Chapter 8

Learning Words through Linguistic Context

Suppose you had no language at all and were about to learn your first word. What could it be? It might be a name for a specific person, such as *Fred,* or a name for an object kind such as *dog*. It could refer to a property, as with *hot,* or an action, as with *hitting.* You would be able to learn these words because they correspond to entities, properties, and actions that are accessible through observation of the material world and attention to the intentional acts of the people around you.

But this first word couldn't be a determiner, quantifier, modal, conjunction, or preposition. It couldn't be a verb such as *dreaming,* an adjective such as *former,* or a noun such as *mortgage.* These words—in fact, most words—do not refer to entities that can be learned by someone without language because their meanings are not accessible in the same way.

How then are these words learned? The answer, in general terms, is obvious enough: we hear them in the context of sentences and use this linguistic context to figure out what they mean. This chapter discusses how such learning takes place.

Learning Words through Nonsyntactic Context

A few months ago, I learned the word *hobbledehoy.* It wasn't in the same way I learned the words *dog* and *foot;* nobody referred to a hobbledehoy in my presence and uttered the word aloud. Instead, I came across the word by reading a passage of a book in which a disapproving father in the 1930s explains to his son why he is forbidden to meet a schoolmate (Amis, 1994, p. 28): "Anyway, to me at least, in one way and another he looks a bit of a hobbledehoy. Also, to me just now over the telephone, he sounded a good deal of a hobbledehoy. Do I make myself clear?"

Syntactically, *hobbledehoy* is a garden-variety count noun, and so—from a solely grammatical standpoint—it could refer to anything from pickles to phonemes. The precise understanding of the word's meaning

emerges instead through a sensitivity to the meaning of the passage as a whole. One can tell, for instance, that *hobbledehoy* refers to a kind of person and that it is a bad thing to be.

This is enough to get a good idea about the meaning of the word, and it gets better with the next passage, which provides a definition of sorts (Amis, 1994, p. 28): "You do, thought Robin. . . . Even bloody clearer than you thought. To you at least Wade is a rough, a rowdy, a hooligan, a johnny whose mother sews him up for the winter, who habitually makes rude noises in front of people and shouts at them from up or downstairs or in the next room instead of going where they are and speaking politely, who picks his nose and eats it and never learnt to talk proper."

This is not the best way to learn words. Children tend to learn better from both ostensive naming and from carefully designed age-appropriate sets of examples (Miller & Gildea, 1987). But once you are no longer a toddler, you don't encounter much ostensive naming, with the exception of learning proper names by being introduced to new people. Explicit sets of examples are useful, but not all children receive this sort of teaching, and even those who do learn at most a few words a week from it (Nagy & Herman, 1987). When it comes to explaining how children end up learning thousands of words each year, the only possibility is that they learn most of them through linguistic context (Sternberg, 1987).

The best way to learn a word through context is by hearing it used in a conversation with another person (Nagy & Herman, 1987). This method has several advantages. There might be a rich extralinguistic context to the conversation, the speaker will often have some sensitivity to the extent of the listener's knowledge, and the listener can ask questions. It is likely that many words are learned this way, particularly by preliterate children and by older children and adults in nonliterate societies.

A less efficient source is through written context, but this is nonetheless how literate people learn most of their words. Under one estimate, even students who read relatively little, and only during the school year, will read about half a million words a year and be exposed to about 10,000 words a year that they do not know (Nagy & Herman, 1987). This is many more words than they would be exposed to through conversation, particularly since most conversation takes place between children of the same age who have roughly the same vocabularies. The only way to explain how adults can acquire very large vocabularies—over 100,000 words, in some cases (Miller, 1996)—is through reading.

How does learning from context take place? Robert Sternberg (1987) discusses three processes. *Selective encoding* is distinguishing between the relevant and the irrelevant information when learning the word. Focusing on just the first passage in which *hobbledehoy* was used, it is relevant for the meaning of the word that the father is disapproving but irrelevant that he spoke to the boy over a telephone. *Selective combination* has to do with combining the cues into a workable meaning of a word. And *selective comparison* relates new information to background knowledge. For instance, the meaning of *hobbledehoy* can be learned from the passage above only if you have some idea of the sorts of qualities that parents tend to disapprove of. In the absence of such knowledge, one might just as well think that *hobbledehoy* could refer to someone who was overly polite or who was injured in a war.

Word learning through attention to nonsyntactic information is an instance of a quite general learning process. In fact, the processes that people use to infer the meaning of *hobbledehoy* in the passages above are the same that psychometric intelligence tests assess, and a strong correlation exists between IQ and vocabulary size. Sternberg (1987) suggests that this correlation exists because the number of words a person knows is related to their ability to learn words from context and that this is the same general learning ability tested on standard IQ tests.

While a large educational literature exists on how to best teach children to learn words from context, little research has been conducted on how this process actually works. An exception to this is a study by Diane Beals (1998; see also Beals & Tabors, 1995). She finds that children are often exposed to rare words in the course of casual conversations at home, such as during mealtime, and that most of the time there is contextual information relevant to the meanings of these words. Two examples follow, the first involving an explicit definition and the second involving more implicit cues:

Mother: You have to wait a little while so you don't get *cramps.*

George (age 4): What's *cramps?*

Mother: *Cramps* are when your stomach feels tight, and it hurts 'cause you have food in it.

Doug (age 4): Can I have an ice cream sandwich please, Mom? Mama, please can I have an ice cream?

Susan: Just a minute! Someone scarfed the last ice cream sandwich, right?

Doug: Oh.

Susan: How about cookies?
Doug: Tammy, can I please have one of your twisters?
Tammy: That's the only one. Gary had two.
Mother: What's the matter? Is this the great ice cream *debate?*

We do not know how, or even if, children learn the meanings of words in these situations. Beals finds a significant positive correlation between the extent of exposure to rare words and children's later vocabulary, but, as she notes, this could occur for many reasons, and it is possible that there is no direct causal relationship between the two factors (see chapter 2). Nevertheless, nobody would deny that children can learn at least some words from hearing them used in conversation, without the referent being present, since they come to know words such as *vacation* and *dreaming,* which couldn't be learned any other way. But the precise nature of this learning process is a mystery.

I think it will remain a mystery for a long time. The right explanation of how people learn word meanings from nonsyntactic context will not emerge from an analysis of capacities such as theory of mind, the ability to form concepts, and an understanding of syntax—although such capacities have to be there for these inferences to be made. It will instead emerge from a theory of problem solving in general—what philosophers call *nondemonstrative inference* (Fodor, 1983). Perhaps for this reason the research focus of many developmental psychologists has instead been on a far more encapsulated (and tractable) issue—the role of syntactic cues in word learning.

Syntactic Cues to Word Meaning

If David Hume were to rise from the dead, walk to the nearest university library, and pick up any state-of-the-art review on the topic of word learning, little of what is written would be entirely unfamiliar to him. This is not to deny that progress has been made in this area of study; it is just that most of this progress has been the development and extension of theories proposed long ago. Debates over the role of perception in the understanding of names for artifacts and natural kinds, for instance, have been going on since antiquity. And Hume would have found arguments over the merits of associative learning in learning common nouns reassuringly familiar.

One exception to this continuity in theory in the study of word learning is a proposal first made by Roger Brown in a paper published in 1957 entitled "Linguistic Determinism and the Part of Speech." In the study reported in that paper, Brown showed three- and four-year-olds a picture of a strange action performed on a novel substance with a

novel object. One group of children was told, "Do you know what it means to sib? In this picture, you can see sibbing" (verb syntax). Another group was told, "Do you know what a sib is? In this picture, you can see a sib" (count noun syntax). A third group was told, "Have you seen any sib? In this picture, you can see sib" (mass noun syntax). The children were then shown three pictures—one depicting the same action, another depicting the same object, and a third depicting the same substance. They were asked, according to what they were initially told, "Show me another picture of sibbing" (verb syntax), "another picture of a sib" (count noun syntax), or "another picture of sib" (mass noun syntax). Brown found that the preschoolers tended to construe the verb as referring to the action, the count noun as referring to the object, and the mass noun as referring to the substance.

It is a simple study, but it supports a profound idea, which is that "the part-of-speech membership of [a] new word could operate as a filter selecting for attention probably relevant features of the nonlinguistic world" (Brown, 1957, p. 21). More generally, "young English-speaking children take the part-of-speech membership of a new word as a clue to the meaning of a new word" (p. 26).

This is a radical claim. It shifts the emphasis from the *content* of the situation toward the *form* of the linguistic expression, raising the possibility that word learning succeeds, at least in part, because children attend to the grammatical contexts in which words are used.

Evidence for Syntactic Cues to Word Meaning

This is an intriguing idea, but is it true? Before reviewing the specific studies that address the role of syntactic cues in the acquisition of word meaning, it is worth discussing what counts (and doesn't count) as evidence for Brown's proposal.

First, a distinction must be made between information conveyed by syntax versus information conveyed by sentence meaning, as in the *hobbledehoy* example above. To take a simple example, hearing the sentence "John learned to drive a zoop" can tell you a lot about what *zoop* refers to. It is unlikely to be a nightmare, for instance, or a spoon, but it could be a car or a truck. This inference is based on our understanding of the sorts of things people drive, not the syntactic context in which the word *zoop* appears.

The distinction between syntactic context and semantics context might seem clear enough in principle, but the two contexts are often difficult to distinguish in practice. This is particularly the case when it comes to the role of closed-class words, such as prepositions and determiners, which fall between the cracks of syntax and semantics. For instance, Fisher, Hall, Rakowitz, and Gleitman (1994) describe

three- and four-year-olds' understanding of the semantic implications of the contrast between "The bunny is zorking the ball to the elephant" versus "The bunny is zorking the ball from the elephant" as evidence for sensitivity to syntax, while Pinker (1994a) argues that children are drawing inferences from the semantic properties of the prepositions, not from their syntax.

Second, there is a difference between showing that children understand mappings between syntax and semantics and showing that this understanding guides inferences about word meaning. Gathercole (1986) points out, for instance, that the Brown experiment described above does not actually demonstrate that children can use syntax to *learn* aspects of word meaning, since they could have succeeded at his task without attending to the new word; all they had to attend to was the syntactic frame of the questions: "Show me another picture of ____ ing/of a ____ / of ____." A similar point applies to other studies, such as those reported by P. Bloom (1994a) and Hirsh-Pasek et al. (1988). These show that children are sensitive to the semantic implications of syntactic structure, which is consistent with, but not the same as, the stronger finding that they can use this understanding to learn words.

A final concern is that in some experiments children might be guessing the meaning of a word by using syntactic cues to identify an already known English word it corresponds to. Pinker (1994a) notes that children can use syntax as a *retrieval cue* even if they have no ability to use syntax to actually learn new words—in fact, even if there is no relationship between a word's syntax and its meaning. To make this point, he gives the example of an experimenter showing children a scene ambiguous between pushing and falling and saying either "The puppet calls this p . . ." or "The puppet calls this f . . . ." In such a task, children would presumably say "pushing" and "falling" appropriately, by using the sound as a retrieval cue to the relevant English word. But this surely does not show that children can use universal sound-meaning mappings to learn word meanings or even that such mappings exist. By the same token, then, studies in which children can use syntax to match up a novel word with a preexisting lexical item do not entail that syntax-semantics mappings play any role in the acquisition of a first language.

In sum, when evaluating studies of the role of syntax on word meaning we have to bear in mind certain considerations, including (1) the distinction between syntactic versus nonsyntactic linguistic information, (2) the distinction between using syntax to learn a new word versus being sensitive to the relationship between syntax and meaning, and (3) the distinction between using syntax to learn a new word

versus using syntax to find an existing word that a new word is closely related to.

For the purposes of review, we move through parts of speech—first nominals, then verbs, then adjectives, and finally prepositions. (This is an expanded version of an earlier review in P. Bloom, 1996c). A further domain, number words, is the topic of the next chapter.

Syntax and the Acquisition of Nominals

Every language has a distinct grammatical class of nominals. These words serve as names and refer to entities in the world (Bloomfield, 1933; Schacter, 1985). In English, nominals fall into three main classes—count nouns, mass nouns, and lexical noun phrases (lexical NPs). Count nouns are words like *dog* and *nightmare,* which can follow determiners such as *a, many,* and *several* and which can be counted and pluralized. Mass nouns are words like *sand* and *advice,* which can follow determiners such as *much* and (in the singular form) *some* and *any* and which cannot be counted or pluralized. Lexical NPs are words like *Fred* and *she,* which are identical syntactically to phrasal noun phrases, such as *the dog* or *my cat* and cannot be modified or quantified at all.

I introduced the term *lexical NP* in the chapter on pronouns and proper names but without much elaboration. It is admittedly an awkward term, but it is the only one that is accurate. The usual alternative is to call words like *Fred* ''proper names'' and words like *she* ''pronouns,'' but these terms pick out semantic classes, not syntactic ones. It is an interesting empirical claim that children can use the fact that *Fred* is an NP as a cue that it refers to a specific individual (see chapter 5). But it is nothing more than a tautology to say that children can use the fact that *Fred* is a proper name as a cue that Fred refers to a specific individual—since to be a proper name is to refer to an individual. If one is going to explore the possibility that children use syntax to learn about meaning, it is important to characterize the syntactic categories distinct from the semantic ones.

When it comes to learning at least some nominals, one can do fine without syntax. If I pointed to a strange object and said ''gloppel,'' you would take the word as a name for that kind of object; if I pointed to a strange substance and said ''gloppel,'' you would take it as a name for that kind of substance; and if I pointed to a person and said ''gloppel,'' you would take it as a name for that particular person. The same is true for children. Two-year-olds treat words that refer to objects differently from words that refer to substances even if the words are presented in syntactically neutral form (Soja, Carey & Spelke, 1991; see chapter 4). And names for specific individuals, such as pronouns and

proper names, are learned by children long before they can attend to syntactic information; some such expressions appear among their very first words (Nelson, 1973).

So syntax is not necessary for at least some nominal learning. But evidence suggests that children are sensitive to nominal syntax and can use it to modify their assumptions about word meanings. I focus below on the count-mass distinction; the role of the noun-NP contrast in learning pronouns and proper names was discussed in chapter 5.

Objects, Substances, and Individuals

Nancy Soja (1992) found that once two-year-olds have productive command of the count-mass distinction, they can use count-mass syntax to infer aspects of word meaning. When taught a mass noun that describes a pile of stuff, they tend to construe it as referring to that kind of stuff (as having a similar meaning to a word like *clay*), but when taught a count noun that describes the same pile of stuff, many construe it as referring not to the stuff itself but to the bounded pile (as having a similar meaning to words like *puddle* or *pile*).

This effect of syntax was limited to the stuff condition. When children were taught count nouns and mass nouns describing a novel object, their interpretation was not affected by the mass-noun syntax: they did *not* construe the mass noun as having the same meaning as words like *wood* or *metal.* This is an interesting asymmetry; count-noun syntax can guide children away from construing a word referring to a substance as naming the kind of substance, but mass-noun syntax cannot override the tendency to treat a word referring to an object as naming a kind of object. This is consistent with other research on the acquisition of solid-substance names that is discussed below.

A study by Leslie McPherson (1991) explored two- and three-year-olds' sensitivity to syntax in a different way, exploiting the ambiguity of the phrase *a little,* which can be a quantifier indicating a small amount when used with a mass noun (*a little water*) or a determiner and adjective indicating a small object when used with a count noun (*a little cup*). Children were taught a word with either count or mass syntax (''These are vaxes. Have you ever seen so many vaxes?'' versus ''This is vax. Have you ever seen so much vax?'') and shown either objects (small yellow pom-poms of two different sizes with faces on them) or stuff (tapioca pearls of two different sizes). They then were asked to ''Give me a little vax.''

McPherson found that children were more likely to choose a small pom-pom when presented with a count noun than with a mass noun and more likely to scoop up a small amount of tapioca when presented with a mass noun than with a count noun. This suggests that

the count-noun syntax biased them toward treating "a little vax" as referring to a small object, while mass-noun syntax favored treating the phrase as referring to a small amount, providing further evidence that children are sensitive to the relation between count-mass syntax and aspects of word meaning.

These studies, along with the findings of Brown (1957), suggest that count-noun syntax can inform young children that a word refers to an object kind. But there are reasons to believe that the semantic import of being a count noun is not limited to objects but extends to individuals more generally (see also chapter 4).

First, count nouns that refer to nonobject individuals show up in the spontaneous speech of young children. For instance, Nelson, Hampson, and Shaw (1993) analyzed the speech of 45 20-month-olds and found that only about half of their nominals referred to basic-level object kinds; many referred to entities such as locations (*beach*), periods of time (*minute*), and events (*party*). And once children start to use count-mass syntax in their productive speech, names for these nonobject individuals are marked appropriately as count nouns, just as words like *dog* are (Gordon, 1992).

Second, there is evidence that children can use count noun syntax to acquire the meanings of words that refer to kinds of nonobject individuals. One such study was mentioned above; recall that Soja (1992) found that when a substance was named with a count noun, many two-year-olds inferred that the noun extended to other bounded individuals of the same kind; they did not infer that it was a name for the kind of stuff. In other words, they treated it as having a meaning like *puddle,* referring to a bounded portion of stuff. In another study (P. Bloom, 1994a), three- and four-year-olds were taught names for a string of bell sounds from a tape-recorder, presented in rapid sequence so that they could be construed either as a set of discrete sounds or as undifferentiated noise. They were told either "These are feps. There really are a lot of feps here" (count-noun condition) or "This is fep. There really is a lot of fep here" (mass-noun condition). Then children were given a stick and a bell; those who were taught the word as a count noun were asked to "make a fep," while those taught the word as a mass noun were told to "make fep." Even the three-year-olds tended to make a single sound when asked to make "a fep" and to make a lot of sounds when asked to make "fep," suggesting that they can map count-noun syntax onto discrete sounds or actions and mass-noun syntax onto continuous sounds or actions.

Bloom and Kelemen (1995) attempted to teach four-year-olds, five-year-olds, and adults novel collective nouns. Subjects were shown an array of unfamiliar objects described either as "These are fendles" or

as "This is a fendle." The prediction was that subjects would interpret the plural count noun as an object name, while singular count-noun syntax would focus them on the collection as a single individual, on a par with nouns like *army* and *family*.

The results were mixed. Adults and five-year-olds were sensitive to the syntactic manipulation; as predicted, they treated the plural count noun as an object name and the singular count noun as a collective noun. The four-year-olds showed the same trend, but the effect was not significant. This was not due to a bias toward construing the word as an object name: errors tended to be evenly divided, with many of the children mistakenly treating the plural count noun as naming the collection. The failure of the four-year-olds to learn the collective noun is instead consistent with the view that their understanding of what sorts of entities can be individuals differs from that of adults in interesting ways (see Bloom & Kelemen, 1995, for discussion).

Solid Substances

Mass syntax can direct a child toward interpreting a new word as referring to an amorphous substance such as water or sand (P. Bloom, 1994b; Brown, 1957, Soja, 1992). But what about words for solid substances, such as *wood?* From a quantificational standpoint these are also nonindividuated entities: one cannot count wood; one must count *pieces* of wood. Wood also passes the *universal grinder* test for stuff (Pelletier, 1979); if you grind up wood, you still get wood (compare this with what happens when you grind up a desk).

Solid substances differ in significant ways from nonsolid substances, however. For one thing, they are not malleable or fluid; they retain their shapes as they move through space. Moreover, any chunk of solid substance is also, by necessity, a discrete physical object, and so it might require some conceptual work on the part of the child to think about the chunk as a portion of stuff rather than thinking about it as an individual countable entity, as a whole object (see chapter 4 for discussion). Do these considerations make such words harder to learn?

Explorations of children's production (Soja, 1991) and comprehension (Dickinson, 1988; Prasada, 1993) suggest that two- and three-year-olds' understanding of English solid-substance names is relatively limited. On the other hand, Soja (1991) found that adults rarely use such names when speaking to children, so children's ignorance could be due to the input they receive and not to limitations in their own capacities.

Dickinson (1988) attempted to teach preschoolers new substance names in a set of experiments in which he showed children objects or chunks of objects made of novel solid substances. Children were

presented with words in neutral syntax (''This is the blicket''), count syntax (''This is a blicket''), mass syntax (''This is some blicket''), or an informative mass-noun condition (''This is made of blicket''). When the items were objects, the preschoolers rarely interpreted the words as solid-substance names, regardless of the linguistic context (see also Markman & Wachtel, 1988). Five-year-olds, on the other hand, showed more sensitivity to the linguistic manipulation, giving the substance interpretation over half of the time in the ''made of'' condition as compared to less than one-fifth of the time in the neutral condition. Dickinson concluded that young children find solid-substance names hard to learn, regardless of the linguistic context.

In contrast, Prasada (1993) found that even two- and three-year-olds were capable of learning solid-substance names when they were presented with mass syntax in ''made of'' constructions, so long as they referred to familiar objects that already had names. Similarly, Markman and Wachtel (1988) found that three- and four-year-olds could interpret the word *pewter* in the sentence ''This is pewter'' as a substance name (or as an adjective referring to a substancelike property) when the object that it referred to already had a name.

Why do children find it so difficult to learn solid-substance names for unfamiliar objects? It can't merely be due to a bias to treat words for unfamiliar objects as describing object kinds because even two-year-olds are capable of learning proper names that refer to unfamiliar objects (Gelman & Taylor, 1984) and slightly older children can learn adjectives for such objects (see below). Why isn't this also true for solid-substance names?

One suggestion was raised above. Children's problems with solid-substance names may be due in part to their strong bias to treat whole objects as individuals. Such a bias would not get in the way of learning proper names (which refer to specific individuals) or many adjectives (which refer to attributes of individuals). But it would interfere with the learning of solid-substance names, since construing an entity as a portion of stuff is plainly inconsistent with construing it as a single individual.

Syntax and the Acquisition of Verbs

The role of syntax in verb learning has generated considerable controversy. While investigators such as Brown were content to argue that syntax can facilitate the acquisition of nominal meanings, some scholars have made the stronger claim that syntax is essential for the acquisition of at least some verb meanings. This is a claim we return to below.

Letitia Naigles (1990) conducted one of the first studies on the role of syntactic cues in verb learning. She showed 25-month-olds videotaped scenes showing two events—a causal event with two participants and a noncausal event with a single participant. For instance, a duck would repeatedly push a rabbit into a bending position at the same time that both the rabbit and duck were waving their free arms. Children saw the video as they heard a novel verb either in a transitive context (''The duck is gorping the bunny'') or an intransitive context (''The duck and the bunny are gorping''). Then children were shown two new videos simultaneously—one containing just the causal scene (a duck pushing a rabbit, with no arm waving), the other containing just the noncausal scene (the duck and rabbit arm waving, with no pushing)—and were told ''Find gorping.'' The two-year-olds looked longer at the causal scene when they had heard the transitive verb and longer at the noncausal scene when they had heard the intransitive verb.

Naigles and Kako (1993) conducted further experiments suggesting that, while causation is associated with transitive verb frames, it is not an essential semantic correlate. Two-year-olds who were exposed to a verb in a transitive frame tended to associate the verb to actions of *contact without causation* (as when a frog repeatedly touches the duck, without any effect) more so than those children who were just exposed to the verb in a neutral frame (''Look! Gorping!''). This suggests that hearing a verb used in a transitive frame might inform the child that the verb refers to an action with some property more general than causation, such as *object affectedness* (see also Gropen, Pinker, Hollander & Goldberg, 1991; Pinker, 1989).

A different methodology was used by Cynthia Fisher and her colleagues (1994). Three-year-olds, four-year-olds, and adults were shown a video depicting an event and given sentences with novel verbs to describe it, such as ''The bunny is nading the elephant'' versus ''The elephant is daking.'' The scenes were chosen so that actions in them could be described with existing English words. When participants were asked what these verbs meant, they tended to give correct translations or paraphrases. For instance, when presented with a video in which the bunny was giving food to the elephant, children would tend to say that *nading* meant ''feeding'' and *daking* meant ''eating,'' suggesting that their interpretations of the meaning of the words were guided by syntactic cues.

The precise interpretation of the Fisher et al. results are a matter of some disagreement: Pinker (1994a) has suggested that they show children can *access* existing lexical items via syntactic structure but do not support the stronger claim that they can use syntax to *learn* new words. In response to this concern, Fisher et al. (1994) conducted a further

analysis of just those instances where children responded with phrasal descriptions instead of existing English words (for instance, if they said "licking it off the spoon" instead of "eating"). An analysis of the three- and four-year-olds taken together found the same effect of syntax, suggesting that while prior lexical knowledge might play some role in children's responses (since they might have accessed these phrasal descriptions only via their knowledge of existing English words), these results cannot be entirely due to direct lexical retrieval.

Other research by Fisher (1996) explored the role of linguistic cues with three- and five-year-olds in a different fashion. Children were shown videos depicting novel events and were presented with sentences differing in number of arguments ("She's pilking" versus "She's pilking her") and in the type of preposition ("She's pilking the ball to her" versus "She's pilking the ball from her"). The subjects were then asked to point to the person performing the action ("Who's pilking the ball to her?"). Fisher found that both age groups responded to these linguistic manipulations (syntactic in the case of transitive versus intransitive; lexical in the case of *in* versus *from*) when identifying the agent of the new verb.

Other considerations support some of the premises behind the proposal that syntactic cues are relevant to verb learning. It has long been noted that correspondences exist between verb syntax and verb semantics, some of which are universal (e.g., Jackendoff 1990; Levin, 1993; Pinker, 1989). Studies of parental speech find that syntactic cues to verb meaning are present in the sentences that children hear (e.g., Fisher, Gleitman & Gleitman, 1991; Naigles & Hoff-Ginsberg, 1995, 1998) and that the extent of syntactic cues partially predicts the order in which verbs are acquired (Naigles & Hoff-Ginsberg, 1998).

The Role of Syntax in the Acquisition of Adjectives and Prepositions

Adjectives draw children's attention toward properties or subkinds. For instance, Taylor and Gelman (1988) presented two- and three-year-olds with either a novel noun ("a zav") or a novel adjective ("a zav one") describing an object. Children who heard the word as a noun extended the word to objects of the same kind more often than they extended the word to objects that share the same superficial properties, while children who heard the word as an adjective gave the opposite response—focusing more on properties, like color, pattern, and texture, and less on object kind (see also Gelman & Markman, 1985; Hall, Waxman & Hurwitz, 1993). Smith et al. (1992) obtained a similar finding, noting that the same shape bias that exists for count nouns does not apply to adjectives. Using a similar design, Waxman and Kosowski

(1990) found that nouns focused two- to five-year-olds on taxonomic categories (following Markman & Hutchinson, 1984) but that adjectives did not.

Other research explores the effect of the noun-adjective contrast on children's hierarchical classification. In a task involving classifying animals and foods, for instance, Waxman (1990) found that nouns facilitated categorization at the superordinate level but not at the subordinate level (see also Waxman & Gelman, 1986), while adjectives provided the opposite effect, drawing attention to subordinate kinds.

Some puzzles arise here, as the relationship between the two putative semantic roles of adjectives—adjectives as denoting properties (as viewed by Taylor & Gelman, 1988, for instance) versus adjectives as denoting subkinds (as viewed by Waxman, 1990, for instance)—is unclear. A typical adjective, such as *good,* does not pick out a meaningful subordinate category within a psychologically natural taxonomy. Conversely, poodles and collies are perfectly good subkinds, but this contrast is marked by nouns, not by adjectives.

It may be that the syntactic category *adjective* is too rough-grained to capture the sorts of semantic implications children and adults are sensitive to. Bolinger (1967) distinguishes between predication (as in "The dog is fep") and modification (as in "the fep dog"). Roughly, predication attributes a property to the entity denoted by an NP (the specific dog), while modification is *restrictive;* it picks out a subclass of the category referred to by a noun (the category of dogs). It may be that the results from the property studies are tapping children's sensitivity to adjectives as predicates while those from the subkind studies are tapping children's sensitivity to adjectives-as-modifiers. In support of this, Prasada (1997) finds that two- and three-year-olds are more likely to give an adjective a "restrictive" interpretation when it appears prenominally, as a modifier, than when it appears as a predicate.

Landau and Stecker (1990) explored whether the syntactic contrast between nouns and prepositions can cue young children toward the distinction between words referring to objects versus words referring to spatial relations. Children were shown a novel object placed on a box and were either told "This is a corp" (count noun syntax) or "This is acorp the box" (preposition syntax). In the count noun condition, both three-year-olds and adults generalized the application of the word to objects of the same shape regardless of location, while in the preposition condition, they generalized the word to objects in the same location (or class of locations), regardless of object shape. More recently, Landau (1996) found that English-speaking three-year-olds are sensitive to prepositional syntax when learning words that map onto spatial notions not present in English—such as the Tzeltal relational marker

lechtel, which is used to denote a wide flat object that is lying flat (P. Brown, 1993).

Such results can be taken to support the proposal by Landau and Jackendoff (1993) that there is a universal distinction between the semantics of count nouns, which denote objects and other individuals, and prepositions, which denote only certain limited classes of spatial relationships. In contrast, Bowerman (1996) suggests that the constrained inferences that Landau and her colleagues find are not rooted in innate universals; they instead result from children's prior learning of the semantics of English nouns and prepositions. This issue is a matter of current debate, possibly to be resolved by research with much younger children.

How Do Children Learn about Syntactic Cues to Word Meaning?

The studies above suggest that preschool children can use the following cues to word meaning (see table 8.1). Where does this understanding come from? It is sometimes said to be acquired through observation of contingencies between the meanings of words and the syntactic categories they belong to. For instance, Brown (1957, p. 26) suggests that "Human beings are generally adept at picking up imperfect probabilistic implications, and so it may be the case that native speakers detect the semantic nature of the parts of speech of their language." And Katz, Baker, and Macnamara (1974, p. 472) state that "we can effectively eliminate the possibility that [the children] are determined by nature to notice definite and indefinite articles on the grounds that many languages, like Latin, do not have them." They propose that children notice the correlation between words without determiners and words that refer to animate beings.

Table 8.1
Syntactic cues to word meaning

Syntactic Cue	Usual Type of Meaning	Examples
"This is a *fep*/the *fep*."	Individual member of a category	*cat, forest*
"These are *feps*."	Multiple members of a category	*cats, forests*
"This is *fep*."	Specific individual	*Fido, John*
"This is some *fep*."	Nonindividuated stuff	*water, sand*
"John *feps*."	Action with one participant	*sleeps, stands*
"John *feps* Bill."	Action with two participants	*hits, kisses*
"This thing is *feppy*."	Property	*big, good*
"The dog is *fep* the table."	Spatial relationship	*on, near*

Cross-linguistic differences clearly exist. Some languages do not have a distinct class of adjectives, for instance; others lack a count-mass distinction. Furthermore, the surface realization of syntactic categories cannot be innate; it is an arbitrary fact about English that determiners precede nouns or that verbs are sometimes marked with *-ing.* So some learning must be going on (see Levy, 1988; Maratsos & Chalkley, 1981).

But what sort of learning? There are reasons to doubt that children relate meaning and form through a sensitivity to statistical correlations, observing that certain forms and certain meanings just happen to go together. Correlational learning is a fine way to learn arbitrary relationships, such as shapes of English letters and the sounds they correspond to. But the relationship between syntax and semantics is not an arbitrary one.

Consider a couple of examples. First, the number of NP arguments that a verb takes is related to the number of entities involved in the action that it refers to, in the following way:

V with 1 NP argument:	V = action with one entity, as in "John sleeps"
V with 2 NP arguments:	V = action with two entities, as in "John kissed the dog"
V with 3 NP arguments:	V = action with three entities, as in "John gave Fred the book"

Is it really reasonable that this one-to-one mapping between the number of NP arguments and the number of entities encoded in the meaning of the verb is learned through a sensitivity to correlations? That is, children just happen to notice that verbs with one NP argument have meanings like *sleep* and verbs with three NP arguments have meanings like *give?* This would suggest that children could have just as well learned the mapping the other way around and that the pattern is an accident of English; some languages should use one NP argument for *give* and three with *sleep.*

But this never happens. Instead the generalization appears to reflect a linguistic universal: an isomorphism between the conceptual structure of a predicate and its syntactic structure (Chomsky, 1981). It is striking support for the existence of this universal that the same relationship is also found in the spontaneous communication systems created by deaf children (home-sign; Goldin-Meadow & Mylander, 1984). For instance, one boy, David, used his invented sign for *give* (hand outstretched, palm upward) with three arguments but his sign for *sleep* with only one. As Lila Gleitman and Henry Gleitman put it (1997, p. 33): "Nobody has to learn from the external linguistic environment that

the notion of giving requires three arguments and sleeping only one, or that these elements of conceptual structure map regularly onto the number of NP positions in the clause. At least some of this mapping comes for free.''

Or consider the count-mass distinction. Children come to know the following:

a/another N: N = kind of individual
much N: N = kind of stuff

Clearly something must be learned here, since the specific English words that cue the count-mass distinction are not innate, and some languages have no count-mass distinction at all. But it is not that children note, over the fullness of time, that some kinds of words go with *a* and *another* and other kinds of words go with *much.* Such learning would be superfluous because the knowledge follows from what the determiners mean. Part of knowing *a* and *another* is knowing that they interact with nouns that refer to kinds of individuals to form NPs that refer to specific individuals. Part of knowing what *much* means is knowing that it interacts with nouns that refer to kinds of stuff to form NPs that refer to portions of that stuff. Once children have learned the meaning of these determiners (see chapter 4 for some discussion of how they do so), nothing more needs to be learned.

In general, then, the knowledge necessary to use syntactic cues to word meaning can be explained either in terms of other properties of language, such as universal relationships between meaning and form (as in the verb example) or the meanings of specific closed-class items (as in the count-mass example).

One issue remains. The ability to use syntax as a cue to word meaning presupposes the ability to syntactically categorize new words. This categorization is easy enough once the structure of a language, and some of its closed-class terms, have been learned. As someone who knows English, you can use your understanding of the grammar of English to parse the novel words in Lewis Carroll's sentence:

> And, as in uffish thought he stood,
> The Jabberwock, with eyes of flame,
> Came whiffling through the tulgey wood
> And burbled as it came.

It is easy to infer that *uffish* is an adjective and *whiffling* is a verb (see Pinker, 1984). And based on this syntactic categorization, you can infer that *uffish* refers to a property and *whiffling* to an action. But what if you don't know any English? How can a child who is new to the language figure out the syntactic category a word belongs to?

One proposal—sometimes called *semantic bootstrapping* (Pinker, 1984)—is that children use the mappings between syntax and semantics not to infer the meanings of words from their syntax as discussed throughout this chapter but the other way around—to infer their syntactic category from their meanings (Bloom, 1999; Grimshaw, 1981; Pinker, 1984). For instance, given that *dog* refers to an object and *big* refers to a property, children can infer that *dog* is a noun and *big* is an adjective and, hence, on hearing "big dog" can infer that adjectives precede nouns within the NP. Once children know this, they can use this grammatical knowledge to infer the syntactic category of words whose meaning they do not already know; for instance, when they hears "big idea," they can infer that *idea is* a noun.

Early in development, children appreciate the relationship between syntactic categories and semantic categories and can use this relationship both to bootstrap their way into the syntax of natural language and to infer aspects of the meanings of words. One obvious objection is that this account is circular. It cannot be the case, for instance, *both* that children know that *chair* refers to an object kind because it is a count noun *and* that they know that *chair* is a count noun because it refers to an object kind. But this isn't a serious concern, since under any account children can learn some word meanings (such as the meanings of words like *chair*) without the help of syntax. Once they do so, they can learn syntactic rules and use these rules to infer the syntactic categories of unfamiliar words, as in the Jabberwocky example above.

The Importance of Syntax

The experiments reviewed above show that children can use syntax to learn aspects of the meanings of words. But just how important is syntax?

A sensitivity to syntax clearly is not sufficient to learn the entire meaning of a word; at best it can help children learn aspects of the meaning of a word. For one thing, the relationship between the syntax of a word and its meaning is not entirely predictable: there is limited variation both within and across languages. Certain words that are count nouns in French are mass nouns in English and vice-versa; some verbs that appear in the double-object dative structure in English do not do so in Dutch, and so on. And near synonyms within a language (such as *clothing*, a mass noun, and *garments*, a plural count noun) can belong to different syntactic categories. This arbitrariness is quite constrained, but it does exist (Bloom, 1994a; Pinker, 1989).

Furthermore, grammar draws relatively crude distinctions, picking out ontological kinds (such as individuals versus stuff) and subtypes

of events (such as events with one participant versus events with two participants). Word meanings are much more fine-grained. Children have to learn the difference between *cup* and *saucer* (both count nouns), *good* and *evil* (both adjectives), *five* and *six* (both quantifiers of precise numerosity), and *loving* and *hating* (both verbs with identical argument structures). No word meaning can be learned entirely through syntactic cues.

Is syntax ever necessary? As discussed above, children and adults can learn object names, substance names, and proper names without the aid of linguistic cues. But what about other parts of speech? Lila Gleitman and her colleagues (e.g., Fisher, Hall, Rakowitz & Gleitman, 1994; Gleitman, 1990) have argued that syntax plays a significant role for the acquisition of many verbs.

Why verbs? There are certain ways in which learning verbs might be harder than learning other words, such as object names, and therefore might require the helping hand of syntax.

First, object nouns can be taught through ostensive naming: parents can point at a dog and say "dog," and in at least some societies they tend to do just that. But parents almost never use verbs to name actions (Gleitman, 1990; Tomasello, 1992). A study mentioned earlier by Gillette et al., reported in Gleitman and Gleitman (1997), suggests that this might make verbs harder to learn. Adults were shown videos of interactions between mothers and one-year-olds. There was no audio, but when the mothers used a word, either a noun or a verb, subjects heard a beep. Their task was to guess which English word the beep corresponded to. When exposed to beeps that corresponded to nouns (and told to expect nouns), subjects got it right about 45 percent of the time, and they did much better over multiple trials. But when exposed to beeps that corresponded to verbs (and told to expect verbs), they got it right only about 15 percent of the time and didn't get better over multiple trials. Gleitman and Gleitman (1997) suggest that this is in part because of the poor temporal correspondence between verbs and what they refer to.

A second reason that verbs might have been more difficult to learn in the Gillette et al. study—and in real life—is that many verbs name events or activities that are not directly observable, such as *thinks.* Object names, of course, typically do refer to entities that one can see and touch.

Third, object nouns correspond to entities that humans universally see as distinct individuals (see chapter 4), but this is not necessarily so for verbs. Across languages, there are differences in how verbs typically "package" events. In languages such as English, verbs typically encode the manner of an event, as in *run, jump, skip, hop, dance, leap,*

and *somersault*. The path of the motion is expressed as a prepositional phrase, as in this sentence: "He is running down the stairs."

In Romance languages such as French and Spanish, however, verbs typically encode the path of the motion. The manner is expressed through an adverb (Talmy, 1985; Naigles, Fowler & Helm, 1995): "Il descend l'escalier en courant" (literal translation: He goes down the stairs in running).

Even within a language, there is flexibility as to how events can be described. If Fred is handing something to Mary and a verb is used to describe the scene, it could (among other things) mean *giving*, but it could also mean *receiving*. Its meaning depends crucially on the perspective one takes. In general, then, events are cognitively ambiguous in a way that objects are not. Lila Gleitman (1990, p. 17) puts it as follows: "Verbs seem to describe specific perspectives taken on . . . events by the speakers, perspectives that are not 'in the events' in any direct way . . . since verbs represent not only events but the intent, beliefs, and perspectives of the speakers on these events, the meanings of the verbs can't be extracted solely by observing the events."

Syntax might help solve these special problems of verb learning. Consider the perspective problem raised above: How can children figure out whether a given verb means *giving* or *receiving?* One solution is syntactic. If Fred is handing something to Mary and the child hears "Fred is ____ the thing to Mary" then the verb is likely to mean *giving;* if the child hears "Mary is ____ the thing from Fred," the verb is likely to mean *receiving*. Or consider the problem of acquiring more abstract verbs such as *thinking*. If a verb is followed by a sentence, as in "John ____ that Bill is upset," then its meaning is consistent with an action that has a proposition as its object, which entails that it is a verb of perception or cognition.

When one considers that reliable cues to word meaning exist and that young children can exploit these cues, and when we note as well the strong correlation between the growth of vocabulary size and the development of syntactic knowledge in young children (Caselli et al., 1995; Fenson et al., 1994), the evidence for the claim that syntax is central to verb learning seems quite decisive.

But syntax might not be necessary. Verbs are plainly distinct from object names, but they are not that different from other more abstract nouns. Consider a noun such as *nightmare*. It is just as hard to teach the noun through ostensive naming as it would be to teach a verb like *dreaming*. And just as there is flexibility in how verbs package events, there is also flexibility, both within and across languages, in how nouns encode more abstract nonobject individuals.

These considerations undermine the claim that syntax is necessary for learning the meanings of verbs. Children are supposed to need syntax to learn at least some verbs because such verbs are too difficult to learn otherwise. But abstract nouns are equally hard, and yet children learn them without syntactic support. And if they can do this for nouns, why can't they also do it for verbs? In other words, perhaps children learn a verb such as *dreaming* in the same (nonsyntactic) way that they learn a noun such as *nightmare.*

How then is a noun such as *nightmare* learned? It happens through the same sort of general inferential abilities that worked for the noun *hobbledehoy.* A child could wake up after a nightmare and be told that she just had a nightmare. She could hear the word used to refer to a scene in a story, in which the mental life of a sleeping character is described. Or the word might even be explicitly defined for her. Some such account has to be right because there is no alternative: syntax cannot do the trick. And again, since one of these proposals must work for the noun *nightmare,* it might apply as well to a verb like *dreaming.*

Although children might not need syntactic cues to learn *dreaming,* there is little doubt that they need *linguistic* cues—that is, children can learn the verb only by hearing it in the context of sentences. I agree, then, with the thrust of Gleitman's argument: simply "observing the events" does not suffice for the learning of most verbs. What is less clear is whether it is syntax that fills the gap, as opposed to the other information that sentences convey.

The Role of Syntax in a Theory of Word Learning

What role does syntax play in word learning? There are three possibilities, but only one of these fits with the evidence reviewed above.

The first is that syntax does very little. It is icing on the cake. This is the right position to take for object labels; the advantage that the child obtains knowing that *dog* is a count noun is negligible. But it is not right for most other words. If children hear that someone is "a nasty person," the fact that *nasty* is an adjective is an excellent cue that it refers to a type of person. It would be difficult to learn *wood* without knowing that it is a mass noun or *thinking* without knowing that it is a verb that takes a sentential complement. While syntax might not be necessary for learning the meanings of such words, it nonetheless plays an important role.

Another conception of the role of syntax is as a *filter* (Brown, 1957) or *zoom lens* (Gleitman, 1990; Pinker, 1994b). It draws the child's attention to relevant aspects of a scene, determining, for instance, whether

an event should be construed as giving or receiving, thinking or standing, walking or moving.

But in certain regards, this is also an unrealistic perspective. The notion of a filter or zoom lens implies that children start off with all the candidate meanings in mind and then syntax helps them to filter out the irrelevant ones and zoom in on the right one. But in fact much of the time that words are used, the events or entities that they denote are not present in the environment. If syntax is going to play a role in actual word learning outside the laboratory, it has to be able to affect children's construals of scenes that are not being attended to.

A third perspective is that syntax is an important informational source as to the meanings of words, one that works in concert with information obtained from other inferential mechanisms of the sort discussed in previous chapters. The child's task in word learning, then, is to integrate these different sources of information and from them to infer the most plausible candidate for the word's meaning (see P. Bloom, 1996c; Gleitman & Gleitman, 1997).

The relative importance of syntactic information—and linguistic information, more generally—depends on a host of factors. The meanings of words such as the noun *dog*, the adjective *red*, and the verb *break* might be relatively easy to learn without linguistic support. These are learned first and provide the foundation for the learning of other words, such as the noun *mortgage*, the adjective *former*, and the verb *dreaming*, whose meanings can only be conveyed through the vehicle of language.

Chapter 9
Number Words

Children's emerging ability to think about and talk about numbers poses some fascinating puzzles for developmental psychologists. Numbers are unlike objects such as cats and shoes. They have no material existence—no color, shape, size, or mass. And they are unlike properties such as redness and sadness because they do not correspond to properties that any individual can possess. Instead, numbers correspond to properties of sets of individuals (Frege, 1893). When you say that three cats are outside, the *three* does not refer to any of the individual cats or any property that a cat might have. It instead refers to a property of the set of cats: it is of a certain numerosity; the set has three members.

Sets are notoriously abstract entities. One can see and hear cats, but nobody has ever been wakened in the middle of the night by the yowling of a set. The apprehension of sets might therefore require some cognitive capacity above and beyond the normal apprehension of entities in the world (Maddy, 1990). Then there is the question of the ontological status of numerical properties. Some philosophers and mathematicians take a so-called Platonist position, arguing that numbers are real entities, existing independently of human thought. This argument gains force from the utility that mathematical thought has for explaining and manipulating the natural world. If numbers don't exist, why is it so beneficial to use them in science? But this approach raises the mystery of how our material minds could make contact with such immaterial entities in the course of learning and evolution. Other scholars have proposed that numbers exist as constructions of the mind or that they are parts of a formal system that humans have invented, akin to the elements of chess. Some have even argued that numbers are fictional entities, like leprechauns—that no such things as numbers really exist.

Whatever, precisely, numbers are (or are not), children learn their names—words like *two* and *seven* and *one hundred and eight.* I first discuss what babies know about number and then review different