these potential discourse status cues immediately raises two issues. First, can children even track these types of information as they unfold in conversation, and do they actively do so? Second, does the input provide a clear enough signal in order to achieve the adult-like generalization about *know* and *think*? In this paper, we leave the first issue for future work, and attempt to address the second issue. Previous empirical work suggests that these cues are not likely to appear in speech to children, at least if adults speak to children in much the same way that they speak to each other (Spenader 2003; Beaver 2010), but no study to date has explicitly evaluated the reliability of cues like (13) and (14) in children's linguistic input.

4.1.1 Predictions

How reliable are discourse status cues to veridicality and factivity in speech to children? If the veridicality cues in (13) are available, we should expect to find data

like those in (15), and if the factivity cues in (14) are available, we should expect to find data like those in (16).

- (15) Informative cues as to *think*'s non-veridicality: unlike *know*, *think* can be used to talk about false beliefs as well as true beliefs. As a result, informative cases would be utterances of sentences whose complements the speaker takes to be false.
- a. She thinks Bill is coming to the party (...but isn't she silly?)
 - b. I thought Bill was coming to the party (...but then I saw his RSVP.)
- (16) Informative cues as to *know*'s factivity: as compared with *x thinks p* utterances, *x knows p* utterances should more often describe information which is familiar to the interlocutors. Additionally, projective contexts, if available, could be helpful. For example, the following cases could be helpful for noticing that uses of *know* presuppose or entail the truth of the complement:
- a. Bill is coming to the party! Oh, does Mary know he's coming?
 - b. Bill is coming to the party! Oh, I didn't know that!

4.2 Methodology

To investigate which cues to factivity are made available to children, we examined tokens of *know* and *think* in child ambient speech from the Gleason corpus in CHILDES (Masur & Gleason 1980; MacWhinney 2000). The Gleason corpus is comprised of conversations between 24 target children and their families recorded in the late 1970s in the Boston area. The ages of the target children in this corpus range from 2-5 years, the average age is about 3.5. The corpus includes dinner conversations in the home, as well as two separate play sessions in a laboratory setting between each parent-child dyad. During these play sessions, each dyad was required to complete three activities: working with a toy car that could be taken apart and put back together; reading a picture book with no words; and playing with a grocery store set.

Know and *think* were relatively frequent in this corpus. We identified 1231 tokens of *know* and 1156 tokens of *think*. On average, each child might hear *know* sentences 17 times per conversation and *think* sentences 16 times per conversation. *Know* occurred in 3.7% and *think* in 3.5% of all child ambient utterances.

4.3 Coding scheme

Our coding scheme was designed to assess what information is made available about the discourse status of the complements to *know* and *think*, by measuring syntactic

properties of *know* and *think* tokens which serve as proxies as well as their relationship to the surrounding discourse. We examined the types of subjects (1st person, 2nd person, other), tense (present, past, other), negation (present, absent), complements (declarative, interrogative, noun phrase, prepositional phrase, non-overt, etc.) and types of clauses (declarative, interrogative) that the verbs occur with as well as the status of the information that their declarative complements express (17-19). Syntax-level codes (i.e., subject, tense, negation, complement, clause, projective contexts) were made based on examining the utterance in isolation and therefore in the absence of any information about the surrounding discourse. Discourse-level codes (i.e., status of information in complement clauses) were made on a subset of the utterances, as applicable. For these codes, 50 lines of the preceding discourse and 5 lines of the following dialogue were examined in order to establish a discourse context against which the utterance was evaluated. In most cases, this was more than necessary to determine what code to provide.

Status of information in complement clause

- (17) **old**: information that has been previously mentioned in the discourse and accepted into the common ground¹

...

mother: Because they're working in there.

mother: And they don't want you to come there now.

mother: After when they're finished you can come there.

father: They will be happy to have you.

sister: And me finished.

mother: I know you're finished, Rachi.

...

- (18) **new**: information that has not been previously mentioned, or is uttered out-of-the-blue²

...

child: You could have hot dogs.

father: Not for breakfast.

1 example from conversation with John (4;2) at dinner, participants include the target child, his mother, his father and his sister

2 example from conversation with Isadora (3;7) during grocery-set play interaction, participants include the target child and her father

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child: Mhm.

father: Well.

father: Look.

father: I know I want some milk.

...

- (19) **unclear**: information that has not been explicitly mentioned and accepted into the common ground, but which could be shared by the interlocutors, because of world knowledge, family routines, children's habits and preferences, or which could be inferred from the previous discourse³

...

mother: Would you like a story?

child: What, Mama?

mother: Would you like a story?

child: Yeah.

mother: I saw a little tiny book over here.

mother: And I know you like little books.

...

All utterances were coded by the first author and a subset were checked by one of two undergraduate research assistants. Different procedures were carried out for syntax-level codes and discourse codes due to the sample sizes available. For the majority of the syntax-level coding categories, 98% or more of the tokens were included in the reliability check. Since the reliability statistics were so high for each category, only 80% or more of the tokens were included for the last two syntactic-level categories to be checked (tense-type and complement-type). For all syntax-level categories, intercoder agreement was high ($.99 < \kappa < .80$). For the one discourse-level category, 100% of the relevant tokens were included in the reliability check, given that only approximately 11% of the entire sample was eligible for discourse-level coding. For this discourse-level category, intercoder agreement was not high ($\kappa = .44$). Arguably, this reflects how hard it is to track propositions within a naturalistic parent-child discourse and determine whether they express information that is part of the common ground or new to (some of) the interlocutors. We return to this issue in the results section.

³ example from conversation with Victor (2;3) during picture-book play interaction, participants include the target child and his mother

4.4 Results

Results for the syntactic-level coding categories are provided in Table 1. Results for the discourse-level coding category are provided in Figure 2.

4.4.1 Veridicality data

First, we examined whose beliefs were under discussion in using *know* and *think* by tracking the subjects that occur with each verb — as an indication of whether the conversational participants took them to be true or false. We find that the verbs are most often used with subjects that refer to the conversational participants, given that subjects which were not first or second person occurred in less than 10% of tokens for either verb. This indicates that the beliefs under discussion are typically those of the interlocutors: the speaker (usually a parent, but sometimes another family member or experimenter) and an addressee (sometimes the target child and sometimes another person present); the beliefs of someone external to the conversation are rarely discussed. Furthermore, *know* occurs primarily with second person subjects (61% of all *know* tokens), *think* occurs primarily with first person subjects (61% of all *think* tokens). These data also suggest that there is a difference in whose beliefs are discussed with *know* vs. *think*. A chi-square test of independence was performed to determine the relationship between subject-types and verbs. The relation between these variables was significant, $\chi^2(2, N = 2387) = 236.1, p < .00001$. Speaker's beliefs were discussed most with *think* and addressee's beliefs were discussed most with *know*.

Given that *think* is most often used to express the speaker's beliefs, we next asked how often these beliefs are described as currently held beliefs. We thus looked at the types of tense that occurred with the verbs. We find that both verbs occur most often in the present tense (95% of *know* tokens and 91% of *think* tokens). Past tense tokens of either verb were infrequent; these forms occur in only 4% of *know* tokens and 8% of *think* tokens. This indicates that the beliefs under discussion when using either verb are most often beliefs that hold at the time of utterance.

Pulling together these data, a particular picture of children's experience with *think* emerges. *Think* is often used in first person tokens in the present tense. These *I think p* tokens (which make up 47.6% of children's input with *think*) cannot be used to report a false belief. What about the rest? We've already seen that there are very few third person subjects, but 30% of all *think* tokens have second person subjects. Out of these *think* tokens, 13.6% are questions like *What do you think?* and 11.9% questions like *Do you think that p?*. Such questions asking for the addressee's

verb	subject			tense			negation	
	1st	2nd	other	present	past	other	present	absent
<i>know</i>	34	61	5	95	4	1	28	72
<i>think</i>	61	30	9	91	8	1	11	89

verb	complement					clause		
	CP - Q	CP + Q	NP	PP	null	decl.	wh-inter.	polar inter.
<i>know</i>	15	52	6	-	26	50	49	2
<i>think</i>	85	-	-	4	10	64	20	17

Figure 1 Syntactic contexts data: percentage of tokens in each category per verb

opinion are unlikely to be uttered in contexts in which p is false, but rather used to ask $p?$ with the assumption that the addressee might have the answer. Given the the majority of *think* tokens (approximately 75%) are these *I think p* or *what do you think?* or *do you think p?* tokens, there are few opportunities to observe *think* as reporting a false belief overall.

4.4.2 Factivity data

To determine how often speakers presuppose p with *x thinks p* vs. *x knows p*, we first had to isolate the relevant *think* and *know* tokens, namely those with declarative complements.⁴ In our corpus there were 796 *x thinks p* tokens and only 131 *x knows p* tokens, given that the majority of *know* tokens had either interrogative or null complements (for more details, see Dudley 2017).⁵

Given that we had only 131 *x knows p* tokens (only 11% of all *know* tokens in the sample), we used all of them in the subsequent analyses, as well as an equivalent sample of *x thinks p* tokens (128 tokens or 11% of total *think* tokens). For these tokens, we examined the transcripts that they came from to determine how often p expressed information that was part of the common ground, using the discourse-level coding categories discussed above. Due to disagreement between coders, data for this coding category was re-categorized to provide the most generous estimate of what information was old. As reported here, “old” data includes the union of utterances which either coder marked as old; “new” data includes the intersection of

⁴ Declarative complements were isolated because factives do not presuppose the truth of their complement when the complement is a noun, preposition or embedded question, and because we could not be sure to recover the right complement type for null, or non-expressed, complements.

⁵ We also filtered out tokens with declarative complements if they were in *wh*-questions or if part of the complement was unintelligible (marked in CHILDES transcripts as “xxx”) such that the corresponding proposition was unrecoverable.

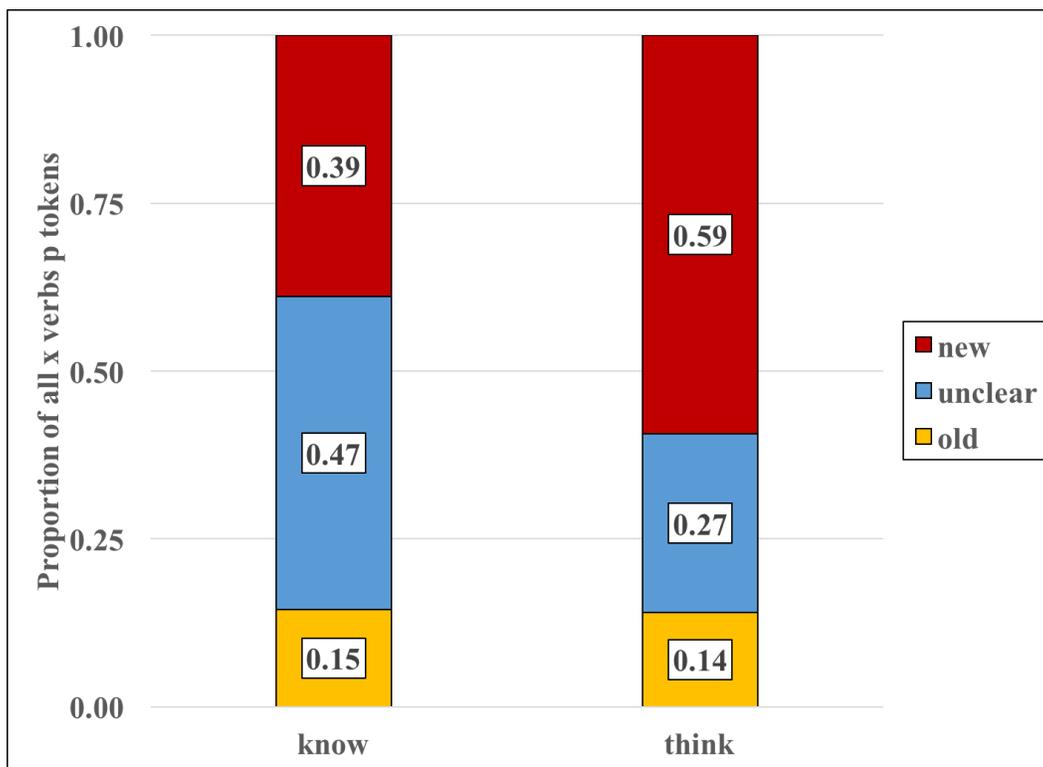


Figure 2 Status of the complements within the sample, as a proportion of *x verbs p* tokens for each verb

utterances which both coders marked as new, and “unclear” data includes all other utterances (i.e., those that were marked as new by one coder and unclear by the other coder).

Even with this generous classification, we found that the complements of both *x thinks p* and *x knows p* tokens rarely expressed information that had been previously mentioned in the conversation and accepted into the common ground. In our sample, *p* described old information in only 15% of all *x knows p* tokens and 14% of all *x thinks p* tokens. Unclear and new tokens were far more frequent, and occurred in different proportions for the two verbs. For *x thinks p* tokens in our sample, *p* most often described new information (59% of the tokens), while *x knows p* tokens were most often unclear tokens (47% of the tokens). A chi-square test was performed to determine the relationship between the two verbs and the status of their complements. The relation between these variables was significant, $\chi^2(2, N = 259) = 12.59, p < .002$. Declarative complements more often expressed new information with *think*

than with *know*.

However, we might want to ask if these patterns — while statistically significant — are also cognitively significant for children or can help them learn something about the factivity of *know* vs. the non-factivity of *think*. Does this kind of input distribution support the learning strategy that factives have complements which express common ground information, given that *x knows p* tokens are so rare, that *x thinks p* tokens are so frequent, and that *p* expresses “old” information at similar rates for the two verbs? To determine this, we analyzed the cue validity of a complement expressing “old” information for determining which verbs are factive.⁶ In our sample, the probability of getting a *know* token given an “old” token is only .15, while the probability for *think* is .85. Thus our sample suggests that using declarative complements which express common ground information as a cue to factivity would lead the learner to sooner conclude that *think* is factive than that *know* is factive, due to the similar rates of “old” tokens for the two verbs and the fact that such cases are overwhelmingly more frequent for *think* than *know*.

Furthermore, to give a sense of what children are dealing with if they rely solely on this kind of cue, we can look at how often cues like this occur. Less than 20 tokens in the entire sample were *x knows p* tokens where *p* expressed “old” information. This corresponds to 1.5% of all *know* tokens in this sample. If this is indicative of the representative of children’s experience, then children could expect to observe 5-6 such informative examples in every 10,000 utterances that they hear. Given estimates by Akhtar, Callanan, Pullum & Scholz (2004) based on data from Hart & Risley (1995), this would amount to approximately 1,500 such utterances by the point that children are beginning to differentiate between *know* and *think* at age 3. But such calculations should be taken with a grain of salt given the nature of corpus data and the size of our sample here.

Now, if we want to be more generous to these kinds of cues, we can include the “unclear” cases (19) as tokens that can be classified as common knowledge from the perspective of the child. If so, we find that *know* occurs more often with known information (old/unclear in 62% of *x knows p* tokens) whereas *think* occurs more often with new information (new in 59% of *x thinks p* tokens). *Think* tends to be used with complements which express new information while *know* tends to be used with complements that express known information. However, the cue validity statistic does not improve much with this generous grouping: the cue validity for *know* only rises to .20 while *think*’s lowers to .80 (as compared to .15 and .85, respectively).

Finally, we also examined how often these *x knows p* tokens occurred in p-family contexts which could be informative about the projection behavior of *know*. We

⁶ A cue validity statistic expresses the reliability of a particular cue for identifying some category as a conditional probability with a value ranging between 0 on the low end and 1 on the high end (Brunswick 1956; Gibson 1966).

found that out of the 131 *x knows p* tokens, only 50 of them (36%) occurred in projective contexts and they were exclusively under negation and question operators (with no conditional or modal contexts).

Now, there are some important caveats in considering our data. Our discourse-level coders failed to become reliable ($\kappa = .44$). This could be taken to suggest that our coding scheme was not appropriate to handle this task. It could also be taken to suggest that this task — tracking whether propositions are new or known given some prior discourse — is actually quite difficult given the kinds of discourses that parents and children participate in. It is suggestive that children might have similar difficulty as our coders in deciding what the status of *p* is when they hear *x knows p* or *x thinks p*.

4.4.3 Discourse status of the complement vs. other cues to factivity

With this corpus study, we investigated the reliability of discourse status cues to the factivity and veridicality distinctions between *know* and *think* in children's linguistic input. We asked two specific questions: (i) how often is *think* used to describe false beliefs as compared to *know* and (ii) how often is *know* used to describe known information as compared with *think*.

To answer the first question, we find that *think* is typically used to discuss the speaker beliefs. Moreover, these first person *think* sentences were rarely used in the past or with negation. This data suggests that *think* is rarely used to report false beliefs. This indicates that, in children's experience, speakers are often committed to the truth of the complements of *think* (see also Diessel & Tomasello 2001; Lewis, Hacquard & Lidz 2017; among others). As a result, there may be very few instances where a child could observe that *think* can be used to describe false beliefs and is thus non-veridical.

To answer the second question, we found that there was a difference in how often *know* vs. *think* was used to describe discourse-old vs. new information. But this difference (approx. a 40% - 60% split under the most generous estimates) was not of the kind that we would expect if children need to use the discourse status route. In fact, our analyses suggest that this kind of learning strategy might lead the learner to conclude that *think* is factive over *know*, which is not consistent with findings in the acquisition literature (Dudley et al. 2015; Hacquard et al. 2016). And we find that projective contexts are rare with these *x knows p* tokens, suggesting that they might not be the most readily available context from which to learn about the factivity of *know*.

Whether children are able to make use of these subtle differences in the discourse status of the complements of *think* and *know* remains an open question for the future research. For now, the fact that they are so subtle motivates looking to alternative

routes for figuring out the factivity contrast between *know* and *think*.

One possibility would be to use the syntactic distribution of the two verbs to infer their meaning, and in particular the kinds of complements that they select for (declarative complements almost exclusively for *think*, interrogative and declarative complements for *know*). Such syntactic bootstrapping (Gleitman 1990) requires that the link between a verb meaning and its syntactic distribution be principled, in ways that learners can be privy to. To use this route, children must: (i) track syntactic distributions in their input, (ii) notice differences in the distributions of *know* and *think* and (iii) be able to reason about this difference using principled syntax-semantics links, such as between question-embedding and factivity (see Egré 2008; among others). Can children do this? We have growing support from other cases of attitude verb acquisition that syntactic bootstrapping is at play (Harrigan, Hacquard & Lidz 2016; Lidz, Dudley & Hacquard 2016), but not for a contrast of this grain size.

Another route would be to exploit the pragmatic function that these verbs are typically used for (Hacquard 2014; Hacquard & Lidz under review; Dudley 2017). *Know* is often used to ask indirect questions (e.g. Do you know where my keys are?), *think* is often used to make indirect assertions (e.g., I think they're in your purse). If a child understand that with “do you know Q?”, her parent is really asking her “Q?”, she might infer that *know* relates the subject to the true answer to Q, as a point of entry as to its factivity. Similarly, if she understands that assertions of “I think p” are really indirect assertions of “p”, she might infer that the subject of *think* is committed to the truth of p and that she assumes that it isn't already common knowledge. In order to use such pragmatic bootstrapping, children must: (i) track the intentions of their interlocutors, (ii) track the words used by their interlocutors, (iii) notice relationships between them and (iv) reason about the nature of those relationships via pragmatics-semantics links. Can children do this? There is some evidence are sensitive to the assertivity of *think* (Urmson 1952; Hooper 1975; Shatz, Wellman & Silber 1983; Diessel & Tomasello 2001; Lewis, Hacquard & Lidz 2013; Lewis et al. 2017) and to the speaker's intentions in performing other indirect requests (Gelman & Shatz 1977; Shatz 1978), but we do not yet have the same evidence for *know*.

5 Conclusion

In this paper we made a first attempt at developing and testing hypotheses about how children learn about the distinction in meaning between *know* and *think*. *Know* is veridical and entails the truth of its complement, while *think* is non-factive and thus does not. Furthermore, *know* is factive and presupposes the truth of its complement, while *think* is non-factive and thus does not. One acquisition hypothesis would be the learner uncovers these distinctions by trying to observe the direct consequences

of them: if the learner can keep track of the status of each verbs' complements within a discourse, they may be able to infer whether that verb entails or presupposes the truth of its complement. Our findings cast doubt that such a direct strategy which uses cues about the discourse status of complements will be viable for the case of *know* and *think*. First, utterances of *think p* often occur with a first person subject, and used to proffer *p*. This could neutralize the traces of any veridicality distinction between it and *know*. Second, speakers do not systematically utter *know p* in situations where *p* is a part of the common ground, potentially neutralizing any trace of the factivity distinction between the two verbs. Our corpus data provide the first detailed investigation of such concerns in child-ambient speech and suggest that these fears are founded.

Our data suggest that children do not have many opportunities to observe that speakers presuppose *p*, when they hear *know*. This is because *x knows p* utterances are relatively rare, and when they occur, they are not systematically used to presuppose the truth of *p*. As a result, the child may not have reliable opportunities to observe that *know* is used to talk about established information — or facts — whereas *think* is not. If these data are reflective of children's experience generally, then there is some signal in the relatively few instances they get to learn from, but this signal is very noisy. If a child could use these cues, it would be via probabilistic reasoning about slight differences in proportions within their experience; children would have to actively entertain factivity as a hypothesis and the learning trajectory would be slow because the data would have to accrue over a long period of time. There are however alternatives to this direct route which would rely on other kinds of evidence that is widely available in children's linguistic input. We briefly discussed two possible routes, one which exploits the syntactic distribution of these two verbs, and one which exploits their typical pragmatic function.

In principle, each of these routes are possible, but which one is actually taken? Multiple sources of information may be necessary for solving such difficult learning problems (Gleitman, Cassidy, Nappa, Papafragou & Trueswell 2005). And perhaps each route is viable and children utilize whichever one is made most available to them in their individual experience. We are currently conducting a follow-up study to gain some experimental insight into which set(s) of cues are related to children's understanding of factivity. For preliminary results, see Dudley (2017).

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