

# The child in semantics\*

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**Abstract** This paper discusses the challenges that children face in acquiring natural language meaning, and the kinds of linguistic and nonlinguistic capacities that they may draw from to face these challenges.

**Keywords:** Acquisition; word learning

## 1 Introduction

Linguistic theory aims at what makes language possible, and part of this is figuring out what the human child brings to the acquisition of linguistic competence. For the most part, however, the semantic aspect of this capacity has not been the object of work in semantics, which has concentrated on the specification of truth and reference, and viewed with little urgency (less than has work in syntax), the question of how children naturally acquire the languages we use to assert and refer. But semantics has become increasingly integrated into linguistic theory, thanks in large part to Angelika Kratzer, whose work connects semantics to our understanding of both syntax and cognition more broadly. Now the child is playing a more prominent role. In this paper, I would like to discuss what we know about the challenges of acquiring meaning, and about the linguistic and nonlinguistic capacities that equip children to face them, drawing on what I've learned in recent years from working with acquisitionists.

Like all of language, word meanings are acquired from limited input, without much negative evidence or explicit teaching. What a word means is constrained only weakly by the physical environment of its use, which changes little as one word follows another. But neither could it always be decided by perfect insight

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\* For insightful discussions on the topics discussed in this paper, I would like to thank Jeff Lidz, Alexander Williams, Rachel Dudley, Aaron White, Shevaun Lewis, Kate Harrigan, Ailis Cournane, Nick Huang, Annemarie van Dooren, Anouk Dieuleveut, Mina Hirzel, and Laurel Perkins. And I would like to thank Angelika Kratzer for her steady encouragement and support over the last decade, and for pushing all of us to look to the future.

into what the speaker means to convey, on any one occasion, since this will generally go beyond what is encoded in words. The child will still need to abstract the meaning of a phrase from what a speaker means in using it, and then divide this up among its constituent words. Yet despite these challenges, children somehow succeed, by exploiting multiple cues in concert. Included among these are some, perhaps less obvious, that come from the structure of sentences and conversations in which the word is used. What other words are its regular companions? What is its syntactic category? What sorts of arguments does it take? What is the immediate topic of conversation? What has already been discussed? What is the speaker paying attention to? And what is she trying to achieve? These are among the sources of information, less direct than a finger pointing to a ball while the speaker says “ball”, that might help the child—or also sometimes confuse her, when she sees them in a non-adult way.

Whether and when children can make use of these cues depends on the linguistic, conceptual and pragmatic abilities and biases they have at different stages of development. Right at the start, a few conceptual pre-requisites need to be in place for word learning to get off the ground. Children need to be attuned to communicative intentions and goals; they need to parse the world in roughly the same chunks as the speakers around them; and they need to have access to the underlying concepts that the words express. If children can't see the rabbit for its body parts, and grasp the intention to refer to it as such, they won't be able to resolve classic problems of indeterminacy that arise even for a simple word like *rabbit*. Likewise without a concept of possibility, and an expectation that people might talk about what is non-actual, children will be hard-pressed to acquire modal words such as *must* or *can*.

The last three decades of research in cognitive development have shown that young children's conceptual abilities are much more in line with that of their parents than was originally thought. Children tend to parse the world into the same pieces as adults do, and view those pieces under the same concepts (Gleitman 1990, Spelke 1990, Markman 1990, Waxman & Lidz 2006, Carey 2010). Furthermore, they can track the goals and intentions of their interlocutors (Baldwin 1991, Bloom 2001, Clark & Amaral 2010), and 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). This helps resolve one side of the word learning problem: if children parse the world in the right chunks, their task is just to figure out what word corresponds to what concept or chunk of the world. And for some words, like *ball* or *rabbit*, they might succeed solely on the basis of cues from the extra-linguistic context, by paying attention to what objects speakers are directing their attention to, and seeing these objects in the same light.

However, this strategy will be less useful for more abstract words, with no obvious referents in the physical context of speech. In these cases, children may need to depend more on cues from the linguistic context, grammatical and conversational. And just as seeing the world through the same eyes as their parents can narrow the space of candidate meanings for the child, sharing certain linguistic biases may narrow it further. These biases might include expectations about what concepts are likely and unlikely word meanings, or about how the meaning of a word might correlate with its distribution in syntax, for example.

More than in the past, it is plausible that we might discern what is properly linguistic in the acquisition of semantics, owing to breakthroughs on the conceptual end of the word learning problem. And this makes it an exciting time for semanticists to collaborate with acquisitionists. This paper provides a brief survey of how these issues are currently being addressed. My goal here is not to provide a comprehensive overview, but to simply highlight the kinds of methods that have been developed to probe different aspects of the word learning problem. Section 2 outlines the kinds of cues that children could in principle exploit when word learning, and the kinds of linguistic, conceptual, and pragmatic abilities and biases that would allow them to do so. Section 3 reports on methods that have been developed to probe which of these cues and biases children actually make use of when word learning.

## **2 Word learning from limited evidence: potential cues & biases**

Ordinarily children learn words not from verbal or ostensive definitions, but from hearing them in conversation. This seems incredible at first, since the space of possible meanings for a given word in any given situation is vast. But there are various sources of information that children can in principle make use of. Here I review a few of these, and consider what abilities would allow a child to exploit them.

### **2.1 Potential cues from the linguistic and extra linguistic context**

The *physical context* can provide cues, if learners are able to associate a word with an object that keeps on reoccurring whenever the word is used, especially if speakers draw attention to that object by directing their eye gaze or through pointing gestures. To exploit cues from the physical context, children need to be able to keep track of co-occurrence patterns. They also need to view the world in roughly the same chunks as the speakers around them. They may need further mindreading abilities, to infer speakers' referential intentions, by tracking what part of the world they are attending to. Once children figure out the meanings of a few words this way, these words can then be used to exploit cues from the

linguistic context to figure out the meaning of more abstract words (Gleitman *et al.* 2005).

Various aspects of the *linguistic context* can provide valuable cues as to a word's meaning. The *lexical context* (the set of words that occur in the same sentence), for instance, could be quite useful in learning the meaning of verbs like *eat* or *drink*, which co-occur with noun phrases from a very narrow semantic range (edibles and drinkables; see discussion in Resnik 1996, White 2015). The *syntactic context* could be useful if the syntactic distribution of a word correlates with aspects of its meaning (Landau & Gleitman 1985; Gleitman 1990 a.o.). Gleitman and colleagues propose that syntactic cues play a critical role in children's acquisition of "hard words", such as attitude verbs like *think* or *want*, which express abstract notions for which the physical context provides few cues. One aspect of the syntactic signal is *syntactic category*: knowing that a word is a noun, for instance, will narrow the range of possible meanings. Another is *syntactic selection*: knowing the kinds of arguments a word takes can further narrow the range of its possible meanings.

For such "syntactic bootstrapping" to work, there need to be robust correlations between the meaning of a word and its syntactic distribution, and children need to recognize them. What the correlations might be appears in the formal literature as the question of how well syntactic selection can be semantically motivated. In the case of attitude predicates, for instance, there is a rich literature about whether various selectional requirements track fundamental semantic distinctions, such as mood selection (Bolinger 1968, Farkas 1985, Giannakidou 1997, Villalta 2008, a.o.), or the ability to take both interrogative and declarative complements (Lahiri 2002, Egre 2007, a.o.). We then have the further question of whether, at a given age, children are able to use these correlations in learning. This requires both the ability to perceive the correlated categories, syntactic and conceptual, and the ability to observe the correlation. These abilities will not emerge instantaneously; even if they draw on some innate expectations, they will develop through infancy and early childhood.

The **conversational context** can also provide very valuable cues. The *topic of conversation* can constrain the lexical field of content words. Other more indirect cues might come from the speakers' *conversational goals*. For instance, figuring out that a verb like *want* is systematically used to make indirect requests might give away the fact that it expresses a kind of preference. Other cues might come from the state of the *common ground*, and what assumptions are shared over the course of a conversation. For instance, tracking what speakers presuppose might help learners figure out whether a given word is a presupposition trigger. To exploit cues from the conversational context, learners will need a combination of pragmatic and linguistic abilities.

## 2.2 Linguistic, conceptual and pragmatic biases

There are various sources of cues about word meanings that learners can in principle draw from. But whether children can actually exploit these cues will depend on the conceptual, pragmatic and linguistic abilities and biases they have at different stages of development.

### 2.2.1 Conceptual and pragmatic abilities and biases

To exploit cues from both the physical and the conversational contexts, children need a certain amount of *conceptual* and *pragmatic* competence. First, they need to carve the world in roughly the same chunks as the speakers around them, viewed under roughly the same concepts. And as we saw, the cognitive development literature suggests that they do from infancy. Children also need some mindreading abilities, to see what part of the world speakers are attending to, in order to figure out their referential intentions. And here again, many infant studies have shown that such abilities are in place very early on (Gleitman 1990, Spelke 1990, Markman 1990, Baldwin 1991, Bloom 2001, Waxman & Lidz 2006, Carey 2010, a.o.). Other studies show that young children further pick up on the intended illocutionary force of speakers' direct and indirect speech acts (Shatz 1978, Spekman & Roth 1985, Grosse *et al.* 2010, Grosse & Tomasello 2012, a.o.).

One tricky aspect of word learning is that children are not exposed to literal meanings in isolation: just like objects are embedded in scenes, word meanings are embedded in conversational contexts. What children are exposed to are speaker meanings, and from these they have to distill the contributions made just by the words alone. This may be tricky, if a word is regularly used to express a pragmatically enriched meaning. For instance, if children were to hear *some* only when the speaker means *some and not all*, might they not lexicalize this stronger meaning? This doesn't seem to happen. If anything, children have been reported to be hyper-literal, and unable to compute scalar implicatures with *some* (Noveck 2001). If pragmatic enrichments are routine with scalar terms like *some*, children's hyper-literality is puzzling. It suggests that something either in their experience, or in the expectations they have about word meanings points them to the literal meaning of *some*: perhaps there is enough data in children's experience to show that the meaning of *some* is not *some and not all*; perhaps learners do not expect meanings like *some and not all* to be lexicalized into a single morpheme (see Horn 1972).

The hyper-literality of children with scalar implicatures seems to go against the pragmatic sophistication they display early on, which helps them pick up on speakers' referential and conversational goals. There is now a growing consensus

that children's pragmatic abilities are much more sophisticated than was initially assumed, and that the difficulty they seem to have with scalar implicatures is not with reasoning about speakers' choice of words or computing the implicature itself, but with figuring out what alternatives are relevant in a given context; when the alternatives are made explicit, children have no problem deriving the relevant implicatures (see Pouscoulous 2012, Lewis 2013, Papafragou & Skordos 2016 and references therein).

While it seems clear that children can track and reason about speakers' referential and conversational goals, less is known about their ability to track what speakers presuppose, though there is evidence that young children keep track of the knowledge and shared experience of the people around them (Liebal *et al.* 2009, O'Neill 1996, Moll *et al.* 2008, a.o.). Children seem to have some amount of difficulty with different presupposition triggers like definites (Karmiloff-Smith 1979, Schaeffer & Matthewson 2005, van Hout *et al.* 2010, a.o.) or factives (Schulz 2003; Dudley 2017), but it is not always clear whether the difficulty stems from problems with understanding what is common ground, or instead with noticing that use of a certain word triggers a presupposition.

To sum up, children seem to have rich conceptual and mindreading abilities that could support their exploitation of cues stemming from speakers' referential and conversational goals, when word learning. There are, of course, limits on what children can do, which makes them different from adults. But these limits seem to be more quantitative than qualitative in nature, and based on having less experience of the world and of language, along with processing limitations due to a linguistic parser, which is also developing (see Omaki & Lidz 2015).

### 2.2.2 Linguistic abilities and biases

When word learning, children will only be exploit linguistic cues once they have the necessary grammatical knowledge and linguistic parsing abilities to identify these cues. As children's vocabulary and grammatical knowledge grows, so does their ability to exploit various syntactic cues (Valian 1990, Fodor 1998, Perkins *et al.* 2017, a.o.) To make fruitful use of syntactic cues, children may need certain linguistic expectations about what are possible meanings and how these meanings relate to syntactic distribution. This is where language acquisition can truly benefit from theory of linguistic meaning.

Expectations about possible and impossible or unlikely word meanings could help children narrow their hypotheses space. Are there concepts that are not expressible in natural language, or perhaps more realistically, not likely to be expressed by a single word? Are there constraints on how notions like time or possibility are expressed in natural language? Do children come with such expectations build in? Here again, questions of acquisition and cross-linguistic

variation overlap. And while there may not be many robust semantic universals as far as content words are concerned, there may be more promising constraints for function words (see Fintel & Matthewson 2007). Most famously, there may be constraints on determiner meanings, for instance, whether they may all obey conservativity (Barwise & Cooper 1981).

Expectations about links between a word's meaning and its syntactic distribution could also help the child, provided that these links are principled, in ways that are accessible to the child. And here again, cross-linguistic variation needs to be taken into consideration. To illustrate, consider how children might acquire attitude meanings. The acquisition literature shows that there is an asymmetry in the apparent mastery of belief verbs like *think* and desire verbs like *want*. Putting aside the cause of the asymmetry, its mere existence suggests that children systematically distinguish the two verbs early, even before they have fully mastered one of them. What might help them distinguish the two verbs early could be syntax. For instance, mood selection in Romance has been argued to correlate with a split in attitude meanings between belief (indicative) and desire verbs (subjunctive). Perhaps mood helps Romance learners differentiate *think* and *want* early. One important caveat for such syntactic bootstrapping is that mood is not a universal way of distinguishing the two verb classes: English doesn't have a productive mood distinction, though it does distinguish the two classes syntactically through other means, for instance, via the finiteness of the complement (finite for belief verbs, nonfinite for desire verbs); German uses mood productively, but not to track the belief vs. desire split, though it does distinguish the two classes via word order (belief—but not desire—verbs, allow V2 word order in their complement). Children do not know what language they are learning, so for syntax to be informative about meaning in a way that supports syntactic bootstrapping, it has to do so in a way that leads to language specific mappings. In Hacquard & Lidz (2018), we propose that the way children might use syntax to distinguish belief vs. desire verbs is by tracking whether a given attitude verb takes complements with syntactic hallmarks of declarative main clauses in their respective language (e.g., indicative mood in Romance, V2 word order in German, finiteness in English).

### **3 Figuring out how children figure out word meanings**

We have seen that there are various cues that children could *in principle* exploit in word learning, coming from both the linguistic and the extra linguistic context. Whether children can make use of these cues depends on whether they have and can deploy various linguistic and cognitive abilities and biases about word meanings and their distribution. In this section, I discuss steps that have been taken to probe which cues and biases learners exploit *in practice*, drawing mostly

from research done by students and colleagues at the University of Maryland as an illustration.

### 3.1 Figuring out what's in the input and what cues are useful *in principle*

The first step to figure out what cues children make use of is to see what cues are actually present in the input to children. To do so, language acquisitionists have used corpora of naturalistic interactions between children and their parents, to track how parents use various words. Corpus studies investigating questions of meaning are much trickier than those investigating questions of syntax or morphology. For questions of meaning, one must not only look at the kinds of sentences a given word occurs in, but also at how the word is used in context, to figure out what meanings get conveyed in the conversational context, and what speakers presuppose. These kinds of studies are time consuming, but crucial to address questions of how children acquire various word meanings, and sometimes, they reveal new learnability problems. Dudley (2017), for instance, shows that speakers often use the factive verb *know* in contexts where the proposition expressed by its complement is not in the common ground, in ways that doesn't really distinguish it from non factive *think*. This suggests that the way children pick up on the factivity contrast between *think* and *know* is unlikely to come from tracking what speakers are presupposing. Van Dooren *et al.* (2017) show that the way speakers use modal auxiliaries in English makes it challenging to see that they can express different flavors of modality: modals that are in principle polysemous are in practice mostly used monosemously.

Corpus studies can thus reveal the kinds of cues to word meanings that are available in the input: what syntactic environments do the words appear in? What discourse cues correlate with the use of the words? Once the cues have been identified, one can ask which of them are reliably predictive of semantic distinctions. To do so, language acquisitionists have turned to computational modeling, to see whether a virtual learner could learn the right semantic distinctions by tracking various clues. White *et al.* (2018b), for instance, test whether a virtual learner could distinguish belief from desire verbs by tracking whether the complements of the verbs share syntactic features with declarative main clauses, and find that it can, at least for English.

### 3.2 Figuring out what cues are useful *in practice*

Once we know which cues are available and reliable in the input, and which aren't, we can ask which *children* actually make use of. There could be very obvious cues that children simply ignore, or much more subtle ones that they still

make use of. This can help us get at the underlying conceptual, pragmatic and linguistic competence that enables the child's exploitation of such cues.

There are various ways to address this question. The first is to look at correlations between input and output: does the robustness of cue X for word *w* in the input lead to earlier production of *w*? A limitation of this method is that there could be all kinds of reasons why children fail to produce *w*: they do not like to talk about whatever *w* refers to; they prefer to use some other means of expressing what *w* expresses... Conversely, production of *w* does not necessarily mean full grasp of what *w* means for adult speakers.

Another possibility is to "train" children on the relevant cue, by artificially exposing them to sentences that exhibit the cue, and comparing their performance on *w* post training to the performance of children trained on different sentences. Hale & Tager-Flusberg (2003) for instance developed such a methodology to test whether exposure to (speech) verbs with a sentential complement would help children not just with sentential complements, but with their performance on a standard false belief task: they had groups of children trained on false belief, sentential complements, and relative clauses, and found that the performance of children trained on sentential complements not only improved for sentential complements, but false belief tasks as well, whereas the other types of training only improved performance on the condition that they were trained on.

Another way of getting at the relationship between input and output was pioneered by Rachel Dudley in her recent dissertation investigating children's acquisition of *know* and *think*. Through an initial corpus study, Dudley identified various cues to the factivity contrast in speech to children: cues from the discourse context (what information is discourse old or new), cues from the syntax (what types of complements the verbs take), and cues from the discourse function of utterances of these verbs (what indirect speech acts they are used for). Dudley then set up a behavioral task testing children's grasp of the factivity of *know* and non-factivity of *think*. In this task, children had to figure out where out of two boxes a toy is hidden, using cues like "Chris thinks/knows that it's in the blue box" or "Chris doesn't know/think that it's in the blue box". She found that some three-year-olds treated *know* as factive but that others did not, and that none took *think* to be factive. To see whether this gap in performance was due to differences in their linguistic experience with the verbs, and what aspect of the input lead to earlier mastery of factivity, Dudley designed a final task testing the relation between children's linguistic experience with *think* and *know* and their understanding of factivity. She had the parents of a group of children record various conversations with their children, to get a measure of children's input, and then tested these children on the toy finding task. She then looked for input factors that best predicted children's performance. While her results are not yet conclusive, the methods she introduces provide a good model for how to

investigate the relationship between input and output for words with subtle meaning properties, like presupposition triggers.

### 3.3 Figuring out what linguistic biases children have

Once we know more about children’s linguistic experience with the various words they learn, and what cues from this input seem to matter for their acquisition, we can ask what linguistic biases help children make use of the cues. To get at this, language acquisitionists have devised various tasks, which typically involve novel or unfamiliar words, to control for children’s experience with the words.

Turning first to expectations about possible and impossible word meanings, Hunter & Lidz (2012) for instance tested whether children expect determiner meanings to be conservative. To do so, they used a variant of the “picky puppet task” (Waxman & Gelman 1986) to teach children novel determiners, by showing them cards with different configurations of boys and girls on the beach or on the grass. The picky puppet liked some of the cards (the ones that supported a certain determiner meaning) “because *gleeb* girls are on the beach”, but didn’t care for others (the ones that did not support that determiner meaning), “because it’s not true that *gleeb* girls are on the beach”. Their results show that while children could easily learn a conservative determiner, they failed to learn a non-conservative one.

As for expectations about word meanings and their syntactic distribution, various studies have shown that children use syntactic information when word learning, both in terms of syntactic category (Waxman & Booth 2001; He & Lidz 2017, a.o.), or argument structure (Landau & Gleitman 1985; Pinker 1989; Naigles 1990, 1996; Naigles & Kako 1993; Lidz *et al.* 2003; Yuan & Fisher 2009, a.o.; for an overview, see Williams 2015). Here I will briefly describe two studies as illustration. Using the picky puppet task again, Wellwood *et al.* (2016) found that children were sensitive to syntactic position when they heard novel superlatives: when the novel word appeared in the syntactic position of a determiner (*gleebest of the cows are in the barn*), children preferred quantity-based interpretations, but when it appeared in the position of an adjective (*the gleebest cows are in the barn*), they preferred quality-based interpretations (tracking the cows’ spottiness vs. their distribution in and out of the barn). Finally, to test children’s sensitivity to syntactic distribution when learning attitude meanings, Harrigan *et al.* (2016) presented children with a low frequency attitude verb (*hope*), in contexts that made salient both the beliefs and desires of a puppet. Children’s interpretations of *hope* sentences depended on whether it appeared with a finite (“*Froggy hopes that it’s a heart*”) or a nonfinite complement (“*Froggy hopes to get a heart*”): with the former, children tended to interpret *hope*

sentences as reporting on Froggy's beliefs; with the latter, they tended to interpret them as reporting on his desires.

#### **4 Looking forward**

How do children figure out meaning from very limited evidence? We can now pursue this question in earnest, due to headway made on many fronts. From our analyses of the syntax, semantics, and pragmatics of languages, we now have a better understanding of the target knowledge for various morphemes and constructions. Our expanding knowledge of cross-linguistic diversity for semantic matters gives us a better sense of what is linguistically attested and attestable. From cognitive development, we have more and more evidence that children see the world through similar eyes, and make sense of it with the same conceptual toolkit as the adults around them. From language acquisition, tasks testing children's pragmatic and semantic competence have become more and more savvy, and more often than not, they reveal that when the pragmatics of the task are natural, children tend to know more than we originally thought. Moreover, sophisticated corpus analyses and computational modeling give us a better sense of children's linguistic experience: what evidence children get or fail to get for various word meanings. All of this can help us figure out what it is that children bring to the learning problem, what linguistic biases and expectations they have about natural language meaning and its connection to syntax. The various linguistic, conceptual and methodological breakthroughs have made it possible to start addressing not just when, but how children learn from their limited experience, making it a particularly fruitful time for language acquisitionists and semanticists to collaborate.

The hope from language acquisition is that it can illuminate linguistic theory. In particular, we expect that language acquisition should help arbitrate between competing theories about the target grammar. But this expectation often leads to frustration, as the grain size of the questions that can be addressed in language acquisition cannot always match that of semantic theorization: Until we know everything about children's linguistic experience and about their conceptual, pragmatic, linguistic and processing abilities at various stages of development, we won't be able to tell how well their semantic representations line up with those of the adults around them. But while language acquisition research may not yet be in a position to arbitrate between theory A and theory B for any given semantic phenomenon X, it can address the prior and fascinating question of what linguistic, conceptual, pragmatic abilities and biases would be required for children to acquire X, were it to be analyzed as A vs. B, given the evidence they get from their experience.

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