to our students

FOUNDATIONS OF LANGUAGE

Brain, Meaning, Grammar, Evolution

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CHAPTER 1

The Complexity of Linguistic Structure

1.1 A sociological problem

Those of us who make it our business to study language often find ourselves in the curious position of trying to persuade the world at large that we are engaged in a technically demanding enterprise. Mathematicians are not expected to be able to relate their work to others: “Oh, I never could do math!” And although biologists and neuroscientists may be expected to explain the goals of their research in a very general way, the formidable chemical and physiological details that constitute the real substance of their work are freely granted to be beyond the understanding of non-specialists.

But language seems to be a different story. When we begin describing the sorts of issue we deal with, a typical response is “Oh, yes, I know how hard language is: I tried to learn Russian once!” When we try to explain that, no, that’s not the half of it, we rapidly lose our audience’s attention. The reaction is understandable: who but a linguist wants to hear at a cocktail party or barbecue about current thinking on long-distance extraction or the role of extrametricality in stress assignment?

Language and biology provide an interesting contrast in this respect. People expect to be baffled or bored by the biochemical details of, say, cell metabolism, so they don’t ask about them. What interests people about biology is natural history—strange facts about animal behavior and so forth. But they recognize and respect the fact that most biologists don’t study that. Similarly, what interests people about language is its “natural history”: the etymology of words, where language came from, and why kids talk so badly these days. The difference is that they don’t recognize that there is more to language than this, so they are unpleasantly disappointed when the linguist doesn’t share their fascination.
It may well be that individuals who are attracted into linguistics have a certain talent for metalinguistic reflection—a delight in constructing ungrammatical sentences, finding curious ambiguities and implicatures, hearing and imitating accents, and the like—and that professional training as a linguist only amplifies this proclivity. It would then be no surprise that linguists’ sense of what is interesting in language is different from that of our friends in biology, economics, and dentistry. It is just that we linguists have made the mistake of assuming everyone else is like us. We are sort of in the position of an avid opera-goer who hasn’t quite caught on that he is in the company of a bunch of rock-and-rollers.

In itself this mutual misperception would be merely a harmless source of social annoyance. But it can have a more pernicious side. A good example is the debate in the middle 1990s over the proposal by the School Board of Oakland, California that the dialect of the African-American community (“Ebonics”) be employed as an integral part of class instruction (see Perry and Delpit 1998). The proposal was based on the well-documented structural integrity of this dialect as a language from the point of view of linguistics, and on linguistic research suggesting that instruction in a vernacular can be a valuable scaffolding to support acquisition of literacy in the standard language (Labov 1972; Rickford 1999). However, scientific documentation was of no concern to the general public. During the height of the debate, it was not uncommon to find letters to the editor in newspapers and even scientific journals to the effect that whatever the linguists in their ivory towers might think, Ebonics is a barbaric perversion of English, and it is nonsense to encourage its use.1

This example is revealing in two ways. First, it underlines the importance of language to social identity, and the way linguistic issues come to be conflated with broader social attitudes. Unlike cell metabolism, language is something that people have a personal stake in. Second, it demonstrates the way that people feel entitled to enter the conversation in the absence of expertise, and even to demean the experts in the interest of making a point. The behavior is reminiscent of creationists reacting to evolutionary theory, or oil corporations reacting to evidence of global warming.

Of course the experts aren’t always right, and often there are dueling experts arrayed on opposite sides of a politically charged issue. But one ought to feel obliged at least to consider some of the facts and arguments that the experts have to offer before rejecting them.

Even when broader social issues are not at stake, one finds a curious readiness on the part of the lay public to speculate about the nature of language, and to be satisfied with the answers they arrive at. Unfortunately, such attitudes sometimes extend to influential practitioners of disciplines impinging on linguistics such as philosophy, neuroscience, and computer science. The effect is to divide disciplines from each other when they should be providing mutual support.

The goal of this chapter, therefore, is to establish a baseline of what a theory of linguistic structure must be responsible for. For linguists, the chapter should serve as a reminder of the scope of the enterprise and as an orientation into the outlook of the present study. As for those in neighboring disciplines, I certainly don’t expect them to follow every detail of the structure to be described. But I hope the chapter will help them see beyond “natural history” aspects of language and to recognize the subtler issues at stake in linguistic theory, so that in succeeding chapters I can bring these issues to bear on psychological and biological concerns.

To be sure, there are many other aspects to language besides raw structure, such as its role in social identity and its power in poetry. But it is in the study of structure that I think linguistic theory finds its deepest and most characteristic concerns, and it is structure that will be the principal focus here.

1.2 The structure of a simple sentence

A good way to get into the complexity of linguistic structure is through a rather full analysis of a very simple sentence of English:

(1) The little star’s beside a big star.

The structure of this sentence is given in Fig. 1.1 (next page). Fig. 1.1 is organized into four domains or levels, each of which has a characteristic formal structure. I have given a pretty fair articulation of phonological (sound) structure and syntactic structure, though many particulars are still omitted. The gross articulation of semantic/conceptual structure (alias meaning) is given here, but much of the detail is unknown. I have also included a very sketchy articulation of a level I have called spatial structure, the level at which this sentence can be compared with the perception of the world.

Fig. 1.1 serves as a useful baseline because nearly every bit of structure encoded in it represents a broad consensus among linguists—even if there is disagreement.
about exactly how various aspects are to be systematically formalized. In particular, some variant of the phonological and syntactic structure will be found in every introductory textbook of linguistics.

The format of Fig. 1.1 is, however, a bit idiosyncratic in the way it divides the structure into levels. I have chosen this format in anticipation of the theory of linguistic structure to be developed in Part II; each level of structure is to be thought of as the product of an independent combinatorial ("generative") system. But this is getting ahead of the story. For the moment let us take a tour of Fig. 1.1.

1.3 Phonological structure

The phonological structure consists of four subcomponents or tiers. Down the middle is the segmental structure, the string of discrete speech sounds or phonemes, notated here in the phonetic alphabet (representing more or less standard American pronunciation). However, the speech sounds are actually compositional, made up of a matrix of distinctive features. Fig. 1.2 zooms in on the segmental structure of the word star, now broken into distinctive features. These features define a similarity space among speech sounds. Here is a classic example that illustrates their usefulness. The English regular plural suffix has three pronunciations: 's' as in cats, 'z' as in dogs, and 'z' ('zuh') as in horses. The choice of which to use is determined by the final sound of the word that the suffix is attached to—in particular the sound's distinctive features. The [-voiced] sound 's' is used with words that end with a [±voiced] sound ('t', 'p', 'k', 'f', etc.); the [±voiced] sound 'z' is used with words that end with a [±voiced] sound ('d', 'b', 'g', 'm', etc. plus vowels); and 'z' is used with words that end with the sounds 's', 'z', 's' ('sh'), 'z' ('zh'), 'c' ('ch'), or 'j', all of which have feature compositions

![Fig. 1.2. Detail of segmental structure of the word star](image)

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2 As we will be making reference to Fig. 1.1 extensively in this chapter and then sporadically throughout the rest of the book, readers may find it useful to photocopy the page.
close to those of 's' and 'z'. That is, the generalizations concerning the exact phonetic form of the plural suffix fall out very naturally from the similarity space defined by the distinctive features. Hundreds of phenomena of this sort have been studied by phonologists. These features play a role in child language acquisition, in historical change, and in speech errors, as well as in the description of many dozens of languages. It is a scientific question what the right set of features is—one that is gradually being settled through phonological and phonetic research.

However, phonological structure is more than just a sequence of phonemes; it is organized into a number of semi-independent “tiers,” labeled along the right-hand side of the phonology in Fig. 1.1. One is the grouping of speech sounds into syllables, indicated by σ. Now it could have been that syllables were just unstructured strings of phonemes, like this:

\[
\begin{array}{c}
\sigma \\
/ & \ \\
/ b & / \\
/ i & / \\
/ g \\
\end{array}
\]

But in fact there are hierarchical distinctions inside the syllable. A syllable has to have one segment that functions as a Nucleus—the sonorant core around which the syllable is built. This is designated by \(\text{N} \) in Fig. 1.1. The nucleus is usually a vowel, but consonants with the distinctive feature [+sonorant] can also serve as syllabic nuclei. One of these is 't', which serves as nucleus in the second syllable of *little*, as seen in Fig. 1.1.

The rest of the syllable’s structure is optional. The nucleus and any following material (called the Coda) are grouped as the Rime (the part of the syllable that remains the same in rhymes). The material before the nucleus is grouped as the Onset (the part that remains the same in alliteration). These are indicated in Fig. 1.1 by \(\text{R} \) and \(\text{O} \) respectively. Notice also in Fig. 1.1 that the segment D in *little* (a “flapped” 'd' or 't') is *ambisyllabic*: it serves both as coda of one syllable and as onset of the next.

Above the syllabic structure is the tier of *prosodic structure*, which has two subcomponents. The brackets indicate the organization of the syllables into *intentional phrases*: pauses in pronouncing the sentence can occur only between bracketed units. Within the brackets are the xs of the *metrical grid*, which indicates the relative stress of syllables. Syllables with no xs above them are unstressed; more xs indicate more stress, so that the word *big* receives the main stress of the sentence.

Looking now below the grammatical string, we find the tier of morphophonological structure—the grouping of the speech stream into words (indicated by \(\text{Wd} \)). Notice that the words *the* and *a* do not have the symbol \(\text{Wd} \) below them. Rather, they are treated phonologically as *clitics*—phonological fragments that attach to adjacent words to form a larger \(\text{Wd} \) constituent. Finally, notice that the sound 'z' by itself also is a clitic, notated orthographically in sentence (1) by 's'.

### 1.4 Syntactic structure

Consider next the syntactic structure. This is a tree diagram of the familiar sort. The largest constituent, the sentence (S), divides into a noun phrase (NP) (which serves as the subject) and a verb phrase (VP) (which serves as the predicate); the NP divides into a Determiner, a modifying adjective phrase (AP), and a head noun (N), which carries the features 3rd person count singular. (If this were a French or German sentence, the D and A would also have number, and all constituents of NP would have grammatical gender as well.) The VP divides into a head verb (V) and a prepositional phrase (PP), the PP divides into a preposition and its NP object, and the NP divides like the subject NP. Attached to the V is an Inflection which includes present tense plus the features 3rd person singular, which agree with the subject.

The way I have notated this tree differs from standard convention in two respects. First, it is customary to put the words of the sentence at the bottom of the tree, as in (3).

\[
\begin{array}{c}
\text{Det} \quad \text{NP} \\
\text{the} \quad \text{A} \quad \text{star} \\
\text{little} \\
\end{array}
\]

I have omitted the words for reasons to be discussed more fully in Chapter 5. The basic reason is that things like *the* and *star* are actually pieces of phonology, not syntax. The only aspects of words that play a role in syntax are the part of speech (Det, N, etc.) and syntactic features such as 3rd person singular and present tense.

The other way this notation differs from tradition is that some of the connections in the tree are notated with double lines. These are connections between phrases and their heads. The idea is that phrases like NP, VP, AP, and
1.5 Semantic/conceptual and spatial structure

If phonology and syntax are fairly well settled at least at this relatively gross level, there is considerably less agreement about the proper formulation of semantic/conceptual structure, even with respect to whether there is such a thing. Fig. 1.1 unabashedly presents one aspect of this structure in my own version of the notation. Chapter 12 will call this aspect the descriptive tier; it corresponds roughly to the information that might be encoded in a predicate logic. Chapter 12 will also motivate other tiers of semantic/conceptual structure, related to this tier in roughly the way the tiers of phonology are related. One is the referential tier, which corresponds roughly to the aspects of meaning added when moving from a predicate logic to a quantificational logic. Another is the tier of information structure, the division of the content of the sentence into foreground and background (topic/locus and presupposition).

The structure given in Fig. 1.1 is a labeled bracketing, in which each pair of brackets surrounds a conceptual constituent. The label on a constituent designates it as belonging to a major conceptual type such as Situation, Event, State, Object, Place, or Property.

Two kinds of relation among conceptual constituents appear in this structure. The first is function-argument structure, noted as in (5).

(5) \[ F(\ldots, I, \ldots) \]

Here \( F \) is a function that maps a constituent of type \( Y \) and a constituent of type \( Z \) into a constituent of type \( X \). (5) shows a two-place function. \( B \) is such a function in Fig. 1.1. There are also one-place functions (such as \( \text{BE} \) in Fig. 1.1) and possibly three-place functions. The second kind of relation is modification, notated as in (6).

(6) \[ \ldots \]

(6) is a constituent of type \( X \), in which the inner constituent, of type \( Y \), specifies a further characteristic of the outer constituent. An example of this in Fig. 1.1 is the modification of the first Object constituent by the Property \( \text{LITTLE} \).

Using this notation, the conceptual structure in Fig. 1.1 says that there is a Situation in the present, consisting of a State. This State is one of an Object being located in a Place; the function \( \text{BE} \) maps the Object and the Place into this State.

Now look at the Object that is the first argument of \( \text{BE} \). It has three pieces of structure. The first designates the Object as of the category \( \text{STN} \) (which presumably has more internal articulation, not notated here; see Chapter 11). The second piece is a marker \( \text{DEF} \) ("definite"), which indicates roughly that the identity of
1.6 Connecting the levels

The structure of our sentence cannot exist apart from the particular circumstances of the environment. It is not possible to determine the relationship between the parts of a sentence without considering the role of speech in the communicative process. For example, the phonological structure, which is a prerequisite for the formation of words and sentences, cannot be separated from the syntactic structure, which organizes sentences into meaningful units. Similarly, the syntactic structure, which organizes sentences into meaningful units, cannot be separated from the semantic structure, which gives meaning to the words and sentences. The relationship between these structures is not fixed but rather depends on the context in which the sentence is used. Thus, the study of language must consider the relationship between the various levels of organization. The relationship between these structures is not fixed but rather depends on the context in which the sentence is used. Thus, the study of language must consider the relationship between the various levels of organization.
example, the features 3rd person and singular on the verb are purely syntactic agreement features that have no particular effect in semantic/conceptual structure (in English at least).

Another thing to notice about these correspondences is that the units that are connected between phonology and syntax are not always the same units that are connected between syntax and conceptual structure. For example, the inflected verb (the upper V in Fig. 1.1) is connected to the phonology (subscript 1), where it appears as the clitic 2, but the bare verb and the inflection are connected separately to semantics (subscripts 6 and 7), where they are separate elements.

Generally speaking, the mapping between phonology and syntax preserves linear order, while the mapping between syntax and meaning tends to preserve the relative embedding of arguments and modifiers. In particular, the head of a syntactic phrase tends to map into the outermost function of the corresponding conceptual constituent. For instance, the preposition beside, the head of the PP, maps into the function beside that governs the Place-constituent in Fig. 1.1.

In turn, some but not all parts of semantic/conceptual structure correspond to spatial structure—in Fig. 1.1, the two Object-constituents and the Place. Other parts of conceptual structure are harder to represent directly in any spatial format. For instance, little and big raise the problem of how to note relative size in spatial structure; definiteness (DEF) raises the problem of how to note uniqueness. My impression is that these explicit pieces of conceptual structure encode distinctions that are only implicit in spatial structure—so it is hard to see how to note the relationship with a simple co-subscripting.

One aspect of this correspondence merits special attention. As noted a moment ago, the little clitic 'z' in phonology is of course the contracted verb is, which expresses the verb be in the 3rd person singular present tense, a smallish part of the syntactic tree. In turn, the verb be corresponds to the next-to-largest function in semantic/conceptual structure. The largest function in semantic/conceptual structure is present tense. But this appears as a feature of the verb be in syntax, and is not even an independent element in the phonology. So, by virtue of this two-step correspondence, elements of relative insignificance in phonology can correspond to major organizing features of meaning. (A similar situation arises in vision, where tiny features of a boundary can dramatically affect the three-dimensional interpretation of an array.)

This behavior of the part of Tense is a good illustration of the kinds of tensions that arise in syntactic theory. Tense has been noted in Fig. 1.1 as a feature on the verb, making it easy to match to phonology. But as a result it is more difficult to match to meaning, because it is necessary to say, exceptionally, that this feature attached to a verb (rather than the verb itself) maps to the function of largest scope in semantic/conceptual structure. We can improve the mapping to semantic/conceptual structure by adopting the alternative syntactic structure shown in (4), with Inflection as the head of the sentence: now the superordinate syntactic head maps to the largest-scope semantic function. But this creates a problem in mapping to the phonology, since the clitic 'z' now must match two separate pieces of syntax at once, the Verb and the Tense. So changing the syntactic analysis to simplify one mapping makes the other mapping more complex.

A third possibility is to keep both correspondences simple by localizing the complexity in the syntactic component itself. This has been the standard approach in generative grammar. The idea is that the syntactic structure of our sentence contains two different trees. The form given in Fig. 1.1 is the "surface structure," which interfaces easily with the phonology; and the form in (4) is the "underlying (or deep) structure," which interfaces easily with meaning. Then, internal to syntax, these two forms are related by a transformation that combines the underlying Inflection and Verb into the single unit found in surface structure. This approach was the major innovation in Chomsky's Syntactic Structures (1957) and has been a staple of syntactic analysis ever since.

Whichever of these three ways to deal with Tense proves correct, the point is that there is a mismatch between phonology and meaning, which has to be encoded somewhere in the mapping among the levels of structure. If this mismatch is eliminated at one point in the system, it pops up elsewhere. Much dispute in modern syntax has been over these sorts of mismatch and how to deal with them. (I don't think most linguists have viewed it this way, though.) We will encounter such mismatches pervasively in the course of Parts II and III.

1.7 Anaphora and unbounded dependencies

For the sake of completeness, let me step away from our little sentence for a moment, to mention briefly two syntactic phenomena that have been the focus of a great deal of research in linguistic theory and that will turn up now and again in the present study: anaphora and unbounded dependencies.

The set of constraints on the use of anaphoric elements such as pronouns and reflexives has come to be called Binding Theory (not to be confused with the neuroscientist's notion of binding, to be taken up in Chapter 3). Some standard examples of reflexives appear in (8).
8. a. Joe adores himself. \[\text{[himself = Joe]}\]
b. Joe thinks that Fred adores himself. \[\text{[himself = Fred]}\]
c. Joe thinks that you adore himself.

Example (8a) shows that a reflexive pronoun in object position can co-refer with (or be bound by) an NP in subject position. (8b) shows that it must co-refer with the subject of the same clause, not just any subject. (8c) shows that if the reflexive cannot be bound by the subject of its own clause—here because you and himself cannot co-refer—its use is ungrammatical (in English; certain other languages such as Japanese work differently).

Turning to ordinary pronouns, consider the examples in (9).

9. a. Joe adores him. \[\text{[him = Joe]}\]
b. Joe thinks that Fred adores him. \[\text{[him = Joe or third party]}\]
c. Joe thinks that you adore him. \[\text{[him = Joe or third party]}\]
d. He thinks that Joe adores Fred. \[\text{[he ≠ Joe or Fred]}\]
e. If you tickle Joe, he laughs. \[\text{[he can = Joe]}\]
f. If you tickle him, Joe laughs. \[\text{[him can = Joe]}\]

Example (9a) shows that a simple pronoun in object position, unlike the reflexive in (8a), must not co-refer with the subject of its clause. (9b, c) show that it can, however, co-refer with an NP in another clause—again unlike a reflexive. (9d) shows that a pronoun cannot co-refer with an NP in a subordinate clause on its right. However, (9e) shows that a pronoun can co-refer with an NP in a subordinate clause on its left. In (9f) the pronoun is, atypically, to the left of its antecedent; but this case is saved by the fact that the pronoun is in a subordinate clause.

Another sort of anaphoric element is the expression do so, which stands for a VP rather than an NP. Its relation to its antecedent resembles that of pronouns. Compare (10a–d) to (9c–f).

10. a. Fred impressed the boss without trying to do so. \[\text{[do so = impress the boss]}\]
b. Fred did so without trying to impress the boss. \[\text{[did so ≠ impress the boss]}\]
c. Without TRYING to impress the boss, Fred did so. \[\text{[did so ≠ impress the boss]}\]
d. Without trying to do so, Fred impressed the boss. \[\text{[do so = impress the boss]}\]

These examples make it clear that it is a complex matter to state the exact conditions under which an anaphoric element can co-refer with an antecedent.

In particular, the conditions crucially involve linguistic structure, and not just linear order. Thus it is no surprise that these conditions have been a constant preoccupation of linguistic research. The main lines of dispute are whether the linguistic structure involved in conditions on anaphora is syntactic structure alone (Chomsky 1981; Lasnik 1989), or whether semantic/conceptual structure plays a role as well or even instead (six independent approaches among many appear in Jackendoff 1972; Fauconnier 1985; Kuno 1987; Levinson 1987; Van Hoek 1995; and Cookey and Jackendoff 1993).

For a different sort of phenomenon, consider the examples in (11). The italicized elements are understood as having a role appropriate to the position marked by t. For instance, in (11a), which movie is understood as the object of the verb saw.

11. a. Which movie does Susan imagine that Sarah saw t last night? \[\text{[tub-direct question]}\]
b. John was wondering who Sarah decided she would go to the movies with t on Sunday. \[\text{[Indirect question]}\]
c. I didn’t like the movie which you said that everyone was talking about t the other day. \[\text{[Relative clause]}\]
d. You may take whichever sandwich you find t on the table over there. \[\text{[Free relative]}\]
e. That movie, I wouldn’t recommend that anyone consider taking their kids to t. \[\text{[Topicalization]}\]

It is significant that the understood position can be within a subordinate clause, in fact deeply embedded within multiple subordinate clauses, as in (11e). For this reason, the relation between the italicized constituent and the understood position is called a long-distance dependency.

The analysis of such constructions within mainstream generative grammar is that the italicized constituent is actually in its understood position in underlying (deep) structure, and that it moves to the fronted position in the course of a syntactic derivation. The movement leaves behind an “unpronounced pronoun” called a trace, which is indicated by t in (11). However, other generative frameworks, especially Head-Driven Phrase Structure Grammar (Pollard and Sag 1994), have proposed analyses in which there is no movement, but instead the grammar directly establishes an anaphora-like relation between the italicized constituent and the trace (or a formal equivalent of the trace).

These constructions pose an interesting problem in that there are strong constraints on the structural position that an “extracted” constituent can occupy in relation to its trace. For example, an “extracted” constituent cannot be outside of a conjoined construction (12a), a relative clause (12b), or an indirect question
(12c), or a noun complement (12d) that the trace is inside of. The examples in (12) all involve direct wh-questions, but the same thing happens with all the constructions in (10).

12. a. *What did Beth eat peanut butter and {t} for dinner?
   b. *Who does Sam know a girl who is in love with {t}?
   c. *Who does Betty know which professor flunked {t}?
   d. *What food were you never aware of the hypothesis that you shouldn't eat {t}?

As with anaphora, it has been a preoccupation of linguistic research for three decades (starting with Ross 1967) to characterize precisely the environments from which “extraction” is possible. Again, one of the issues is whether the criteria are completely syntactic or partially semantic as well (Ertischik-Shir and Lappin 1979; Deane 1991; Kuender 1992; Van Valin 1994; Culicover and Jackendoff 1997). But the overall outlines of the phenomenon are clear.

Any adequate theory of language must begin with the fact that even the simplest sentences contain at least this rich a structure. Although I don’t feel comfortable making moral statements, I will make one nevertheless. In my opinion, if one wishes to join the conversation about the nature of language, one must recognize and acknowledge this complexity. One need not have an account of all of it, but one may not willfully ignore it and still expect to be allowed in the game. This is the minimum that scientific responsibility demands.

Having recognized all this complexity, the obvious question is: What can we make of it? That is what the rest of this book is about.

2.1 What do we mean by “mental”?

The remarkable first chapter of Noam Chomsky’s Aspects of the Theory of Syntax (1965) sets in place an agenda for generative linguistic theory, much of which has survived intact for over thirty-five years. The present chapter and the next two will be devoted to evaluating and rearticulating this agenda, and to replying to some of the more common and longstanding criticisms of the approach.

We follow Aspects by starting with the issue of the status of linguistic description. The standard techniques of linguistic research lead us to some posited structure, say Fig. 1.1, for the sentence The little star’s beside a big star. How is such a structure to be understood? The fundamental claim of Aspects is that this structure is more than just a useful description for the purposes of linguists. It is meant to be “psychologically real”: it is to be treated as a model of something in the mind of a speaker of English who says or hears this sentence. What does this claim mean?

Often the answer is put in these terms: Fig. 1.1 is a model of a mental representation of the sentence. Unfortunately, I have to plunge right in and attempt to wean readers away from this terminology, which I think has led to unnecessary and prolonged misunderstanding. The problem is that the term “representation” suggests that it represents something—and for something to represent something else, it must represent it to someone. But we don’t want to say that Fig. 1.1 “represents the sentence to the language user”; that would suggest somehow that the language user has conscious access to all the structure in the figure, or could have it with sufficient introspective effort. Nor do we want to say that the figure represents the sentence to some entity within the language user’s unconscious mind that would conjure up the notorious homunculus, the
tion in the collaborative actions of highly social mammals such as wolves and especially chimpanzees.

Establishing and maintaining a joint intention is yet another way of tuning conceptualizations. It differs from the other ways of tuning conceptualizations—either accepting or fighting the status quo—in that it is not one-sided; the participants are cooperating in establishing a tuning and actively maintaining it.

However, such cooperation is subject to defection. An all-too-common example occurs when one participant takes the common enterprise to be one of cooperation in solving a problem (i.e., presumes tuning), and the other takes it to be one of social coercion ("the truth is what I say it is"). The first participant, on discovering the defection, justifiably accuses the second of a swindle or worse.

This brief discussion of "tuning" may evoke in readers a rich range of associations, from education to politics to mental illness to multiculturalism to postmodernism. This is not the place to go on; I encourage others to explore the connections.

For present purposes, the point is that "tuning" seems to me the last piece we need to close the loop in creating a conceptualist account of reference and truth. Not only is our conceptualized world our own reality, we constantly check whether it converges with everyone else's. To the degree that we sense that it converges, we take the common view as flowing from the "objective character of the world." On the other hand, to the degree that we sense conflict, we are forced to acknowledge subjectivity, and the sense of what is "objective" becomes less stable.

This is not to say that objectivity and truth reduce to consensus (a view urged by Rorty 1979, for instance). Rather, objectivity is understood as an ideal that we aspire to achieve. Consensus or "co-tuning" is one important factor that the 1-mind weighs (and often we weigh consciously) in judging objectivity and truth. But there are others. The rebel trusts his or her own perception and inference and holds out against the consensus ("The emperor has no clothes!"). Achieving the proper balance is often difficult, and the line between courage and madness can be a tough call.

Here is where I think we are, after pursuing a rigorously mentalistic approach to meaning. We have not ended up with the rock-solid rigid notion of truth that the realists want. Rather, I think we have begun to envision something that has the promise of explaining our human sense of truth and reference—and of explaining why philosophical and commonsensical disputes about truth and objectivity so often proceed the way they do. I have no illusions that this work is over, but it strikes me as a path well worth exploring.

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CHAPTER II

Lexical Semantics

11.1 Boundary conditions on theories of lexical meaning

Back to the trenches. An overall framework for studying meaning is not enough: an important part of its value lies in the opportunities it offers for understanding the gritty details of language. Accordingly, this chapter discusses a potpourri of issues concerning the concepts associated with words; the next chapter turns to larger linguistic units.

The mentalist stance of generative grammar, as extended to meaning in the past two chapters, leads us immediately to three important boundary conditions on a theory of lexical concepts—concepts that form the conceptual structure component of lexical items. First, since lexical items must be stored in long-term memory (Chapter 6), so must lexical concepts. As emphasized in the previous chapter, this precludes explicating word meanings in terms of the extension of sets to which the speaker has no access, for example treating the conceptual structure of dog as the set of all dogs in all possible worlds. Rather, the meaning of dog has to be specified in terms of a set of conditions or features that speakers of English use to distinguish dogs from other entities.

A second boundary condition on the theory of lexical concepts is that they must somehow get into long-term memory. Almost everyone who thinks about it takes it for granted that lexical concepts are learned—though many recognize that this presents formidable problems (section 4.7).

A third boundary condition on a theory of lexical concepts concerns their contribution to the meanings of sentences. The contextualized understanding of a novel sentence (perceived or produced!) has to be composed online in working memory (Chapters 6 and 7). It must be built from the following sources:

- The meanings of its words (the lexical concepts).
- Conceptual structure conveyed by the grammatical structure of the sentence.
- Overall conditions on composed conceptual structure: Is the structure well-formed? Is it plausible?
- Conceptual structure derived from context.
Lexical concepts must be rich and specific enough to play their necessary role in this mix. It may be possible to reduce the richness of lexical concepts by enriching the theories of the other three components, but in the end it is necessary to show that the contributions of the four components add up to the full interpretation.

11.2 The prospects for decomposition into primitives

Let us begin by focusing on the necessity for lexical concepts to be learned. Nearly everyone thinks that learning anything consists of constructing it from previously known parts, using previously known means of combination. If we trace the learning process back and ask where the previously known parts came from, and where their previously known parts came from, eventually we have to arrive at a point where the most basic parts are not learned: they are given to the learner genetically, by virtue of the character of brain development. We went through this trope in Chapter 4; I hope nothing further need be said. Applying this view to lexical learning, we conclude that lexical concepts must have a compositional structure, and that the word learner’s f-mind is putting meanings together from smaller parts.¹

The major exception to this view of lexical learning is Jerry Fodor, who takes the position (e.g. 1975; 1998) that all lexical concepts (or at least all morphologically simple lexical concepts) are innate. This includes, for instance, the meanings of telephone, carburator, merlot, softist, and yarmulka: even if some of these words are absent from someone’s vocabulary, their meanings are present in his or her f-mind, just waiting to be triggered. Fodor arrives at this position because he maintains that lexical concepts are monadic: they have no parts, hence no parts that could be previously known. Hence he is forced to say that all lexical concepts are innate. He never addresses the question of how they could all be coded genetically, nor how evolution could have come up with them. I take it that this is a position we want to avoid.

Fodor believes that lexical concepts have no parts because he assumes an extremely limited view of what the parts could be and how they could combine. His argument that lexical concepts are monadic stems from a paper entitled “Against Definitions” (Fodor et al. 1980). The title of the paper gives the game away. Observing (correctly) that one usually cannot find a right definitions that work all of the time, Fodor concludes that word meanings cannot be decomposed.

However, his notion of definition is the standard dictionary sort: a phrase that elucidates a word meaning. So what he has actually shown is that word meanings cannot be built by combining other word meanings, using the principles that also combine words into phrases.² But there are other options.

A comparison with phonology is useful. The phonology of a word is certainly not monadic and innate; it is built from known parts. At the first layer of decomposition, we find a repertoire of language-specific syllables; at the second, a repertoire of partly language-specific speech sounds; at the third, a universal repertoire of distinctive features. What we take to be innate is the repertoire of features, plus general principles for building them into language-specific repertoires of sounds, syllables, and words.

Notice what happens as we decompose further and further. Among the syllables of a word, many could be words on their own (e.g. within syllables, sill and bulls). At the next layer down, most speech sounds cannot be words on their own (vowels can, but individual consonants can only be clitics, as in cats, he'll, I'm, named)—but at least they can be intuitively discriminated. However, at the next layer down, distinctive features not only can’t be words on their own, they can’t even be sounds on their own. We have no conscious access to them, and it requires a theory of phonology to uncover their differentiation and their role in building words. Moreover, although speech sounds combine into syllables by concatenation, and syllables combine into words by concatenation, and words combine into phrases by concatenation, distinctive features do not combine into speech sounds by concatenation.

Whether or not we suffer physics envy, a physical parallel is also suggestive. In explaining the variety of substances in the world, a first layer of decomposition gives us a limited repertoire of substances such as oxygen, boron, sulfur, and gallium, combined by chemical bonds. The next layer down gives us entities that can exist in isolation but are not substances: electrons, protons, and neutrons, combined by electromagnetic and nuclear forces. The next layer down gives us quarks, which not only are not substances but cannot exist in isolation; they are as it were features of elementary particles.

I suggest that the same is true of lexical concepts. As we explore the parts from which they are built, suppose we find layers of structure whose units cannot individually serve as possible word meanings. This would preclude an explication of

¹ For a more detailed critique of Fodor’s position, see Jackendoff 1981: 122–7; 1990a: 57–61, 150–2. As far as I am aware, Fodor has not replied to these critiques. He does offer an argument against my type of decomposition in Fodor (1998: 49–56, also discussed in Laurence and Margolis 1999: 58–9). But his argument is made only on methodological grounds and completely ignores all empirical generalizations captured by the decompositional approach. We return to this argument briefly in section 13.8.
lexical meanings in terms of linguistically expressed definitions, i.e. synonymous phrasal expressions. In addition, suppose the principles by which sublexical units combine into word meanings are not the same as the principles by which word meanings combine into phrase meanings. Then, even if the sublexical units composing a word meaning could themselves be expressed as words, no phrase composed of those words could express what the original word expresses. And of course, just as we have no conscious access to phonological primitives, we should not be able to expand on word decomposition on the basis of raw intuition.

So here is the answer to Fodor’s argument against definitions: although he has shown that lexical meanings cannot be decomposed definitionally, he neglects the possibility that there are non-definitional forms of decomposition of the sort found in phonology and physics. Since his alternative to non-definitional decomposition is genetic transmission of the whole meanings of quark and fax, our choice ought to be clear.

An important question often raised about lexical decomposition is the justification of primitives. Where does decomposition end? When do we know to stop? I don’t think the parallel question in physics worries its practitioners too much. The history of the last two hundred years is a continual quest to explain deeper and deeper regularities. Semantics is just getting started; let’s show some patience. In the meantime, we do the best we can to extract and characterize relevant generalizations.

A quick example here might be helpful to illustrate both the non-definitional character of lexical decomposition and the issue of primitives. A staple of lexical semantic analysis (going back at least to Gruber 1965, McCawley 1968, and Lakoff 1970) has been the extraction of causation as a significant component of many verb meanings. For instance, the sentences in (1) are related to those in (2) by a common approximate paraphrase relation, shown in (3).

(1) a. The window broke.
   b. The door opened.
   c. The ball rolled down the hill.
   d. Harry received a flower.
   e. Harry died.
   f. Harry decided to talk.

(2) a. Beth broke the window.
    [= Beth caused the window to break]
   b. Beth opened the door.
    [= Beth caused the door to open]
   c. Beth rolled the ball down the hill.
    [= Beth caused the ball to roll down the hill]
   d. Beth gave Harry a flower.
    [= Beth caused Harry to receive/get a flower]
   e. Beth killed Harry.
    [= Beth caused Harry to die]
   f. Beth persuaded Harry to talk.
    [= Beth caused Harry to decide to talk]

3) Beth V2 NP X = Beth cause NP to V1 X

In cases (a–c) the verbs in (1) and (2) are morphologically identical, in cases (d–f) they are different; but the paraphrase relation is uniform throughout. As Fodor (1970) points out, this paraphrase relation is not exact (see McCawley 1978 and Jackendoff 1990a: ch. 7 for some reasons why); Fodor uses this as an argument against lexical decomposition. But the fact that the very same not quite paraphrasable relation occurs over and over, in language after language, suggests that something of linguistic importance is going on—but not at the level of decomposition into words.

So, following custom, let us introduce an abstract term cause for the semantic element the verbs in (2) have in common. In many approaches to lexical semantics this is taken as a primitive. However, Talmy 1995 (reanalyzed in Jackendoff 1990a: ch. 7 and Jackendoff 1996a: an earlier partial analysis is Gruber 1965) shows that cause is not simplex; it is one of a family of concepts related through feature decomposition. They all invoke a basic situation involving two characters; one, the “Antagonist,” is trying to get something to happen to the other, the “Agonist.” Causing is a situation in which the Antagonist succeeds in opposition to the Agonist’s resistance or inaction. For instance, in (2a) Beth (Antagonist) acts on the window (Agonist), which would not tend to break (Action) unless Beth acted on it. But there are other combinations, for example:

(4) a. Beth pressured/urged Harry to talk (but he didn’t talk and he did talk).
    [Beth acts in opposition to Harry, possibly not succeeding.]
   b. Beth helped/aided/assisted Harry in washing the dishes (but they didn’t finish and they finished)
    [Beth acts in concert with Harry, possibly succeeding]
   c. Beth let Harry talk/allowed Harry to talk.
    [Beth ceases to oppose Harry]

There is no word that expresses the basic function these all have in common; Jackendoff calls it cs, and Talmy resorts to an annotated diagram. The two analyses differ in the features posited to distinguish causing, pressuring, helping, and letting; but on either analysis the features involved have no simple lexical paraphrase.
A further generalization of the analysis extends it to verbs expressing propositional relations: at the proper degree of abstraction, entail and imply are analogous to verbs of causation, permit and be consistent with are analogous to verbs of letting, and reinforce and support are analogous to verbs of helping. These patterns of commonality are recognized as significant by many lexical semanti- cists. But we cannot pull them out without resorting to considerable sublexical formal abstraction, not readily expressible as definitions. And once we do so, are we down to primitives? We don’t know. All we know is that we are three stages of generalization away from actual words.

It is all well and good to extract significant parts from word meanings; but what about the part that is left? For example, suppose we accept, even approximately, McCawley’s (1968) famous analysis of kill as [cause [become [not [alive]]]] where I use words written in small capitals to designate the meanings of those words. The first three elements are widespread among lexical concepts and are candidates for primitives or near-primitives. But what about alive? Can it be decomposed, or do we have to accept it as a primitive? Laurence and Margolis (1999) call this the “problem of completers.”

This problem also arises in analyzing variation among closely related words. For instance, how does break differ from shatter and crumble? It does not appear likely that the differences among them are elements of any larger generality, such that we would find other groups of verbs that differ in exactly the same dimensions. Such facts, which we confront at every turn, threaten to undermine the prospect of completely decomposing words into primitives that are descriptively useful and that have some plausibility for innateness.

For some linguists this is not taken to be a problem. Pinker (1989: 167): “I will not try to come up with a small set of primitives and relations out of which one can compose definitions [sic] capturing the totality of a verb’s meaning.”

Grishaw (1993): “Linguistically speaking, pairs like [break and shatter] are synonyms, because they have the same structure. The differences between them are not visible to the language.” Pustejovsky (1995: 38): “What I would like to do is to propose a new way of viewing decomposition, looking more at the generative or compositional aspects of lexical semantics, rather than decomposition into a specified number of primitives.” For Pinker and Grishaw, all that is at issue is the syntactic behavior of words; since the syntax–semantics interface cannot “see” all of meaning, a complete decomposition is unnecessary and even irrelevant (section 9.7.3). Pustejovsky is interested in previously unexplored aspects of lexical meaning that go beyond mere feature decomposition (see sections 11.9 and 11.10), so he too can bypass the question of primitives.

However, the requirement of learnability forces us to take the problem of primitives seriously. If children can acquire the fine-scale differences among words, they must have some resources from which the differences can be constructed. Therefore it ought to be a long-range goal for conceptualist semantics to characterize these resources.

A particularly austere approach to primitives would be the thoroughly empiricist claim that meaning is built entirely from primitives provided by sensation or perception, and that all else is built by association or statistical inference. I take it that this is a non-starter. For instance, it was shown as long ago as David Hume’s Treatise on Human Nature that the notion of causation, here cause, cannot be built up by these means (see discussion in Macnamara 2000). And words like function, any, and nevertheless seem altogether unapproachable perceptually. In the terms of Chapter 10, perceptual descriptive features alone are not sufficient for characterizing meaning; and there is no way to construct inferential descriptive features from perceptual primitives. Thus there is no question that we are going to have to accept some abstract primitives.

In view of these considerations, we will adopt as a practical policy the necessity for lexical conceptual decomposition. And we will note as we go the prospects, good and bad, for finding primitives.

11.3 Polysemy

Another much-discussed question of lexical semantics is how the theory should deal with polysemy. How should we treat apparently different senses of a lexical item that bear some intuitive relationship, for instance the two uses of break, open, and roll in (1) and (2)? Let me lay out some cases, mostly not new, that illustrate the complexity of the problem; others will appear in the course of the chapter.

First, a baseline for how rigorous it is possible to be. Gooseberry and strawberry have nothing to do with goose and straw. Yet given the chance to create folk etymologies, people will invent a story that relates them. Overcoming the strong intuition that there must be a relation is not easy, and one must not insist on closer relations than there really are. But how can we tell when to give up and

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1 For an interesting case that also bears on non-definitional decomposition, it has often been noticed (Talen 1978; Jackendoff 1991) that the substance–object (mass–count) distinction in nouns (water vs. bowl) parallels the process–event distinction in verbs (run vs. arrive), and that there are often strong interactions between the two distinctions in the meanings of sentences. This parallelism motivates a semantic feature [bounded] that contributes to both domains: objects and events have inherent boundaries, substances and processes do not. As shown in Jackendoff (1991), it is in part this common distinction that allows us to say that both a table [object] and a speech [event] can have an end. But there is no perceptual similarity between the end of a table and the end of a speech.
call some putative explanation a “gooseberry etymology”? I don't know in general; I only know that doing so is an honorable last resort.

Next consider some cases where it is easy to make a judgment. On one extreme, I think everyone agrees that the banks in river bank and savings bank represent separate homonymous concepts listed in the lexicon, not a single polysemous concept. On the other extreme, I doubt anyone thinks that the mental lexicon lists ham sandwich as potentially referring to a person, or Russell as referring to a book, or John as referring to a car, even though they are understood that way in (5).

(5) a. [One waitress to another:] The ham sandwich in the corner wants some more coffee.
   b. Plato is on the top shelf next to Russell.
   c. John got a dent in his left fender.

Rather, these “extended” meanings are built up online from lexically listed meanings by general principles; we take this process up in section 12.2.

The cases between these two extremes are of greater interest. One that I find uncontroversial is the sort of multistep chaining of association found in cardinal. According to the Oxford English Dictionary, the earliest meaning is ‘principal,’ as in cardinal points of the compass and cardinal virtues. From there it extended to the high-ranking church official, then to the traditional color of his robes, then to the bird of that color. All of these senses are still present in English, but they surely do not constitute a single polysemous word—especially the first and last member. The reason is that the basis for connection changes en route, so that one cannot trace the connection without knowing the intermediate steps. What should we say about these cases? They are more closely related than plain homonyms, but not closely related enough to be said to form a unified concept. One might call them “opaquely chained concepts.”

We find a quite different situation in the related senses of open in (6), which are related by semiproductive lexical relations; the relation between (6b) and (6c) is the causative relation illustrated in (1) and (2).

(6) a. The door is open,
   b. The door opened,
   c. John opened, the door.

[John caused the door to open, = John caused the door to become open,]

I have the same sense about Lakoff's (1987:164–9) analysis of the Japanese classifier hon; among the entries to which it applies, there is a motivated route from candle to Zen contexts and to TV programs, but I find it hard to think of them as constituting any sort of unified category, as Lakoff claims.

This chaining, unlike the chaining of cardinal, is semantically transparent, in that the original concept is contained in both the derivative concepts. This sort of transparent chaining is a standard case of polysemy.

One might try to claim (with Deane 1996 and Ruhl 1989) that these three uses are not separate senses that must be learned individually, but rather form a single sense that can be extended from the simple core prototype (6a). This treatment runs into problems, though, when we start dealing with long branching chains.

An example is the word smoke. The core is the noun smoke, the wispy substance that comes out of fires. From this we get at least the senses in (7).

(7) a. smoke₁ = ‘wispy substance’
   b. X smokes, = ‘X gives off smoke,’
   c. Y smokes, X = ‘Y causes X to smoke,’ where X is a pipe, cigar, etc., by putting in the mouth and puffing, taking smoke into the mouth, etc.
   d. Y smokes, X = ‘Y makes something’
   e. Y smokes, X = ‘Y causes smoke to go into X, where X is a ham, herring, etc., by hanging X over a fire in an enclosure’

Although all the steps in (7) are transparent, I would be reluctant to say that these five uses together form a single concept for which smoke₁ is the prototype. In particular, there is really no relation between smoke₁ and smoke₁ other than the presence of smoke₁ as a character in each action. One reason for this is that each step of the chain adds idiosyncratic information. For instance, it could only be a joke to speak of smoking₂ a herring by setting it on fire and putting it in your mouth and puffing, or of smoking₂ a cigar by putting it in a smoky room.

Because of these multiple branches and idiosyncrasies, it makes more sense to say there are five senses arranged in two transparent chains branching outward from smoke₁ (1–2–3–4 and 1–5). These senses are not any more closely related to each other than they are to, say, smoky and smoker (the latter meaning either ‘a person who smokes’ or ‘a vessel in which one smokes, things’). And in a morphologically richer language than English they might be morphologically distinct; for instance German has Rauch for smoke₁, rauchen for smoke₁ and rauchen for smoke₁. In other words, even if all these senses are related, the language user must learn them individually.

A check on the validity of such putative relationships is the extent to which they occur in other lexical items. Here are the linkages for smoke, listing other words that show the same relationships among their senses:

(8) smoke₁ → smoke₁ (V = ‘give off N’):
    steam, sweat, smell, flower
language. In fact, there are without question general processes such as metonymy and metaphor, as well as the processes illustrated in (5), which apply productively to any conceptually appropriate expression, so that the derived meanings don't have to be listed in the lexicon. I have taken pains to show that the cases discussed in this section are not like this: we still need lexical polysemy of various sorts.

The distinction between productive processes of meaning extension (such as (5)) and semiproductive instances of polysemy such as open and smoke is strongly reminiscent of the distinction between productive and semiproductive morphology discussed in Chapter 6. My sense is that the same solution is applicable: the semi-regular cases are listed in the lexicon, related by inheritance hierarchies, whereas the regular relations are extracted as independent rules, which (with luck) can themselves be formulated as lexical items. A couple of the latter cases will be addressed in section 12.2.

11.4 Taxonomic structure

One sort of structure universally acknowledged as part of lexical semantics is taxonomic structure: poodles are kinds of dog, dogs are kinds of animal, animals are kinds of living thing, living things are kinds of physical object. The point of such structure is that it provides more general access to rules of inference: any inference rule that pertains to dogs or to animals in general will automatically apply to poodles.

However, there are some problems about how taxonomies are to be arranged formally. Suppose we list under each category only its immediate antecedent in the hierarchy, so that Poodle only says it is Kind-of Dog. Now suppose we need to draw an inference based on a poodle's being a physical object, say that it continues to exist over time: we have to construct a chain of inferences from Poodle to Dog, from Dog to Animal, and so on till we reach Physical Object. This seems like an inefficient way to arrange matters. In addition, there is the problem of how many layers the taxonomy should contain. For example, should Mammal be inserted between Dog and Animal? If so, this would appear to further lengthen chains of inference. If not, where does Mammal fit in?

5 Well, maybe this is just a competence theory, and nothing follows about performance. But, as urged in previous chapters, such a move is dangerous.
6 The same problems crop up if we conceive of the taxonomic structure as an arrangement of nodes in a semantic network, linked by IS-A relations: from Poodle we have to go all the way up the taxonomy in order to find out what can happen to it by virtue of being a Physical Object. An approach based on meaning postulates (e.g. Poodle → Dog) faces parallel difficulties. I encourage advocates of these approaches to recast all the arguments of this section in their own terms.
Alternatively, one could conceive of all taxonomic structure appearing in each lexical entry. Then poodle would contain kind-of [dog], kind-of [animal], kind-of [physical object], and so on. This makes it a one-step process to compute an inference based on any taxonomic relation, and we do not have to decide exactly how many layers of taxonomy go into a concept. Of course, the price is crushing redundancy in lexical concepts.

A parallel problem occurs in dealing with knowledge of individuals. Should we include in the lexical entry for Dan Dennett just that he is a male human (or a male philosopher), and then should we derive the fact that he can move under his own power by going up the taxonomy to animal? Or should we include in his entry all the superordinate categories he belongs to, and accept all the attendant redundancy?

This dilemma is reminiscent of the one we faced in the encoding of morphological and constructional structure in Chapter 6. There I suggested that the proper solution probably lies in how long-term memory hierarchies are instantiated in the brain, not in some choice of notation in the competence theory. Similarly, Chapter 7 invoked taxonomic relations in discussing lexical priming, without saying how the brain actually encodes these relations. For present purposes, I suggest that we leave our options open.

It has often been noted that inferences based on taxonomy are not altogether strict. For example, one would want to characterize birds as animals that fly—but then there are ostriches and penguins. This too resembles the semiprimitive relations found in morphology (section 6.2) and especially inheritance hierarchies; Pinker (1999) draws an explicit parallel between the two phenomena, suggesting that morphological and conceptual taxonomies are two manifestations of the same brain process.

More controversial perhaps is the question of whether a lexical concept carries structure relating it to lower members in the taxonomy. For instance, does tree carry a list of its subkinds, including palm, pine, and plum? To carry things to an extreme, does physical object carry within it a list of all its known subkinds? Implausible. On the other hand, people do use information derived by going down the hierarchy in order to draw inferences: this is “case-based reasoning.” Of course, case-based reasoning is notoriously unreliable (“Welfare should be eliminated, because let me tell you about this woman who took advantage of the system”), but people use it all the time nevertheless.

It seems clear that at least some downward links from kinds to their instances are readily accessible. For most people in cognitive science, linguist evokes Chomsky and bongo invokes Kanzi. For dog owners, dog likely evokes their own as an exemplar. Moreover, concept learning is often based on the presentation of exemplars (“This is a kangaroo”), and there is no reason that such links, which get concept learning off the ground, should necessarily be abandoned.

When the subordinate is another kind rather than an instance, the strength of a downward link may correlate with the judged “typicality” of the subordinate as a subcategory (Rosch and Mervis 1975; Smith and Medin 1981). For instance, fruit evokes apple more quickly and reliably than it evokes pomegranate or prickly pear. A category such as furniture has no independent perceptual characterization (what does a piece of furniture look like?), so the collection of its prominent subcategories—chairs, tables, sofas, and so on—comes more prominently to the fore.

There are other categories for which taxonomic information seems to play little role. What larger category includes puddle? It doesn’t really fit into bodies of water along with lakes and rivers. And it doesn’t have subcategories or permanently remembered prominent instances. The same goes for junk. So simple taxonomic structure is often useful, but not always. As will be seen, this is typical of every kind of lexical information we find.

11.5 Contributions from perceptual modalities

Next let us ask how perceptual features are structured. In order to learn a category from presented instances (“This is a dog”), one must use analysis of features to learn the structure of the visual system that encodes what the instances look like. Memories stored in terms of these levels of structure are used to identify new instances of a category on the basis of their appearance (“Is THIS a dog?”), and to recognize known individuals (people, objects, and scenes). Structures in other sensory modalities must be stored as well: the sound of a flute or of a particular individual’s voice, the taste of curry, the feel of the key in your front door lock, the sensation of hunger.

If such structures are stored, there is no reason they should not be linked up in long-term memory with lexical items. One might wonder: Are they still part of “meaning,” or are they somehow “encyclopedic” information? Such a question grows out of the usual assumption that the domain of meaning is a uniform, homogeneous level of structure, say some form of logic? But this is an oversimplification. After all, phonology and syntax are built out of formally distinct interacting subcomponents. Why shouldn’t “meaning” also subdivide into natural subcomponents?

A major division in the structure of meaning appears to lie between what

Fodor (1975; 1981) shares this assumption, in his claim that the Language of Thought is homogeneous and non-modular.
have called conceptual structure (CS) and spatial structure (SpS) (Jackendoff 1987; 1996d; Landau and Jackendoff 1993). CS, with which most of the rest of this chapter will be concerned, is a hierarchical arrangement built out of discrete features and functions; it encodes such aspects of understanding as category membership (taxonomy) and predicate–argument structure. SpS, by contrast, is concerned with encoding the spatial understanding of the physical world—not just moment-by-moment appearance, but the integration over time of the shape, motion, and layout of objects in space (and possibly the forces among them).

Although for a first approximation SpS can be thought of as the “upper end” of the visual system, it also receives and integrates inputs about shape and spatial layout from the haptic system (sense of touch), auditory localization, and the somatosensory system (feel position of one’s own body). This integration is what enables you to know by looking at an object where to reach for it, and what it should feel like when you handle it. Thus SpS should be thought of as a system of central cognition, to some degree modality-independent.

The drawing of two adjacent stars in Fig. 1.1, labeled “spatial structure,” is only the crudest and most tentative sketch of this level’s content. To be more precise in order to serve as a locus of spatial understanding, SpS must encode the shape of objects in a form that is suitable for recognizing an object at different distances and from different perspectives, i.e. it must solve the classic problem of object constancy. It must be able to encode spatial knowledge of parts of objects that cannot be seen, for instance the hollowness of a balloon. It must be able to encode shape variations among objects of similar visual type, for example making explicit the range of shape variations possible among different cups. That is, it must support visual object categorization as well as visual object identification. It must be able to encode the degrees of freedom in objects that can change their shape, for instance human and animal bodies. It must be suitable for encoding the full spatial layout of a scene, and for mediating among alternative perspectives (“What would this scene look like from over there?”), so that it can be used to support reaching and navigating.

The best articulated (partial) theory of spatial structure I know of is Marr’s (1982) 3D model, with Biederman’s (1987) “geonic” constructions as a particular variant. Some of the factors listed here go beyond the Marr and Biederman theories of object shape, but nothing prevents these theories in principle from serving as components of a fuller theory of spatial understanding, rather than

strictly as theories of high-level visual shape recognition. In particular, the 3D model does not have an intrinsically visual character—it is no longer retinotopic, for example; nor, as Marr stresses, is it confined to the observer’s point of view.

It is important to see how abstract the hypothesized level of SpS is. Although SpS is geometric in character, it is not “imagistic” in the sense of the “percepts” of section 10.5; it is not to be thought of as encoding “pictures” or “statues in the head.” An image is restricted to a particular point of view, whereas SpS is not. An image is restricted to a particular instance of a category, whereas SpS is not (recall Berkeley’s objection to images as the vehicle of thought: how can an image of a particular triangle stand for all possible triangles?). An image cannot include the unseen parts of an object—its back and inside, and the parts of it occluded from the observer’s view by other objects—whereas SpS does. An image is restricted to the visual modality, whereas SpS can equally well encode information received haptically or through proprioception. Nevertheless, even though SpSs are not themselves imagistic, it makes sense to think of them as encoding image schemas; abstract structures from which a variety of images can be generated and to which a variety of percepts can be compared.

The work of understanding the conceptualized world is divided between CS and SpS (and probably other levels). Judgments and inferences having to do with predicate–argument relations, category membership, the type–token distinction, quantification, and so forth can be formulated only in terms of CS. Judgments and inferences having to do with exact shapes, locations, and forces can be formulated only in terms of SpS. On the other hand, there is overlap between the two levels, in that the notions of physical object, part–whole relationships, locations, force, and causation have reflexes in both systems. It is these shared components that enable the two systems to communicate with each other through an interface of the usual sort. This division of labor is thus a more abstract version of Paivio’s (1971) old dual-coding hypothesis: CS is sort of

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10 Some colleagues have objected to Marr’s characterizing the 3D sketch as “object-centered,” arguing that objects are always seen from some point of view or other—at the very least the observer’s. However, I interpret “object-centered” as implying only that the encoding of the object is independent of point of view. This neutrality permits the appearance of the object to be computed as necessary to fit the object into the visual scene as a whole, viewed from any arbitrary vantage point. Marr, who is not concerned with spatial layout, but only with identifying the object, does not deal with this further step of respecting the object into the scene. But I see such a step as altogether within the spirit of his approach.

I recognize that Marr’s 3D model is now out of fashion in the vision community. Still, the criteria for SpS must be satisfied by some cognitive structure or combination of structures. Readers more conversant than I in the vision literature should feel free to substitute their favorite theory of high-level vision here, as long as it satisfies the criteria we need to provide a “perceptual front end” for language.
"propositional," though not strictly linguistic, and SpS is sort of "imagistic," though not strictly visual.11

My working hypothesis at the moment (Jackendoff 1996d) is that the grammatical aspects of language make reference only to CS, not to SpS. Nothing in grammar depends on detailed shapes of objects.12 On the other hand, SpS is language's indirect connection to visual, haptic, and proprioceptive perception, and to the control of action; it is through the SpS connection that we can talk about what we see. This leads to the diagram of components and interfaces in Fig. 11.1, in which the "meaning" component of Fig. 9.1 is opened out into CS and SpS.

Going back to lexical semantics, a stored piece of SpS can take the place of what many approaches (e.g. Rosch and Mervis 1975; Putnam 1975) informally term an "image of a prototypical instance of the category." For example, cat will have a CS that identifies it as an animal and a member of the feline family and that specifies its typically being a pet. It will also have an SpS that encodes how cats are shaped and colored and how they move. Not all lexical items, of course, have an SpS component. Those expressing abstract concepts such as fairness and value and those expressing logical concepts such as and, if, and not come to mind as prominent examples. These will have only CS components. I would imagine that words denoting sounds, tastes, smells, and feelings have components relating to those sense modalities instead of to SpS.

Let us return to the issue of the homogeneity of linguistic meaning. One might fear that the linguistic integrity of lexical items is violated by allowing the meaning of a word to contain an SpS component: as sketched in Fig. 11.2a, SpS falls outside the standard tripartite organization of language into phonology, syntax, and semantics. But consider the evolutionary perspective. Suppose one deletes the phonological and syntactic structures. What is left is a non-linguistic association of cognitive structures in memory, much of which could be shared by a non-linguistic organism. Phonological and syntactic structures can then be viewed as further structures tacked onto this concept to make it linguistically expressive. Such a perspective is suggested in Fig. 11.2b.

With or without language, the mind has to have a way to unify multimodal representations and store them as units (that is, to establish long-term memory "binding" in the neuroscience sense). The structures that make this a "linguistic item" rather than just a "concept" simply represent an additional modality into which this concept extends: the linguistic modality.

Admitting SpS as a component of lexical meaning provides immediate and welcome aid on the problem of "completers." For instance, Katz (1972) offers, as part of the semantic structure of chair, features like [HAS A BACK] and [HAS LEGS]. But what kind of features are these? They are not very general: the kind of back appropriate for chairs will not do for people, camels, houses, or books; and something would not be a chair by virtue of having insect legs. What's really going on is that we call some part of a chair the back because of (a) its spatial configuration with respect to other parts of the chair and (b) possibily its proximity to the back of the sitter. We call chair legs legs because they are skinny vertical supports. With the provision of SpS, much of this difficulty vanishes: SpS can encode what a chair looks like, including its part structure. The fact that certain parts of chairs are called legs and back is encoded in the lexical entries for these words, not necessarily in the entry for chair.

More generally, many perceptual properties can be encoded directly in SpS. Yellow, for instance, may be encoded in CS as simply KIND-OF COLOR, a reasonable
primitive; the distinction between it and all the other colors then is a matter of SpS, where color distinctions need to be encoded anyway for perceptual purposes.

More interesting are the verbs. For instance, *walk, jog, limp, strut*, and *shuffle* are similar in being verbs of self-locomotion. They differ only in manner of motion, one of those things that is extremely awkward to characterize through algebraic features. However, we can distinguish these words by their appearance (and how they feel in the body). Assuming SpS can code dynamic as well as static spatial configurations (Who knows how? Well, some level must), it would make sense to leave the distinctions of manner of motion among these verbs to the geometric/topological encoding of SpS, and abandon the attempt to find primitive algebraic features for this purpose.

As with all interacting components, interesting questions of balance of power arise between CS and SpS. How far can content be bled out of CS into SpS? For example, *slither and slide* are somewhat more distant from the verbs above; are they still differentiated from *walk* only in SpS, or is there a CS difference as well? At present I don't know how to decide. (For some other cases, see Jackendoff 1996d; van der Zee 2000; Bloom et al. 1996.)

Notice that pushing some semantic distinctions into SpS does not simplify lexical semantics as a whole. All distinctions must still be encoded somehow (and I hope researchers on vision and action might be persuaded to collaborate in the task). However, this move takes a great deal of the burden off the feature system of CS, where the problems with “completers” arise. It also accounts for the fact that it is so hard to define words part of whose content is spatial: after all, a picture is worth ten thousand words (and an image schema is worth a dozen pictures).

This position further predicts that lexical items distinguished only by SpS structure will have identical grammatical behavior, which for a first pass seems to be correct. For instance, this explains the intuition behind Grimshaw's claim that *walk, jog, etc.* are “synonymous” for linguistic purposes.

We will make further use of SpS in subsequent sections. But it is time to move on to the next amplification of semantic structure.

### 11.6 Other than necessary and sufficient conditions

As may have already become apparent, the study of lexical meaning has given rise to considerable investigation into categorization: how humans place individuals into categories, and how systems of categories are constructed mentally. In traditional semantic terms, the problem can be framed in terms of stating the truth-conditions for the sentence *This is an X*, where X is the category in question.

However, a mentalist approach to “truth-conditions” differs from the philosophical/logical tradition in two important respects.

First, as stressed in Chapter 10, “truth-conditions” are not taken to constitute absolute truths in the world or in possible worlds. Rather, they are taken to be the conditions by which a language user judges that some conceptualized individual is a member of a category; and the form of these conditions is constrained by human psychology, not by logical necessity. Such psychological conditions can be studied experimentally, as a rich research tradition has shown.

Second—and this is the burden of the present section—the main philosophical tradition adopts rather uncritically Tarski's assumption (1956) that the truth-conditions for a sentence constitute a set of conditions that are individually necessary and collectively sufficient to guarantee truth of the sentence: “Snow is white is true if and only if the following conditions hold: . . . .” Even the avowed mentalist Fodor, in arguing against definitions, assumes that necessary and sufficient conditions are the appropriate way to accomplish semantic decomposition of lexical items, e.g., “Something is a *bachelor* if and only if it is human, male, adult, and unmarried.”

By contrast, much conceptualist semantic research (e.g., Jackendoff 1983; Lakoff 1987) stresses the insufficiency of Tarskian conditions to characterize the richness of human categories. This section presents examples of some of the problems that have arisen.

#### 11.6.1 Categories with graded boundaries

Consider the category *red*. This cannot be identified with a particular perceived hue, since a broad range of hues are all called *red*. However, as hues shade imperceptibly from red toward orange, there comes a point where observers are no longer clear about their judgments. Observers may hesitate or disagree with one another. In addition, the judgment of a particular hue may depend on what hues have immediately preceded it in presentation (if presented after focal red, it is judged orange, but if after focal orange, it is judged red). That is, there is a focal range in which judgments are secure and consistent, but it shades into a borderline range in which there is conflict with a neighboring category, and in which judgments become less secure and more context-dependent.

This “fuzziness” in the boundary of a category is not a matter of speakers “not knowing the meaning of *red*”; rather, it is inherent in the structure of the concept itself. One can make *red* more “Tarskian” by stipulating rigid boundaries with orange, pink, purple, and brown, but then one is not dealing with the ordinary meaning of the word. Similarly, one can create a new category *red-orange* at the boundary, but then the same sort of fuzziness occurs at the boundary of red and
red-orange. (The existence of such phenomena is noted by Putnam 1975; Berlin and Kay 1969 is the classic work on color judgments.)

Similar boundary problems arise with words like *hot* and *tall* that express significant deviation from a norm. What is the lower bound of temperature for, say, *hot soup*, or the lower bound of height for *tall woman*? (Recall also the classic puzzle about how few hairs are needed to be *bald*.) It is inherent in the structure of these concepts that the boundaries are not classically sharp; there is no way to place every woman definitively either in or out of the set of tall women.

Returning to a theme from Chapter 9, these adjectives also present evidence for the interdependence of “linguistic meaning” and “encyclopedic knowledge” in judgments of truth. For, as has often been observed, a *small elephant* is bigger than a *big mouse*: the norm to which the adjective is applied depends on one’s knowledge of the standard size of the animals in question. (Bierwisch and Lang 1989 discuss in detail adjectives that relate an instance to a norm.) Similarly, as Talmy (1978) points out, what counts as a *nearby* star is metrically quite different from a *nearby* piece of furniture; nearness too is defined in terms of the normal distance expected among individuals of the category in question.

These examples all have to do with perceptual properties of objects. But any evaluative adjective presents the same problems. As we all know, the boundary between a good term paper and an excellent one is far from sharp, as is the boundary between a smart student and a brilliant one; and a dull student is usually smarter than a brilliant rat. And at what point does one consider oneself well-paid? It takes far less to be a well-paid academic than to be a well-paid CEO, and so on. Katz’s (1966) treatment of *good* is an early treatment of such a case: a good knife is good for cutting; a good book is good for reading, and so on: the evaluation of an object is relativized to its normal function (see section 11.9 for more on normal function).

### 11.6.2 “Cluster” concepts

In the cases so far, necessary and sufficient conditions cannot be stated because of a blurred and/or context-dependent boundary. A different situation arises when multiple conditions interact in such a way that none of them is necessary. The classic example of this phenomenon is Wittgenstein’s (1953) analysis of *game*, in which he demonstrates that there is no single necessary condition that distinguishes games from other activities. He suggests that the word is understood in terms of “family resemblance”: there is a cluster of conditions that define games; but no games satisfy all of them, and none of them is shared by all games. That is, none of the conditions is necessary for an individual to be judged a member of the category, but various suitable combinations of them are sufficient. Such categories are now called “cluster concepts.”

This analysis is amplified by Rosch (1978; Rosch and Mervis 1975), who shows experimentally that categorization judgments may contain a cline of “typicality,” ranging from typical exemplars of the category (e.g. a robin is a “typical” bird) to atypical exemplars (e.g. a penguin is an “atypical” bird). There are various sources for typicality effects; but among them is a set of conditions that form a cluster concept.13 Examples that satisfy fewer of the conditions are generally regarded as less typical than examples that maximally satisfy the conditions.

The effects of cluster concepts can be observed in concepts involving as few as two conditions. A case first discussed by Fillmore (1982) is the verb *climb.* Consider the following examples:

\[(10)\]

a. Bill climbed (up) the mountain.

b. Bill climbed down the mountain.

c. The snake climbed (up) the tree.

d. ??The snake climbed down the tree.

*Climbing* involves two independent conceptual conditions: (a) an individual is traveling upward, and (b) the individual is moving with characteristic effortful grasping motions (clambering). On the most likely interpretation of (10a), both conditions are met. (10b) violates the first condition and, since snakes cannot clamber, (10c) violates the second; yet both examples are acceptable instances of climbing. However, if both conditions are violated, as in (10d), the action cannot be characterized as climbing. Thus neither of the two conditions is necessary, but either is sufficient. Moreover, the default interpretation of (10a), in which both conditions are satisfied, is judged to be more prototypical climbing; (10b) and (10c) are judged somewhat more marginal but still perfectly legitimate instances.

One possible account of this would be to say that *climb* is ambiguous or polysemous between the readings *rise* and *clamber.* But this does violence to intuition: (10a) is not ambiguous between these two senses. Rather, other things being equal, it satisfies both of them. Another possible account would be to say that the meaning of *climb* is the logical disjunction of the two senses: *rise* or *clamber.* But this is too crude: a disjunction isn’t “more prototypically satisfied”

13 Other sorts of typicality judgments occur, for instance, in color concepts, where a focal red is judged more typical than a red tinged with orange. Armstrong et al. (1983) show that typicality judgments can be obtained even for sharply defined concepts: e.g. a man is judged less typical even number than 4, and a man is judged less typical even number than 4 even number. Thus typicality in and of itself is only a symptom for a number of underlying phenomena in categorization. But the existence of multiple sources for typicality does not undermine the existence of cluster concepts, as Armstrong et al. claim it does. See Jackendoff (1983: ch. 7, n. 6) and Lakoff (1987: ch. 9).
if both disjuncts are true, as climb is. If we want to think of constructing meanings by means of conditions connected with logical operators, we could introduce a new non-Boolean operator with this curious property. We might call it “ψ-or,” (“ψ” for “psychological”), so that climb means “rise ψ-or climber.”

Parallel analyses have been proposed for the verbs lie ("tell a lie") (Coleman and Kay 1981) and see (Jackendoff 1983, based in part on Miller and Johnson-Laird 1976). Similar phenomena arise in lexical entries for nouns as well. For instance, a prototypical chair has a prototypical form and a standard function. Objects that have the proper function but the wrong form—say beanbag chairs—are more marginal instances of the category; and so are objects that have the right form but cannot fulfill the function—say chairs made of newspaper, or giant chairs. An object that violates both conditions—say a pile of crumpled newspaper—is by no stretch of the imagination a chair. Lakoff (1987: ch. 4) applies such an analysis to the concept mother, which includes the woman who contributes genetic material, the woman who bears the child, and the woman who raises the child. In today's arrangements of adoption and genetic engineering, not all three of these always coincide, and so the term is not always used prototypically.

Garrod et al. (1999) suggest that even prepositions may display this sort of component structure. For instance, in has a geometric and a functional component. The geometrical component stipulates that if X is in Y, X must be geometrically within the interior of the region subtended by Y. The functional component is “containment”: roughly, X is not attached to Y, but if one moves Y, X is physically forced to move along with it. The prototypical instances of in, such as a stone in a bottle, satisfy both conditions. However, there are well-known counterexamples to the geometrical condition, such as the pear in the bowl shown in (11a) and the knife in the cheese shown in (11b).

(11) a. The pear is in the bowl.  
  b. The knife is in the cheese.

These do satisfy the functional condition. One might suggest therefore that the functional condition is the correct definition of in. But when the objects being related are such that the functional condition cannot be satisfied, such partial geometrical inclusion is far less acceptable:

Thus we see again the characteristic non-Boolean interaction of conditions to form a cluster concept.

In Jackendoff (1983) called a system of conditions of this sort a “preference rule system”; Lakoff (1987) calls it (one aspect of) an “idealized cognitive model”; the frames of Minsky (1975) have similar effects. Concepts organized this way, like Tarskian concepts, are combinations of conditions. They differ from Tarskian concepts in that the conditions are combined differently, namely by “ψ-or.” Thus a proper theory of word meanings must go beyond traditional philosophical assumptions. Default logic comes closer to capturing the effect of such conditions, which function as default values where there is no evidence to the contrary, for instance in (10a).)

Appealing to the psychological goals of conceptualist semantics, such enrichment of the theory proves to be plausible on broader grounds. The manner in which conditions interact in cluster concepts is central in visual perception (Wertheimer 1923; Marr 1982), in phonetic perception (Liberman and Studdert-Kennedy 1977), in musical cognition (Lerdahl and Jackendoff 1983), and in Gricean implicature (Bach and Harnish 1979) (see Lerdahl and Jackendoff 1983: ch. 11 for discussion of all of these). Moreover, such an interaction can be plausibly instantiated in the brain, where the firing of a neuron is normally not a rigid function of other neural firings (like a logical conjunction), but rather a composite of many excitatory and inhibitory synapses of varying strengths. Thus cluster concepts, even though unusual in a logical framework, are quite natural in a psychological framework.

A different interpretation of cluster concepts appears to be more widespread in psychology. Laurence and Margolis (1999: 27), for instance, say “According to the Prototype Theory [e.g. Smith et al. 1988], most concepts—including most lexical concepts—are complex representations whose structure encodes a statistical analysis of the properties their members tend to have. . . . [A]pplication is a matter of satisfying a sufficient number of features, where some may be weighted more significantly than others.” The present analysis is not inherently statistical, although learning doubtless involves some statistical correlation of attributes. However, the differences between the two approaches remain to be explored.
The present account must also be distinguished from the view that a concept is a representation of a prototypical instance. On the present account, the prototype is simply an instance that happens to maximally satisfy the cluster conditions. This does not preclude concepts from being linked to standard instances (section 11.4)—it's just that this creates distinct effects from the cluster conditions.

Most of the arguments against cluster concepts are directed against this latter version of the prototype theory. For instance, Fodor (1998) argues that the standard pet fish (goldfish, guppy, etc.) cannot be derived from the intersection of prototypical pets (dog, cat, etc.) with prototypical fish (trout, flounder, etc.). Quite right. This is because we know about pet fish: pet fish is lexicalized and anchored as a unit to its own standard examples such as goldfish. In a similar case that is not anchored to standard examples, as in pet marsupial, we are likely to imagine precisely the prototypical marsupial, a kangaroo. In terms of conditions, though, pet fish comes out about as one would expect: it’s a fish that people keep in their house for amusement. I don’t see any problem in principle here, as long as one distinguishes knowing standard examples from knowing defeasible conditions. Both are potential parts of a concept.

11.7 The same abstract organization in many semantic fields

A foundational result in conceptualist semantics originates with Gruber (1965), who showed that many grammatical patterns used to describe physical objects in space also appear in expressions that describe non-spacial domains.

The groups of sentences in (13) through (16) illustrate this result. Notice especially the parallels indicated by the italicized words.

(13) Spatial location and motion:
   a. The messenger is in Istanbul. [Location]
   b. The messenger went from Paris to Istanbul. [Change of location]
   c. The gang kept the messenger in Istanbul. [Caused stasis]

(14) Possession:
   a. The money is Fred’s. [Possession]
   b. The inheritance finally went to Fred. [Change of possession]
   c. Fred kept the money. [Caused stasis]

(15) Ascription of properties:
   a. The light is red. [Simple property]
   b. The light went/changed from green to red. [Change of property]
   c. The cop kept the light red. [Caused stasis]

(16) Scheduling activities:
   a. The meeting is on Monday. [Simple schedule]
   b. The meeting was changed from Tuesday to Monday. [Change of schedule]
   c. The chairman kept the meeting on Monday. [Caused stasis]

Each of these groups contains one sentence with the verb be, one with go or change, and one with keep. When be appears with a preposition (as in (13a) and (16a)), the same preposition can appear with keep; if be appears without a preposition (as in (14a) and (15a)), so does keep. On the other hand, go and change characteristically appear along with the prepositions from and to.

These grammatical patterns cannot be motivated by the physical nature of the situations expressed. Changing possession does not necessarily entail changing location: the sale of a house or of stocks does not involve motion at all. An object’s color has nothing to do with where it is or who owns it. Setting the appointed time for a meeting or trip bears no apparent relationship at all to the other three.

On a more abstract level, however, the meanings of the four groups of sentences are parallel.

• The be sentences all describe some state of affairs in which some characteristic is ascribed to the subject of the sentence: location in a region in (13), belonging to someone in (14), having a property in (15), and having an appointed time in (16).

• The go/change sentences all describe a change involving the subject of the sentence, in which it comes to have the characteristic ascribed by the corresponding be sentence. The subject’s characteristic at the beginning of the change is described by the phrase following from, and at the end of the change by the phrase following to.

• The keep sentences all describe the subject of the sentence causing the object of the sentence to have the characteristic ascribed by the corresponding be sentence, and this characteristic persists over a period of time.

In other words, the linguistic parallelism among these sets reveals an underlying conceptual parallelism. Thus it is not accidental that many of the same lexical items recur in (13)–(16).

Gruber’s insight behind the conceptual parallelism is this: The characteristics that things can be conceived to have fall into broad families or “semantic fields” such as the headings in (13)–(16). Within a field, be sentences express simple characteristics such as being in a particular location, belonging to a particular person, being of a particular color, or being scheduled at a particular time. But in addition, the conceptual system contains complex concepts that can be applied to any field, among which are (a) a change from one characteristic to...
another (the go/change sentences) and (b) something making something else have a particular characteristic over a period of time (the keep sentences). Because similarly structured complex concepts appear in many (and possibly all) semantic fields, it is convenient for the language to use the same words as it switches from one field to another.14

This underlying abstract system is most evident in semantic fields that vary along a one-dimensional range of values: they invariably are expressed in terms of the linear opposites up and down or high and low. Numbers (and hence prices, weights, and temperatures) go up and down, military ranks go up and down, pitches on the musical scale go up and down, and so does one’s mood. (Time concepts, however, are a partial exception to this generalization. In just about every language, they are expressed by terms that also apply to space; but instead of up and down, they use a front-to-back continuum, for example before and after in English.)

Similar grammatical and lexical patterns appear in language after language. Cognitive linguists such as Talmy (1978; 1985) and Langacker (1987) essentially take them for granted and build theories of conceptual structure around them. Lakoff and Johnson (1980; Lakoff 1987; 1990) argue that they are part of a vast system of metaphor, inextricably embedded in the conceptual structure expressed by language. They further argue that the pervasiveness of metaphor makes it impossible to base a semantic theory on a simplistic notion of “literal truth,” and impossible to treat metaphor as non-truth-conditional and therefore marginal.

While acknowledging the ubiquity of metaphor in thought, I would argue for a finer-grained account for these particular phenomena (Jackendoff 1983; 1992a; ch. 3; Jackendoff and Aaron 1991). Lakoff and Johnson use the term “metaphor” for any extension of terms from one semantic field to another. By contrast, the traditional notion of metaphor is reserved for creative, novel expressions, often with a patent semantic clash, used to make speech more colorful. The parallels illustrated in (13)-(16) exhibit no semantic clash, and they are the only ways available in English of expressing the concepts in question. Thus they are not metaphorical in the traditional sense. I would contend rather that they reflect a set of precise abstract underlying conceptual patterns that can be applied to many different semantic fields. These patterns are the basic machinery that permits complex thought to be formulated and basic entailments to be derived in any domain. Among these domains, the spatial domain exhibits a certain degree of primacy due to its evolutionary priority

14 “Convenient for the language” is an abbreviation for a variety of factors. Among them: speakers who lack a word for something they want to say will press a conceptually related word into service; learners figure out less concrete meanings more easily if more concrete (especially spatial) parallels are made evident by phonological identity.

and its strong linkage to perception. At the same time, Lakoff and Johnson’s insight about the pervasiveness of metaphor still stands, if in a more limited fashion.

These cross-field parallels raise an interesting question of polysemy. Does keep, for instance, have a single sense that is neutral as to what field it appears in? Or does it have four related senses? I am inclined to take the latter route, because of the syntactic and lexical peculiarities in each field. For instance, in three out of the four fields above, keep requires a direct object and a further complement; but in the possessive field, keep takes only a single argument, the direct object. Go appears in three of the four fields, but we cannot say *The meeting went from Tuesday to Monday in the scheduling sense—we can only say was changed moved. Change appears with the simple from-to syntax only in ascription and scheduling; in the spatial field we have to say change position/location and in the possessional field we have to say change hands. We also have to know that in English, we say on Monday rather than in Monday, the latter certainly a logical possibility. All these little details have to be learned; they cannot be part of the general mapping that relates these fields to each other. This means that each word must specify in which fields it appears and what peculiarities it has in each. Thus we are dealing with semiproductive alternation in the sense of Chapter 6 again. If this be polysemy, so be it.

I have described these as senses related by feature variation. This differs from the usual view in cognitive linguistics that (14)-(16) are derived from (13), the spatial field, by metaphor or image-schema transformation (Lakoff 1987). The two views are compared in (17).

(17) a. Conceptual semantics
    \[ to \ \text{in (13)} = T_{\text{spatial}} \]
    \[ to \ \text{in (14)} = T_{\text{pos}} \]
    \[ to \ \text{is a path-function that is field-neutral, and the subscripts specialize it for a field} \]

b. Cognitive linguistics
    \[ to \ \text{in (13)} = T_o \]
    \[ to \ \text{in (14)} = f_{\text{pos}}(T_o) \]
    \[ T_o \text{ is a spatial path-schema, and } f \text{ is a function that maps the field of spatial images into possessional images} \]

That is, cognitive linguistics tends to view cross-field parallelisms as derivational. Hence the polysemy of keep is a multiply branching chain, rather like smoke (section 11.3). By contrast, I view them as parallel instantiations of a more abstract schema (Jackendoff 1976, 1983; ch. 10, 1992a; Jackendoff and Aaron
1991; Fauconnier and Turner 1994 propose a somewhat similar view in terms of a "generic space"). Here the polysemy is the result of a feature variation, with no fully specified sense as core.

However these disputes are resolved, all major schools of thought in conceptual and cognitive semantics agree that the linguistic parallelisms shown in (13)–(16) reflect substantive parallelisms in the concepts these sentences express, and thereby reveal fundamental organization in human conceptual structure.

11.8 Function–argument structure across semantic fields

11.8.1 Some basic state- and event-functions

Every theory of semantics back to Frege acknowledges that word meanings may contain variables that are satisfied by arguments expressed elsewhere in the sentence. In Chapter 5, for example, we treated the meaning of eat as a two-place function eat(x, y), where x is expressed as the subject of eat and y is optionally expressed as its object. (And we recall that such organization constitutes a challenge for neural network theories of language). Many approaches, including most of formal semantics, leave it at that, simply expressing verb meanings as unanalyzed functions written in capital letters.

However, other approaches take the decomposition of verb meanings seriously, asking if there is a set of primitive functions out of which the semantic argument structure of verbs (and other argument-taking words) can be built. Schank (1973) was an early attempt in the AI tradition; Miller and Johnson-Laird (1976) offered extensive analysis with an attempt to ground verb meanings in psychological primitives; Wierzbicka (1985; 1987; 1996) has offered extensive analyses of verbs in terms of a small set of English words (the latter two in fact deal with far more than just verbs).

My own approach to verb decomposition (Jackendoff 1976; 1983; 1990) grew initially out of the insights of Gruber discussed in the previous section; a similar approach in quite a different notation appears in cognitive grammar (Lapacker 1987). The most basic unit is a two-place function be(x, y), supplemented by a field feature. The field feature determines the character of the arguments of be and the sorts of inferences that can be drawn. If the field feature is Spatial, X is an object and Y is a location where X is located. This configuration in CS interfaces with the Sb’s conceptualization of space and the associated inferences; it is the configuration expressed, for instance, in our old favorite, The little star is beside a big star. If the field feature on be(x, y) is Possession, X is an object and Y is a person who owns it; this configuration invokes inference rules about rights to use and so forth. If the field feature is Ascription, X is just about anything and Y is a Property or a Kind to which it belongs; this configuration invokes whatever inferences follow from the ascribed Property or Kind. If it is Scheduling, X is an Event and Y is a time period; the inferences concern the time at which there is an opportunity to participate in the event.

be(x, y) is of the ontological category State; it is the conceptualization of a static configuration that can be localized at a point in time or throughout an interval of time. This is the function underlying all the "be" verbs in (13)–(16). Another basic function is stay(x, y), which is just like be except that it is of the ontological category Event: it is the conceptualization of a static configuration being maintained over a period of time. This underlies verbs like stay, maintain, and continue; for instance notice the difference between the little star was beside a big star and the little star stayed beside a big star. STAY is a component of the "keep" verbs in (13)–(16).

Underlying the go verbs in (13)–(16) is a function go(x, y). In each field, X is as before, but Y is now a Path or Trajectory, and go(x, y) is the conceptualization of the Event of X traversing Y. One way to build a Path is illustrated in (13)–(16): designate a starting point (or Source), marked by from, and/or an endpoint (or Goal), marked by to. Some early approaches such as Gruber (1965), Schank (1973), and Jackendoff (1976) recognized only this possibility. However, particularly in the spatial domain, there are other possibilities. The simplest is to designate a direction: The airplane went up/north/abroad. Another is to designate the shape of the trajectory, as in round and round and zigzag. A third way, for instance go along the river past the house, does not say where motion started or ended, but specifies the configuration of an intermediate point; I have called such Paths "Routes."

Paths can have some of this structure in certain other semantic fields as well. For instance, in Ascription one can specify a direction (The temperature went up) or an intermediate point (The temperature passed through 100 degrees on its way to record height). On the other hand, Possession is a discontinuous "space," with no intermediate points between one possessor and another: something can be halfway between two spatial locations A and B, but something cannot be halfway between belonging to A and belonging to B. Thus, by virtue of the inference patterns having to do with Possession, the only Paths in this field are Source-Goal Paths.

\[15\] I glide over the distinction between ownership and merely temporary control, as when one borrows something. Both of these are distinct from "imbedded possession," which often uses the same vocabulary, as in The house has a roof. The latter involves things having parts, bringing yet another set of inference rules into play.
When the Path is a Source-Goal pattern (from W to Z), the second argument of go has its own function-argument structure—which is why Path-prepositions take syntactic objects. We can notate the composite as (18), where Z is the Source and W the Goal.

\[
(18) \quad \text{GO} \ [x, \underbrace{\text{FROM} [W]}_{\text{Path}} \ \text{TO} \ [Z] ]
\]

The characteristic inference from (18) can be stated informally as (19).

\[
(19) \quad \text{At the beginning of (18), BE} [x, W] \\
\quad \text{At the end of (18), BE} [x, Z]
\]

(19) is independent of semantic field. However, the consequent clauses of (19) lead to the characteristic field-specific inferences for BE described above, which add further aspects of interpretation.

In much of the literature, Paths are recognized only in the context of motion along a path, and therefore Path has been thought of as a purely temporal notion (e.g. Hinrichs 1983 and Verkuyl 1993). (18) recognizes Path as a distinct ontological type, and motion or change over time is expressed solely by the function go. Paths themselves are atemporal, and can appear as arguments of other functions, including the two kinds of state-function shown in (20).

\[
(20) \quad \begin{align*}
\text{a. EXT} [x, \text{Path}] & \\
& \text{Non-temporal extension: The road goes across the river.} \\
\text{b. ORIENT} [x, \text{Path}] & \\
& \text{Orientation: The sign points across the river.}
\end{align*}
\]

The inferences from these functions are quite different than from go. In a motion event (go), X is located at different parts of the Path at different times. In a state of extension like (20a), different parts of X occupy different parts of the Path, all at once. In a state of orientation like (20b), the sign is oriented along the Path, but it neither travels along it nor occupies it. Without an independent category of Path, it would be impossible to unify these disparate uses, showing why they can all be expressed by the same preposition.

The five functions listed so far (BE, STAY, GO, EXT, and ORIENT) are major members of a family of "core functions" around which situations (States and Events) are organized. Another family constitutes "aspeclual functions." The most prominent of these is Inchoative, INCH(X), a one-place function whose argument is a State; it denotes an Event of this state coming about. For instance, the relation between the adjective open, and the intransitive verb open, (examples (6a), (b)) is that open conceptualizes the coming about (INCH) of the state of being open. A sort of converse of INCH is the Perfective, PERF(X), a function whose argument is an Event, and which denotes the State of that Event being complete. It is seen most clearly as the perfect tense in sentences like Sue has eaten lunch—roughly, 'Sue is presently in the state of having completed eating lunch.' We will see more formally how INCH combines with the core functions in a moment.

A third family of functions is the causative family, which includes CAUSE, LET, and HELP in various Eventive and Stative versions, again relativized to semantic field. CAUSE has two obligatory arguments, the Agent and the Effect, and an optional argument, the Patient. (21) makes these options clearer.

\[
(21) \quad \begin{align*}
\text{a. The wind made it rain.} & \\
& \text{CAUSE (WIND, [Event IT-RAIN])} \\
& \quad \text{Agent Effect} \\
& \quad \text{the wind caused the event of its raining'} \\
\text{b. The wind made me fall down.} & \\
& \text{CAUSE (WIND, MF, [Event I FALL DOWN])} \\
& \quad \text{Agent Patient Effect} \\
& \quad \text{the wind, acting on me, caused the event of my falling down'.}
\end{align*}
\]

My intuition is that the three-argument version (21b) is preferred when possible; but in the absence of an identifiable Patient on which the Agent can act, the two-argument version (21a) is a fallback. LET works the same way; HELP has only the three-argument version. These three functions are related by features in a fashion sketched in section 11.2.

Readers more familiar with standard formal semantics may recognize in

---

16 Making it more formal requires characterizing 'beginning' and 'end', for instance as in Jackendoff (1991: 1996b).
17 It is often contended (e.g. Talmy 1996a) that extension is "metaphorical" or "active" motion, giving the sense of an observer scanning the extended object. Although this has some intuitive appeal, I just don't see how it can account for the difference in inference patterns. Jackendoff (1996b) offers a formal decomposition of go and ext that brings out their similarities and differences.
18 An important result of Jackendoff (1991) is that INCH and PERF have identical further decompositions, except that one pertains to situations and one to space; they both denote a one-dimensional directed entity end-bounded by their arguments. This leads to a quark-like feature decomposition of the ontological categories, as suggested in section 11.1. Jackendoff (1996c) shows how this common decomposition contributes to the computation of aspectuality of a sentence.
these families of functions a nonstandard version of type logic. Instead of the usual primitive types $e$ and $t$ (individuals and truth values, respectively—the two possible types to which expressions can refer, according to Frege), this approach has a much broader range of primitive types: the major ontological categories Object, Event, and so forth. Using the standard notation $<a,b>$ to denote a function from semantic objects of type $a$ into semantic objects of type $b$, we can encode the types of these functions as follows:

$$\text{BE} : <(X,Y), \text{State}>, \quad \text{X and Y an ordered pair, where the types of X and Y depend on semantic field}\$$

$$\text{STAY} : <(X,Y), \text{Event}>, \quad \text{(same stipulations as 22a)}$$

$$\text{GO} : <(\text{Object}, \text{Path}), \text{Event}>$$

$$\text{EXT}, \text{ORIENT} : <(\text{Object}, \text{Path}), \text{State}>$$

$$\text{TO}, \text{FROM} : <X, \text{Path}>, \quad \text{where the type of X depends on semantic field}$$

$$\text{INCH} : <\text{State}, \text{Event}>$$

$$\text{PERF} : <\text{Event}, \text{State}>$$

$$\text{CAUSE}, \text{HELP}, \text{LET} \text{ (three-argument version):}$$

$$<(\text{Object/Event}, \text{Object}, \text{Event}), \text{Event}>$$

$$\text{CAUSE}, \text{LET} \text{ (two-argument version):}$$

$$<(\text{Object/Event}, \text{Event}), \text{Event}>$$

(22) may seem like a major departure from type logic. However, I have encountered no empirical arguments that $e$ and $t$ are the correct choice of primitive types—only methodological arguments based on the desire to minimize primitives. In the end, the parsimony of a logic containing only two primitive types must be weighed against the potential explanatory power of a richer system; it is an empirical issue, not just a methodological one. Another difference from a more standard type logic is that the category corresponding to a sentence is an Event or State rather than a truth value, as argued in Chapter 10. A truth value can be seen as the evaluation of the Event or State expressed by the sentence with respect to world as conceptualized. Again, this choice is to be weighed on empirical grounds.

11.8.2 Building verb meanings

These functions can be used to build up revealing skeletons of verb and preposition meanings that explain their argument structure. For instance, (23) shows how a simple sentence of motion expresses a conceptual structure in this format. (I omit the semantic field feature, which is Spatial, as well as the interpretations of the Tense and the definite article.)

$$\text{(23)} \quad \text{a. Syntax and phonology:}$$

$$[\text{John}, \text{went}, [\text{into}, \text{the room}], \text{in}]$$

$$\text{b. CS:}$$

$$[\text{Event}, \text{GO}([\text{Object, John}], [\text{Path, TO}, \text{IN}([\text{Object, Room}], \text{in})])]$$

In this example, the verb went expresses the function GO$(X,Y)$; the other constituents—the NP John and the PP into the room—express its arguments. Into means roughly 'to in': it expresses a Path-function whose argument is a Place, which itself has a function-argument structure (not discussed in the previous subsection—see Jackendoff 1990a). The syntactic argument of into expresses the argument of this Place.

As the labeled bracketing (23b) may be a bit difficult to read, I offer the alternative tree notation in (24), where functions are attached by double lines and their arguments by single lines. (John and room, as phrasal heads, are treated as zero-argument functions, i.e. constants.) The contributions of each word are picked out by dashed lines; the overlaps between them are the points of attachment where variables are satisfied.

(24)

Another way to express the structure (23b) is John entered the room. In this case the verb "incorporates" the Path- and Place-functions, as in (25a); the lexical entry of the verb thus decomposes as (25b).

11.6.5 A different interpretation of this notation as a type logic is worked out in Zwarts and Verkuyl (1994). There is no problem in principle reducing the functions of two and three variables in (24) to the more standard successively embedded functions of a single variable; however, I have found no particularly compelling reason to do so at the present level of detail of the theory.

11.6.6 This strategy was recognized already by Gruber (1965), and, in a different guise, it played an important role in the Generative Semantics analyses of verb meanings (McCawley 1968, Postal 1970a). A recent version of the Generative Semantics approach has reappeared in Hale and Keyser (1993); see Jackendoff (1997a: 231–233) for commentary.

11.6.7 Yet a different notation is offered by Niankee (1990; 2000a).
version of \textsc{cause}, as in (27b), with \textit{food} as an explicit Patient.). The very same conceptual configuration can be realized lexically in other ways, by “incorporating” larger parts of the tree in (26). Here are two possibilities, representing two classes of transitive denominal verbs.

(27) a. Bill buttered the bread

\begin{itemize}
\item \textit{CAUSE Object Object}
\item \textit{Event}
\item \textit{butter}
\item \textit{BILL BREAD INCH}
\item \textit{State}
\item \textit{BE Object Place}
\item \textit{BUTTER ON Object}
\item \textit{BREAD}
\end{itemize}

b. Paul pocketed the penny

Similar incorporation structures are involved in some of the cases of polysemy discussed in sections 11.2 and 11.3. For instance, if the meaning of the adjective \textit{open}, is (28a), then the intransitive verb \textit{open}, is (28b) and the transitive \textit{open}, is (28c). (28c) is identical to (27a) aside from the arguments of \textit{be}.

(28) a. open = Property
\begin{itemize}
\item \textit{OPEN}
\end{itemize}
The cores of the verbs *smoke*₁, ‘smoke (a cigar)’, and *smoke*₂, ‘smoke (a ham)’, can be seen as variants on the structure (27a) as well. Ignoring the specialized manner modifiers discussed in section 11.3, these are roughly ‘cause smoke, to go out of a cigar’ and ‘cause smoke, to go into a ham’ respectively. I leave the tree structures as an exercise for the compulsive reader.

This exercise shows how decomposition into functions brings out explicit similarities and differences among verb meanings, how these cut across patterns of syntactic expression, and how relations among readings of polysemous items can be made explicit. In particular, “thematic roles” such as Agent, Patient, Source, and Goal are determined in structural terms in CS, so their partial lack of systematicity in syntax (section 5.8) is a function of the way CS maps into words and syntactic structure.

There is no room here to go into more detail, in particular the fascinating cross-linguistic differences in patterns of incorporation, first brought to light by Talmy (1985); the way semantics affects alternations in the syntactic argument structure of verbs (Pinker 1989; Levin 1993; Jackendoff 1990a); the maximal event structure associated with a clause (Levin and Rappaport Hovav 1996; Rappaport Hovav and Levin 1998; Nikanne 1990), and the decomposition of preposition meanings (Brugman 1981; Herskovits 1986; Vandelooise 1986; Landau and Jackendoff 1993; and many papers in Bloom et al. 1996). The overall picture, however, is that it is of great interest to construct such decompositions. Each primitive function, relativized to semantic field, gives a concept access to characteristic inference patterns; and in the spatial field, to perceptual patterns as well.

Fodor (1998) objects to such decomposition, on the grounds that we have gotten no closer to explicating meaning if the meanings of the primitives have not themselves been explained (this is also Lewis’s 1972 objection to “Markerese”, quoted in section 10.4). My working hypothesis is that the meaning of the primitives is exhausted by (a) their capacity for combination with other primitives and (b) their use in triggering inference rules and interface rules, individually and in combination. But I acknowledge that this remains to be demonstrated.

Another major challenge is to enumerate the primitives and the inference rules. The spatial field has been well served, but other fields such as mental verbs and verbs of social interaction have hardly been touched (though Wierzbicka 1987 goes into considerable detail within her somewhat less structural approach). Finally, functional decompositions such as (24a)–(27a) are only skeletal, and there is the usual problem of “completers”: can we characterize the rest of the meaning? Even as greater success is achieved in functional decomposition, it is important to keep these larger questions in mind.

11.9 Qualia structure: characteristic activities and purposes

By comparison with verbs, the compositional semantics of nouns has been relatively neglected. James Pustejovsky (1995) proposes two major innovations that take the theory of noun meanings beyond mere lists of features: qualia structure and dot objects. We take these up in order.

Pustejovsky’s theory of qualia structure includes three major points. First, following suggestions of Aristotle (via Julius Moravcsik), one can partition the properties of lexical concepts into a number of distinct types called “qualia.” Second, these properties need not be single monadic features like [HAS-A BACK]; they may themselves have rich internal structure. Third, the meaning of a sentence cannot be constructed by the simple technique of gluing together the meanings of its words. Rather, the information within the qualia structure plays an active role in constructing the connections among word meanings in a sentence, a process called “co-composition.”

Pustejovsky identifies four qualia: formal, constitutive, agentive, and telic. I do not take this to be an exhaustive list, but it is useful in classifying properties of a great number of concepts.²³ The formal quale includes the taxonomic structure discussed in section 11.4, for instance that a dog is a kind of animal, a kind of living thing, and a physical object. It might also look downward in the tax-

²³ In the interests of coherence, I have distributed certain properties among the qualia somewhat differently than Pustejovsky. I do not take these differences to be of any great theoretical significance.
onymy, specifying what subtypes of dogs there are and perhaps some salient instances.

The constitutive quale includes information about an entity's structural attributes. These attributes appear to divide into three subtypes:

- The entity's sensory attributes: dimensionality, shape, size, color, texture, weight, smell, and so forth.
- The material(s) the entity is composed of.
- The entity's part structure; if it is itself inherently a part (such as a wing), what larger structure it is a part of.

When the entity is a physical object, much of this structure will interface with the associated Spatial Structure, as suggested in section 11.5.

The other two qualia are more complex in that they involve actions in which the entity is a character. The agentive quale encodes information about how the entity comes into existence: if an artifact, how it is made; if an organism, its lifecycle stages. Pustejovsky views this as encoding primarily the entity's past. However, this quale might also encode information about what an entity will develop into. For instance, an embryo is characterized as something that will grow into an animal; a fiancée is someone who is to be married. Of course, an embryo might in fact be aborted and a fiancée might break off the engagement, so a specification of future developmental course must be properly modulated, a point to which we return below.

The telic quale gives information about activities in which the entity takes part. Pustejovsky envisions this quale primarily as encompassing an object's purpose, for instance that a pencil is for writing with. However, it makes sense to include here a range of other sorts of action. For instance, the moon has no purpose per se, but we need to encode our knowledge of its characteristic actions, for instance that it moves across the sky and changes shape in a monthly cycle. The telic quale is the natural place to localize this information.

Another important sort of information is how the entity "works." For instance, pencil sharpeners all have the purpose of sharpening pencils, but different subtypes accomplish this function through different actions on the part of the user. These different subtypes can be differentiated by form in the constitutive quale, and the way each works will be differentiated in the telic quale. (By extension, the fact that pencils need to be periodically sharpened presumably belongs in the telic quale of pencil too.)

Another possibility in the telic quale is an activity in which the entity is currently engaged. This is necessary to characterize words such as pedestrian, passenger, and customer (Busa 1996; Macnamara and Reyes 1994). I may often walk to work, but on those occasions that I drive I am not a pedestrian. As many have observed, such a specification results in an entity's being individuated by occasions in which it takes part in the activity: American Airlines may have carried three million passengers but only one million different people, thanks to lots of frequent flyers.

Returning to purposes, consider a word like mail. What makes something mail rather than a piece of paper is (in part) that it is intended to be sent and delivered; for instance being burnable is not an essential part of being mail. But let us be a bit more specific about "intended to be sent and delivered." Sometimes it happens that a piece of mail is not sent, or, more commonly, alas, that it is not delivered. So these activities do not constitute necessary conditions for something to be mail. On the other hand, they are too important to the understanding of the concept of mail to be described as mere "tendencies" or "probabilistic associated activity." I believe the correct characterization is to be found in Ruth Millikan's notion of "proper function." Roughly, "having a proper function is a matter of having been 'designed to' or of being 'supposed to' (impersonal) perform a certain function" (Millikan 1984: 17). An object need not actually ever perform its proper function. Millikan's striking example is a sperm, only one of millions of which ever performs its proper function of fertilizing an egg. This can hardly be described as a "tendency" or a "probabilistically associated activity." This modality for proper functions—the possibility that the activity never takes place but is yet essential—is also just what we need for the cases of embryo and fiancée discussed above.

What kinds of things can have proper functions? There are two major classes. The first is artifacts: objects constructed by volitional beings who have some function in mind for the objects, or who benefit from their functioning. As Millikan is quick to point out, we want to include here not just concrete artifacts such as pencils and beard dams but also abstract artifacts such as myths and contracts. Millikan is particularly concerned with claiming that beliefs have a proper function, namely to guide reasoning and action. She can then say that false beliefs still have a proper function; it is just that, like undelivered mail, they fail to fulfill it.

A second important class of objects with proper functions is parts. In the case of parts of artifacts such as the back of a chair, the proper function is clear: it serves as a part of the proper function of the artifact. But in addition the parts of organisms have one or more proper functions: the heart is to pump blood, the kidney is to remove wastes from the blood, the leaves of a plant are to perform photosynthesis, and so forth.

A possible variant on proper function is occupation, which is in complementary distribution with proper function: only humans (and perhaps animals like sheepdogs, bloodhounds, and packhorses) have occupations; only artifacts and
object parts have proper functions. One might therefore consider occupation to be a special type of proper function, relativized to humans and domestic animals.

I am inclined to see proper function as a basic element of human conceptualization (and here I fundamentally diverge from Millikan’s realist approach). It is not without significance that children are inclined to ascribe proper functions to more things than adults do (Kelemen 1999), for example a lake is to swim in, The sun is to keep us warm. A lot of science (including evolutionary theory) has been concerned with removing unwarranted teleology from our understanding of the natural world; Skinner just went too far in trying to remove it from our understanding of behavior.

In sum, an entity’s telic quale encodes actions in which the entity takes part, modulated by a modality such as characteristic action, current action, characteristic function, and proper function. The telic quale is the locus for forming the meaning of so-called agentic (‘-er’) nominals (Aronoff 1980; Bussa 1996). For instance, driver has a telic quale ‘X drives’. If a person, it can denote a person who is currently driving or whose occupation is driving; if an artifact, it denotes something whose proper function is driving (e.g. a golf club or a driving wheel on a locomotive).

A somewhat more complex relation appears in words like violinist. A violinist is someone whose activity (telic quale) is playing the violin. But the activity ‘playing’ is not overtly specified (as in violin player). Rather it comes from the meaning of violin. A further expansion yields: ‘person whose activity is using a violin in its proper function (namely playing it).’ In addition, the playing of a violinist can be either an occupation (29a), a characteristic activity (29b), or even just a current activity (29c).

(29) a. Linda is a violinist in the symphony, but she hasn’t played for months, since they’ve been on strike.

b. Jerome is an occasional violinist.

c. Oddly enough, none of the violinists in the orchestra tonight have ever played the violin before—that’s why they sound so bad.

Words don’t have to be derived morphologically in order to have this sort of complexity in their telic quale. For instance, fuel is a substance whose proper function is to burn, this function in turn forming a part of the proper function of something else. The something else can be made explicit in a variety of ways, for instance fuel for a rocket, rocket fuel.

Pustejovsky motivates qualia structure by showing that it is necessary for understanding the direct objects of verbs like begin and enjoy. These verbs require an activity as their semantic argument: one begins doing things and enjoys doing things. Yet they occur syntactically with direct objects such as begin/enjoy the book and begin/enjoy the beer. Such sentences are understood (in the default case) as ‘begin/enjoy reading the book’ and ‘begin/enjoy drinking the beer’ (an observation appearing also in Newmeyer 1969/75). Pustejovsky observes that the default activity necessary to understand these direct objects comes from the telic quale of the nouns themselves: books are for reading, beer is for drinking. Thus, he argues, qualia structure is on occasion necessary in order to accomplish the semantic composition of a verb and its object, normally the province of simple variable satisfaction. (Section 12.2 takes up other cases where simple variable satisfaction is insufficient.)

Finally, qualia structure can also be adapted to activities, whether expressed by verbs or nouns. In particular, argument structure falls into the formal quale; for instance, the formal quale of sprint will say it is a type of locomotion, and therefore involves a character traversing a path. The constitutive quale will include the rapid (and effortful?) character of the motion. The agentive quale will perhaps specify that the activity arises from the character’s will to move, i.e. it is not a passive motion like falling. More generally, the agentive quale would include causes and reasons that give rise to the activity in question. Purposes (proper functions) also occur as part of verb meanings. For example, the meaning of chase must specify that the subject’s purpose is to catch the object. This information might be encoded in the telic quale (or possibly in the agentive quale, as proper outcome).

11.10 Dot objects

Pustejovsky’s other important innovation grows out of the observation that certain classes of objects belong to more than one taxonomy. One such class consists of information-bearing objects such as novels and newspapers. As a physical object, a novel has a size and weight, and it has covers and pages as parts. But a novel also bears information which is about a topic and represents certain events pertaining to that topic. As a physical object, the novel came into existence by being printed and bound; as an information object, it came into existence by being written. And yet the word novel is not ambiguous or polysemous, since both aspects can be invoked at once: That novel about the Crimean War has a red cover.

Pustejovsky formalizes this dual aspect of an information-bearing object by

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24 It is not clear to me that Pustejovsky’s way of carrying out this extension is altogether optimal or consistent. In this informal account I will attempt to express the basic insight as I myself see it; Pustejovsky is not to be held responsible.
concatenating its two taxonomic features within the formal quale, as in (30). He calls this concatenation a *dot object*.

(30) [PHYSICAL OBJECT•INFORMATION]

In turn, each of these aspects gives rise to further quale structure. The physical object's constitutive quale describes the physical makeup of a book; the telic quale includes how books are sold and stored; the agentic quale includes how books are printed and bound. The information's constitutive quale describes what the information depicts—if a novel, under a modality designating the information as fiction. The telic quale says the information is intended for amusement; the agentic quale says that the information is made up by a novelist. In addition, there are two crucial links between the dual qualia structures. The constitutive qualia are linked by the fact that the physical object bears the information. The telic qualia are linked by the fact that people read books, a physical activity whose outcome is the reader's assimilation of the information borne by the physical object. The upshot of this innovation is that quale structure goes even further beyond a list of features. Dot objects have a richly interconnected pair of quale structures.

And there can be dot-object activities. We have already come across one: *reading* consists of two "dotted" actions: the action of visually scanning a writing-bearing (dot-)object, combined with the action of assimilating the information therein. Another prominent case is speech acts, which involve both making a noise and transmitting information of which the noise is the vehicle.

Perhaps the most important dot-object in the conceptual system is the concept of a person. On one hand, a person is conceptualized as a physical object, and all the predicates pertaining to physical objects can be applied to people: spatial extent and location, construction out of parts, the possibility of motion and of contact with other physical objects, susceptibility to gravity, and so on. On the other hand, a person is conceptualized simultaneously as a mind or a self or (dare we say it) a soul. This aspect is not physical, and if it has parts, they are things like memory and will rather than arms and legs. The predicates pertaining to the mind are mental and social predicates, having to do with volition, memory, understanding, social roles, rights and obligations.

These two components are universally conceptualized as separable. In particular, every culture is concerned with what happens to the mind/self/soul after death, when the body reverts to a mere physical object. All cultures I've ever read of have a notion of spirits or ghosts—minds/selves/souls lacking a body, but capable of acts of will and memory, and of entering into social relationships with each other and with ordinary people. The notion of reincarnation is widespread—minds/selves/souls coming to occupy a different body. On a more mundane level, we sometimes have dreams in which someone who looks like one person is "really" someone else (I was talking to Uncle Harold but for some reason he looked like Bill Clinton). In such cases a mind/self/soul has been "dotted" with a different body.

The "dotted" aspects of speech acts are each connected to the appropriate "dotted" aspects of the speaker: the body makes the noise, thereby conveying the information "contained in" the mind. Interestingly, social roles, which are abstract concepts in the mental/social domain, are often embodied in the physical domain by "dorring" them with aspects of physical appearance such as uniforms, costumes, or haircuts. These physical aspects thus become symbols of the social role: a symbol is one object regarded as simultaneously something else, hence yet another sort of dot-object.

It remains as a challenge for future research to work out the details of dot-objects and their quale structure, and to sort out which aspects are innate (surely some of them must be) and which are culturally determined. In particular, what kinds of ontological entity can be "dotted" with each other and how can they be connected in quale structure? Are the possibilities totally open, or is there a delimited set (say several dozen or a hundred) of dot-object types? However the answer turns out, it raises further questions of principle and of detail for learning and evolution.

**11.11 Beyond**

I want to touch briefly on one further layer of complexity in lexical semantics before closing this chapter.

One of the classic examples of lexical decomposition is *bachelor*, analyzed by Katz and Fodor (1963) as 'unmarried adult human male.' This is often taken as a parade case of analytic decomposition. But consider the putative feature 'unmarried': what sort of feature is this anyway? It is approximately on a par with [HAS-A-BACK] in the analysis of chair. It is certainly not primitive, but any attempt to further decompose it requires a whole analysis of the social institution of marriage. That is, the meaning of bachelor is inseparable from the understanding of a complicated social framework in which it is embedded. Lakoff (1987) makes much of this fact; he observes, for instance, that it is odd to speak of the Pope as a bachelor, because the Pope falls outside the social institutions in which marriage is an available option. In addition, of course, it is odd to consider an adult unmarried man living in a long-term relationship with a woman as a bachelor. Obviously 'unmarried' is not a sufficient condition. The upshot is that the prospects for a simple analytic feature decomposition for bachelor dissolve in favor of something with a great deal more implicit structure, in particular overall understanding of larger social frames.
Another such case, raised by Searle (1994), is a point in a game. The idea behind points is that they are abstract units that you acquire in the course of a game, and in order to win you need more of them than the other player at the end of the game. How you get points depends on the rules of the game; your reasons for wanting them make sense only in the context of understanding games and what it means to win or lose them. In other words, the conceptual structure of point cannot be constructed independently of its embedding in a whole elaborate social frame.

A third example, from Fillmore and Atkins (1992), is the semantics of risk. This word has multiple argument structures and is thus polysemous in the sense of section 11.3. (31) gives four of the many frames in which it occurs.

(31) a. We decided to risk going into the jungle.
   b. We risked our lives by going into the jungle.
   c. We risked getting sick by going into the jungle.
   d. There's quite a bit of risk in going into the jungle.

On Fillmore and Atkins's analysis, all these uses advert to a common conceptual frame: the subject is choosing an action which in turn leads to a chance of either benefit or harm; the subject of course hopes to get the benefit. In (31a), going into the jungle refers to the chosen action; in (31b), our lives is the thing potentially harmed; in (31c) getting sick is the harmful action itself. In all of these, risk is a verb that appears to refer to the making of the risky choice. In (31d), risk is a noun that appears to refer to the chance of harm versus benefit. The point is that all these meanings are different, but they are related by virtue of picking out different parts of the common conceptual frame. Hence again a word meaning cannot be explicated without making use of a larger implicit frame of related circumstances.

I think a larger implicit frame of reference is also necessary to understand proper names of fictional characters. Santa Claus is understood properly only in the context of the "Santa Claus legend" of reindeer, going down the chimney with presents, and so forth; Hamlet makes sense only in the context of the play.

My inclination is to think that these examples are just the tip of the iceberg and that there is a great deal more complexity to be explored in word meanings. One may be tempted to shrug all this off as "encyclopedic" meaning, hence not part of linguistics. However, as Chapter 9 argued, on the one hand there is no principled dividing line between linguistic and encyclopedic meaning, and on the other hand someone has to study these more complex aspects of meaning eventually. So why not linguists?

In closing this chapter, let me briefly return to the issue of lexical decomposition raised in section 11.2. It should be clear by now that the generalizations of word meaning cannot be studied without a theory of lexical decomposition. The kind of decomposition required, however, is not a simple list of necessary and sufficient features of the sort envisioned by Tarski and Fodor. Rather, it is a richly textured system whose subtleties we are only beginning to appreciate: division into CS and SpS components, conditions that shade away from focal values, conditions that operate in a cluster system, features that cut across semantic fields, function-argument structure, qualia structure, and dot-object structure. It does remain to be seen whether all this richness eventually boils down to a system built from primitives, or if not, what alternative there may be. And it does remain to be seen whether lexical meaning can be exhaustively constituted by the techniques discussed here. But even if the ultimate answers are not in sight, there is certainly a sense of progress since the primitive approaches of the 1960s.

It should be recognized that there are fundamental methodological and expository difficulties in doing lexical semantics. What does it take to be properly systematic? It is all too easy to build an industry on the endless details of a single word; good examples are belief and knowledge in the traditional philosophical literature and over in the cognitive linguistics tradition. The unfortunate result is that one loses sight of the goal of a systematic account of the patterns of meaning. Alternatively, one can look for the patterns by covering a broad range of words somewhat less deeply; but the result is all too often a tiring list, impossible for anyone but the most dedicated reader to assimilate. Alas, Pinker's (1989) study of verb frames and much of Anna Wierzbicka's work (e.g., 1987), although amazingly clever and insightful, tend to fall prey to this problem; the present chapter may as well. Perhaps there is no way out: there are just so many goddamned words, and so many parts to them.

On the other hand, these difficulties in themselves point out one of the fundamental messages of generative linguistics: We language users know so much. And hence as children we learned so much—starting with some innate conceptual basis of unknown richness. Next to lexical semantics, the acquisition problem for grammar pale by comparison.