Conceptual Semantics

Ray Jackendoff

Conceptual Semantics is a formal approach to natural language meaning developed in Jackendoff 1983, 1987, 1990, 2002; Pinker 1989; the work of Pustejovsky (e.g. 1995) has played an important role in its formulation as well.

The approach can be characterized at two somewhat independent levels. The first is the overall framework for the theory of meaning, and how this framework is integrated into linguistics, philosophy of language, and cognitive science (section 1). The second is the formal machinery that has been developed to achieve the goals of this framework (sections 2 and 3). The general framework might be realized in terms of other formal approaches, and many aspects of the formal machinery can empirically motivated within any framework for studying meaning.

1. Overall framework

The fundamental goal of Conceptual Semantics is to describe how humans express their understanding of the world by means of linguistic utterances. From this goal flow two theoretical commitments. First, linguistic meaning is to be described in mentalistic/ psychological terms – and eventually in neuroscientific terms. The theory of meaning, like the theories of generative syntax and phonology, is taken to be about what is going on in people's heads when they use language. Second, the theory aspires to describe the messages that speakers intend for their utterances to convey. Thus it potentially includes everything that traditionally falls under the labels of 'pragmatics' and 'world knowledge' as well as 'semantics.' It does not specifically seek a level of representation that might be characterized as 'pure/literal linguistic meaning' or 'meaning that is relevant to grammar.' If there is such a level, it will emerge in the course of empirical investigation. We take these two commitments up in turn.

1.1. Mentalism: reference and truth

The mentalist commitment of the theory sets it apart from traditions of formal semantics growing out of logic (e.g. Frege, Russell, Carnap, Tarski, Montague, Lewis, Davidson), which aspire to study the relation of sentences to "the world" or to "possible worlds" (where a "the/a world" is often specified in set-theoretic terms). In generative grammar, a sentence is not regarded as a free-standing object that can be related to the world: it is a combinatorial structure in a speaker's mind that can be shared with other speakers via acoustic or visual signals. Similarly, an entire language is not a free-standing object (or set of sentences) in the world. Rather, a speaker's "knowledge of a language" is instantiated as a set of stored mental structures and stored relations among structures, plus the ability to combine these stored structures and relations into an unlimited number of expressions. The notion of "the English language" is thus regarded as an idealization over the systems of linguistic knowledge in the minds of a community of mutually intelligible speakers. We typically presume that these systems are homogeneous, but we readily drop this assumption as soon as we need to take into account dialect differences, vocabulary differences, and stages in children's acquisition of language.

This treatment of linguistic expressions extends to the meanings they convey. The meaning of a word or a sentence is not a free-standing object in the world either. Rather, the meaning of a word is to be regarded as a mental structure stored in a speaker's mind, linked in long-term memory to the structures that encode the word's pronunciation and its syntactic properties. The meaning of a sentence is likewise to be regarded as a mental structure, constructed in a speaker's mind in some systematic way from the meanings of its components. Under this conception, then, meaning must always be relativized to the language user. It makes no sense to say, with Putnam (1975), that speakers don't really *know* the meanings of words, or that the true meaning of, say, natural kind terms awaits a more mature science. There is no place other than in speaker's heads to localize meaning. If no speakers in 1500 knew the molecular structure of water or the DNA profile of tigers, it seems quixotic to maintain that no one was in possession of "the" meaning of *water* and *tiger*. They were managing to communicate with each other quite adequately, in the terms in which they understood these concepts at the time. Similarly, if speakers have different meanings for words (say, experts have more highly articulated meanings for words in their area of expertise), mutual intelligibility is thereby endangered unless speakers take precautions. And this seems a realistic assessment of how people use language. (See also section 2.5.)

The mentalist approach also leads to theoretical notions of reference and truth different from canonical formal semantics and philosophy of language. Reference is standardly regarded as a relation between linguistic expressions (typically noun phrases) and things in the world. For convenience, let us call this *realist reference* (or *r-reference*). However, the goal of Conceptual Semantics is not an account of free-standing sentences, but rather an account of human understanding. Thus the relation that plays the role of reference in the theory is between the mental structure encoding the linguistic expression and the language user's *conceptualization* of the world – all inside the mind. Let us call this relation *mentalist reference* (or *m-reference*).

For example, in sincerely uttering *The cat is on the mat*, a speaker is committed to there being a situation in the world in which an entity identifiable as a cat is in contact with the upper surface of another entity identifiable as a mat. A theory of meaning must account for these m-referential commitments. Now note that the speaker has not arrived at these commitments by somehow being in direct contact with reality. Rather, the speaker has arrived at these commitments through either hearsay, memory, inference, or perception. The first three of these require no direct contact with the cat or the mat. This leaves only perception as a potential means of direct contact with the world.

However, if we are to take the mentalist approach seriously, we must recognize that perception is far from direct. Visual perception, for example, is a fearsomely complex computation based on fragmentary information detected by the retina. It is far from well understood how the brain comes up with a unified perception of stable objects situated in a spatial environment, such as a cat on a mat. Nevertheless, it is this unified perception, not the objects in the world per se, that lead the speaker to referential commitments about cats and mats.

This treatment of reference is an important respect in which Conceptual Semantics differs from the mentalistic theory of Fodor (1975, 1983, 2001). Although Fodor wishes to situate meaning in the mind, encoded in a combinatorial "language of thought," he insists that linguistic

expressions are connected to the world by the relation of *intentionality* or *aboutness*. For him, the expression *the cat* is *about* some cat in the world, and a semantic theory must explicate this relation. In Conceptual Semantics, there is no such direct relation: the speaker's intention to refer to something in the world is mediated by conceptualization, which may or may not be related to the world through perception. For cases in which conceptualization is not based on perception, consider mortgages and dollars. We speak of them as though they exist in the world, but, unlike cats, these are entities that exist only by virtue of social convention, i.e. shared conceptualization. *For us*, they are nevertheless just as real as cats. (And for cats, they are not!)

Similar remarks pertain to the notion of truth. For the purposes of a mentalist theory, what is of interest is not the conditions in the world that must be satisfied in order for a sentence to be true, but rather the conditions in *speakers' conceptualization* of the world under which they *judge* a sentence to be true, i.e. m-truth rather than r-truth.

On a tolerant construal of Conceptual Semantics, the investigation of m-reference and m-truth might be taken to be complementary to a classical approach in terms of r-reference and r-truth. To explain how speakers *grasp* r-truth, a theory of m-truth will play a necessary part. On a more confrontational construal, Conceptual Semantics might be taken to claim that only the mentalistic approach leads to a theory of meaning that integrates gracefully with a mentalistic theory of language and with cognitive psychology. Either construal is possible; both result in the same empirical questions for research.

It might be added that Conceptual Semantics, as part of its theory of word meaning, must of course describe the ordinary language or "folk" meanings of the words *refer* and *true*. These appear to correspond closely to the notion of r-reference and r-truth, that is, they express what is conceptualized as objective relations between linguistic expressions (as conceptualized) and the world (as conceptualized). But again, this does not mean that r-reference and r-truth should be the overall objectives of the theory, as they are in classical semantics. After all, Conceptual Semantics is also responsible for the meanings of all manner of "folk" concepts such as *karma*, *ghost*, and *phlogiston*. All of these are possible human concepts, widely subscribed to in various cultures at various times. Including the "folk" meanings of *refer* and *true* among human concepts doesn't seem like a terrible stretch.

1.2. Boundary conditions and comparison to other frameworks

A theory that seeks to describe the range of human thoughts that can be conveyed in language must meet a large collection of boundary conditions. The first two are shared with formal semantics.

C1 (Compositionality): The meaning of an utterance must be composed systematically in a way that incorporates the meaning of its words and the contribution of its syntax. (However, this does not require that *all* parts of utterance meaning are expressed by particular words of the utterance, as in classical Fregean composition; see section 3.)

C2 (Inference): Utterance meanings must serve as a formal basis for inference.

However, there are also boundary conditions that derive from the mentalist basis of the theory.

C3 (Categorization): The meanings of words must conform to what is known about human categorization.

C4 (Learnability): The meanings of words must be learnable on the basis of the acquirer's experience with language and the world, preferably in conformance with empirical evidence on word learning (e.g. Bloom 2000).

C5 (Connection to perception and action): Phrase and utterance meanings that deal with physical objects and physical actions must be connected to mental representations appropriate to perception and action, so that one can, for instance, talk about what one sees and carry out actions based on imperative sentences. (see Landau's chapter)

A final hypothesis of Conceptual Semantics connects it with questions of the evolution of language:

C6 (Nonlinguistic thought): The mental structures that serve as utterance meanings are present to some degree in nonlinguistic organisms such as babies and apes, and play a role in their understanding of the world. It is in service of expressing such prelinguistic thought that the language faculty evolved (Jackendoff 2002, chapter 8).

These conditions together serve to differentiate Conceptual Semantics from other major semantic frameworks. It differs from formal semantics not only in its commitment to mentalism, but in the corollary conditions C3-C6. A word meaning must be a mental structure, not a set of instances in possible worlds. Furthermore, human categorization does not operate strictly in terms of necessary and sufficient conditions, but rather in part in terms of default conditions, preference conditions, and distance from central exemplars (see section 2.4-2.5). Hence word meanings do not delimit classical categories and cannot be treated in terms of traditional definitions.

The learnability of an unlimited variety of word meanings argues that word meanings are composite, built up in terms of a generative system from a finite stock of primitives and principles of combination. By contrast, in classical semantics, word meanings (except for words with logical properties) are typically taken to be atomic. Fodor 1975 argues that all word meanings are atomic, and seeks to account for learnability by claiming that they are all innate. Beyond this position's inherent implausibility, it calls for a commitment to (a) only a finite number of possible word meanings in all the languages of the world, since they must all be coded in a finite brain; (b) a reliable triggering mechanism that accounts for concept learning; and eventually (c) a source in evolution for such "innate" concepts as *telephone*. Fodor's arguments for this position are based on the assumption that word meanings, if composite, must be statable in terms of definitions, which is denied by Conceptual Semantics and other cognitively rooted theories of meaning (Jackendoff 1983, 122-127; 1990, 37-41; 2002, 334-337).

Finally, as observed in the previous section, classical semantics makes no connection with human perception and action; nor, as a theory of purely linguistic meaning, does it speak to evolutionary concerns.

A different framework coming out of computational linguistics and cognitive psychology is Latent Semantic Analysis (Landauer et al. 2007). It characterizes the meanings of words in terms of their cooccurrence with other words in texts (i.e. linguistic use alone). Thus word meanings consist of a collection of linguistic contexts with associated probabilities. There is no account of compositionality or inference; word learning consists of only collating contexts and calculating their probabilities; and there is no relationship to nonlinguistic categorization and cognition.

The approach of Wierzbicka (19xx, 19xx) is concerned primarily with decomposition of word meanings. Decompositions are carried out in terms of a small vocabulary of English words that are taken to represent semantic primitives. This approach does not aspire to account for any of the boundary conditions on Conceptual Semantics above.

Various other approaches to semantics are concerned primarily with the impact of semantics on grammatical form, for instance the Lexical Conceptual Structures of Levin and Rappaport Hovav, Lieber's approach to morphological meaning, and Distributed Morphology. Again there is little concern with a full account of meaning, nor with inference, word learning, or connection to perception, action, and nonlinguistic thought.

The major framework closest in spirit to Conceptual Semantics is Cognitive Grammar (Langacker 1987, Lakoff 1987, Talmy 2000, Fauconnier 1985). This tradition takes seriously the cognitively-based rather than logically-based nature of meaning, and it stresses the nonclassical character of word meanings and sentence meanings. Besides differences in the phenomena that it focuses on, Cognitive Grammar differs from Conceptual Semantics in three respects. First, the style of its formalization is different and arguably less rigorous. Second, it tends to connect to nonlinguistic phenomena through theories of embodied cognition rather than through more standard cognitive neuroscience. Third, Conceptual Semantics is committed to syntax having a certain degree of independence from semantics, whereas Cognitive Grammar seeks to explain all aspects of syntactic form in terms of the meaning(s) expressed.

1.3 Conceptual Structure and Spatial Structure; interfaces with syntax and phonology

The central hypothesis of Conceptual Semantics is that there is a level of mental representation, *Conceptual Structure*, which instantiates sentence meanings and serves as the formal basis for inference and for connection with world knowledge and perception. The overall architecture of the mind in which this embedded is shown in Fig. 1.

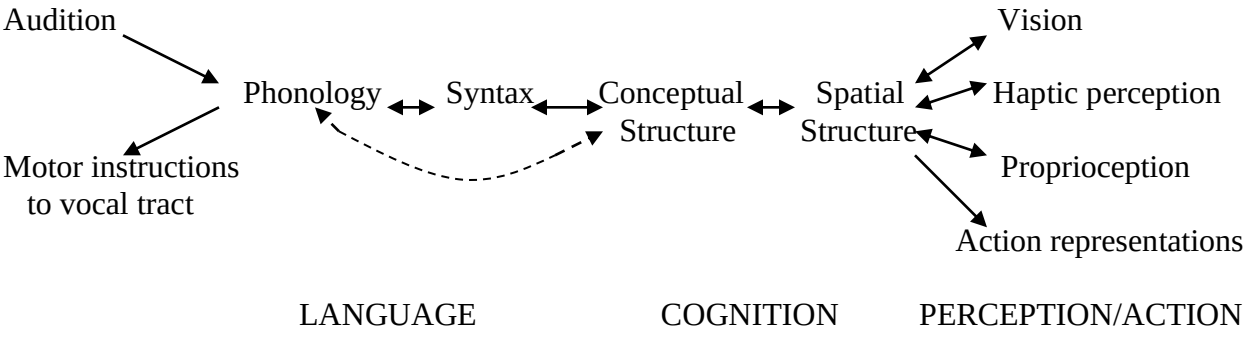

Figure 1. Architecture of the mind

Each of the levels in Figure 1 is a generative system with its own primitives and principles of combination. The arrows indicate interfaces among representations: principles that provide systematic mappings from one level to the other. On the left-hand side are the familiar linguistic levels and their interfaces to hearing and speaking. On the right-hand side are nonlinguistic connections to the world through visual, haptic, and proprioceptive perception and through the formulation of action. (One could add general-purpose audition, smell, and taste as well.)

In the middle lies cognition, here instantiated as the levels of Conceptual Structure and Spatial Structure. Spatial Structure is hypothesized (Jackendoff 1987, 1996a; Landau and Jackendoff 1993) as a geometric/topological encoding of 3-dimensional object shape, spatial layout, motion, and possibly force. It is not a strictly visual representation, because these features of the conceptualized physical world can also be derived by touch (the haptic sense), by proprioception (the spatial position of one's own body), and to some degree by auditory localization. Spatial Structure is the medium in which these disparate perceptual modalities are integrated. It also serves as input for formulating one's own physical actions. It is moreover the form in which memory for the shape of familiar objects and object categories is stored. This level must be generative, since one encounters, remembers, and acts in relation to an indefinitely large number of objects and spatial configurations in the course of life.

However, it is impossible to encode all aspects of cognition in geometric/topological terms. A memory for a shape must also encode whether this is the shape of a particular object or of an object category, i.e. the standard type/token distinction. Moreover, the taxonomy of categories is not necessarily a taxonomy of shapes. For instance, forks and chairs have no similarity in shape, but both are artifacts, and there is no general characterization of artifacts in terms of shape or the spatial character of the actions one performs with them. Likewise, the distinction between familiar and unfamiliar objects and actions is not characterizable in terms of shape. Finally, social relations such as kinship, alliance, enmity, dominance, possession, and reciprocation cannot be formulated in geometric terms. All of these aspects of cognition lend themselves to an algebraic encoding in terms of features (binary or multi-valued, e.g. TYPE vs. TOKEN) and functions of one or more arguments (e.g. x INSTANCE-OF y, x SUBCATEGORY-OF y, x KIN-OF y). This system of algebraic features and functions, whatever it turns out to contain, constitutes Conceptual Structure. Note that at least some of the distinctions just listed, in particular the social relations, are also made by nonhuman primates.

Thus a description of primate nonlinguistic cognition requires some form of Conceptual Structure, though doubtless far less rich than in the human case.

Conceptual Structure too has its limitations. One of the difficulties that has always confronted attempts to formalize meaning and reasoning is the impossibility of coding perceptual characteristics such as color, shape, texture, and manner of motion in purely algebraic terms. The architecture in Fig. 1 proposes to overcome this difficulty by sharing the work of encoding meaning between the geometric format of Spatial Structure and the algebraic format of Spatial Structure.

Turning now to the interfaces between meaning and language, a standard assumption in both standard logic and mainstream generative grammar is that semantics interfaces exclusively with syntax, and in fact that the function of the syntax-semantics interface is to *determine* meaning in one-to-one fashion from syntactic structure. The tacit assumption, rarely made explicit (but going back at least to Descartes), is that combinatorial thought is possible only through the use of combinatorial language. This comports with the view, common well into the 20th century, that animals are incapable of thought. Modern cognitive ethology (Hauser 200x) decisively refutes this view, and with it the assumption that syntax is the source of combinatorial thought. Conceptual Semantics is rooted in a complementary intuition that language evolved to express a pre-existing faculty of thought (condition C6).

Under this view, it is quite natural to expect Conceptual Structure to be far richer than syntactic structure – as indeed it is. Culicover and Jackendoff (2005) argue that the increasing complexity and abstraction of the structures posited by mainstream generative syntax up to and including the Minimalist Program has been motivated above all by the desire to encode all semantic relations in overt or covert syntactic structure, and that ultimately the attempt fails because semantic relations are too rich and multidimensional to be encoded in terms of purely syntactic mechanisms.

In Conceptual Semantics, a word is regarded as a part of the language/thought interface: it is a longterm memory association of a piece of phonological structure, some syntactic features, and a piece of Conceptual Structure. If it is a word for a concept involving physical space, it may include as well a piece of Spatial Structure. Other interface principles establish correspondences between semantic argument structure (e.g. what characters an action involves) and syntactic argument structure (e.g. transitivity), between scope of quantification in semantics and position of quantifiers in syntax, and between topic and focus in semantics (information structure) with affixation and/or position in syntax. In order to deal with situations where topic and focus are coded only in terms of stress and intonation (e.g. *The dog CHASED the mailman*), the theory offers the possibility of a further interface that establishes a correspondence directly between semantics and phonology, bypassing syntax altogether.

If it proves necessary to posit an additional level of semantic structure that is devoted specifically to features relevant for grammatical expression (e.g. Bierwisch and Lang 19xx), such a level would be inserted between Conceptual Structure and syntax, with interfaces to both. Of course, if language is to be understood, it is still necessary for words to bridge all the way from phonology to Conceptual Structure and Spatial Structure. In general the content of Conceptual

Structure, which is necessary to drive inference and the connection to perception, would remain unchanged with the addition of such an extra component.

2. Major features of Conceptual Structure

This section sketches some of the important features of Conceptual Structure (henceforth CS). A more detailed sketch appears in Jackendoff 2002, chapters 11-12.

2.1. Tiers in CS

A major advance in phonological theory was the realization that phonological structure is not a single formal object, but rather a collection of *tiers*, each with its own formal organization, which divide up the work of phonology into a number of independent but correlated domains. These include at least segmental and syllabic structure, the amalgamation of syllables into larger domains such as feet, phonological words, and intonational phrases, the metrical grid that assigns stress, and the structure of intonation contours correlated with prosodic domains.

A parallel innovation is proposed within Conceptual Semantics. The clearest division is into *Propositional Structure*, a function-argument encoding of who did what to whom, how, where, and when (arguments and modifiers), versus *Information Structure*, the encoding of Topic, Focus, and Common Ground. These two sorts of features of meaning are orthogonal, in that virtually any constituent of a clause, with any thematic or modifying role, can function as Topic or Focus or part of Common Ground. Languages typically use different grammatical machinery for expressing these two aspects of meaning. For instance, roles in Propositional Structure are typically expressed morphosyntactically in terms of position and/or case with respect to a head. Roles in Information Structure are typically expressed by special focusing constructions, by special focusing affixes, by special topic and focus positions that override propositional roles, and above all by stress and intonation – which is never used to mark propositional roles. Both the syntactic and the semantic phenomena suggest that Propositional and Information Structure are orthogonal but linked organizations of the semantic material in a sentence.

More controversially, Jackendoff 2002 proposes segregating Propositional Structure into two tiers, a *descriptive tier* and a *referential tier*. The former expresses the hierarchical arrangement of functions, arguments, and modifiers. The latter expresses the sentence's referential commitments to each of the characters and events and the binding relations among them; it is a dependency graph along the lines of Discourse Representation Theory. The idea behind this extra tier is that such issues as anaphora, quantification, specificity, and referential opacity are in many respects orthogonal to who is performing the action and who the action is being performed on. The canonical grammatical structures of language typically mirror the latter rather closely: the relative embedding of syntactic constituents reflects the relative embedding of thematic constituents. On the other hand, scope of quantification is not at all canonically expressed in the surface of natural languages; this is why theories of quantification typically invoke something like "quantifier raising" to relate surface position to scope. The result is a semantic structure in which the referential commitments are on the outside of the expression, and the thematic structure remains deeply embedded inside, its arguments bound to quantifiers

outside. Dividing the expressive work into descriptive and referential tiers helps clarify the resulting notational logjam.

The division into descriptive and referential tiers also permits an insightful account of two kinds of anaphora. Standard definite anaphora, as in (1a), is anaphoric on the referential tier and indicates coreference. *One*-anaphora, as in (1b), however, is anaphoric on the descriptive tier and indicates a different individual with the same description. (This approach could readily be adapted to formal logic.)

(1) a. Bill saw a balloon and I saw it too.
b. Bill saw a balloon and I saw one too.

2.2. Ontological categories and aspectual features

Reference is typically discussed in terms of NPs that refer to objects. Conceptual Semantics takes the position that there is a far wider range of ontological types to which reference can be made (m-reference, of course). The deictic *that* is used in (2a) to (m-)refer to an object that the hearer is invited to locate in (his or her conceptualization of) the visual environment. Similarly, the underlined deictics in (2b-g) are used to refer to other sorts of entities.

(2) a.	Would you pick <u>that</u> [*pointing*] up, please?	[reference to object]
b.	Would you put your hat <u>there</u> [*pointing*], please?	[reference to location]
c.	They went <u>thataway</u> [*pointing*]!	[reference to direction]
d.	Can you <u>do this</u> [*demonstrating*]?	[reference to action]
e.	<u>That</u> [*pointing*] had better never <u>happen</u> in MY house!	[reference to event]
f.	The fish that got away was <u>this</u> [*demonstrating*] long.	[reference to distance]
g.	You may start ... right ... <u>now</u> [*clapping*]!	[reference to time]

This enriched ontology leads to a proliferation of referential expressions in the semantic structure of sentences. For instance, *John went to Boston* refers not only to John and Boston, but also to the event of John going to Boston (corresponding to a Davidsonian event-variable) and to the trajectory 'to Boston', which terminates at Boston. It should be recalled that the 'existence' of trajectories is a matter not of how the world *is*, but of how speakers *conceptualize* the world.

Notice that the trajectory in this sentence does not intrinsically involve motion. Motion along the trajectory is a product of composing *went* with *to Boston*. The same trajectory is referred to in *the road leads to Boston* – a stative sentence expressing the extent of the road – and in *the sign points to Boston* – a stative sentence expressing the orientation of the sign. The difference among these examples comes from the semantics of the verb, not that of the prepositional phrase. The semantics of expressions of location and trajectory – including their crosslinguistic differences and relationships to Spatial Structure – has become a major preoccupation in areas of semantic related to Conceptual Semantics (e.g. Bloom et al. 1996, Levinson 2003, van der Zee and Slack 2003).

Orthogonal to the ontological category features are *aspectual* features. It has long been known that the distinction between objects and substances (expressed by count and mass NPs

respectively) parallels the distinction between events and processes (telic and atelic sentences). Conceptual Semantics expresses this parallelism (Jackendoff 1991) through a feature [±bounded]: [+bounded] materials are objects (count), [–bounded] are substances (mass); [+bounded] situations are events (telic), [–bounded] situations are processes (atelic). Trajectories or paths also partake of this feature: a path such as *into the forest*, with an inherent endpoint, is [+bounded]; *along the road*, with no inherent endpoint, is [–bounded]. Another feature, [±internal structure] (or [±i]) deals with aggregation. Single objects are [–i]; aggregates (plurals) are [+i]. Similarly, single events are [–i] and iterated events such as hammering are [+i]. Because these features cut across ontological categories, they can be used to calculate the telicity and iterativity of a sentence based on the contributions of all its parts (Jackendoff 1996b). For instance, (3a) is telic because its subject and path are bounded. (3b) is atelic because its path is unbounded. (3c) is atelic and iterative because its subject is an unbounded aggregate of individuals. (3d) is stative, hence atelic, because the verb is stative.

(3) a. John walked into the forest.
b. John walked along the road.
c. People walked into the forest.
d. The road leads into the forest.

2.3. Feature analysis in word meanings

Within Conceptual Semantics, word meanings are regarded as composite, but not necessarily built up in a fashion that lends itself to definitions in terms of other words. This subsection and the next three describe some of the means of composition that lead to this view.

The first such situation is when a particular semantic feature spans a number of semantic fields. Conceptual Semantics grew out of the fundamental observations of Gruber (1965), who showed that the notions of location, change, and causation extend over the semantic fields of space, possession, and predication. For example, the sentences in (4) express change in three different semantic fields, in each case using the verb *go* and expressing the endpoint of change as the object of *to*.

(4) a. John went to New York. [space]
b. The inheritance went to John. [possession]
c. The light went from green to red. [predication]

Depending on the language, sometimes these fields share vocabulary and sometimes they don't. Nevertheless, the semantic generalizations ring true crosslinguistically. The best way to capture this crosscutting is by analyzing, for instance, motion and change as a primitive function GO (alternating with BE and STAY) plus a "field feature" that localizes it to a particular semantic field (space vs. possession vs. predication). Neither the function nor the field feature is lexicalized by itself: GO is not on its own the meaning of *go*. Rather, these two elements are more like features in phonology, where for example *voiced* is not on its own a phonological segment but when combined with other features serves to distinguish one segment from another. Thus these meaning components cannot be expressed as word-like primes.

An extension of this approach involves force-dynamic predicates (Talmy 1988, Jackendoff 1990, chapter 7), where for instance *force*, *entail*, *be obligated*, and the various senses of *must* share a feature, and *permit*, *be consistent with*, *have a right*, and the various senses of *may* share another value of the same feature. At the same time, these predicates differ in whether they are in the semantic field of physical force, social constraint, logical relation, or prediction.

Another such case was mentioned in the previous subsection: the strong semantic parallel between the mass-count distinction in material substances and the process-event distinction in situations (Jackendoff 1991 and many others). Despite the parallel, few words cut across these domains. One happens to be the word *end*, which can be applied to speeches, to periods of time, and to tables of certain shapes (e.g. long ones but not circular ones). On the Conceptual Semantics analysis, *end* encodes a boundary of a one-dimensional entity of any type – and because only certain table shapes can be construed as elaborations of a one-dimensional skeleton, only these tables have ends. (Note that an approach in terms of metaphor only restates the problem. Why do these metaphors exist? Answer: Because conceptualization has this feature structure.)

The upshot of cases like these is that word meanings cannot be expressed in terms of word-like definitions, because the primitive features are not on their own expressible as words.

2.4. Spatial structure in word meanings

One of the motivations for concluding that linguistic meaning must be segregated from "world knowledge" is that there are many words with parallel grammatical behavior but clearly different semantics. For instance, verbs of manner of locomotion such as *jog*, *sprint*, *amble*, *strut*, and *swagger* have identical grammatical behavior but clearly differ in meaning. Yet there is no evident way to decompose them into believable algebraic features. These actions differ in how they look and how they feel. Similarly, a definition of *chair* in terms of "[+has-a-seat]" and "[+has-a-back]" is obviously artificial. Rather, our knowledge of the shape of chairs seems to have to do with what they look like and what it is like to sit in them – where sitting is ultimately understood in terms of performing the action. For a final example, our knowledge of *dog* at some level involves knowing that dogs bark. But to encode this purely in terms of a feature like "[+barks]" misses the point. It is what barking *sounds like* that is important – and this is also involved in our understanding of the verb *bark*.

In each of these cases, what is needed to specify the word meaning is not an algebraic feature structure, but whatever cognitive structures encode categories of shapes, actions, and sounds. Among these structures are Spatial Structures of the sort discussed in section 1.3, which encode conceptualizations of shape, color, texture, decomposition into parts, and physical motion. As suggested there, it is not that these structures *alone* constitute the word meanings in question. Rather, it is the combination of Conceptual Structure with these structures that fills out the meanings.

Jackendoff 1996a hypothesizes that these more perceptual elements of meaning are grammatically inert; that is, only Conceptual Structure makes a difference in syntactic behavior. If correct, this would account for the fact that such factors are not usually considered part of

"linguistic semantics", even though they play a crucial role in understanding. Furthermore, since these factors are not encoded in a format amenable to linguistic expression, they cannot be decomposed into definitions composed of words. The best one can do by way of definition is ostension, relying on the hearer to pick out the relevant factors of the environment.

2.5. Centrality conditions and preference rules

It is well known that many words do not have a sharply delimited denotation. An ancient case is *bald*: the central case is total absence of hair, but there is no particular amount of hair that serves as dividing point between bald and non-bald. Another case is color terms, where, for instance, there are focal values of *red* and *orange* and a smooth transition of hues between them, but no sharp dividing line, one side of which is definitely red and the other side is definitely orange. To reinforce a point made in section 1.1, it is not our ignorance of the true facts about baldness and redness that leads to this conclusion. Rather, there simply is no fact of the matter. When judgments of such categories are tested experimentally, the intermediate cases lead to slower, more variable, and more context-dependent judgments. The conclusion is that the structure of these categories has something to do with how they are conceptualized – something that does not always lend itself to certain and consistent judgment.

In Conceptual Semantics, such words involve *centrality conditions*. They are coded in terms of a focal or central case, which serves as prototype. Cases that deviate from the prototype (as in baldness) – or for which another candidate prototype competes (as in color words) – result in the observed slowness and variability of judgments. Such behavior is in fact what would be expected from a neural implementation – sharp categorical behavior is actually much harder to explain in neural terms.

A more complex case that results in noncategorical judgments involves so-called cluster concepts. The satisfaction conditions for such concepts are combined by a non-Boolean connective (let's call it "smor") for which there is no English word. If a concept C is characterized by [condition A "smor" condition B], then stereotypical instances of C satisfy conditions both A and B, and more marginal cases satisfy either A or B. For instance, the verb *climb* stereotypically involves (A) moving upward, (B) by clambering along a vertically aligned surface, as in (5a). However, (5b) violates condition A while observing condition B, and (5c,d) are just the reverse. (5e,f), which violate both, are not acceptable. This shows that neither condition is necessary, and either is sufficient.

(5) a. The bear climbed the tree.
b. The bear climbed down the tree/across the cliff.
c. The airplane climbed to 30,000 feet.
d. The snake climbed the tree.
e. *The airplane climbed down to 10,000 feet.
f. *The snake climbed down the tree.

The connective between the conditions is not simple logical disjunction, because if we hear simply *The bear climbed*, we assume it was going upward by clambering. That is, both conditions are default conditions, and either is violable (Fillmore 19xx).

This connective is involved in the analysis of Wittgenstein's famous example *game*, in the verb *see* (Jackendoff 1983, chapter 8), in the preposition *in* (Jackendoff 2002, chapter 11), and countless other cases. It is also pervasive elsewhere in cognition, for example gestalt principles of perceptual grouping (Wertheimer 1923, Jackendoff 1983, chapter 8) and even music and phonetic perception (Lerdahl and Jackendoff 1983). Because the connective "smor" is not lexicalized, word meanings involving it cannot be expressed as standard definitions.

2.6. Dot-objects

An important aspect of Conceptual Semantics stemming from the work of Pustejovsky 1995 is the notion of *dot-objects* – entities that subsist simultaneously in multiple semantic domains. A clear example is a *book*, a physical object that can have a size and weight, but that also is understood as a bearer of information that can be uninteresting or can end sadly. Like other cluster concepts, either aspect of this concept can be absent: a blank notebook bears no information, and the book whose plot I am currently developing in my head is not (yet) a physical object. But a stereotypical book partakes of both domains. The information component can be linked to other instantiations besides books, such as speech, thoughts in people's heads, computer chips, and so on. Pustejovsky notates the semantic category of objects like books with a dot between the two domains: [PHYSICAL OBJECT • INFORMATION], hence the nomenclature "dot-object."

Note that this treatment of *book* is different from considering the word polysemous. It accounts for the fact that properties from both domains can be applied to the same object at once: *That book that fell off the shelf* [physical] *discusses the war* [information].

Corresponding to this sort of dot-object there are dot-actions. *Reading* is at once a physical activity – moving one's glance over a page – and an informational one – taking in the information encoded on the page. *Writing* is creating physical marks that instantiate information, as opposed to, say, *scribbling*, which need not instantiate information.

Implied in this analysis is that spoken language also is conceptualized as a dot-object: sounds dotted with information (or meaning). The same information can be conveyed by different sounds (e.g. by speaking in a different language), and the same sounds can convey different information (e.g. different readings of an ambiguous sentence, or different pragmatic construals of the same sentence in different contexts). Then *speaking* involves emitting sounds dotted with information; by constrast, *groaning* is pure sound emission.

Another clear case of a dot-object is a university, which consists at once of a collection of buildings and an academic organization: *Walden College covers 25 acres of hillside and specializes in teaching children of the rich*. Still another such domain (pointed out by Searle 1995) is actions in a game, where for example hitting a ball to a certain location is a physical action whose significance in terms of the game may be a home run, which adds runs, or a foul ball, which adds strikes. For such a case, the physical domain is "dotted" with a special "game domain," in terms of which one carries out the calculation of points or the like to determine who wins in the end.

More generally, symbolic uses of objects, say in religious or patriotic contexts, can be analyzed in terms of dot-objects and dot-actions with significance in the symbolized domain. Similarly with money, where coins, bills, checks, and so on – and the exchange thereof – are both physical objects and monetary values.

But perhaps the most far-reaching application of dot-objects is to the domain of *persons* (Jackendoff 2007). On one hand, a person is a physical object which occupies a position in space, has weight, can fall, gets sick, and so forth. On the other hand, a person has a personal identity in terms of which social roles are understood: one's kinship or clan relations, one's social and contractual obligations, one's moral responsibility, and so forth. The distinction between these two domains is recognized crossculturally as the difference between body on one hand and soul or spirit on the other. Cultures are full of beliefs about spirits with personal identity and social significance but without bodies, for examples ghosts and gods. We quite readily conceptualize attaching personal identity to different bodies, as in beliefs in life after death and reincarnation, films like *Freaky Friday* (in which mother and daughter involuntarily exchange bodies), and Gregor Samsa's metamorphosis into a giant cockroach. A different sort of such dissociation is Capgras Syndrome (McKay et al. 2005), in which a stroke victim claims his wife has been replaced by an impostor who looks exactly the same.

Social actions partake of this duality between physical and social/personal as well. For example, shaking hands is a physical action whose social significance is something like an expression of mutual respect. This same social significance is attached to different actions in different cultures, say to bowing, high-fiving, or a man kissing a lady's hand. And the same physical action can be attached to different social significance; for instance hissing is evidently considered an expression of approval in some cultures, rather than an expression of disapproval as in ours.

Note that this social/personal domain is not the same as Theory of Mind, although they overlap a great deal. On one hand, we attribute intentions and goals not just to persons but also to animals, who do not have social roles (with the possible exception of pets, who are treated as "honorary" persons). On the other hand, social characteristics such as one's clan and one's rights and obligations are not a consequence of what one believes or intends: they are just bare social facts. The consequence is that we likely conceptualize people in three domains "dotted" together: the physical domain, the personal/social domain, and the domain of sentient/animate entities.

A formal consequence of this approach is that the meaning of an expression containing dot-objects and dot-actions is best treated in terms of two or more linked "planes" of meaning operating in parallel. Some inferences are carried out on the physical plane, others on the associated informational, symbolic, or social plane. And particularly through the importance of social predicates to our thought and action, such a formal treatment is fundamental to our understanding of human conceptualization and linguistic meaning (even if it is as yet far from well worked out).

3. Compositionality

A central idealization behind most theories of semantics, including those of mainstream generative grammar and much of formal logic, is classical Fregean Compositionality, which can be stated roughly as (6).

(6) (Fregean compositionality)
The meaning of a compound expression is a function of the meanings of its parts and of the syntactic rules by which they are combined.

This is usually interpreted in the strongest possible way: the meaning of a phrase is a function *only* of the meanings of its constituent words, assembled in simple fashion in accordance with the syntax. This is often further supplemented with an assumption that semantics is *derived* from syntax (perhaps proof-theoretically), and the principles of semantic composition mirror those of syntactic composition rule for rule (for instance in Montague Grammar).

Early work in Conceptual Semantics (Jackendoff 1983) adopted a position close to (6): heads of syntactic phrases correspond to semantic functions of one or more arguments; syntactic subjects and complements correspond to semantic constituents that instantiate these arguments. Syntactic adjuncts, which are attached differently for complements, correspond to semantic modifiers, which compose with semantic heads differently than arguments do.

However, subsequent work has revealed a host of cases where such simple relations between syntactic and semantic structure cannot obtain. One class of cases involves semantic information for which there is no evidence in the words or the syntax. (7) illustrates one variety, *aspectual coercion* (Talmy 1978, Verkuyl 1993, Pustejovsky 1995, Jackendoff 1997). (7a) and (7b) are syntactically identical; however, (7a) implies repeated acts of jumping but (7b) does not imply repeated acts of sleeping.

(7) a. Jack jumped on the couch until the bell rang.
b. Jack slept on the couch until the bell rang.

Strong Fregean composition would therefore require that *jump* (along with every other telic verb) is ambiguous between single and repeated jumping; repetition would come from the latter meaning of the word. The problem is that telicity depends not just on the verb but on the entire verb phrase. For example, (8a) implies repeated (masochistic) action and (8b) does not. The difference is that 'run into the wall' is telic and 'run alongside the wall' is atelic, because of the paths implied by the two prepositions.

(8) a. Jack ran into the wall until the bell rang.
b. Jack ran alongside the wall until the bell rang.

The solution proposed in the references above is that *until* places a temporal bound on an otherwise unbounded activity. In case the verb phrase is telic, i.e. it designates a temporally bounded event, semantic composition is licensed to reinterpret the verb phrase iteratively (i.e. it "coerces" the interpretation of the VP), so that the iterations constitute an unbounded

activity. However, there is no reflex of this extra step of composition in syntactic structure. This view is confirmed by psycholinguistic experimentation (Piñango et al. 1999); additional processing load is found in sentences like (7a), taking place at a time and brain location consistent with semantic rather than syntactic processing.

Another such case is *reference transfer* (Nunberg 1979), in which an NP is used to refer to something related such as 'picture of NP', 'statue of NP', 'actor portraying NP' and so on:

(9) a. There's Chomsky up on the top shelf, next to Plato. [statue of or book by Chomsky]
b. [One waitress to another:]
The ham sandwich in the corner wants some more coffee.
[person who ordered sandwich]
c. I'm parked out back. I got smashed up on the way here. [my car]

Jackendoff 1992 shows that these shifts cannot be disregarded as "merely pragmatic," for two reasons. First, a theory that is responsible for how speakers understand sentences must account for these interpretations. Second, some of these types of reference transfer have interactions with anaphoric binding, which is taken to be a hallmark of grammar. Suppose Richard Nixon goes to see the opera *Nixon in China*. It might happen that ...

(10) Nixon is horrified to watch himself sing a foolish aria to Chou En-lai.

Here *Nixon* stands for the real person and *himself* stands for the portrayed Nixon on stage. However, such a connection is not always possible:

(11) *After singing his aria to Chou En-lai, Nixon was horrified to see himself get up and leave the opera house.

(10) and (11) are syntactically identical in the relvant respects. Yet the computation of anaphora is sensitive to which NP's reference has been shifted. This shows that reference transfer must be part of semantic composition. Jackendoff 1992 demonstrates that the meaning of reference transfer cannot be built into syntactic structure in order to derive it by Fregean composition.

Another sort of challenge to Fregean composition comes from *constructional meaning*, where ordinary syntax is paired with nonstandard semantic composition. Examples appear in (12): the verb is syntactically the head of the VP, but it does not select its complements. Rather, the verb functions semantically as a means or manner expression.

(12) a. Bill belched his way out of the restaurant. ['Bill went out of the restaurant belching']
b. Laura laughed the afternoon away. ['Laura spent the afternoon laughing']
c. The car squealed around the corner. ['The car went around the corner squealing']

Jackendoff (1990, 1997b) and Goldberg 1995 analyze these examples as instances of distinct meaningful constructions in English. The *way*-construction in (12a) is an idiom of the form *V Pro's way PP*, meaning 'go PP by/while V-ing'; the *time-away* construction in (12b) has the

form *V-NP[time period] away*, meaning 'spend NP V-ing'; the sound-motion construction in (12c) has the form *V PP*, meaning 'go PP while emitting sound of type V.' It is shown that there is no way to derive these meanings from standard syntactic structures; rather they stipulate nonstandard ways to compose a VP in English (though by no means crosslinguistically).

Constructional meaning is also found in expressions with nonstandard syntax, such as (13).

(13) a. The more I read, the less I understand.
b. Into the cellar with you!
c. One more beer and I'm leaving.
d. rule for rule; day after day; student by student

In these cases one might be able to maintain a sort of Fregean composition, in that the special syntax directly denotes a particular sort of meaning composition. But the principles of composition here are (a) completely idiosyncratic and (b) introduce their own elements of meaning rather than just assembling the meanings of the words. This is not the spirit in which Fregean composition is usually intended.

A final set of cases that cast doubt on Fregean compositionality are those where syntactic composition vastly underdetermines semantic composition. An example is *Bare Argument Ellipsis*: the meaning of B's reply to A is not determined by the syntax of the reply, which is just *yeah* plus a bare NP. Rather, it has to do with a best pragmatic fit to A's utterance.

(14) A: I hear Ozzie's been drinking again.
B: Yeah, scotch. ['Yeah, Ozzie's been drinking scotch.' – *not* 'Yeah, I/you hear Ozzie's been drinking scotch']

Mainstream generative theory (e.g. recently Merchant 2001) has maintained that B's reply is derived by deletion from an underlying structure which expresses the way the reply is understood and which therefore can undergo Fregean composition. However, Culicover and Jackendoff 2005 (along with a host of others, including among philosophers Stainton 1998) argue that in general it is impossible to state a canonical rule of ellipsis based on syntactic identity, and that the proper generalization must be stated over meaning relations between A's and B's utterances. This means that there is no syntactic structure from which the understood meaning of B's reply can be derived; hence Fregean composition again is violated.

A more radical example is pidgin languages, where there is arguably no syntactic structure (or at least very little), and yet structured meanings are conveyed. In these cases, as in (14), it is up to the listener to use heuristics and world knowledge to surmise the overall semantic configuration intended by the speaker. However, such rudimentary syntax is not confined to pidgins. It also appears in standard language in noun-noun compounds, where the semantic relation between the two nouns is quite varied despite the very same uninformative syntactic configuration:

(15) wheat flour = 'flour made from wheat'
cake flour = 'flour of which cakes are made'
dog house = 'house in which a dog characteristically lives'
house dog = 'dog that lives in a house' (and not a doghouse!)
garbage man = 'man who handles garbage'
snow man = 'simulated man made of snow'
sun hat = 'hat that protects one from the sun/that one wears in the sun'
bike helmet = 'helmet that one wears while riding a bike'
rocket fuel = 'fuel that powers a rocket'
etc.

The range of semantic possibilities, though not unlimited, is quite broad; yet these examples show no syntactic contrast. Therefore the meaning cannot be derived simply by arranging the meanings of the words.

The upshot of all these sorts of examples (see Jackendoff 1997a, Jackendoff 2002, and Culicover and Jackendoff 2005 for a more extensive enumeration and discussion) is a different view of the relation between syntax and semantics. This might be stated as (16).

(16) (Autonomous semantics)
Phrase and sentence meanings are composed from the meanings of the words plus independent principles for constructing meanings, only some of which correlate with syntactic structure. Moreover, some syntactic structures express elements of meaning (not just arrangements of elements) that are not conveyed by individual words.

It can be seen that Fregean composition is a special case of (16), in which all elements of meaning come from the words, and syntactic structure expresses only the arrangement of word meanings, not content. This will work for simple examples like *Pat kissed Frankie*, but not for the sorts of examples presented here – which are pervasive in language.

There are two important consequences of adopting this view of the syntax-semantics relation. First, it is possible to recognize that much of the complexity of mainstream syntax has arisen from trying to make covert syntax (D-structure or Logical Form) rich enough to achieve Fregean compositionality. Once one acknowledges the richer possibilities for composition argued for here, it becomes possible to strip away much of this complexity from syntax. The result is a far leaner theory of syntax, partly compensated for by a richer theory of the mapping between syntax and semantics (Culicover and Jackendoff 2005). The tradeoff, however is not even, because no defensible version of Fregean compositionality, no matter how complex the syntax, can account for any the phenomena adduced in this section.

A second consequence of Autonomous Semantics is that one can now come to view language not as a system that *derives* meanings from sounds (say proof-theoretically), but rather as a system that *expresses* meanings, where meanings constitute an independent mental domain – the system of thought. This is consistent with the view of Conceptual Semantics laid out in section 1 above, in which Conceptual Structure and Spatial Structure are the domains of

thought and are related to linguistic expression through the interfaces with syntax and phonology. Thus the empirical phenomena studied within Conceptual Semantics provide arguments for the theory's overall worldview, one that is consistent with the constraints of the mentalistic framework.