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Meaning and the Lexicon

The Parallel Architecture 1975–2010

Ray Jackendoff

MEANING AND THE LEXICON

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1987
Consciousness and the Computational Mind

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Abbreviations

ASL	American Sign Language
CR	contrastive reduplication
CS	conceptual structure
GB	Government and Binding Theory
GF	grammatical function
GPSG	Generalized Phrase Structure Grammar
HPSG	Head-Driven Phrase Structure Grammar
LCS	lexical conceptual structure
LF	Logical Form
LFG	Lexical Functional Grammar
MP	Minimalist Program
PF	Phonetic Form
RP	resultative phrase
S&C	*Semantics and Cognition*
SPE	Chomsky and Halle, *The Sound Pattern of English*
SR	spatial representation
UG	Universal Grammar

Preface

Curating a retrospective of one's own papers is inevitably a bit of a self-indulgence. I'm doing so at the suggestion of a number of friends and colleagues who thought that such a collection, amplified by commentary, might serve as a useful journey through the evolution of my thinking over the past thirty-five years.

The papers offered here focus on the theory of meaning and on the theory of the lexicon—two issues which, as the years go on, have come to be more and more intertwined. How are the meanings of words formulated, such that they are sufficiently rich to do the work of inference and reference that they are supposed to? How does linguistic meaning interface with visual meaning, such that we can talk about what we see? How are those parts of meaning formulated that *don't* come from words? How can it be that the *same* meanings come sometimes from words and sometimes from other sources? The latter two questions have led to my growing interest in coercions and constructions, in which grammar, lexicon, and pragmatic factors intersect. A further recurring theme among the papers is productivity versus semiproductivity. Standard generative grammars expect us to find complete productivity; yet language is full of semiproductive phenomena, in both morphology (as is well known) and syntax (as is less widely acknowledged). Semiproductivity is still problematic, and it too leads into the structure of the lexicon.

Many other papers of mine could have been included in this volume, except that they had already been folded into my books *Semantics and Cognition* (1983), *Semantic Structures* (1990), *Languages of the Mind* (1992), *The Architecture of the Language Faculty* (1997), *Foundations of Language* (2002), and *Simpler Syntax* (2005). (I've decided to include 'On Beyond Zebra', despite its appearing in *Consciousness and the Computational Mind* (1987), because linguists rarely engage with that book.) So the picture presented by this volume alone is necessarily somewhat fragmentary.

In order to help tie the papers together, I have provided a Prologue that contextualizes the papers in terms of my current framework—the Parallel Architecture and its major components, Conceptual Semantics and Simpler Syntax. Chapter 2 is about the structure of the lexicon. Chapters 3 and 4 concern the relation between language and vision. Chapters 5 and 6 deal with

the intertwined issues of mereology (parts) and aktionsarten (event structure). Chapters 7–9 turn to special constructions in the English VP: verb-particle constructions, the time-*away* construction, and the resultative. Chapters 10–12 deal with three less ruly phenomena of English: a quotative NP construction, a reduplicative construction with curious semantics and morphosyntax, and the ubiquitous NPN construction (*day after day*). Finally Chapter 13 is about the semantics of noun-noun compounds.

Many of the papers are preceded by remarks that place them in their time and/or set out unifying themes. Throughout, but especially in the earlier papers, I have also inserted commentaries as 'subfootnotes', keyed by superscript letters and printed in sans serif font, which discuss what I think was wrong, how I might now fix it, further formalization, subsequent reactions in the literature, and so on.

I have tried to leave the original texts of the articles intact, insofar as it made sense to. I have deleted, abridged, or moved a few sections in the interests of reducing duplication, and I have thoroughly rewritten a couple of very thorny (or muddled?) sections in the interests of comprehensibility. In both cases I give notice in the text. I have kept section and example numbering intact from the originals, even at the expense of some gaps. Short comments have been inserted in square brackets; I have clarified a few passages and updated some references without notice.

Each article contains its own acknowledgments. But in addition, I must express my gratitude to Peter Culicover, Maria Piñango, Lila Gleitman, Andrew Winnard, Gina Kuperberg, and my editor John Davey for their encouragement and good advice on the project as a whole. Many thanks to Adele Goldberg, Jila Ghomeshi, Nicole Rosen, and Kevin Russell, my collaborators in Chapters 9 and 11. I deeply appreciate their willingness to cross theoretical divides; I'm sure there were times when I tried their patience. Teresa Salvato has been of great help in converting the older papers into electronic format, as well as in the more general task of making my life at the Tufts Center for Cognitive Studies go smoothly. I'm indebted to Neil Cohn for redrawing the illustrations, which in some of the original papers were embarrassingly crude drawings of my own. I'm grateful to Dan Dennett, Jamshed Bharucha, Kevin Dunn, and Ed Merrin, who made my move to Tufts University in 2005 possible, and to them and Maryanne Wolf, Phil Holcomb, Gina Kuperberg, Mark Richard, Nancy Bauer, Diane Souvaine, and John McDonald, among many others, who have made it such a pleasure to be there. Thanks to the generous efforts of Chris Wood, I was able to complete this project in residence at the fabulous Santa Fe Institute. And, at the end of the day, there's Hildy to thank profusely, as always.

R.J.

CHAPTER 1

Prologue

The Parallel Architecture and its Components (2010)

Each of the chapters in this volume has played a significant role in developing the framework I have called the Parallel Architecture. The basic premise of the theory is that phonology, syntax, and semantics are independent generative components in language, each with its own primitives and principles of combination. It contrasts with the mainstream assumption that the syntactic component is the sole generative component of language, responsible for the combinatorial properties of phonology and semantics. In the earlier papers represented here, many divergences from mainstream assumptions are proposed rather casually; I thought of them as minor fixes without great import. However, during the middle 1990s it slowly became clear to me that I had come to think about the architecture of language in a fashion very much at odds with the mainstream conception, and I began to articulate and explore the differences systematically in *The Architecture of the Language Faculty* (1997) and especially *Foundations of Language* (2002).

The Parallel Architecture has three important subcomponents. The first, Conceptual Semantics, is an approach to meaning that I have been developing steadily since *Semantic Interpretation in Generative Grammar* (1972), which was a much expanded version of my 1969 dissertation. The first full working out of this component is in *Semantics and Cognition* (1983), and it is further amplified in *Semantic Structures* (1990).

The second subcomponent of the Parallel Architecture is the lexicon, which comes to include not just words and morphemes, but also idioms, memorized fixed expressions such as clichés, constructions, and even the most general rules

of grammar. This treatment began to emerge in *Semantic Structures*, but *Foundations of Language* really fleshed it out and showed how it leads to a considerable reframing of the problem of linguistic knowledge and language acquisition.

The third subcomponent of the Parallel Architecture is a greatly simplified theory of syntax and a somewhat more complex theory of the syntax–semantics interface. Again, this was developing implicitly in my work for many years, but a first explicit statement was in *Semantic Structures*, and a second, far more ambitious statement appeared in *Simpler Syntax* (2005), co-authored with Peter Culicover.

This prologue offers a brief discussion of these theoretical developments, in part consolidating discussions from the original versions of the chapters in this volume, and in part bringing the discussion a bit more up to date.

1.1 The Parallel Architecture

The Parallel Architecture builds on insights about phonology and semantics that arose in the middle and late 1970s. Phonology was demonstrated to have highly articulated structure that cannot be derived directly from syntax. In particular, structured units such as syllables and prosodic constituents do not correspond one to one with syntactic units. Moreover, phonological structure includes several independent substructures or *tiers*, each with its own type of generative structure: segmental-syllabic structure, the metrical grid, intonation contour, and (in tone languages) the tone tier. The tiers are correlated with each other by *interface rules*: principles that establish optimal correspondence between structures of two independent types. For instance, stress rules are treated not as rules that derive stress patterns *de novo*, but as interface rules that create the best match between segmental-syllabic patterns and an optimal metrical grid. In turn, since these multitier phonological structures cannot be derived from syntactic structures, the connection between syntax and phonology has to be mediated not by derivations, but by a component of interface rules.

The 1970s also witnessed the development of approaches to meaning as different as formal semantics and Cognitive Grammar, with my Conceptual Semantics somewhere in between. Despite their differences, all of these approaches see meaning structures as combinatorial and potentially unlimited in complexity. These structures are not built out of or derived from syntactic units such as NPs and VPs (as they were in Generative Semantics). Rather, they are built of characteristic semantic units such as conceptualized objects, events, times, properties, and quantifiers, which do not correspond one to one with syntactic

categories. As a consequence, semantics too becomes a generative component of language that cannot be derived from syntax, but rather is correlated with syntax by a component of interface rules. Moreover, semantic structure, like phonology, demonstrably has an articulation into tiers, including at least propositional structure (who did what to whom) and an orthogonal dimension of information structure (topic/focus/common ground; old vs. new information).

Syntax too may be articulated into independent tiers. LFG (Bresnan 1982b, 2001) is well known for proposing an articulation of syntax into constituent structure (the standard tree) and functional structure (grammatical functions); a stripped-down version of the latter is the grammatical function tier of Culicover and Jackendoff 2005. Autolexical Syntax (Sadock 1991) and Role and Reference Grammar (Van Valin and LaPolla 1997) propose an articulation into phrasal and morphosyntactic tiers—essentially principles that operate above and below the word level respectively. Again, the tiers of syntax must be brought into registration by interface rules.

The result is an architecture of the form in Figure 1.1, where phonology, syntax, and semantics also have further internal articulation of a similar sort.

Figure 1.1 offers a model in terms of which various other theories can be compared. For instance, in mainstream generative grammar (Chomsky 1965, 1981, 1995), the combinatorial properties of phonology and semantics are derived from syntax; hence there are no independent formation rules for phonology and semantics, only derivational interfaces from syntax into these two components. By contrast, Cognitive Grammar (e.g. Langacker 1987a) claims that all (or at least most) syntactic structure is semantically motivated, so it eliminates or minimizes the syntactic formation rules. Within the Parallel

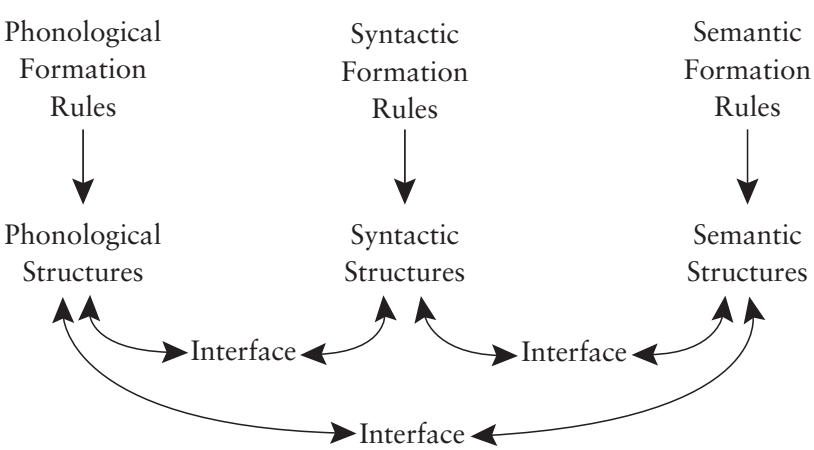


Fig. 1.1 The Parallel Architecture

Architecture, the empirical issue is the proper balance between these two extremes.[1]

An important constraint on the balance comes from the fact that semantic structure ultimately has to be rich enough to support inference. In the mainstream architecture, where semantic structure is *derived* from syntactic structure, all this richness has to come from syntax. This puts syntactic theory under constant pressure for greater articulation and complexity. By contrast, the Parallel Architecture grants semantics its own generative capacity, and therefore syntax has to be only rich enough to modulate the mapping between semantics and phonology—a Simpler Syntax (Culicover and Jackendoff 2005).

A crucial advantage of the Parallel Architecture is that it extends naturally to the relation of language to other capacities such as visual perception. It ought to be self-evident that the combinatorial structure of the visual field cannot be derived from syntactic NPs and VPs. Nevertheless, speakers refer freely to the structure of the world as understood through vision, e.g. in reporting that *The cat is on the mat*. Following the overall conception of the Parallel Architecture, the relation between language and vision can be treated as yet another interface component, this time linking the semantic structure of language to the combinatorial structures responsible for visual understanding. This interface is the topic of Chapters 3 and 4. The conclusion is that the relationships among faculties such as language and vision are mediated by exactly the same sorts of formal components—interface rules—as the relationships among the components of language and, within them, the subcomponents or tiers. In other words, the Parallel Architecture is applicable to all scales of mental organization.[2]

[1] Notice that Figure 1.1 contains an interface going directly from phonology to meaning, bypassing syntax. Such an interface is of course impossible under mainstream assumptions, where everything is derived from syntax. However, it provides a way to directly encode the influence of stress and intonation on meaning, without the involvement of syntax, and it is possible that other linguistic phenomena make use of this route as well. See Jackendoff 2002, chapter 8, and Chapter 13 of the present volume.

[2] Detailed comparisons of the Parallel Architecture with mainstream generative grammar appear in Jackendoff 1997b, 2002 (especially chapters 5–8), 2007b, 2008; Culicover and Jackendoff 2005. To my knowledge, discussion of the Parallel Architecture by proponents of the Minimalist Program (often without citation, but see, e.g., Phillips and Lau 2004, Marantz 2005) has been limited to the charge that the parallel architecture requires three or more 'generative engines' plus the interface components, and so it is a priori less economical and elegant than the traditional architecture, which requires only syntax as its 'generative engine'. A first reply to this criticism is that the Minimalist Program offers no formal account of either phonology or semantics, nor of the so-called 'sensorimotor and conceptual-intentional interfaces', so it is no wonder that it needs only a syntactic engine. A second reply, echoing Chomsky (1972b) (who is attacking Postal's (1972) 'The Best Theory' without actually citing it), is that formal elegance is not the only criterion for an empirical theory: it must first of all account for the facts and generalizations of language. As shown by Culicover and Jackendoff 2005 (chapters 2 and 3), the pursuit of theoretical elegance in mainstream generative grammar has led to continual shrinkage in its descriptive coverage.

1.2 The character of interface mappings

To see what interface mappings are like, let us focus for a moment on the interface between phonology and syntax, the two best-understood levels of mental representation.

It is obvious that there cannot be a complete *translation* between phonology and syntax. Many details of phonology, most notably the segmental content of words, play no role at all in syntax. Conversely, many details of syntax, for instance the layering of specifiers and of arguments and adjuncts, are not reflected in phonology. In fact, a complete, information-preserving translation between the two representations would be pointless, since it would in effect make them notational variants—which they clearly are not.

The relation between phonology and syntax is actually something more like a partial homomorphism. The two representations share the notion of *word* (and perhaps morpheme), and they share the linear order of words and morphemes.[3] But segmental and stress information in phonology has no direct counterpart in syntax; and syntactic category (N, V, PP, etc.) and case, number, gender, and person features have no direct phonological counterparts.[4] Moreover, syntactic and phonological constituent structures often fail to match. A classic example is given in (1).

(1) Phonological: [This is the cat] [that ate the rat] [that ate the cheese]
Syntactic: [This is [the cat [that ate [the rat [that ate [the cheese]]]]]]

The phonological bracketing, a flat tripartite structure, contrasts with the relentlessly right-embedded syntactic structure. At a smaller scale, English articles cliticize phonologically to the following word, resulting in bracketing mismatches such as (2).

(2) Phonological: [the [big]] [house]
Syntactic: [the [big [house]]]

Thus in general, the phonology–syntax interface module creates only partial correspondences between these two levels.

A similar situation obtains with the interface between auditory information and phonological structure. The complex mapping between wave-forms and

[3] Caveats are necessary concerning nonconcatenative morphology such as reduplication and Semitic inflection, where the relation between linear order in phonology and syntax is unclear, to say the least. See Jackendoff 1997b, chapter 6 on nonconcatenative morphology and Chapter 11 of the present volume for reduplication.

[4] To be sure, syntactic features are frequently realized phonologically as affixes with segmental content. But the phonology itself has no knowledge of what syntactic features these affixes express. See Jackendoff 1997, chapters 5 and 6.

phonetic segmentation in a sense preserves the relative order of information: a particular auditory cue may provide evidence for a number of adjacent phonetic segments, and a particular phonetic segment may be signaled by a number of adjacent auditory cues, but the overlapping 'bands' of correspondence progress through the speech stream in an orderly linear fashion. On the other hand, boundaries between words, omnipresent in phonological structure, are not reliably detectable in the auditory signal; contrariwise, the auditory signal contains acoustic information about the identity of the speaker that is disregarded by phonology. So again the interface module takes only certain information from each representation into account in establishing a correspondence between them.

In addition to general mapping principles such as order preservation, an interface can also make use of specialized learned mappings. The clearest instances of such mappings are *lexical items*. For instance, the lexical item *cat* stipulates that the phonological structure /kæt/ can be mapped simultaneously into a syntactic noun and into a conceptual structure that encodes the word's meaning. In other words, the Parallel Architecture leads us to regard the lexicon as a learned component of the interface modules within the language faculty (see Jackendoff 1997b, 2002). We return to the lexicon in section 1.4.

Both these examples—syntax to prosody and segmental phonology to acoustics—show that each level of representation has its own proprietary information, and that an interface communicates only certain aspects of this information to the next level up- or downstream. As will be seen, the same general characteristics obtain in other interfaces, most notably the syntax–semantics interface, which is so crucial to explicating the nature of human language. I put off discussion of this interface to section 1.5. These same characteristics extend to the interface between language and vision, discussed in Chapters 3 and 4, and to the interfaces within the musical faculty (Lerdahl and Jackendoff 1983). To me, the fact that similar characteristics emerge in case after case over multiple faculties of mind is strong evidence in favor of this conception of language.

1.3 Outline of Conceptual Semantics

One factor that made it possible to work out a detailed statement of the Parallel Architecture and the lexicon was the theory of Conceptual Semantics, which, unlike other extant semantic theories, was developed in full cognizance of the overall goals of generative grammar. Receiving its first full statement in *Semantics and Cognition* (*S&C*), Conceptual Semantics answers to a number of

constraints not normally considered central by theories within philosophy, psychology, and AI.

Among the leading points of this theory are the following:

1. *Meanings are mentally encoded*. This is the foundational assumption of Conceptual Semantics, necessary to embed the theory within the psychologically based framework of generative grammar. The theory is concerned not just with meaning *tout court*, but with the speaker's *grasp* of meaning. This premise decisively parts company with standard model-theoretic approaches, in which meanings are taken to be sets of individuals in possible worlds, extrinsic to the language user rather than encoded in the user's mind. To adapt the terms of Chomsky 1986, Conceptual Semantics is a theory of I-semantics ('internal(-ized) semantics') rather than E-semantics ('external(-ized)').

Conceptual Semantics encodes meanings in terms of a level of representation called *conceptual structure* (CS). Conceptual structure is taken to be the form (or one of the forms) in which human thought is couched—it serves as the 'syntax of thought'.[5] It is by hypothesis common to all natural languages: translation preserves conceptual structure. Moreover, CS is to some degree independent of language, and some aspects of it are shared with nonlinguistic organisms such as apes and babies. The language faculty—phonology, syntax, and the interfaces of Figure 1.1—can then be seen as serving the purpose of making thoughts communicable (including to oneself, through verbal imagery).[6]

2. *The reference of linguistic expressions is a mental construct*. Standard formal semantics and philosophy of language seek to explicate the relation of reference between language and the external world, usually modeling the world set-theoretically and often using the notion of possible worlds. In Conceptual Semantics, the relation between language and the external world is taken to be mediated by the way the mind *understands* the world, as encoded in mental representations. Thus this theory contains no notion of reference in the standard sense. Rather, the corresponding construct is reference to the world as the mind *construes* it, or how the speaker is at the moment inviting the hearer to *view* the

[5] I use this term to distinguish my notion of conceptual structure from Fodor's (1975) 'Language of Thought'; the latter carries with it the property of intentionality, from which I wish to distance myself. See Jackendoff (1990, 1991b, 2002) for discussion.

[6] In recent writings, Chomsky (e.g. Hauser, Chomsky, and Fitch 2002) has put forward the position that the basic function of language (if one may use the term) is to structure thought, and that 'externalization' via phonology is secondary. This fails to explain why the experience of one's own thought is through verbal imagery, complete with phonological structure. It also fails to explain how it is possible for nonlinguistic organisms such as chimpanzees and baboons to think (Köhler 1927, Cheney and Seyfarth 2007). See Pinker and Jackendoff 2005 for discussion.

world. This difference plays an important role in many of the chapters in this volume, where semantic analyses prove to depend crucially on what construals of objects and events are possible and salient.

3. *Meanings are decompositional*. That is, word and phrase meanings have internal structure built up 'algebraically' from a finite, innate stock of primitives and principles of combination. The argument for this point (Jackendoff 1983, chapters 5 and 7; 1990; 2002) parallels Chomsky's (1957) arguments concerning the generativity of syntax: we are capable of grasping an unlimited number of meanings, both for words and for phrases. Since they cannot all be memorized or hard-wired, they must be the product of a finite generative system. This position concurs with the main traditions in lexical semantics (Miller and Johnson-Laird 1976; Lehrer and Kittay 2002; Pinker 1989; Pustejovsky 1995, to cite only a few parochial examples). It rules out, among other things, most approaches to model-theoretic semantics and semantic network theories, in which word meanings are unstructured nodes in a finite network of inferences or associations; it also rules out the monad-meaning postulate theory of Fodor et al. (1980).[7]

4. *Meanings do not, however, decompose into necessary and sufficient conditions*. The theory acknowledges the numerous arguments that concepts have fuzzy borderlines and family resemblance properties. *S&C*, chapter 8, develops and defends in detail appropriate formal devices that incorporate such phenomena integrally into the possible decompositions of word meanings. In particular, some conceptual features and some interactions among features have continuous (i.e. analog) characteristics that permit stereotype and family resemblance effects to be formulated. This aspect of the theory is shared with Cognitive Grammar (e.g. Lakoff 1987).

5. *There is no formal distinction of level between semantics and pragmatics*. *S&C*, chapter 6, shows that once one has the primitives and principles of combination appropriate for nonlinguistic tasks such as object categorization, the same machinery will account for many 'purely semantic' tasks such as linguistic inference. It is concluded that there is no reason to posit a separate 'semantic' component that deals exclusively with inference. Rather, one may view 'semantics' as providing the part of the conceptual structure of an utterance that is related directly to linguistic expression, and 'pragmatics' as providing the part that arises through inference, heuristics, world knowledge, and understanding of the context. In other words, the same sorts of structures can arise through multiple sources, often overlapping and intertwining in the

[7] See also Fodor 1970; Fodor, Fodor, and Garrett 1975; Fodor 1981. For replies, see Jackendoff 1983, chapter 7; 1990, chapter 1; 2002, chapter 9; Pinker 2007.

complete structure. This property of CS will become central at many points on the chapters in this volume, but especially in chapters 5 and 6.

I part company here with Bierwisch 1986, Partee 1993, and to a certain extent Pinker 1989, who posit a separate level of 'linguistic semantics'. Within the present approach, a separate semantic level is unnecessary and to some extent undesirable, given the interdigitation of conceptual structure information coming from language and that coming from nonlinguistic sources (Bolinger 1965 is still a touchstone on this issue). To the extent that there is a domain of 'linguistic semantics'—the part of meaning that is 'grammatically relevant'—this consists of the part of conceptual structure which is visible to the interface with syntactic structure. In other words, the domain is defined by the character of the interface, not by the character of conceptual structure itself. However, the issues are at this point far from resolved. The main point, on which Bierwisch, Pinker, and I agree (I am unclear about Partee), is that there *is* a language-independent and universal level of CS, whether directly interfacing with syntax or mediated by an intervening level.

Since CS serves as the form of linguistic meaning, there must also be a set of interface rules that permit meanings to be expressed, as shown in Figure 1.1. Since different languages express the same meaning in different ways, the interfaces must be language-particular, though no doubt constrained by UG. In addition, as mentioned in section 1.1, the conceptualization of the world must be related to perception and action. Thus CS must be linked by further interfaces to the mental representations proprietary to the perceptual systems and to the production of action.

Accordingly, an important goal of Conceptual Semantics is to articulate three systems of principles:

- The formation rules for CS, that is, the primitives and principles of combination that collectively generate the infinite class of possible concepts—both lexical concepts (word meanings) and phrasal concepts (including sentential concepts or *propositions*)
- The rules of inference, pragmatics, and heuristics
- The interface rules between CS and the other representations with which it interacts

Within this inquiry, the leading questions of lexical semantics then come to be framed as:

- What fragments of conceptual structure can be encoded in lexical items?
- When lexical items are combined syntactically, how are they correspondingly combined in CS, and what principles license these correspondences?

None of these goals, of course, can be pursued in isolation; they are intimately interdependent. Each chapter in this volume touches on all of them to varying degrees.

The formation rules for semantic/conceptual structure include, among other things, a vocabulary of primitive conceptual categories or 'semantic parts of speech'. Among these categories are such entities as Thing (or Object), Event, State, Action, Place, Path, Property, and Amount (*S&C*, chapter 3). They are combined according to (at least) three structural principles: function-argument structure, modifier-head relations, and binding.

The general form of function-argument structure is notated as in predicate calculus: *F(X)* for a one-place function and *F(X, Y)* for a two-place function. (3) shows a number of possible realizations of primitive conceptual categories involved in understanding spatial states and events in terms of function-argument structure.

(3) a. PLACE $\rightarrow$ [$_{\text{Place}}$ PLACE-FUNCTION (THING)]

b. PATH $\rightarrow$ $\left[\left\{ \begin{array}{l} \text{TO} \\ \text{FROM} \\ \text{TOWARD} \\ \text{AWAY-FROM} \\ \text{VIA} \end{array} \right\}_{\text{Path}} \left(\left\{ \begin{array}{l} \text{THING} \\ \text{PLACE} \end{array} \right\} \right) \right]$

c. EVENT $\rightarrow$ $\left\{ \begin{array}{l} [_{\text{Event}}\ \text{GO (THING, PATH)}] \\ [_{\text{Event}}\ \text{STAY (THING, PATH)}] \end{array} \right\}$

d. STATE $\rightarrow$ $\left\{ \begin{array}{l} [_{\text{State}}\ \text{BE (THING, PLACE)}] \\ [_{\text{State}}\ \text{ORIENT (THING, PATH)}] \\ [_{\text{State}}\ \text{EXTEND (THING, PATH)}] \end{array} \right\}$

Let me briefly explain these expressions. (3a) says that a conceptual constituent of the basic category Place can consist of a Place-function plus an argument of the category Thing. The argument serves as a spatial reference point, in terms of which the Place-function defines a region. For example, in the expression *under the table*, *the table* designates a reference object, and *under* expresses a Place-function that maps the table into the region beneath it. (3b) similarly shows how a Path, or trajectory, can consist of one of five functions that map a reference Thing or Place into a related trajectory. An example of a Path with a reference Thing is *to the house*; a Path with reference Place is *from under the table*, where the trajectory begins at the Place 'under the table'.

(3c) says that a constituent of the category Event can consist of either of the two Event-functions GO or STAY, each of which takes two arguments. The arguments of GO, which denotes motion along a path, are the Thing in motion (or Theme) and the Path it traverses. This structure is seen most transparently in a sentence like *Bill went to New York*, where the Theme is expressed as the subject and the Path as the PP. The arguments of STAY, which denotes stasis over a period of time, are the Thing standing still (again called Theme) and its Location, as seen in *Bill stayed in the kitchen*. (3d) gives three realizations of State. The first is used for specifying the location of objects (*the dog is in the park*), the second for specifying the orientation of objects (*the sign points toward New York*), and the third for specifying the extension of linear objects along a Path (*the road goes along the beach*). Beyond the functions in (3) that encode spatial relations, the system includes a family of basic causative functions (CAUSE, LET, HELP, and ENABLE), and a set of mereological functions that encode part–whole relations (PART-OF, BOUNDARY-OF, etc.), the latter developed in Chapter 5.

A founding insight of Conceptual Semantics (due to Gruber 1965) is that all of these functions can be applied to semantic fields other than physical space. For instance, an object's being owned by someone (a social relation) is often expressed crosslinguistically as the object 'being at' the owner, and changes of possession are often expressed as the object 'going' 'from' one owner 'to' another. This suggests that these conceptual functions can be decoupled from their physical context so as to apply to more abstract domains as well, such as time (*The meeting is at 6*), ascription of properties (*The light changed from red to green*), and (in the case of causation) social coercion (*Bill persuaded Alice to go*) and logical entailment (*P entails Q* = 'P causes Q to be true').[8]

Further functions that have been investigated (Jackendoff 2007b) involve the personal and social domains. They include theory-of-mind predicates (e.g. perception, belief, intention, and commitment to norms); value predicates in various domains (e.g. affective, utility, quality, moral); predicates of exchange (actions done in exchange, return, or retaliation for someone else's action); and the system encompassing obligations, rights, and authority.

In addition, of course, function-argument structure appears in the conceptual structure of relational nouns such as kinship terms and of argument-taking adjectives such as *proud of* and *angry at*.

[8] This insight is treated somewhat differently in Cognitive Grammar (Lakoff 1987), where it is taken to show that linguistic expression and thought are pervaded by an extensive and powerful system of conceptual metaphor.

There are two other means of conceptual combination besides function-argument structure. *Modifier-head* relations are exemplified by the relation between a place modifier and an NP or VP that it modifies: *a house in the woods*, *Pat visited Sue in Chicago*. This is notated in two different ways in the chapters in this volume:

(4) a. $\begin{bmatrix} \text{HOUSE} \\ \underset{\text{Thing}}{[_{\text{Place}}\ \text{IN}\ ([_{\text{Thing}}\ \text{WOODS}])]} \end{bmatrix}$

b. $[\ _{\text{Thing}}\ \text{HOUSE};\ [_{\text{Place}}\ \text{IN}\ ([_{\text{Thing}}\ \text{WOODS}])]]$

Other cases of modification include prenominal adjectives modifying NPs (*big house*); degree phrases modifying APs (*extremely noisy*); and manner, instrumental, and time adverbials modifying VPs (*run slowly*, *cut with a knife*, *come at 6:00*).

The third means of conceptual combination is binding. This is used to define a constituent in conceptual structure in terms of another, more fully fleshed out constituent, the antecedent. Two classic cases are the representations of reflexive pronouns and control. Binding is notated in terms of a Greek superscript on the antecedent and a corresponding Greek letter for the bound constituent, as in (5).

(5) a. Fred likes himself: $[_{\text{State}}\ \text{LIKE}\ ([_{\text{Person}}\ \text{FRED}]^{\alpha}, [_{\text{Person}}\ \alpha;\ \text{MALE SG}])]$
b. Al likes to swim: $[_{\text{State}}\ \text{LIKE}\ ([_{\text{Person}}\ \text{AL}]^{\alpha}, [_{\text{Event}}\ \text{SWIM}\ ([\alpha])])]$

Binding is also implicated in the conceptual structure of relative clauses, where the gap in the relative clause is bound to the head, so that the entire event described by the relative clause becomes a modifier of the noun (Culicover and Jackendoff 2005).

(6) the man who Sam saw:
$[_{\text{Person}}\ \text{MAN}^{\alpha};\ \text{DEF};\ [_{\text{Event}}\ \text{PAST}\ [_{\text{Event}}\ \text{SEE}\ ([\text{SAM}], [\alpha])]\ ]]$
'man α the (such that) Sam saw α'

One further important aspect of the Conceptual Semantics formalism needs to be mentioned. The type–token distinction is formalized as a simple binary feature TYPE vs. TOKEN, applied to concepts that are otherwise formally similar.[9] In this respect the theory differs from, e.g., predicate calculus, in which tokens are encoded as constants and types as predicates—formal

[9] An alternative formulation might treat TOKEN as a privative feature, so that tokens are CS constituents with the feature TOKEN and types are constituents lacking this feature. Still another alternative is that tokens are CS constituents linked to indices on the *referential tier* (see next paragraph), and types are constituents lacking such linkage.

expressions of entirely different sorts. Within the Conceptual Semantics formalism, three basic predication relations emerge as fundamentally similar:

(7) a. Token identity (e.g. *Clark Kent is Superman*)
[$_{\text{State}}$ IS-TOKEN-IDENTICAL-TO ([*x*; TOKEN], [*y*; TOKEN])]
b. Categorization (e.g. *Rover is a dog*)
[$_{\text{State}}$ IS-INSTANCE-OF ([*x*; TOKEN], [*y*; TYPE])]
c. Category inclusion (e.g. *A dog is an animal*)
[$_{\text{State}}$ IS-INCLUDED-IN ([*x*; TYPE], [*y*; TYPE])]

The similarity in form among these conceptual structures parallels their similarity in linguistic expression, namely *NP is NP*. Moreover, it is shown that the three functions, IS-TOKEN-IDENTICAL-TO, IS-AN-INSTANCE-OF, and IS-INCLUDED-IN, are at least closely related if not virtually identical—as revealed in the use of the same verb *be* to express all of them. (This treatment of predication is developed in detail in *S&C*, chapters 5 and 6.)

The structures described so far constitute only one of the tiers of conceptual structure—where *tier* is taken in exactly the same sense as in phonology: an independent subcomponent with its own primitives and principles of combination, linked to other subcomponents by interfaces. Orthogonal to the specification of who did what to whom, the content of a sentence is also partitioned into topic, focus, and common ground, so-called *information structure*. There is also some evidence pushing in the direction of a tier of *referential structure*, which encodes referential claims and referential relations such as specificity, opacity, and scope of quantification, to some degree independent of propositional organization. These aspects of meaning are not addressed in the chapters in the present volume; see *Foundations of Language*, chapter 12.

When one claims that conceptual structure can be described in terms of primitives and principles of combination, and in particular that lexical items can be conceptually decomposed into primitives, it is natural and proper to ask how one justifies proposed primitives. This question in turn falls into two parts. First, how does one tell in general whether one putative primitive is better than another? Of course, an isolated primitive can never be justified; a primitive makes sense only in the context of the overall system of primitives in which it is embedded. With this proviso, however, I think a particular choice of primitives should be justified on the grounds of its capacity for expressing generalizations and explaining the distribution of the data. That is, a proposed system of primitives should be subject to the usual scientific standards of evaluation.

The second part of the question of justifying primitives is: How does one tell whether the primitives one has proposed are *really* primitive? Often this question is raised with the insinuation that if one can't tell whether one is all the way

at the bottom, the enterprise is hopeless. My answer is that one probably *can't* tell, but that should not be a matter for worry. The decomposition of all substances into ninety-two primitive elements was a major breakthrough at the end of the nineteenth century. But over the course of the twentieth century these primitives in turn were further decomposed, first into electrons plus nucleus, then into electrons plus protons and neutrons, then the latter two of these into quarks, which in turn are combinations of more primitive features such as spin, color, up/down, etc. Each level of decomposition explained more about the nature of matter and raised new questions of its own; and each step was cause for excitement, not discouragement. We will see parts of a similar progression in Chapters 5 and 6, when the categories treated as primitive in *Semantics and Cognition* (and in (3)) undergo further decomposition in terms of a more explanatory set of primitives.

Among other things, it will develop that there are probably no *words* that directly express conceptual primitives; all words are composite. This should not be cause for alarm. In chemistry/physics, after all, none of the quarks (not to mention quark-features) appear in isolation. Closer to home, no phonological primitives appear in isolation either; one of the major points of Prague School phonology, preserved in the generative tradition, is that the phoneme is always divisible into features which themselves never occur in isolation.

1.4 The lexicon

In the Parallel Architecture, a well-formed sentence is a triplet consisting of well-formed phonological, syntactic, and conceptual structures, plus the links between them established by the interface components. For example, the sentence *Sue goes into the room* has the structure in (8); the subscripts denote parts of the three structures that correspond.

(8) a. *Phonological structure*:
$[_{\text{Utterance}}\ [_{\text{Wd}}\ \text{suw}]_1\ [_{\text{Wd}}\ \text{gow}_2\ [_{\text{Aff}}\ \text{-z}_3]\ ]_4\ [_{\text{Wd}}\ \text{intuw}]_5\ [_{\text{Wd}}\ [_{\text{Cl}}\ \text{ðə}_6]\ [_{\text{Wd}}\ \text{ruwm}]_7]_8\ ]_{10}$

b. *Syntactic structure*:
$[_{\text{S}}\ [_{\text{NP}}\ \text{N}_1]\ [_{\text{VP}}\ [_{\text{V}}\ \text{V}_2\text{+[pres+3sg]}_3\ ]_4\ [_{\text{PP}}\ \text{P}_5\ [_{\text{NP}}\ \text{Det}_6\ \text{N}_7\ ]_8\ ]_9\ ]]_{10}$

c. *Conceptual structure*:
$[_{\text{Event}}\ \text{PRES}_3\ [_{\text{Event}}\ \text{GO}_2\ ([_{\text{Person}}\ \text{SUE}_1],\ [_{\text{Path}}\ \text{INTO}_5\ ([_{\text{Thing}}\ \text{ROOM}_7\text{; DEF}_6]_8)]_9)]\ ]_{10}$

Let me unpack (8) by working through its conceptual structure. The entire Event (subscript 10) corresponds to the phonological utterance and the

syntactic S. This Event is set in a time frame (subscript 3) expressed by tense in syntax and pronounced as the affix *-z*. The Event is characterized by the Event-function GO; that is, this is an event of motion. This function is expressed by the verb and the sound /gow/ (subscript 2). The first argument of GO (subscript 1) corresponds to the subject in syntax, pronounced *Sue*. The second argument of GO (the Path, subscript 9), corresponds to the PP in syntax. This Path argument is composite: the Path function INTO, expressed by the preposition *into* (subscript 5), takes a Thing as its argument, expressed by an NP (subscript 8). The Thing in turn decomposes into the category ROOM, expressed by a noun pronounced /ruwm/ (subscript 7), and the feature of definiteness, corresponding to the determiner, pronounced /ðə/ (subscript 6).[10]

(8) encodes the standard thematic roles of Theme and Goal structurally. Theme, the thing in motion, is the conceptual structure constituent that serves as the first argument of GO; Goal, the point at which motion terminates, is the constituent that serves as the argument of TO or INTO. Thus [SUE] is Theme of (8) and [HOUSE] is Goal of (8). This is an essential feature of Conceptual Semantics: thematic roles are treated as structural positions in conceptual structure, not as an independent system of diacritics (or case-markers).

In order to see how (8) is put together from its parts, it is necessary to look at the lexical entries for the two words in (8) that have argument structure, namely *go* and *into*. In the entries in (9), the first line is the phonological structure; the second is the syntactic structure; the third is the conceptual structure. The co-subscripting indicates a long-term memory association between these structures. Thus each lexical entry can be though of as a small-scale interface rule; the semantic portion is the word's *lexical conceptual structure* (LCS).

(9) a. Phonology: gow_2
Syntax: $V_2\ PP_9$
Semantics: $[_{\text{Event}}\ \text{GO}_2\ (\ [_{Thing}\ x],\ [_{Path}\ y]_9)]$
b. Phonology: intuw_5
Syntax: $P_5\ NP_8$
Semantics: $[_{\text{Path}}\ \text{INTO}_5\ ([_{Thing}\ z]_8\ )]$

The items' contextual features are notated in italics in (9): subcategorization appears as part of syntactic structure, and selectional restriction as part of conceptual structure. These are interpreted as typed variables that must be

[10] Note that phonological information such as /suw/ is not notated as part of syntactic structure, as is customary. The notation in (8) reflects the division of labor between the three components. The fact that this person's name is pronounced *Sue* rather than *Wolfgang* or *Armadillo* is a fact of phonology, not syntax. The only thing that is significant for syntax is that this is a proper noun. The syntax is however linked to the pronunciation by the subscript.

instantiated in a well-formed sentence. *Into* requires an NP object that is coindexed with the argument position in conceptual structure. *Go* (in this context at least) requires two arguments, a Thing in motion and a Path that specifies the trajectory of motion. The first carries no subscript, as it is mapped into subject position by independent principles. The second argument is filled in with the reading of the PP following the verb.

It is sometimes useful to align the LCSs of the words so as to show each one's contribution to the overall conceptual structure of the sentence. (10) does this for sentence (8). The important part to see here is how the variables of one item are instantiated by other items.

(10)

$[_{Event}\ PRES_3\ [_{Event}\ GO_2\ ([_{Person}\ SUE_1], [_{Path}\ INTO\ ([_{Thing}\ ROOM_7; DEF_6]_8)]_9)]\ ]_{10}$

-s $[_{Event}\ PRES_3\ [\qquad\qquad]]$

go: $[_{Event}\ GO_2\ ([_{\mathit{Thing}}\ x\quad], [_{\mathit{Path}}\ y\qquad]_9)]$

Sue: $[_{Person} SUE_1\ ]$

into: $[_{Path}\ INTO\ ([_{\mathit{Thing}}\ z\qquad]_8)]_9$

the: DEF_6

room: $[_{Thing}\ ROOM_7\quad]$

A conceptual structure similar to (8c) can be expressed in different phonological and syntactic form, for example by a sentence like (11).

(11) Sue enters the room.

Here *enter* is an optionally transitive verb, with a lexical entry like (12).[11]

(12) Phonology: εntr_{11}
Syntax: $V_{11}\ (NP_{12})$
Semantics: $[_{Event}\ GO\ ([_{\mathit{Thing}}\ x], [_{Path}\ INTO\ ([_{\mathit{Thing}}\ y]_{12})]_{11}$

This verb incorporates into its meaning the conceptual material expressed separately by the preposition *into* in (8). It leaves the Goal as an open variable, which can be expressed by an NP object. However, this verb also allows the Goal to be left unspecified. The intransitive version, *Sue entered*, means not just 'Sue traversed some path,' but 'Sue went into something.' That is, the sense of *into* appears even when the second argument is unexpressed.

We can see from these examples that the Parallel Architecture treats the 'argument structure' or 'θ-grid' of a lexical item not as a separate level of lexical representation (as in Stowell 1981, Williams 1984, Higginbotham 1985,

[11] I slide over some tricks of subscripting involved here. See Jackendoff 2002, section 12.1.

Rappaport and Levin 1985, 1988, Grimshaw 1990, and many others), but simply as the collection of typed variables in the item's lexical structure. The structural positions of these variables in turn determine the θ-roles of the syntactic arguments in the sentence. Hence the process of 'θ-marking' amounts essentially to linking syntax to conceptual structure.[12]

Within this conception, then, a word is thought of not as a passive unit to be pushed around in a derivation, but as a part of the interface components. It is a long-term memory linkage of a piece of phonology, a piece of syntax, and a piece of semantics, stipulating that these three pieces can be correlated as part of a well-formed sentence.

In large part, this conception of lexical items can be adapted easily into a mainstream architecture (and I assumed such an integration for many years). However, a further issue can be raised about the nature of the lexicon. Three different criteria might be assumed as defining a lexical item:

(13) Lexical items are
  a. The words (and morphemes) of the language.
  b. The exceptional, idiosyncratic parts of the language that cannot be predicted by rule.
  c. The parts of language that are listed in long-term memory.

(13a) and (13b) are traditional views of the lexicon; (13c) is a more cognitively based definition. For a stereotypical lexical item such as *dog*, they coincide: *dog* is a word of English, not predictable by rule, and obviously stored in speakers' long-term memory.

However, in less stereotypical circumstance, the definitions diverge. The pronunciation, syntax, and meaning of the word *unhappy* are completely predictable from the word *happy* plus the regular principle for forming *un-*adjectives. Thus, although *unhappy* is a word of English and therefore satisfies (13a), it does not satisfy (13b); and its status vis-à-vis (13c) is an empirical question (my guess is yes for *unhappy*, though perhaps not for, say, *unprovocative*). For a different case, the idioms *kick the bucket* and *bite the dust* are not words or morphemes of the language, so they do not satisfy (13a). Their phonology and syntax are predictable from the phonology and syntax of the

[12] Even though syntactic and semantic argument structures are normally closely correlated, it is important to keep them distinct. There is a double dissociation between them. On one hand, as seen in (12), some semantic arguments need not be expressed syntactically. On the other hand, there are verbs with supernumerary syntactic arguments that add nothing to the semantics, such as the reflexive arguments of *perjure oneself*, *avail oneself of X*. Moreover, there are pairs of verbs that are essentially synonymous but realize their arguments in different syntactic configurations, e.g. *replace X with Y*, *substitute Y for X*.

constituent words, just like *throw the shovel* and *chew the gum*, but their (identical) meaning is not. So something must be present in the grammar to list their idiosyncrasy (13b), and this something must be stored in speakers' long-term memory (13c). Finally, clichés and fixed expressions such as *money can't buy me love* and *I don't care* satisfy neither (13a) nor (13b), as they consist of multiple words with their literal predictable meanings. Yet they do satisfy (13c): what makes them clichés is precisely that they are phrases everyone knows.

DiSciullo and Williams (1987) show there are important grammatical distinctions between words and morphemes on one hand and phrases on the other, a position that the Parallel Architecture adopts. However, they also assert that the issue of what is listed in long-term memory is 'of no interest to the grammarian'. In contrast, the Parallel Architecture takes this distinction to be crucial to defining the *lexicon*. That is, the notion of *word* and the notion of *lexical item* are not coextensive. This move leaves the way open for including in the lexicon all manner of units larger than single words, such as idioms and clichés. After all, they have to be listed *somewhere*. (Idioms are incorporated into the lexicon in my 1975 paper reproduced here as Chapter 2; clichés first appear in *The Architecture of the Language Faculty*.)

This approach further permits the lexicon to contain *meaningful constructions*—the stock-in-trade of Construction Grammar—such as the sound+motion construction illustrated in (14).

(14) The trolley squealed around the corner.
The bullet whistled by my ear.

The verbs themselves describe sound emission, and therefore do not license the path PPs as part of their semantic argument structure. Moreover, no word in the sentence expresses the understood motion of the subject. The meaning and syntax are instead provided by a construction that imposes an idiomatic interpretation on the VP and that takes both the verb and the PP as arguments. (15a) states its syntactic structure; (15b) states its semantics.

(15) a. Syntax: $[_{VP}\ V_1\ PP_2]$
b. Semantics: [GO ($[_{Thing}\ x]$, $[_{Path}\ y]_2$);
WHILE *[PRODUCE-SOUND*$_1$ *(*$[_{Thing}\ x]$*)]*]
'go PP while V[produce sound]-ing'

Construction (15) can be thought of as a lexical item, one that happens to lack phonology. It is however more 'rule-like' than words and idioms, because its syntax consists entirely of variables that must be filled by other items. VP constructions like this play a major role in the Parallel Architecture beginning in *Semantic Structures*, and are represented here by Chapters 7, 8, and 9.

In turn, regular VPs, idiomatic VPs, and sound+motion VPs are all instantiations of the more general piece of structure (16), which therefore can also be thought of as a lexical item, this time consisting only of syntactic variables.

(16) $[_{VP}\ V\ (NP)\ (PP)]$

A language may also contain constructions with irregular syntax, which Peter Culicover (1999) has termed 'syntactic nuts'.

(17) a. The more you eat, the worse you feel.
b. How about some lunch?
c. One more beer and I'm leaving.
d. day after day

These too can be formalized as lexical entries; Chapters 10–12 deal with three cases.

Finally, the formalism for lexical entries generalizes readily to regular affixes. For instance, the regular 3rd singular present tense verb affix can be written as (18).

(18) Phonology: $[_{Wd}\ [_{Wd}\ x]_2\ [_{Aff}\ \text{-z}]\ ]_1$
Syntax: $[_{V}\ V_2 + [\text{pres}+3\text{sg}]\ ]_1$
Semantics: $[_{Event/State}\ \text{PRES}_1\ [_{Event/State}\ y]_2]$

One consequence is that regular morphology is to be treated analytically (or declaratively) rather than procedurally. For instance, the English regular past tense is not a *rule* that says 'add *-d* to a verb to form its past tense'. Rather, the past tense is a lexical entry parallel to (18), which combines with verbs the same way transitive verbs combine with their direct objects, namely through the instantiation of a variable. In principle, this approach extends to all regular affixation; Chapter 11 deals with an intriguing regular reduplicative affix of English, illustrated in (19).

(19) I'll make the tuna salad, and you make the SALAD-salad.

Thus we arrive at the position (*Foundations of Language*, chapter 6) that words, idioms, rules of grammar, and regular affixes are all stated in a common format, namely as pieces of stored structure. This continuum between idiosyncrasy and regularity is a feature of Cognitive Grammar, HPSG, and Construction Grammar as well as the Parallel Architecture. Such a treatment goes strongly against the traditional assumption that a language can be partitioned cleanly into a lexicon and a grammar. Mainstream generative grammar has adopted this central assumption uncritically. However, open-minded examination of a fuller range of phenomena reveals instead that words are in one corner of a multidimensional continuum of stored structures, maximally general

rules are in another corner, and in between are all sorts of phenomena of varying degrees of regularity.

1.5 The syntax–semantics interface

As mentioned in section 1.1, mainstream generative grammar derives all semantic combinatoriality from syntactic combinatoriality. Following traditional grammar and philosophers of language such as Frege and Carnap, this approach takes it for granted that the syntax–semantics interface is essentially an isomorphism: phrase and sentence meanings are built up strictly from the meanings of their words, following the constituency dictated by syntactic structure. Culicover and Jackendoff 2005 call this assumption *interface uniformity*.

A consequence of this assumption is that syntax is forced to be at least as combinatorially complex as semantics—if not more so, since it also has to answer to its own internal imperatives such as word order and agreement. And indeed this consequence has been achieved twice in the history of generative grammar: in the Generative Semantics movement of the late 1960s and early 1970s (Lakoff 1971), and in Government-Binding Theory of the 1990s and the Minimalist Program. In both cases, the burgeoning complexity of derivations and the proliferation of hidden structure have been hailed as a great advance in understanding, but (in my judgement at least) rigorous empirical analysis and psychological plausibility have been sacrificed (for detailed discussion, see Culicover and Jackendoff 2005, chapters 2 and 3).[13]

In the Parallel Architecture, the combinatorial properties of meaning are not derived from syntax; they arise from autonomous conceptual combinatoriality. Syntax functions in the grammar not as the fundamental generative mechanism, but rather as an intermediate stage in the mapping between meaning and sound (in either direction). Part of the mapping is provided by the words, which are interface rules between small-scale pieces of meaning and sound. The remaining part of the mapping is the encoding of the semantic relations *among* the words: the function-argument, head-modifier, and binding relations. This is the role of syntax: it encodes the semantic relationships among the words in a sentence in terms that are visible to phonology, such as linear order, inflectional morphology, and anaphoric elements—as well as coding the overall semantic force of a clause, such as declarative vs. interrogative. But syntax need not encode any more of semantic structure than is necessary to map between phonology and meaning.

[13] The Minimalist Program often presents itself with a rhetorical façade of rigor (e.g. Chomsky 2000). On the other hand, when attacked for lack of precision, proponents typically protest that this is not a *theory*, it is only a *program*. You can't have it both ways.

In *Semantics and Cognition* (1983) I adopted a version of interface uniformity called the *Grammatical Constraint*, and used it to argue for conceptual structures that are more like syntactic structure than like quantificational logic. This canonical or default correspondence accounts for a vast range of facts about semantic compositionality, particularly in the domain of argument structure. However, by the time of *Semantic Structures* (1990), I had discovered numerous syntactic structures that did not map in canonical fashion into conceptual structure, and this paved the way for seeing the syntax–semantics interface as a 'dirty' correspondence, similar to the relation of phonology to syntax—hence providing stronger evidence for the Parallel Architecture.

Consider first the canonical mapping. Here the interface between CS and syntax preserves embedding relations among constituents:

- If a syntactic constituent *XP* expresses the CS constituent *X′*, and if another syntactic constituent *YP* expresses the CS constituent *Y′*, and if *XP* contains *YP*, then, as a rule, *X′* contains *Y′*.
- A verb (or other argument-taking item) in syntax corresponds to a function in CS, and the subject and object of the verb normally correspond to CS arguments of the function.
- Adjuncts in syntax normally correspond to modifiers in CS.

Hence much of the overall structure of syntax corresponds to CS structure. This can be seen in the correspondences illustrated in (8)–(12) above.

But even in the canonical mapping between syntax and CS, each representation has properties not shared by the other. Unlike syntax, CS has no notion of linear order. For instance, CS can be expressed syntactically in English, where the verb precedes the direct object, or in Japanese, where the verb follows the direct object. Furthermore, CS is indifferent to grammatical gender and grammatical case features (nominative/accusative), which are purely syntactic in character.

Conversely, there are aspects of CS to which syntax is indifferent. Most prominently, other than argument structure, much of the conceptual material bundled up inside a lexical item is invisible to syntax, just as phonological features are. As far as syntax is concerned, the meanings of *cat* and *dog* (which have no argument structure) are identical, as are the meanings of *eat* and *drink* (which have the same argument structure): the syntactic reflexes of lexical meaning differences are extremely coarse.[14]

[14] Taylor 1996 and Wierzbicka 2007 attack this position, on the grounds that if two words are syntactically indistinguishable, then every collocation involving these words is expected to be the same. But this confuses syntactic structure with idiosyncratic lexical behavior. For example, just

And even within the canonical mapping, it is characteristic for the syntax–semantics correspondence to be many-to-many. For instance, (20a,b) are noun complement constructions and (20c,d) are noun-noun compounds. But the semantic relationships cut across this pattern: in (20a,c) the head denotes a part of the dependent, and in (20b,d) the dependent denotes an ingredient of the head (see Chapters 5 and 13).

(20) a. leg of a chicken
b. house of stone
c. chicken leg
d. stone house

Under mainstream assumptions, the syntactic structure must reflect the semantics precisely; thus the superficially different (20a) and (20c) must be derived from a common underlying syntactic form, and the superficially parallel (20a) and (20b) must be derived from distinct syntactic forms. By contrast, the Parallel Architecture proposes that no hidden syntax is involved. Rather, English syntax offers complementation and compounding as alternative ways to combine words, and the syntax–semantics interface is flexible enough to map either meaning into either form.

Going beyond the canonical mapping, many constructions do not preserve relative embedding between syntax and semantics. A first case is the relation of tense to sentence meaning: in (8)–(10), for instance, the tense, one of the most deeply embedded elements in syntactic structure, expresses the outermost operator in the semantics. This has typically been mitigated in syntactic theory by making tense the uppermost underlying predicate in the sentence, then through a sequence of deformations attaching it to the verb. Such operations are typical of what proves necessary if interface uniformity is to be preserved.

Another case of mismatch is the sound+motion construction illustrated in (14)–(15) (*The bullet whistled by my ear*). The *semantic* head of the construction is the function GO, which appears nowhere in the syntax; and the *syntactic* head, the verb, corresponds to a manner modifier in semantics. This construction belongs to a larger class of constructions discussed in detail in Chapters 7–9.

Another syntax–semantics mismatch is illustrated in (21).

because *cat* and *dog* are syntactically identical does not mean that alongside the compound *hot dog* we should find **hot cat*; just because *cellar* and *basement* are synonymous (in my speech) does not imply that alongside *wine cellar* we should find **wine basement*; and just because *eat* and *drink* are syntactically identical does not imply that alongside the idioms *eat NP out of house and home* and *drink NP under the table* we should find **drink NP out of house and home* and **eat NP under the table*.

(21) that disaster of a theory (= 'that theory, which is a disaster')
a nightmare of a discussion (= 'a discussion that was a nightmare')
a hell of a guy (= 'a remarkable guy')

In these expressions, the *of*-complement functions as the semantic head: *that disaster of a theory* is referring to a particular theory, not a particular disaster. Conversely, the syntactic head functions semantically as a modifier: the theory is being incidentally characterized as disastrous. Thus this construction reverses the canonical correspondence of heads and complements (Asaka 2002, and for the cognate construction in Dutch, Booij 2002).[15]

The sound+motion construction illustrates another 'dirty' characteristic of the syntax–semantics interface: as noted a moment ago, the notion of motion, notated as GO is CS, is not expressed in syntax at all. Another example of unexpressed meaning, due to Talmy (1978a), is (22).

(22) The light flashed until dawn.

The interpretation of (22) contains the notion of repeated flashes. But this repetition is not coded in the verb *flash*, since *The light flashed* normally denotes only a single flash. Nor is it encoded in *until dawn*, since, for instance, *Bill slept until dawn* does not imply repeated acts of sleeping. Rather, the notion of repetition comes from the fact that (a) *until dawn* specifies the temporal bound of an otherwise unbounded process; (b) *the light flashed* is a point-event and therefore temporally bounded; (c) in order to make these compatible, a principle of *coercion* interprets the flashing as stretched out in time by repetition. This notion of repetition, then, appears in the CS of (22) but not in the LCS of any of its words. Chapters 5 and 6 (from 1991 and 1996 respectively) discuss this particular type of coercion ('aspectual coercion') in detail.

Another phenomenon with similar properties is *reference transfer* (Nunberg 1979, Fauconnier 1985):

(23) a. The ham sandwich over in the corner wants more coffee. (= 'guy with ham sandwich')
b. Plato is on the top shelf, next to Chomsky. (= 'book by/bust of Plato/Chomsky')

[15] Collins, Moody, and Postal 2008 discuss a construction of African-American Vernacular which appears to have the same property: *Bill's ass* can be used to mean 'Bill', and all its selectional properties correspond to the semantics. Collins et al., assuming interface uniformity, conclude that this construction is produced from a hitherto unattested underlying form by hitherto unattested principles of raising. The implausibility of their analysis reflects the difficulties of mainstream theory in microcosm. In a Parallel Architecture treatment, it is altogether parallel to *a hell of a guy* (a construction which they do not address).

Jackendoff 1992 (incorporated into Culicover and Jackendoff 2005) shows that these cannot be derived from a semantically transparent underlying syntactic form, yet they interact with grammatical phenomena such as binding, so they cannot be purely 'pragmatic', either.

Based on numerous phenomena of this sort, I concluded in *The Architecture of the Language Faculty* that the correspondence between syntax and CS is much like the correspondence between syntax and phonology. Certain parts of the two structures are in fairly regular correspondence, but many parts of each structure are invisible to the other, and there are numerous noncanonical correspondences as well. Thus the mainstream assumption of interface uniformity must be replaced with an approach in which simple 'Fregean' compositionality is still at the core of the syntax–semantics interface, but there are also numerous cases of 'enriched composition' that violate uniformity.

Another angle on the interface comes from considering crosslinguistic differences. Despite the fact that CS is universal, languages can have different strategies in how they typically bundle up conceptual elements into lexical items. For example, Talmy 1980 documents how English builds verbs of motion primarily by bundling up motion with accompanying manner, while Romance languages bundle up motion primarily with path of motion, and Atsugewi bundles up motion primarily with the type of object or substance undergoing motion. Levinson 1996 shows how the Guggu Yimithirr lexicon restricts the choice of spatial frames of reference to cardinal directions (see section 4.8). These strategies of lexical choice affect the overall grain of semantic notions available in the language.

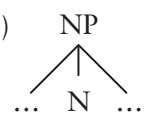
In addition, of course, there are differences in meaning among apparently synonymous lexical items across languages, such as the differences among prepositions discussed by Bowerman 1996. Moreover, each language has its own repertoire of special meaningful syntactic constructions such as those illustrated above in (15), (17), (19), and (21).

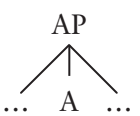
Languages also differ in what elements of conceptual structure they *require* the speaker to express in syntax. For example, French and Japanese require the speaker always to differentiate his or her social relation to the addressee, a factor largely absent from English. Finnish and Hungarian require the speaker to express the multiplicity (or repetition) of events, using iterative aspect, a factor absent from English, as seen in (22). On the other hand, English requires the speaker to express the multiplicity of objects by using the plural suffix, a requirement absent in Chinese. Again these differences suggest that the syntax–semantics interface is not a simple isomorphism.

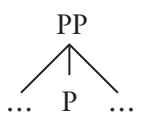
1.6. Simpler Syntax

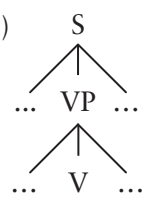
From this perspective emerges the basic stance of Simpler Syntax (Culicover and Jackendoff 2005). Semantic structure requires a certain degree of complexity in order to explain inference and the relation of language and thought to perception. Given that this complexity is independently necessary, it should play as large a role as possible in constraining the grammatical structure of sentences, and syntax should play as small a role as possible. Hence the theory should cut syntactic structure down to the bare minimum necessary to accomplish the sound–meaning mapping.[16] However, the theory must still acknowledge that the 'generative engines' of syntax and morphosyntax cannot be eliminated altogether: they are necessary to account for differences among languages in word order, case marking, agreement, handling of long-distance dependencies, and the existence of special constructions. The resulting syntactic theory is by no means simple, but it is far simpl*er* than mainstream models (whatever 'simple' means in this context).

A consequence of this stance is that syntactic structures can be kept relatively flat (i.e. undifferentiated). Aside from linear order, there is no *syntactic* distinction between specifiers, arguments, and adjuncts, as this is already provided for in the semantics. The result is X-bar skeleta for NP, AP, and PP with only two layers, as in (24a–c). The only exception to the two-layer schema is S, which is a three-layer projection of V, as in (24d).

(24) (a) 

(b) 

(c) 

(d) 

One price of this structural simplification is the need for trees with multiply branching nodes, rather than the strictly binary branching in contemporary mainstream structure. However, Culicover and Jackendoff 2005 argue that strictly binary branching is often not an advantage but a disadvantage. For instance, a putative advantage of strictly binary branching is that rules of grammar need not be sensitive to linear order, only to dominance. But from a larger perspective, linear order comes for free in the signal, and hierarchical

[16] This is thus a 'minimalist' approach to syntax, but with different premises from the Minimalist Program about what is to be minimized. See also Jackendoff 2008 for a discussion of how this approach represents an 'alternative minimalist vision'.

structure does not. So rules that depend in part on linear order actually should be easier for the child to learn. Hence the alleged advantage of strictly binary branching evaporates on closer inspection.

Simpler Syntax makes use of almost no empty nodes in syntactic structure. This is desirable in principle, because empty nodes make heavier demands both on the learner (who has to figure out where they are) and on processing (which also has to figure out where they are). Most empty nodes in the classical theory are posited either for semantic reasons or to promote syntactic uniformity. For instance, it is standard to posit a phonologically empty element PRO that serves as subject of an infinitival VP where there is none at the surface, thereby giving all verbs a syntactic subject. Simpler Syntax instead allows for infinitival VPs without syntactic subjects, and it uses the interface to identify their 'understood' subjects in Conceptual Structure. Return to the example *Al likes to swim* (5b), which illustrated the conceptual structure associated with control of missing subjects of infinitivals. The mapping to phonology and syntax can be encoded as in (25), with no empty subject in the syntax of the complement clause.

(25) Phonology: $æl_1$ $layk_2$-s_3 tuw_4 $swim_5$
Syntax: $[_S\ [_{NP}\ N]_1\ [_{VP}\ [_V\ V_2+[pres+3sg]_3]\ [_{VP}\ to_4\ \ V_5]\ ]]$
Conceptual structure:
$[_{State}\ PRES_3\ [_{State}\ LIKE_2\ ([_{Person}\ AL]_1{}^{\alpha}, [_{Event}\ SWIM_5\ ([\alpha])])]\ ]$

Likewise, ellipsis is not derived through empty nodes or deletion. Rather, elliptical configurations, especially when they are syntactically unusual (as in Gapping), are treated as meaningful constructions listed in the lexicon. The interpretation of an elliptical construction is derived from the conceptual structure of its antecedent—or from the conceptual structure of the context—not from a deleted syntactic structure. Culicover and I cite many cases of ellipsis for which there is no plausible syntactic antecedent, such as the underlined constituents in (26).

(26) a. It seems we stood and talked like this before. We looked at each other in the same way then. But I can't remember <u>where or when</u>. (= 'where or when we stood and talked like this before and looked at each other in the same way as we're looking at each other now') [Rodgers and Hart]
b. Something Alan said attracted Bea's attention—or vice versa—but I can't remember <u>which</u>. (= 'whether something Alan said attracted Bea's attention, or whether something Bea said attracted Alan's attention')
c. [Spoken to someone about to jump off a building] <u>*Don't!!!*</u> (= 'Don't jump!')

Similarly, constructional meaning, such as that of the sound+motion construction illustrated in (15), has no syntactic reflex. Nor do cases of coercion such as those in (22) and (23). Some of these constructions are treated in mainstream theory in terms of syntactic (or PF) deletion of unexpressed elements; others are not treated in mainstream theory at all. Culicover and I show that they are all best treated in terms of elements of semantics that have no syntactic realization.

Like other constraint-based theories such as HPSG and LFG, Simpler Syntax has no movement and no covert level of syntactic structure such as Logical Form. The effects ascribed to movement in mainstream theory are accounted for with a variety of mechanisms, most of them shared with other constraint-based theories, especially HPSG. These mechanisms include:

- Free phrase order (e.g. among adjuncts in VP, where the order is constrained only by prosody and focus)
- Alternative argument realizations (e.g. dative alternation)
- For long-distance dependencies, operator–trace relations along the lines of HPSG (where trace is the only kind of empty node in Simpler Syntax). The well-known constraints on long-distance dependencies arise from multiple sources, only some of which are syntactic. Others arise from processing complexity and from semantics.
- As illustrated above, binding and control are relations over Conceptual Structure, not over syntactic structure, though they may involve syntactic conditions on the relation between anaphoric elements and antecedents.

In order to account for so-called A-movements, in particular passive and raising, it is unfortunately necessary to introduce extra machinery. Simpler Syntax proposes a *grammatical function (GF-) tier* that modulates the syntactic realization of semantic arguments expressed as NPs, that is, subjects, objects, and indirect objects. We are not too dismayed by this extra mechanism, as the principles behind it appear in every substantive syntactic theory: as f-structure in LFG, as essentially *all* of Relational Grammar, as the complement hierarchy in HPSG, and as abstract case in GB/MP. Given that this tier plays no role in the analyses in the present volume, the reader is referred to Culicover and Jackendoff 2005 for motivation and details.

In a way, Simpler Syntax is a realization of the Interpretive Semantics of the late 1960s and early 1970s, developed as an alternative to Generative Semantics. Back then it looked as though the expressive power of the syntactic component could be considerably reduced through appropriate use of interface principles (then called 'projection rules'). But the theory could not be worked

out in detail, in large part because there was no independent characterization of semantics on which the interface could be anchored. The development of Conceptual Semantics over the intervening three decades—along with the field's deepened understanding of a wide range of phenomena—has made it possible to develop a rigorous theory of independent syntactic and semantic components and their connection.

1.7 The issue of semiproductivity

I also want to bring up an issue that is not directly related to the Parallel Architecture per se, but which does concern the structure of the lexicon. This issue is a theme running through the chapters in this volume (especially Chapters 2, 7, 8, 9, 12, and 13): the problem of semiproductivity.

The basic observation behind generative grammar is that language cannot consist simply of a list of memorized utterances: speakers can say and understand an unlimited number of things they've never heard before. Thus generative grammar has always concentrated on characterizing the productive rules of language. A stereotypical productive rule is the phrase structure of the English VP: one can learn new transitive verbs and compose them with novel direct objects and novel adjuncts without limit. Within morphology, a stereotypical productive rule is the English regular plural. This can be applied to new nouns one has never heard before, and there are no surprises. In fact, the classic illustration of speakers' knowledge of its productivity is the 'wugs test' (Berko 1958), in which 6-year-old children reliably produce plurals for nonsense nouns (and 4- and 5-year-old children do so somewhat less comprehensively). Another well-known productive rule is English expletive infixation (McCarthy 1982), which, if properly constrained prosodically, is perfectly reliable in licensing forms such as *manu-fuckin-facturer.*

In contrast, semiproductive phenomena have always evoked some embarrassment or avoidance in generative theory. Such phenomena display a regularity that can be stated as a rule. Nevertheless, acceptable instances of the rule must be learned individually. Often speakers have the intuition that a new form sounds unusual; they may observe that they have never heard it before, or they may find it amusing. A classic case of semiproductivity is the English irregular past tense with ablaut. Although one can state phonological conditions that are necessary for a verb to have an ablaut past tense, speakers must still learn which verbs undergo ablaut, and what the vowel changes to. For instance, alongside *sing-sang, ring-rang,* and *stink-stank*, we find that the phonologically similar *swing* has the past *swung*, the homophone of *ring* has *wring-wrung*, *stink* has

the alternate past form *stunk*, and *think* and *bring* fall into an entirely different family with *seek*, *fight*, *teach*, and *buy*. Evidently, then, the appropriate past tense form must be listed in the lexicon. Yet simple listing of the forms in the lexicon apparently precludes capturing the family resemblances among particular cases.

Two cases discussed in Chapter 2 are the English deverbal nouns such as *contribution*, *destruction*, *appraisal*, and *harassment*, and English denominal verbs such as *butter (the bread)*, *pocket (the money)*, *weed (the garden)*, ***de**-claw (the cat)*, *hammer (a nail)*, *father (a child)*, *mother (one's students)*, *waitress (in a restaurant)*, and so on. To some extent the forms are predictable; for example verbs ending in *-ate* invariably have a nominal in *-ation*. But not every case is predictable. *Recite* has the two nominals *recital* and *recitation*, with different meanings. The phonologically parallel *incite* has *incitement* rather than **incital* or **incitation*, and *excite* has *excitation* and *excitement* but not **excital*. Alongside *butter (the bread)*, we might expect to find **mustard (the bread)*, but we do not (except, if Google can be trusted, *very* rarely in the context of recipes); alongside *pocket the money* we might expect **envelope the letter* (where *envelop* means something rather different synchronically). As with the ablaut past tenses, the issue is how the grammar can both list the existing forms and capture the subregularities among them. An additional complication in these cases, which involve derivational morphology, is that the meanings of the existing forms are not entirely predictable either. For instance, a *recitation* is only vaguely related to *reciting*, and *excitation*, unlike *excite*, can pertain to electrons but not to people (this point goes back to Chomsky 1970). And despite the semantic similarity of the nouns *father* and *mother*, the corresponding verbs have radically different meanings.

Within a semiproductive pattern, moreover, there may be little pockets of true regularity. For instance, among the English denominal verbs, there is a subclass that means 'fasten with N', such as *nail*, *screw*, *tape*, and *glue*. This class seems altogether productive, in that the new fastener *velcro*, unlike *mustard*, occasions no hesitation in forming a related verb. There is no evident reason, morphological or semantic, for one of these classes to be productive and the other semiproductive.

Semiproductivity is not confined to morphology. Chapters 9 and 12 deal with two phrasal constructions that unexpectedly prove to be semiproductive: the English resultative construction with the structure V-NP-AP (e.g. *burn the pot black*) and the NPN construction (e.g. *day after day*). Similarly, Chapter 7 deals with the verb-particle construction, where, as is well known, there is productive use of particles as directional phrases (e.g. *send the letters out*), overlaid with a plethora of verb-particle idioms (e.g. *look the answer up*). In each of these cases,

as in derivational morphology, we find an interweaving of productive cases, semiproductive cases, and singleton idioms.

The overall issue, then, is how a grammar/lexicon encodes semiproductive phenomena, at once listing the instances and capturing the generalizations among them. Chapter 2, originally from 1975, develops a theory of *lexical redundancy rules* which is intended precisely to enable the grammar to express such generalizations. Some of the background of this approach—and its drawbacks—are discussed in the remarks preceding the chapter and in the commentaries interspersed throughout.

A decade later, the productive/semiproductive distinction reappeared as a focus of the 'past tense debate' between connectionists (Rumelhart and McClelland 1986) and Pinker and associates (e.g. Pinker and Prince 1988, Pinker 1999). The connectionists claimed that all items are listed, and the cases that we *call* productive are just more frequent. There are no rules per se in language; regularities are simply a result of analogical extension. Such an approach makes some sense for semiproductive phenomena: because we've never heard *mustard the bread*, we don't say it, but we still understand it by analogy with *butter the bread*. The approach makes less sense, however, for truly productive phenomena such as *wugs* or *Bachs* or *manu-fuckin-facturer*.

Pinker and his associates defend a mixed position. They agree with the connectionists and disagree with traditional generative grammar (e.g. Chomsky and Halle 1968) about semiproductive phenomena: there are no semiproductive rules, only networks of associations among listed items. However, they disagree with the connectionists and agree with traditional generative grammar about the status of productive phenomena: these are the product of derivational rules along the lines of 'To form plural nouns in English, add *-z*.'

Foundations of Language essentially adopts Pinker's position on the split between semiproductive and productive morphology. Items related semiproductively are taken to be stored in the lexicon and to be related only by association; but there is no separate statement of a *rule* per se that captures the regularity among them. On the other hand, productive phenomena are expressed by rules. Unlike Pinker's approach, though, rules are themselves taken to be lexical items. For instance, the regular third person singular present tense inflection in English is the lexical item encoded in (18) above: a phonological suffix *-z* that attaches to a word, linked to a morphosyntactic suffix *[3sg+pres]* that attaches to a verb stem, linked to the meaning *PRESENT* pertaining to a situation expressed by the verb.

On further reflection, though, the position that semiproductive phenomena are merely associative is suspicious. It implies, for instance, that the grammar

nowhere says explicitly that there is a V-NP-AP resultative construction or an NPN construction: there is only a collection of similar-looking idiomatic constructions, some of which are productive. Similarly, consider the situation in morphology. If there are no semiproductive rules, the grammar will also nowhere say that there is an affix *-al* for forming deverbal nouns: there is just a collection of deverbal nouns that happen to end in *-al*. And, considering a case discussed in section 2.5.1, the grammar will nowhere say that there is a semiproductive system for forming Latinate verbs such as *transfer*, *infer*, *confer*, *transmit*, *commit*, *transport*, *import*, *comport* that involves a specific family of prefixes and stems—there will just be a collection of phonologically associated verbs. All of these conclusions seem odd (at least to a linguist).

An alternative possibility is that the grammar *does* contain explicit semiproductive rules, but that there is some formal difference between them and productive rules. Let's ask what this formal difference might be. It cannot be anything about the *form* of the rule. For instance, the rule (or lexical item) that encodes V-NP-AP resultatives is of exactly the same general form as the completely productive rule (15) for the sound+motion construction. The only alternative that springs to mind is some diacritic feature on the rule, stipulating whether it is productive or semiproductive.

Some approaches (e.g. HPSG) arrange the lexicon in terms of inheritance hierarchies, so that related items inherit properties from more abstract items in a taxonomy. If the lexicon is arranged in terms of inheritance hierarchies, a semiproductive rule can be thought of as a node in the hierarchy whose daughters are all the instances. For instance, the rule for *-al* nominals will be an expression consisting of a variable followed by *-al*, and this expression will dominate all the known instances of *-al* nominals in the inheritance hierarchy. This expression would in essence say that there is an *-al* affix in English with certain stipulated properties.

Inheritance hierarchies are not confined to the linguistic lexicon. The literature on semantic memory for concepts has explored parallel notions in considerable detail—in particular, taxonomies with default values and exceptions (Raphael 1968, Smith and Medin 1981, Murphy 2002). Consider the taxonomy for, say, animals. One is familiar with a finite number of kinds of animals. Upon encountering a novel kind of animal, one may recognize it as an animal because of its similarity to animals one knows. But one also recognizes it as a *new* kind and stores it away as an instance of another member of the taxonomy.

If this parallel between lexical and conceptual taxonomies is genuine, it provides a solid argument against the position that there are no semiproductive

rules, only associations among instances. For this position would entail that, similarly, there is no category of *animal* in mental representation, and there are no categories of *cat* and *dog* and so on that are particular cases of animals—there are only various collections of individuals one happens to have experienced. In other words, the notion of semantic taxonomies would collapse entirely to the crudest sort of exemplar theory, a conclusion rather difficult to stomach. The argument, then, is that if there is a category of animals in mental representation, there should be no problem with specific semiproductive rules for forming *-al* nominals, V-NP-AP resultatives, NPN constructions, and so on. (And Pinker and I were wrong about semiproductivity.)

Suppose then that the proper way to think about semiproductive rules is as nodes in an inheritance hierarchy. Where do *productive* rules fit in? The problem is that they potentially have exactly the same form as semiproductive rules. They too are expressions consisting of some combination of variables and constants. What makes them productive is only that their instances cannot all be listed. But it is not that they have *no* listed instances. Experimental research has shown that even within productive phenomena, high-frequency derived instances may be stored (Baayen, Levelt, and Haveman 1993; Nooteboom, Weerman, and Wijnen 2002), and these would necessarily appear in an inheritance hierarchy. Moreover, since the learner has to induce the existence and form of a productive rule from heard and stored instances, a number of stored instances of such rules are likely to remain after acquisition, at least for some period of time.

A case for which experimental results are unnecessary is English compounding, discussed in Chapter 13. On one hand, we store thousands and thousands of compounds with specialized meanings, so the phenomenon is at least semiproductive. But on the other hand, we constantly encounter novel compounds, have no difficulty interpreting them, and do not notice them as unusual (unlike *mustard the bread*). So this is a productive rule that clearly also has huge numbers of listed instances.

Hence, apparently the only difference between a productive and a semiproductive rule is that productive rules license one to go beyond the listed instances without any special effort. This suggests that the formal distinction between the two sorts of rule is specifically localized in a diacritic on the variable: those in productive rules are marked [+productive] and those in semiproductive rules are not. This is still less of a difference than before. Is this a Good Thing or a Bad Thing? I hope it's a Good Thing, because that's where the facts seem to take us.

A child acquiring a language has to pick out the regularities in the input and construct rules. But how does the child discover whether a particular regularity

is productive or semiproductive? It's not given in the data. How is it that everyone comes up with essentially the same answer? I find this a serious puzzle for linguistic theory.

In morphology, sometimes there is competition between regularities, for instance between regular past tense, ablaut, zero marking, and the tiny family of verbs whose past ends in *-ought*. Presumably only one of these can be the regular default, so the others must be admitted as semiproductive. But on the other hand, there isn't always a competing form. For instance, zero denominal verbs such as *butter* are not in competition with anything.

One might guess that productive phenomena are more frequent in the data than semiproductive phenomena. For instance, this is presumably a clue that the *-ed* past is the regular form. But this can't always be the case. Consider the morphological form illustrated in (27).

(27) (all) X-ed out = 'exhausted from experiencing X to excess'
I'm Olympic'd out. [recorded in conversation with someone who worked at the Olympics]
You must be entertained out. [recorded in conversation after weeks of guests]
He's all knitted out. [after knitting for three days solid]
I'm Edward G. Robinsoned out. [after watching an Edward G. Robinson marathon]

This morphological form, mentioned again in section 7.7, is completely productive, with either nouns or verbs in the variable position. Yet it is exceedingly infrequent—I would guess one hears it perhaps three times a year in conversation. How do language learners come to the conclusion that it is productive on the basis of so little evidence?

It is plausible that children observing a regularity initially encode it as semiproductive, and later, if evidence warrants, upgrade it to productive. This would comport with the evidence that on the whole children are cautious about extending generalizations to new items (Tomasello 2003), yet they do eventually 'go productive'. On the other hand, children are known to overgeneralize semiproductive processes (e.g. Bowerman's example *Mommy, giggle me*, overgeneralizing the English causative), so it is not clear that there is a uniform one-way move from semiproductive to productive.

Ideally, we would like an account in which children do not have to 'decide' whether a phenomenon is productive or not. Rather, we would hope that the course of acquisition would follow from the distribution of the data in speech and independent properties of how the brain learns.

The material presented in this volume (Chapters 2, 7, 8, 9, 12, and 13) does not solve these problems, it only makes them more pointed. Insofar as semi-productivity is an issue not only for phonology and morphology but also syntax, in my opinion it must take a place as one of the central issues of linguistic theory for the coming years.