EDITED BY

GILLIAN RAMCHAND

CHARLES REISS

The Oxford Handbook *of* LINGUISTIC INTERFACES

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Contents

Abbreviations

A	Agent
Abl	ablative case
ABS	absolutive case
ACC	accusative case
ACT	active
Agr, AGR	agreement
AgrP	Agreement Phrase
AI	animate intransitive
ANIM	animate
ANT	anterior
AOR	aorist
APASS	anti-passive
Asp	aspect
AspP	Aspect Phrase
ATB	across the board
ATR	advanced tongue root
AUX	auxiliary
C	Complementizer
CAUS	causative
CCA	cross-clausal agreement
CCG	Combinatory Categorial Grammar
CFG	Context-Free Grammar
CG	Categorial Grammar; clitic group
CI	conventional implicature
COMPL	completive
COND	conditional
CONJ	conjunct
CONT	continuative
COP	copula
CP	Complementizer Phrase
CT	Contrastive Topic
DAT	dative case
DECL	declarative
DEF	definite
DET	determiner
DIST	distal
DM	Distributed Morphology
DP	Determiner Phrase
DRT	Direct Reference Theory
DU	dual
DUB	dubitative
EBA	End-Based Approach
ECM	exceptional case-marking
EMPH	emphasis
EP	Event Phrase
EPDA	embedded push-down automaton
EPP	Extended Projection Principle
ERG	ergative case
ERH	Expletive Replacement Hypothesis
EVID	evidential
EX	exclusive
EXPL	expletive
F	focus
FEM, fem	feminine
FOC	focus
Ft	foot
FUT	future
GB	Government and Binding
Gen	genitive case
GPSG	Generalized Phrase-Structure Grammar
HAB	habitual
HP	high plateauing
HPSG	Head-Driven Phrase-Structure Grammar

ILL	illative case	PF	Phonetic/Phonological Form
IMPERS	impersonal	PFM	Paradigm Function Morphology
IMPF	imperfective	PhP	Phonological Phrase
INESS	inessive case	PHT	Prosodic Hierarchy Theory
INF	infinitive	PL	plural
INSTR	instrumental case	POSS	possessive
IntP	Intonational Phrase	POT	potential
INV	inverse	POV	point of view
IP	Inflection Phrase	PPC	past participle
IPP	*infinitivus pro participio*	PRES	present
IRR	irrealis	PROG	progressive
IS	Information Structure	PSBM	Paradigmatic Sign-Based Morphology
LCA	Linear Correspondence Axiom	PST	past tense
LF	Logical Form	PTC	particle
LFG	Lexical–Functional Grammar	PURP	purposive case
LGB	*Lectures on Government and Binding*	PWd	prosodic word
LIG	Linear Indexed Grammar	QUD	question under discussion
LMT	Lexical Mapping Theory	RBA	Relation-Based Approach
Loc	locative case	REAL	realis
masc	masculine	REFL	reflexive
MIR	Minimal Indirect Reference	REL	relative
MP	Minimalist Program	REM	remote
MS	Morphological Structure	RFX	reflexive
MWP	Maximum Word Hypothesis	RS	*raddoppiamento sintattico*
NA	nominal appositive	SBM	Sign-Based Morphology
Neg, NEG	negation, negative	SG	singular
neut	neuter	SMT	Strong Minimalist Thesis
NPA	nuclear pitch accent	SOC	sociative
NUM	number	*SPE*	*The Sound Patterns of English*
OBV	obviative	SR	Surface Representation
OT	Optimality Theory	Syl	syllable
PA	pitch accent	T	Tense
PART	partitive case	TAG	Tree-Adjoining Grammar
PASS	passive	TERM	terminative
PAST	past tense	TG	Transformational Grammar
PCI	Principle of Categorial Invisibility of Function Words	TH	Theme
PDA	push-down automaton	TI	transitive inanimate
PERF	perfective	Tns, TNS	tense
PERS	person	Top	topic
		TopP	Topic Phrase
		TP	Tense Phrase

TR	transitive	Voc	vocative case
U	Utterance	*v*P	small verb phrase
UG	Universal Grammar	VP	Verb Phrase
UR	underlying representation	VR	vowel raising
V	verb	VS	vowel shortening
VA	vowel assimilation	WCO	weak crossover

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INTRODUCTION

GILLIAN RAMCHAND AND
CHARLES REISS

In the Introduction to *Syntactic Structures*, Chomsky (1957: 11) states that the "central notion in linguistic theory is that of 'linguistic level'... such as phonemics, morphology, phrase structure... essentially a set of descriptive devices that are made available for the construction of grammars." The term "grammar" is used here in the usual ambiguous fashion to refer to both the object of study and the linguist's model of that object. Thus, in chapter 3 (p.18), Chomsky comes back to the issue of levels referring, both to the complexity of languages and the usefulness of theoretical descriptions.

> A language is an enormously involved system, and it is quite obvious that any attempt to present directly the set of grammatical phoneme sequences would lead to a grammar so complex that it would be practically useless. For this reason (among others), linguistic description proceeds in terms of a system of "levels of representations". Instead of stating the phonemic structure of sentences directly, the linguist sets up such "higher level" elements as morphemes, and states separately the morphemic structure of sentences and the phonemic structure of morphemes. It can easily be seen that the joint description of these two levels will be much simpler than a direct description of the phonemic structure of sentences.

In current parlance, we say that knowledge of language is *modular*, and individual linguists tend to specialize in research on a particular module—syntax, morphology, semantics, or phonology. Of course, the very existence of each module and the boundaries and interfaces between the modules remain issues of controversy.

For many years the dominant model of the the architecture of the language faculty, including the relationship among modules, has been the Chomskian T-model dating from the 1960s. However, linguistic theory has been undergoing important changes over the last ten years. Recent work has succeeded both in deepening the theoretical issues and expanding the empirical domain of the object of inquiry. While the D-structure and S-structure levels are no longer universally accepted as useful levels of representation, the nature of PF, the interface of the grammar module(s) with the auditory-perceptual system, and LF, the interface of the grammar with the conceptual-intentional system, have increased in theoretical importance. The recent empirical and theoretical challenges to the dominant T-model have in many cases undermined the presuppositions underlying that basic architecture and have reopened many important questions concerning the interactions between components of the grammar.

One striking discovery that has emerged from recent work is the importance of the various interfaces between modules *within* the grammar in understanding the nature of the language faculty. Indeed, one could argue that in understanding the interfaces between syntax and semantics, semantics and pragmatics, phonetics and phonology, or even syntax and phonology, we place boundary conditions on the scope and architecture of the theory as a whole. It is not surprising then that some of the most intellectually engaging and challenging research in recent years has emerged precisely at these interfaces.

In commissioning the chapters for this volume, we have deliberately adopted a narrow interpretation of the term "interfaces" as referring to the informational connections and communication among putative modules within the grammar. The term "interface" can of course legitimately be applied to the connections between the language faculty and other aspects of cognition (e.g. vision, reasoning) or between linguistics and other disciplines (e.g. philosophy, psychology). Our choice of scope here reflects our belief that the narrower interpretation of "interface" allows us to focus on the most crucial issue facing generative linguistics—the internal structure of the language faculty—which we believe should be prior to consideration of how this faculty interacts with others. In other words, our decision reflects not only a practical choice based on current research trends but also the logical priority of defining the elements of comparison (say, language and vision) before undertaking such comparison.

The chapters in the book are original contributions by authors who have been working on specific empirical problems and issues in areas that cross-cut traditional domains of grammar. In some cases the authors address a particular debate that is ongoing in the field; in others, their aim is to throw light on an empirical area that has proved challenging for the modular view in general or in which the choice of analytic tools is still open. In some ways, this is a handbook with a difference because there is no prejudged territory to cover, and no obvious partitioning of our researchers' concerns into neat components (by definition). Our purpose here in the introduction, therefore, is to provide something of a road map for the users of this book, and to integrate the questions each author addresses into the larger debates of the field.

Part I Sound

Though he presents several possibilities found in the literature both for a strict demarcation of phonetics and phonology and also for no demarcation at all, **Scobbie** himself favours a less categorical view of the matter. He suggests that the problems faced by researchers in categorizing low-level but language-specific phenomena into phonetics or phonology, in defining clear-cut modules and their interface, reflect the nature of the phenomena themselves: the very existence of an ambiguous no-man's-land between phonetics and phonology may reflect (and be reflected by) the non-deterministic mental representations in the systems of individual speakers. Scobbie thus argues for a more flexible quasi-modular architecture, best modelled, he claims, stochastically. He points out that descriptive data based on transcription is biased in necessarily assuming traditional categorical and modular interpretations. Quantitative continuous data, he suggests, could provide new evidence for meaningful debate on the nature of the interface.

In addition to providing a useful survey of issues related to phonetics and phonology from a wide range of approaches, including generative phonology, articulatory phonology, exemplar theory, and others, Scobbie forces us to recognize that many common and intersecting assumptions concerning phonological representation and computation are rarely justified explicitly, even for the analysis of familiar data from languages as well studied as English.

In a chapter diametrically opposed to Scobbie's theoretical ecumenicism and desire to blur the phonetics–phonology boundary, **Reiss** defines a number of modules composing what are typically referred to as phonetics and phonology. He assumes that these modules are informationally encapsulated from each other, and defines the "*i*–*j* interface" as a situation in which the outputs of one module M_i serve as the inputs to another module M_j. His claim is that the problem of understanding the *i*–*j* interface reduces to identification of those outputs of module M_i which M_j receives. Reiss provides a speculative discussion about how results in auditory perception can aid our understanding of phonology. His general point is that by better understanding what phonology is not, we can understand better what phonology is: we will then not mistakenly attribute a property to the phonology that rightly belongs elsewhere. This issue is related to a general discussion of the purview of Universal Grammar and the relationship between our sources of data and the theories we construct.

Hale and Kissock use the Marshallese vowel system, which underlyingly has four distinct members, to explore the phonetics–phonology interface from an acquisition perspective. On the surface, these four vowels show wide variation, depending on the features of flanking consonants. Hale and Kissock discuss the difficulties that such a system poses for phonetically grounded versions of Optimality Theory. They also claim that acquisition of such a system would require, under OT assumptions, that markedness constraints be low-ranked at the initial state of the grammar. This claim, which contradicts all work on acquisition in OT, except for earlier work of Hale, leads to a general critique of various aspects of the OT framework including Richness of the Base and "the emergence of the unmarked" in child language.

Orgun and Dolbey discuss the morphology–phonology interface in the context of a theory of Sign-Based Morpology. In this framework, the grammar consists of lexical items and sets of relations among them. For example, the grammar lists both singular *book* and plural *books*, and there is a relation that maps these items to each other. In order to address the issue of apparent cyclicity and over- and underapplication of phonological processes in morphologically complex words, the authors develop a specific version of Sign-Based Morphology which treats paradigms as elements of the theory, paradigmatic sign-based morphology (PSBM). The authors present solutions for a number of puzzling phonology–morphology interactions in Turkic and Bantu languages by embedding their PSBM within an OT grammar, which allows them to invoke the type of output–output correspondence and uniform exponence constraints found elsewhere in the OT literature.

Elordieta surveys various models of the phonology–syntax interface of the past twenty years, all of them fairly closely related to the Government and Binding and the Minimalist versions of syntactic theory. This chapter is explicit about the shortcomings of its predecessors each new model was most concerned to address. It concludes with Elordieta's analysis of a vowel-assimilation pattern in Basque which he analyses as reflecting the syntactic and phonological closeness of elements entering into feature chains consisting of feature checking relations. The process in question occurs in nominal contexts between a noun and a following determiner or case marker, and in verbal contexts between a verb and a following inflected auxiliary. The point of the analysis is to show that these two contexts form a natural class under a certain version of Minimalist checking theory. This contribution leads naturally into the second part of the book, in which researchers in the area of non-phonological structure grapple with problems and issues from a syntactic perspective.

PART II STRUCTURE

The existence of a syntactic component of grammar, encoding hierarchical structural relations, does not seem to be in any doubt within the field of generative grammar. However, questions arise as to the nature of the relational and transformational mechanisms involved (if any), and how far they should extend into domains like morphology and the lexicon. An important portion of this book is devoted to the question of whether morphology follows the same rules as syntax, closely related to the issue of whether the lexicon exists as a distinct module of grammar with its own primitives and modes of combination.

In her contribution, **Rosen** adopts a syntactic perspective on issues traditionally considered within the domain of lexical semantics and argument structure. She proposes a close connection between argument roles and the syntactic projections that are responsible for case, agreement, and notions like grammatical subject. However, she suggests that languages can systematically differ in whether they use a lower domain of functional projections for argument licensing (ones like *v*P and TP that are correlated with the well-known phenomena of nominative and accusative case), or whether they choose higher functional projections (those within the CP domain). In the former languages, arguments are classified on the basis of their effect on the event structure (specifically, initiation and telicity), while in the latter case the arguments are classified along more discourse driven lines (topic-hood, point of view). Rosen offers a survey of the different languages of each type and the syntactic properties that distinguish the behaviour of their arguments. The claim here is that the supposedly semantic and thematic differences among arguments and their modes of organization are actually tied to syntax and the functional projections that are active, and do not belong to some separate semantic module of grammar.

Julien then presents a view of the syntax–morphology interface, arguing that the notion of word is an epiphenomenon, based on the specifics of syntactic structure combined with the possibility of certain morphemic collocations to assume a distributional reality. She suggests that items traditionally considered to correspond to "word" actually derive from many possible distinct syntactic head configurations (head–head, head–specifier of complement, and specifier–head in the basic cases) where movements and lexical access conspire to create linear adjacency and distributional coherence. Drawing on evidence from a variety of languages, she shows that constraints on syntactic structure, and specifically the functional sequence, can explain the patterns and non-patterns of so-called word-formation across languages, without invoking morphology-specific modes of combination. In this sense, Julien is arguing for a strongly syntactic approach to morphology and against a lexicalist view of the notion of "word".

Svenonius approaches the same interface with a rather different set of theoretical tools in mind, and a different set of ordering data. He observes that, when elements ordered in a logical hierarchy appear in natural languages, some cross-linguistically robust patterns of linear ordering emerge at the expense of others. Rather than reflecting a simple syntactic head parameter, these generalizations, he shows, are more insightfully described by different sorts of phrasal movement—roll-up, curl, and constituent fronting. Strikingly, he reveals that in a parallel fashion, morpheme ordering conforms to many of the very same patterns and generalizations as are found in the syntactic domain. The argument here is thus not only that morphology operates on the same sorts of hierarchically ordered structures and primitives as syntax, but that it also participates in the very same sorts of transformations that affect word-word linearization.

Embick and Noyer present a Distributed Morphology view of the relation between morphology and syntax which shares some important properties with Julien's. In particular, they argue that the notion of "word" does not correspond to any genuine linguistic primitives and that the morphological patterns of vocabulary insertion are a direct reflection of syntactic structure. They position themselves strongly against what they call the "lexicalist" camp and deny that there is an independent lexical module with its own primitives and modes of combination. For them, the only generative component is the syntax, and they argue that this is the null, most "minimal" hypothesis. However, they differ from Julien in assuming that "words" are inserted at syntactic terminals, and therefore only countenance a subset of the syntactic configurations (basically just complex heads formed by head–head adjunction) that Julien allows to give rise to "word-like" (distributionally privileged) sequences. This more restrictive mapping from the syntax to insertion forces them to admit a larger set of counter-examples to the straightforward mapping between the two domains. Thus, in their system, they have a number of post-Spell-Out operations that can modify the syntactic representation prior to vocabulary insertion, as well as phonological rules that can change linear ordering. Embick and Noyer claim that these operations are only minimal departures from the strong hypothesis that syntactic structure is responsible for morphological patterns, and that these rules are learned on a language by language basis. However, the large number and the power of these operations raises the question of whether they are not in fact covertly constructing, perhaps not a lexical, but certainly a morphological component.

Ackema and Neeleman argue for keeping the domains of morphology and syntax distinct, but within the larger domain of the syntactic module. They argue that "morphology" is actually "Word syntax", whereas what is traditionally called syntax is actually just a submodule concerned with "Phrasal syntax". While both submodules share some primitives inherited by the fact that they are both a type of syntax (e.g. category labels, merge, c-command, argument), they also each have more specialized operations and primitives that make them distinct. For example, phrasal syntax makes reference to notions such as EPP and wh-movement; word syntax must make reference to features such as "latinate" vs. "germanic" or features that encode declension class membership. They present evidence in their chapter that the two types of syntax are indeed autonomous and that they do not interact with each other directly, and that it would complicate the notions required in phrasal syntax if one were to attempt to do so. In cases where it seems direct interaction might be necessary, they present analyses to argue that the effects derive instead from the interaction between the syntactic module as a whole with the phonological module of grammar, that is, the correspondence principles required between the two macromodules.

This leads naturally to the chapter by **Williams**, who takes a position similar to that of Ackema and Neeleman despite some superficial differences in terminology. Williams argues that the syntax of the word is distinct and informationally encapsulated from the syntax of phrases and that this is responsible for a series of basic and robust effects. He agrees that both levels are in some sense syntactic and that they share some basic properties in that they are combinatoric and are sensitive to some of the same features. However, they differ in that the word-level does not tolerate "delayed resolution" of certain relations such as argument relations or anaphoric dependency. Williams uses the term "lexical" to refer to the word-level but, like Ackema and Neeleman, is careful to distinguish it from the notion of "listeme", which clearly cross-cuts the word and phrasal domains. Again like Ackema and Neeleman, he argues that the confusion in the use of the term "lexicon" has been responsible for some of the general confusion in the debate, most particularly in the criticism of lexicalism by the proponents of Distributed Morphology. The second half of Williams's chapter is a careful criticism of the assumptions and analyses of a particular version of the DM view, showing that they cannot actually avoid the distinction between word-level and phrase-level syntax that he takes as primitive.

Stewart and Stump argue for a particular version of a realizational-inferential view of morphology, which they call Paradigm Function Morphology (PFM). The crucial aspects of this position involve the idea that the interface between morphology and syntax is "word-based" rather than "morpheme-based" and that external syntax is blind to the internal morphological structure of a word. They present analyses of important and pervasive properties of natural language morphological systems which can be straightforwardly described by a system of rules which, in a language-specific way, map roots and an associated bundle of morphosyntactic features to phonological forms. In this system, there is no internal "syntactic" structuring to the morphosyntactic features, although there is some structural complexity in the way in which reference to paradigms is exploited to express systematic generalizations about the way in which which certain feature clusters or rule blocks interact in a particular language. They contrast their perspective with that of Distributed Morphology which, although also "realizational", is fundamentally morpheme-based, and argue that the word-based view is empirically better motivated and conceptually preferable in being more restrictive. For Stewart and Stump, mirror principle effects, or effects that seem to correlate with syntactic generalizations, are epiphenomenal and derive from historical grammaticalization paths; they should not be built into the theory of the synchronic system which inserts words as unanalysed wholes into the syntactic derivation. Thus, the view presented in this chapter also contrasts generally with the more syntactic approaches to word formation as found in most radical form in the contributions by Julien and Svenonius, and is an important counterpoint to them.

Part III Meaning

One of the important issues at the syntax–semantics interface concerns the notion of compositionality. **Higginbotham**, in his contribution, argues forcefully that this is not a conceptual triviality, but an empirical working hypothesis which should be used to probe important questions about the syntax–semantics interface in natural language. In particular, if it is taken as a constraint which imposes function-argument application as the only semantic mode of combination for syntactic merge at the same time as allowing a *n*-ordered logic of indefinitely large *n*, then the principle itself reduces to vacuity. On the other hand, if it is construed as a hypothesis that restricts the composition of semantic values to be genuinely local within a conservative second-order logic, then it has some bite. Higginbotham emphasizes that the syntax–semantics interface problem is essentially one in three unknowns: the nature of the meanings involved, as known by a native speaker of the language; the nature of the syntactic inputs to interpretation; and the nature of the mapping between the two. Actual natural-language examples may require adjustments in any of these three areas, keeping strong compositionality as a background assumption. Higginbotham also assumes that there is a principled distinction between the semantics of lexical items and the "combinatorial semantics" of natural languages, only the latter being subject to the compositionality thesis. He takes a fairly conservative position on the size of those lexical items, eschewing the finer syntactic decompositions of lexical items such as those found in some recent theoretical work (see, for example, Rosen, this volume). On the other hand, his main theoretical point concerning the status of the compositionality thesis holds even if one believes that "lexical items" (in the sense of listed elements) are somewhat smaller than he assumes.

Büring examines an issue that directly concerns the phonological "component", namely, intonation. This important area is a domain where phonological/intonational and semantic/informational structural information seem to be most directly correlated. Do we need to forge a direct connection, or are the relationships more subtle? Büring proposes an account whereby a single syntactic representation, which contains formal features such as F (focus), and CT (contrastive topic), is seen by both the phonological and interpretational modules of the grammar. He argues that there is no need for a level of information-structure representation per se, and further that there are formal syntactic features that have predictable effects at the interpretational interface. For Büring, these effects are discoursal and not directly truth conditional in nature, although they can be modelled in terms of an update function from context to context. Focus is marked according to lack of "givenness" in the sense of Schwarzschild (1999), but is also affected by general principles relating to Question–Answer Congruence (QAC). The phonological interface operates with an entirely different vocabulary, and interprets the formal features as constraints on the placing of pitch accent, nuclear pitch accent, and intonational tunes within the context of a general prosodic implementation involving both specific rules and defaults. Büring finally considers the effect of information structure on constituent order in various languages. Here he suggests that some movements are clearly triggered by prosodic constraints. He discusses the implications of this for a derivational view of syntax: such a view would either have to embody "anticipatory" movements, or allow optional movements while filtering out ill-formed derivations at the interface under a matching condition. The latter system would be equivalent to a direct non-derivational mapping between prosodic and syntactic structure, and would raise the issue of whether a derivational view of the syntactic component gives the most natural modelling of the relation between syntax and prosody.

Potts takes the old definition of conventional implicatures from its Gricean source and argues that, far from being a class of meanings with no coherent identity, it singles out a distinct and pervasive phenomenon in natural language. He shows that the class of meanings does exist which is at once (a) linguistically driven, (b) non-defeasible, and (c) independent of the main assertive content ("at-issue" content) of the sentence. This turns out to be the class of appositive, speaker-oriented meanings with its own particular syntactic and semantic properties. He first shows that these meanings must be distinguished from presuppositions (with which the old class of conventional implicatures has often been wrongly conflated), conversational implicatures, and at-issue content. He then argues that, given the parallel contribution of these items to the at-issue content (despite their syntactic integration), there are two obvious ways to create a compositional analysis of their systematic contribution to meaning: assume non-standard syntactic structures with a non-standard syntax–semantics mapping; or use a standard tree architecture within a radical multidimensional semantics. Potts argues that the former route is both theoretically undesirable and empirically problematic and develops the latter as an elegant formal solution to the problem. The impact of this class of meanings and their solution drastically alters our view of the structure of meaning representations: the multi-dimensionality it embraces has implications for the syntax–semantics interface and the relationship between semantics and pragmatics.

Beaver and Zeevat take on the complex and intricate problem of accommodation, which sits right at the interface between semantics and pragmatics. Since Lewis (1979) accommodation has been understood as the process by which speakers "repair" presupposition failures to achieve felicity in discourse, and as such it has been closely tied up with the research on presupposition. As with presupposition, the phenomena treated here extend the question of the various roles of syntax, information structure, discourse representation, and conversational principles in accounting for the ways in which speakers negotiate meanings. Presupposition triggers come both from open-class lexical items (such as verbs like *stop* and *realize*), functional items such as determiners, and even certain constructions (such as clefts). Beaver and Zeevat argue that the complex process of accommodation is not a mere pragmatic accessory, but is "at the heart of modern presupposition theory" and not distinct from the problem of presupposition projection. Like the latter, it seems to be sensitive to syntactic domains and/or levels in discourse representation structure. The specific location and nature of accommodation also seems to be guided by conversational implicatures, information structure, and specific contextual information, although the debate continues about the centrality of these different influences. A further intriguing problem for a systematic and unified treatment of the phenomenon of accommodation lies in the fact that certain presuppositional elements such as *too*, definite determiners, and pronominals, seem to require discourse antecedents explicitly and cannot be "saved" by post hoc accommodation of referents. An important question raised for language is not only why there should be linguistic items that trigger presuppositions in the first place, but also why such differences between them in terms of possibility of accommodation should exist.

PART IV ARCHITECTURE

Because of the recent changes and re-axiomatizations ushered in by the Minimalist Program (following on from Chomsky 1993), the architecture of the grammar and its relation to the interfaces and levels of representation has been subject to more internal scrutiny and questioning of assumptions. Part IV addresses issues concerning the overall model of grammar.

Boeckx and Uriagereka present an overview of the issues that have motivated generative grammar and the changes within the specifically Chomskian line of thinking that culminates in the Minimalist Program (MP). They argue that the MP shows clear continuities with Chomsky's earlier thinking, and that it represents an advanced stage of theoretical understanding of the core syntactic and interface issues. In particular, they show that it allows novel and more explanatorily adequate analyses of phenomena such as existential/expletive constructions in natural language. They take these constructions as their case study since it is one of the most basic and simple constructions on one level, but also because it is representatively complex in implicating many different (simple) interacting elements of grammar. Their strongly derivational minimalist approach to the particular problem of expletive constructions is used to demonstrate that the minimal devices present in this theory are sufficient to account for a phenomenon of great internal complexity. One interesting interface issue is raised by the prospect (made available in the MP) of a dynamically split model of multiple spell-out, in which the interfaces at PF and LF are accessed cyclically and locally in derivational chunks or "phases", based on a partitioned numeration. This theoretical option gives a rather different architecture and makes different predictions from the pre-MP T-model. On a more conceptual level, Boeckx and Uriagereka argue that minimalist theorizing allows new and deeper questions to be asked about the relationships between grammar and mind/biology.

Steedman, in his chapter, argues that many basic minimalist tenets are sound and that our model of grammar should indeed be driven by our understanding of the necessary properties of the minimally necessary interfaces with sound and meaning. He gives a proposal for the form of the intervening derivational module which combines these basic prerequisites with the insights of computational and non-derivational frameworks (claiming that such a convergence is both timely and necessary, given that the ideal is a model in which competence and performance are closely linked). Essentially, he argues for a version of categorial grammar (Combinatory Categorial Grammar) which can be translated into a system of productions for generating information structures and syntactic-category structures in parallel. The novel aspects of his proposal (from the point of view of mainstream minimalism) lie in the fact that traditional notions of constituency are abandoned in favour of a more flexible mode of combination, and that final word order is argued to be under lexical control. Steedman motivates the flexibilities in constituency with data from the groupings found in intonational phrasing, and shows that the account he proposes can also account for classic cases of crossing dependencies in Dutch. The system also depends on re-evaluating the role of the numeration: rather than starting the derivational process with an arbitrarily chosen multiset of lexical elements (which may support more than one distinct string in the language, or no string at all), the numeration is simply the ordered multiset of terminal lexical elements of the derivation. As such, the notion of a numeration is largely redundant, being entirely determined by either the string or the derivation, depending on whether the analytic or generative viewpoint is taken. The advantages of the Steedman system are that PF, S-structure, and intonational structure can be unified under a single surface derivational module capturing many otherwise problematic correlations. At the same time, the model conforms with standard desiderata of having syntactic rules be universal and invariant, with language-specific information being relegated to the lexicon. In an important way, Steedman's model is much more lexicalist than the MP: word order and all bounded constructions are controlled by lexically specified information. With respect to word order, it is important to recognize that under certain versions of minimalism (i.e. those involving elaborate movements to derive word order effects (cf. Svenonius, this volume)), the triggering features and parametric differences distinguishing languages with different word orders are currently fairly obscure. Steedman's solution to locating these effects is an unashamedly lexical one. The issues in this Chapter thus also bear on the debates elsewhere in this volume concerning the independent status of the lexicon as a module of grammar, and on the contribution by Jonas Kuhn on constraint-based models of grammar which clearly place considerable weight on the lexicon as a module.

Kuhn considers the notion of interface from the point of view of non-derivational theories of grammar—specifically LFG and HPSG. As he points out, in some sense the notion of interface gains greater prominence within this class of theories than in either the Principles and Parameters framework or the MP. For the latter theories, there is one derivation (possibly with levels of representation linked by transformations) and the only "interfaces" are with modules outside the domain of the computation—minimally PF, LF, and possibly the Lexicon or Morphology if these are to be considered distinct modules. Within constraint-based theories, transformations are eschewed in favour of parallel representational modules with potentially different primitive elements and internal relations. A particular complex network with parallel representations in different domains is well formed if it can be successfully "unified". Under this view, every set of constraining relations between one module and another constitutes an "interface". Thus, for every level of representation or module there is a potential interface with every other module, since the modules form a network rather than a serialized pipeline set of representations. Kuhn offers a perspective from which the drive to eliminate modules does not exist. Within these theories, the claim is that distinct modules do more justice to the heterogeneity of linguistic generalizations and mismatches between domains than do theories which attempt to reduce the important domain of generalizations to very few modules. In addition, the perspective is different because the mapping principles themselves constitute the interface between highly articulated levels of representation. Within the MP, the syntactic computation is the mapping between the "interface" levels of PF and LF. It is important to keep this difference in the interpretation of "interface" in mind when approaching constraint-based theories, and to see what a difference in perspective it implies: from a constraint-based point of view, minimalists are actually pursuing a highly elaborated explanation of the *interface* between the representational levels of PF and LF, albeit couched within a derivational metaphor.

The issues explored in this volume are still in many cases open for debate. We do not think that it is appropriate to argue for any particular position in this introduction, but we feel that the issues that emerge most forcefully from this collection are (i) the scope and limitation of the syntactic component, and in a parallel way (ii) the autonomy of phonology. Although many of the debates remain inconclusive, we do believe that the chapters in this book are useful and original contributions to the most important questions in the field today.

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PART I

SOUND

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CHAPTER 1

INTERFACE AND OVERLAP IN PHONETICS AND PHONOLOGY

JAMES M. SCOBBIE

1.1 Border Disputes, Political and Topographical

The concept of an interface in linguistics implies a connection between two distinct theoretical domains, each concerned with a distinct group of linguistic phenomena. If the domains or phenomena are very different, the purpose and

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nature of an interface in the theory is to state (explicitly and without redundancy) any necessary connections between what would otherwise be independent aspects of the grammar. On the other hand, if the domains or phenomena have numerous similarities, the interface is additionally characterized by theoretical competition between descriptions of and explanations for particular phenomena. In this situation, linguistic data are thought to be capable of providing evidence for particular theories of modular demarcation. Signature phenomena acquire the status of being theoretically crucial puzzles, and if generally acceptable solutions are found, they define the watershed for a generation of researchers until better data, broader research questions, or theoretical innovations come along to disrupt the consensus.

The phonetics–phonology interface is very much of this confrontational type. There is a pressure to circumscribe, describe, and explain any a priori "phenomenon" in the sound system theoretically from *either* a phonetic *or* a phonological perspective. Therefore, both descriptive and theoretical research converge precisely on those phenomena which cannot easily be apportioned. Consequently, the literature is dense with competing theoretical proposals for what, despite some variation, are labelled as the "same" phenomena. Some research may explicitly evaluate the evidence that a phenomenon should belong discretely to one module rather than the other, even in the situation where the phenomenon itself is somewhat nebulous. More commonly, phenomena recur as topics for reanalysis within one domain or the other, where the goal is to remove any arbitrary stipulations needed in previous theories, without typically calling the modular affiliation of the phenomenon into question. And as for splitting the behaviour in question between phonetics and phonology as a solution to those arbitrary stipulations—this is thought either to deny the phenomenon's existence as a homogeneous entity or redundantly to duplicate the analysis.

An increasing number of phoneticians and phonologists have taken the phonetically grounded character of some indisputably phonological phenomena (such as categorical assimilation or lenition) as a signal that only fresh phonetically oriented empirical and theoretical research can hope to resolve these boundary disputes, thereby enabling more satisfying explanations for the underlying systems. In fact, finer-grained data can also add to our problems. Phonetically detailed studies of multiple speakers reveal the extent of language-specific control of phonetic targets (often resulting in subtle interspeaker variation) in phenomena that are firmly within the phonological canon. Such work shows the extent to which subtle, gradient, and variable (i.e. phonetic) patterns exist alongside the gross and categorical (i.e. phonological) ones previously easily detected via native speaker intuition and impressionistic transcription of individuals or small homogeneous groups of speakers. My feeling is that an increased rate of phonetically sophisticated research will uncover more cases of such parallelism as well as adding phonetic detail to uncontroversial phonological patterns.

Of course, even broad impressionistic data can reveal parallels between patently contrastive and non-contrastive phenomena. The topic was perhaps most influentially discussed by Halle (1959). Thereafter, to some extent, it was regarded by many phonologists as a problem solved: homogeneous phenomena should not be split across modules. Consequently, in most generative phonology, surface structure is specific enough to enable the representation of a great deal of redundancy, with a consequential emphasis in phonology towards the rules that govern it. Even a radical increase in the theoretical importance of constraints on surface representation has not yet been reflected in any deep concern over the complete lack of any scientific basis or objective definition as to which phenomena should, and which should not, be represented at all in surface structure. To put it as a question: what counts as phonological data? What gets into surface structure in the first place? The presence of some types of allophonic variation in surface structure will require different theories of constraints and constraint interaction than others. But despite the fact that phonological theory is utterly dependent on the inclusion or exclusion of particular phenomena from the set of relevant data (because capturing certain patterns may require extensions to the expressive power of the formalism), the main reawakening of interest in the theoretical importance of the interface to phonology has come, it seems to me, from the relatively small number of researchers who are interested in understanding quantitative phonetic data or whose interest has been the interface in its own right. Yet if the surface representations which phonological theory aims to generate are arbitrary, idealized, and at the whim of the phonologist, then the repercussions for phonology extend far beyond the merely substantive issue of whether some low-level phenomenon is given an analysis or not. For surface-oriented phonology, the interface with phonetics is its foundation and defines its remit, and is not an avoidable, peripheral topic.

So, my prediction is that debates about phenomena which straddle the fence between phonetics and phonology will increase in number and complexity, and in addition to providing descriptive subtlety, the theoretical value of detailed empirical work will also be more widely appreciated. For reasons that I will try to make clear below, however, I do not think this more scientific approach to phonology means that such debates will or should reach a settled conclusion. Consequently, my aim here is to present very general issues which I think are especially relevant to evaluating theories of the relationship between phonetics and phonology rather than to review previous work on the interface or specific phenomena.

One reason for an increasing exploitation of phonetically oriented concepts and data by phonologists is that new, relevant, comprehensive, and complex data on phenomena of long-standing interest can be obtained (with relatively little effort) directly by phonologists, in a way simply not possible a generation ago. The rate of quantitatively based arguments in the literature does seem to be increasing. This is largely due to the ready availability of what used to be highly specialized and expensive acoustic-analysis hardware and software. Now any phonologist can present new arguments based on the type of data which may previously only have been found in the phonetic or psycholinguistic literature, though not always, it must be said, with such a reliable or rigorous methodology, and sometimes with disturbing naivety. What is not yet changing is the preferred method of resolving disagreements about the phonological status of difficult cases such as marginal contrasts, positional allophony, parallels between morphophonemic and allophonic alternations, and parallels between continuous distributions and more categorical phonotactics. Generally, solutions propose moving the theoretical fence marking the border between the domains to shift the affiliation of the phenomenon, or argue that the entire phenomenon must be moved into the other domain.

Why? Because our generative phonological tradition relies exclusively on discrete categories, while phonetics permits (*demands*) continuously gradient and non-categorical models. When the theoretical fence is shifted "down" such that phonology is augmented (in a way that echoes Halle's approach) in order to deal with prima facie "lower-level" phenomena, phonology ends up with a very large number of very small phonological categories and distinctions which do not themselves seem to be needed to express contrast or otherwise percolate upwards. Alternatively, if the remit of phonology is kept small by moving the fence "up", focusing phonology on core "high-level" phenomena such as discrete phonemic contrast, then it is phonetic theory that must be augmented. Thus incompatible solutions to the nature and location of the interface exist in the field even if there is a shared view that the interface fences off phonological from phonetic phenomena.

Let us pause for a moment, because metaphors of fences beg some questions. First, let us change from the physical fence to a comparable but more abstract concept, the border. Now, instead of beginning with a simple modern political border—a line on a map representing a real but abstract boundary arbitrarily passing though and over all topographical features—think instead of a huge and (in parts) impenetrable forest of thorn trees, and the two politically independent city states which it separates. Though the existence of a border is indisputable in political and physical terms, its location as a precise line on the map (compare phonology) or on the ground (compare phonetics) is somewhat arbitrary and clearly subject to challenge. The border is an abstract expression of the categorical distinctness of the two political units, and in this case it is patently also motivated by functional/markedness factors, for the physical impenetrability of conditions on the ground has contributed to the independence of the states. Nevertheless, the jurisdiction of either city state over this or that part of the frontier forest is increasingly arbitrary and indeed fanciful, the further into or across the forest it is drawn, from either state's point of view. The physical instantiation of the categorical political border is wide, moveable, and penetrable (making it arbitrary in the fine detail of its location), and both its existence and character are explained by reference to the natural landscape. Think of the difficulties if a linear representation of this border had to be agreed diplomatically. Would it be equidistant from the (rather indeterminate) "edges" of the forest? Would it follow river valleys or watersheds? Would the stronger state claim the entire border territory as its own? Different (reasonable) ideas (compare "principles" of grammar) will compete, but no precisely located border can be an accurate interface other than in an arbitrary way, let alone explain the city states' independence. Moreover, a focus on categorical "independence" fails even to address the undoubted partial similarities and connectedness that will be found when these two states are viewed from a wider geopolitical context. So, when talking of a linear fence-like interface, we must be aware that we are making a number of strong assumptions, most of which are so deeply embedded in the mindset of the generative linguist as to go unchallenged.

Demarcation problems within abstract synchronic grammar are dwarfed by the challenges arising from the assumption of a linear phonetics–phonology interface in acquisition, speech pathology, sociolinguistics, diachrony, or other areas involving systems comparison. For example, the diachronic emergence of phonemic contrast from previously phonetic patterns over decades or centuries tends to be modelled by phonologists as a discrete trans-generational movement of phenomena from one module to the other. While such a model permits two individuals at some point in time to differ in how they grammaticalize ambiguous input data, it does not permit either speaker's grammar to be indeterminate or flexible. Groups of speakers can be indeterminate; individuals can vary; but in the generative tradition the mental grammar of an individual cannot be non-deterministic: the grammar itself cannot fail to choose whether such-and-such a phenomenon is phonological or phonetic, let alone permit both readings simultaneously (perhaps with a statistical bias one way or the other).

In this chapter I will briefly review some competing conceptions of a discrete interface, because this is the more normal perspective, but I will also consider the possibility that phonology and phonetics overlap on cognitive and theoretical levels as well as superficially on the empirical level. The very existence of an ambiguous no-man's-land between phonetics and phonology may reflect (and be reflected by) the non-deterministic mental representations in the systems of individual speakers.

1.2 How Many Phonetics–Phonology Interfaces Are There?

One highly simplified aspect of the interface that is commonly found (see below) is that phonetic stuff in all its redundancy is seen as the output of a function of phonetic "implementation" or "interpretation" to which phonological surface structures are input. More generally, this must be a bidirectional relationship between the domain of abstract and categorical relationships and entities (somehow implemented in cognitive structures within the individual, where multiple individuals possess congruent abstract systems) and the domain of gradient, continuous parameters (implemented in real space and time) which can be shared by multiple individuals via visual and acoustic modalities. Speech production and perception are real-time instantiations of the interface because they relate continuous real-time events to stored (categorical) knowledge. Phonological practice usually tries to capture just some of these aspects of the interface while being insulated from real-time psycholinguistic processing, and I too will shy away here from neurolinguistics and psycholinguistics as much as possible.

Even under such an overly limited view, phonetics and phonology can and have been defined in many and varied ways, and there are therefore many conceptions of "the" interface within the broad church of generative grammar. What I will try to do below, rather than listing and comparing these in any detail, is to try to model some of the more general underlying themes which motivate particular models, then sketch some broad families of interface types within that overview, relying heavily on other previous reviews of the literature and the interest of the reader to fill in the specifics.

One common assumption is that it is only a phonological level of representation, specifically, the "surface" representation, which shares an interface with phonetics. Nevertheless, it has often been observed that aspects of phonological theory employed in all levels (whether principles, units, or rules) vary in how phonetically grounded they are. In that sense there is an "interface" for theories and theoretical constructs which deal with the phonetic underpinning of phonological theory itself. This logically separate aspect of the relationship between phonetics and phonology is somewhat tangential to the thrust of the discussion, but should not be forgotten because it is so crucial theoretically.

As mentioned, the location of the interface is intimately related to different definitions of the remit of phonology and phonetics. But other concerns also result in the inclusion or exclusion of particular classes of phenomena from the to-do lists of phonologists and phoneticians, independently of changes to the relationship of these, one to the other. This is because each area has interfaces with other grammatical and non-grammatical systems. Take phonetics, for example. We all have our own unique vocal-tract physiology that must be used to convey linguistic in addition to merely indexical information. Are both the concern of linguistic phonetics? Surprisingly perhaps, the answer may have a bearing on the phonetics–phonology interface. For other examples, consider the shape of the palatal arch or the ability to mimic other people's voices. These are both generally excluded from most definitions of linguistic phonetics (though both may be relevant to the way an individual learns their language or functions as a speaker), because phonetic and phonological systems comprise abstract universals of grammar plus linguistic specifics that can be and must be learned by all speakers.

Atypical vocal-tract structures or abilities are of interest, however, if the "idealized" speaker-hearer is understood as a member of a normal distribution rather than as a decontextualized ideal, for atypicality is part of the normal distribution. Phonetics aims to study patterns and systems in a normalized physiological/mental setting, using evidence from specific examples of learning in childhood, application in production and perception, and storage in the brain. Like phonology, phonetics theory is interested in *systems* (of a spatio-temporal character).

Of course, since phonetic data is typically from our physical universe, embodying aspects of real space and time, phoneticians must be trained to interpret noisy real-world data. These skills make them disposed to address other physical and quantitative aspects of speaker behaviour, so non-linguistic phonetics is highly relevant to phonetic research. Phonologists' skills, on the other hand, lead them away from phonetics towards abstract relations between contrastive units. The fields come together when phoneticians address the subset of a language which directly relates to the realization of those abstract relations and when phonologists seek to explain aspects of the abstract patterns by reference to those self-same phonetic realizations.

1.3 A General Model of the Generative Interface

There are four particularly useful, comprehensive, and insightful collections of papers relevant to the phonetics–phonology interface, incorporating summaries and position papers by many of the major figures in the field, as well a recent review paper (Cohn, in press) which touches on many of the same topics raised here, and the longer view of Ohala (1995). These collections are Volume 18 of the *Journal of Phonetics*, containing the special issue on Phonetic Representation (Beckman 1990) as well as other papers (Ohala 1990; Lindblom 1990); the more recent and extremely useful book *Phonological Knowledge* (Burton-Roberts, Carr, and Docherty 2000); the special issue of *Phonology* (Gussenhoven and Kager 2001) on Phonetics in Phonology; and another special issue of the *Journal of Phonetics* (Hawkins and Nguyen 2003). Also highly relevant is the literature in the Laboratory Phonology subfield which attempts to bridge the gap between experimental phonetics and formal phonological research by recasting phonology as a quantitative science (Pierrehumbert, Beckman, and Ladd 2000), and the move to integrate these and other phonetic findings into relatively traditional generative grammar by extending the scope of the phonological apparatus (Boersma 1998; Hume and Johnson 2001;

Hayes, Kirchner, and Steriade 2004). See also Fodor (1983), whom I take to be broadly representative of a modular standpoint. Rather than resummarizing these rich and essential resources in their own terms, I will present a very general model of the interface which may enable the reader to evaluate the overlapping and competing summaries (and models) themselves.

In this general model, phonetics and phonology differ in two independent dimensions which in any particular model will tend to be combined. Since different researchers attach more or less importance to one dimension or the other, it can be extremely hard to evaluate the arguments of one position against the orthogonal arguments of another. One dimension reflects an obvious a priori motivation for the modularization of phonology and phonetics, namely, the cognitive (or social?) vs. physicalistic instantiation of sound systems. Adopting a strong position on this symbolic-physical duality means there must be an interpretative relationship between phonetics (physiological, kinematic, aerodynamic, acoustic) on the one hand and phonology (psychological, signifying, algebraic) on the other. This is a conception of the phonetics–phonology interface which Hale and Reiss (2000*a*: 169) call transduction, citing Pylyshyn's work in cognitive science in which generally symbol-processing cognition (and the principles underlying it) must be logically separate from the semantic issue of how the symbols relate to substance. This non-arbitrary relationship of transduction generalizes over the psycholinguistic processes of speech production and perception (and, it seems to me, acquisition). In Figure 1.1, the horizontal dimension of dissociation between phonology and phonetics represents transduction, the relationship between substance and form.

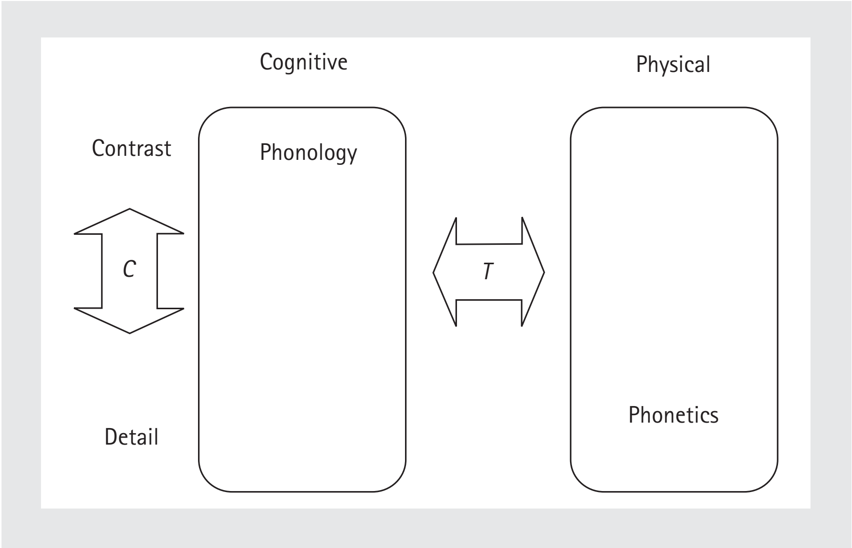

Fig. 1.1 Interfaces: discrete transduction (T) and relative concreteness (C)

Phonetics and phonology are used as labels for two clearly demarcated and non-overlapping domains: whereas the former must deal with events in the physical realm, the latter must characterize abstract relationships (typically conceptualized as cognitive systems of mental representation). Hale and Reiss condemn the trend, found even in the most highly formalistic symbol-processing research, to try to incorporate findings from phonetics as functionalistic principles expressed within formal phonology, or to explain patterns of markedness from within the symbolic formalism. (Despite the trend towards functionalistic "grounding" of phonology in phonetics, which Hale and Reiss criticize, dualism is, rather ironically, generally reflected in practice by the very different research cultures and methods found in experimental phonetics and theoretical phonology.)

The a priori need for an interface is also justified on another set of grounds. These arguments will be presented as an independent dimension, represented vertically in Figure 1.1, though the fields of phonetics and phonology do actually differ in both dimensions simultaneously, which is why they are represented diagonally in the figure: but crucially I do not want to collapse the justifications for the separation of phonetics and phonology into one composite dimension. Most discussions of the interface intermingle aspects of both, paying more attention now to one, now to the other. This makes the various claims about the interface in the literature rather difficult to compare, and it may help us to keep a dimension of "fine, gradient, and natural patterns" vs. "categorical and unnatural patterns" separate from another dimension of "cognitive" vs. "physical" in following the various arguments that are put forth. It is hard to find a term able to capture all the non-transduction differences between phonetics and phonology, but because I think most relate to the relative abstractness vs. the descriptive accuracy of grammars (i.e. the scope of the grammar and how phonetically accurate it should be), I will adapt my previous terminology (Scobbie 1997) and call the entire dimension "concreteness".

I take it as axiomatic that phonology, by definition, has abstract systems of lexical contrast as a central property, while phonetics relates crucially to richly redundant language in the oral-aural channel. Thus the key characteristics attributed to phonetic and phonological phenomena are not determined by the transduction relation alone, but also by the concreteness of the respective systems.

I wish to avoid at this stage the implication that transduction must also be a relationship between detail and generalization, but rather stress its logical independence. This point should be clear even if it is not quite clear how transduction relates stuff to structure or indeed whether a different conceptualization of the relationship of the mental to the physical would be preferable (cf. Carr 2000). So, in what ways are phonetic detail and phonological structure irrelevant to this dimension? First, physical substance of whatever level of specificity is related by the transduction dimension to all linguistic information, not just phonology. Substance (primarily brains, bodies, and the air) provides the media in which speaker-hearers instantiate, store, embody and collaboratively transmit their linguistic structures. The structures comprise semantics, discourse, abstract morphophonemic relationships, phonological contrast, detailed language-specific or sociolinguistic phonetic targets, speaker-specific tendencies, etc., plus, of course, non-linguistic information. Secondly, each language user has to have a cognitive systemization of *both* the phonological and the phonetic aspects of their sound system, at least on most linguists' working usage of these terms. Moreover, such an internalization of abstract relations and the precise details needed to, say, control the speaker's own (changing) articulatory system, occur in the context of each speaker-hearer's unique genetic endowment for language, cognition, and physiology. (At this stage I would like to retain the option that grammatically learned information shades off into both the universal and the idiosyncratic, each of which will be detectable at the periphery of a grammar's system.) If it is reasonable to say that "language-specific phonetic patterns exist", then the cognitive system itself cannot by definition be free from the representation of phonetic detail, though it may be, by definition, free of the actual substance in Hale and Reiss's sense. Finally, since aspects of both phonetics and phonology are learned, that is, are made part of an individual's grammar, then aspects of the interface are learned too. Thus there must by definition be a dimension of interface that does not equate to the transduction dimension, and the interface as a whole is not exhausted by the cognitive/physical interface, however it is characterized.

I have noted above that there is little effort in contemporary phonology to solve the Concreteness Problem by defining the extent to which non-contrastive aspects of sound systems are incorporated or not into phonological theory. There is, however, one widely adopted assumption, or rule of thumb. Since phonology has the categorical phenomenon of contrast at its core, many phonological theories are couched in categorical symbol-processing formalisms. In practice, the interface is defined to occur at that level of concreteness where evidence can be found that phenomena are continuous or gradient rather than discrete and categorical. And, since concreteness is conflated with transduction, the interface is often seen as being utterly discrete.

In order better to compare and understand different approaches to phonetics and phonology and their interaction, I will avoid begging the question that there is a discrete and uni-dimensional distinction between abstract, categorical phonological and concrete, gradient phonetic representations in the grammar. Given the two dimensions in Figure 1.1, I can keep the options open even if I assume that transduction is strictly binary at this stage (not least because I am ignoring the neurophysiological aspects of language perception, storage, and production which I think complicate this view), whereas the concreteness dimension is, a priori, less obviously modular in this way.

There are nevertheless two broad conceptions of the interface. It may be a crisp, clean, and principled delineation in which phonetics and phonology are modular in function and in form: a modular interface. On this view, arguments based on both transduction and concreteness will reveal the strictly modular nature of the interface. It may be, however, that the interface is more like an overlap. The latter position would appear to have one a priori advantage: it would at least be able to explain why successive attempts to find the location of a modular interface have been so varied (i.e. unsuccessful). Under the overlap hypothesis, the interface combines aspects of discrete modularity with non-modularity. On this view, the interface would not really resemble the relationship between abstract political borders and actual geographical and social situations on the ground. Rather, phonology and phonetics would have a transition zone, like a tidal shore ecosystem, which is defined by its dynamic transitions between seabed and land surface. Sea and land are (like cognitive and physical domains) categorically distinct, but the tides create a habitat in its own right. The dynamic nature of tidal habitats has selected for many species which are specifically attuned to this ecosystem, even though they are closely related (i.e. in a non-categorical way) to other land-based or sea-based flora and fauna. If we see some phonetic or phonological phenomena as being characteristic of the overlap itself, we might be able to avoid the continuing attempt to attribute them exclusively to either phonology or phonetics, a process which I think may ultimately be doomed to circularity. Overlap does not imply loss of identity: the land and the sea are not the same and neither are phonetics and phonology.

Before going on to discuss contemporary models of the interface a bit more specifically, it would be useful to explore very briefly the characteristics of phonetics and, more significantly, phonology. As might be expected, there are some core meanings for these terms which together pick out just a subset of the aspects of the sound structures of language which phonology and phonetics cover in practice. The core concerns of each domain do not even appear to touch. It is only when they are taken in broad view that they need an interface, and by then, the clarity of each discipline can get lost.

1.4 Phonology

Phonology is primarily about structured systems of lexical contrast, being a theory of how each language maintains a lexicon of tens of thousands of words by systematizing the ways in which the form of each word can differ from the forms of others, using a relatively small number of meaningless components which recur in different positions and combinations. It is, or should be, more than this, but cannot be less, so let us consider the core characteristics first. For example, consider the contrast in lexical meaning signalled by the different sounds of English *big* and *hullo*. Listing all such categorically distinct lexemes is a simple and finite problem, but would not address the basic insight that each language has a phonemic system of distinctiveness. Understanding such systems is the goal of phonological research. The phonologist therefore has to present arguments as to the identity of the basic units of contrast, and their combinatorial possibilities; both universally and in a particular language. Such analyses are not simple or clear-cut, and so form the basis for fascinating theoretical and empirical debates.

Notable sub-lexical units of contrast are the segment and/or the feature. Both enable us to systematize and define "phonemic" contrast on a basic level: minimal distinctiveness involves a change in just one basic unit. For example, *big* and *pig* are a minimal pair because their differences are encoded phonologically in a single segment, and indeed in the value of a single distinctive feature. (Either is sufficient.) The featural level of analysis allows the phonologist to identify natural classes of contrast among different phonemes by reusing the same feature (let us call it /VOICE/) for different pairs of English words such as *train* and *drain*, *Sue* and *zoo*, or *nip* and *nib*. This necessitates the postulation of the same minimal difference across different structural positions; and in different groupings of features (i.e. different segments) in the same position. These analytic steps immediately abstract away from the very different phonetic relationships between, say, stop and fricative pairs or initial and final pairs (see below), because patently the /VOICE/ dimension is not, and need not be, related in any simple or invariant way to phonetic parameters such as consonantal phonation. The ability to insert, link, or spread features to redundant positions enables two words that differ phonologically in more than one segment in surface representation to be treated as a minimal pair.

Alternations between forms of a word or stem, if the forms are analysed as comprising different distinctive units, are also a key part of phonology even though they do not involve a change in lexical meaning. Rather, we say that a unit such as the word has systematically conditioned phonological variants. Alternation is therefore postulated when there are some reasonable grounds for assigning different featural analyses to (a set of) words or stems in different environments. To take a simple case, the phonological environment of a following vowel seems to condition an /r/-final form of all non-high word-final or stem-final vowels in many varieties of British English. Lexemes such as *saw* alternate between an r-ful form (e.g. in *saw it*, *sawing*) and an r-less form (e.g. in *saw Kim*, *saws*). The presence vs. absence of the rhotic is typically seen as a phonological phenomenon.

More often, sub-segmental variants may be conditioned, such as the voiced and voiceless variants of the simple plural or past-tense suffixes of English. It is crucial to note that only a small subset of all the variation which can be found is treated as phonological; usually phonological status is reserved unless there are categorical changes in sound which can neutralize contrasts or feed other phonological rules. These criteria can be hard to prove. Phonetic similarity seems to be another criterion used in practice to avoid some logically possible alterations.

Allophonic variation is also a key part of phonology. It is the corollary of the claim that the same contrast or featural difference can occur at different places in structure, because the structural context has such a pervasive influence on phonetic form. (Indeed, different structural positions, as a functional consequence, have different potentials for encoding phonological systems.) For example, consider the two English pairs *tear–deer* and *neat–need*. Typically, both pairs are said to exemplify the same phonological contrast, at different places in structure. But of course the phonetic instantiation of the difference between the members of each pair differs a great deal, because the stops are post-vocalic in latter case and pre-vocalic in the former. In most varieties of English, there will be an aspirated stop in *tear* and an unaspirated one in *deer*. In *neat* and *need*, however, other phonetic cues to the contrast apply, perhaps relating to a greater vowel duration before /d/ or glottalization of /t/. In most phonological analyses, /t/ is encoded phonologically with identical phonological featural specifications in both words, meaning that the /t/ phoneme in English has two allophones rather than having two different /t/ phonemes, one restricted to initial position and one to final position. Instead, the linguistic systemization of contrast results in observably different contrasts being brought in under the same set of context-independent phonological descriptors.

It is crucial to realize that the step of equating an initial phoneme Φ_1 and a final phoneme Φ_2 via an allophonic relationship does not in any way define the allophonic relationship itself as either phonological or phonetic. This is absolutely still a matter that is open to theoretical argument and empirical investigation. If the predictable differences between Φ_1 and Φ_2 can best be handled with the theoretical machinery needed elsewhere to express phonemic contrast, then the allophony is likely to be regarded as phonological, but if some other mechanism that is never used theoretically to encode contrast is used, then the allophony is going to be called phonetic: I used this sort of argumentation myself in Scobbie (1995). Thus even when it is unarguable that Φ_1 and Φ_2 are the same phoneme it may not be clear which side of the interface specifies the differences. Is there a *phonological* specification in English in surface structure for short vs. long vowel duration; or vowel nasalization; or flapping; or aspiration; or light vs. dark /l/; or pitch; or any other of the well-known (and lesser-known) low-level allophonies?

Alternation and allophony often interact. Consider the situation in which word-initial Φ_1 and word-final Φ_2 are accepted as allophones of the same phoneme Φ, and a word-final consonant Φ_2 alternates between two variants Φ_{2A} and Φ_{2B} in conditioning environments A (pre-vocalic) and B (pre-pausal). The pre-vocalic environment in which Φ_1 is found is therefore more similar to A than B and a word-final consonant Φ_{2A} is more likely to resemble a word-initial Φ_1 than the pre-pausal Φ_{2B}. Does this mean that Φ_1 and Φ_{2A} are phonologically identical, or that Φ_{2A} and Φ_{2B} are phonologically distinct, or both?

Even with details of the phonetic differences and/or speaker intuitions, different decisions about the phonological identity of Φ_1 and Φ_{2A} in surface structure in such situations are possible, as we can see from the many debates in the literature. Phonological considerations vary from one school of phonology to another, and so do phonetic considerations. Simple empirical data on its own will not provide an uncontroversial answer, because Φ_1 and Φ_{2A} cannot be phonetically *identical* (because of pervasive differences between word-initial and word-final position even in connected speech), and speaker intuitions about such situations tend to vary and/or be gradient, or influenced by orthography or sociolinguistic attitudes.

Similarly, the differences between Φ_{2A} and Φ_{2B} are likely to be assigned to phonetics by researchers if they are subtle variation of a type which does not seem to be found used as a major cue to contrast in other languages or contexts, or is too gradient or variable to be thought of as being in the same component of grammar as phonological contrast, but such properties are in the eye of the beholder. Since phonology's irreducible goal is the analysis of contrasts and contrast-like relationships, without some additional grounds for postulating a phonological alternation between Φ_{2A} and Φ_{2B} on the one hand, or a phonological allophony between Φ_1 and Φ_2 on the other, the panoply of systematic relationships in the sound system (whether discovered by instrumental research or broad transcription) should probably be assumed to be phonetic unless reasons are presented as to *why* they achieve the status of phonological data. Such arguments could be the phonetic arbitrariness (i.e. unnaturalness or marked nature) of the variants or conditioning environments, similarities between the variants and demonstrably contrastive units or relationships (perhaps cross-dialectally), strong lexical conditioning, speaker intuitions of categoricalness, etc. (cf. Scobbie and Stuart-Smith, to appear). Often, phonologists have also relied on their own intuitions and the categoricalness of their broad transcriptions as evidence for the phonological status of allophonic variation and alternations. Apart from this being arbitrary, even clear categoricalness is no indicator of phonologization when contexts are categorically distinct, because the variants may differ phonetically by virtue of context alone (cf. aspiration in English).

As a result of these sorts of analytic problem, the broad consensus in phonology on the core inventories and structures of many languages tends to gloss over some very basic problems in justifying the choice of minimal structures when two forms differ by more than one phonological feature. For example, in many varieties of English, *neat* and *need* could be argued to contrast in both vowel length and final-consonant voicing. If this were the case, they would not form a minimal pair. The problem is finessed by positing a distinctive role for /VOICE/ and a redundant allophonic role for the vowel-length difference (which may or may not be phonological, as discussed above). But the architecture of the theory, built as it is on systems of minimal contrast, demands that there is one core, distinctive difference which is the underlying phonological difference. Difficult cases like this abound, because every phonological contrast is cued by the specification of multiple phonetic parameters. Consider varieties of English in which words like *hand* have a nasal vowel but only rarely any nasal stop phonetically: is the contrast one of oral vs. nasal vowel, or the presence vs. absence of an abstract /n/ which is not observable directly? And once that decision is made about the nature of the basic phonological contrast, which of the many other phonetic differences between pairs like *had* and *hand* are to be defined as phonological, and which phonetic? These problems are both fundamental to the phonological description of any language and inherently about how phonetics and phonology interact.

Finally, it cannot be stressed too much that a great deal of research in phonology is not limited to lexical contrast. Much of this type of phonology does, however, consider the various structures, domains, and relationships which provide the infrastructure for contrast, including demarcative phenomena such as stress systems. Yet other phenomena are non-lexical but quasi-contrastive, such as intonational meanings or discourse functions. These and more must be added to alternation and allophony (which are by definition non-contrastive) as phenomena central to phonological research. In each of these cases, the problem of distinguishing the phonetic from the phonological aspects of the relevant phenomena are, I think, even more problematic than in the core case of lexical contrast itself, which relies on very firm intuitions or judgements of categorical difference rather than on the weaker phonological judgements of identity or parallelism.

1.5 Phonetics

Phonetics deals with the production, transmission, and perception of linguistically relevant speech sounds, without necessarily referring to their meaning or linguistic function. Phonetic research is inclusive, however, for it constitutes not merely a negatively defined theory of those aspects of the linguistic sound system that do not signal lexical contrast. A great deal of work in the field addresses specifically the phonetics of contrast and other core phonological phenomena. Phonetic research is generally quantitative and of a general experimental character familiar to most scientists, and examines physicalistic data (whether acoustic, articulatory, neurological, or perceptual) from the right-hand side of Figure 1.1. Nevertheless, in normal usage, a "(merely) phonetic" difference between two words indicates a narrow interpretation that this is a non-contrastive or lexically meaningless difference in sound.

The goals of phonetic theory itself overlap with the goals of phonology insofar as they attempt to explain the parameters which are used to convey contrast, the reasons for the existence or unmarked nature of particular types of contrast in particular structural positions. The two domains of inquiry therefore have a great deal in common, and in some ways it is methodology that differentiates the academic fields. Even when we consider such truly phonetic concerns as the relationship of the physical speech-production mechanism to the acoustic signal, we find an overlap in interests, because phonological distinctive features have tended to find a phonetic grounding in either the articulatory or acoustic domain.

In this review, I will not attempt to characterize the main research goals and results of phonetics independently of their interaction with phonology, because the central topic here, the phonetics–phonology interface, is, I believe, more divisive and problematic for phonological than phonetic research. The main point I want to make is that it is widely held that the quantitative measurement of physicalistic phonetic parameters gives rise to a picture of organically and statistically gradient phenomena. Gradient, continuous variation is indeed typical of phonetic phenomena, but care needs to be taken. A more accurate characterization is that, if a phonetic study is either constrained very tightly so that, say, a single item in a single context from a single speaker is examined, or alternatively, if a study is based on an extremely heterogeneous set, then the results are likely to display various aspects of continuous variation. If, however, qualitative variation is introduced as a set of factors into the design of the study, then categorical effects are likely to be observed. This is obvious: qualitative changes in the materials under study can result in qualitative changes in the results. For example, measurement of the duration of a vowel in some word, say English *cat*, will typically produce a normal distribution around a mean, but if the duration of that speaker's *bat* had been measured, the same /a/ vowel would likely have been a bit shorter because the aspiration of the /k/ in *cat* partially eats into the time allocated to the vowel. It is, in fact, very easy to find bimodal or multi-modal distributions of values for phonetic parameters, where each mode is associated with some conditioning factor. Consequently, if we could consider all the various phonetic parameters which go together to cue some phoneme, say, in the full range of environments which can be found (some discretely distinct from others), we would not expect to find a set of unrelated unimodal continua. Rather, there would be areas of wide variation, areas of consistency, and correlations between the different parameters in the multidimensional phonetic space, so that relatively discrete clusters of values fall into constellations which would be characteristic for that phoneme. There is thus the possibility that phonetic variation is at heart partly continuous and partly discontinuous in a way that forms the basis for categorization at a finer level than lexical contrast—in other words, that it forms the basis of phonology.

1.6 The Interface from a Modular Perspective

Let us take it for now that phonology involves discrete mentalistic or analytic categories grounded in cognitive judgements of lexical contrast, while phonetics involves gradient and continuous categories anchored in the physical domains of speech production, acoustics, etc., and that phonetic comparisons and distinctions which are not inherited from contrast at the phonological level are couched in terms of similarity in aspects of multidimensional phonetic space. Under such a view, which I think is typical of the assumptions underlying modern Generative Linguistics, we can finally address the range of views on how these very different domains interface with each other. The main problem is reconciling the physical and cognitive biases of each field with the need to provide a model of a speaker-hearer's internalized grammar which encodes language-specific information about phenomena which may be clearly phonological, but which may also be readily characterized as phonetic.

Within a domain-and-interface model of grammar, we typically find an organization based on a small number of categorically distinct modules. If the number of modules is kept small enough, this architecture does not seem impossibly unwieldy. But the number of modules may be very large, as seems to be the case given the number of sub-modular (i.e. relatively independent) theories specific to stress, to intonation, to feature theory and to constraint interaction, to perception, production, sociophonetics, and phonemics. If there are sub-modules within phonology, then the number of interfaces increases, as do the number of "border disputes" with phonetics. For simplicity, I will content myself here with a bimodular view, in which most of the discussion will relate to simple segmental phenomena. The problem of the attribution of particular phenomena to one domain or the other is as great, if not greater, in other areas of interest such as intonation or stress, so the observations I make should be easy to extend.

There are a number of goals in defining the interface. One, which began this chapter, is to be able to attribute phenomena (e.g. American English /t/ and /d/ flapping, the nasalization of vowels before nasals, or a whole raft of post-lexical sandhi phenomena) to either one domain or another. In such a case, the basic defining principles of one of the domains (such as categorical neutralization of contrast or continuous gradient variation) would ideally be exemplified by the phenomenon. Many phenomena, however, seem nearly to satisfy strict criteria, while leaving some doubt, a fact that keeps the debates alive. Another goal of modularity is to explain phonologization as the discrete movement of phonetic phenomena across the interface into phonology. Indeed, most fields of linguistics which deal with spoken language have their own reasons for distinguishing phonetic from phonological phenomena in a discrete way. This makes it possible to find cross-disciplinary evidence for the status of a phenomenon from such different fields as acquisition research or psycholinguistics, for example. Consequently, since almost all research in phonology presupposes a rigid interface of some kind with phonetics, the field can be said to be making progress partly by revisiting the same phenomena and developing arguments about the affiliation of phenomena to one or other module, whether those arguments come from theories of language change, acquisition, or the more internal considerations of speech production or phonological theory itself.

There is a real problem, however, for some of this "progress" is entirely spurious. When familiar phenomena are considered and reconsidered, the conclusions will always be biased when the data come ready categorized. The categorical bias comes from data the nature of which reflects written language, transcription, introspection about phonemic contrast, or analysis of relationships between previously established phonemic units both within and across languages. Far more useful, because it is challenging and able to test the division between phonetics and phonology from both categorical and continuous perspectives, is quantitative data: particularly *new* data. It can completely reinvigorate the descriptive basis of many phenomena, as well as provoking deeper theoretical understanding of the broader picture of linguistic sound systems. Unfortunately, broad pre-categorized transcription data is still the norm in the phonological literature even though it cannot logically be used to investigate the categorical vs. continuous nature of phenomena. Such an approach limits the purview of phonology arbitrarily to easily observable and transcribable phenomena. On the other hand, distributional patterns within quantitative phonetic data can be examined and distinct centres of gravity proposed as the instantiation of phonological categories, or quantitative studies of speaker intuitions about well-formedness can be undertaken which can then identify strong categorical patterns as well as weaker ones. Such an approach gives just as much room for debate and argument as exists presently, but it would be well-informed debate.

We should not expect unrealistic standards of proof of phonological categorization from quantitative data. When a few minor phonetic parameters or speaker uncertainties are found which suggest that a well-known neutralization, say, is subtly incomplete, we must not simply reject the insights of previous generations of researchers without further consideration (a point made strongly by Manaster-Ramer 1996*a*, *b*). Evidence of subtle deviations from categorical behaviour is not the same as evidence of completely non-categorical behaviour. If it proves impossible to square new data with old phonological models, the fault may lie in the models rather than in the insights of previous descriptive research. Our models may have to change to encode nearly categorical procedures, operations, and indeed fuzzy categories themselves without giving up the insight that core phonological phenomena are, at heart, *not* smoothly gradient and continuous.

Let me now briefly turn to a few specific examples of proposals of the nature of the interface, offered not as an exhaustive list, but to illustrate some of the variety which can be found.

1.6.1 Language-Specific Phonology, Universal Phonetics

The influential work of Chomsky and Halle (1968) stands as an example of an interface with an apparently clear definition. The "output" of the phonological module, that is, the specification which interfaces with phonetics, is a cognitive representation of language-specific information. Once universal phonetic detail is added, the transduction interface can be the same in every language. This proposal expands phonology downwards a bit: the formal phonological mechanism necessary for contrast would be used to express all language-specific sound system generalizations from the most phonetic-like to the most morphophonemic.

It is unclear to me whether the phonetics–phonology interface in a transduction sense coincides with the interface conceived of as the boundary between the language-specific and the universal. The idea that all language-specifics belong to "phonology" makes it easy to draw parallels between language-specific phonetic and (morpho)phonological phenomena within the grammar. But the interface faces a new set of boundary disputes concerning the language-specificness of particular phenomena. And the categorical formal mechanism, developed for lexical contrast, was not up to the task of encoding all the gradient minutiae that we now know to be part of what must be learnt when a language is acquired (Keating 1985). In terms of Figure 1.1, this interface is drawn quite high, and so very low-level but language-specific phonetic phenomena have no real home. They belong neither with universal phonetics nor with high-level categorical phonology.

1.6.2 Language-Specific Interpretation

Phonetic "interpretation" introduces language-specific phonetics via, it seems, transduction. There is categorical discrete phonology on the cognitive side and continuous phonetics in space–time, on the other, with quantitative numerical functions to mediate between them (e.g. Keating 1984, 1990; Pierrehumbert 1990; Cohn 1993; Silverman 1997; Pierrehumbert and Beckman 1998; Cho, Jun, and Ladefoged 2002). Consequently, such models are phonetically detailed, but add the detail as part of a model of transduction using continuous mathematics, not in phonological representations. The finest-grained language-specific detail exists only in the real physical world as an exponent of the abstract structures. Even quite high-level aspects of sound structures can be left unspecified in the grammar for distinctive features, because the transductional interpretation is itself language-specific, and able to mediate between categorical and continuous aspects of the system. On this view, the interface is part of the grammar, and yet distinct from the formalism required to capture core phonological phenomena, so that the phonology can be relatively abstract and categorical.

Much research work (especially in the Laboratory Phonology tradition) seems to follow the basic method of looking for the quantitative relationship between real phonetic data and categorical phonological structures which this approach requires. There tends to be a balance between empirical and theoretical aspects which makes for a pleasing symmetry, but the need for quantitative data has tended to restrict the appeal of this approach.

1.7 The Interface From a Non-Modular Perspective

An alternative to dealing with low-level language-specific phonetics along the dimension of transduction is to combine highly concrete representations with other aspects of phonology, so that the dimension of concreteness is explored.

1.7.1 'Phonology' All the Way Down

The categorical machinery used to encode contrast and other core phonological concepts can be augmented so that all language-specific detail, quantized into small enough units, is expressed within one formalism. The granularity can be very fine-grained indeed, and, as was noted above, the smaller and more numerous the categories, the less categorical they are relative to phonemic contrast. Thus there are aspects of chunky gradience and continuousness in these theories, though they share the same discrete category-based architecture that is essential for contrast: different levels of granularity capture different phenomena.

Putting language-specific fine detail in the grammar brings the interface, and hence phonology, right down in Figure 1.1 towards concreteness. It is not clear if all language-specifics are incorporated. On the transduction dimension of the interface, these highly concrete and representationally rich phonologies still seem to maintain a strict demarcation between the generative grammar and physicalistic phonetics, but this is a point of contention. Hale and Reiss (2000*a*, *b*) criticize such phonology as being rich in phonetic substance, but perhaps it is richness of detail which represents substance rather than substance itself.

There are a number of approaches which I think can be roughly grouped together as being phonology stretched all the way down to make a unified non-modular framework (e.g. Boersma 1998; Flemming 2001; Steriade 2004). Moreover, some of this work represents also an approach in which the phonetic grounding of phonological patterns (including the parallelisms between phonetic and phonological phenomena first brought to general attention by Halle) and functional considerations of speaker effort and perceptibility are central concerns (Silverman 1997; Kirchner 1998; Hume and Johnson 2001; the papers in Hayes et al. 2004). In language, there seems to be a set of functional pressures to maintain contrast, to favour more perceptible contrast, and to reduce articulatory effort, for example. In non-modular theories, these functional tendencies (presumably universal) are incorporated into the grammatical formalism (including representational units and computational processes) along with substance-free phonological principles and operations. Such functional approaches vary in the extent to which representations are phonetically detailed. Some make it possible to specify fine detail and hence derive very concrete surface representation; others use phonetic tendencies to control the distribution of very high-level categories. Just as highly detailed phonological representations are not actually phonetics (because there is no transduction) despite being *more* phonetic than less-specific ones, the functional principles are not truly phonetic, for the same reason, despite being *more* phonetic than many phonological principles. These phonological codifications of phonetic detail and phonetic tendencies cannot replace true phonetics by being integrated into a cognitive, symbolic phonological module.

1.7.2 'Phonetics' All the Way Up

Articulatory Phonology (e.g. Browman and Goldstein 2004) provides a very different kind of unified model which tends to be even richer in fine-grained detail than the concrete models of the preceding section. This and related models display their phonetic origins in their structural and theoretical organization just as those in the previous section display their phonological antecedents.

Articulatory Phonology has been extremely successful for researching phenomena relevant to the phonetics–phonology interface. Its spatio-temporal, time-aligned and internally dynamic articulatory gestures can be subject to subtle and fine-grained realignment, or changes in amplitude, which are ideally suited to explaining some sorts of variation in output, including acoustically categorical ones. Many phenomena which previously were assumed to be categorical processes of insertion, deletion, assimilation, or reduction have been shown instead to result from particular instantiations of continuous relationships between gestures (e.g.

Browman and Goldstein 1995; Zsiga 1997). Like the research into functional explanations for phonemic patterns in section 1.7.1, this research has spanned phonetics and phonology and led to a greater understanding of their interaction, though in this case the formalism generally has a far more phonetic flavour. The major difficulty with Articulatory Phonology is seeing how it deals with core phonological phenomena with all their categoricalness, and how to abstract away from the specific information in its representations.

In terms of the tidal-zone analogy, Articulatory Phonology is like a sea creature specialized to explore up to around the high-water mark, whereas the functional phonologies are like a wading bird whose domain extends down to around the low-water mark. Articulatory Phonology and the functional phonologies reflect their antecedents so very clearly that it is hard to ignore their different origins. Thus their theoretical and descriptive interests overlap, but extend in opposite directions. Ohala (1995) is surely right when he says that views of the interface reflect the primary interest of the viewer.

1.8 Quasimodularity

1.8.1 From a Continuum Towards Overlap in a Broadly Conceived Sound System

Ohala is in fact a long-standing advocate of non-modularized phonetics and phonology (e.g. Ohala 1990, 1995). His own interests extend well beyond the specification of all and only the well-formed outputs of a synchronic grammar, which may explain why he has so consistently stressed the continuity of phonetics and phonology for so long, and the role of phonetics as the source of explanation for some phonological patterning and change. But this does not mean that phonetic naturalness plays any actual role in speakers' grammars. His stance is that grammar is capable of encoding whatever it finds, by and large, but the "by-and-large" functional effects (of all sorts) tend over time to change languages, presumably from one phonetically relatively natural state to another.

For Ohala, functional processes occur primarily in interactions between speakers, not within a single speaker's own grammar. He is also well aware that phonology is not always natural (Anderson 1981) despite being oriented towards natural phonetic patterning, because incompatible phonetic functional tendencies are in competition with each other, and also with phonological tendencies. Successive generations are able to transmit patterns that become increasingly unnatural in some regard as the natural phonetic cause is lost of a contrast or paradigm which itself is maintained phonologically. Thus patterns arise that contradict one set of functional tendencies, perhaps initially in a minor way, as a consequence of the speaker-learner paying greater heed to other sets. Ultimately only a diachronic explanation for the language's patterns will satisfy, and a synchronic battle between different functional constraints within the phonological grammar is rejected. This is an approach in which modularity of some sort is inherent, despite Ohala's view that there is no interface between phonetics and phonology. His perspective on this issue may be in relation to generative grammar.

For Ohala, phonology poses the questions, phonetics provides some of the answers, and our general abilities to learn abstract patterns (which creates tension between the two levels) provide most of the rest. For another non-universalist perspective, see Vihman's cross-linguistic work on language acquisition, mentioned briefly below. Another distinct approach is Firthian Prosodic Analysis (Firth 1948; Ogden and Local 1994). This seems to be the best place to address this framework, because although it separates phonetics and phonology very strictly (via a relation of "exponency"), thus is modular, it gives enormous and parallel scope to *both* domains, with implications for the interface. The sheer expansiveness of a language's sound system in the fullest sense (extending well beyond mere autosegmental contrast, allophony, and alternation) is explicitly recognized, as are the varying functions of fine phonetic detail (e.g. Local 2003; see also Docherty et al. 1997).

The polysystematicity so characteristic of the Firthian paradigm is important, because it means that the phonetics–phonology interface slides around within a language, depending on a host of factors (see e.g. Hawkins and Smith 2001). When we reject the idea that in a language "once in the phonology, always in the phonology", then we have adopted a polysystemic approach, one in which a given parameter can be conditioned by very different "phonetic" or "phonological" factors (and serve different functions) depending on its phonological, lexical, or grammatical context. If so, an interface crisply conceived becomes so dependent on context that it loses any straightforwardly modular interpretation. But for an approach with strict exponency (i.e. phonetic interpretation) to get further towards the sort of overlap discussed in the opening section it needs more than mere polysystematicity: what is also required is the broad conception of the sound system (incorporating stylistic, social, and discourse functions) so typical of the Firthians.

On balance, it does seems appropriate, I think, to define Ohala's work and these others as exemplifying a "quasimodular" approach, and this is the perspective with which I conclude.

1.8.2 Phonetics and Phonology Are Not the Same Thing

Some approaches to phonetics and phonology begin by stressing parallels between the two domains (e.g. assimilation is like co-articulation). While such parallels are extremely important to understanding the interface, it must not be forgotten that at the limits, the core of phonology has no parallel in phonetics: contrast and patterns of contrast are different in kind from sounds and patterns of sounds. Phonological differences can and have been successfully studied without a great deal of phonetic sophistication. They are, to an extent, open to analysis through introspection of the distribution of other high-level phenomena. Phonological contrasts are even amenable to expression in other media, such as in alphabetic writing systems. This is why the existence of an independent phonological module is repeatedly defended.

For a familiar example, consider the phonemes that condition the distinct allomorphs of the past-tense or plural suffixes in English. The facts of the distribution are not established in the synchronic grammar on phonetic grounds but primarily through facts of contrast and analytic identity. Yes, the "natural" classes of /VOICED/, /VOICELESS/, and /STRIDENT/ and the distributional restriction on /GEMINATION/ which dictate *baths*, *lounges*, and *groves*, or *chapped*, *chatted*, and *hummed* can be explained by reference to phonetic facts of production and perceptibility, but they do not need to be identified through phonetic analysis. In fact, it is not clear that they could be found on a purely phonetic basis without the help of top-down information. This is why these and other non-natural classes can, and have been, found through phonological analysis, and why phonological patterns persist well past their phonetic sell-by date. Nor do even the most natural of classes have to have a particular phonetic exponent: the same phonological classes can exist for speakers with different accents. Consider the wealth of phonetic differences that variationist research can reveal even within what is often thought of in linguistics as a single dialect. Some speakers of Scottish English use completely devoiced final /VOICED/ obstruents, but phonetic differences between /s/, /f/, /t/ and /z/, /v/, or /d/ do not alter the choice of allomorph. (Though such shifts in phonetics may lead diachronically to phonological reanalysis.) The phonetics of a phonological class is a compromise between different functional pressures. It will be, however, largely high-level categorical alternations, phonotactics, phonologically conditioned morphology, and the shared lexicon which determine the membership of such a class at any synchronic point.

But, though appearing to hold relatively steady (rejecting merger or split), as the phonetic exponents of phonological categories smear diachronically, cross-dialectally or stylistically across phonetic space, changes to the phonological system do occur. A strictly modular grammar would permit these patterns to be phonetically gradual but phonologically discrete, but this is not the only logical possibility. The phonological changes might themselves be gradual. As the phonetic underpinnings of the phonological categories shift from one balanced set of cues into another (perhaps by reweighting the cues or changing the set), so the contrastiveness of individual words, or phonological classes of words, could be gradually attenuated. If so, the interface between what seem to be distinctly phonological and phonetic systems has to be flexible.

So it seems that we do need two domains, the phonological and the phonetic, fairly traditionally drawn; but it is precisely an understanding of the nature of their interface for which we need a new set of theoretical ideas if we are to make progress. One view, which I feel drawn to, is that they form module-like domains that are not completely distinct, in that they share a middle ground. This is interface as overlap. Alternatives are that they form the ends of a continuum (interface as transition or continuum) or two discrete and distinct modules (interface as interpretation). These alternatives have been represented for some time, and by a number of approaches, some of which have been cited above. What has been and still is lacking, however, is a formal theory of overlap. How can we have relatively crisp categories such as those established through phonological contrastive analysis coexisting with gradient phonetics; and how can cognitive and physical domains be only quasi-distinct?

One way may be through a framework in which *both* transduction and concreteness are continuous rather than discrete, but where the phonetic and phonological ends of the continuum are nevertheless characterized by continuousness and categoricalness, respectively. The trick would then be to have an interface between them which was in some respects continuous (gradience would give way slowly to categoricalness, and vice versa), and in some ways not (it being possible, if not necessary, to take a perspective in which intermediate cases belong to one domain more than the other). Thinking back to the tidal ecosystem, the overlap could be temporary home to truly phonological and truly phonetic phenomena, as well as providing a home for intermediate, transitional, and ambiguous ones. This is a model in which the language user's grammar can be flexible, non-deterministic, and gradient about modularity.

1.8.3 Exemplars

Such a model seems to be being developed by a number of people exploring a probabilistic framework sometimes called Exemplar Theory (Bybee 2001; Pierrehumbert 2001, 2002, 2003; Hawkins and Smith 2001; Coleman 2002; Bybee and Hopper 2002; Hawkins 2003; Bod, Hay and Jannedy 2003; Silverman 2006; Foulkes and Docherty, to appear). This work integrates phonological patterning and phonetic detail by looking at how generalizations and abstractions emerge statistically from raw distributional patterns, and how the patterns themselves may have functional explanations. This chapter has been greatly influenced and stimulated by that work and more cited therein, and in many respects the chapter is my way of working through the very radical proposals which they contain in an attempt to understand how they fit with the more familiar linguistic traditions that are also a strong influence on current theory and on my own ideas.

Exemplar Theory comes naturally from approaches to the sound system which explore catholically the wide range of functions which phonetic specifications can have, such as those mentioned earlier in this section. It draws on psycholinguistic "multiple-trace" or "episodic" models (the terms seem to be interchangeable) of the mental lexicon and speech perception (e.g. Goldinger 1997; Mullenix 1997; Pisoni 1997; Johnson 1997). In these models, the fact that learnt language is a type of memory is central, and the physicality of phonetics and phonology is extended from models of speech production into neurolinguistic models of storage, planning, and perception. Multiple detailed exemplars or traces of every lexeme are stored: but in storing such an enormous number of only subtly different tokens of real-world productions, abstraction, and coalescence occur by necessity. This happens automatically by virtue of encountering "different" tokens of the "same" word. Memories are contextualized to the situation of use, so sound patterns are associated or labelled with a contextual meaning. Actually, the immediate context of utterance is so rich that the range of meanings is huge, but only recurring sound–meaning pairings are strengthened. The abstractions that are formed must be much like traditional distinctive features and phonological units, forming a hugely complex, partially hierarchical web of associations. The lexicon, as it is acquired, becomes a mix of structured abstractions and detailed memories of previous speech events and contexts. Probability distributions over phoneme- or lexeme-sized categories are automatic (since more frequent tokens and categories are represented more frequently), so the theory has been used to explain frequency effects in phonological patterning and to model the gradience of judgements of phonotactic well-formedness. In such a model, transduction is less relevant to the interface because the initial cognitive representations of speech sound and articulation are so highly detailed, well beyond the levels needed to encode any linguistic contrast, somewhat like a high-fidelity recording. There is of course transduction during perception and production, and it is likely to be relevant to phonology, but not in the same way as the far more extreme separation dividing abstract phonology from substance.

High-fidelity memorization of such enormous quantities of such subtly varying detail in the repetition of a given word over long periods of time cannot be maintained, and the ways in which a trace blurs into others in memory reinforces semantic links with lexical meaning, phonological categories, etc., as well as speaker identity, mood, paralinguistic and social aspects of language use, and so on. The pairing of sound and meaning exists for any continuum or set of categories arising from speech, so long as the speech "sounds likes" an example of a category or a region on a continuum, more or less. Individual exemplars form parts of many distributions in the many dimensions of phonetic space. Input automatically appears in this space in relationship to previously encountered input. The power of lexical contrast is that despite phonetic variation, *pin* and *bin* are semantically disjoint, and once the lexical identity of a trace is known, the rich phonetic detail, however subtly distinct from other traces, can be viewed though a categorizing lens.

If unfamiliar lexis, voices, or accents are encountered, new traces are formed which overlap less with previous distributions and may, if they are initially disjoint enough or if additional tokens reinforce them, form new distributional modes and loci. Categorical, semi-categorical, or non-categorical intuitions about patterns usually modularized into sociolinguistics, orthography, phonology, paralinguistics, and morphophonemics are all available for introspection, as is awareness of articulatory or acoustic detail. In this sort of model, a broader conception of phonology is natural: intuitions about other people's sound systems are as naturally explicable as intuitions about one's own.

All categories, including phonological ones, emerge as probability densities in distribution of tokens in a multidimensional map. For example, in Figure 1.2 (based on a figure in Pierrehumbert and Gross 2003) there is a highly simplified map of continuous phonetic space (in only two dimensions). Each individual trace (of lexical items, say) is actually encoded in so many dimensions that the distributions in just two may be viewed as being normalized for the other differences, so that vowel duration distributions are not muddied by the effects of vowel height, for example. In Figure 1.2 are two fairly clear categories, one lower to the left, and one to the right. The distribution partitions the space fairly clearly into two parts. These may correspond to classes of lexical items differing in their vowel, in other words to a contrast. They may indicate a relatively primary cue (e.g. to a phonemic vowel contrast), or a more minor one (e.g. to the post-vocalic voicing contrast), depending on the density and unambiguousness of the cluster and how it interacts with more or less gradient distributions along other dimensions that are

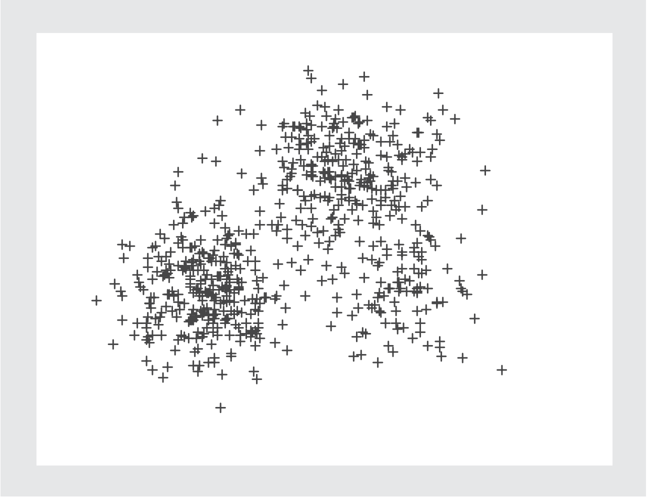

Fig. 1.2 Sample phonetic distribution in two arbitrary dimensions

not shown. Continuous phenomena can also be labelled, and, as indicated above, labels can encode not merely lexical meaning but all sorts of contextual meaning, such as sociolingistic or paralinguistic information.

Note that there is also a minor distributional split between the upper and lower distribution on the right. This split may function in the same way as the major split (i.e. arise for the same sorts of reasons), but its existence as a category is less clear-cut. In this way, the difference between categorical and non-categorical is itself gradient. The question of whether there are two or three modes in Figure 1.2 does not have a clear answer. It is in this way that the sort of "difficult" interface phenomena referred to above need not be attributed to either one module or the other, but can be indeterminate and ambiguous. Categorically distinct labels on each of these datapoints could enable clear categorization in one sense, but how reliably those differences are *conveyed* depends on their whereabouts in the phonetic space.

Such a model is compatible with language learners forging their own phonological and phonetic systems, under the influence of phonetic and phonological patterns in the input and our cognitive-linguistic predispositions (Vihman and Velleman 2000). Indeed, a great deal of support for the overlap model is likely to come from work which, like Vihman's, charts the emergence of categorization by the child. It is not compatible with universal phonological features or the sort of strict modular separation discussed above in which phonology *cannot* be influenced by phonetics. Rather, high-level phonological generalizations will tend not to be influenced, but phonetically weaker, less frequent, less categorical, more variable patterns will indeed be more contingent on actual phonetic substance. Within higher-level phonology itself it has always been understood that in addition to the clear categories, there are others whose status is more problematic. Especially difficult for traditional approaches are highly limited phonotactics, complex morphophonemics and suppletion. Furthermore, every phonological system has a periphery of dubious candidates, (especially those with limited lexical distribution, e.g. in loanwords or names) and it may be that these reflect either clear phonetic modes with little systematic generality, phonetically weak modes, or both.

These properties of the model are advantageous in capturing interface cases in which there is evidence of clear phonological categorization (established at least in part on non-phonetic grounds) associated with overlapping, continuous, or congruent phonetic distributions, or categorically distinct phonetic distributions which are of indeterminate phonological status. I am drawn to the model because of evidence that we can acquire the contrasts and system of our speech community with some degree of flexibility (and in a bottom-up, category-forming way, cf. Vihman and Velleman 2000). For an example, in a study of a group of twelve Shetlandic adults (Scobbie 2006), I found that the individuals' VOT targets for /p/ (and the distribution of tokens) provided no evidence that each individual was limited by universal grammar to learning either a short- or a long-lag target for /p/

(the traditional Shetlandic dialect form [p] or Standard English [p^h].) Interspeaker variation was wide-ranging and continuous: some produced a unimodal distribution between the two "universal" short and long lag targets. Nevertheless, when all the data is pooled, the general functional tendency towards stops being either short or long lag does seem to be clearly discernable (Figure 1.3). Markedness is evident from the group behaviour, but not necessarily in individual behaviour—just what we might expect from Ohala's work.

Exemplar theory does not demand that one feature or another is distinctive. So the same lexical items can be distributionally distinct in different dialects of a language, but the locations of the phonetic distributional modes will differ. And one dialect's distribution of tokens may be more or less distinct from the general background or other local peaks than is the other dialect, automatically meaning that different contrasts can be more or less robust.

Finally, it was mentioned above that the Exemplar model raises the interesting possibility that the transduction dimension is also quasi-modular. Since the model is based on multiple cognitive traces which directly encode phonetic detail, far beyond what will eventually be necessary for the sound system, the distinction between cognitive and physical is broken down somewhat (Figure 1.4). This raises very interesting possibilities for research in language acquisition (cf. Vihman's work on phonetics and phonology) and speech pathology (cf. Perkins 2005 and

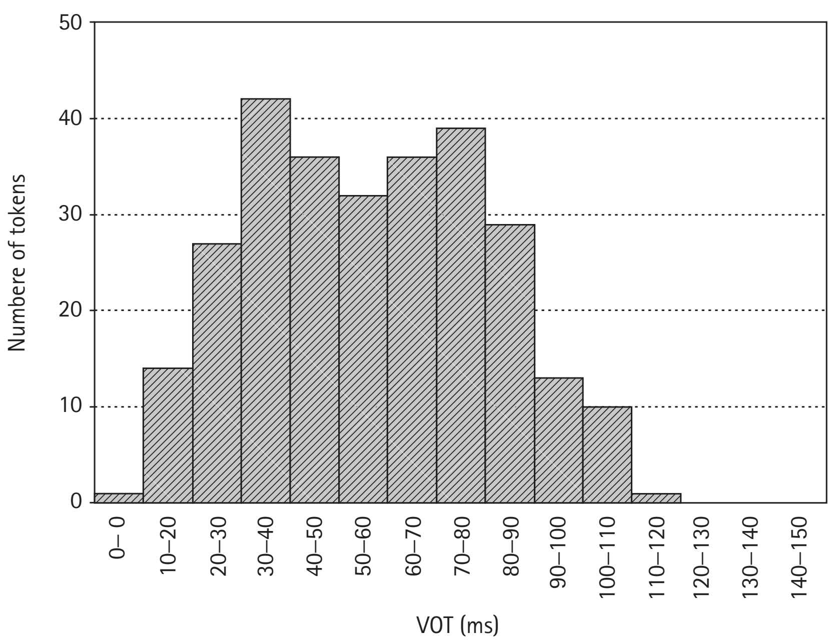

Fig. 1.3 Histogram of VOT for /p/ from twelve unimodal Shetlanders: a distribution in one phonetic dimension with two phonological modes

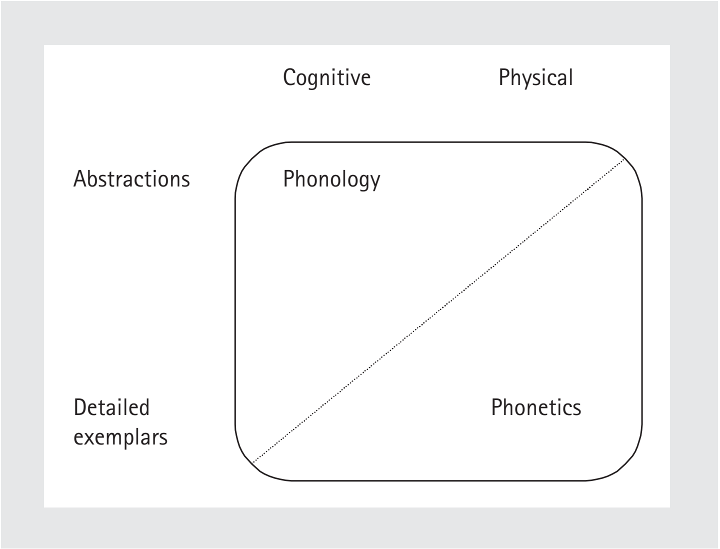

Fig. 1.4 Model of non-modular phonetic and phonological space

references and papers therein on comparable developments in pragmatics), two fields in which the cognitive linguistic aspects of the system interact with physical and/or non-linguistic aspects.

Phonetics and phonology still differ in two dimensions, but exemplars are so detailed that, like a compressed digital recording, they merely transpose relevant aspects of an acoustic waveform to neural storage to enable a relatively faithful trace of the input. This may only be short-term storage, which will excite and reinforce certain previously stored abstractions and pathways, but long-term mental representation of language is also, in this theory, biased towards being as highly concrete as it can be. The physical–cognitive distinction therefore does not seem so relevant to phonology as it does when dealing with a discrete and crisp mapping between such higher-level units as distinctive features and phonetic stuff.

In general this seems a beneficial situation, because phonetic substance, after all, requires multiple transductions, for it is acoustic, and aerodynamic, and articulatory, where one is caused by the next. The articulations themselves result from motor planning, and the motor plans are themselves stored neurologically as exemplars of productions. When, in this process of transforming a memory into a movement, does the speaker discretely transform the cognitive into the physical? And how great is the linguistic role of transduction in perception? This is a complex process of many facets which has to separate and analyse information in parallel, such as the lexical content of input and its indexical, discourse, and paralinguistic content, and use top-down semantic, pragmatic, and lexical frequency information (stored neurologically and obtained from other perceptual senses) in addition to detailed mental representations of phonetic substance.

1.9 Conclusions

Phonology is widely accepted as a linguistic module (in the sense of Fodor 1983), and phonetics too, to a lesser extent, though this must not be taken to imply that there is agreement as to how to define either domain, let alone their interface. In this chapter I have indicated some of the key characteristics which support the separation of phonetics and phonology into distinct domains—conceptual, descriptive and methodological—while keeping the issue of strict modularity open for discussion. I have reviewed some of the basic approaches to the interface between phonetics and phonology within the modular tradition, which pits phonology against phonetics in a theoretical battle over a tranche of interface phenomena. We have also seen that there is an approach which is non-modular in practice, in which the two domains fall on a continuum with a single underlying theoretical architecture linking them. By their very nature, such non-modular frameworks are most successful when dealing with intermediate phenomena, because they can readily encode parallels with *slightly* higher- or lower-level phenomena. Even so, there seems to be little support for the position that phonology and phonetics are one and the same, even in a unified formalism, for the traditional core characteristics of phonology and phonetics are so distinct. There must be an interface of *some* description even in non-modular approaches. It could be a point on—or portion of—the continuum: it might be possible to define it clearly, or not. In the work of different linguists, as I have suggested, descriptive and explanatory analyses couched in broadly phonetic or phonological terms will be able to compete, but in mainstream generative linguistics such ambiguity can less easily be the property of a single grammatical analysis.

There is a general consensus in linguistics that there must somehow be a clear definition of "the" interface (though ideas of what, or where, it actually *is* vary widely) because phonology has at its core the study of an irreducibly cognitive and categorical phenomenon—contrast—while phonetics has as its core the study of the continuous physical media of speech production and perception. I think it important to distinguish the dualistic separation of physical and mental domains from the question of how phonetically concrete the grammar of the cognitive system should be, particularly when trying to understand different research traditions. It is also essential to recognize that even though there are clear differences between the core aspects of phonetics and phonology, this does not mean there needs to be a clear phonetics–phonology interface.

Generative phonological theories must address the concreteness aspect of the interface: to what extent are the formal representations and operations required for core aspects of phonology used to encode (even just language-specific) fine phonetic detail? In each descriptive grammar the instantiation of this concreteness problem is: which (parts of which) phenomena require phonological analysis? For theoretical phonology generally: *what* counts as data and *why*? These are fundamental interface issues for surface-oriented phonology because they delimit the lower limit of the field by defining the very data which must be, or need not be, described and explained. In Exemplar theories, however, whether a given phenomenon is strongly categorical or not may be speaker-dependent, context-dependent, or otherwise a matter of degree, and a clear answer as to whether a given phenomenon is or is not phonological is not possible. The data relevant to such frameworks are far more inclusive, giving phonology in a broader sense a role beyond its traditional modular limits. To address such new perspectives, indeed, to evaluate traditional approaches to the interface and make progress in the debate on the fundamental phonetic nature of phonology itself, detailed quantitative research methods must be employed, both phonetic and phonological.

The transduction aspect of the interface struggles with how (non-contrastive language-specific) physical differences come to be represented cognitively, and how functional phonetics can explain phonological tendencies. However, when the cognitive dimension of language becomes highly concrete, as detailed as is necessary to represent the relevant physical reality, perhaps this moves functional explanations across the transductional divide, whether in a discrete modular way, or more gradually. It is not clear to me what this means in practice, except that functional *explanation* for phonological patterns in general is very different from codifications of specific, often un-natural phonological patterns. Moreover, the most natural patterns and tendencies found in a language's sound system are likely to be regarded as not phonological at all, displaying as they do many of the traditional characteristics of phonetic patterns. Thus fundamental phonological problems (e.g. inventory size and membership), which seem to be amenable to functional explanation, still demand a transductional separation of domains to make conceptual sense.

I think that the most exciting prospect for progress may come from models which blur both dimensions, for a number of reasons. First, modular and generative theories set themselves the task of *solving* the interface problem, and so far have not merely failed to reach any long-lasting consensus but, by relying on pre-categorized data, have sometimes been so descriptively inadequate as to be theoretically misleading: the claimed categoricalness of many external sandhi assimilations in English being a good example of how the questions were begged when the only data thought relevant was already categorical. Second, individuals (and groups) can vary both subtly and radically in language acquisition, structure, use, and pathology, suggesting that models based on non-determinism and variable systemization could enable more realistic insights into sound structure. Flexibility may be modelled by allowing a continuum from categorical to continuous phonetic distributions, by maintaining distinct theoretical principles of core phonology and phonetics, and letting them compete and simultaneously account for (parts of) ambiguous phenomena. If a complex phenomenon turns out to have predominantly phonological characteristics in some contexts but predominantly phonetic in others, then our theoretical models should reflect this and be forced neither to choose one domain over the other nor to characterize the phenomenon (which will always be fuzzily defined to some extent) as being cleanly "split" down the middle.

A quasimodular framework rejects the widespread assumption among phonologists that "categorical" and "gradient" are themselves distinct (see Cohn in press for an excellent discussion). Choosing "meta-gradience" does not mean there are no clear phonological categories, but not-so-clear categories also exist, and the framework rests on some sort of a statistical foundation from which units and categories can emerge (for a specific proposal, see Pierrehumbert 2003) rather than discrete and substance-free symbols. Strong categories are clear modes in the distribution of values in multi-dimensional phonetic space. Phonetic space is not a flat equilibrium, but a highly complex distribution which successfully communicates linguistic structure from one speaker to another. All language-specific information is there in the phonetics to be learnt, but some modes are bigger, crisper, and stand out from the background more than others.

Recent results motivating Exemplar approaches involve interaction between idiolectal phonetics and the phonetics of contrast: somehow the characteristics of individual speakers can be stored and processed along with phonological and lexical information. It seems that the interface should be dynamic, ambiguous, and soft on the one hand, but without denying that the categorical characteristics of lexical contrast are very different from the continuous nature of sociolinguistic and idiolectal variation in the phonetic realization of such systems.

Though the assumption that there is a strict interface has prompted a great deal of research, some of it of lasting value, it is not an assumption which is logically necessary. Nor is it one which is useful to many researchers looking precisely at those phenomena whose affiliation is unclear. Further, it does not provide a safe and non-circular basis for demarcating the body of data which phonological or phonetic theory attempts to explain. And finally, the assumption that there is a strict interface does not seem to limit particularly the variety of ways in which *core* contrastive phonology can be approached. On the other hand, the view that phonetics and phonology differ but overlap predicts that difficulties of demarcation and identity exist as part of an individual language user's mental grammar, thus prompting new questions, models, and solutions to old analytic problems of language structure, acquisition, change, and use. The ebb and flow of different theoretical conceptions of the relationship between phonetics and phonology may be explained ultimately by the flexible nature of the interface itself.

Further Reading

Here are some ideas for further reading in addition to the work cited in the initial paragraphs of sections 1.3 and 1.8.3, and my papers on VOT (2006) and fuzzy phonology (to appear).

Demolin, D. (2002), "The Search for Primitives in Phonology and Explanation of Sound Patterns: The Contribution of Fieldwork Studies", in C. Gussenhoven and N. Warner (eds.), *Laboratory Phonology 7*, Berlin: Mouton de Gruyter, 455–513.

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CHAPTER 2

MODULARITY IN THE "SOUND" DOMAIN: IMPLICATIONS FOR THE PURVIEW OF UNIVERSAL GRAMMAR

CHARLES REISS

2.1 Modules and Interfaces

In this chapter, I adopt the position that cognition, including linguistic cognition, is best understood as a set of modules, each of which is characterized by mappings involving inputs and outputs in a particular format. I assume that these modules

Many of the ideas in this chapter have developed over the years in collaboration with Mark Hale. I also benefited from discussion with various people and presentations at various conferences. Jim Scobbie deserves special mention for a thoughful and challenging set of comments, only some of which I have been able to address. I am also particularly indebted to Morris Halle for encouraging me to pursue these ideas, despite their speculative nature. This work was supported by two grants from the Canadian Social Sciences and Humanities Research Council: a Standard Research Grant to the author for 'Explicit Models of Phonological Computation' and a Major Collaborative Research Initiative on 'Asymmetry at the Interfaces' (A.-M. di Sciullo, P. I.)

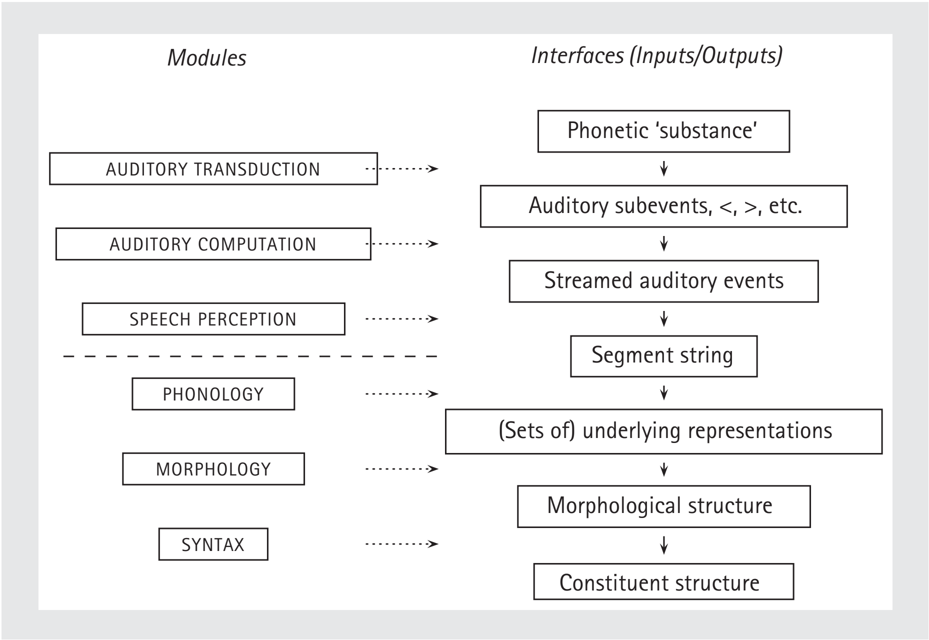


Fig. 2.1 Components of the speech chain

are informationally encapsulated from each other—a module may have access to the outputs of another module, or feed its own outputs as inputs to another module, but a module does not have access to the internal workings of another module. I define an interface as such a configuration in which the outputs of one module M_i serve as the inputs to another module M_j. This situation defines the "*i–j* interface". Thus, I reduce the problem of understanding the *i–j* interface to identification of those outputs of module M_i which M_j receives.

As an indication of where this discussion is headed, consider the simplified diagram of the "speech chain" in Figure 2.1. The content of each box on the right, with the exception of the "phonetic substance", is a representational format that defines an interface. The vertical arrows between boxes correspond to the modules listed in the lefthand column. For example, the segment string is the output of the speech perception module and the input to the phonology, and thus it defines the interface of these two modules.

For expository convenience, I focus on input, or parsing, so there is no reference to articulation, for example. Another simplification here is that top-down processing in actual language use is not represented—for example, knowledge about the context of utterance can induce speakers to arrive at judgements about phoneme identification that conflict with the computations of the speech perception module. In some cases, listeners may even judge stimuli to contain segments whose acoustic correlates have in fact been completely replaced by white noise. It is unfortunate that the term "speech perception" is typically used to refer both to the kind of computations intended by the term in this chapter and to higher-order processes involving judgements that can be affected by listener's expectations, knowledge of the lexicon, etc. I take the position that listener judgements are a source of evidence for the nature of speech perception, but that judgements are the result of many interacting factors. The parallel to grammaticality judgements in syntax, which may be affected by garden-path structure, multiple negation, and other processing challenges, should be obvious. Just as your legs do not go for a walk (Chomsky 2000: 113) and your grammar does not communicate, your speech perception module does not make segment identification judgements; you, a complex of interacting modules, with goals, intentions, and expectations, do all these things: go for walks, communicate, and judge whether and which segments are present in stimuli.

The terms "phonetics" and "phonology" are both used with a wide range of meanings in the literature. In this chapter, I adopt a narrow definition of phonology as a component that involves computations over discrete symbols corresponding to the familiar types of distinctive features ([$\pm$nasal], etc.) and syllable structures. Phonetics, on the other hand, will be used as a cover term for all components above the phonology in Figure 2.1. Some aspects of Figure 2.1, such as the symbols for the auditory sub-events, will be clarified below.

The dashed line in Figure 2.1 delimits the traditional core domains of study of generative grammar—phonology, morphology, and syntax—as opposed to the performance systems that enter into linguistic behaviour. I will follow generative tradition in calling the modules below the line "language", the concern of grammatical theory. The study of the representational and computational properties of humans that allow for language will be called Universal Grammar (UG).[1]

2.2 The Language Faculty and the Performance Systems

As a phonologist, my primary interest is to understand the phonological component of the language faculty, phonological grammar. In this section, I discuss the fact that UG, the study of the language faculty, including phonology, actually requires us to consider the nature of the performance systems as well. The idea is not to

[1] Strictly speaking, UG is generally understood to be concerned with properties of mind that are relevant only to language, not to other modules. For example, memory is necessary for language, but the study of the nature of memory is considered more general than UG. This is a clear case, but sometimes the issues are not as clear, and I will not address them here.

collapse the distinction between the language faculty (grammar) and the performance systems, but, rather, better to understand which aspects of observed phenomena are due to the former versus the latter. The necessity of this approach is apparent as soon as we appreciate the fact that data does not come to us sorted and labeled as "phonological" vs. "other".

Chomsky has long argued that the nature of the language faculty, linguistic competence, as opposed to performance systems, should be the focus of study for theoretical linguists. In the following quotation, Chomsky suggests that this competence–performance contrast is relevant to all areas of cognition, not just language.

> In my opinion, many psychologists have a curious definition of their discipline. A definition that is destructive, suicidal. A dead end. They want to confine themselves solely to the study of performance—behaviour—yet, as I've said, it makes no sense to construct a discipline that studies the manner in which a system is acquired or utilized, but refuses to consider the nature of this system. (Chomsky 1977: 49)

The focus on competence has been influential, not only in linguistics but in cognitive science generally (cf. Pylyshyn 1973), although in practice the issues remain unclear and controversial. I hope to support Chomsky's position in the following discussion of the necessity of competence models, by considering how non-competence factors can obscure our view of underlying competence. In other words, non-competence factors may distort the scope and quality of the data we can access in building competence models.

While Pylyshyn, too, stresses the importance of constructing competence models, he also argues that not all aspects of apparently systematic symbol processing behaviour should be attributed to competence. Pylyshyn proposes the following thought experiment (1984: 205ff). Consider a black box that outputs signals of spikes and plateaus. When a two-spike pattern and a one-spike pattern are adjacent, it is typically the case that the former precedes the latter, as on the left side in Figure 2.2. However, we occasionally see the order switched, but only when the two- and one-spike patterns are preceded by the double plateau-spike pattern on the right side of Figure 2.2. Pylsyhyn asks what we can conclude from such observations about the computational capacities of the system in the box. His answer, perhaps surprisingly, is that we can conclude almost nothing from such observations. This, he explains, is because "we would not find the explanation of the box's behaviour in its internal structure, nor would we find it in any properties intrinsic to the box or its contents."

Pylyshyn's claim is based on what he designed his imaginary black box to be doing. The spikes and plateaus in Figure 2.2 correspond to the dots and dashes of Morse code, and the observed regularities reflect the English spelling rule "*i* before *e*, except after *c*". In other words, the system is processing English text. If we fed it German text, with *ie* and *ei* clusters freely occurring in overlapping distribution, we would no longer observe the same output patterns.

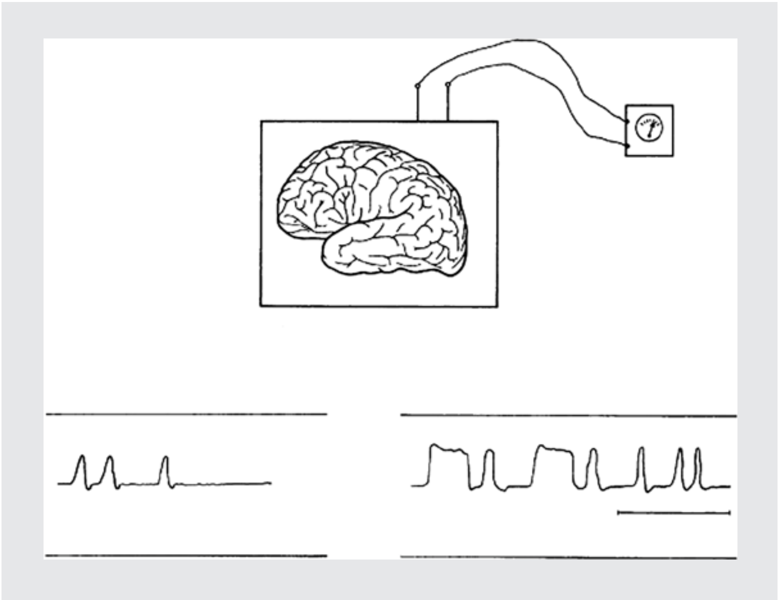


Fig. 2.2 How do we figure out the computational capacity of the system inside the box? Reproduced from Pylyshyn (1984) by permission of MIT Press

Pylyshyn explains:

> The example of the Morse-code box illustrates . . . that two fundamentally different types of explanation are available for explaining a system's behaviour. The first type appeals to the intrinsic properties of the system . . . The second type of explanation appeals, roughly, to extrinsic properties . . . of real or imagined worlds to which the system bears a certain relation (called *representing*, or, more generally, *semantics*). The example illustrates the point that the appropriate type of explanation depends on more than just the nature of the observed regularities; it depends on the regularities that are *possible* in certain situations not observed (and which may never be observed, for one reason or another) (Pylyshyn 1984: 205)

In linguistic terms, the explanation for the patterns we see in the data (either patterns we see or patterns in what we do not see, systematic gaps) may not reflect intrinsic properties of the language faculty, but instead reflect properties of the kinds of information the language faculty has access to.

We can clarify this by asking what Universal Grammar (UG) should be a theory of, and considering the relationship between this theory and available data. A rather naive first proposal would be that UG should account for all and only the attested languages. Obviously, we do not want our theory to reflect just the accidents of history, everything from genocide and colonialism to the decisions of funding agencies to support research in one region rather than another. So, the purview of UG must be greater than just the set of attested languages.

It would be an error in the other direction to propose that UG should be general enough to account for any statable language. For example, we can describe a language that lengthens vowels in prime-numbered syllables, but there is no reason to think that the human language faculty actually has access to notions like "prime number".[2] To make UG responsible for all of formal language theory would reduce biolinguistics to a branch of mathematics, with absolutely no empirical basis.

A tempting intermediate hypothesis between the set of attested languages and the set of all statable languages is the suggestion that UG is responsible for all attestable languages. In other words, we know that there are extinct languages, and languages that have not yet come into being, and these are attestable in principle.[3]

However, even this middle-of-the road compromise turns out to be insufficiently broad for reasons that relate to Pylyshyn's point that "the appropriate type of explanation depends on more than just the nature of the observed regularities; it depends on the regularities that are *possible* in certain situations not observed (*and which may never be observed, for one reason or another*" [emphasis added—CR].

Why should we have to account for classes of languages that can never be observed? Consider that grammars are embedded in humans and that they are partially learned. It follows from this that the human transducers (input and output systems), the language acquisition inference systems, and performance systems place a limit on the set of attestable languages beyond the (upper) limits determined by S_0, the initial state of the language faculty.

In Figure 2.3, we can see, as discussed above, that the set of attested languages, corresponding to the small dark circle, is a subset of the attestable languages, shown as the hatched region. Obviously, this latter set is a subset of the statable languages, the box that defines the universal set in our diagram. However, there are two remaining regions defined in the diagram that need to be explained. Note that the set of attestable languages corresponds to the intersection of two sets, the set of humanly computable languages, the large grey circle, and the white circle labelled as "processable/transducible/acquirable".

In order to be attestable, a language must be acquirable on the basis of evidence presented to a learner; an attestable language must also not overload the processing capacity of a human; and finally, an attestable language must be able to be

[2] Actually, the notion of prime number appears to have no relevance in any empirical field. This point leads to an issue that has arisen in numerous discussions of the proposal that phonology is pure computation and thus substance-free, as discussed by Hale and Reiss (2000*a*, *b*). It has been objected that our claim is uninteresting since it appears that we are proposing that the phonology is basically a Universal Turing Machine. This is not a valid conclusion, since our position is that phonology is all, that is, only, computation—not that all computations can be used by the phonological faculty of the mind.

[3] Of course, in the context of mentalistic, I-linguistics, we have to recognize that only an infinitesimal number of attestable languages have been described in any detail.

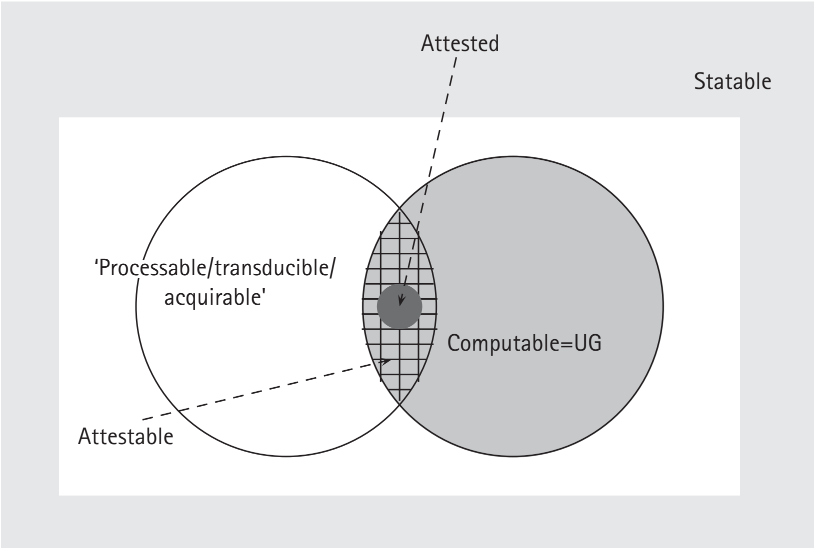


Fig. 2.3 What is UG about?

presented to the language faculty via the perceptual and articulatory transduction systems. If a language failed to meet any of these criteria, it would not be attestable, even if it made use only of the representational and computational primitives of the human language faculty—that is, even if it were a member of the set represented by the large light grey circle.[4]

An example of an unprocessable language, one falling outside the white circle, would be one in which all words contained at least 98 syllables—word recognition memory buffers would presumably not be able to handle such input. An example of an untransducible language would be one presented in a signal outside the range of human hearing. We would not want to explain the fact that such a language is unattested or unattestable by appealing to properties of the language faculty qua computational system.

Languages that fail to fall inside the white circle may or may not fall inside the large grey circle. Those that do fall within the grey circle would fall in the part that is not hatchmarked. It would take us too far afield to present an example here of a computable language that is nonethless not acquirable, in other words, fails to be attested specifically because no evidence could lead a learner to posit such a language, but I discusses elsewhere one such case in the domain of stress computation (Reiss forthcoming).

[4] The careful reader will notice that this diagram should be interpreted as fairly informal, since the languages represented are sometimes conceptualized as grammars, sometimes as sets of sentences or even utterances. I think the expository usefulness of the diagram outweighs this inconsistency.

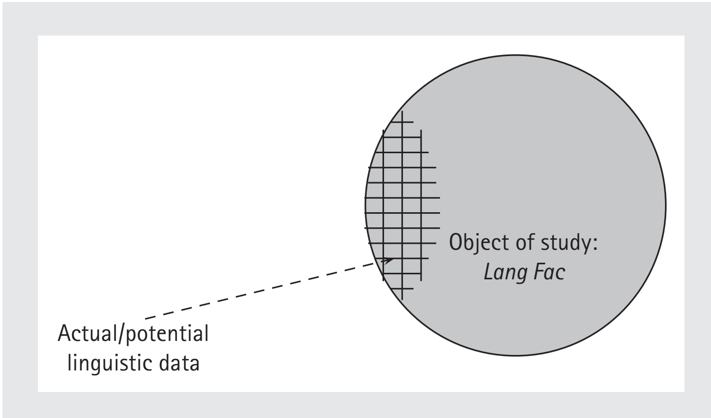


Fig. 2.4 Evidence and object of study

So, according to our discussion, the purview of linguistic theory should be the set of humanly computable languages, the large grey set, even though some such languages are unattestable—they "may never be observed, for one reason or another".

This situation, which I think may be relatively normal in science, can be best appreciated by extracting part of Figure 2.3, as in Figure 2.4. Our source of actual and potential data is restricted to the set of attestable language, but we have to induce from this empirical data the nature of the larger set of potential languages. It is important to keep in mind the fact that inducing this larger set will probably be a matter of positing *fewer* properties for the language faculty—by being less specific, more general, we describe a larger set. To make this idea concrete, contrast a phonological UG that just specifies that there are rules that insert, delete, and change feature values with one that specifies all this, as well as stipulating that, in codas, feature-changing rules affecting [voiced] always involve turning [+voiced] to [−voiced] and never [−voiced] to [+voiced]. The position I am pushing is that the first version of UG, the one that makes no mention of specific features in specific rules, is what we should aim for. This is not to say that UG does not specify a set of representational primitives—features. The claim is just that the attested combinations of representational and operational primitives found in particular languages, like "Change [+voiced] to [−voiced] in codas", are not encoded in UG. The building blocks for the phonology of attestable, and even some unattestable, languages must obviously be present in UG, but not the rules of particular languages.

The approach is expressed in the following quotation concerning the ultimate goals of linguistic theory:

> . . . to abstract from the welter of descriptive complexity certain general principles governing computation that would allow the rules of a particular language to be given in very simple forms. (Chomsky 2000: 122)

Thus, the frequently attested pattern of coda devoicing (whatever the correct featural description of this may be), and the perhaps complete absence of coda voicing, as phonological processes in the languages of the world is thus, in my view, not to be accounted for by UG. This view is inspired by a long history of empirical work concerning the phonetics of sound change by John Ohala (see Hale and Reiss 2000*a*, *b* for discussion).

Part of this task of understanding phonology, or grammar more generally, requires that we understand the nature of the systems that pass information to or receive information from the grammar, either via direct interface or through the mediation of other systems. The relevance of the competence–performance distinction, discussed above, is sometimes obscured by the fact that discussion of performance tends to focus on so-called "performance errors", which include mispronunciations, failures to mark obligatory agreement, etc. In fact, every utterance "in a language" reflects competence and performance. It is sometimes said that insistence on competence theory is not valid unless we provide a theory of performance, but I adopt the position that there should not be a single theory of performance since performance includes all the components of Figure 2.1 above the dashed line ("phonetics"), as well as other things. By better understanding what is not phonology, we can better understand what phonology is—we will not mistakenly attribute a property to the phonology that rightly belongs elsewhere. It is to this problem that we now turn.

2.3 Transduction vs. Computation

In this section, I introduce the distinction between transduction and computation as part of an elaboration of the first two modules in Figure 2.1. In section 2.5, I sketch Bregman's theory of auditory perception as well as a suggestion for a 'grammar' of auditory perception developed by Nakajima and colleagues. Section 2.6 presents an auditory illusion along with an analysis in terms of Bregman's and Nakajima's work. In section 2.7, I apply this result to an understanding of speech, particularly segmentation. I return to a general discussion of interfaces, including a comparison of "substance-free" phonology (Hale and Reiss 2000 *a*, *b*) and recent approaches to phonetically grounded phonology in sections 2.8 and 2.9.

Pylyshyn (1984: 152) calls transduction the "bridge from the physical to the symbolic" and provides the following discussion:

> This, then is the importance of a transducer. By mapping certain classes of physical states of the environment into computationally relevant states of a device [*e.g.* a human], the transducer performs a rather special conversion: converting computationally arbitrary

physical events into computational events. A description of a transducer function shows how certain nonsymbolic physical events are mapped into certain symbolic systems.

Fig. 2.5 Inferring continuation behind an occlusion

When Bregman (1990: 3) points out that "In using the word representations, we are implying the existence of a two-part system: one part forms the representations and another uses them to do such things as calculate . . .", I interpret this as making a similar distinction between transduction (which forms representations) and computation (which calculates over symbols). To take a typical example, the detection of edges and colours in a visual scene like Figure 2.5 involves transduction; the inference that two discontinuous regions with the same shade of grey are parts of a single, partially occluded object is an inference or computation.

Bregman and Pylyshyn are concerned with the transduction from physical signal to symbolic representation.[5] I will extend the term "transduction" to refer to any mapping that generates inputs to a module. So, the auditory perception system contains a transduction component, in the narrow sense, which converts acoustic signals to symbolic representations; and we can also talk of the transduction, in the broader sense, from the signal to the phonology. This broad notion of transduction will include all the components of Figure 2.1 above the dashed line. In other words, mappings between symbolic representations within a module will be called computations, whereas mapping between formats proper to different modules (or between a physical or neural format and a symbolic structure) will be called a transduction.

We may not be able simultaneously to understand all the transducers, but I hope to show that understanding more about transducers, that is, performance systems, can help us understand the nature of competence. In the following two sections I discuss transduction and computation in auditory perception with the goal of returning to phonology, in the narrow sense developed above.

[5] Note that this definition of psychological transduction differs from the notion of a physical transducer which converts energy from one form to another, electrical to mechanical, for example.

2.4 Discussion

The distinction between transduction and inferential computation is obviously useful in many domains, for example, to understand how hard it is for a machine to infer that regions with the same colour and texture are part of the same object in a visual scene. Getting a machine to recognize colours and textures is relatively easy, but getting them to make inferences like those a human makes is difficult.

Similarly, the position sketched concerning the purview of UG and the need to recognize that there are computationally possible but unattestable human languages seem to follow naturally, once we recognize that grammars are embedded in complex organisms and that linguistic behaviour reflects the effects of many interacting systems. To deny the position laid out above is to claim that no other features of humans than the nature of their language faculty affect the sample of attestable languages. However, despite the simplicity of my argument, we should recognize that there is a long tradition in generative grammar of rejecting it implicitly. To illustrate, consider arguments of the following form:

> There is some logically possible combination *C* of linguistic primitives which is not attested (and, assuming that we have taken a good sample of the world's languages, is not attestable), and so *UG* must somehow preclude *C*, for example, via a constraint against *C*.

This ubiquitous form of argument is in direct conflict with the view developed in this chapter, since it does not recognize the possibility that *C* is unattested for reasons having nothing to do with UG. A simple example would include explanations for unattested phonological feature combinations, like say [+syllabic, −continuant] that rely on universal markedness constraints against such feature combinations instead of, or in addition to, appeals to acoustic or articulatory incompatibilities. Examples can be found as well within the morphology and syntax literature. This is not the place to examine particular cases (see Hale and Reiss 2000*a*, *b*), and so I just note the conflict between this traditional form of reasoning and the arguments developed here.

The source of this reasoning in generative tradition appears to be the following analogy. A grammar (a theory) of a language *L* is supposed to generate all and only the grammatical sentences of *L*, and a theory of Language (the human language faculty) is similarly supposed to generate all and only the possible languages. First note that the term "generate" is implicitly being used in two different senses—there is a technical meaning to the term "generate" in the generative literature that can be paraphrased as "assign a structural description to a sentence, including sets of phrase markers related by a derivation, indexation, etc.". This is definitely not the meaning of "generate" that is relevant to the definition of the set of possible languages. Secondly, the crux of the matter lies in the definition of "possible". My impression is that the term is implicitly taken to mean "which we could possibly find attested with a representative sample of current, past and future languages". There is an obvious problem of logic in inducing the principled absence of a pattern from any finite sample, but the criticism here goes further in claiming that even an exhaustive survey of attestable languages may be misleading with respect to the nature of UG. This is my understanding of how so much of the generative literature has misunderstood the search for UG and led to a failure to appreciate the filtering effect of extragrammatical factors on patterns of attestation.

While I consider the foregoing discussion to be straightforward and non-controversial, the question of how to solve the problems which I have identified is quite controversial. In the following sections, I jump into this controversy with some speculations about how results in auditory perception could provide insight into patterns of attestation in phonology. This work is related to work referred to above that combines phonetics and historical linguistics to account for some of the patterns that have, wrongly in my opinion, been attributed to properties of grammar. Thus, I hope that a reader who finds the following to be vague and overly speculative can still be persuaded of the need for explanations of the type I am proposing, based on the arguments made in the preceding sections. Deeper explanations and further experimental work is clearly needed, but I offer the following speculations as a rough guide to how modular explanations may yield insight into the modules and interfaces of the mind/brain.

2.5 Auditory Scene Analysis (Bregman 1990)

> The perceptual world is one of events with defined beginnings and endings... An event becomes defined by its temporal boundary. But this impression is not due to the structure of the acoustic wave; the beginning and ending often are not physically marked by actual silent intervals. (Handel 1989)

Auditory scene analysis is a framework for studying auditory perception developed by Albert Bregman and his collaborators. I think Bregman would be the first to admit that work in the field is still in its infancy. However, it has now become possible to ask questions concerning the nature of auditory perception that approach the sophistication of questions in domains such as visual perception.

Auditory scene analysis can be broken down into two main components. One problem, given the fact that sounds waves from various sources are combined into a single wave that reaches the eardrum, is that of simultaneous *spectral* integration and segregation. The auditory system integrates into a single representation parts of the sound spectrum reaching the ear within a temporal window that "go together". Of course, the decision that spectral regions go together is determined by properties of the auditory system, and in the case of an illusion, the decision may lead to a non-veridical percept. An example of spectral integration is the perception of a played musical note and the over-tones that give the instrument its unique timbre as emanating from the same source. The process of assigning parts of the spectrum to different perceptual sources is called spectral segregation: attending to speech while a fan provides a high-frequency hum in the background requires spectral segregation.

The other main component of auditory scene analysis is *sequential* integration—acoustic events occurring separated in time may be integrated into a single auditory stream. Examples of streams include a sequence of footsteps or the continuous sound of falling rain. Individual sounds of a foot striking the ground are separated by silence or other sounds, yet the steps are integrated into a single perceptual object, a stream.

The complexity of the task of auditory scene analysis can be appreciated by considering the spectrogram in Figure 2.6. This is the spectrogram of a wave created by mixing a sample of recorded speech and some music. The spectrograms of the music and speech separately are shown in Figure 2.7. In this example, I was able to display the music and speech separately because I had the separate recordings. The mind has to extract such information from a complex stimulus, like the mixed signal, to construct distinct streams from a single physical signal.

2.5.1 Streams and Speech

Because of the complexity of this task of integration and segregation of a signal like simultaneous music and speech, it is more manageable to study auditory scene analysis under controlled laboratory conditions with simple synthesized stimuli.

An early result that led up to the auditory scene analysis framework is the demonstration by Warren et al. (1969) in which subjects were played a continuous loop consisting of a high tone (1000 Hz), a hiss (2000 Hz octave band noise), a low

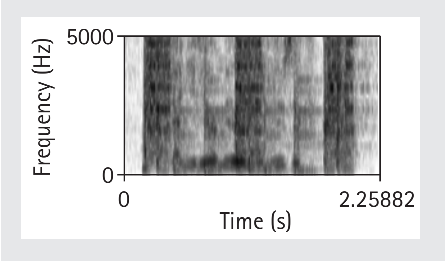


Fig. 2.6 Spectrogram of a complex wave consisting of music and speech

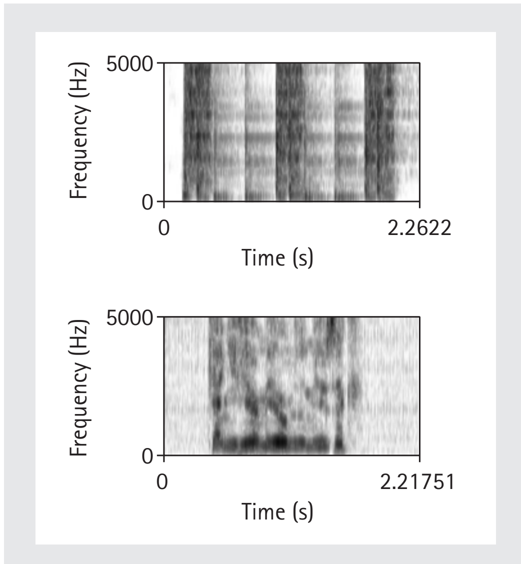


Fig. 2.7 The music (above) and the speech (below)

- The signal: . . . HIGH TONE — HISS — LOW TONE — BUZZ . . .
- The percept:

. . .	HIGH TONE	. . .	HIGH TONE	. . .
. . .	HISS	. . .	HISS	. . .
. . .	LOW TONE	. . .	LOW TONE	. . .
. . .	BUZZ	. . .	BUZZ	. . .

Fig. 2.8 Continuous loop perceived as four separate streams

tone (796 Hz), and a buzz (4000 Hz square wave). Under certain circumstances of overall looping speed and intersignal gap, the percept consisted of four separate streams: a repeating high tone, a repeating hiss, a repeating low tone, and a repeating buzz, as illustrated in Figure 2.8. The elements of these streams had no temporal relations to elements of other streams in the percept, so subjects could not reliably identify, say, which sound came directly after the low tone in the loop—they performed at chance levels.[6]

In order to stream auditory events, they must be "close" enough to each other along some auditory dimensions, such as pitch, quality, or loudness. By manipulating these parameters, it is possible to manipulate perception of single vs. multiple streams. In the stimuli that Warren and his colleagues presented, the four types of sound were too distinct from each other to be streamed together.

[6] Interestingly, performance was significantly above chance when the sequence was played only once.

In light of such results, Bregman points out that it is surprising that the sounds in speech, which includes vowels, fricatives, stops, nasals, etc., should be so easily integrated. Bregman explains that processing of speech may be aided by the fact that listeners have cues such as transitions between these sounds, location, and source size and volume to help them. Despite the acoustic variety of speech sounds, speech seems to be easily streamed, and thus separated from other ambient signals. Henceforth, I will assume that speech processing involves the construction of a single stream for the input signal:

(1) **Proposal**
The input to the speech perception module is an auditory stream.

This stream is the auditory computation–speech perception interface, as shown in Figure 2.1.

2.5.2 A Simple Grammar for Auditory Scene Analysis

Building on the work of Y. Nakajima and T. Sasaki, Nakajima (1996) proposes that auditory scene analysis can best be understood in terms of a "grammatical"[7] system of symbolic primitives and rules of combination. The primitives are elements even smaller than the sounds (a footstep, a musical note, etc.) that make up auditory streams (the sound of someone walking, a melody). These primitive elements, auditory subevents, are classified into at least four fundamental types:

(2) **Types of auditory subevent**

- Onset (denoted by <): a steep rise of sound intensity within a certain frequency range (e.g. a critical band) can be a clue of an onset.
- Termination (denoted by >): a steep fall of sound intensity within a certain frequency range can be a clue of a termination.
- Filling (denoted by =): a piece of sound energy extending for a certain duration without any sudden change of frequency range can be a clue of a filling.
- Silence (denoted by /): if the sound energy across a certain frequency range and a certain duration is very thin despite some amount of sound energy in the preceding part, this makes a clue of a silence.

Onsets and terminations will be referred to below as boundaries.

As these definitions make clear, what is of interest to us are the cognitive representations transduced from the physical signals. So, for example, the auditory grammar subevent "silence" can be transduced in a context of *acoustic* energy, for example, where the energy is not part of the same stream as the perceptual "silence". It is sometimes difficult in discussion to be consistent in distinguishing

[7] Obviously, the term "grammar" here is being used in the general sense of a rule system for combining primitive symbols, and not in the specifically linguistic sense.

the cognitive subevents from their acoustic correlates. However, use of the symbols mentioned above will be helpful: the symbol "/" is called a "silence", but it refers to a representation that may be transduced during a period of acoustic energy. Presumably, even the representations accessed in auditory imagery and memory (that is, in the absence of any acoustic correlates) are constituted of the same primitive symbols as those that are transduced from acoustic signals.

According to Nakajima, most auditory events in our everyday life seem to take one of the following three modes:

(3) **Auditory events**

a. An onset followed by a silence (e.g. a clap sound): $(<)/$
b. An onset, a filling and a termination followed by a silence (e.g. a cat's meow): $(< = >)/$
c. An onset and a filling followed by the onset of another auditory event (e.g. a note in a melody played legato): $(< =)<$

Following Nakajima, the auditory events in (3) correspond to the portions within parentheses. The subevents following the right parenthesis represent the beginning of the next auditory event or a silence.

The primitive auditory subevents are thus grouped into events which are the immediate constituents of auditory streams. The events are combined into streams acording to a small set of principles.

(4) **Definition of auditory stream**

a. An auditory stream is a linearly ordered string of auditory events and silences.
b. An auditory stream begins with an onset and ends with a silence.
c. A silence is not followed immediately by another silence.

To summarize the model developed thus far, an auditory scene is composed of auditory streams that are composed of auditory events that are composed of auditory subevents.

In what follows, we will see that the component events of a stream can be embedded in other events, in addition to being linearly ordered.

2.6 Gap Transfer Illusion

In this section I discuss an auditory illusion, the gap transfer illusion (see Nakajima 2000 for on-line demonstrations), discovered by Nakajima and Sasaki, that suggests that when a signal does not correspond in a straightforward manner to a licit, grammatical parse the auditory system "inserts new subevents, interprets the same clues twice or more, or suppresses some clues" (Nakajima 1996). It is crucial to keep in mind that the subevents are discrete symbols over which auditory scene analysis computes. The four primitives are manipulated by the computational system in the construction of the auditory scene. Nakajima and Sasaki invoke Gestalt principles such as proximity and similarity to explain some of the manipulation of subevents by cognition—we will refer to these below, but also provide another perspective.

Our discussion of the gap transfer illusion will necessarily be rather informal. In Figure 2.9, the *x*-axis corresponds to time and the *y*-axis to frequency. Arrowheads are to be equated with the boundary symbols, $<$ and $>$, introduced above. Lines correspond to fill, $=$. The gap transfer illusion arises when a stimulus such as Figure 2.9B is perceived as Figure 2.9A. Stimulus A contains a long rising acoustic glide (*not* a linguistic glide like [w]!) and two shorter falling glides separated by a gap that the long glide passes through. Stimulus B is similar overall, but here, instead of a long rising glide, we have two glides separated by a gap, which is crossed by a single falling glide. That is, the gap in the acoustic rising glide in B is transferred by the perceptual system to the falling glide, so that B is perceived as A—the two signals give rise to the same percept.

There are actually several things going on here, some of which are strictly speaking not part of the gap transfer effect. It will be useful to discuss them, however, to illustrate the working of the auditory grammar that Nakajima and his colleagues propose. First, note that the stimulus in (B) does not begin with an onset, $<$, or end with a termination, $>$. This is because the rise and fall of the sound intensity in these locations were not 'steep enough to give such clues', according to Nakajima. A filling at the beginning of an auditory stream or a filling immediately followed by a silence is ungrammatical. That is, such contexts cannot be derived from the above-mentioned grammatical rules. Apparently, the solution for the

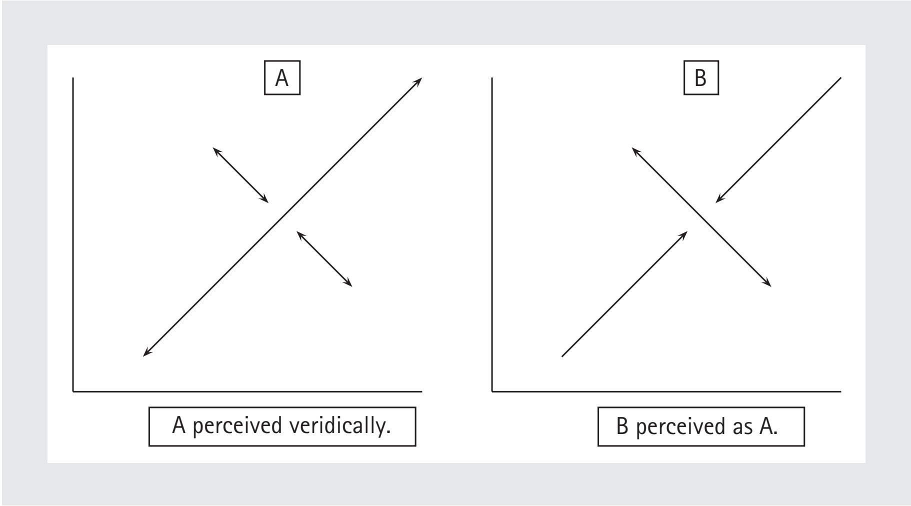
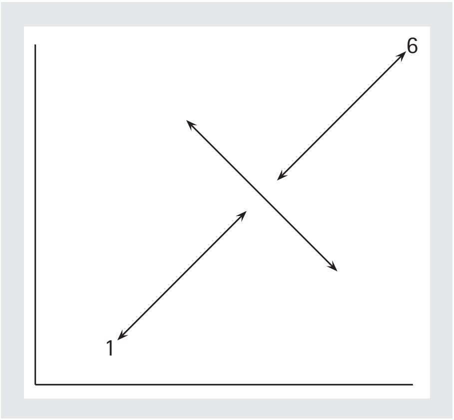


Fig. 2.9 Gap transfer illusion

auditory system is to insert an onset (in accordance with (4b)) and a termination (in accordance with (3b)).

The insertions demanded by these auditory rules would give something like (5). (Note that I am fudging the issue of what exactly (5) is. It is not exactly a representation of the stimulus and it is not the final percept. Perhaps it is best thought of as an intermediate auditory representation.)

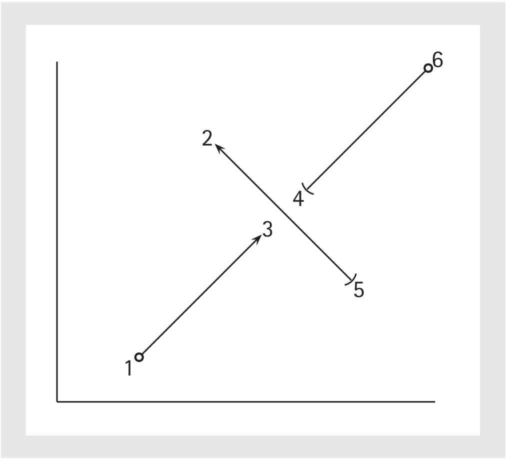
(5) **Boundary insertion**



The relevant onset and termination are inserted by the auditory grammar at the points labelled 1 and 6.

We are now ready to relate Nakajima's description of the Gap Transfer Illusion via the Gestalt Principle of Proximity. In order to do this, I have replaced some of the arrowhead onset and termination markers with other symbols. The recoupling or reassociation of these boundary markers can be deduced by matching pairs of symbols. The discussion will also be facilitated by the numerals, corresponding to the physical temporal sequencing, that I have assigned to the boundary markers.

(6) **Boundary reassociation**



In the signal or, more precisely, the intermediate representation in (5), boundaries 1 and 3 belong together, as the subscript *a* denotes below in (7). Boundaries 2 and 5, with subscript *b* also belong together. Finally, 4 and 6, with subscript *c*, belong together.

(7) SIGNAL (plus perceptual insertion of 1 and 6)

$$<a_1 \qquad <b_2 \qquad >a_3 \qquad <c_4 \qquad >b_5 \qquad >c_6$$

However, the percept is very different. The temporally close onset-termination pair (2,3) have been coupled, as indicated by the matching normal arrowheads in (6) and by the subscript β that they share in (8). Similarly, the pair (4,5) have matching curved boundary markers in (6) and the subscript γ in (8), denoting the fact that they have been perceptually coupled. This leaves the pair (1,6), with open circles for boundary markers in (6) and subscript α in (8).

(8) PERCEPT (after reassociation of boundaries)

$$<\alpha_1 \qquad <\beta_2 \qquad >\beta_3 \qquad <\gamma_4 \qquad >\gamma_5 \qquad >\alpha_6$$

The percept resulting from insertion and reassociation of boundaries from an input stimulus like B in Figure 2.9 is thus structurally identical to that resulting from an input stimulus like A in Figure 2.9.

Before moving on to speech perception, let us make two observations. First, the percepts of onsets and terminations, as well as their mutual associations, are constructed in the process of auditory stream analysis. The percept cannot be read directly off the signal, without knowing how the auditory system associates boundaries. In other words, the construction of the auditory percept is to some extent divorced from the structure of the input signal.

The second observation is perhaps the crux of this chapter. Nakajima et al. invoke the principles of Gestalt psychology to account for the gap transfer illusion—boundaries that are in close temporal proximity and similar enough acoustically to be associated perceptually. However, they also develop the notion of auditory grammar, and this is where convergence with linguistics becomes interesting—not in the use of the term "grammar", but in the fact that the effect of reassociation in the gap transfer illusion is to provide the auditory stimulus with an immediate constituent analysis. In the final percept associated with stimulus B, as denoted in (8), constituent α contains constituents β and γ, and β precedes γ, but there are no interlocking constituents. I suggest that this is a defining characteristic of auditory streams, as well as of linguistic representations. In other words, the illusion arises from fact that two auditory events, *x* and *y* within a stream may be sequentially ordered (as in (9a)) or embedded (as in (9b)), but not interlocked (as in (9c)).

(9) Immediate constituent analysis of streams

a. $[_x \quad]_x \quad [_y \quad]_y$ sequential–POSSIBLE

b. $[_x \quad [_y \quad]_y \quad]_x$ embedded–POSSIBLE

c. $[_x \quad [_y \quad]_x \quad]_y$ interlocked–NOT POSSIBLE

These are exactly the relations we see among constituents in a well-formed syntactic tree, for example.

Obviously, the gap transfer illusion only occurs under certain conditions—not every stimulus of this general form will induce the illusion. The point is that, if the illusion is not induced, that is, if the subject hears temporally interlocking events, then streaming has not occurred.

2.7 Application to Speech Segmentation

In this section, we treat speech signals as complex auditory streams composed of simpler streams consisting of various auditory events that correspond to the acoustic cues generated by a human vocal tract in speech. In other words, acoustic parameters such as the value of the first formant or the presence of high-frequency broadband noise each constitute, by hypothesis, an auditory stream. These streams, of course, can be further analysed into their component events and subevents. However, of more interest to us is the idea that the streams corresponding to acoustic parameters can be combined via the relations of embedding and precedence, to form the complex streams that are the input to speech perception, as proposed in (1).

We can imagine an idealized representation of the relationship between the acoustic cues that are transduced to phonological featural representations with perfect temporal alignment for all the cues. In the example in (10), Cue_3 is absent from segment *x*.[8]

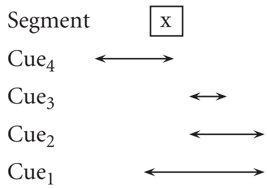
(10) Idealized segment

Segment	$\boxed{x}$
Cue_4	$\longleftrightarrow$
Cue_3	
Cue_2	$\longleftrightarrow$
Cue_1	$\longleftrightarrow$

However, it is well known that from either an articulatory or an acoustic perspective, temporal relations of gestures or perceptual cues are much less orderly, as shown in (11), where Cue_1 extends over Cue_3 completely, Cue_1 partially overlaps with Cue_4, and the latter completely precedes Cue_2 and Cue_3.

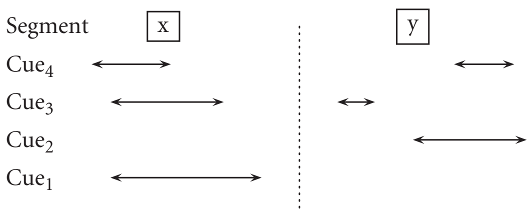
[8] A segment can be thought of as a phonological timing unit and all associated features.

(11) Acoustic cue-articulatory-gesture alignment



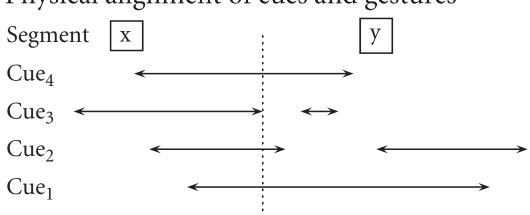
Even granting that cues do not all line up perfectly in duration, we could imagine an idealized representation of the temporal sequencing of cues in a sequence of segments, with a neat division between the cues belonging to two segments *x* and *y*, as in (12):

(12) Idealized alignment of cues and gestures



However, once again, the acoustic and articulatory reality is much messier. The alignment relations in (13) are much more representative.

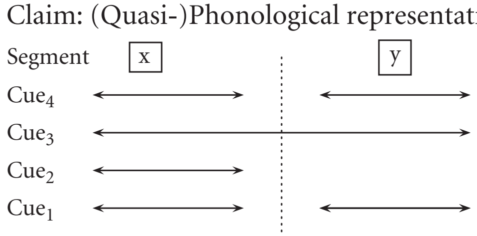
(13) Physical alignment of cues and gestures



In other words, cues that end up being interpreted as belonging to a given segment may partially or even fully overlap temporally with the cues of another segment.

Despite the complex temporal relations among cues both within and across segment boundaries, I would like to suggest that the equivalence classes generated in the process of speech perception lead to a representation more like (14), where I have equated (simplistically) cues with features.

(14) Claim: (Quasi-)Phonological representation



In other words, cues are mapped via a series of transductions and computations to feature bundles (segments) which are complexes of discrete categorical symbols.

This organization via precedence and containment suggests a basis in perception for the phonological segment. One way to express this is that the segment is the Gestalt imposed on the signal by an auditory system that organizes cues via immediate constituent analysis. Another way to say this is that segments are the equivalence classes transduced and inferred from the messy signal in the course of speech perception. These equivalence classes are the constitutive objects of the speech processing "scene".

If the view sketched thus far is correct, then it appears that phonology should not be able to "look inside" any of the modules that feed it. The segment string constitutes the interface of speech perception and phonology and the assumption of informational encapsulation guarantees that no other information is available to the phonology from the other levels. In other words, phonology cannot have access to processes of auditory inference that may have inserted or deleted subevents or associated them non-veridically. The phonology also cannot have access to the input to the auditory transduction—the raw acoustic (or cochlear or auditory nerve) signal. To summarize, if we use the term "phonetics" to refer to everything above the dashed line in Figure 2.1, then the only phonetics–phonology interface is the segment string.[9]

We now consider the implications of this view of the phonetics–phonology interface.

2.8 Substance-Free Phonology (and Syntax)

The speech-chain diagram in Figure 2.1 shows that "auditory perception" or "audition" consists of two parts:[10] the transduction of the physical signal into a symbolic alphabet of $<, >, =, /, \ldots$; and the computations/calculations/inferences that parse the output of transduction into auditory events.[11]

After the transduction of the signal—that is, once we get inside the organism—there is no direct access to acoustic substance, so even the inference-making part of audition is "substance-free" in the sense that it may insert, delete, or non-veridically associate boundaries in computing over the symbolic representation that is the

[9] For the sake of simplicity, I am not addressing difficult issues such as the nature of suprasegmentals like tone and stress.

[10] These components can surely be broken down further, but for present purposes, this two-way distinction is sufficient.

[11] It is worth noting that the auditory inference engine may infer the existence of subevents in the absence of physical evidence in the process of constructing a licit parse of the signal, something it apparently must do.

output of transduction. For example, the potential reassociation of boundaries that it is necessary to attribute to the auditory system in order to account for the gap transfer illusion imposes a potentially non-veridical interpretation on a transduced signal. To say that audition is not necessarily veridical is to recognize that acoustic substance may be ignored or overridden in constructing auditory percepts.

This conclusion in turn lends credence to the "substance-free" approach to phonology advocated by Hale and Reiss (2000*a*, *b*). Speech perception, which must be used in the acquisition of phonology and also feeds phonological parsing when understanding speech, is dependent on auditory perception, which in turn is composed of a transducer and a sometimes non-veridical computational system—the alignment of terminations and onsets, qua elements of a symbolic representation, does not have to correspond to the alignment of their physical correlates. Phonological computation is thus at least two steps removed from the transduction from acoustic signals (by one (narrow) transduction and one computation), and thus is at least two steps removed from acoustic substance.

Note that the diagram in Figure 2.1 extends beyond phonology. After phonology, the input must be morphologically parsed, associated with lexical items, and syntactically parsed. Given the model proposed, there would be no more reason to posit access to phonetic substance, i.e. the physics of the sound wave, for phonology than for syntax. Both are only remotely linked by intervening processes to the sound. An advocate of access to acoustics for phonology would have to accept such access for syntax (i.e. offer phonetic grounding for syntax) as well, or else stipulate why there is no such access.

The idea that "higher" levels such as syntax and phonology have no direct access to the properties of stimuli has been expressed aphoristically by Bruce Bridgeman as "the brain is deaf, dumb, and blind". My colleague Roberto de Almeida, also a psychologist, puts it like this, "After transduction all hell breaks loose." I would suggest that the substance-free phonology proposal is actually quite orthodox in the larger context of cognitive science, even though it meets with scepticism within phonology.

2.9 Conclusions

2.9.1 Relating Epistemology and Ontology

The discussion surrounding Figure 2.1 is primarily concerned with ontological issues—it tells us what (some of) the components of the speech chain are. Figure 2.3, on the other hand, is useful for epistemology with questions like "What kind of evidence can we collect to study the language faculty and construct a theory of UG?" To relate these two diagrams, consider that all the components above the dashed line in Figure 2.1 will necessarily limit what is attestable below the line. That is why only a subset of languages in the large grey circle of Figure 2.3 are attestable. Much confusion in current phonological work arises from the failure to distinguish the epistemological questions concerning our sources of evidence, discussed with regard to Figure 2.3, from ontological questions about the nature of the language faculty, the object of inquiry of generative linguistics. For example, patterns in the data that result from the nature of the transducers or the acquisition process are mis-attributed to the language faculty proper.

2.9.2 Inheritance versus Grounding

I have proposed that the phonological segment is a construction built ultimately on the auditory subevents constructed in the first stages of auditory perception.[12] This proposal differs in two ways from the common claim that there is evidence for the segment in the speech stream. First, this proposal views the situation from the phonological top down to the auditory bottom—as recognized by Sapir (1933/1949) and Hammarberg (1976), phonological categories are logically prior to those of phonetics. Linguistic categories have to be imposed on certain signals, thus differentiating them from potentially physically identical signals that are non-linguistic.[13] Sapir's famous examples are a voiceless *w*, [ʍ], vs. the sound of blowing out a candle and an [s] versus a hiss. As Hammarberg points out, we cannot even undertake a *phonetic* study of variant pronunciations of /k/ within a language, unless we first recognize the *phonological* category /k/.

I have suggested that the segment as a unit of phonology reflects the immediate constituent structure imposed on incoming auditory signals when these signals are incorporated into a single stream. The appropriate conception of the relationship of phonology to phonetics, I submit, is one of inheritance. If we use the term "phonetics" to refer to all the components above the dashed line in Figure 2.1, then the symbols of phonology must inherit any structures passed down from those components. The phonology cannot, for example, reassociate auditory subevents to allow segments to interlock. This proposal is simple, and consistent with standard

[12] That is, segments stored in memory as phonological representations of lexical items are initially constructed on the basis of auditory cues received as input during language acquisition.

[13] Actually, the recurrent claim that there is no poverty of the stimulus argument for phonology, that all the evidence for segments is derivable from the signal, seems completely nonsensical; my dog has very acute hearing, and yet does not appear to have figured out much about speech segments in almost nine years, whereas my baby boy, whose hearing is less acute, has already figured out quite a lot. The evidence is only in the signal if you are a human with a Language Acquisition Device that imposes an interpretation on speech, but not if you are a dog.

cognitive science assumptions of modularity and informational encapsulation. I think it is worth pursuing.

This view is in contrast with recent attempts to "ground" phonology in phonetics by building markedness statements into the phonology—putative statements that constitute universal grammatical knowledge concerning the "well-formedness" of phonological representations and the utterances they transduce to and from. I propose instead that it is more useful to conceive of *phonetics* as grounded in *phonology*—phonetic facts are such only by virtue of being transduced into the categories, the equivalence classes, provided, or rather imposed, by the phonological component of the human language faculty.

2.9.3 Against Markedness and Phonological Pathology

We have supported the discrete nature of phonological representations by arguing for discrete symbolic representations as the objects of the more basic auditory computations too. There is no sense in which segments are "emergent" properties of raw acoustic signals—listeners have no access to raw signals, because transduction turns them into symbol structures. The rejection of phonetically based markedness considerations in phonology (see Hale and Reiss 2000*a*, *b*) follows from our results thus far—the phonology can have no access to aspects of acoustics or articulation since so many purely symbolic systems intervene between these levels of analysis.

Rejecting phonetically based markedness also leads us to reject notions of phonetic and phonological "pathology", the idea that phonology tends to repair or fix phonetically marked structures (see Reiss 2003). One expression of the pathology metaphor can be found in Yip (1988: 74): "The main contribution of the OCP [Obligatory Contour Principle] is that it allows us to separate out condition and cure. The OCP is a trigger, a pressure for change." More recently, Hayes and Steriade (2004) discuss markedness: "the *what* is phonetically difficult is not the same as the *how to fix it*." Such discourse makes no sense in the model I propose in this chapter—as we saw, the phonology has no direct access to the signal (and presumably parallel considerations hold with respect to articulation). This conclusion, like the other points I made in favour of substance-free phonology, allows us to focus on the computational properties of the language faculty. We are in a better position to understand what a computable language is when we have factored out the confounding effects of the transducers which I claim have misled phonologists to posit a notion of phonetically based phonological ill-formedness as part of grammatical knowledge.

The general view I have presented in these conclusions is to be contrasted with the traditions of markedess theory, dating from Jakobson, continuing (weakly) into SPE, natural phonology (Stampe 1979), Grounded Phonology (Archangeli and

Pulleyblank 1994) and Optimality Theory, and especially the "phoneticist" and functionalist versions of the latter represented by Hayes and Steriade's volume of collected papers: "The hypothesis shared by many writers in this volume is that phonological constraints can be rooted [a.k.a. "grounded"—CR] in phonetic knowledge ... the speaker's partial understanding of the physical conditions under which speech is produced and perceived." My own prejudice is that the burden of proof falls upon those researchers who heretofore have tacitly rejected the assumptions of modularity and encapsulation developed over the last decades. They need at least to explain why their non-modular and apparently redundant model is even worthy of serious consideration.

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CHAPTER 3

THE PHONETICS–PHONOLOGY INTERFACE AND THE ACQUISITION OF PERSEVERANT UNDERSPECIFICATION

MARK HALE
MADELYN KISSOCK

3.1 Introduction

This chapter explores the phonetics–phonology interface, both in the broadest sense of "phonetics" which addresses aspects of articulation and acoustics and in the narrow sense of "phonetics" which is concerned with abstract surface and/or phonetic representations which are the output of phonological computations. We

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examine here a particular type of underspecification, which we will call "perseverant", acquisition of which is motivated primarily by exposure during the learning process to speech sounds which are not consistent in their physical properties with assignment to any fully specified set of features. The more common types of underspecification are motivated by data from alternations or by a desire for economy of representation, both of which result in underspecification at the level of Underlying Representation (UR) but not at the phonetic level. By contrast, the type of underspecification we will be discussing is motivated by a particular well-defined property of the acoustic signal and *perseveres* from the underlying forms *through* the surface or output forms. Because of its perseveration, the underspecification detailed here provides an especially fertile ground for the exploration of the phonetics–phonology interface. Data from the Marshallese vowel system provide the empirical basis for our discussion. We will use this data to explore what sorts of physical phonetic information can trigger an acquirer to store underspecified representations as well as how both the acquisition and ultimate grammar can be modelled using Optimality-Theoretic assumptions. This discussion will reveal various problems with the notion of "markedness" as currently used, as well as with the acquisition path to an OT grammar. Much of the discussion will have implications for the more global question of how and why an acquirer assigns certain features to an abstract representation based on information extracted from an acoustic event. The second section of the chapter outlines our basic theoretical assumptions and provides definitions of terms. Section 3.3 presents very briefly an example of a more common type of underspecification for purposes of contrast and then outlines two cases of what we call perseverant underspecification, a Russian example discussed in Keating (1988) and the case of Marshallese vowels. In section 3.4, we present the details of a constraint ranking that would capture this underspecification in an adult grammar. Section 3.5 discusses how an adult grammar of this type can be acquired. Section 3.6 presents some additional supporting data from Marshallese loanwords and section 3.7 presents our conclusions.

3.2 Background Assumptions

Since our primary interest is in modelling aspects of the phonological computational system (including the primitives over which such computation takes place), which are the result of phonological acquisition (and some innate properties of Universal Grammar, UG), we begin by presenting our assumptions about the nature of this computational system. This necessitates a discussion of the division between phonology and phonetics and of the distinction between linguistic and non-linguistic processing, as well as explicit definitions of the terminology we use. Explicitness is particularly important in the present context since there is no general agreement among researchers on these matters and we believe that considerable confusion has been introduced by the use of vague or ambiguous terminology. The one point on which there *is* general agreement, at least among phonologists, is that phonology, in its narrowest sense, consists of the mapping from underlying representation to surface representation. Keating (1988) explicitly addresses this issue and we follow her both in our use of terms and in our definition of "phonology". For Keating and for us, phonology involves only a feature-to-feature mapping and nothing else. Other researchers have defined phonology much more broadly and have extended it well beyond the feature-to-feature mapping. Hammarberg (1976), for example, defines any aspect of pronunciation that involves cognition (e.g. anticipatory co articulation) as part of "phonology". For Hammarberg, then, a mapping of a set of features to a gestural score[1] or of an acoustic score to a set of features, because both are considered "cognition", would be included within the scope of his "phonology".[2]

We propose that mappings between dissimilar representational formats, such as from features to a gestural score, are performed by *transducers*. Transduction, in general, is a function which converts a form in one representational "alphabet" to a form in a different representational alphabet.[3] Phonetic transduction is thus to be distinguished from phonological computation by the fact that it incorporates some type of *conversion* process—it changes one type of representation (featural, for example) into another type of representation (gestural score, for example). In our model, phonological computations, unlike transduction, operate on only a single type of symbolic representation, namely, features. Features are both the input to and the output of the phonology—phonological computations cannot convert features into other types of representation. Under any analysis, however, the incorporation of a transduction process of some type into the model of speech production seems inescapable, since there are no features actually present in the acoustic output of speech.

A further logical necessity is the presence of two distinct transducers, one for processing representations concerning audition and one for processing representations concerning articulation. Positing two transducers is suggested by the fundamentally distinct nature of auditory vs. articulatory processing. For example, while both involve unidirectional processing, the *direction* of processing is not the same in the two cases. Articulation demands transduction of features (the input) to some gestural score

[1] We borrow the term "gestural score" from Browman and Goldstein (1990) and extend it to the acoustic domain.

[2] While Hammarberg defines phonology more broadly than we do, he maintains distinctions between processes within this broader domain.

[3] We borrow this terminology from Pylyshyn (1984). Our use of the term is related to his but not identical with it. Pylyshyn's primary concern is the more general area of computation and cognition.

(the output), whereas audition requires transduction of a percept (the input) to features (the output).[4] In addition, we assume that there is an actual, physical difference between the mechanisms involved in audition and those involved in articulation, and that dedicated transducers reflect this difference. We assume that these two transducers are innate and invariant; they are identical in all humans (barring some specific neurological impairment) and do not change over time or experience (i.e. they do not "learn").[5] Our model assumes strict modularity, that is to say that the modules are cognitively encapsulated such that no component can see inside another component. Only the output of one module may be fed to another module and then only in the case of particular modules. So, for example, the output of the phonology is the input to the auditory transducer, but the acoustic transducer does not feed its output to the auditory transducer, nor vice versa. Thus the two transducers operate independently of one another and have no interaction. Following Hale and Reiss (2000), our model necessarily divorces (phonological) features from both articulation and audition. Features are simply symbolic, "substance-free" primitives which are manipulated by the phonology and the transducers. The very fact that two separate transducers are required—one for articulation and one for audition—forces the separation of features from any physical substance. Since what is mapped onto a single feature comes from two very different sources, this separation from the physical substance is a logical necessity; a single feature cannot, for example, be derived *both* from the muscle commands involved in raising the tongue body *and* from a neural impulse triggered by some portion of an acoustic wave (let alone some actual property of the wave itself). Thus, we can consider the transduction process, too, as invariant in that the *relationship* or *mapping* between a particular feature bundle and a particular gestural score is a deterministic (and thus consistent) conversion process and, similarly, that the relationship or mapping of a particular auditory input to a feature bundle is deterministic. Crucially, the features and their transduced output forms are different from one another. Finally, we assume that phonological features, themselves, are universal in the sense of UG. A universal feature is not one that is found "universally" but rather a feature which is drawn from a universally available but finite inventory.[6] Any UG feature *may* be present in the actual mental representations of a particular instantiation of natural language but it is not clear that every feature *must* be present. Since the symbolic representations of natural

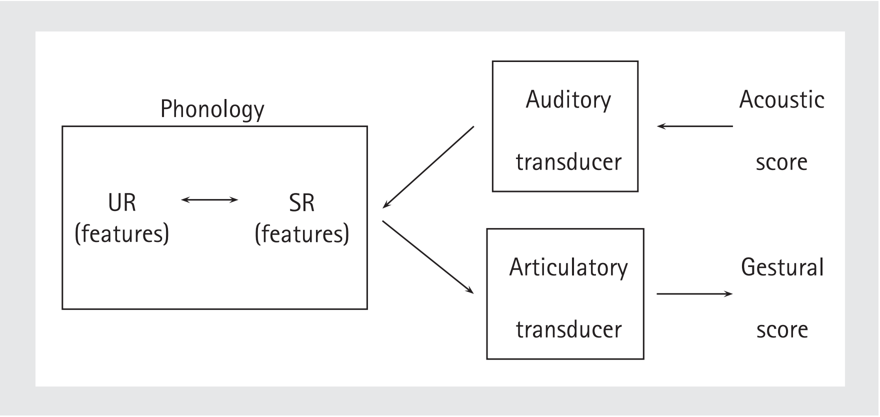
[4] We do not intend by this that there are only two transducers. We assume that transduction is a complex process which involves many different transducers. However, for our purposes here, only the highest level of transduction is immediately relevant—namely, that of features to gestural score or acoustic score to features.

[5] This claim regarding innate, unchanging transduction is made solely for these two transducers which take one type of symbolic representation and convert it to another type of symbolic representation. It is not a claim that motor skills, for example, are not learned or do not develop or mature over time; it is not a claim about motor skills at all.

[6] For a view opposing the universality of features, see Pulleyblank (2001).

language segments appear invariably to be feature *bundles*, it is actually the possible featural combinations that are responsible for the wide variety of sounds found in language, not the sheer number of features.[7] The relevant mappings in our model of phonology and transduction are shown in (1).

(1) Phonology: Underlying Representation (UR) ↔ Surface Representation (SR)
Transducer$_{auditory}$: SR ← Acoustic score
Transducer$_{articulatory}$: SR → Gestural score



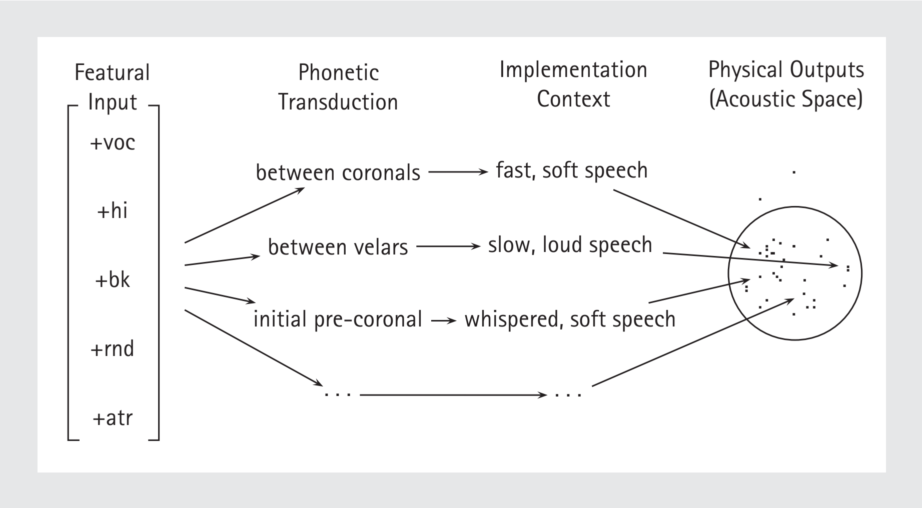
This model and the accompanying discussion have so far presented only what we believe to be computations and processes specific to language. As such, they represent only a portion of what makes up an individual's actual behavioural output or performance. We assume that between, for example, the gestural score and the point of actual physical output, there can be input or modification from many other non-linguistic facets of cognition that determine amplitude, speech rate, affect (e.g. tone of voice), and other situational effects. Crucially, none of these post-gestural-score additions contained in the physical output appears to be used by the linguistic computational or processing systems, and therefore a sharp distinction between the two types of processing, linguistic vs. non-linguistic, is indicated.[8] While we believe that features are purely formal representations and that the transducers are invariant across speakers and deterministic in the way they perform conversions, we still predict that there will be differences in the measurable, physical instantiations of any single feature bundle. These differences will have at least one of three possible sources (and will probably be due to more than one): (1) the articulatory transducer, although mechanical, implements features

[7] We use the term "bundles" loosely to represent groupings of features. We take no position here on the best way to represent these groupings.

[8] As is well known, phonological acquisition routinely and successfully takes place in environments where there is great variability in the physical production of featurally identical speech sounds. For a summary of some of the research on this topic, see Jusczyk and Luce (2002).

and feature bundles in a context-sensitive manner;[9] (2) there are within- and cross-speaker differences in physical attributes (e.g. subglottal pressure, size and shape of oral cavity); and (3) there are external, physical forces which may interfere with production (e.g. external air density). As a result, a particular featural representation will correspond to multiple physical instantiations (on separate occasions) which nevertheless typically fall within some reasonably well-defined area—namely, the *acoustic space*.[10] We will see that, in the Marshallese cases, it is specifically the absence of a well-defined area along certain dimensions that is crucial evidence for the acquirer of Marshallese. This potential chain of events leading to physical output can be schematically represented as in (2).

(2) Transduction and the acoustic space



The figure in (2) schematizes only articulation. However, the concept of multiple physical instantiations being related to a single featural representation is, of course, the same for audition. In the case of audition, however, physically distinct inputs (from different occasions) will be stripped of their context-dependent and idiosyncratic physical properties, and reduced to a single identical set of features. In both articulation and audition, the acoustic space is a label for some physically definable area. We hypothesize that only a change in features will produce any significant change in acoustic space. This is because the differences incurred through changes in context or physical attributes will remain, we assume, relatively constant independent of the make-up of the particular feature bundle. So, roughly, the particular features determine the locus of activity and non-featural attributes determine the cluster pattern around the locus. In the next section we turn to a

[9] This includes whatever effects the implementation of one feature may have upon the implementation of another feature within a single feature bundle as well as coarticulation effects.

[10] We avoid using the term "target" since it incorrectly suggests both that there exists a single, "correct", physical target and that the transducer has frequent "misses".

consideration of some of the implications of underspecification, both underlying and so-called “phonetic”, for this model of phonology.

3.3 Phonological Underspecification with and without Phonetic Underspecification

As cases of underspecification at the level of underlying representation will be familiar to most readers, we present only an extremely abbreviated discussion of them here, citing a case discussed in Inkelas (1994) as an example.

3.3.1 Phonological Underspecification with Full Phonetic Specification

Most commonly, discussions of underspecification have been directed towards featural underspecification at the underlying, lexical level of representation, not towards underspecification in derived phonetic representations. The motivations for such underlying underspecification have been varied but are generally based upon arguments from markedness or economy (see e.g. Steriade 1995). Underspecification has also been proposed within Optimality Theory to account for alternations of the type discussed in Inkelas (1994). Some of the data Inkelas provides to support underspecification concern the case of Turkish plosives, an example of which is given below.

(3) Turkish Plosive Underspecification (Inkelas 1994)

	Nom	Acc	Gloss
Non-alternating	sanat	sanat-ɨ	‘art’
Non-alternating	etüd	etüd-ü	‘etude’
Alternating	kanat	kanad-ɨ	‘wing’

Inkelas argues that in the case of predictable alternating forms such as the “wing” forms above, the process of Lexicon Optimization will force an underspecified representation. The plosive will be underspecified for voice in the input and the voice value in the winning output candidate will be determined by the ranking of structure-filling constraints. Underspecification of this type is crucially different both in the type of data which motivates the need for underspecification (largely data from alternations) and the extent of the underspecification itself (underlying representation only) from the cases we focus on in the rest of this chapter.

3.3.2 Underspecification in both Phonological and Phonetic Representations—Perseverant Underspecification

The focus of this chapter is on underspecification which persists from underlying representation through phonetic representation, resulting in forms which are never fully specified featurally. We have called this phenomenon "perseverant underspecification". The general characteristics of perseverant underspecification are (1) absence of an articulatory or acoustic target for one or more features; (2) an articulation which is determined in some relevant respect by context (as opposed to by some feature value or values); and (3) the existence of alternating but entirely predictable articulations and corresponding acoustic products.

Keating (1988) convincingly argues that Russian [x], in the case where no context rules apply, consists of a *phonetic* feature bundle with no specification for the feature [back].[11] Therefore, the following two instances of [x] are crucially different with respect to phonetic feature specification in the output of the phonology: the (*a*) case has a fully specified feature bundle and the (*b*) case is underspecified, having no [back] feature.

(4) Fully Specified and Underspecified Russian /x/ (Keating 1988)

a. /axi/ → fully fronted fricative; context rule filled in [−back] in the course of phonological computation;

b. /ixa/ → transient fricative, gradual transition throughout its duration from acoustic correlates appropriate to the preceding [−back] segment to those appropriate to the following [+back]) segment; fricative remains underspecified throughout phonological computation.

Keating (1988: 285) notes as part of this discussion that:

> ...if a segment acquires a feature value from an adjacent segment, it will share a phonetic property with that segment across most or all of its duration; if a contour is built through a segment it will have a more or less continuously changing, transitional, quality from beginning to end that will depend on context on either side.

As described above, the outcome of the velar fricative in /ixa/ shows the continuous, transitional features characteristic of those sounds which are entirely dependent in some aspect of their articulation upon a feature or features of adjacent sounds. The case of Marshallese vowels is a rather more elaborate instance of perseverant underspecification and one which will highlight the questions which

[11] Note that this means that its feature bundle will never have a feature specification for [back] because the transducer does not "fill in" feature values.

such underspecification cases raise for acquisition. The Marshallese vowel system, discussed *inter alia*, in Hale (2000) is quite striking. The "surface" vowels are given below, where the "tie" symbol (as in i͜u) represents a smooth transition from one vowel to another, e.g. in this case, *i* to *u*.

(5) Marshallese "Surface" Vowel Inventory

i	ɯ	u	i͜ɯ	i͜u	ɯ͜i	ɯ͜u	u͜i	u͜ɯ
ɪ	ɤ	ʊ	ɪ͜ɤ	ɪ͜ʊ	ɤ͜ɪ	ɤ͜ʊ	ʊ͜ɪ	ʊ͜ɤ
e	ə	o	e͜ə	e͜o	ə͜e	ə͜o	o͜e	o͜ə
æ	a	ɒ	æ͜a	æ͜ɒ	a͜æ	a͜ɒ	ɒ͜æ	ɒ͜a

To understand how these surface vowels come into being, we need to explore the phonology of Marshallese. We will begin with the consonants, which are themselves rather unusual. The features of these underlying consonants play a key role in developing an account of the Marshallese surface vowels given above. A chart of the underlying/contrastive consonants is given in (6).

(6) Marshallese Underlying Consonant Inventory

	Oral stops			Nasals			Liquids and glides		
	Labial	Dental	Velar	Labial	Dental	Velar			
"Light" [−bk,−rnd]	p^j	t^j		m^j	n^j		l^j	r^j	j
"Heavy" [+bk,−rnd]	$b^{ɯ}$	$t^{ɯ}$	k	$m^{ɯ}$	$n^{ɯ}$	ŋ	$l^{ɯ}$	$r^{ɯ}$	ɰ
"Round" [+bk,+rnd]			k^w		n^w	$ŋ^w$	l^w	r^w	w

As Choi (1992) demonstrates, in CVC sequences there is a steady transition during the vowel articulations between the [back] and [round] features of the preceding consonant to the [back] and [round] features of the following consonant in every instance. These transitions are phonetically distinct from diphthongs which have a relatively long-duration nucleus and a brief on- or off-glide. As Bender (1968) showed, the most coherent phonological analysis of the Marshallese vowel inventory is one in which the vowels themselves bear no features along the dimensions back and round. That is, they differ from one another *only* along the height and ATR dimensions. We will use C^j to represent "front" (i.e. palatalized) consonants, $C^{ɯ}$ to represent back non-round (i.e. velarized) consonants and C^w to represent back round (i.e. labialized) consonants. For the vowels not specified along the back or round dimensions, we introduce the new symbols [V_{HI}] for a [+high, −low, + ATR] underspecified vowel, [V_{MID}] for a [−high, −low, +ATR] underspecified vowel, and [V_{LO}] for a [−high, +low, −ATR] vowel, likewise underspecified.[12] One

[12] Hale (2000) uses the somewhat less common symbols ☕, ⚽, and ☯, respectively.

Table 1.1 The Underlying Sources of the Marshallese "Surface" Vowels

Input V-features		Consonantal environment								
hi	ATR	F–F	B–B	R–R	F–B	F–R	B–F	B–R	R–F	R–B
+	+	i	ɯ	u	i͜ɯ	i͜u	ɯ͜i	ɯ͜u	u͜i	u͜ɯ
+	–	ɪ	ɤ	ʊ	ɪ͜ɤ	ɪ͜ʊ	ɤ͜ɪ	ɤ͜ʊ	ʊ͜ɪ	ʊ͜ɤ
–	+	e	ə	o	e͜ə	e͜o	ə͜e	ə͜o	o͜e	o͜ə
–	–	æ	a	ɒ	æ͜a	æ͜ɒ	a͜æ	a͜ɒ	ɒ͜æ	ɒ͜a

Note: F=non-back, non-round consonants; B=back, non-round consonants, R=back, round consonants.

can readily see how the 'surface inventory' of Marshallese vowels arises from these consonant–vowel interactions in Table 1.1. The phonological representations for vowels are listed on the left with only featural representations of the vowels. The corresponding articulations are listed on the right.

Finally, we introduce the *necessary* distinction between the output of phonological computation (which we place between traditional square brackets) and the articulatory–acoustic output of the body (which we place between 'body' brackets). We can then represent schematically the treatment of the underspecified Marshallese vowel segments as follows:

(7) From UR to 'Surface' realization

a. $C^jV_{HI}C^w$: /$n^jV_{HI}k^wn^jV_{HI}k^w$/ > [$n^jV_{HI}k^wn^jV_{HI}k^w$] > ⟦n^ji͜u k^wn^ji͜u k^w⟧ 'clothing'

b. $C^jV_{MID}C^ɯ$: /$n^jV_{MID}t^ɯ$/ > [$n^jV_{MID}t^ɯ$] > ⟦n^je͜ʌ$t^ɯ$⟧ 'squid'

c. $C^jV_{LO}C^j$: /$t^jV_{LO}t^j$/ > [t^jV_{LO} t^j] > ⟦t^jæt^j⟧ '*Lutjanus Flavipes*'

Note that this gives Marshallese what appears superficially to be a large and rather unique vowel inventory with a grand total of 36 vowels whereas, in fact, for all grammatical (i.e. featural) purposes, the Marshallese inventory is quite small, having only four featurally distinct vowels at both UR and SR levels.

The case of /$t^jV_{LO}t^j$/ is particularly interesting. This vowel will show apparent steady-state realization in the ⟦æ⟧ space, much like English ⟦æ⟧. Further analysis, however, reveals that this identity is purely superficial and that it actually obscures a significant difference between Marshallese ⟦æ⟧ and English ⟦æ⟧. The two are quite distinct, representationally, with the front and non-round properties of Marshallese ⟦æ⟧ determined entirely by the [back] and [round] features of the adjacent consonants and the front and non-round properties of English ⟦æ⟧ the result of a feature bundle that includes specific values for [back] and [round]. Cases like this of superficial similarity are especially relevant to acquisition and will be discussed in more detail in section 3.5.

3.4 Constraint-Based Approach to Perseverant (Phonetic) Underspecification

At first glance, the Russian and Marshallese cases appear to be made for an optimality-theoretic approach.[13] The obligatory underspecification of Marshallese output vowels for the features [back] and [round] can be made to follow trivially in OT by simply ranking the Markedness constraints against values for these features (abbreviated here as *[±round] and *[±back]) higher than the Faith requirements which would necessitate respecting such values. Such a ranking will force winning candidates to be underspecified, as can be seen from the sample tableau for /$p^{ɯ}V_{HI}p^{ɯ}$/ ‘black triggerfish’, which is articulated as 🯅$p^{ɯ}$ɯ$p^{ɯ}$🯅 , given in (8).[14] The ranking in this tableau results in candidates (a)–(c) above being eliminated because of their violations of the relevant Markedness constraints. The even more underspecified, and thus seemingly less marked, candidate in (d) is unfaithful to the [+Atr] specification on the input vowel. Since this vowel is too underspecified for Marshallese, the Faithfulness constraint Max-IO (which requires that the [+ Atr] specification in the input be respected in the output) must outrank the Markedness constraint *[+Atr] (which would require the elimination of the underlying [+Atr] specification) in Marshallese. This leaves as the optimal candidate the V[+hi, +Atr] vowel of (e), underspecified in the output along the backness and roundness dimensions.

We see a number of interesting and unusual properties in the way these underspecified vowels interact with constraints. For example, insofar as the features of the vowel itself go, the optimal candidate violates neither Faithfulness constraints (Max-IO and Dep-IO) nor the relevant Markedness constraints, for example,

[13] Note, however, that this is true only if one assumes the formal approach to phonology sketched above—namely, one where features are simply symbolic representations manipulated by the grammar.

[14] Since the input representation in this case is underspecified, MAX and DEP constraints alone—regardless of the ranking of the Markedness constraints against specification along the [back] and [round] dimensions—would suffice to get the appropriate output. As pointed out earlier, the requirement that the Markedness constraints be ranked high is necessitated by the attempt to develop an account of the across-the-board underspecification of Marshallese vowels.

(8) OT and Perseverant Underspecification

/$p^{ɯ}V_{HI}p^{ɯ}$/	*V[±round]	*V[±back]	Max-IO	Dep-IO	*[+Atr]	*[+hi]
a. [$p^{ɯ}up^{ɯ}$]	*!	*		**	*	*
b. [$p^{ɯ}ip^{ɯ}$]	*!	*		**	*	*
c. [$p^{ɯ}ap^{ɯ}$]	*!	*		**		
d. [$p^{ɯ}$V [+hi]$p^{ɯ}$]			*!			*
☞ *e.* [$p^{ɯ}V_{HI}p^{ɯ}$]					*	*

*V[±round], *V[±back]. In addition, the missing features of the input candidate's vowel are treated, for purposes of IO constraints, in the way that epenthetic vowels (or consonants) are treated. "Given the fact that an epenthetic segment has no input features to be faithful to, their feature content is delegated to markedness constraints" (Kager 1999: 125). However, unlike in the epenthesis cases, there is no violation of Dep-IO by the winning candidate since *no features are present in the output candidate which were not present in the input representation.* Finally, if we consider only those features relevant to vowels, there will be no metric for determining the relative ranking of Faithfulness and Markedness constraints, except with respect to those Markedness constraints regarding height and ATR features for vowels (both of which must be ranked below the IO-Faith constraints).

The tableau also raises some issues which are potentially more serious, however. One of these concerns the definition of markedness in OT. While formally defined as "having violation marks" (i.e. a more marked form is one which has incurred more violation marks for its output structure than some other competing form), markedness is, in OT practice, closely associated with the notion of "typological markedness" and issues such as cross-linguistic frequency of occurrence. By formal markedness definitions, Marshallese vowels are highly unmarked, with a mid vowel which is less marked than a fully specified /ə/.[15] However, in terms of typology or frequency of occurrence, the inventory of Marshallese vowels is highly marked in two ways:

(9) Marshallese Vowels as "Marked" Segments
a. At the phonological level. From a featural standpoint, the vowel inventory is extremely small, a total of four contrastive vowels. Due to the lack of features, there can be no real notion of distribution throughout the vowel space—arguably the same as having a "poor" distribution.

[15] As indicated earlier, Faith constraints are not relevant to this determination.

b. At the articulatory/acoustic level. The majority of the articulations appear to fall into the "not a natural language sound" category. From a more formal standpoint, it appears that the articulations of the vowels give physical outputs that virtually cover the acoustic space, such that many of the vowels would be minimally contrastive acoustically.[16]

Before we turn to the next section, it should be noted that the contextual determination of vowel realizations along the [back] and [round] dimensions is *not* due to Marshallese speakers somehow "storing" the complex transitions for each lexical entry.[17] We see this from an examination of affixes such as the productive agent noun prefix /rʲV_{HI}-/, whose vowel alternates between 🚹rʲi-🚹, 🚹rʲi͜ɯ-🚹, and 🚹rʲi͜u -🚹 depending on the features of the initial consonant of the root to which it attaches.

(10) Variant Realizations of Marshallese /rʲV_{HI}-/
- 🚹rʲi-tʲerʲpᵚalᵚ🚹 'worker'(cf. 🚹tʲerʲpᵚalᵚ🚹 'to work')
- 🚹rʲi͜ɯ-pᵚɯ͜itʲpᵚɯ͜itʲ🚹 'one who kicks' (cf. 🚹pᵚɯ͜itʲpᵚɯ͜itʲ🚹 'to kick')
- 🚹rʲi͜u -ŋʷo͜erʲtᵚak🚹 'snorer' (cf. 🚹ŋʷo͜erʲtᵚak🚹 'to snore')

Further evidence of this is provided from loanwords into Marshallese in section 3.6.

3.5 Acquiring Perseverant Underspecification in an OT Grammar

We turn now to the question of the acquisition of underspecified forms in an Optimality-Theoretic framework. Acquiring an adult-state constraint ranking in OT is done through the process of Constraint Demotion (e.g. Tesar and Smolensky 2000,). The majority position holds that, at the initial state, all Markedness constraints are ranked above all Faithfulness Constraints (but see Hale and Reiss 1998 for the alternative view). Certain Markedness constraints are then demoted, based upon positive evidence—evidence which indicates that some more marked candidate wins over some lesser-marked candidate. As Tesar et al. (2003) note, the awkwardness in this process lies in the fact that the acquirer must determine both lexical representations and a constraint ranking, each of which is dependent to a greater or lesser extent upon the other. They propose that the acquirer approaches

[16] This is actually the "correct" result from the point of view of the lexicon, where there are only four contrastive vowels, that is, the *number* of contrasts is minimal.

[17] It would be hard to imagine what form such transitions could, in fact, be stored in, in any event.

the problem with a bias toward changing the ranking as a first step (with a further bias toward keeping Markedness constraints high whenever possible) and later, only if their ranking fails, modifying the lexical representation.

The target grammar for Marshallese is going to require a ranking where Markedness constraints on round and back features outrank the relevant Faithfulness constraints, so *V[±round], *V[±back] >> Max-IO,Dep-IO. The data that we assume is available to the acquirer includes the following.

a. Both alternating and non-alternating forms.
b. Forms, for example the one originating from Marshallese /$\text{t}^{\text{j}}\text{V}_{\text{LO}}\text{t}^{\text{j}}$/, that are indistinguishable (acoustically) from what could be fully specified forms such as [tʲætʲ].
c. Forms which, as far as we know, cannot be represented by any combination or geometry of our current feature set—for example, the steady transition from the [ɯ]-space to the [u]-space in 🯅ɯ͜u🯅—and therefore cannot be outputs of any human grammar (nor inputs for a human grammar).

If we consider an initial state where Markedness constraints are ranked above Faithfulness constraints (again, this is the majority view), then the path to acquisition of the grammar will proceed as follows. Suppose the acquirer first gets a form such as 🯅tʲætʲ🯅. The default hypothesis should be that the vowel in this form is a fully specified vowel [æ] featurally identical to English [æ]. Such a hypothesis should result in the acquirer changing the initial ranking by moving Faithfulness constraints Max-IO and Dep-IO (at least for the features [back] and [round]) above Markedness constraints *V[±round] and *V[±back].

Now consider the effect of a second possible piece of evidence for the acquirer, a form such as 🯅nʲe͜ətᶬ🯅. The transitional quality of the vowel in combination with the non-back and round features of the consonants will lead the acquirer to posit only height and ATR features for the vowel but leave the vowel unspecified for [back] and [round]. The effect on the ranking of those constraints involving the features [back] and [round] will be null. The form [$\text{n}^{\text{j}}\text{V}_{\text{MID}}\text{t}^{\text{ɯ}}$], realized as 🯅nʲe͜ətᶬ🯅, will still be the winning candidate with no change of ranking, since any competitors which have back and round features specified will incur gratuitous Dep-IO violations.[18]

A further step in the grammar acquisition process, Lexicon Optimization, will presumably lead to the acquirer positing additional underspecified vowels, namely those which are involved in morphological alternations. A vowel which is invariably realized as 🯅æ🯅, however, will maintain its fully specified underlying representation and its fully specified phonetic output form, since the grammar will produce an acceptable input–output mapping for such cases (i.e. it will not fail). This grammar, once hypothesized by the learner, will also be supported (1) by

[18] Note that if we reverse the order in which the acquirer receives the two pieces of data above, this will not alter the ranking outcome.

the fact that the *V[±round] and *V[±back] constraints have *already been demoted* relative to MAX-IO and DEP-IO, and thus their re-elevation would be disallowed under OT learning-theoretic assumptions, and (2) by the fact that Richness of the Base requires that no constraints on input forms (such as one requiring all inputs to be underspecified) be imposed.

This ranking is, however, the wrong result. First, it holds that Marshallese has a fully specified vowel for the ⟦æ⟧ of ⟦tʲætʲ⟧ as well as underspecified vowels such as the [−hi, +ATR] vowel of /nʲV$_{\text{MIT}}$tᵚ/. Second, it fails to account for the complete absence in Marshallese of words of the shape [kʷækʷ] with a fully specified [æ] between [+back] and [+round] consonants.

Now let us consider the alternative view, one where the initial ranking places Faithfulness constraints above Markedness constraints. Keeping other things equal, the first data for the acquirer is the form ⟦tʲætʲ⟧. As before, the acquirer's hypothesis at this point should be that the vowel is a fully specified [æ]. In this case, however, nothing about the constraint ranking needs to be changed since the winning candidate will be the one that is most faithful to fully specified [æ].

Upon examination of the second piece of data, ⟦nʲe͜ətᵚ⟧, the acquirer's hypothesis should once again be the same as in the first case, that is that the vowel has height and ATR features but is underspecified on the back and round dimensions. And, as in the first case, no action with respect to the constraint ranking will be taken. As in the earlier scenario, these forms will be correctly handled by the current grammar (because Faith constraints outrank Markedness constraints, and maximally faithful outputs in this case will be underspecified).

Once again, the process of Lexicon Optimization will lead to the acquirer positing underspecification for vowels which show alternations, which reveals to a learner that even seemingly fully specified vowels (like the ⟦i⟧ of ⟦rʲitʲerʲpᵚalᵚ⟧ "worker") may be only apparently fully specified, and can in fact be derived from an assumption of underspecified inputs. This will be successful only if the learner has not already (mistakenly) reranked Markedness constraints. Further Lexicon Optimization on the part of the acquirer uncovers the fact that this is true of *all* apparently fully specified vowels (even the non-alternating ones). This process also reveals that *all* outputs can be treated as underspecified along the back and round dimensions (even those which are apparently [+back, +round]), leading to the reranking of *V[±back] and *V[±round] relative to the MAX-IO and DEP-IO constraints. Note that this is the first change in constraint ranking under the assumption of high-ranking initial Faith. An initial ranking of Faithfulness above Markedness constraints achieves the correct result. It allows the construction of a grammar of Marshallese in which vowels are underspecified phonetically for [back] and [round]. It also makes the correct prediction—unlike the assumption of highly ranked Markedness constraints at the initial state—about the behaviour of vowels in loanwords into Marshallese, as shown in the next section.

3.6 Evidence from Loanwords

As we have seen from the discussion above, the Optimality-Theoretic learner, under standard assumptions, ends up positing fully specified vowels for Marshallese in just those cases in which the surrounding consonants have identical specifications for [back] and [round]. The inevitability of this development is rooted in the articulatory/acoustic identity between the realization of Marshallese's underspecified vowels in this context (e.g. /V_{LO}/ realized as ⟦æ⟧ between non-back, non-round consonants) and fully specified vowels in other languages (e.g. English /æ/ realized as ⟦æ⟧, regardless of surrounding consonants). Since the assumption of Richness of the Base precludes restrictions on the inventory of underlying segments, the learner, having (in our view, mistakenly) posited, for example, underlying /æ/ for a given Marshallese segment, is under no pressure to modify this assumption. We mentioned one argument for why this is an undesirable result above—that the widespread and predictable distributional regularity of Marshallese vowels such as ⟦æ⟧ (which occurs only between "light" consonants) would be completely unexpected.

This aspect of the problem can also be examined using a standard OT technique for exploring Richness of the Base—namely, the study of the phonological properties of loanwords. Since there is no restriction on underlying forms under the assumption of Richness of the Base, loanwords are often assumed in the literature to have the same underlying representation in the borrowing language as in the source language. Loanword "adaptation" is then simply a function of playing the source language's lexical items through the constraint ranking of the borrowing language. If Marshallese speakers allow fully specified underlying representations for vowels such as /æ/, and allow the winning candidates for such fully specified underlying vowels to also contain fully specified vowels (as would seem to be required by the standard OT acquisition account, as sketched above), then loanwords containing such vowels in the source language should require no adaptation.

In CVC loanwords with English vowels which "match" (roughly) the pronunciation of Marshallese vowels and where the flanking consonants have the same values for the features [back] and [round] as the English vowel, the Marshallese pronunciation is, as expected, relatively similar to the English source vowel in articulatory/acoustic terms.[19]

(11) Marshallese Loanwards with Relatively Faithful Realization of "Target" Vowels

−back,−round both	+back,−round both	+back,+round both
/$jV_{HI}t^j$/ ⟦jit^j⟧ 'yeast'	/$l^ɯV_{LO}k$/ ⟦$l^ɯak$⟧ 'lock'	/$k^wV_{HI}k^w$/ ⟦k^wuk^w⟧ 'cook'

[19] The loanword data cited in this section of the chapter has been taken from Abo et al. (1976).

This is of course expected under any analysis: it is impossible to tell whether such vowels are fully specified or underspecified along the back and round dimensions in Marshallese without consideration of the full range of data.

When the flanking consonants have different values for the features [back] and [round], or when these consonants conflict with the values for the English vowel along these dimensions, a Marshallese speaker who, as in the "standard" OT account, allows fully specified vowels in underlying and output representations, and is confronted by an English vowel which (roughly) matches that found in his own output forms, would be predicted to borrow such words intact, and pronounce them accurately. Marshallese shows a variety of treatments of such English CVC loanwords, all of which, however, involve glide epenthesis, contrary to expectation on the standard OT account. Marshallese has three glides—a palatal (traditionally, /y/, here /j/), a back non-round (traditionally, /h/, here /ɰ/), and a back round (traditionally, /w/) glide, each with the expected effect on adjacent vowels. The glides themselves are said to be "weakly articulated" and noticeable principally through their effects on adjacent vowels. The examples in (12) are grouped by type of flanking consonant in the loanword and by the target vowel in the source language.

(12) Marshallese Loanwords with Seriously Divergent Realizations of the "Target" Vowel

a. Flanking back consonants

Front V target		Round V target	
/kV$_{\text{MID}}$jV$_{\text{MID}}$k/ [kə͡ejе͡ək]	'cake'	/tᵚV$_{\text{HI}}$wV$_{\text{HI}}$lᵚ/ [tᵚɯ͡uwu͡ɯlᵚ]	'tool'
/kV$_{\text{LO}}$jV$_{\text{LO}}$ŋ/ [ka͡æjæ͡aŋ]	'gang'	/kV$_{\text{MID}}$wV$_{\text{MID}}$tᵚ/ [kə͡owo͡ə tᵚ]	'goat'

b. Flanking front consonants

Back non-round V target	Round V target	
	/tʲV$_{\text{HI}}$wV$_{\text{HI}}$nʲ/ [tʲi͡uwu͡inʲ]	'June'
	/tʲV$_{\text{HI}}$wV$_{\text{HI}}$tʲ/ [tʲi͡u wu͡itʲ]	'shoes'

c. Mixed flanking consonants

Front V target		Back non-round V target	
/kʷV$_{\text{HI}}$jV$_{\text{HI}}$nʲ/ [kʷu͡ijinʲ]	'queen'	/tʲV$_{\text{LO}}$ɰV$_{\text{LO}}$tᵚ/ [tʲæ͡aɰatᵚ]	'shot'
/tʲV$_{\text{LO}}$jV$_{\text{LO}}$k/ [tʲæjæ͡ak]	'check'		
/pʲV$_{\text{LO}}$jV$_{\text{LO}}$k/ [pʲæjæ͡ak]	'back, bag'		
/pᵚV$_{\text{MID}}$ɰV$_{\text{MID}}$tʲ/ [pᵚəɰə͡e tʲ]	'base'		

Round V target

/tʲV$_{\text{LO}}$wV$_{\text{LO}}$pᵚ/ [tʲæ͡ɒwɒ͡apᵚ] 'soap'
/tʲV$_{\text{LO}}$wV$_{\text{LO}}$k/ [tʲæ͡ɒwɒ͡ak] 'chalk'

Two facts emerge from a consideration of this loanword data from Marshallese. First, the glide-insertion process appears to take place just in the case where an underspecified Marshallese output vowel would be realized—because of the effects of the surrounding consonants—as a vowel quite distinct from that of the source language. For example, English /ʃuz/ without glide insertion would be, under our assumptions, stored as Marshallese /$t^jV_{HI}t^j$/ and pronounced as ⟦t^jit^j⟧. Note that under "traditional" OT assumptions, the word would presumably be stored as Marshallese /t^jit^j/ and pronounced as ⟦t^jut^j⟧. Neither of these reflects the observed data: apparently the Marshallese speaker cannot avail himself of the standard OT analysis, and does not allow an analysis which leads to such a divergent realization as in the non-glide insertion analysis. It would appear that the most plausible analysis of the observed loanword phenomena involves not the automatic positing of a Marshallese underlying form which matches precisely that of the English source (as is commonly assumed in approaches to these questions), but instead some consideration of how a Marshallese speaker might parse—in other words, assign a linguistic analysis to—a particular English word. In the *shoes* case, for example, what the Marshallese speaker appears to do is analyse the voiceless coronal fricatives as realizations of his/her /t^j/.[20] The [+back] and [+ round] properties of the English vowel in [ʃuz] are of course very salient, and the Marshallese speaker needs to posit a parse which accounts for the presence of these properties in the string. Since the non-nasal coronal stops of Marshallese do not include a [+back], [+round] phoneme, and since [back] and [round] specifications arise in Marshallese only through the presence of consonants in the representation, the speaker posits the existence of a back, round glide (/w/) in his/her parse to account for the vowel realization.[21] By inserting a glide which triggers backing and rounding of the high vowel in *shoes*, the result is a vowel, a significant portion of the duration of which is accurate given the English target. This leads us to our second point. It appears that mechanically adopting underlying representations from the source language—the process generally assumed in much of the OT discussion of loanword phenomena—is insufficient to capture the somewhat more subtle factors which shape contact-related phonological phenomena.

At first glance, it may appear that this story about how Marshallese loanwords come to have glide insertion is in direct violation of the principle of Richness of the Base. After all, why does not the borrower simply posit either an underlying /u/, or underlying back, round coronal stops, or, for that matter, /ʃ/ and /z/, in his/her representation of English /ʃuz/, as the standard OT approach to these matters appears to assume? But we would like to maintain an (in our view) important contrast between what the borrower actually does in a particular instance of borrowing—which is a function of the nature and intensity of contact, the sociolinguistic situation, and potentially many other factors—and what the *representational capacity* of the borrower is. Under the right set of (essentially

[20] This is a consistent pattern, perhaps aided by the fact that Marshallese /t^j/ often has affricated realizations.

[21] Presumably the glide is posited, as opposed to some other "heavy" consonant (e.g. /k^w/) because it has, aside from its effects on adjacent vowels, the least salient acoustic cues—in other words, it is the segment most likely to be difficult to perceive beyond its effect on vowels.

extra linguistic) circumstances, it may be quite possible for Marshallese speakers to posit representations containing /u/s, or /ʃ/s, or whatever. Our claim is merely that those circumstances did not prevail at the time of the borrowing of /ʃuz/ (or any other loanwords in Marshallese from English known to us).

3.7 Conclusions

With these Marshallese facts, we hope first to have contributed to the literature on the need for underspecification that persists through to phonetic form. It is already well known that an abstract, feature-based, representation system requires that *some* aspects of articulation not be specified (e.g. the transitions from [g] to [ɛ] in *get*), because the grammar provides no appropriate representational apparatus. In parallel fashion, we assume that one of the cues to the acquirer in the Marshallese case is precisely the absence of any UG-given feature available to be assigned to some input form, resulting in *no* feature being assigned along the relevant dimension. Specifically, as we discussed earlier, one source of variation in the realizations of identical feature bundles that is stripped away for purposes of phonological representation is the transitional effect determined by context (coarticulation effects). Crucially, in Marshallese, the transitions last *throughout the duration of the vowel* for backness and roundness in the appropriate consonantal environment and are treated, for purposes of featural representation, just as all other transitions are, with no features for back and round being assigned. More interestingly, perhaps, Marshallese teaches us that the grammar may similarly leave some aspects of articulation not specified (e.g. the backness of the tongue and roundedness of the lips during the vocalic segments of a string) for which the representational apparatus *is*, in principle, available. This lends further support for the idea that the symbolic representations manipulated by the grammar should be divorced from the articulatory and acoustic dimensions. The Marshallese case illustrates that no necessary connection between a particular articulatory/acoustic event and a given feature holds.

The Marshallese case also reveals several shortcomings in Optimality Theory, as traditionally practised. The first of these is that formal notions of markedness and those based on typology, or cross-linguistic frequency, do not converge on the same set of "Markedness constraints"—the latter should therefore not be used in arguing in support of the former (and vice versa). The second shortcoming is that the most reasonable account of the acquisition path for Marshallese appears to require an initial state in which Faithfulness constraints are ranked above Markedness constraints, contrary to widespread OT practice. Finally, we have presented some reasons to believe that the current approach to loanword phonology within OT, particularly the invocation of loanword phenomena in support of the concept of Richness of the Base, is overly optimistic about the assumed simplicity of the mechanisms involved in "language contact" events.

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CHAPTER 4

PHONOLOGY–MORPHOLOGY INTERACTION IN A CONSTRAINT-BASED FRAMEWORK

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4.1 Introduction

Any theory of the phonology–morphology interface has to deal with effects in which subconstituents of a morphologically complex form seem to undergo phonology on their own. As an example, consider apparent overapplication of nasalization in Sundanese forms with infixes (Robins 1959; Cohn 1990). In bare roots, nasalization spreads from left to right; nasal spread is blocked by nonlaryngeal consonants (1).

(1) Nasalization in bare roots (nonlaryngeal consonants stop nasal spread)

ɳĩãr	'seek'	ŋãtur	'arrange'
ɳãĩãn	'wet'	ŋõbah	'change'

bɨŋhãr	'to be rich'	ŋ̃ĩsər	'displace'
ɳãũr	'say'	ŋ̃ũliat	'stretch'
niʔĩs	'relax in a cool place'	mãrios	'examine'
naʔãtkɨn	'dry'	ŋ̃ĩwat	'elope'

In infixed forms, however, nasalization appears to spread across any nonlaryngeal consonants in the infix (here, the plural -*aR*-).

(2) Nasalization in forms with infixes (overapplication across oral segment in infix)

Root	Infixed form	Gloss
ɳĩãr	ɳ-ãl-ĩãr	'seek-PL'
ɳãũr	ɳ-ãl-ãũr	'say-PL'
mãhãl	m-ãr-ãhãl	'expensive-PL'
naʔãtkɨn	n-ãr-aʔãtkɨn	'dry-PL'

In traditional approaches, such phenomena are handled by cyclic application of phonology: a cycle of phonology applies to the root without the infix present. The infix is subsequently added and another cycle of phonology applies. Nasality can spread to all root consonants regardless of the place of articulation of any infix consonant because the infix is simply not there during the first cycle of nasal spread, as the derivation in (3) from Cohn shows.

(3) Cyclic (interleaving) account of Sundanese data

UR	ɳiar
Cycle 1: nasal spread	ɳĩãr
Infix	ɳ-aR-ĩãr
Cycle 2: nasal spread	ɳ-ãl-ĩãr

An alternative to cyclic derivation is to use paradigm uniformity constraints that cause morphologically related forms to be phonologically similar to one another (current approaches include Bochner 1993; McCarthy 1995, 2002; Benua, 1995, 1997; Kenstowicz 1996, 1997, 2002; Buckley 1999; Steriade 2000; Stump 2001; Burzio 2005). In a paradigmatic approach, the presence of apparently unexpected nasalized vowels in the infixed form is due to their presence in the bare form. Paradigm uniformity is improved at the expense of surface transparency of nasal spread.

In this chapter we develop Paradigmatic Sign-Based Morphology (PSBM). PSBM handles morphological relatedness effects (cyclic effects, paradigm uniformity, and non-uniformity) by imposing grammatical relations that hold between certain morphologically related forms. In developing this model, we pay attention to a number of issues that have been addressed inadequately (if at all) in current paradigmatic approaches. These include bound stems that are not independent words, the apparent inside-out nature of cyclic effects, the presence of apparent noncyclic effects, paradigm non-uniformity, and Bracket Erasure effects.

4.2 PSBM

This section describes the PSBM model. We start with a discussion of signs, after which we present the organization of the morphological component of a sign-based grammar.

4.2.1 Signs

What we mean by sign is quite close to the traditional Saussurean understanding: a sign is a pairing of sound and meaning. In SBM, we see a sign as a linguistic unit containing phonological information as well as morphosyntactic and semantic features. A sign is the only linguistic construct recognized in SBM. We represent signs as feature structures with attributes that we call PHON and SYNSEM. Since in this chapter we are interested only in the phonology–morphology interface, we simply use the value of the SYNSEM attribute as a convenient placeholder for glosses, or, when convenient, simply omit this attribute. Thus, the sign representing the root *book* will be:

(4) $\begin{bmatrix} \textsc{synsem} & \textit{book} \\ \text{phon} & \text{bʊk} \end{bmatrix}$

Morphologically complex forms, too, will be represented as signs. Thus, the sign corresponding to the plural noun *books* is:

(5) $\begin{bmatrix} \textsc{synsem} & \textit{books} \\ \text{phon} & \text{bʊks} \end{bmatrix}$

The grammar must, of course, relate these two forms to one another in some way. In particular, this grammatical relation should be such that it can be seen as "licensing" the complex form *books* given that the root *book* exists. In the next section, we describe the form of these grammatical licensing statements.

4.2.2 The Grammar as a Set of Relations

An SBM grammar consists of a set of relations between lexical items and of licensing statements based on these relations. Thus, there will be a grammatical relation $\mathfrak{R}$ such that $\mathfrak{R}$([SYNSEM *book*, PHON bʊk], [SYNSEM *books*, PHON bʊks]) holds. This would imply that any phonological realization of the plural suffix would be part of the relation $\mathfrak{R}$. Alternatively, we can specify the phonological material introduced by the affix as a third argument to the grammatical relation (affixation constructions will thus be represented by three-place relations): $\mathfrak{R}$([SYNSEM *book*, PHON bʊk], [PHON z], [SYNSEM *books*, PHON bʊks]). This is the approach we will take here, simply because of its greater transparency (though see Orgun 1996 for some theory-internal arguments for the superiority of this choice). $\mathfrak{R}$ must include specifications of its two arguments (e.g. that they are both count nouns; the first one is singular, the second one is plural, etc.), as well as a statement of the required correspondences between the arguments (e.g. that they share their major semantic features). On the phonological side, we assume the relationship specified by $\mathfrak{R}$ to be a set of ranked and violable constraints—that is, an Optimality Theoretic phonological grammar. We leave the choice of the syntactic and semantic relation open. Some possible choices are: Lieber's (Lieber 1980) percolation conventions, the somewhat more detailed conventions (e.g. Head Feature Principle, Foot Feature Convention) of HPSG (Pollard and Sag 1987; Kasper 1994; Sag and Wasow 1999), or perhaps an Optimality Theoretic constraint system as well. The grammatical statement of the licensing of *books* based on *book* is then:

(6) The sign $\begin{bmatrix} \textsc{synsem} & \textit{books} \\ \textsc{phon} & \text{bʊks} \end{bmatrix}$ is well-formed if:

(i) The sign $\begin{bmatrix} \textsc{synsem} & \textit{book} \\ \text{phon} & \text{bʊk} \end{bmatrix}$ is well-formed and

(ii) $\mathfrak{R}\left(\begin{bmatrix} \textsc{synsem} & \textit{book} \\ \text{phon} & \text{bʊk} \end{bmatrix}, [\textsc{phon z}], \begin{bmatrix} \textsc{synsem} & \textit{books} \\ \textsc{phon} & \text{bʊks} \end{bmatrix}\right)$

Condition (i) is satisfied since the root *book* is found in the lexicon; condition (ii) is satisfied assuming that the OT ranking is set up appropriately.

If desired, morphosyntactic and semantic features to go along with the phonological material /z/ could be introduced as well (that is, the affix could be represented within $\mathfrak{R}$ as though it were a sign, though it would still not be listed independently in the lexicon; the only mention of the affix in the grammar is within the statement of $\mathfrak{R}$). We leave the choice open. What is the general form of the noun pluralization construction? We present it here:

(7) Sign B is well-formed if:
 (i) Sign A is well-formed and
 (ii) $\mathfrak{R}$(A, [PHON Z], B)

We assume all affixation constructions have this form and that the placement of the affix (as a prefix, infix, or a suffix) is handled by $\mathfrak{R}$, as in Noyer (1994).

Compounding structures are similar, except that they consist of a mother node and two daughters, both of which are signs (found listed in the lexicon or licensed by other grammatical relations):

(8) Sign C is well-formed if:
 (i) Sign A is well-formed and
 (ii) Sign B is well-formed and
 (iii) $\mathfrak{R}$(A, B, C)

There will be a grammatical relation corresponding to each morphological construction found in the language. Thus, for example, each affix will be represented as a grammatical relation, as will each reduplication, truncation, compounding, etc., process. For convenience, we will subscript our grammatical relations with labels describing the morphological construction they represent, as in $\mathfrak{R}_{\text{plural}}$ and $\mathfrak{R}_{\text{compound}}$. In principle, these grammatical relations might differ from one another in the patterns of percolation of SYNSEM features and in the ranking of their Optimality Theoretic constraint systems. This in turn raises a set of questions concerning the capturing of generalizations that hold across various grammatical relations and restricting the possibility of unlimited differences between them. These issues have been addressed in some detail in works such as Koenig (1994); Riehemann (1994, 1998, 2001); Orgun (1997, 1999).

One consequence of our approach is that words (signs in general, in fact) do not need to have internal morphological structure. We discuss the desirable implications of this in section 4.4.5.

4.3 A Simple Example

In this section, we illustrate the emergence of cyclic phonological effects from paradigmatic constraints. Uighur, as described in Orgun (1994), has two phonological alternations that interact in a sometimes opaque manner. First, the vowels [a] and [e] raise to [ɨ] and [i], respectively, in nonfinal open syllables (but only when they are the last vowel in a morpheme).

(9)	bala	'child'	balɨ-lar	'child-PL'
	ameriqa	'America'	ameriqɨ-lɨq	'American'
	adam	'man'	adɨm-i	'man-POSS'

Additionally, [ɨ] and [i] delete between identical consonants in the two-sided open syllable environment:

(10) qazɨn-i 'pot-POSS' qazɨn-ni (qazan + i + ni) 'pot-POSS-ACC'

In a typical case of phonological opacity, input [a] and [e] raise to [ɨ] and [i] but do not delete.

(11) /bala – lar/ balɨ-lar 'child-PL'

It therefore follows that the [ɨ] (from input [a]) in /bala-lar-i/ should not delete if phonology is noncyclic: input [a] raises to [ɨ] but does not delete in (9). However, the vowel in /bala-lar-i/ does delete, presumably because the underlying [a] corresponds to a [ɨ] in [balɨlar] 'children' and this [ɨ] somehow counts as the 'input' for [ballɨri]. Similarly, in /bala-lar-ni/, the surface form is [ballarni], again presumably because of the raised vowel in [balɨlar].

(12) bala 'child'
balɨ-lar 'child-PL'
bal-lɨr-i 'child-PL-POSS'
bal-lar-ni 'child-PL-ACC'

A cyclic approach would handle this quite straightforwardly by assuming that the form [ballɨri] 'child-PL-ACC' is in fact derived from the intermediate form [balɨlar] 'children'. In a paradigmatic model, the account is equally simple. All that needs to be done is to set up grammatical relations between [balɨlar] and the corresponding accusative and possessive forms.

(13) $\mathfrak{R}$(balɨlar, i, ballɨri) Grammatical relation for 'child-PL-POSS'
$\mathfrak{R}$(balɨlar, i, ballarni) Grammatical relation for 'child-PL-ACC'

While a traditional underlying-surface mapping would have favoured a [ɨ] in 'child-PL-ACC', paradigmatic correspondence with [balɨlar] (in a manner to be specified in the constraint ranking) favours zero. The cyclic account can be translated to a paradigmatic account because in this case (as in many others) the intermediate form in the cyclic derivation also happens to be an independent word form on its own. This allows the analyst to assume that the two words correspond to each another, but are not derived from each another. Having presented the paradigmatic correspondence approach, we now turn to challenges and modifications.

4.4 Challenges and Modifications

In this section we consider a wide range of phenomena that pose problems to the paradigmatic correspondence approach. We propose modifications to the approach that the challenges necessitate and we show how SBM incorporates those necessary modifications.

4.4.1 Ungrammaticality and the Inside-Out Nature of Cyclic Effects

While this section does not pose a challenge to PSBM, it does present data that create difficulties for some paradigmatic theories. The first difficulty is posed by ungrammaticality. We will see that the ungrammaticality of an intermediate form prevents the existence of a more complex form even though that more complex form is otherwise well formed. This suggests that ungrammaticality is a property that may be copied by paradigm uniformity constraints. However, it is rather strange that ungrammaticality should be subject to apparent paradigm uniformity effects, as it is not a phonological feature. The second challenge is that the reverse effect, where the ungrammaticality of a complex form causes a simpler form to be ungrammatical, is not found. That is, cyclic effects are inside-out, not outside-in. Thus, it is necessary to build some sort of directionality into the paradigm uniformity constraints.

The data have to do with a certain minimal-size condition in some varieties of Turkish. Detailed discussions can be found in Inkelas and Orgun (1995) and Itô and Hankamer (1989).

Some Turkish speakers impose a disyllabic minimal-size condition on suffixed words.

(14)	sol^j	'musical note G'	do:	'musical note C'
	sol^j-ym	'my G'	*do:-m	Intended: 'my C'

When further morphological derivation from these forms is attempted, an interesting pattern emerges.

(15)	sol^j-ym-y	'my G-ACC'	*do:-m-u	Intended: 'my C-ACC'
	sol^j-y	'G-ACC'	do:-ju	'C-ACC'

The form *[do:-m-u] is ungrammatical although it contains the required two syllables. This form is ungrammatical because the morphologically simpler form [do:-m] is subminimal. In a cyclic approach, one would say there is no intermediate form from which *[do:-m-u] could be derived; in a correspondence approach, there are no intermediate forms. Instead, there are correspondence constraints between related forms.

For [sol^j-ym-y] the constraints will have the following pattern of application (for simplicity, we ignore vowel harmony and show underlying representations with harmonic vowels):

(16) Grammatical relation for [sol^j-ym-y]
$\mathfrak{R}$(sol^j-ym, y, sol^j-ym-y)

We must take a small detour here to address a problem that arises in theories that have traditional underlying-surface mappings in addition to paradigm uniformity constraints (most of the recent OT work previously cited falls into this category). In such a theory, one would not expect the absence of the intermediate form *[do:-m] to cause the complex form [do:-m-u] to be ungrammatical. This complex form will be subject to the usual input–output faithfulness constraints:

(17) IO constraints on [do:-m-u]

Surface	[do:-m-u]	
	↑	*IO-Faith*
UR	/do:-m-u/	

However, this mode of constraint application does not lead to ungrammaticality. Since [do:-m-u] is two syllables, it should be grammatical.

This is the first challenge, then: how does paradigm uniformity cause [do:-m-u] to be ungrammatical? We might be tempted to claim that the form *[do:-m] does exist and is able to stand in paradigmatic correspondence relations. Furthermore, ungrammaticality needs to be seen as a property of this form that paradigm uniformity constraints can copy (it should be noted that, to our knowledge, ungrammaticality has actually never been addressed in the Optimality Theoretic transderivational correspondence literature, and that we are here attempting to extend the reach of the framework to new empirical ground). The constraints applying to [do:-m-u] then become:

(18) Constraints on [do:-m-u]

		Paradigmatic Identity		
Surface	*[do:-m]	→	*[do:-m-u]	
	↑		↑	*IO-Faith*
UR	/do:-m/		/do:-m-u/	

While this extension of paradigm uniformity seems to solve the problem, it in fact raises a more significant issue that does not just apply to this example, but has traditionally been the main motivating factor of interleaving (see especially the Lexical Phonology literature, including Kiparsky 1982, Mohanan 1982, Mohanan 1986).

Given that one of two forms in paradigmatic correspondence can cause the other to be ungrammatical, what is there to prevent a complex form from making a simpler form ungrammatical? In particular, the root [do:] in Turkish is a possible word form. Yet one can easily set up a paradigmatic correspondence that would lead one to expect this form to be ungrammatical:

(19) Backward propagation of ungrammaticality

		Paradigmatic Identity		
Surface	*[do:-m]	→	*[do:]	
	↑		↑	*IO-Faith*
UR	/do:-m/		/do:/	

This type of pattern is never found. Cyclic effects are always inside out. A paradigm-based model is by its very nature symmetrical and therefore ill-equipped to deal with this. Within OT approaches, various ad hoc proposals have been made to handle this (Benua's "primacy of the base" and "recursion of Con", Kenstowicz's "base identity"). Such a basic fact, however, should really follow from more fundamental architectural aspects of a theory and not from tacked-on stipulations.

As we now demonstrate, the licensing statement approach in PSBM avoids these two problems. To deal with the Turkish data, we need two grammatical constructions (licensing statements), one for the possessive suffix and one for the accusative suffix:

(20) Possessive
B is a form if:
(i) A is a form
(ii) $\mathfrak{R}_{\text{poss}}$(A, /m/, B)

(21) Accusative
B is a form if
(i) A is a form
(ii) $\mathfrak{R}_{\text{acc}}$(A, /I/, B)[1]

With these grammatical statements in place, the licensing of [sol^j-ym-y] takes the following form:

(22) [sol^{j}ymy] is a form if:
(i) [sol^{j}ym] is a form and
(ii) $\mathfrak{R}_{\text{acc}}$([sol^{j}ym], /I/, [sol^{j}ymy])

We assume that the OT constraint ranking of $\mathfrak{R}_{\text{acc}}$ is such that $\mathfrak{R}_{\text{acc}}$([sol^j-ym], /I/, [sol^j-ym-y]) does indeed hold. Then, [sol^j-ym-y] will be grammatical just in case [sol^j-ym] is well formed. This too is verified by checking the appropriate grammatical statement.

(23) [sol^{j}ym] is a form if:
(i) [sol^j] is a form and
(ii) $\mathfrak{R}_{\text{poss}}$([sol^j], /m/, [sol^{j}ym])

Statement (i) is satisfied by the existence of the root [sol^j] in the lexicon. $\mathfrak{R}_{\text{acc}}$([sol^j], /m/, [sol^{j}ym]) is satisfied, disyllabic minimality being its only constraint of interest to us. Therefore, we can conclude from the grammar that [sol^j-ym-y] is a possible word.

Let us now turn to *[do:-m-u]. The licensing statement is:

(24) [do:mu] is a form if:
(i) [do:m] is a form and
(ii) $\mathfrak{R}_{\text{acc}}$([do:m], /I/, [do:mu])

Statement (ii) is satisfied. Statement (i) needs to be verified by using the appropriate grammatical construction, $\mathfrak{R}_{\text{poss}}$.

[1] The symbol [I] represents, as it traditionally does in Turkish linguistics, an underlying high vowel subject to rounding and front–back harmony. The actual featural specification of this vowel is subject to one's phonological commitments, especially as to the question of lexical underspecification.

(25) [do:m] is a form if:
(i) [do:] is a form and
(ii) $\mathfrak{R}_{poss}$([do:], /m/, [do:m])

Statement (i) is satisfied since the lexicon contains the root [do:]. Statement (ii), however, is not satisfied, since [do:-m] is subminimal. Therefore, *[do:-m-u] is not licensed.

Let us summarize how our modification deals with the challenges we raised for the paradigmatic correspondence approach. First, because the grammar is seen as a collection of licensing statements and because licensing statements are inherently directional, the inside-out nature of cyclic effects follows. Second, again because correspondence constraints are licensing statements, the nonexistence of a simple form leads to the nonexistence of a more complex form, since there is nothing to license the more complex form. This contrasts with the paradigmatic correspondence view which assumes that words are built from (licensed by) their underlying morphemes by constructing a constituent structure and uses paradigmatic correspondence as an additional stipulative mechanism to handle cyclic effects. As discussed in section 4.2.2, the grammar in paradigmatic SBM consists entirely of licensing statements of the sort we argued for in this section.

4.4.2 Noncyclic Effects

When cyclic and noncyclic effects coexist in the same language, paradigmatic correspondence often gives rise to the wrong expectations. Such is the case in Turkish. We have already looked at apparent cyclic enforcement of prosodic minimality, where *[do:-m-u] is ungrammatical though supraminimal because *[do:-m] is subminimal and ungrammatical. It turns out, however, that in other morphological constructions, supraminimal derivations from subminimal bases appear to be possible. The relevant data involve the aorist suffix [r] and the passive suffix [n]. When the passive suffix is added to a CV base, the resulting monosyllabic word is ungrammatical.

(26) je ‘eat’ *je-n ‘eat-PASSIVE’
ovala ‘rub’ ovala-n ‘rub-PASSIVE’

Unlike *[do:-m], however, *[je-n] appears to be able to undergo further morphology:

(27) je-n-ir ‘eat-PASSIVE-AORIST’

In paradigmatic correspondence, we would expect there to be a paradigmatic correspondence between *[je-n] and [je-n-ir], similar to that between *[do:-m] and *[do:-m-u]. This correspondence should cause [je-n-ir] to be ungrammatical, since it causes *[do:-m-u] to be ungrammatical (or, perhaps more accurately, the absence of the form *[je-n] implies the absence of the relation $\mathfrak{R}$(jen, r, jenir) and therefore the absence of [je-n-ir], which remains unlicensed).

(28) Ill-formed grammatical relation for [je-n-ir]
$\mathfrak{R}$(*jen, r, jenir)

This, however, is the wrong result. How can we deal with this noncyclic effect? What is needed is the ability to circumvent the intermediate stem *[je-n] altogether and add the suffixes [n] and [ir] together as a group to the root [je]. This can be done by allowing the grammar to contain complex licensing statements. In the case of [je-n-ir], we will have:

(29) [jenir] is a form if:
(i) [je] is a form and
(ii) $\mathfrak{R}_{\text{pass-aor}}$([je], /n/, /ir/, [jenir])

Orgun (1995) and Orgun and Sprouse (1996) provide further evidence from Turkish morphology for such complex licensing statements (in Orgun's approach, these correspond to ternary branching constituent structures). The formal mechanism for handling such licensing in the grammar is open to debate.

4.4.3 Choice of Correspondents

Paradigmatic correspondence might seem to be a laissez-faire approach in that it allows any pair of related words to stand in correspondence (without explicitly defining what it means for words to be "related"). This section shows that the grammar needs some means of determining which forms may stand in correspondence.

In a traditional cyclic approach, cyclic effects hold only between a form and its immediate subconstituents. Allowing other types of correspondence gives rise to strange predictions. In Turkish, for example, we might set up a correspondence between the singular–plural pair *[do:-m] 'my C' and [do:-lar-ɯm] 'my C-PLURAL'.

(30) Turkish forms that do not interact

*do:-m	'my C'
do:-lar-ɯm	'C-PL-1SGPOSS'

Putting these forms in paradigmatic correspondence would lead us to expect [do:-lar-ɯm] to be ungrammatical.

(31) Unwanted correspondence
$\mathfrak{R}$(*do:m, lar, do:larɨm)

In order to avoid this type of problem, we must make sure that only those correspondences are possible that are explicitly sanctioned by the grammar. In other words, the grammar must specify what kinds of word pairs (or, generally, multiples) can stand in correspondence. SBM does this by setting up the grammar as a collection of licensing statements. Every grammatical correspondence is sanctioned by one of these statements. *[do:-m] and *[do:-lar-ɯm] do not correspond because there is no grammatical relation $\mathfrak{R}$ such that $\mathfrak{R}$([do:m], /…/, [do:larɯm]) holds. Instead, there is a relation $\mathfrak{R}_{poss}$ such that $\mathfrak{R}_{poss}$([do:lar], /m/, [do:larɯm]) holds, as well as a relation $\mathfrak{R}_{pl}$ such that $\mathfrak{R}_{pl}$([do:], /lar/, [do:lar]) holds. Thus, [do:larɯm] is fully licensed; the ungrammaticality of *[do:-m] is irrelevant.

4.4.4 Cyclic Effects Involving Non-Words

It is assumed in most paradigmatic correspondence approaches that paradigm uniformity should hold only between output (surface) forms, taken loosely to mean words. We show in this section that paradigmatic correspondence can also hold between bound stems, which, by definition, are not possible words.

Dolbey shows that phonologically conditioned "syllable counting" suppletion in Saami must refer to bound stems. In certain morphological contexts in Saami allomorphs are selected so as to optimize the metrical structure of the output form by making sure it can be exhaustively parsed into disyllabic feet. The passive and second-person dual suffixes are among those subject to this type of allomorphy.

(32) Second-person dual suffix: -*beahtti* ~ -*hppi*

jear.ra.-beaht.ti	veah.ke.hea-hp.pi
'ask-2DU'	'help-2DU'

In each case, the chosen allomorph allows the stem to be exhaustively footed by making sure it contains an even number of syllables.

(33) Passive suffix: -*juvvo* ~ -*vvo*

je:r.ro.-juv.vo-	veah.ke.hu-v.vo-
'ask-PASS-'	'help-PASS-'

Here, too, allomorphy is based on optimizing the metrical structure of the output of affixation. What is important here is that the passive stems are bound and cannot be used as words without agreement morphology. Fully inflected passive forms with second-person dual agreement are given below.

(34) Fully inflected passives (verb-passive-2dual)

je:r.ro.-juv.vo-beaht.ti	veah.ke.hu-v.vo-beaht.ti
‘ask-PASS-2DU’	‘help-PASS-2DU’

Applying metrical optimization to the complete word might give rise to the wrong result by using the monosyllabic allomorph of each affix instead of the disyllabic allomorph of each. This result might be expected, for example, based on Zoll's (1998) *STRUC constraint.

(35) ☞(je:r.ru)-(v.vo-hp.pi)

What is needed here is the ability to let bound stems, not just words, stand in correspondence. This is in line with recent theories of morphology where stem-based rather than word-based morphology is often used (see, for example, Aronoff 1994).

This result does not require a major change in correspondence theory, except perhaps for a change in the name of the theory. Otherwise, all we need is to admit that any lexical root or stem is a possible correspondent in a paradigmatic relation. In SBM, of course, no special status is given to words in the structure of licensing statements, which are free to refer to any lexical item, be it a root, stem, or word.

It is sometimes pointed out in the paradigmatic literature (Kenstowicz 1995) as well as in the LP literature (see Inkelas 1990 for thorough discussion and comprehensive references) that bound morphemes (especially affixes) do not figure in cyclic or paradigmatic effects. In that literature, this is attributed to the fact that affixes are not independent words, and since correspondence holds only between words, affixes by definition cannot participate. In this section we have shown that correspondence should not be limited to words. Do we thereby weaken the theory? We do not. There is a different, even more fundamental reason in paradigmatic SBM why affixes cannot be subject to paradigmatic correspondence. The reason is that affixes are not signs and therefore not lexical entries. Since all licensing statements hold between lexical items, affixes cannot participate. Instead, affix material is included within licensing statements that describe affixal morphology, as, for example, in (6).

4.4.5 Bracket Erasure Effects

The term Bracket Erasure refers to a Lexical Phonology-specific implementation of an observed locality effect in morphology and the phonology–morphology interface. The observation is that phonology applying on a particular cycle may be sensitive to morphological structure (in particular, morpheme boundaries) introduced on that same cycle, but not to information from deeper cycles.[2] In this section, we go through one example that illustrates potential undesirable consequences of a theory without some equivalent of Bracket Erasure. The example in question is Turkish velar deletion. We first present a brief summary of velar deletion in Turkish, then we develop an unattested variant of this system based on unlimited reference to internal morphological structure.

In certain morphological constructions in Turkish, intervocalic velars delete in derived environments. Third-person singular suffixation is one of the environments for such deletion:

(36) bebek 'baby'
bebe-i 'baby-3SG'
sokak 'street'
soka-ɯ 'street-3SG'

Other affixes, incudling the future suffix, do not trigger velar deletion.

(37) birik 'accumulate'
birik-edʒek 'accumulate-FUT'
gerek 'be necessary
gerek-edʒek 'be necessary-FUT'

It is quite simple to handle these facts. One simply needs to set up two different phonological constraint systems for the two affixation constructions. Such different systems are called "co-phonologies" and have been extensively discussed in the OT literature. See Inkelas (1998) for basic discussion and Orgun (1997) for possible ways to restrict the power of a grammar using co-phonologies.

The third-person singular suffix may attach to stems containing the future suffix. When this happens, only velars that are next to the third-person singular affix delete. Internal velars stay intact.

(38) /birik-edʒek-i/ birikedʒei 'accumulate-FUT-3SG'
*biriedʒei
/gerek-edʒek-i/ gerekedʒei 'be necessary-FUT-3SG'
*gereedʒei

This is exactly what one expects based on Bracket Erasure: the internal boundary between [birik] and [edʒek] is not visible to phonology applying to /birikedʒek-i/. The internal velar, therefore, is not in a detectable morphologically derived environment. As such, it does not satisfy the environment for deletion. In an approach without Bracket Erasure, however, this boundary would be visible

[2] There also are less restrictive versions that limit reference to the most recent lexical stratum rather than cycles, and at least one stricter version—Anderson (1992)—that does not allow reference to any morpheme boundaries, even to those most recently introduced.

([/birik-edʒek-i/]) and one could set up the phonological constraint system such that it would delete both velars in this form, while still preserving root-internal velars (as in [sokak] 'street'). The lack of existence of such cases is what motivated the proposal for Bracket Erasure in the Lexical Phonology framework; paradigmatic correspondence as commonly practised does not have an equivalent restrictive mechanism. On the contrary, it has even more power in that it allows full reference to the entire constituent structure and underlying forms of each words as well as paradigmatic reference to related words. This excess power must be restricted. One obvious way to do this is to remove the complete constituent structure and with it, the possibility to global reference to all aspects of it all the way down to UR. The work of grammar would then be delegated fully to the paradigmatic correspondence constraints. Paradigmatic SBM, of course, already does this. The grammar consists entirely of licensing statements that relate lexical items to one another. The internal structure of a given form is handled by its own licensing statement and is not present in other statements that refer to that form.

It should be noted here that the issue of Bracket Erasure is quite complicated and that there are a number of serious challenges. A discussion of these (and a demonstration of how the SBM approach is empirically more successful than the literal bracketing erasure of previous theories) can be found in Orgun and Inkelas (2002).

4.4.6 Paradigmatic Non-Uniformity and Proximal Base Effects

In this section, we examine data from a number of Bantu languages that show that cyclic effects do not always serve to improve paradigm uniformity. Sometimes they might destroy paradigm uniformity; at other times cyclic or noncyclic application gives rise to equivalent results with respect to paradigm uniformity and therefore paradigm uniformity cannot be the motivation for cyclic effects. We will also see that reference is crucially made only to the "proximal base" (corresponding to an immediate constituent in a constituent structure approach) and not to more distal bases (corresponding to more deeply embedded constituents).

The data are quite complex and a full discussion can be found in Hyman (1994, 1998). Here, we discuss two of the language types that Hyman presents: cyclic and restored cyclic. A third type he discusses, noncyclic, is of no interest to us here as it does not pose a challenge to any theory of the phonology–morphology interface. The analysis is adapted from Hyman. The data in all three cases involve the causative and applicative suffixes. In all three types of language, the causative [i̧] attaches as an infix to stems containing the applicative (usually [il]). Furthermore, the causative causes some stem-final consonants to mutate; the exact system of mutation depends on the language. In all cases, we will be interested in the patterns of mutation in stems containing both the causative and the applicative.

We start with Bemba, a typical cyclic language. We first look at mutation of the root-final consonant before the causative [į]. Nasals are not subject to mutation. Non-nasal labials mutate to [f]. Other consonants mutate to [s].

(39) Bemba mutation

a.	*-leep-*	'be long'	→	-leef-į-	'lengthen'	(p,b → f)
	-lub-	'be lost'	→	-luf-į-	'lose'	
b.	*-fiit-*	'be dark'	→	-fiis-į-	'darken'	(t,d,l,k,g→s)
	-tʃind-	'dance'	→	-tʃins-į-	'make dance'	
	-lil-	'cry'	→	-lis-į-	'make cry'	
	-buuk-	'get up'	→	-lis-į-	'get (s.o.) up'	
	-lúng-	'hunt'	→	-lúns-į-	'make hunt'	

In addition, [s] allophonically palatalizes to [ʃ] before high front vowels; we do not show this in our transcriptions.

We now take a look at the pattern of mutation in forms containing the applicative infix as well as the causative suffix. As expected, the [l] of the applicative mutates to [s] in these forms. More surprising is the fact that the root-final consonant too mutates.

(40) Double mutation

a.	-leep-el-	'be long for/at'	vs.	-leef-es-į-	'lengthen for/at'
	-lub-il-	'be lost for/at'	vs.	-luf-is-į-	'lose for/at'
b.	*-fiit-il-*	'be dark for/at'	vs.	-fiis-is-į-	'darken for/at'
	-tʃind-il-	'dance for/at'	vs.	-tʃins-is-į-	'make dance for/at'
	-lil-il-	'cry for/at'	vs.	-lis-is-į-	'make cry for/at'
	-buuk-il-	'get up for/at'	vs.	buus-is-į-	'get [s.o.] up for/at'
	-lúng-il-	'hunt for/at'	vs.	lúns-is-į-	'make hunt for/at'

Hyman's cyclic analysis, based on his earlier interfixation analysis, proceeds as follows. The causative suffix is added first and causes the root-final consonant to mutate. The applicative is then infixed and its final [l], now adjacent to the [į], also mutates. While these data do not pose a particular challenge to paradigmatic correspondence, they do raise an interesting question. Let us compare the actual Bemba data with what we would expect in a noncyclic system:

(41)

Root	Appl.	Caus.–Appl.
leep	leepel	leefesį
leep	leepel	leepesį

In both systems we have a paradigm consisting of three forms. In Bemba, two members of the paradigm, the applicative and the causative-applicative, have the same root-final consonant. The third, the root, has a different consonant. In the hypothetical noncyclic system, two members of the paradigm have the same root-final consonant as well: the root and the applicative. The causative-applicative has a different root-final consonant. We see therefore that the apparent cyclic effect in Bemba does nothing to improve paradigm uniformity overall. It simply shifts the locus of non-uniformity to another part of the paradigm.

This demonstration does not require a major change in the mechanism of paradigmatic correspondence. It does, however, require a reconceptualization. Paradigmatic correspondence is commonly referred to (in the OT literature and elsewhere) as paradigm uniformity, transderivational identity, and other similar terms. The Bemba data show, however, that paradigmatic correspondence is more similar to the traditional input–output relation of generative phonology than these terms suggest: it is capable of enforcing a number of different types of phonological relation, not limited to uniformity or faithfulness.

Another aspect of the data is worthy of mention: in a hyper-paradigmatic system, perfect uniformity could be achieved by fricating the root-final consonant in the isolated root without any affixes:

(42)

	Root	Appl.	Caus.–Appl.
	leef	leefel	leefesį

This kind of system is of course not attested. We have already addressed this issue in section 4.4.1, where we showed that the licensing approach of SBM allows the attested inside-out pattern but not this unattested outside-in pattern (of course, such paradigm levelling could in principle take place diachronically; if this were the case, one would no longer posit an underlying stop for the morpheme in question and therefore the synchronic analysis would not motivate outside-in application of paradigm uniformity constraints).

We now turn to Nyamwezi, a "restored cyclic" language. In this language, the root-final consonant is not mutated in causative applicatives.

(43) Lack of root-final mutation in Nyamwezi

	-root-		-root-į-		-root-il-į-
a.	-βak-	'shine, burn (intr.)'	-βatʃ-į-	'light'	-βak-ídʒ-į-
	-og-	'bathe intr.'	-odʒ-į-	'bathe (s.o.)'	-og-ídʒ-į-
	-zeeŋg-	'build'	-zeeɲdʒ-į-	'have built'	-zeeŋg-idʒ-į-
	-nų̨ų̨ŋh-	'smell'	-nų̨ų̨ɲh-į-	'make smell'	-nų̨ų̨ŋh-idʒ-į-
b.	-βįs-	'hide'	-βįʃ-į-	'make hide'	-βįs-ídʒ-į-
	-βon-	'see'	-βoɲ-į-	'make see'	-βon-ídʒ-į-

The data seem amenable to a noncyclic analysis, where mutation occurs just in case its environment is found in the complete word form. However, when we turn to cases where mutation is neutralizing, we find that the situation is somewhat more complex. In particular, instead of the actual underlying root-final consonant, we find in the causative-applicative a velar consonant.

(44) Replacement velar when mutation is neutralizing

-gul-	'buy'	-ɡudʒ-i̧-	'sell'	-gug-i dʒ -i̧-
-kaànz-	'wash'	-kaàɲdʒ-i̧-	'have washed'	-kaàŋg-i dʒ -i̧-
-buúnh-	'swim'	-búɲh-i̧-	'make swim'	-buúŋh-i dʒ -i̧-

Why does Nyamwezi resort to a replacement velar consonant when either cyclic application (retention of the mutated consonant) or noncyclic application (full recovery of the underlying root-final consonant) would have given rise to better paradigm uniformity? Hyman's analysis has two aspects. First, palatals such as [dʒ] are not allowed before vowels other than [i̧]. A different consonant is therefore required in the causative applicative. The question is why the underlying root-final consonant is not used. Hyman's answer is that only the proximal base, in this case the causative, is visible to the phonology of the causative applicative. The identity of the underlying consonant therefore is invisible. The only choice is to use a replacement consonant.

This discussion raises two points that are relevant to our topic. First, cyclic effects in Nyamwezi destroy rather than enhance paradigm uniformity. This is an even stronger version of the point raised by Bemba: the role of paradigmatic correspondence is not necessarily enhanced uniformity. As in SBM's licensing statements, the role of correspondence is to allow the language to generate morphologically complex forms by using whatever phonological mechanisms are available in UG.

The second point is intimately related to the discussion of Bracket Erasure in section 4.4.5, but goes beyond morpheme boundary information to include all phonological information. Only the proximal base is visible to the phonology of a form. More distal bases are not available. In the paradigmatic correspondence model, this entails abandoning the full constituent representations from UR up and depending solely on correspondence constraints between forms in the grammar. It was already suggested in section 4.4.5 that allowing global reference to each form's full constituent structure is overkill. The discussion in this section provides further proof of this.

SBM's licensing approach already satisfies this requirement. The grammar consists of relations between signs and therefore makes reference to distal bases impossible.

4.5 Conclusion

Paradigmatic alternatives to traditional cyclic accounts of phonology–morphology interface phenomena have become increasingly common. However, many paradigmatic approaches have not explicitly addressed certain generalizations that have been taken to be among the main motivations for cyclicity. In this chapter we have presented Paradigmatic Sign-Based Morphology, a paradigmatic conceptualization of Orgun's configuration-based approach to the phonology–morphology interface. This approach differs from other current paradigmatic views in explicitly addressing a number of issues, which we summarize here.

In section 4.4.1, we looked at data that demonstrate the inside-out nature of cyclic effects: a morphologically simple form exerts a phonological effect on a more complex form, but not vice versa. We showed that this basic property follows in PSBM from the fact that grammatical relations are seen as licensing statements for morphologically complex items. In this section, we also showed that the licensing approach accounts for the impossibility of further morphological derivation from ill-formed bases. In section 4.4.2, we showed that apparent cyclic and noncyclic effects may coexist in a language. PSBM is able to handle noncyclic effects by allowing *n*-place grammatical relations. Section 4.4.3 demonstrated that the grammatical licensing approach can regiment the choice of correspondents (a task relegated to constituent structures in configurational approaches). This avoids the problem of setting up undesired paradigmatic correspondences between forms that accidentally happen to share morphological or semantic features. Bound stems (and not just independent word forms) might stand in paradigmatic correspondence, as argued in section 4.4.4. Section 4.5 addressed Bracket Erasure Effects, whereby the internal morphological structure of a form is not available to the phonology. This follows automatically in a purely paradigmatic approach, in which there is no such thing as internal morphological structure. Finally, in section 4.6 we showed that paradigmatic effects are not restricted to paradigm uniformity. Other factors come into play as well, such as proximal base effects.

We have not considered extended paradigms in which more than just a morphologically simple form and one complex form are involved (an example might be an entire inflectional paradigm), or issues of traditional interest to morphologists such as syncretism and multiple exponence. Nor have we addressed the traditional problem of Bracketing Paradoxes. These issues deserve further consideration.

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CHAPTER 5

SEGMENTAL PHONOLOGY AND SYNTACTIC STRUCTURE

GORKA ELORDIETA

5.1 Introduction

One objective in this chapter is to provide a survey and critical review of the phonological theories that deal with segmental phenomena whose domains of application are directly or indirectly determined by syntactic structure. Another objective is to present data and arguments that have recently come to light in this area which constitute a challenge to these theories and posit the need for considering another way of creating phonological domains from syntactic structure. The chapter is structured as follows. In sections 5.2–5.6 an overview of the most relevant theoretical approaches to phrasal and prosodic phonology is provided; section 5.7

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will be devoted to a presentation of data that pose problems for these theories and suggest the need for an alternative proposal. Finally, section 5.8 concludes.

5.2 The Direct Reference Theory

The main idea in Kaisse's (1985) Direct Reference Theory (DRT) is that the domains of application of phonological processes of external sandhi are directly constrained by syntactic relations such as c-command and edge locations (cf. Rotenberg 1978, Manzini 1983, Lobeck and Kaisse 1984 for earlier proposals along these lines).[1]

An illustrative example is lenition in Gilyak. In this language, in a sequence of words *a b*, an obstruent in initial position of *b* is voiced if *a* ends in a nasal and spirantized if *a* ends in a vowel, but only if *b* c-commands *a*. Other phenomena analysed by Kaisse include French liaison, tone sandhi in Ewe, Italian *raddoppiamento sintattico*, Mandarin tone sandhi, and Kimattumbi vowel shortening, which cannot be reviewed here for for reasons of space. The reader is referred to the original source. Critical evidence will be provided in section 5.3 showing the shortcomings of this theory.

Not many scholars have adopted Kaisse's view of the syntax–phonology interface. Odden (1987, 1990, 1996) is the clearest defender of the DRT and suggests adding reference to the syntactic notion of head as a relevant parameter for discriminating contexts of application of certain postlexical rules.

Within DRT, a more sophisticated model would be the one proposed by Rizzi and Savoia (1993) (R&S) to account for u-propagation in southern Italian dialects. The phenomenon is triggered by the vowel /u/ ending a word, which spreads its feature [+back] to the first vowel in a following word, or causes the insertion of a /w/ onglide before it. For instance, in the Verbicaro dialect:[2]

(1) *a.* [u ˈmwɛːlə] vs. [ˈmɛːlə]
'the honey' 'honey'

b. [lu ˈfwattsə] vs. [i ˈfattsə]
it I-do them I-do
'I do it.' 'I do them.'

Rizzi and Savoia observed that the phenomenon of u-propagation occurs in specific syntactic contexts, different in the eight dialects studied. According to the

[1] Kaisse's definition of c-command is actually m-command, that is, *x* m-commands *y* if the first maximal projection dominating *x* also dominates *y*. To avoid any confusion, I will maintain the name "c-command", keeping in mind that it stands for m-command.

[2] Rizzi and Savoia only provide phonetic transcriptions of the data rather than orthographic transcriptions. We will follow their system, except for the trigger of the process, which we transcribe as /u/, instead of surface [ə], for ease of identification of the trigger.

authors, contexts of application of phonological processes can be defined by making reference to five parameters of syntactic cohesion holding between the trigger and the target in a phonological process. The general syntactic relation between trigger and target is that the trigger X-governs the target, where X-government is a variable ranging over the following types of relations:[3]

(2) *a.* A and B govern each other.
b. A F(unctionally) governs B.
c. A Agr(eement) governs B.
d. A governs B.

Rizzi and Savoia define government in traditional terms (i.e. A governs B if the first maximal projection dominating A also dominates B). Then, A F-governs B if A is a functional category governing B, and A Agr-governs B if A and B stand in an agreement relationship and A governs B.

Let us consider one of the dialects illustrating the need for F-government in order to explain the facts. In the Stigliano dialect, u-propagation in nominal contexts only occurs between a determiner and a following adjective or noun (i.e. (3*a*–*c*)), but not between a quantifier and a following adjective or noun (see (3*d*–*e*)), a prenominal adjective and a noun (see (3*f*)), or a noun and a following adjective (see (3*g*)):

(3) *a.* [l/u/ ˈpweːðə]
the foot

b. [ˌn aːt/u/ ˈkwɔːnə]
another dog

c. [n/u/ bˈbwellə ˈfɪɟɟə]
a dear/nice boy/son

d. [cc/u/ ɡˈɡrannə] (*ɡˈɡrwannə)
more big
('bigger')

e. [ˈɔtt/u/ ˈkaːnə] (*ˈkwa.nə)
eight dogs

f. [nə bˈbrɔv/u/ ˈfɪɟɟə] (*ˈfwɪɟɟə)
a good boy/son

g. [nə ˈswɪcc/u/ ˈɣrannə] (*ˈɣrwannə)
a bucket big
'a big bucket'

In verbal contexts, u-propagation occurs only between a preverbal clitic and a following verb (4*a*). It does not apply between an auxiliary and a past participle

[3] An additional parameter is proposed that does not involve any kind of syntactic cohesion between trigger and target, namely, that A and B are adjacent.

(4*b*), between a modal or causative verb and an infinitive (4*c*, *d*), between a copula and a following adjective or noun (4*e*), between a verb and an object (4*f*), or between a verb and the first word in a small clause (4*g*):

(4) *a.* [l/u/ ˈfwattʃə]
it I-make
'I make it.'

b. [ˈl addʒ/u/ maɲˈdʒa:tə] (*mwaɲˈdʒa:tə)
it I-have eaten
'I have eaten it.'

c. [ɣwəˈloim/u/ maɲˈdʒa] (*mwaɲˈdʒa)
(we) want eat
'We want to eat.'

d. [fɔˈtʃeim/u/ ˈfa] (*ˈfɔ)
(we)-make do

e. [s/u/ tˈtaβələ] (*tˈtwaβələ)
(they)-are tables

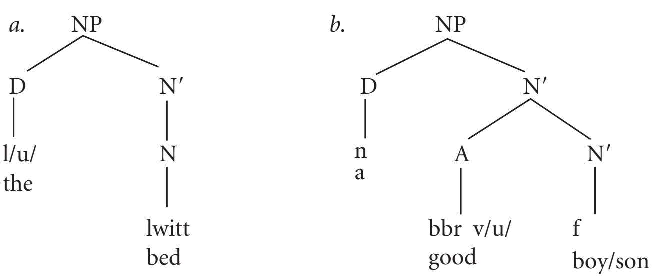
f. [təˈneim/u/ ˈseːtə] (*ˈsweːtə)
(we)-have thirst
'We are thirsty.'

g. [faˈneil/u/ ˈnɪurə] (*ˈnwiurə]
make-it black

Finally, u-propagation does not take place across a subject–predicate juncture:

(5) [lə ˌpəttʃəˈnwɪnn/u/ ˈcaɲdʒə] (*ˈcwaɲdʒə)
the child is crying

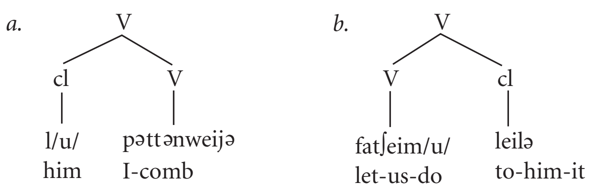
Rizzi and Savoia point out that a purely structural condition such as c-command or government is not sufficient to capture the correct environment of application of u-propagation. For instance, the structural relationship between a determiner and an adjective or noun does not seem to be different from the one holding between a pronominal adjective and a noun, but u-propagation occurs in the first case and not in the second. The structures assumed by R&S are the following:

(6)


As R&S also argue, a puzzling asymmetry arises in verbal contexts, as u-propagation applies in the sequence clitic–verb (see (4a)), but it does not apply in the sequence causative-verb–clitic:

(7) [fatʃeim/u/ leilə] (*lweilə)
let-us-do to-him-it
'Let us do it to him.'

The sequence clitic–verb does not seem to be more connected in terms of c-command or government than the sequence where u-propagation does not occur. Indeed, orthography would seem to indicate otherwise, as the sequence verb–clitic is written as a single word. R&S provide the structures in (8) to illustrate their point. Although they do not actually state their syntactic assumptions, it seems apparent from the structures in (8) that they assume that a proclitic originates as a complement of V and adjoins to it, whereas in a construction involving a causative verb followed by an infinitive, the clitic is the subject of the clause with the infinitive:

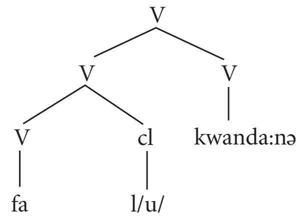
(8)


We have seen in (4*c*, *d*) that a modal or causative verb does not trigger u-propagation on a following infinitive. Interestingly, a causative verb with an enclitic does trigger /u/ propagation on a following infinitive, in imperative constructions:

(9) [ˈfall/u/ ˈfɔ]
make-him-it do

Structurally, the sequence formed by a causative verb and a following infinitive should be the same whether or not an enclitic is attached to the causative verb, but then the results cannot receive an account in terms of c-command or government. R&S argue that the difference lies in the fact that u-propagation occurs only if the trigger is a functional category, and they add that trigger and target must govern each other. The first condition would account for the absence of u-propagation between an adjective and a noun or a noun and an adjective (see (3*f*, *g*)), between a verb (without an enclitic) and what follows (see (4*c*, *d*, *f*)), or between a subject and a predicate (see (5)). The requirement for mutual government stems from the need to explain the absence of u-propagation between an auxiliary and a main verb or a copula and a following adjective or participle (see (4*b*, *e*)). R&S also claim that mutual government holds between an enclitic of a causative verb and the following infinitive by assuming right-adjunction of the clitic to the causative verb and incorporation (i.e. right-adjunction) of the infinitive to the causative verb+clitic complex:

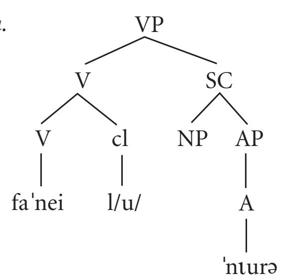
(10)



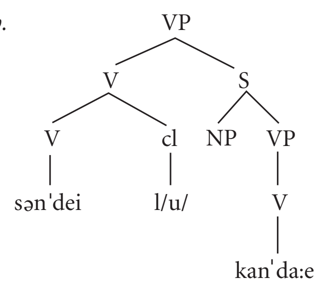
Rizzi and Savoia then argue that mutual government helps explain the absence of u-propagation between an enclitic on a perception verb and the first word in its small clause complement (see (4*g*)) or between an enclitic in a causative verb and a following infinitive (see (11)). In both cases, the potential target does not govern the enclitic, as shown in the structures in (12*a*, *b*), respectively:

(11) sən'deil/u/ kan'danə (*kwan'danə)
hear-him sing

(12) *a.*



b.



Thus, R&S analyse the environment where u-propagation occurs as one in which an element A (the trigger) F(unctionally) governs an element B (the target), and both A and B govern each other.

Certain issues arise with R&S's analysis which should be clarified. First of all, notice that for the proposed analysis to work, R&S have to assume a non-DP structure for nominal contexts (as in (6)). Indeed, as R&S themselves discuss (n. 7, p. 313), if the most widely assumed DP structure were considered, determiners and nouns would not be in a mutual government relationship, as nouns would be dominated by NP. R&S would then need to assume that there is incorporation of the head noun (and the pronominal adjective) to DP, or that the determiner itself merges or cliticizes to the pronominal adjective or noun in PF. The former option would face the problem of having to posit left-adjunction of the adjective to the head noun, and then right-adjunction of the complex head adjective-noun to D.

As for the case of u-propagation between enclitics of causative verbs and a following infinitive, the problem arises with the fact u-propagation occurs even when causative verbs excorporate, or at least move to a higher functional head.

Mutual government between the enclitic and the following word is hard to defend there, as adverbs may be inserted between the two verbs. This is a problem that R&S acknowledge (in n. 7, p. 313), and speculate that mutual government may be calculated under reconstruction. This move is crucial, and it certainly deserves detailed elaboration, rather than being left as a sketchy mention in a footnote; R&S need to state clearly how this reconstruction is computed. The same problem arises when trying to account for the domain of application of u-propagation in Verbicaro, for which R&S argue that u-propagation occurs obligatorily between any functional head and another head that it governs (i.e. F-government) or between any two heads that mutually govern each other (cf. R&S: 292–5).

Finally, it is worth pointing out that R&S make certain debatable assumptions, such as the claim that quantifiers and numerals are not functional categories, in order to explain why they do not pattern with determiners in allowing for u-propagation (see 3*d*, *e*). This assumption clashes with a substantial amount of syntactic literature that treats quantifiers and numerals as functional categories in the DP or NP projection (Shlonsky 1991; Giusti 1991; Ritter 1991; Sigurðsson 1993; Matthewson 1998, 2001; Longobardi 2001; Vangsnes 2001; Artiagoitia 2002; Giannakidou 2004; Borer 2005; Etxeberria 2005, among others).

In sum, though the model proposed by R&S constitutes a sophisticated and elaborate attempt to pin down the whole range of parameters of syntactic cohesion that may determine contexts of application of phonological phenomena applying across words, certain syntactic assumptions are not without problems, and perhaps further work would have avoided them. However, the distinction between functional and lexical categories that is advocated in this proposal is an important one that is recurrent in other models of the syntax–phonology interface, as we will see in this chapter.

There is a more recent development of the syntax–phonology interface that argues for a direct influence of syntax on the creation of contexts of application of phonological processes, namely, that of Seidl (2001). However, we will first review the other major competing alternative theory of the syntax–phonology interface, namely the Prosodic Hierarchy Theory, since Seidl (2001) points at the shortcomings of this theory.

5.3 The Prosodic Hierarchy Theory

The basic postulates of the Prosodic Hierarchy Theory (PHT) are explicitly stated in its original form in Selkirk (1980*a*, *b*) and Nespor and Vogel (1982, 1986). The main claim of the PHT is that there exists a suprasegmental, hierarchically arranged organization of the utterance, called "prosodic structure". This structure is composed of a finite set of universal prosodic constituents, which are the domains of application of phonological rules and phonetic processes. From the bottom up, these constituents are the syllable, the foot, the prosodic or phonological word, the clitic group, the phonological phrase, the intonational phrase, and the utterance. These constituents are mapped from morphosyntactic structure by algorithms which make reference to non-phonological notions, that is, syntactic information, but prosodic structure and the constituents that compose it are not isomorphic with syntactic structure. Proponents of this theory claim that syntactic constituents do not determine the domains for the application of phonological rules in a direct way. Those processes that are directly sensitive to morphological structure, triggered by certain morphemes or after certain morpheme combinations, are considered the object of Lexical Phonology (cf. Kiparsky 1982, 1985; Mohanan 1986). There are some rules that are sensitive to syntactic-category information, referring to syntactic labelled bracketings, such as the two vowel-deletion rules of Greek discussed in Kaisse (1977), which require that the words participating in those rules are contained in the same NP or VP. Another example would be the rule of Verb-Final Vowel Deletion in Italian, which optionally deletes the final vowel of a word *a* when followed by another word *b* which is its complement, but only if word *a* is a verb (see Vogel et al. 1983). For instance, according to Nespor and Vogel (1986: 32–3), in an example such as (13) the final vowel of the verb can be deleted, but not that of the noun:

(13) a. *So che vuol(e) nuotare.*
I-know that he-wants swim
'I know he wants to swim.'

b. *Ho le suole nuove.* (**suol*)
I-have the soles new
'I have new soles.'

These and similar examples (described also in Kenstowicz and Kisseberth 1977) are considered to fall outside the scope of prosodic phonology and form a different subsystem of rules.[4] Hayes (1990) claims that these rules receive a better treatment if they are considered to apply in the lexicon, as precompiled phrasal rules, given their idiosyncratic domains of application; we'll return to this shortly.

Two different approaches can be distinguished in the PHT: the Relation-Based Approach (RBA), developed mainly by Nespor and Vogel (1982, 1986) and Hayes (1989), and the End-Based Approach (EBA), proposed initially by Selkirk (1986).

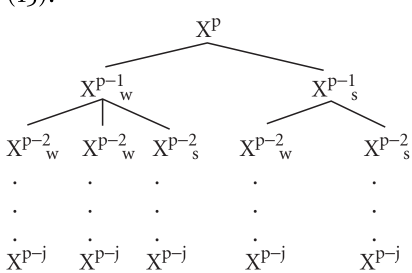
[4] But see Meinschäfer (2004) for an alternative analysis of the facts in prosodic phonology terms, which does without specific reference to syntactic categories. Further research would be necessary to see whether closer inspection of similar facts reported in the literature could lead to the same outcome, but the issue is definitely worth investigating.

5.3.1 The Relation-Based Approach

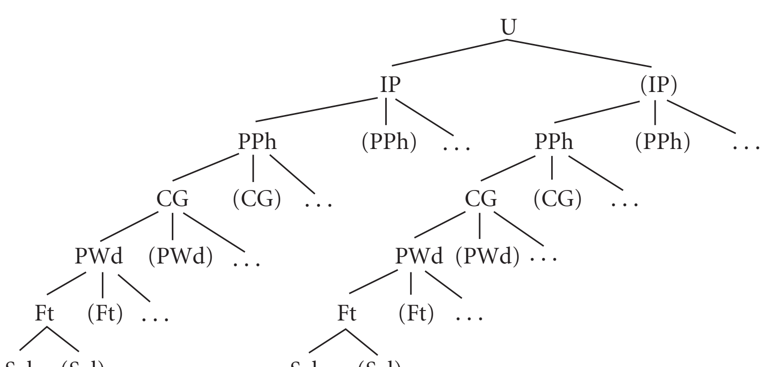
The principles that establish the geometry of the hierarchical structures of prosodic constituents according to the RBA are presented in (14) (from Nespor and Vogel 1986, henceforth N&V). The first two principles are subsumed under Selkirk's (1984) Strict Layer Hypothesis.

(14) **Principle 1**
A given non-terminal unit of the prosodic hierarchy, X^p, is composed of one or more units of the immediately lower category, X^{p-1}.
Principle 2
A unit of a given level of the hierarchy is exhaustively contained in the superordinate unit of which it is a part.
Principle 3
The hierarchical structures of prosodic phonology are *n*-ary branching.
Principle 4
The relative prominence relation defined for sister nodes is such that one node is assigned the value "strong" (*s*) and all the other nodes are assigned the value "weak" (*w*).

These four principles construct phonological representations of the form presented in (15).

(15)


The structure in (16) would be a schematic prosodic tree. Notice that at each level there may be more than one constituent, symbolized by parentheses and dotted lines.

(16)


Notice that the principles stated in (14) reveal certain important differences between syntactic and prosodic structure. On the one hand, although prosodic structure has an immediate constituent analysis like syntactic structure, one of the original tenets in Prosodic Phonology is that prosodic structure does not allow for recursion of categories, unlike syntactic structure. That is, whereas a syntactic constituent of a given type (say, an NP) can have as its immediate daughter a token of the same category (another NP), an Intonational Phrase cannot contain another Intonational Phrase, in the same way that a Phonological Phrase cannot contain another Phonological Phrase, or a Prosodic Word cannot contain another Prosodic Word, and so on.[5] In addition, in syntax a category of type n can immediately dominate a category of type $n+1$ or higher (e.g. an NP can select a CP), whereas in prosodic structure this is illegitimate (i.e. a Prosodic Word cannot contain a Phonological Phrase). Finally, the possibility for n-ary branching in prosodic structure is not observed in syntactic structure, which obeys binarity strictly.

Phonological words may be equal to or smaller than the terminal element in a syntactic tree. Thus, there are phonological words which are composed of the stem and all affixes or of the two members of a compound together (e.g. Greek, Latin: see N&V and Nespor and Ralli 1996), and there are also cases in which only a stem plus affixes counts as a phonological word, that is, with each member of a compound word forming its own phonological word (e.g. Sanskrit, Turkish, Italian; see N&V; Nespor and Ralli 1996).[6] However, both possibilities can coexist in the same language, although one option is always the less favoured one (Nespor and Ralli 1996; Peperkamp 1997).

Some languages show distinctions between prefixes and suffixes in terms of phonological word formation. Thus, in Hungarian and Italian, prefixes are specified to form independent phonological words, unlike suffixes, which combine with the stem to form one phonological word (see N&V: 122–34). Then there are affixes which form phonological words on their own by virtue of satisfying minimal prosodic size requirements such as bisyllabicity (e.g. Yidiɲ; see N&V: 134–6) or are idiosyncratically specified to form independent words, as in Dutch (see N&V: 136–40). For more discussion on prosodic words, see Peperkamp (1997), Hall and Kleinhenz (1999), and Vigário (2003), among others.

[5] Selkirk (1995) discusses evidence that prosodic structure can be recursive, and hence suggests considering recursivity as a violable condition or constraint, in the spirit of Optimality Theory. However, she still holds that Layeredness (the property that would prevent one constituent of type n dominating a constituent of type $n+1$ or higher) is inviolable and hence universally highly ranked.

[6] Reiss (2003) offers a reanalysis of vowel harmony in Hungarian that renders superfluous the need to assume that each member of a compound constitutes an independent prosodic word, as argued traditionally in the literature. It could be that other cases could be reanalysed the same way.

The clitic group is defined on the assumption that some elements are lexically specified as clitics, following Klavans (1982), with directionality of attachment as proclitics or enclitics. The existence of this constituent is proposed on the grounds of the observation that there are phonological rules that apply only to the sequence formed by a lexical word and the clitic that attaches to them (see Cohn 1989; Hayes 1989). However, Inkelas (1990) argues that these rules can be reanalysed as applying either in the phonological word or in the phonological phrase, and that no evidence has been provided yet of any language that requires the phonological word, the clitic group, and the phonological phrase. The same position is adopted by Zec (1988, 1993), Selkirk (1995), and Booij (1996), among others. For additional discussion on clitics, see van der Leeuw (1997), Gerlach and Grijzenhout (2001), and references therein.

The building algorithm for the phonological phrase is stated in (17) (taken from Bickmore 1990). Reference is made to the recursive and the non-recursive sides of a head. The recursive side is the direction of branching (i.e. of complementation) in a language, the non-recursive side is the opposite side, that is, the side where specifiers are located.

(17) Phonological phrases contain a head X and all elements on the non-recursive side of the head which are still within X^{max}.
Parameters
a. Obligatory, optional, or prohibited inclusion of the first complement on the recursive side of X.
b. The complement may branch or not.

Most, if not all, proponents of this definition of phonological phrases assume the syntactic model of Chomsky (1981), in which functional categories are considered specifiers or modifiers located on the non-recursive side of heads, that is, on the opposite side of the direction of branching of a language. Determiners, demonstratives, and possessive pronouns are then specifiers of noun phrases, auxiliaries are specifiers of verb phrases, degree adverbs are modifiers of adjectives, and so on. Thus, functional categories which are not already included within a phonological word or clitic group with a stem or phonological word end up being contained in the same phonological phrase with the head that they are syntactically associated with. This is illustrated by the rule of *raddoppiamento sintattico* (RS) in central and southern varieties of Italian, which is analysed as applying across two words contained in a phonological phrase. By this rule, the initial consonant of a word is lengthened when preceded by a word ending in a stressed vowel. Examples of the contexts in which RS applies are marked with _, and those in which it does not, with // (see (18) and (19), respectively):[7]

[7] In examples (18)–(23) I maintain N&V's convention of indicating the relevant stressed syllables with acute accents, although in standard Italian orthography they should be written as grave accents.

(18) a.

Avrá	*_trovato*	*il*	*pescecane.*
(s)he-will-have	found	the	shark

'He must have found the shark.'

b.

La gabbia	*é*	*_giá*	*_caduta.*
the cage	has	already	fallen

'The cage has already fallen.'

c.

É appena	*passato*	*con*	*tre_*	*cani.*
(s)he-has	passed	with	three	dogs

'He has just passed by with three dogs.'

(19) a.

Devi	*comprare*	*delle*	*mappe di*	*cittá //*	*molto*	*vecchie.*	
you-must	buy	some	maps of	city	very	old	

'You must buy some very old city maps.'

b. *La gabbia era dipinta di giá // completamente.*
the cage was painted already completely
'The cage was already completely painted.'

c.

L'entrata	*allo*	*zoo*	*costa*	*di piú //*	*per*	*i*	*turisti*	
					che	*per*	*i*	*locali.*
the-entrance	to-the	zoo	costs	more	for	the	tourists	
					than	for	the	locals

'The entrance to the zoo is more expensive for tourists than for locals.'

These sentences are structured in phonological phrases as indicated in (20) and (21), respectively, following the phonological-phrase-formation algorithm expressed in (17) (where Φ = phonological phrase).

(20) a. (Avrá_trovato)$_{\Phi}$ (il pescecane)$_{\Phi}$
b. (La gabbia)$_{\Phi}$ (é_giá_caduta)$_{\Phi}$
c. (È appena passato)$_{\Phi}$ (con tre_cani)$_{\Phi}$

(21) a. (Devi comprare)$_{\Phi}$ (delle mappe)$_{\Phi}$ (di cittá)$_{\Phi}$ // (molto vecchie)$_{\Phi}$
b. (La gabbia)$_{\Phi}$ (era dipinta)$_{\Phi}$ (di giá)$_{\Phi}$ // (completamente)$_{\Phi}$
c. (L'entrata)$_{\Phi}$ (allo zoo)$_{\Phi}$ (costa di piú)$_{\Phi}$ // (per i turisti)$_{\Phi}$ (che per i locali)$_{\Phi}$

The first complement of a head on its recursive side may be optionally joined into the phonological phrase that contains the head if this complement is non-branching, that is, formed by only one phonological word (and provided the head is not focalized, cf. Frascarelli 2000). This is called "phonological phrase restructuring" by N&V (p. 173). Thus, the phrasing in (22) can be optionally rephrased as in (23).

(22)

(*Se prenderá*)$_{\Phi}$	(*qualcosa*)$_{\Phi}$	(*prenderà*)$_{\Phi}$	(*tordi*)$_{\Phi}$
if (s)he-catches	something	(s)he-will-catch	thrushes

'If (s)he catches something, (s)he will catch thrushes.'

(23) (Se prenderá_qualcosa)$_{\Phi}$ (prenderà_tordi)$_{\Phi}$

More examples of processes analysed as applying within phonological phrases using the RBA can be found in Cho (1990), Condoravdi (1990), Kidima (1990), McHugh (1990), Rice (1991), Hayes and Lahiri (1991), Zsiga (1992), and Frota (2000), among others. It should be borne in mind, however, that the new developments in syntactic theory since the second half of the 1980s assign maximal projections to functional categories, taking lexical categories or other functional projections as complements. Hence, the definition of phonological phrase in the RBA would have to be reformulated. Perhaps proponents of the RBA could define a phonological phrase as a constituent formed by a functional head and a lexical head it dominates, as well as any adjunct of the lexical head. However, the meaning or theoretical implication of such a mapping would remain obscure. Why would such a context form one phonological phrase? Why can functional categories not form independent phonological words or phonological phrases, while lexical heads can? As in R&S's approach, the relationship between functional and lexical categories is crucial in the RBA, but left unexplained. The same criticism holds of the other model of the PHT, which we willl review in the next section.

The syntactic criteria defining the intonational phrase and the utterance are less well understood. Certain syntactic constructions such as parentheticals, non-restrictive relative clauses, topics, vocatives, and tag questions are usually phrased in independent intonational phrases, separated from other material in an utterance by pauses, intonational boundaries, or final lengthening. We refer the reader to N&V, Hayes (1989), Nespor (1990), Vogel and Kenesei (1990), and Frota (2000), among others, for discussion (see Kanerva 1990 for an intermediate constituent between the intonational phrase and the phonological phrase, the focus phrase).

5.3.2 The End-Based Approach (EBA)

The main proposal in this model is that the relation between syntactic structure and prosodic structure above the foot and below the intonational phrase is defined in terms of the ends of syntactic constituents of designated types. The idea is that a derived phonological domain will comprise the string of the surface syntactic structure that is demarcated by the left or right ends of heads or maximal projections. The parameters for the mapping of syntactic structure onto prosodic structure are stated in (24).

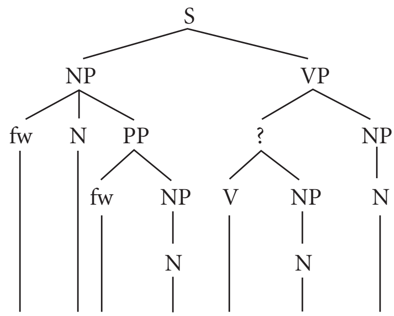
(24) **End parameter settings**

(i) *a.* $]_{\text{Word}}$ *b.* $_{\text{Word}}[$

(ii) *a.* $]_{\text{Xmax}}$ *b.* $_{\text{Xmax}}[$

The string that falls between two left or right boundaries of the relevant constituent level forms one phonological domain. The string contained between two word boundaries is a phonological or prosodic word, and the string contained between two boundaries of maximal projections is a phonological phrase. Assuming a language with right-edge settings for the word and X^{max} constituent levels, the phonological domains shown in (25) would be obtained (from Selkirk 1986: 387).

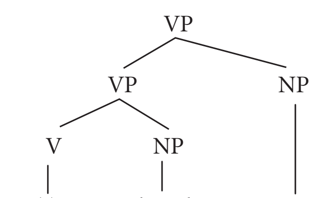
(25) *a.*



b. ....]w............]w.....]w......]w........]w
.......................]Xmax ....]Xmax ...]Xmax
c. (_____) (_______) (__) (____) (_____) Pwd
d. (______________) (________) (_____) PPh

Selkirk exemplifies the workings of this theory by analysing the domains of application of stress assignment in Chi Mwi:ni, which is assigned at the phrasal level. Selkirk identifies the domain as the phonological phrase, delimited by X^{max} right edge boundaries:

(26)



a. *pa(:)nsize* *cho:mbo* *mwa:mba*
b. ....]Xmax..............]Xmax
c. (_______________)PPh (______)PPh
'He ran the vessel on to the rock.'

This shows that the verb and its complement form a domain, and that the adjunct NP forms a separate domain, set off from the first by the right-edge boundary of the complement NP. In noun and verb phrases, which are always right-branching, with the head on the left, the head is joined in a stress domain with what follows; see (27).

(27) *a.* $_{NP}$[*mape:ndo*: [*ya*: $_{NP}$[*maski:ni*:]$_{NP}$]$_{NP}$
b. ....]$_{Xmax}$
c. (___________________________)
'the love of a poor man'

(28) *a.* $_{VP}[_{V}[$*shika:ni:*$]_{V}$ $_{NP}[$*ma:limu:* $[$*wa:* $_{NP}[$*saba:*$]_{NP}$ $]]_{NP}$ $]_{VP}$
b. ....$]_{Xmax}$
c. (____)
'Seize (pl.) the seventh teacher.'

As for the RBA, an important aspect of the EBA is that the boundaries of function words do not count for the mapping between syntactic and prosodic structure, and are included in larger prosodic domains, as stated in Selkirk's (1984) Principle of the Categorial Invisibility of Function Words (PCI). This principle is based on the observation that function words are not assigned the silent demi-beat of syntactic timing that non-function words receive in the syntax–phonology mapping and are not assigned a third-level main word stress, as well as on the observation that function words are usually unstressed. It is a cross-linguistically attested fact that they often cliticize to an adjacent word. This assumption is expressed in (25), where the function words (fw) in the subject phrase do not project any right Word or X^{max} boundaries and are subsumed in the following domains. Indeed, Selkirk claims that the close phonological juncture of function words with an adjacent word is illustrated by the great likelihood that phonological rules of external sandhi operate between a function word and an adjacent word. However, this is an observation of the facts and does not constitute an argument for the PCI.

The PCI has been assumed by all scholars working within the EBA. For instance, Chen (1987) analyses tone sandhi in Xiamen Chinese as applying within phonological phrases, delimited by setting the $]_{Xmax}$ parameter. However, subject and object pronouns do not have phonological-phrase boundaries on their right edges, and they normally cliticize to the tone group on their right. Thus, contrast the examples in (29), which contain subject and object pronouns, with the example in (30), which contains a lexical NP subject and object (cliticization is indicated by the = sign):

(29) *a.* (*yi/lang = sia k'a kin*)$_{\Phi}$
he/someone write more fast
'He/someone writes faster.'

b. (*ts'iah li/lang = lai*)$_{\Phi}$
invite you/someone come
'Invite you/someone to come.'

(30) (*Ting sio-tsia*)$_{\Phi}$ (*p'eu*)$_{\Phi}$ (*sia-liao-loo*)$_{\Phi}$
Ting miss letter write-asp.
'Miss Ting has written the letter.'

Other work on phonological phrase formation using the EBA includes Selkirk and Tateishi (1988) for Japanese, Selkirk and Shen (1990) for Chinese, and Kenstowicz and Sohn (1997) for Korean, among others. Most recently, Selkirk (1995, 2000) and Truckenbrodt (1995, 1999, 2002) have modelled the EBA in terms of alignment constraints operating in Optimality Theory grammars, as we will see below.

Some authors explore the relevance of different aspects of syntactic structure in the definition of a phonological phrase, such as branchingness. In Kinyambo, for instance, high-tone deletion occurs within phonological phrases delimited by the right edge of branching syntactic maximal projections (Bickmore 1990). Thus, observe the difference in phrasing between (31*a*) and (31*b*). In (31*b*) a phonological phrase boundary is inserted at the right edge of the branching indirect object, leaving the direct object on its own. If restructuring were at stake, the direct object would form part of the preceding phonological phrase.

(31) *a.* [*Nejákworech'* [*ábakoz'*]$_{NP}$ [*émbwa*]$_{NP}$]$_{VP}$
(*Nejákworech' ábakoz' émbwa*)$_{\Phi}$
he-will-show workers dog
'He will show the workers the dog.'

b. [*Nejákworech'* [*ómukama* [*w'ábakózi*]$_{PP}$]$_{NP}$ [*émbwa*]$_{NP}$]$_{VP}$
(*Nejákworech' ómukama w'ábakózi*)$_{\Phi}$ (*émbwa*)$_{\Phi}$
he-will-show chief of workers dog
'He will show the chief of the workers the dog.'

In the light of such evidence (see Bickmore 1990 for more details, as well as Cowper and Rice 1987 for a discussion of consonant mutation in Mende), these scholars suggest adding the parameter "(non-)branchingness" to the list of parameters in (24). In a similar vein, although not within the EBA, Zec and Inkelas (1990, 1995) suggest an alternative approach, in which phonological phrases are formed bottom-up from syntactic sisters (head and complement), but syntactically non-branching maximal projections do not constitute independent phonological phrases and are phrased with the adjacent head. The phonological evidence they present is not segmental in nature, but has to do with the distribution of the emphatic particle *fa* in Hausa or the second position clitics in Serbo-Croatian. They even argue that branchingness can have an effect in the opposite direction, from prosody to syntax, in that certain syntactic operations such as topic construction in Serbo-Croatian or heavy NP shift in English have to be branching prosodically at some level. Thus, topics in Serbo-Croatian have to contain at least two phonological words, and the shifted constituents in English have to contain at least two phonological phrases. The problem with this proposal is that syntactic or prosodic branchingness does not seem to be a universally necessary constraint for all languages. It may apply with full force in Kinyambo, Mende, Hausa, and Serbo-Croatian, but in Italian it does not seem to be an obligatory condition to fulfil, according to N&V. Also, it should not escape our attention that allowing prosody to influence syntax has important theoretical implications. In the theory of grammar assumed in the generative model, only a unidirectional relationship or mapping from the syntactic component to the phonological component (the level of

Phonetic Form, which prosody forms part of) is claimed to exist. Thus, arguing for a bidirectional relationship between these two modules raises questions about the theoretical changes that such a move would involve; among others, whether the relationships are bidirectional or multidirectional (i.e. all components or levels are related to one another), or whether the traditional assumption that the construction of an utterance proceeds derivationally from one module to another (i.e. the inverted T- or Y-model) should be abandoned in favour of a parallel derivation between components, perhaps à la Jackendoff (1997). Unfortunately, the authors do not discuss these issues.

Selkirk and Shen (1990) analyse the rules of Obligatory Tone Deletion, Left-to-Right Tone association, and Default Tone Insertion in Shanghai Chinese, and conclude that they apply within a phonological word, defined through the insertion of prosodic word boundaries at the left edge of a lexical word. Function words do not project boundaries, and hence form part of a phonological word together with the lexical word and function words to their left. The examples in (32) illustrate a minimal pair of a verb phrase with a pronominal object and one with a lexical object. Additional examples are provided in (33), with the labelled structures to the left of the arrow representing syntactic structure and the representations to the right of the arrow illustrating the division of the string in phonological words.

(32) *a.* (*taN* ‘*noN* *leq)*
hit you has
‘has hit you’

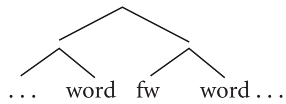
b. (*taN*) (‘*mo leq*)
hit horse has
‘has hit the horse’

(33) *a.* [‘*z* [‘*laq* [‘*zawNhe*]$_{\mathrm{NP}}$]$_{\mathrm{PP}}$]$_{\mathrm{VP}}$ → (‘*z* ‘*laq*) (‘*zawNhe*)
live in Shanghai
‘live in Shanghai’

b. [*taw* [*ziq* *pe* ‘*za*]$_{\mathrm{NP}}$]$_{\mathrm{VP}}$ → (*taw ziq pe*) (‘*zo*)
pour indef. cup tea
‘pour a cup of tea’

Observe the mismatch between syntactic and phonological constituency reflected in (33). The preposition in (33*a*) and the quantifier and classifier *pe* in (33*b*) form part of a PP and NP, respectively, but form prosodic words with the preceding verb. Hale and Selkirk (1987) claim that the PCI is responsible for some of the syntax–phonology mismatches observed in different languages, such as these attested in Shanghai Chinese. Given a syntactic parsing of the string such as the one in (34), head-initial languages would divide the string into prosodic words as in (35*a*) or (35*b*), depending on which setting for the edge parameter they select.

(34)

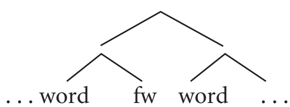


(35) *a.* Parameter = $]_{\text{Word}}$ ... (word) (fw word) ...
(e.g. English, French, Shona)

b. Parameter = $_{\text{Word}}[$ ... (word fw) (word) ...
(e.g. Kwakwala, Kukuya, Shanghai Chinese)

Head-final languages, on the other hand, would parse the string in the opposite fashion, as shown in (36), and the only observed output in phonological wording is the one in (37a):

(36)



(37) *a.* Parameter = $_{\text{Word}}[$ ... (word fw) (word) ...
(e.g. Japanese, Shanghai Chinese)

b. Parameter = $]_{\text{Word}}$ ... (word) (fw word) ...
No examples found.

The conspicuous absence of examples of possibility (37*b*) deserves a comment. Hale and Selkirk attribute it to the alleged tendency of function words to be attracted to preceding stress. But this is a stipulation, and empirically wrong: as shown in (35*a*), in head-initial languages, function words most naturally form prosodic words with following words, although stress precedes those function words (i.e. the default assumption is that the lexical words preceding the function words bear stress). This pattern covers the overwhelming majority of cases. Only a few cases of function words grouping with the preceding word are attested in head-initial languages; to the three languages in (35*b*) we could perhaps add Dschang-Bamileke (see Hyman 1985) and Yagua (see Payne & Payne 1989; Everett 1989). This is surprising under Hale and Selkirk's assumptions on the inherent attraction to the preceding stress that function words display. In the majority of cases, then, it seems that a function word tends to associate phonologically with a word with which it is syntactically more closely related. This observation needs to be clearly stated as well as explained, and unfortunately the EBA (similar to the RBA and R&S's proposal) does not attempt an explanation. Evidence is presented in section 5.7 showing that the syntactic relationship holding between a functional and a lexical category acts as a constraining force in the syntax–phonology interface, and an alternative view is presented that is based precisely on the nature of the morphosyntactic relationships between functional and lexical heads.

It is not easy to show the superiority of the EBA over the RBA or vice versa, as most phenomena could receive an analysis under both approaches. Only Bickmore (1990) and Cho (1990) attempt a comparison of both models, and reach opposite conclusions. In addition, Chen (1987, 1990) suggests that phonological domains in one language may be constructed following the EBA but that certain relation-based considerations may also play a role. For Xiamen tone sandhi, he claims that adjuncts do not project phonological-phrase boundaries, but as Truckenbrodt (1999) points out, it could be that such adjuncts do not project onto phrases and hence no boundaries are inserted at their edges.

The EBA saw new developments with the advent of Optimality Theory. In Selkirk (1995, 2000) and Truckenbrodt (1995, 1999, 2002) the syntax–phonology mapping is conceived as the result of having candidate prosodic phrasings of the input syntactic structure of a sentence evaluated by a ranked set of violable constraints. The empirical evidence comes from languages such as English, Italian, Bengali, Brazilian Portuguese, Tohono O'odham, Kimatuumbi, Chichewa, and Chi Mwi:ni.

As illustrative examples of this approach, let us summarize Truckenbrodt's (1995, 1999) analyses of vowel shortening in Kimatuumbi and Chi Mwi:ni and vowel lengthening in Chichewa (three Bantu languages). In Kimatuumbi and Chi Mwi:ni, shortening applies in words that are not XP-final. Thus, in the examples from Kimatuumbi in (38*a*), the long vowel of *mpúunga* 'rice' is shortened because it is not final in the NP, whereas the long vowel in *baándu* 'people' is not shortened because it is final in its NP. In (38*b*), the long vowel in *mpúunga* is not shortened because it is final in its NP (the lack of shortening in *waabói* 'has rotted' is due to the same circumstance). In (38*c*) shortening does not apply to the direct object *kikóloombe* 'shell' or to the indirect object *Mambóondo* 'Mamboondo' because they end their NPs.

(38) *a.*	$[_{\mathrm{N}}[$*mpúunga*$]$	*wá*	$[$*baándu*$]_{\mathrm{NP}}]_{\mathrm{NP}}$ $\rightarrow$	*mpunga wá baándu*	
	rice	of	people		
	'people's rice'				
b.	$[$*mpuungá*$]_{\mathrm{NP}}$	$[$*waabói*$]_{\mathrm{VP}}$ $\rightarrow$	*mpuungá waabói*		
	rice	has-rotted			
	'The rice has rotted.'				
c.	$[$*naampéi*	$[$*kikóloombe*$]_{\mathrm{NP}}$	$[$*Mambóondo*$]_{\mathrm{NP}}]_{\mathrm{VP}}$ $\rightarrow$	*naampéi kikóloombe Mambóondo*	
	I-him-gave	shell	Mambóondo		
	'I gave Mamboondo the shell.'				

In the Chi Mwi:ni example in (39) the same condition for shortening applies. Only the vowel in *panziize* 'he ran' can shorten, as it is not final in its XP, that is, the VP. The other two words are final in their NPs, and thus the long vowels they contain cannot be shortened.

(39) [*panziize* [*choombo*]$_{NP}$ [*mwaamba*]$_{NP}$]$_{VP}$ → *panzize choombo mwaamba*
he-ran vessel rock
'He ran the vessel onto the rock.'

Based on a previous analysis of the facts couched in the EBA by Cowper and Rice (1987), as an alternative to a DRT analysis provided by Odden (1987), Truckenbrodt (1995, 1999) claims that in Kimatuumbi and Chi Mwi:ni long vowels shorten except in the prosodic word immediately preceding the right edge of a phonological phrase. Phonological-phrase boundaries are determined by the constraint ALIGN-XP,R ((ALIGN (XP, R; ϕ, R)), which demands that the right edge of a lexical maximal projection be aligned with the right edge of a phonological phrase. This explains why an indirect object and a direct object are separated in different domains for vowel shortening: a phonological phrase boundary is inserted at the right edge of the indirect object NP.

In Chicheŵa, on the other hand, penultimate vowels in a word lengthen if the word is final in its XP:

(40) *a.* [*mleé*ⁿ*do*]$_{NP}$ (cf. [*mle*ⁿ*dó uuyu*]$_{NP}$)
'visitor' 'this visitor'

b. [*kagaálu*]$_{NP}$ [*kanáafa*]$_{VP}$
(small) dog died
'The (small) dog died.'

Thus, it seems as if phonological phrases in these three Bantu languages are constructed the same way, by the force of a highly ranked ALIGN-XP,R. However, in Chicheŵa, no lengthening occurs on the indirect-object NP *mwaná* 'child' in (41*a*) or on the direct object *nyu*ᵐ*bá* 'house' in (41*b*), although it applies to the words ⁿ*jíí*ⁿ*ga* 'bicycle' and *mwáála* 'rock', which end their phrases.

(41) *a.* [*tinapátsá* [*mwaná*]$_{NP}$ [ⁿjíiⁿ*ga*]$_{NP}$]$_{VP}$
we-gave child bicycle
'We gave the child a bicycle.'

b. [*amaményá* [*nyu*ᵐ*bá*]$_{NP}$ [*dí mwáála*]$_{NP}$]$_{VP}$
he-hit house with rock
'He hit the house with a rock.'

Truckenbrodt (1995, 1999) analyses the asymmetry between Kimatuumbi-Chi Mwi:ni and Chicheŵa as the effect of two other constraints, WRAP-XP and NON-REC. WRAP-XP demands that each XP is contained in the same phonological phrase, that is to say, without having the words in the XP in separate phonological phrases. This constraint is compatible with ALIGN-XP,R in cases in which a bigger or more inclusive XP1 containing two or more XPs projecting right edges of phonological phrases is still wrapped together in one phonological phrase. This would be the case of a VP wrapped as a phonological phrase but containing two objects whose right edges are aligned with the right edge of phonological phrases as well. Banning or allowing such recursive phonological phrases is the role of Nonrec. In Kimatuumbi such recursive structures are allowed, thus respecting Align-XP,R and Wrap-XP but violating Nonrec. In Chichewa̗, however, an XP must be wrapped in a phonological phrase without having inner phonological phrases. That is, a VP forms a single phonological phrase, respecting Wrap-XP and Nonrec but violating Align-XP,R. The relative ranking of these constraints for Kimatuumbi and Chichewa̗, then, is as in (42).[8]

(42) *a.* Kimatuumbi: Align-XP,R, Wrap-XP » Nonrec
b. Chichewa̗: Wrap-XP, Nonrec » Align-XP,R

However, example (40*b*) needs some clarification, as the subject and the verb are in separate phrases; why is the IP or CP containing the subject and the verb not wrapped? Truckenbrodt (1995, 1999) explains these cases by assuming Selkirk's PCI (i.e. that functional projections are invisible to prosodic boundary insertion) and that IP or CP do not need to be wrapped together. Thus, Align-XP,R applies without obstacles.[9]

Narrow focus, however, plays a role in Chichewa̗, as a constituent bearing narrow focus is phrased separately. Thus, if the verb in (43*a*) were focalized, penultimate lengthening would apply to it, and if the first object in (43*b*) were focalized its penultimate vowel would be lengthened as well:

(43) *a.* [*tinapáatsá* [*mwaná*]$_{NP}$ [^{n}jíí^{n}*ga*]$_{NP}$]$_{VP}$
we-gave child bicycle
'We *gave* the child a bicycle.'

b. [*amaményá* [*nyuú*^{m}*bá*]$_{NP}$ [*dí mwáála*]$_{NP}$]$_{VP}$
he-hit house with rock
'He hit the *house* with a rock.'

Truckenbrodt (1995, 1999) attributes these facts to the effect of a constraint Align-Foc(Align (Foc,R; Φ,R)), which demands that each focused constituent is right-aligned with a phonological-phrase boundary, and it has to be ranked above Wrap-XP in order to enforce violations of this constraint.

Finally, another positive aspect of this kind of OT analysis is that it allows a reanalysis of Hale and Selkirk's (1987) account of Tohono O'odham eliminating lexical government from the parameters of the syntax–phonology interface. In this language, there are phonological phrase boundaries at the right edge of subjects in Spec of IP and VP-adjoined objects but not at the right edge of VP-internal objects

[8] For Chi Mwi:ni, Seidl (2001) shows that an OT analysis along the lines of Truckenbrodt's would have to posit a higher ranking of Align-XP, R, and Nonrec over Wrap-XP.

[9] Truckenbrodt (1995, 1999) uses the same argument to account for the presence of a left-edge prosodic boundary on VP when preceded by a subject in Kimatuumbi; hence the presence of phrasal high-tone insertion at the right edge of the subject.

or subjects. Hale and Selkirk (1987) argued that this asymmetry could be explained on the assumption that in Tohono O'odham, lexically governed maximal projections do not project right-edge phonological phrase boundaries. Truckenbrodt (1995, 1999) shows that such a parameter is not needed. Having WRAP-XP and NONREC ranked above ALIGN-XP,R accounts for the absence of breaks in the VP.

The survey of OT analyses of the syntax–prosody interface can be closed by mentioning that, in addition to constraints such as ALIGN and WRAP that make reference to syntactic information, other purely prosodic constraints imposing conditions on size and balancing of phonological phrases have been invoked in the literature. For instance, UNIFORMITY (phonological phrases must be of equal length, i.e. contain the same number of prosodic words; see Ghini 1993; Sandalo and Tuckenbrodt 2002; Prieto 2005, in press), SYMMETRY (a string is divided into phonological phrases displaying a symmetrical distribution of length, i.e., $(ww)_{\Phi}$ $(w)_{\Phi}$ $(ww)_{\Phi}$ is better than $(w)_{\Phi}$ $(ww)_{\Phi}$ $(ww)_{\Phi}$; see Ghini 1993), INCREASING UNITS (phonological phrases on the recursive side are heavier, i.e. contain more prosodic words, than those in the non-recursive side; see Ghini 1993), BINARY-MAP (a major phrase/phonological phrase must contain minimally and/or maximally two minor phrases, i.e. prosodic words; see Selkirk 2000; Prieto 2005, in press), or MAXIMUM-MAP (a major phrase/phonological phrase must not contain more than a language-specific maximum number of syllables or of levels of prosodic branchingness; cf. Elordieta, Frota and Vigário 2005).

5.4 Minimal Indirect Reference

As pointed out in section 5.2, after Kaisse's (1985) proposal of the DRT there have been very few attempts at continuing with this approach to the syntax–phonology interface, and the PHT has been dominant in the field, especially the EBA. However, Seidl's (2001) Minimal Indirect Reference model (MIR) criticizes the assumptions of the PHT, claiming that there is a prosodic hierarchy independent of syntax and defending a more syntactic account for determining phonological domains. Seidl argues that there are two parses or levels of representation of post-syntactic structure: the first morphosyntactic parse, which she calls "Morphosyntactic Representation", or M_0, is mapped from syntactic structure, and a further parse, which she calls the "Prosodic Representation", or P_0, is mapped from M_0 by the Phonological Domain Generator. Seidl goes on to argue that there are rules that are specified in the grammar to operate at either of these two levels. Rules applying at M_0 are called M-rules, and Seidl claims that they apply on edges of phases (Chomsky 2001*a*), that is, at the edges of propositional units such as a verb phrase (vP) or a full proposition (CP). On the other hand, rules operating at the later level of P_0 are called P-rules and can make reference only to theta-domains, or domains where theta-roles are assigned, namely, VP, vP, and NP. Seidl calls M-rules and P-rules early and late rules, respectively. The architecture of the Minimal Indirect Reference (MIR) model that she proposes is the following:

(44) Output of Morphosyntax (M_0) ⇐ Early Rules

↓ ⇐ Phonological Domain Generator

Prosodic Representation (P_0) ⇐ Late Rules

↓

Surface Phonological Representation

Seidl calls the theory she advocates Minimal Indirect Reference because, although P-rules operate on a level of representation that is not purely syntactic in nature, M-rules operate directly on syntactic information. It is worth pointing out in this regard that there are questions that arise about the exact nature of the levels M_0 and P_0. It is not clear whether M_0 is a level of syntax or of the phonological component. On the one hand, Seidl claims that hers is a theory of post-syntactic grammar; hence both M_0 and P_0 should be levels of representation created after the derivation is sent to the phonological component or PF. However, in some other instances she claims that M-rules apply to a level of syntax, or that they apply directly on the syntactic representation. Perhaps M_0 is a level of PF immediately after Spell-Out that still preserves all syntactic information, a level such as Morphological Structure proposed in the theory of Distributed Morphology (cf. Halle and Marantz 1993, 1994, and the literature thereafter), which Seidl adopts. In fact, she refers to the P-parse (i.e. P_0) as a "post-Morphological Merger structure", citing Marantz (1988) and following work (see Seidl 2001: 20, 23). Although the level of Prosodic Representation is vaguely left at that, Seidl makes it clear that the domains on which rules operate at this level are prosodic domains, although different from those in the prosodic hierarchy of Prosodic Phonology, reviewed in section 5.3. These prosodic domains are theta-domains, or, to express it in better terms, prosodic domains that are derived or mapped onto P_0 from theta-domains of M_0. However, this implies in turn that M_0 is a level of representation that preserves almost all syntactic information and is therefore almost indistinguishable from a syntactic level. Unfortunately, the exact nature of this level is not explicitly stated.[10]

[10] This point leads to the issue of the mapping from syntax to phonology, that is, what syntactic information exactly is mapped onto the phonological component or PF. According to the

Seidl's main criticism of the PHT is that it is too restrictive, in that it assumes that the phonological domains are of only one kind, derived from an algorithm that creates prosodic domains from syntactic structure. She claims that the existence of domain-clustering violations and domain paradoxes (or layeredness violations) poses serious problems for the PHT, and that these phenomena are assumed naturally under MIR once the dichotomy between M-rules and P-rules is recognized. Domain-clustering violations arise in cases in which it seems that there are not enough levels in the Prosodic Hierarchy to cover the domains in which prosodic rules apply, and domain paradoxes or layeredness violations arise when the domains for two rules may be of equal size, or smaller or bigger than each other.

Mende is an example of a language showing domain-clustering violation. A first rule of tone sandhi changes a high (H) tone to a low (L) tone when it is preceded by another H tone within the same phonological domain. Thus, in (45) the H tone of *fájì* changes to a L tone as it is preceded by a H tone in the preceding word:

(45) *nyɛ̌ fájì wɛ̌-ìtà* → *nyɛ̌ vàjì wɛ̌-ìtà*
six fish buckets
'six fish buckets'

A second rule of consonant mutation lenites the initial consonant of a word in certain domains. In the following examples, /k/ and /ng/ change into /g/ and /w/:

(46) a. *ngǐ kànáá* → *ngǐ gànáá*
his case
'his case'

b. *bí ngúlɛ́í* → *bí wùlɛ́í*
your oil
'your oil'

Tone sandhi domains and consonant mutation domains are non-isomorphic. Thus, in (47*a*) the subject forms one domain for mutation separate from the object and the verb, but for tone sandhi each word forms its own domain. In (47*b*) the possessor and the noun form one domain for mutation but separate domains for

theory of Distributed Morphology, syntactic structure is mapped onto the level of Morphological Structure and is visible there (syntactic labels included), in order for morphological processes such as merger, fission, fusion, impoverishment, and vocabulary insertion to work. Also, some recent influential proposals argue that word order is computed at PF with algorithms that compute syntactic structure, more concretely, c-command relationships (cf. Kayne's 1994 Linear Correspondence Axiom and Nunes' 2004 Chain Reduction, for instance).

tone sandhi. The domains for these two rules are indicated in brackets in the glosses.[11]

(47)	*a.*	*ì*	*nyá*	*pókɔ́lɛ̀*	*lɔ́*	→ *ì nyá wókɔ́lɛ̀ lɔ́*
		(SUBJ-PST)	(me	imitated	CERTAIN)	*mutation domain*
		(SUBJ-PST)	(me)	(imitated	CERTAIN)	*tone sandhi domain*
		'He imitated me.'				
	b.	*nyá ndóli*	→	*nyá wóli*		
		(my ear)		*mutation domain*		
		(my)(ear)		*tone sandhi domain*		
		'my ear'				

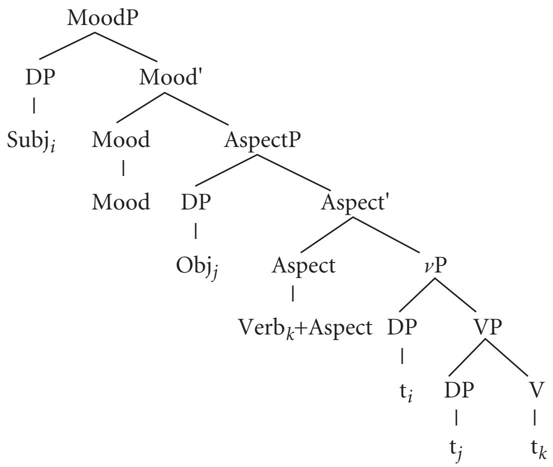
The domains for consonant mutation are of equal size or larger than the domains for tone sandhi. But the problem for the PHT is that the domains of these rules do not seem to correspond to prosodic domains in the PHT. Since tone sandhi operates across words, the domain must be bigger than a prosodic word. If it is a phonological phrase, then consonant mutation should apply in the next higher category, an intonational phrase, but clearly the domain for tone sandhi is not the intonational phrase: no prosodic cues associated to intonational phrases (boundary tones, final lengthening, pauses, pitch reset) delimit the boundaries between the subject and the verb in (47*a*) or the possessor and the noun in (47*b*). Recursive phonological phrases as in Truckenbrodt (1995, 1999) would not be an alternative, either (cf. (48)), as the two rules are of a different nature and they would be applying in the same domain, and it would be difficult to formalize the specific levels of recursive phrasing each rule applies in. For instance, in (47*a*) the object pronoun *nyá* is contained in the same phonological phrase together with the verb for consonant mutation, but it constitutes a separate domain from the verb for tone sandhi. We would have to assume that tone sandhi operates on the lower or most embedded level of phrasing, whereas consonant mutation applies to the second level of recursive phrasing. This is an awkward solution that Seidl rejects.

(48)	*ì*	*nyá*	*pókɔ́lɛ̀*	*lɔ́*	→ *ì nyá wókɔ́lɛ̀ lɔ́*
	((SUBJ-PST)$_\Phi$	((me)$_\Phi$	(imitated	CERT)$_\Phi$)$_\Phi$)$_\Phi$	
	'He imitated me.'				

Seidl (2001) suggests a different solution: that tone sandhi and consonant mutation operate at different levels of representation. Tone sandhi applies first, in the syntactic domain of a phase. The syntactic structure Seidl assumes for Mende is that shown in (49).

[11] In (46*b*), however, the possessor forms one domain for tone sandhi with the noun. Seidl argues that the difference between (46*b*) and (47*b*) is due to the alienable–inalienable distinction between nouns.

(49)



Although Seidl focuses more on consonant mutation and is not very explicit about the phase analysis for tone sandhi, we must conclude from the syntactic structure in (49) that the subject, the object, and the verb are not in a phase (vP), and that therefore they are in separate domains for the application of M-rules, which operate on phases. In order to account for mutation domains, Seidl suggests an analysis in which mutation is caused by a case marker on the initial consonant of a following word in the same maximal projection. She argues that these case markers are non-segmental and are associated with the possessor in (46) and (47*b*) or the object pronoun in (47*a*), and posits the existence of a rebracketing process of the case marker or clitic with a following word (with the head noun in (46) and (47*b*) and with the verb in (47*a*)). This rebracketing takes place at Morphological Structure, the level of representation proposed by the theory of Distributed Morphology, which Seidl assumes. That is, the rebracketing takes place after all syntactic operations have taken place. The following scheme is slightly adapted from Seidl (2001: 28):

(50) $[(\ldots X^0+\text{case})_{w\ w}(X^0\ldots)]_{YP} \rightarrow [(\ldots X^0)_{w\ w}(\text{case}+X^0\ldots)]_{YP}$

Interestingly, consonant mutation has lexical exceptions, whereas tone sandhi does not. Seidl attributes this intriguing difference to the different nature of the rules. Mutation applies after rebracketing—after Morphological Structure—whereas tone sandhi applies at an earlier level, in syntax, before rebracketing and similar Morphological Structure processes take place. What she means is that consonant mutation applies at the P-parse, in the phonological component after Morphological Structure, where, according to the theory of Distributed Morphology, Vocabulary Insertion and all morphophonological operations take place; the phonological processes operating at this level may therefore be sensitive to lexical idiosyncrasies. On the other hand, tone sandhi is an M-rule, applying at a purely syntactic or morphosyntactic representation, at what Seidl calls the M-parse, so it is not subject to lexical idiosyncrasies.

In Luganda and Yoruba there are violations of the principle of layeredness, that is, there are overlapping domains for different rules. In Luganda, the domain for high-tone plateauing (HP) can be identical to, or smaller or larger than, the domain for vowel shortening (VS) (Seidl 2001: 46–51). Along the lines of her proposal for Mende, Seidl argues that HP is an M-rule applying in the *v*P phase, and that VS is a P-rule applying at a later stage, after morphological rebracketing of enclitics with the verb. The difference in levels of application is associated with the fact that VS is sensitive to speech rate, as the rebracketing applies only in fast speech.

In Yoruba, a tonal OCP-rule changing a H tone to mid when preceded by another H tone operates between a verb and an object enclitic but not between a verb and a nominal or verbal stem. On the other hand, regressive ATR harmony applies between a subject proclitic and a verb but not between a verb and an enclitic (Seidl 2001: 51–4). Thus, both rules apply in the clitic group or the prosodic word but have overlapping domains. This situation is represented in (51); curly brackets indicate ATR harmony domains and round brackets, tonal OCP domains.

(51) *a.* {*ó* (*kó*} *wá*) → *ọ́ kọ́ wa*
he taught us
b. {*ó* (*lé*} *wá*) → *ó lé wa*
he chased us

Seidl's solution for this paradox is that the tone rule is an M-rule applying in the *v*P phase (affecting the verb and its object), and ATR harmony is a P-rule applying between a clitic and a host on a post-merger structure which places together a subject proclitic and the verb.

Seidl also criticizes the PHT for its inability to predict the correct domains of application of certain rules. For instance, she shows that Truckenbrodt's (1995, 1999) analysis for Kimatuumbi vowel shortening sketched above runs into problems once a detailed syntactic analysis of this language is considered. Recall that Truckenbrodt accounts for the domain of application of VS by having the constraints ALIGN-XP,R and WRAP-XP ranked high, so that a right-edge boundary is inserted between an indirect object and a direct object, for instance, with a recursive phonological phrase boundary wrapping the VP (see (52)). The relative ranking of ALIGN-XP,R and WRAP-XP higher than NONREC produces the schematic phrasing for a sentence such as (38*c*), repeated as (53), with a verb followed by an indirect object and a direct object:[12]

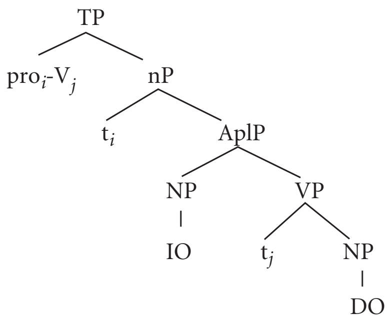
(52) $((\mathrm{V\ NP})_{\Phi}\ \mathrm{NP})_{\Phi}$

[12] The absence of a left boundary on the second NP is due to the low ranking of ALIGN-XP,L.

(53) [*naampéi* [*kikóloombe*]$_{NP}$ *Mambóondo*]$_{NP}$]$_{VP}$ → *naampéi kikóloombe Mambóondo*
I-him-gave shell Mambóondo
'I gave Mamboondo the shell.'

This analysis faces a problem, however. Seidl claims that previous work on Bantu syntax shows that the verb moves out of VP and rises to TP, and that the indirect object is base-generated in a functional projection (Applicative Phrase). The following structure is claimed by Seidl for this type of sentence:

(54)



The maximal projection containing the verb and its objects is TP, but TP is a functional projection, and Truckenbrodt assumes that functional projections do not need to be wrapped. The only lexical maximal projections are the indirect-object NP and the VP. Thus, the resulting phrasing would be V(IO)$_\Phi$(DO)$_\Phi$ (hence, (V)$_\Phi$(IO)$_\Phi$(DO)$_\Phi$), an incorrect output for any Bantu language.

Seidl proposes a solution, not only for Kimatuumbi, but for the two parametric types of phrasing observed in Bantu languages in double-complement constructions, (V NP NP) or (V NP) (NP).[13] These two patterns correlate with different syntactic properties: in almost all languages displaying the (V NP NP) pattern (which Seidl calls "symmetrical languages") the arguments and the verb move out of their base-generated positions to specifiers of functional projections, whereas in almost all languages displaying the (V NP) (NP) pattern (called "asymmetrical languages") the direct object stays in its VP-internal position. Seidl then proposes that theta-domains are phonological domains in Bantu, or, more concretely, that at the P-parse phonological domain boundaries are projected to the left or right edges of theta-domains. But Seidl makes the claim that in order for theta-domains to project boundaries, the constituent theta-marked by the head of that theta-domain must stay in situ. The head itself may move out, as the verb does in asymmetrical Bantu languages, but the theta-marked constituent must stay in situ. In symmetrical languages no argument stays in its theta-domain, where it receives a theta-role, and thus no phonological boundary is projected in the maximal projection it surfaces in. The resulting phrasing is therefore (V NP NP), with left and right

[13] Φ-symbols are eliminated since Seidl argues against the PHT.

boundaries due to default insertion of boundaries at the beginning and end of sentences. In asymmetrical languages, on the other hand, the DO stays in its theta-domain (the VP), and a phonological phrase boundary is projected on the left edge of VP, deriving the (V NP) (NP) pattern.

Finally, Seidl also offers an explanation for the few symmetrical and asymmetrical languages that differ from the most common phrasing pattern in their groups. For instance, the (V NP) (NP) phrasing of a symmetrical language like Chaga is explained by the covert movement of the direct object, that is, after the syntactic derivation is sent to PF, and the (V NP NP) phrasing of an asymmetrical language like Chicheŵa is explained by the parametric choice in this language for inserting right-edge brackets at the right edge of theta-projections, that is, VP.

Overall, Seidl's (2001) MIR theory provides an interesting alternative to the PHT, at least to the empirical shortcomings of this theory. Apart from my previous point that perhaps more clarity in the definition of M_0 would have been desirable, I could also mention a concern that I have about the fact that MIR deals with domains which always include more than one lexical word (phases and theta-domains) but not smaller domains around a lexical word, with adjacent function words. Her theory would gain much more importance if its scope were widened to deal with that level of syntactic structure, where so many phonological processes occur. Also, Seidl's conclusion that prosodic constituency above the word does not exist at all seems too strong, as her model does not offer an alternative for deriving the highest prosodic domains such as the intonational phrase or the utterance, which surpass theta-domains or phases.

5.5 Theories of Phonological Phrasing and Multiple Spell-Out

Assuming the minimalist theory of grammar, Dobashy (2003) and Ishihara (2003) defend an innovative proposal, which is that phonological phrases are mapped from syntactic phases (*v*P and CP) by Multiple Spell-Out. That is, as soon as a syntactic phase is completed by the syntactic operations responsible for creating syntactic structure, a cycle is created and Spell-Out proceeds (cf. Uriagereka 1999; Chomsky 2000, 2001*a*, *b*, among others, for arguments in favour of Multiple Spell-Out). In the minimalist framework, the syntactic constituents that are spelled out are the sisters of the heads of so-called "strong phases" *v*P and CP. The sisters of *v* and C are VP and IP, respectively. Dobashy (2003) claims that Spell-Out linearizes these constituents, that is, it assigns a certain word order within them on the basis of asymmetric c-command relationships as in Kayne (1994): word *a* precedes word *b* if word *a* asymmetrically c-commands word *b*. Dobashy then argues that these constituents (VP and IP, sisters of *v*P and CP, respectively) are also mapped as phonological phrases in PF, without the need for reference to edges or to maximal projections, as in the Prosodic Hierarchy Theory.[14] In a schematic sentence such as (55), first the sister of *v* is mapped, and then the sister of C. This would leave the phonological phrases (or "p-phrases", in Dobashy's terminology) in (56).

(55) $[_{CP}$ C $[_{IP}$ Subj Infl $[_{vP}$ XP v $[_{VP}$ V Obj$]]]]$

(56) *a.* Spell-Out sister of *v*: $_{\Phi}$(V Obj)
b. Spell-Out sister of C: $_{\Phi}$(Subj Infl XP *v*)

However, Dobashy points out that a problem arises when trying to linearize the two constituents. Linearization works on asymmetrical c-command relationships, but the first constituent (V Obj) is not available to future operations of linearization after it is spelled out in a previous cycle, and thus the constituent (Subj Infl XP *v*) cannot be linearized with anything. In order to solve this problem, Dobashy assumes that the first element in a constituent that is linearized is not mapped as part of the p-phrase and is left for future Spell-Out operations that linearize strings. Thus, from (55), V would not be mapped as part of the p-phrase that contains the object, so that it can be computed in the linearization process that produces the linear order between the sister of C and the string that has been spelled out earlier, that is, the sister of *v*. Considering (55) again, the operations of linearization and mapping to phonological constituency would work as follows (for details on linearization, see chapter 1 of Dobashy 2003):

(57) *a.* Spell-Out sister of *v*

Linear order:	V « Obj
Mapping to Φ:	Obj
In Φ:	$(\text{Obj})_{\Phi}$

b. Spell-Out sister of C

Linearization of c-command domain of *v*:	*v* « V
Linearization of c-command domain of Infl:	Infl « XP « *v*
Linearization of the rest:	Subj « Infl
Linear order:	Subj « Infl « XP « *v* « V
Mapping to Φ:	Infl « XP « *v* « V
In Φ:	$(\text{Infl « XP « } v \text{ « V})_{\Phi}$ $(\text{Obj})_{\Phi}$

[14] It should be added that Dobashy follows Chomsky (2001*b*) in assuming that DP is also a phase. Due to space limitations we will not consider examples involving DPs here, but the reader is referred to chapter 3 in Dobashy (2003). On the other hand, it should be pointed out that Ishihara (2003) differs from Dobashy in proposing that it is the phase itself that is spelled out, rather than the sister of the head of a phase. However, in this section we will review only Dobashy's model, due to space limitations and to the fact that Ishihara's work is focused exclusively on phrasing of wh-questions in Japanese, not on more general data bearing on the issue that concerns the present chapter, that is, the issue of how syntactic structure determines domains that are revelant for segmental phonology.

c. Spell-Out Root

Linearization of c-command	domain of C:	C « Subj
Mapping to Φ:		Subj
In Φ:		$(\text{Subj})_\Phi$ (Infl « XP « ν « V)$_\Phi$ (Obj)$_\Phi$

As a result, from the syntactic structure in (55) the following p-structure is created (Dobashy assumes that C is mapped together with the subject in one p-phrase):

(58) $(\text{C Subj})_\Phi$ $(\text{Infl XP } \nu \text{ V})_\Phi$ $(\text{Obj})_\Phi$

As Dobashy points out, this is the prediction for phonological phrasing that the Relation-Based Approach to prosodic theory makes, from a sentence consisting of a subject, a verb, and an object. Thus, something commendable about a theory of syntax–phonology mapping based on Multiple Spell-Out is that it can derive phonological phrasing based on syntactic constituents that exist independently as part of general grammar, that is, as the material that is sent by Spell-Out to the phonological component (sisters of the head of a phase). Dobashy claims that the advantage of this theory is that there is no need to make reference to notions such as maximal projections or recursive and non-recursive sides, as stated in (17) in section 5.3.1.

Of course, $(\text{S})_\Phi(\text{V})_\Phi(\text{O})_\Phi$ is not the only phrasing pattern in an SVO language. These are other choices mentioned by Dobashy (2003: 38):

(59) Italian: $(\text{S})_\Phi$ $(\text{V})_\Phi$ $(\text{O})_\Phi$ or $(\text{S})_\Phi$ $(\text{VO})_\Phi$ if O is non-branching.
Kimatuumbi: $(\text{S})_\Phi$ $(\text{VO})_\Phi$
Kinyambo: (S) $(\text{V O})_\Phi$ or $(\text{S V O})_\Phi$ if S is non-branching.

The option that some languages may display for incorporating a syntactically non-branching object into the phonological phrase containing the verb, in a process known as restructuring, is included in the parameters for phonological phrasing in the Relation-Based Approach (see (17)). Dobashy also assumes the process of restructuring, but parameterizes it as restructuring to the left (the case of the object in Italian) or to the right (the case of the subject in Kinyambo). As for the phrasing $(\text{S})_\Phi(\text{VO})_\Phi$, Dobashy claims that it is due to the raising of the verb to Infl in Bantu languages and to the raising of the object NP to Spec of νP.

5.6 Precompiled Phrasal Phonology

The main idea in Hayes's (1990) Precompilation Theory is that all rules applying across words whose structural description refers to syntactic labels and categories (such as the vowel-deletion rules of Greek and verb-final vowel deletion in Italian mentioned in section 5.2) do not belong to the postlexical component but to the lexical component, and should be considered as rules of phrasal allomorphy. The lexicon is viewed as including a set of phrasal allomorphs for every word, generated by lexical phonological rules. Each of these allomorphs is marked to surface in certain syntactic contexts, encoded by means of phonological instantiation frames. Hayes illustrates this proposal through the rule of Hausa final-vowel shortening, a process where final long vowels of verbs appear as short when the verb precedes a full NP direct object; see (60).

(60) a. *ná: kámà:*
I have-caught
'I have caught (it).'

b. *ná: kámà: ší*
I have-caught it
'I have caught it.'

c. *ná: kámà kí:fí:*
I have-caught fish
'I have caught a fish.'

d. *ná: ká:mà: wà Mú:sá: kí:fí:*
I have-caught prt. Musa fish
'I have caught Musa a fish.'

Only in (60*c*) does the final long vowel of the verb *ká:mà:* appear as short, that is, when followed by a full NP direct object. In all other contexts the vowel appears as long. This distribution would be captured by assuming that the two allomorphs of the verb *ká:mà:* are *ká:mà:* and *ká:mà*, and that the rule of vowel shortening refers to this phonological instantiation frame, generating the allomorph with the short vowel. The longer form is inserted elsewhere. The vowel-shortening rule would be formalized as in (61).

(61) V: → V / [. . . ___]$_{[\text{Frame 1}]}$
Frame 1: / [$_{VP}$ ___ NP. . .], NP non-pronominal

Other cases that Precompilation Theory can deal with is the *a/an* alternation of the indefinite determiner in English, as it affects just this particular syntactic category, and the alternation that the Spanish feminine definite determiner shows between *el* and *la* (i.e. *el* before nouns whose initial vowel is stressed, *la* elsewhere).

Precompilation Theory is suitable as a model of phrasal allomorphy, for phonological processes that are sensitive to syntactic or morphological category information, rather than category-blind processes such as those that the theories reviewed so far occupy themselves with. However, Hayes makes a strong claim, which is that all phrasal rules can be accounted for by the Prosodic Hierachy Theory, and those which are directly sensitive to syntactic information and cannot be handled by the PHT are precompiled rules. Both of these claims would be rejected by Seidl's MIR model, for instance. Seidl argues that the domains of application of post-syntactic phonological rules are not defined by the PHT, and her theory also contains rules which apply on a level which maintains almost all syntactic information, the Morphosyntactic Representation. Her M-rules, applying at M_0, are not precompiled rules in Hayes's sense.

In the next section I present data that pose a challenge to the proposals for phonological domain formation that have been surveyed so far, which thus suggests that the nature of the syntax–phonology interface is more complex than hitherto assumed.

5.7 Phonological Domains Derived from Morphosyntactic Feature-Checking Relationships

5.7.1 Distribution

Elordieta (1997, 1999) presents a process of vowel assimilation (VA henceforth) in Lekeitio Basque (henceforth LB), by which a syllable-initial vowel assimilates in all its features to an immediately preceding syllable-final vowel. This process is optional and it applies in colloquial speech. In nominal contexts, it only applies between the final vowel of a noun or adjective and the initial vowel of a following inflectional head (a determiner or case marker) attached as a suffix. It does not apply across members of compounds, or between a noun and an adjective. This is illustrated in (62), where for each of the underlying forms in the left-hand column two alternative outputs can be obtained. The form on the left represents the surface representation without vowel assimilation having applied, and the right-hand column contains the surface representation with the application of vowel assimilation. The stem-final vowels in the output forms are always high, due to the application of a process of vowel raising (VR henceforth), which raises a stem-final non-high vowel when immediately followed by a vowel-initial suffix (a, e > i; o > u). Syllable boundaries are indicated by dots:[15,16]

15 Nominal inflection in Basque is morphologically attached to the last word of the last constituent of the Noun Phrase, not to every constituent contained in it. Thus, when a noun is followed by an adjective, the determiner and case markers or postpositions will be added to the adjective, the noun remaining in its bare uninflected form. There is a distinction in the plural determiner between locative and non-locative cases: *-a* is the singular determiner, *-ak* is the plural determiner, and *-eta* is the plural determiner for locative cases.

16 Acute marks indicate that the syllable on top of which they are positioned is stressed. See Hualde et al. (1994), Hualde (1999) for more information on how accent is assigned in Lekeitio Basque.

(62) a. /*orma*-a/ *or.mi.a* *or.mi.i*
wall-DET.SG
'the wall'

b. /*baso-ak*/ *ba.sú.ak* *ba.sú.uk*
forest-DET.PL
'the forests'

c. /*seme-a-ri*/ *se.mi.a.ri* *se.mi.i.ri*
son-DET.SG-DAT
'to the son'

d. /*ume-en*/ *u.mí.en* *u.mí.in*
child-GEN.PL
'of the children'

e. /*ortu-eta-tik*/ *or.tu.e.tá.tik* *or.tu.utá.tik*
garden-DET.PL-ABL
'from the gardens'

f. /*polísi gaixto-ak-kin*/ *polísi gaix.tu.á.kin* *polísi gaix.tu.ú.kin*
policeman bad-DET.PL-SOC
'with bad policemen'

Derivational morphemes are consonant-initial in LB, so it is not possible to test their behaviour with respect to VA. VA may also apply in underived domains, that is, roots, although the application of the rule seems to be lexically determined (cf. *bi.ar*, *bi.ir* 'to need', *si.es.ta*, *si.is.ta* 'nap', but *si.ar*, **si.ir* 'through', *bi.á.je*, **bi.í.je* 'trip').

The rule of VA does not apply between two members of a compound or across words. See (63) and (64), respectively:

(63) a. /*buru-andi*/ *buruándi* **buruúndi*
head-big
'big-headed'

b. /*soro-antz*/ *soróantz* **soróontz*
mad-look
'mad look, aspect'

(64) a. *seru asula* *seru asula* **seru usula*
sky blue
'blue sky'

b. *etxe andidxa* *etxe andidxa* **etxe endidxa*
house big
'big house'

In verbal contexts, VA applies between the final vowel of a verb and the following initial vowel of an inflected auxiliary. The lexical verb is inflected for aspect; inflected auxiliaries are formed by the amalgamation of agreement markers and tense and mood morphemes with the roots of auxiliary verbs. Most forms in the verbal paradigm of LB present an initial consonant, but past-tense verbal forms with a third person ergative marker begin with the vowel /e/ (glossed in the examples as a non-present morpheme, *non-pres*). In this context, no rising of the final vowel of the lexical verb occurs, as VR is restricted to morphological concatenation, that is, nominal inflection. As the examples in (65) show, inflected auxiliaries form a separate word from the participial verb.

(65) a. */dxo e-ba-n/* *dxo eban* *dxo oban*
hit 3ERG.-NONPRES-ROOT -PAST
'(S)he hit him/her/it.'

b. */galdu e-ba-s-an/* *galdu ebasan* *galdu ubasan*
lose 3ERG-NONPRES-ROOT-3ABS.PL-PAST
'(S)he lost them.'

c. */ikasi e-b-e-n/* *ikasi ében* *ikasi íben*
learn 3ERG-NONPRES-ROOT.-ERG.PL-PAST
'They learnt it.'

d. */atrapa e-b-e-s-en/* *atrapa ebésen* *atrapa abésen*
catch 3ERG-NONPRES-ROOT-ERG.PL-3ABS.PL-PAST
'They caught them.'

VA does not apply, however, between a lexical verb and a causative verb, *eraiñ*, which in linear sequence appears between the lexical verb and the inflected auxiliary:

(66) *altza eraiñ dotzat* **altza araiñ*
rise make
'I have made him/her stand up.'

There are two modal particles which constitute independent syntactic heads and that may intervene between the lexical verb and the inflected auxiliary. Their basic semantic function is to express epistemic attitudes of the speaker concerning the existence or nonexistence of the state of affairs identified by other elements in the sentence. The modal particle *ete* appears in interrogative and exclamative sentences, and conveys a meaning of wondering, uncertainty, doubt, suspicion, on the part of the speaker about the event expressed in the sentence, and *ei* indicates that what is being expressed in the sentence has been reported by other people and that the speaker cannot fully assure the veracity of the event denoted by the proposition. I call the particles *ete* and *ei* "dubitative" and "evidential", respectively. No VA occurs between a lexical verb and these particles:

(67) a. *etorri* *ete* *díras*? **etorrí ite díras*?
come DUB AUX
'I wonder whether they have come.'

b. *atrapa* *ei* *dósu* **atrapa ai dósu*
catch EVID AUX
'It is reported/said that you have caught it.'

In adverbial non-finite clauses, the verb appears followed by a subordinating conjunction. No VA applies between these elements either:

(68) a. *ekarri* *árren* **ekarri írren*
bring despite

b. *konpondu* *esik* **konpondu usik*
fix unless

c. *amaitxu* *árte* **amaitxu úrte*
finish until

VA does not occur across any other two words, such as an object and a verb, a subject and a verb, or two objects:

(69) a. *arraña erosi dau* **arraña arosi dau*
fish buy AUX
'(S)he has bought fish.'

b. *laguna etorri da* **laguna atorri da*
friend come AUX
'The friend has come.'

c. *amumári erregalúa ein dotzagu* **amumári irregalúa ein dotzagu*
grandmother-DAT present-ABS make AUX
'We have made (i.e. bought and given) a present for grandmother.'

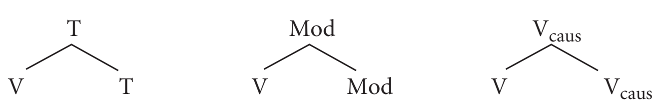
An important distributional generalization arises, then: VA applies only between lexical heads and following elements realizing inflectional features, such as determiners and inflected auxiliaries. The syntactic and prosodic nature of the elements that can and cannot be subject to the process unveils serious problems for the different theories of phrasal and prosodic phonology in order to account for phenomena of this type.

5.7.2 Challenges for Theories of Phrasal and Prosodic Phonology

The rule of VA presents a problem for its classification as a lexical or postlexical rule, following the assumptions of classical lexical phonology. VA cannot be a lexical rule, since it applies across words (i.e. between a verb and its inflection), it may apply in non-derived environments, and is an optional rule depending on register and speech rate. However, VA is not a post-lexical rule in the classical sense, applying across the board, as its context of application is syntactically constrained. Moreover, in the case of nominal roots it may have lexical exceptions, a property recognized for lexical rules. Thus, it would look more like an M-rule in the MIR model, although it will be shown below that it cannot be classified as such.

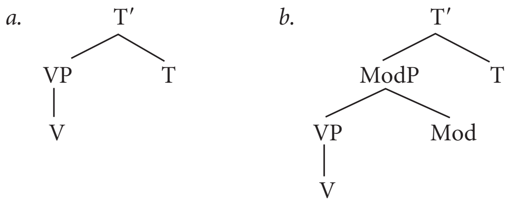
I will now turn to the challenges that VA poses for the different theories of phrasal phonology reviewed so far, starting with the DRT, which argues that c-command relationships and edge locations can define contexts of application of phonological rules. The syntactic structure of the Basque sentence is still a matter of debate, as syntacticians do not agree on whether Basque is a right- or left-headed language or on the nature of head movement. On the one hand, some generative grammarians have been assuming head-final structures for this language, following descriptive observations that heads follow their complements across all or almost all categories (see Ortiz de Urbina 1989, 1994, 1995; Laka 1990; Albizu 1991, 1992; Artiagoitia 1992; Arregi 2003, 2004). On the other hand, some researchers have posited a left-headed structure (Ormazabal et al. 1994; G. Elordieta 1997; Haddican 2004). And still others have assumed a bi-directional structure, right-headed for lexical projections and left-headed for functional projections (A. Elordieta 2001). However, in all these proposals, the c-command relationship between a lexical verb and a modal particle or causative verb in affirmative clauses is the same as the c-command relationship between a lexical verb and an inflected auxiliary. In some proposals, head-to-head incorporation is assumed from the verb to a modal and then to the auxiliary, both in right- and left-headed structures (Ortiz de Urbina 1989, 1994, 1995; Albizu 1991; G. Elordieta 1997; A. Elordieta 2001), creating a complex head. The structures that result after participial verb movement to the inflected auxiliary (abbreviated as T), a modal particle and a causative are schematized in (70). Intermediate heads and projections such as *v*, Aspect and Auxiliary are omitted for reasons of simplification, and Agreement is subsumed under T:

(70)



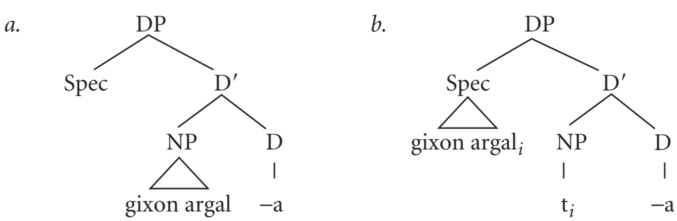
In other proposals all heads stay in situ and thus a modal particle c-commands a lexical verb the same way an inflected auxiliary c-commands the verb in the absence of a modal (Laka 1990; Artiagoitia 1992; Arregi 2003, 2004).[17] The structures in (71) represent right-headed structures assumed by these researchers:

[17] Artiagoitia (1992) assumes a left-headed IP, which merges at PF to the right of the lexical verb. Arregi (2003, 2004) also assumes merging between V and T at MS. Finally, Haddican (2004) defends a left-headed structure and argues that the modal particle and the auxiliary stay in situ and they are both c-commanded by the lexical verb, which rises (together with VP) to a higher projection, Polarity Phrase.

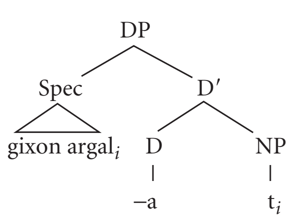
(71)


For the cases of a subordinating conjunction taking a non-finite clause as a complement (see (68)) the same left- or right-headed possibilities as the ones just mentioned could be considered.

For the Determiner Phrase similar scenarios arise. If a right-headed structure is assumed, the NP selected by D may either stay in situ or rise to Spec of DP. In both cases, the determiner cliticizes or merges with its NP complement at PF, or, more correctly, with the right edge of the NP. This explains the fact that the determiner is always attached to the rightmost word in an NP (i.e. as a phrasal clitic: see G. Elordieta 1997).

(72)


If a left-headed structure is assumed, the NP complement has to rise to Spec,DP in order to account for the surface order NP–D. In this case the same process of cliticization would apply.

(73)


With these structures in mind, it seems evident that a DRT analysis of the domains of application of VA in terms of c-command relationships and/or branching configurations will not work, because regardless of the head parameter chosen, the c-command relationships and branching configurations holding between the participial verb and an inflected auxiliary, a modal particle, or a causative verb are identical—that is to say that no distinctions can be drawn. The question could be whether c-command is a necessary although not a sufficient condition, but it is clear in any case that other syntactic parameters must be invoked in order to come up with the correct explanation.

The same problem arises for Rizzi and Savoia's (1993) model, as of the five parameters of syntactic government they posit, none corresponds to the relationships between the heads between which VA applies. Thus, whether the head-adjunction or the in situ analysis is considered, the government relationships are the same in all cases between the different heads. Since both an inflected auxiliary and a modal particle or a complementizer are functional heads, F-government does not seem to be a solution, and neither does Agr-government in the sense of Rizzi and Savoia, as this relationship holds only between expressions displaying morphosyntactic agreement in gender and/or number, in other words, in nominal contexts.

The other model that derives phonological domains from syntactic relationships, Seidl's (2001) MIR, does not fare better. This theory cannot provide an account of the domains of application of VA in LB, since this model is suited to capturing phenomena that hold in phases or theta domains, which are larger than the ones in which VA applies. On the other hand, prosodic considerations do not help discriminate the contexts of application of VA. It cannot be argued that the domain of application of VA is a phonological word, that is, a phonological string that contains one primary stress and is separated from other strings that contain their own primary stress. This is because the lexical verb and the inflected auxiliary may each bear independent stress, and still VA applies. In the following examples, we mark main word stress with an acute accent.

(74) a. *ekarrí ebésen edarídxak* → *ekarrí ibésen edarídxak*
bring AUX drinks
'They brought the drinks.'

b. *saldú ebésen etxíak* → *saldú ubésen etxíak*
sell AUX houses
'The houses they sold.'

Usually, clitic groups are also classified as prosodic units that contain only one syllable with main stress, and thus the domain of application of VA cannot be the clitic group either. The phonological phrase would be too inclusive a domain, because it would incorrectly predict VA across the two members of a compound, even though in compounds there is only one syllable with word stress. According to the RBA lexical words are always contained in different phonological phrases, unless they are modifiers (i.e. adjuncts) or specifiers of another lexical head, or unless the parameters allowing the inclusion of the first complement of a lexical head are selected (cf. the phonological phrase building algorithm presented in (17), in section 5.3.1). If the assumption is considered in which a lexical verb incorporates into a causative verb, modal particle, or inflected auxiliary, it is clear that it is not possible to refer to recursive and non-recursive sides, or relational notions such as modifiers, specifiers, or adjuncts, because none of these relations can apply to distinguish or separate the heads in the resulting structures. And if the proposals with no incorporation are adopted (see (71)), the result is the same, as the elements involved are all independent heads, and none of them is a specifier or adjunct.

The EBA would face the same problems. The domains determined by making reference to left or right edges of XPs would not separate the members of a compound noun, across which VA does not apply. And there would be no way to distinguish the domain formed by a lexical verb and an inflected auxiliary from the one formed by a lexical verb and a modal particle. There would be no XP boundaries if head incorporation is assumed, and if no incorporation is assumed a bracket would be inserted to the left or to the right of a VP in all cases. Referring to boundaries of lexical X^0s would not work, either. Positing left-edge boundaries of lexical heads would fail to explain the absence of VA between a participial verb and a modal particle, a subordinating conjunction, or a postposition, since the latter are not lexical categories and thus cannot be assigned a bracket on their left edge. The EBA is based on the Principle of Categorial Invisibility of Function Words proposed by Selkirk (1984). However, the problem of VA in Lekeitio Basque shows that not all function words behave similarly from a prosodic point of view, even when the syntactic configuration in which they appear is the same. Thus, we have to conclude that VA demonstrates that the distinctions between lexical and non-lexical categories might be richer than hitherto assumed.

The last resort for proponents of the PHT could be the theory of Precompiled Phrasal Phonology, in the hope that the syntactic sensitivity displayed by VA could be dealt with in this theory. A precompilation analysis of VA would force us to posit five allomorphs for vowel-initial auxiliary verbs. There would be the basic allomorph with the underlying initial /e/ and allomorphs with initial /a/, /i/, /o/, and /u/. Likewise, for each determiner we would need three allomorphs: one with the underlying initial vowel (i.e. /a/ for the non-locative singular and plural determiners, /e/ for genitive markers and locative plural determiners), and two more with the high vowels /i/ and /u/, to be inserted after the last word in an NP ending in /i/ or /u/. The problem with this analysis is that the theory of Precompiled Phrasal Phonology is best suited to account for phenomena which affect and are triggered by specific syntactic categories or morphemes. VA, however, is not a process of this kind. It has a limited distribution, but it is not a rule that affects only a specific morpheme or syntactic category. Saying that the rule applies to determiners and auxiliaries preceded by nouns/adjectives and verbs only describes the problem, failing to capture the generalization that only the categories realizing inflectional features are capable of undergoing the process. This is a syntactic regularity, not an arbitrary fact.

From this discussion it is clear then that the domain of application of VA resists an analysis in the different theories of phrasal phonology proposed in the literature, and that another type of phonological constituent must be sought for that corresponds to the domain of occurrence of VA in Lekeitio Basque.

5.7.3 Morphosyntactic Feature Chains and Phonological Domains

In the face of such a challenge, G. Elordieta (1997, 1999) developed an analysis based on the distributional generalization that VA always applies between a lexical head (noun, adjective, or verb) and a following inflectional element (determiner/case marker and inflected auxiliary). Elordieta argues that this relationship between lexical and inflectional heads is a reflex of the syntactic relationships of feature checking among heads as assumed in the minimalist approach to syntax, at least in the version of minimalism that was around at the time, which was Chomsky's (1995). One of the basic tenets in this theory is that formal features have to be checked in the syntactic derivation by other formal features so as to be properly licensed. If features are not checked, the derivation is cancelled. For example, the nominative case feature in the subject is properly licensed if it is checked by the nominative case-assigning feature of T, and the accusative case feature in the object is checked by the head *v*. In both instances, feature checking is carried out in a Spec–Head relationship, by raising the subject and object NPs to Spec of TP and Spec of *v*P, respectively.[18] If the features do not match, the derivation is cancelled. Another relationship is the one holding between the heads T and *v*. In Chomsky (1995), T has V- or *v*-features that attract the raising of V (in *v*). In turn, the verb has Tense features that need to be checked with those of T.[19] Another relationship of this kind is the one established between a Determiner (D) and the head of its NP complement (i.e. N). As argued by Longobardi (1994), the fact that the head N rises overtly to D in many languages constitutes evidence for this relationship; the head D attracts the categorial feature [N] to check the [$\pm$R] (referential) feature of D. Other authors have argued more recently that the overt realization of agreement or concord in phi-features between a determiner, a noun, and an adjective in a DP in some languages means that an operation that checks or values phi-features takes place among these heads (see Pesetsky and Torrego 2001).

[18] Recent developments of the minimalist theory after Elordieta (1997) have abandoned the idea that T or *v* have Case features, and that only DPs have uninterpretable Case features (in D or N) that need to be valued and deleted in Spec of TP and Spec of *v*P (cf. Chomsky 2001*a*, *b*). For Pesetsky and Torrego (2001, 2004), nominative Case is an uninterpretable T feature on D which must be valued by T itself. What matters for the purposes of the discussion is that feature-checking–valuation relationships between DPs (or D/N) and T and *v* are still assumed.

[19] The argument in Chomsky (1995) that the head Tense has a V-feature would have to be revised if Chomsky's (2000) suggestion that categorial features may not exist is correct (following ideas that categorial information arises configurationally, based on the syntactic context in which bare roots are inserted; cf., among others, Marantz 1997). Other authors, however, still defend the existence of categorial features and their participation in operations of feature checking or feature valuation, i.e. the operation Agree (cf. Matushansky 2005, 2006; Rezac 2004; Jouitteau 2005). Irrespective of how this debate is settled, it seems clear that the existence of a syntactic relationship between the features in the heads T and *v*/V is still commonly assumed. For instance, Pesetsky and Torrego (2004) argue that the relationship between the head Tense and the head *v* (and V) consists in the presence of an interpretable unvalued T-feature in Tense, which needs to be valued by the uninterpretable valued T-feature in V (which rises to *v*).

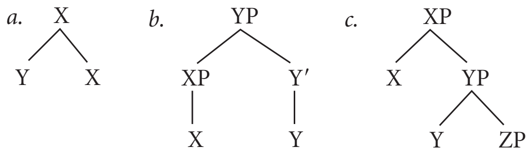
The heads D and T are precisely those that participate in VA with nominal expressions and verbs, respectively. G. Elordieta (1997) (cf. also G. Elordieta 1999) points out that this parallelism is not coincidental; D and T are the inflectional heads that enter in checking relationships with N and V and participate in VA processes with them. Elordieta argues that this link between a close degree of morphosyntactic cohesion as defined in feature checking terms and a close degree of phonological cohesion is part of Universal Grammar, and some languages may instantiate these domains in the phonological component. The main claim is that the relationships of feature checking established among features in syntactic heads are primitive relationships of *feature chains*, following ideas of Zubizarreta and Vergnaud (1997). That is, the heads containing those features involved in feature checking relationships would constitute the feature chains {C, T}, {T, *v*}, {T, D}, {*v*, D} and {D, N}.[20] The feature chain {C, T} is observable in the rising of inflectional heads in T to C in questions or focus constructions. The chain {T, *v*} is established by the relationship between the heads T and *v*/V as discussed above. The chain {T, D} stands for the relationship between T and a subject DP, such as checking of Nominative Case or of the phi-features of the Subject DP, which would be in D and in T. The chain {*v*, D} is determined by the relationship between *v* and the head D of the object DP, as in the assignment of Accusative case or the checking of phi-features of the object. And the chain {D, N} stands for the relationship between the determiner and the noun in a DP (checking of features of referentiality or specificity, or checking of phi-features).

Zubizarreta and Vergnaud (1997) claim that these pairs are primitive entities of grammar, as they express the objectively inescapable fact that in grammar there are formal features contained in heads that are related to formal features on another head. Although this relationship is expressed in minimalist terms as movement operations of feature checking, Zubizarreta and Vergnaud argue that it is not the operation of feature checking itself that expresses a primitive relation in grammar, but the chains themselves. In their theory, these chains are independent of phrase structure, although coexistent with it. They are present throughout the syntactic derivation, up to the moment it is sent to the PF and LF interface levels.

The sets of formal features of these pairs of heads are in a strictly local configuration, by forming a complex X^0 or by being in a Spec–Head or Head–Complement configuration. These three possibilities are schematically represented by the heads X and Y in (75*a*–*c*), respectively.[21]

[20] G. Elordieta (1997) also includes the chain {P, D}, to refer to the relationship between an adposition and a determiner. P assigns Case to the DP complement; an uninterpretable Case feature in D would therefore need to be checked by P.

[21] Chomsky (2000) holds the view that head-movement operations occur in PF, after the syntactic derivation has been spelled out. However, Matushansky (2005, 2006) offers convincing arguments that show that head movement is syntactic in nature.

(75) 

These chains are objects at LF and PF, where they must receive an interpretation. Turning our attention to PF, the relevant interface level for our purposes, the idea in the framework of Zubizarreta and Vergnaud is that the chains presented above are primitive entities of grammar, and that they are units for morphosyntactic mapping. The main idea defended by G. Elordieta (1997, 1999) is that the cohesion of feature chains is represented or made visible in other components of grammar, namely that this syntactic cohesion is reflected in the components of grammar where heads and their features are spelled out. The morphemes realizing the heads in feature chains form phonological constituents, and as such, certain phonological processes may be specified to apply in them. In G. Elordieta (1997, 1999) it was proposed that these phonological constituents could not be identical to phonological or prosodic words, as a lexical verb and an inflected auxiliary may each bear their own stress (cf. (74)). Hence, it was suggested that feature chains were not directly mapped to phonological structure but to an intermediate structure, the level of Morphological Structure (MS), argued for in the theory of Distributed Morphology. From MS, feature chains would be mapped into the phonological component proper as constituents or domains where phonological processes may apply. This is how PF inherits domains which do not look prosodic. That is, in addition to domains formed at PF by prosodic properties of morphemes, PF also contains constituents which are mapped from this intermediate component between syntax and PF. The claim is that feature chains are realized or represented at the level of MS as morphosyntactic units, which we call MS-words, if the heads are spelled out linearly adjacent. The conditions on MS-word formation are stated in (76).

(76) **Conditions on MS-word formation**

Two overtly realized heads will form an MS-word if:

a. the heads form a morphosyntactic feature chain, and

b. the heads are spelled out linearly adjacent, either as a resut of incorporation, or by being spelled out in linearly adjacent heads (i.e. in a Spec–Head or in a Head–Complement configuration; see. (75*b*, *c*)).

Another argument for positing MS as a level where constituents formed by morphosyntactic feature checking operations are represented is the fact that at this level there are morphological operations holding between X°s (merger, fusion, fission; cf. e.g. Marantz 1988; Bonet 1991; Noyer 1992; Halle and Marantz 1993, 1994, which may affect the morphological output of the syntactic string.

A similar idea was expressed more recently in Epstein and Seely (2002). After questioning the theoretical validity of the proposal that phases are the syntactic domains that are spelled out to PF, these authors argue that each and every syntactic object resulting from an operation of feature valuation (or feature checking, in Chomsky's 1995 and G. Elordieta's 1997, 1999 terms) is mapped or spelled out to the interface levels PF and LF. That is, the syntactic object formed by two heads whose features enter in a feature valuation operation are mapped to the interface levels. Thus, the heads forming the feature chains in Elordieta's proposal would be cyclically or iteratively spelled out as syntactic objects (MS-words) to PF, where they would then constitute a phonological domain.

The schematic derivations in (77) for the chains {T, *v*} and {D, N} illustrate this idea. In the syntactic component two steps are reflected, one in which the feature chain is represented as an input in the syntactic structure, and one in which the linear order between heads is realized, before the syntactic derivation is spelled out to MS and PF. In Basque, the lexical verb occurs to the left of the inflected auxiliary, and the noun appears to the left of the determiner. The possible syntactic configurations that give rise to these relative orders were discussed above. In all of them the locality conditions between heads are met. For the sequence *v*/V–T, there is either incorporation of V to *v* to T, as in (70), or a Head–Complement relation between T and *v*, as in (71). For the sequence N–D, either a Head–Complement configuration can be postulated, as in (72*a*), or a Spec–Head configuration, as in (72*b*), (73).[22]

(77) *a.*	*Syntax*	{T, *v*}	*b.*	*Syntax*	{D, N}
		↓			↓
		{*V*/VT}			{N D}
	Spell-Out	↙		*Spell-Out*	↙
	MS	$[\mathrm{V\ T}]_{\text{MS-word}}$		*MS*	$[\mathrm{N\ D}]_{\text{MS-word}}$
		↓			↓
	PF	[V T]		*PF*	[N D]

The proposal in G. Elordieta (1997, 1999) is that these MS-words are interpreted in the phonological component (PF) as phonological constituents or domains, where certain phonological processes may be specified to apply. As shown by the fact that verbs and inflected auxiliaries in Basque may have independent primary stresses, the domains corresponding to MS-words need not coincide with prosodic domains, such as the prosodic word, the clitic group, or the phonological phrase. In fact, the case of Basque shows the coexistence of two types of domain: on the one hand, the verb and the auxiliary form one MS-word—one phonological domain, therefore—for certain rule applications such as VA, and on the other hand they form two

[22] Elordieta does not assign labels to the constituents at PF whose sources are MS-words, in part because of lack of proper terminology. They could be called PF-words, but this term should not be confused with the notion of Phonological Words, used in the Prosodic Phonology literature as a synonym of Prosodic Word.

prosodic words. The domain of application of VA in Lekeitio Basque would then be the phonological constituents formed by the MS-words [V T] and [N D].

With this analysis, the fact that VA does not occur between two lexical categories can be explained. There is no feature chain involving two lexical categories, and thus two adjacent lexical heads are not mapped as one MS-word, but as separate ones. Hence, they do not fall in the same constituent that is visible at PF. On the other hand, the relationship between a participial verb and a causative verb, a subordinating conjunction, or a modal particle is not a feature chain relationship; the verb does not check tense features or any other feature in the modal particle or the causative verb. These heads do not possess features that the verb also possesses and has to check. Thus, the heads realizing those syntactic nodes are not mapped as part of the same MS-word and hence cannot form a domain where VA is specified to apply. The same analysis would apply to compounds. Interestingly, the case of compounds is the opposite of the one involving a verb and an inflected auxiliary: compounds only display one word accent but they are not a domain for VA, whereas a verb and its inflection may have one accent each and together they do form a domain for VA. In particular, from the data presented, we have to conclude that there exist other sources for phonological constituency apart from prosodic properties.

It should be pointed out that the details of the feature relationships between heads advocated in G. Elordieta's (1997, 1999) proposal would have to be revised and updated in accordance with developments in the minimalist framework. For instance, the operations of feature checking and the operation Attract-F(eature) that Elordieta assumes (following Chomsky 1995) would have to be interpreted in terms of the operations of feature valuation and Agree: unvalued features in probes seek goals with valued features that can assign or share their value with them. But the spirit of the relationship between features in heads is still the same. The pairs of heads (more accurately, the pairs of features in those heads) involved in feature valuation remain identical (cf. notes 18 and 19).

Elordieta (1997, 1999) presents other phenomena that pose challenges for the PHT but can receive an account in his alternative model: ATR harmony in Ìgbo, French liaison, and Irish initial-consonant mutation. For reasons of space, we cannot review these data here; instead, we refer the reader to the original sources. One important thing to bear in mind is that not all languages are expected to reflect the mapping from feature chains to phonological domains empirically. Not all languages need to have processes that apply in such domains, in the same way that not all languages have phonological processes that apply to prosodic domains. It is a mapping that is encoded in Universal Grammar, but in order for it to have any observable effects, the phonological process that selects the phonological constituent so formed has to exist in the first place. Not all languages are rich in phonological processes applying between morphemes or words. Related to this point is the question of whether the inventory of feature chains can be delimited effectively to a finite taxonomy, after a closer look at the different phonological processes of this type (it might be the case that not all feature checking relationships are visible at PF, as Gillian Ramchand points out to me). This is an empirical issue that awaits further study.

The advantages of Elordieta's (1997, 1999) proposal would be threefold. First, it offers a principled explanation for the Principle of the Categorial Invisibility of Function Words (PCI), that is, for the stipulation that functional categories are included in the same prosodic constituent with lexical categories. Secondly, it provides a way of understanding the descriptive observations that Hale and Selkirk (1987) unveil (see (37*b*) and (35*b*) above), namely, the absence of cases in head-final languages in which a functional category forms a prosodic constituent with the adjacent lexical head it is not associated syntactically with (the word to its right), and the very few instances among head-initial languages in which a functional category forms a prosodic constituent with the adjacent lexical head it is not lexically associated with (the word to its left). Third, the theory just described returns to a notion that already exists independently in the grammar, such as feature-checking relationships. DRT models based on c-command and F- or Agr-government relationships also have the advantage of resorting to structural notions that are present in the syntactic derivation already, but the model in Elordieta (1997, 1999) refines these ideas in a more restrictive system. This third aspect is also shared with other approaches that advocate the relevance of syntactic relationships in the creation of phonological constituency at a level that would contain more than one lexical head, such as Dobashy's and Seidl's models. Indeed, perhaps these proposals could be integrated as part of the same theory of the syntax–phonology interface, Elordieta's proposal being a model of the "lower" part (p-words) and Dobashy's being a model of the higher constituents (p-phrases). This is an important possibility that deserves to be pursued.

5.8 Concluding Remarks

In this chapter I have tried to show that in language there may be other sources for phonological constituency apart from the one assumed in the widely known PHT. Seidl's (2001) MIR, Dobashy's (2003) theory on Multiple Spell-Out and phases, and Elordieta's (1997) feature-chain mapping analysis point to three possibilities to be considered when compared with the assumptions in the PHT. One possibility would be that the prosodic structure building algorithms proposed by the PHT (described in section 5.3) could be revised to accommodate the data and problems raised in the work mentioned here, rendering the need for these alternative theories vacuous. A second possibility would be to adopt the opposite position, namely, that the PHT should be abandoned. The third possibility would be that two types of phonological constituency coexist, one of them as envisioned by the PHT and another one as devised by the proponents of a more "syntactic" type of constituency.

Seidl's objections to the PHT and the evidence presented in the previous section from Elordieta's work indicate that the first possibility is not a very likely scenario. As for the second possibility, it might be too soon to adopt it. Alternative theories such as Seidl's MIR or Dobashy's model of mapping of phases do not say anything about the word level or the different possibilities arising between a word and an adjacent functional category, or higher domains such as the intonational phrase or the utterance. As for Elordieta's (1997, 1999) feature-chain mapping proposal, ideally it would have to be assumed that such a mapping is encoded in Universal Grammar and is not language-dependent, but it is important to raise a cautionary note: not all languages should be expected to reflect the mapping between MS-words and PF domains overtly, or to be more exact, the feature chain proposal should not be taken to mean that prosodic constituency as derived by the RBA or the EBA of the PHT is proven not to exist. On the one hand, the feature chain mapping proposal does not extend to higher prosodic domains such as the intonational phrase or the utterance. On the other hand, further work is needed in order to see whether all the phenomena accounted for by the PHT can be successfully reinterpreted in the feature chain-based model. Indeed, Elordieta (1999) suggests that although French liaison could be treated more satisfactorily through the feature chain alternative, certain residual data can be explained by making reference to clitic-hood. Also, the fact that the lexical verb and the inflected auxiliary in Basque may bear independent word prominence suggests that they are independent prosodic words (i.e. they have boundaries that are visible for prosodic interpretation), although they constitute one single domain for the application of VA and function like the domain formed by a noun or adjective and a suffixed determiner. Thus, it might be that the third possible scenario is real, that is, that there are two possible ways of deriving phonological constituency, one as devised in Elordieta's (or Dobashy's) model and one as devised in the PHT.

If the existence of the PHT were proved to be true, one interpretation of the availability of two strategies for mapping phonological constituents from syntactic structure could be that the creation of phonological constituency in PHT terms is a development that simplifies the creation of phonological constituency. In the feature chain mapping, some functional categories form phonological domains with the lexical heads they are syntactically related to and others do not. Whether they form one unit depends on whether they are related in a feature chain. Some languages may have chosen to simplify the mapping from syntax to phonology, so that all functional categories form phonological domains with the lexical heads they select. Intuitively, it seems as if the mapping is simpler. Additional research is necessary in order to elucidate the role that each theory plays in each language, so that a fuller understanding of the mapping between syntax, morphology, and phonology is obtained. It is hoped that the discussion in this chapter has demonstrated the need for such work and has pointed to the directions or avenues to be taken.

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PART II

STRUCTURE

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CHAPTER 6

STRUCTURED EVENTS, STRUCTURED DISCOURSE

SARA THOMAS ROSEN

6.1 Introduction: Argument Interpretation

Standard syntactic theories have generally assumed that case and agreement are somehow implicated in argument licensing. I will suggest that while this is true for some languages, other languages license arguments through the discourse projections residing in the CP layer. This chapter considers the organization and licensing of arguments in the syntax across widely disparate languages and argues (i) that argument placement, licensing, and interpretation are fundamentally syntactic, and (ii) that languages differ in whether argument licensing is determined by the functional projections dedicated to case and agreement (in the TP layer), or

The ideas presented in this chapter were developed with Elizabeth Ritter at the University of Calgary. While I take full responsibility for any errors or misrepresentations, I could not have written this paper without our extensive collaboration. I would like to thank Gillian Ramchand, Betsy Ritter, and John Rosen for comments on earlier drafts of this paper.

whether argument licensing is determined by the functional projections dedicated to discourse roles (in the CP layer).

Possibly, the leading advance in the research on argument licensing in the late 1990s and early 2000s has been the idea that the clausal functional projections determine the interpretation of the arguments and the event expressed in a clause. This research has concluded that the clausal functional projections responsible for case and agreement checking determine the thematic and event interpretation of the arguments. We now know that the organization of the arguments in the syntax and the syntactic marking of arguments reflect the event type of the clause. In particular, it is now known that telicity is associated with the existence and marking of objects and initiation of the action with the marking and position of subjects.

But the grammatical categories of subject and object appear not to be the only organizational tool for predicates and their arguments. Recent work of Ritter and Rosen (2005*a*, *b*) points to an altogether different device that languages may use to license the arguments in a clause. Some languages seem not to make use of the case- and agreement-checking positions either to license or interpret the arguments. Instead of moving DPs to the case and agreement checking positions, some languages appear to license arguments by means of the discourse notions of topic and prominence. Such languages rely on the complementizer layer to license the arguments and make little or no use of the case and agreement checking layer.

The present chapter explains and supports the working hypothesis that there are two distinct systems for licensing arguments. One system licenses arguments by means of the event structure, as represented in the case and agreement checking functional projections. I will call languages that rely on this type of licensing "Event languages". The other system licenses arguments by means of the discourse structure, as represented in the complementizer system. I will call languages that rely on the A-bar system "Discourse languages". Event languages use the A-positions T/*v* to license the arguments, whereas Discourse languages use the A′-positions Topic (Top) or Point of View (POV). Although it is possible that some languages may use both event and discourse roles, we propose that a language must license the arguments in at least one of these two fashions.

6.2 Event Languages: Argument Licensing in A-Positions

The critical parts of the event for syntactic representation are telicity (the terminus) and initiation (or agentivity). Languages that encode telicity or initiation use the functional categories responsible for case and agreement checking, traditionally known as the A-positions. The core arguments (subject and object) of a predicate have case and agreement features that must be checked in a clausal-functional projection. These projections are assumed to be Tense (T) for subjects and *v* or Aspect (Asp) for objects. A number of researchers have argued that T and *v*/Asp contribute to an event interpretation in addition to checking case and agreement. One line of research has explored the relation between telicity and the position responsible for checking accusative case and object agreement. Another line of research examines the relation between event agentivity (roughly including control, performance, and initiation) and the position responsible for nominative-case checking and subject agreement. The research (detailed later in this chapter) indicates that the functional projections responsible for case and agreement checking (the A-positions) are responsible for event interpretation—including telicity, or event terminus and agentivity, or event initiation. Thus, it is the syntax that provides the event interpretation (see e.g. Borer 1994, 2004; Tenny 1994; van Hout 1996, 2000; Ramchand 1997, to appear; Ritter and Rosen 1998, 2000, 2001; Travis 2000).

6.2.1 Telicity: AspP or *v*P as Quantity

A clear connection exists between the direct object and the aspectual contours of the event denoted by the clause. Research has shown that telicity[1] is associated in various ways with the direct object (cf. Borer 1994; van Hout 1996; Ritter and Rosen 1998; Tenny 1994; and others). The association between aspect and the direct object may be syntactically realized in several ways. (i) It may be realized simply in the existence of an overt direct object, as in the examples in (1)–(4). Predicates with a direct object are more likely to be telic than those without. (ii) It may be realized on the grammatical marking on the direct object. In some languages, direct objects that are marked with accusative case appear in telic contexts, as in (5). Or it may be that the position of the object determines the aspectual reading, as in (6). Other object marking may have an effect, such as the conative in English (7) or antipassive in Inuit (8). (iii) It may be realized on the internal characteristics of the object (specificity, mass/count, quantization, etc). Direct objects that are specific (9) and count nouns (10) tend to appear in telic contexts. Other examples of the internal characteristics of the object affecting the interpretation of the event include the addition of an object in verb particle constructions (11), and resultative constructions (12).

[1] Throughout, I will use the term "telicity" as a cover term that includes telicity, boundedness, and delimitation. Although these all have slightly different definitions and pick out different aspects of the event, they all have to do with the endpoint or the completed nature of the event. I will gloss over these distinctions here in spite of their importance.

(1) Addition of object

a. Terry ran for 5 minutes/*in 5 minutes. atelic
b. Terry ran the mile *for 5 minutes/in 5 minutes. telic

(2) Cognate object

a. Terry sang for an hour/*in an hour. atelic
b. Terry sang the ballad ?for an hour/in an hour. telic

(3) Fake reflexive

a. Terry sang for an hour/*in an hour. atelic
b. Terry sang herself to sleep in an hour/*for an hour. telic

(4) X's way construction

a. Terry sang for an hour/*in an hour. atelic
b. Terry sang her way to the Met *for 10 years/in 10 years. telic

(5) Object case (Finnish; Kiparsky 1998: 2–3, 5)

a. Hän kirjoitt-i kirje-i-tä atelic
he/she write-PST.M.3SG letter-PL.PART
'He/she wrote (some) letters (... and left).'
'He/she was writing letters (... when I came).'
'He/she was writing the letters (...when I came).'

b. Hän kirjoitt-i kirjee-t telic
he/she write-PST.M.3SG letter-PL.*ACC*
'He/she wrote the letters (... and left).'

(6) Object shift (Mandarin Chinese; Yan Ling, pers. comm.)

a. Ta sha-le Zhangsan, keshi Zhangsan mei si. atelic
he kill-asp Zhangsan, but Zhangsan not die
'He killed Zhansan, but Zhangsan did not die.'

b. Ta ba Zhangsan sha-le, (**keshi Zhangsan mei si*). telic
he BA Zhangsan kill-asp (but Zhangsan not die)

(7) Conative

a. Terry ate at the apple for 10 minutes/*in 10 minutes. atelic
b. Terry ate the apple ?for 10 minutes/in 10 minutes. telic

(8) Antipassive (Inuit; Bittner and Hale 1996: 36)

a. Juuna (*Anna-mik*) ... *kunis-si-vu-q.* atelic
Juuna-ABS$_i$ (Anna-INSTR) kiss-*APASS*-IND-(-TR)-3SGA$_i$
'Juuna kisses/is kissing (Anna).'

b. *Juuna-p* *Anna* *kunip-p-a-a.* telic
Juuna-ERG$_i$ Anna-ABS$_j$ kiss-IND-(+TR)-3SG$_i$/3SG$_j$
'Juuna kissed Anna.'

(9) Specificity of object

a. Terry painted pictures for an hour/*in an hour. atelic
b. Terry painted the picture *for an hour/in an hour. telic

(10) Count/mass object

a. Terry drank coffee for an hour/*in an hour. atelic
b. Terry drank a cup of coffee *for an hour/in an hour. telic

(11) Verb particle

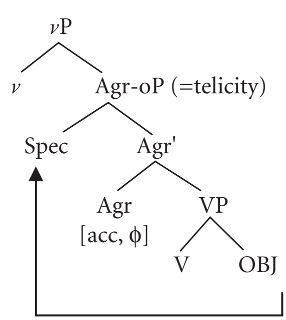
a. Terry thought for an hour/*in an hour. atelic
b. Terry thought up an answer in an hour/*for an hour. telic

(12) Resultative

a. Terry ran for an hour/*in an hour. atelic
b. Terry ran us ragged in an hour/*for an hour. telic

In order to explain the association between the object position and telicity, researchers have proposed that the position which checks object case and agreement is also responsible for the interpretation of the event as telic or atelic. For some, this position is Aspect Phrase (AspP) (Travis 2000; Borer 2004); for others it is Agr-oP or *v*P, the position that checks object case and agreement (Ritter and Rosen 2000, 2001). The diagram in (13) gives the structure proposed by Ritter and Rosen (2000, 2001), using the functional projection Agr-oP. This projection might be placed between the *v*P shell and the lexically headed VP (as in e.g. Travis's AspP).

(13) SYNTACTIC REPRESENTATION OF TELICITY



Although there are differences across proposals linking telicity to the syntactic representation of objects, all assume that telicity is encoded in the syntax, and all place the representation of telicity in the clausal functional projections. All agree that the direct object is critical in establishing telicity in a clause, and all place the representation of telicity within the functional projection that checks accusative case and object agreement.[2]

If the general approach to telicity is correct, then the position responsible for case and agreement checking must have a telic interpretive component to it. The semantic essence of telicity has been identified as either quantization (Kiparsky 1998; Ritter and Rosen 2001) or quantity (Borer 2004, 2005). A telic event is quantized in the sense that it is discrete or countable (Krifka 1992). DPs are also quantized when they are discrete or countable, including specific DPs and DPs with count nouns in them. For this reason, telic events are associated with count nouns and specific direct objects.

Borer (2004, 2005) has argued quite convincingly that quantization, delimitation, or boundedness cannot be precisely the right characteristic for telicity and its syntactic representation. She claims instead that the appropriate property is that of quantity, defined as non-homogeneous, and proposes that quantity be represented syntactically. Homogeneity of the event, or lack of homogeneity in particular, appears to be a closer descriptor for the syntactic representation of telicity. An event like that expressed in (14) is telic and has quantity (is non-homogeneous) but the object is clearly non-quantized. Although the object is non-specific, the event is telic.

(14) *a.* Terry ate some apples in 10 minutes.
b. Terry ate some cake in 10 minutes.

The situation is even more pronounced in the examples in (15), where the event has no natural endpoint, but the event is non-homogeneous and therefore telic (examples from Borer, 2005).

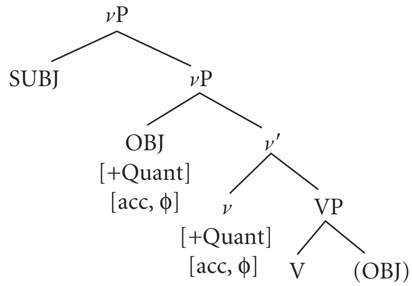
(15) *a.* Her face reddened.
b. We filled the room with smoke.

Borer proposes that telicity is mediated by the notion of quantity. A functional projection Asp_{Q} bears the feature of quantity. Only with the quantity feature can an event be interpreted as telic.

Ritter and Rosen (2005*a*) proposed that the functional projection responsible for object case and agreement checking also has a quantity feature [Quant] that renders the event quantized or telic. In a telic event, a quantity DP may move into the position and check the [Quant] feature. The structures proposed below use the minimalist representation of case and agreement checking, in which the object checks its case and phi features in Spec of *v*P (Chomsky 1995, 2001). Case and agreement checking in *v*P rather than AgrP or AspP does not constitute a shift away from the earlier accounts of aspect encoded in the functional structure; it simply places the requisite functional features in *v* rather than Asp or Agr.

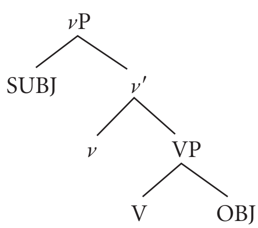
[2] The one exception is Ramchand (to appear), who proposes that the elements of the event are determined from the initial merge of the lexical items into the syntax, not by the clausal functional projections. I discuss Ramchand's approach later in this section.

(16) TELIC TRANSITIVE STRUCTURE
(*TERRY ATE THE APPLE; TERRY RAN THE MILE.*)

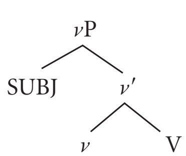


In contrast to the structure of telic events, the *v* of atelic events does not include an accusative case feature, and so either no object will merge in, or the object will not raise to Spec of *v*P. In our work on the syntactic representation of telicity, we argued that objects of atelic events remain in the VP and receive inherent (non-accusative) case VP internally (Ritter and Rosen 1998, 2001). The diagram in (17) shows an atelic transitive structure, (18) gives an atelic intransitive structure.

(17) ATELIC TRANSITIVE STRUCTURE
(*TERRY DROVE THE CAR.*)



(18) ATELIC INTRANSITIVE MANNER OF MOTION VERBS (UNERGATIVES)
(TERRY RAN.)



6.2.2 Quantity in DP

Not all languages that grammaticize object quantity also grammaticize telicity. Ritter and Rosen (2001) showed that some languages grammaticize quantized object DPs through object placement, object agreement, and object case without also grammaticizing telicity. For example, in Hebrew and Turkish, only definite direct objects are marked with overt accusative case, but accusative case on the object does not signal telicity. In Scandinavian languages, particularly Icelandic, definite objects undergo object shift, but the object shift does not affect the interpretation of the event as (a)telic.

(19) Hebrew accusative case

a. *anig makir et/*Ø Dani.*
I know acc Dani
'I know Dani.'

b. *ani makir (*et) harbe yeladim xaxamim.*
I know (*acc) many children smart
'I know many smart children.' (Ritter and Rosen 2000)

(20) Turkish accusative case

a *Dani-**yi** tanI-yor-um.*
Dani-**acc** know-pres.prog-1sg.
'I know Dani.'

b. *BirCok akIllI Cocuk tanI-yor-um.*
many smart child know-pres.prog-1sg
'I know many smart children.'
(Jaklin Kornfilt, pers. comm., as cited in Ritter and Rosen 2000)

(21) Icelandic object shift

a. *Jón las ekki bækurnar.*
John read not the books
'John did not read the books.'

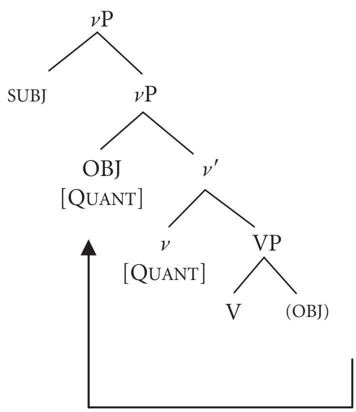
b. *Jón las bækurnar ekki.*
John read the books not
'John did not read the books.' (Collins & Thráinsson 1996: 392)

c. *Hann las ekki bækur.*
he read not books
'He didn't read books.'

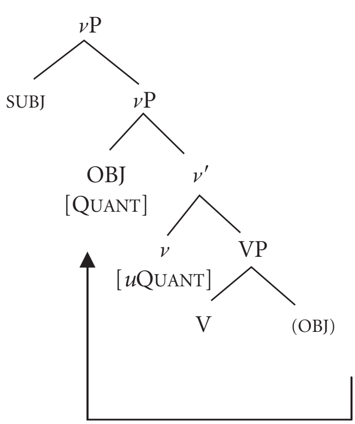
d. **Hann las bækur ekki.*
he read books not (Diesing 1997: 412)

In languages such as Hebrew, Turkish, and Icelandic, the object may bear the [Quant] feature, and this allows it to raise to *v*P to check features. Only quantity DPs—those that bear [Quant]—may raise to this position to check case and phi features. But [Quant] in *v* is not interpretable, and so the quantity DP has no bearing on the interpretation of the event. In languages like Finnish and Mandarin, [Quant] in *v* is interpretable, therefore the quantity DP in its specifier will result in a telic event (examples in (5) and (6)). In languages that grammaticize telicity (event quantity) the [Quant] feature of *v* is interpretable; in languages that grammaticize only DP quantity, it is not.

(22) *a.* GRAMMATICIZATION OF EVENT AND OBJECT QUANTIZATION: MANDARIN CHINESE, FINNISH, ENGLISH



b. GRAMMATICIZATION OF OBJECT QUANTIZATION ONLY: HEBREW, TURKISH, ICELANDIC

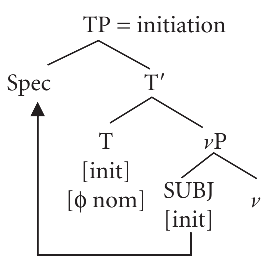


6.2.3 Subjects: TP as agency

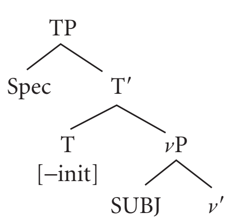
Telicity is represented in the functional structure that checks the case and agreement of the direct object. The question now is: is there an equivalent event–syntax connection between subjects and the functional case and agreement checking position for subjects? In this section I turn to the representation of subjects and show that some languages identify events via the subject argument rather than the object. In languages that identify the event via the subject, agentivity, or initiation of the event, appears to be a critical factor in argument licensing and in event interpretation. Some languages make a grammatical distinction between agent and non-agent, instigation and non-instigation, and control and non-control. Ritter and Rosen (2001, 2005*a*) called such languages initiation-based languages (I-languages). Our research indicates that the functional projection that checks case and agreement of the external argument (TP) is the same functional projection associated with event initiation. A language that identifies events via agency or the initial bound will use TP to mark events. We showed that the identification of events via initiation leads to split behaviour of subjects in the language. The behaviour of subject DPs divides between those that are more agentive and receive nominative case, and those that are less agentive and receive quirky case.

An I-language has the canonical structure of clauses given in (23). We proposed that the functional projection that checks nominative case and subject agreement also carries with it an event role of initiation. We suggested that when a clause has no initiation the subject remains inside *v*P. When it fails to move to TP, the subject is marked with quirky or some non-nominative case.

(23) *a.*



b.



Some languages distinguish initiators from non-initiators through the assignment of structural versus inherent case. In such languages, a couple of different scenarios play out. Some languages do not allow non-initiators to be subjects. We find this in Irish and in certain instances in Japanese. Some languages allow non-initiators to be subjects, but mark them with quirky case. We find this in Icelandic.[3]

[3] Still other languages force passivization when the subject does not have the features associated with initiators. We find this in the animacy hierarchies of Southern Tiwa (Ritter and Rosen 2005*a*). I will discuss animacy hierarchies of Algonquian in section 6.3, where I argue that the CP layer is responsible for argument licensing, rather than TP. It is not clear whether Southern Tiwa should be

Irish and Japanese: subjects as agents

In Irish and Japanese, only agents can be initiators, and only agents can be grammatical subjects. We find, for example, that these two languages do not allow the so-called instrument subject alternation, as the examples in (24) and (25) show.

(24) a. *D'oscail* *Seán* *an* *dorais.* Irish
open-PAST Seán the door
'Sean opened the door.'

b. **D'oscail* *an* *eochair* *an* *dorais.*
open-PAST the key the door
'The key opened the door.' (Waitai 1996: 38)

(25) a. *Tom-ga* *doa-o* *aketa.* Japanese
Tom-NOM door-ACC opened
'Tom opened the door.'

b. **kagi-ga* *doa-o* *aketa.*
key-NOM door-ACC opened
'The key opened the door.' (Waitai 1996: 39)

Neither language allows non-agents with structural nominative case.[4] Thus, the sole argument of an unaccusative predicate and the experiencer argument of a psych predicate receives oblique case, as the examples in (26) to (28) illustrate. Guilfoyle (1997) has argued that these oblique cases in Irish are assigned VP-internally.

(26) a. *Tá* *eagla* ***orm.*** Irish
is *fear* ***on.me***
'I am afraid.'

b. *Is* *maith* ***liom*** é'.
COP good **with.me** it
'I like it.'

treated along with Algonquian, however, or whether TP is responsible for the animacy hierarchy effects of Southern Tiwa. Ritter and Rosen also suggest that the ergative DP splits found in Dyirbal are initiation-based as well. Dyirbal shows a person split in the marking of its subjects, whereby first and second person subjects receive nominative case and third person subjects receive ergative case. Ritter and Rosen argued that person splits are a manifestation of agent splits. See Ritter and Rosen (2000, in press) for discussion.

[4] The analysis of Japanese is complicated by the fact that it has several constructions in which nominative case is clearly assigned to non-subject positions, including multiple subject nominatives and nominative objects. The language clearly has a default nominative, given that it is assigned to arguments that are not subjects, and even non-arguments (i.e. the multiple-subject construction). Importantly, however, instruments may not bear nominative case.

(27) a. *D'eirigh* ***idir*** *na* *fir.* Irish
rise-PAST **between** the men
'The men quarreled.'

b. *Théigh* ***fá dtaobh*** *don* *ghirseach.*
warm-PAST **about** the girl
'The girl became agitated.' (Guilfoyle 1997)

(28) a. *Tom-**ni*** *eigo-ga* *dekiru.* Japanese
Tom-**to** English-NOM capable.to.do
'Tom is capable of English.'

b. *John-**ni*** *kane-ga* *aru.*
John-**to** money-NOM have
'John has money.' (Watai 1996: 42)

Icelandic: quirky case subjects

In Icelandic, too, only agents can be initiators and receive nominative case. Agentive subjects receive (structural) nominative case, as in (29), but non-agentive subjects receive quirky (inherent) case, as in (30).

(29) a. *Konan* *þýddi* *bókina.*
the.woman-NOM translated book-ACC
'The woman translated the book.'

b. *Siggi* *leyndi* *konuna* *sannleikanum.*
Siggi-NOM concealed the.woman-ACC the.truth-DAT
'Siggi concealed the truth from the woman.'
(Yip et al. 1987: 222, 223, 234)

(30) a. *Barninu* *batnai* *veikin.*
the.child-DAT recovered-from disease-NOM(*ACC)
'The child recovered from the disease.'

b. *Barninu* *finnst* *mjólk* *góð.*
the.child-DAT finds milk-NOM good-NOM
'The child finds milk good.'
(Yip et al. 1987: 222, 223, 234)

Properties of the initial bound of an event are grammaticized in languages like Icelandic, Japanese, and Irish. In particular, all three languages mark the subject of non-agentive events with some case other than nominative.

Lakhota and Central Pomo: agent/patient marking

Agent/patient head-marking is another subject-split pattern related to agentivity. In languages with agent/patient head-marking, agentive subjects pattern differently from non-agentive subjects. Mithun (1991) studied agent/patient marking in a variety of Amerindian languages and found that Lakhota makes a morphosyntactic distinction between subjects that "perform, effect, or instigate" the action and those that do not. Some of her examples are given in (31) and (32). Instigating first person subject pronominal prefixes are realized as *wa* (31), whereas non-instigating first person pronominal subject prefixes are realized as *ma* (32). Thus, Lakhota distinguishes morphosyntactically between initiating and non-initiating subjects.

(31)	*a.* ma**wá**ni.	'I walk'	
	b. **wa**k'é.	'I dug'	
	c. **wa**núwe.	'I swam, bathed'	
	d. **wa**t^{h}í.	'I live, dwell'	
	e. **wa**xpáye.	'I'm lying'	
(32)	*a.* **ma**híxpaye.	'I fell'	
	b. **ma**t'é.	'I fainted, died'	
	c. a**má**kisni.	'I got well'	
	d. í**ma**phí.	'I'm tired'	
	e. **ma**lák^{h}ota.	'I'm Sioux'	(Mithun 1991: 515–16)

Mithun also showed that Central Pomo makes a morphosyntactic distinction between subjects that control the action and those that do not. The examples in (33) contain the first person subject pronoun ***ʔa·***, which is only used for controllers of the action, and the examples in (34) contain the first person subject pronoun ***t̪o·***, which is used for uncontrolled action. Central Pomo appears to distinguish between initiating and non-initiating subjects, and grammaticizes the semantic notion of control of the action rather than the more direct initiation that Lakhota grammaticizes.

(33)	*a.* **ʔa·** pʜdíw ʔe.	'I jumped.'	
	b. **ʔa·** mú·t̪u ʔé · yčadiw.	'I chased him away.'	
	c. **ʔa·** swé·lan.	'I play.'	
	d. **ʔa·** béda ʔčʜá·w.	'I live here.'	
	e. **ʔa·** yá · qač'in.	'I'm careful.'	
(34)	*a.* **t̪o·** kasíla.	'I'm cold.'	
	b. **t̪o·** ʔtʜál.	'I'm sick.'	
	c. **t̪o·** šč́éw.	'I'm stuck.'	
	d. **t̪o·** ló·ya.	'I fell.' '	
	e. **t̪o·** ščúkčiya.	'I hiccoughed.'	(Mithun 1991: 518–23)

Mithun shows that the choice of subject pronominal is not driven by the lexical representation of the verb. The same predicate can be interpreted as a controlled action or an uncontrolled action, depending on the choice of the subject pronominal, as exemplified in (35) and (36). It would appear that the eventive interpretation of predicates is not necessarily underlyingly specified for control.

(35) a. *ʔa· sma mtí · č'.* ‘I went to bed.’
b. *t̪o· sma mtíčka.* ‘I must have fallen asleep.’

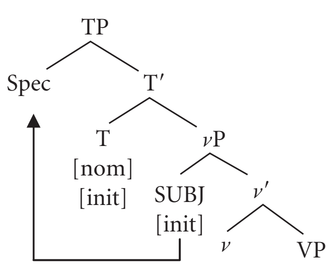
(36) a. *ʔa·* č'ʰném. ‘I ran into it.’
b. *t̪o·* č'ʰném. ‘I bumped into it (not watching).’ (Mithun 1991: 520)

6.2.4 The Syntax of NP Splits

The facts outlined in the previous subsection establishes that some languages make a distinction either between agent and non-agent (Japanese, Irish, Icelandic), instigation and non-instigation (Lakhota), or control and non-control (Central Pomo). These are all characteristics of initiation, and initiation-based languages grammaticize some characteristic of initiation via the functional projection that carries case and phi-features for the subject.

Initiation is clearly associated with the subject argument. Given this, what is the syntactic representation of initiation? Suppose that the functional head T in initiation-based languages has an interpretable feature [init] for event initiation. T also checks structural nominative case and subject phi features. If this is correct, then only external arguments with the [init] feature will raise to [Spec, TP] to check nominative case and initiation feature.

(37)



On this analysis, [Spec, TP] in languages that grammaticize initiation is only available to external arguments that have the appropriate [init] feature to check that of T. External arguments lacking the initiation feature cannot raise to [Spec, TP]. Such an external argument receives inherent quirky case *v*P internally, following Bittner and Hale (1996) and Woolford (1997). For a language like Lakhota or Central Pomo, only subjects that can instigate or control action will bear the [init] feature. Accordingly, only a DP with this feature will raise to Spec of TP and will bear the morphosyntactic feature of initiation.

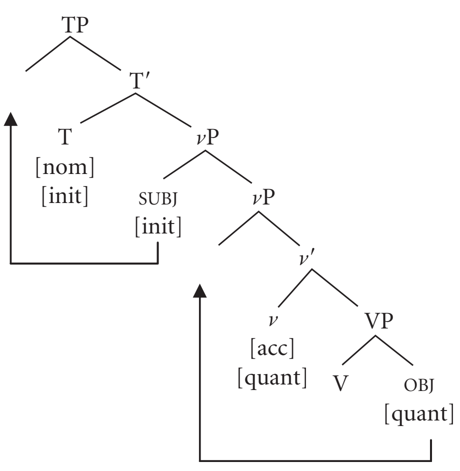
To sum up the discussion so far, languages with NP splits have two separate positions that could be called “subject” position. There are nominative subjects, which tend to be agentive (instigate or control) or highly animate, and there are quirky case subjects, which tend to be less agentive or inanimate. The different manifestations of subject splits are variations on a continuum of initiation (control versus performance, for example); different languages define differently what can and what cannot be an initiator of the action. Once the language has made this distinction, the class of items that can appear in TP is determined.

6.2.5 Putting It All Together: Event Structure in the A-System

Event interpretation is determined by the syntactic structure in the A-system. In particular, telicity is determined by the quantity feature in *v*, and is realized on quantity direct objects. Agentivity is determined by the initiation feature in T and is realized on agentive subjects. Thus, the clausal functional projections that check case and agreement (the A-positions) are responsible for the interpretation of the various aspects of the event.

The structure in (38) puts the structural architecture of an Event language together, based largely on Ritter and Rosen (2000).[5] A given language may not grammaticize all aspects of the event system, but an Event language will tend to reveal some reflexes of this overall architecture.

(38)

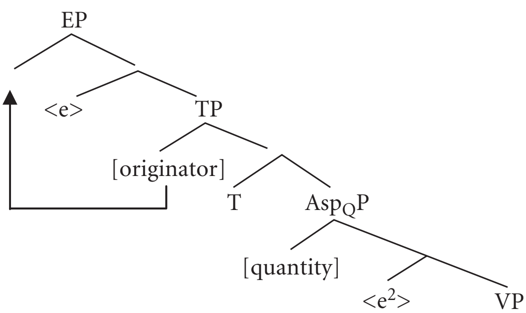


Others have made very similar claims about the relation between event interpretation and the A-positions. Borer (2004), for example, takes a radical approach to the interface between the lexicon and the syntax by proposing that lexical items do not have any syntactic information, including category and subcategory information, theta roles, or selectional information. On her approach, the lexical items are inserted into the syntactic structure and it is the syntactic functional structure

[5] Travis's (2000) event syntactic structure is similar to the one given here.

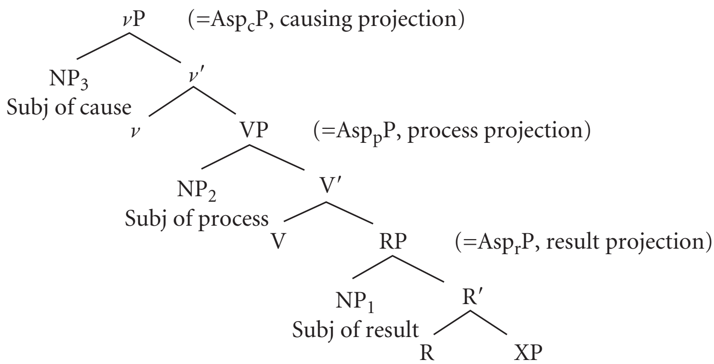
that provides all event/thematic information. For telicity, for example, Borer argues that the functional structure provides a position for the subject of change. The entity undergoing change appears in the functional head Asp_Q, and an argument (the object) with the feature quantity must appear in the Specifier of Asp_Q. Any predicate with a quantity object in the Spec, Asp_Q will be telic. She proposes that the event is also encoded in an event phrase (EP), which gives rise to an event interpretation in a neo-Davidsonian fashion (Davidson 1967; Parsons 1990). Spec, EP may be filled with the originator of the event (possibly raised from TP). Her overall event structure is given in (39). Borer does not assume that the syntax is built from a structured argument structure. Rather, the interpretation of the arguments is determined by the position in which each argument appears in the syntax.

(39)



Much like Borer, Ramchand (to appear) develops a theory of the lexicon–syntax interface that places most of the burden of argument interpretation on the syntax. Her thesis is that the lexicon contains only idiosyncratic information—a meaning representation and subcategory information. In particular, the lexicon does not contain any thematic or aspectual information, but only meaning and world knowledge (not necessarily linguistic) information and category/subcategory information. Much like Borer's approach, the initial merge of lexical information into a hierarchical structure creates the event, using event-based functional structure. Ramchand proposes three syntactically represented event roles—initiator, undergoer, and resultee. Each role determines a sub-event of the event denoted by the clause. These roles are established in the syntax. A given verb is encoded with category selectional features in the form of *v*, V, and/or R. The syntactic structure associated with these features appears in (40). Event structure information then derives from the ensuing syntactic representation, where the argument in Spec of *v* initiates the action (initiator), the argument in Spec of V undergoes the action (process/undergoer), and the argument in Spec of R is the result of the action (resultee).

(40)



In the lexical (*ν*P) layer,

- *ν*P provides a position for event causation and licenses the external argument.
- VP specifies the nature of the change and licenses the argument that undergoes change.
- RP gives the result state and licenses the internal argument that appears in the resulting state.[6]

The three theories outlined here all make very similar claims: the event information, including telicity and initiation, is syntactically represented. For Ritter and Rosen and for Borer, event information is encoded in the functional A-positions. For Ramchand, the event is encoded within the lexical layer, inside *ν*P. The research reported has established a connection between internal arguments and telicity and has proposed a similar connection between external arguments and initiation. In the languages discussed, the functional A-positions are implicated in event structure and event interpretation. Event languages, as I call them, use the case and agreement functional system to organize the arguments and to interpret the arguments according to the role each plays in the event denoted by the predicate.

6.3 Discourse Languages: Argument Licensing in A-bar Positions

Not all languages use the A-positions TP and *ν*P/AspP to license and interpret the clausal arguments; instead they license arguments in the A-bar positions in the CP layer. The languages that license arguments in the A-bar system fail to interpret the

[6] In Ramchand's system, since Spec of *ν* is always interpreted as initiator, it is just as likely that the semantic interpretation of INITIATION came from the lexical category selection information and it is this information that forced the projection of a *ν* and its Spec. Given that there is a one-to-one correspondence between category and interpretation, we still do not know, to my mind, whether *ν*, V, R is in the lexicon, or whether INITIATION, PROCESS, and RESULT are.

arguments via event structure, but rather use the discourse structure as encoded syntactically in the CP layer. I call these "Discourse languages".

The A-bar positions in the CP layer encode clause type, topicalization, focalization, evidentiality, and point of view (Rizzi 1997; Cinque 1999; Speas 1999; Speas and Tenny 2003). Topic, focus, evidence, and point of view are discourse phenomena, and therefore the items in the CP layer are discourse-determined. Ritter and Rosen (2005*a*, *b*) argue that some languages are more discourse-oriented and organize the arguments of the clause around discourse principles related to topic or point of view.

6.3.1 Topic Languages

Discourse-oriented languages license arguments on the basis of the role each plays in the discourse rather than in the event denoted by the predicate. One discourse-based mechanism for argument licensing is that of topic–comment. Li and Thompson (1976) proposed a list of properties characteristic of so-called topic-prominent languages in which the topic, rather than the subject (or direct object), plays a significant role in the organization of the clause. According to Li and Thompson, Mandarin Chinese and the Lolo-Burmese languages Lahu and Lisu are among the topic-prominent languages, and Japanese and Korean are both topic- and subject-prominent. They argue that highly topic-prominent languages have a distinct set of linguistic characteristics, including surface coding for topic but not necessarily for subject, lack of expletive subjects, essentially no passive, a tendency to be verb-final, lack of constraints on what can serve as a topic, pervasive "double subjects" (i.e. sentences with a subject and a base-generated topic). Rizzi (1997) provides additional characteristics distinguishing topics from subjects. Topics must appear at the left edge of the clause, whereas subjects may appear in a variety of positions. Topics rarely trigger verb agreement, whereas subjects often do. Topics must be definite; subjects need not be definite (Rizzi 1997).

Lisu: a topic-oriented language

Lisu, a Lolo-Burmese language, is considered a highly topic-prominent language in that almost every clause contains a topic (Li and Thompson 1976). A striking property of this language is that while every clause has an identifiable topic, it is often impossible to distinguish subject from direct object or agent from patient. There are no diagnostics that reliably identify subjects (or objects) in Lisu. Consider the examples in (41) and (42). In these sentences, as in almost every Lisu sentence, the topic appears in initial position, but it is often impossible to distinguish subject (agent) from direct object (patient); the examples (from Li and Thompson 1976: 475) are ambiguous. Lisu has no morphological marking (case or agreement) to distinguish subjects from objects, and no ordering restrictions to distinguish subjects from objects.

(41) *làthyu* *nya* *ánà* *khù* *-a*
people TOPIC dog bite -DECL
a. 'People, they bite dogs.'
b. 'People, dogs bite them.'

(42) *ánà* *nya* *làthyu* *khù* *-a.*
dog TOPIC people bite -DECL
a. 'Dogs, they bite people.'
b. 'Dogs, people bite them.' (Li and Thompson 1976: 475)

In (41) the topic 'people' is interpreted as either the agent or patient of biting, with the non-topicalized argument 'dogs' as the other argument of the verb. Lisu is an SOV language lacking verb agreement, making it impossible to tell whether the non-topicalized constituent is the internal or external argument of the verb.

Ritter and Rosen (2005*a*) proposed that the Lisu topic is not a subject and does not appear in the A-position in which case and agreement are checked. If this is correct, then Lisu topics should not behave like subjects in other languages. In this light, Ritter and Rosen looked at reflexivization facts in Lisu. If the topic is in the CP layer, then it should not A-bind a reflexive. Although it appears that reflexive DPs can have a topic as their antecedent, as in (43a), and the so-called reflexive can consist of a copy of the antecedent, as in (43b), we argued that Lisu does not have A-bound reflexives.

(43) *a.* *làma* *nya* ***yí*** *kudwè* *khù-a.*
tiger TOPIC he body bite-DECL
'The tiger (topic), he bit his body (=himself).'

b. *làma* *nya* ***làma*** *kudwè* *khù-a.*
tiger TOPIC tiger body bite - DECL
'The tiger (topic), he bit his body (=himself).' (Li and Thompson 1976: 475)

Even Lisu reflexive DPs can be topicalized, as the example in (44b) illustrates; the topicalized reflexive in (44) is clearly not A-bound. The absence of A-bound anaphora is perhaps related to the insignificance of A-positions (subjects and objects) in Lisu.

(44) *a.* ***làma*** *kudwè* *nya* *làma* *khù-a.*
tiger body topic tiger bite-DECL
'His body (topic), the tiger bit it.'

b. ***yí*** *kudwè* *nya* *làma* *khù-a.*
he body topic tiger bite-DECL
'His body (topic), the tiger bit it.' (Li and Thompson 1976: 475)

Sentences without topics are extremely rare in Lisu. Hope (1974) gives but one example of a sentence that appears to have no topic, in that the argument marked with the topic marker is non-specific (recall that topics must be definite or specific). When a non-specific topic sentence occurs, Hope argues that the DP is still presupposed. The example in (45) is the only such example that she provides. In the discussion of this example, she implies that this sentence is used in a situation in which *swu* 'someone' is presupposed, and therefore is d-linked (linked to the prior discourse), and is a viable topic.

(45) *swu* *nya* *áthà* *də̀-a̰.*
one NYA knife forge-decl. marker
'Someone is forging a knife.' (Hope 1974: 60)

Finally, although the syntax does not provide thematic or aspectual information in Lisu, thematic and aspectual information is encoded in the lexicon, giving rise to fine-grained distinctions in Lisu verbs. As a result, Lisu verbs include more specific information about selectional properties, notably animacy, than their English counterparts. The language has, for example, a lexical item *thywu*, which means 'burn an inanimate object'. In order to burn an animate object, the verb *té* is used, which literally means 'sting' (Hope 1974: 29, 39). Notice that the selectional properties are part of the meaning of the verb. In a different example, in (46), the verb *sye* 'kill' obligatorily co-occurs with the noun *yi-p*' 'an end', but need not occur with a patient argument; it would appear that telicity is lexically encoded rather than syntactically encoded. T and *v* do not play any role in the event or aspectual interpretation of the Lisu clause.

(46) *ása* *nya* *yí-pə́* *syḛ́-* *a̰.*
asa topic end kill- declarative
'Asa killed and an end resulted.' (Hope 1974: 38)

6.3.2 The Syntax of Topic-Prominent Languages

Rizzi (1997) proposes that the complementizer layer of a clause consists of several distinct projections, including a Topic Phrase (TopP). TopP is optional, occurring only when needed, and its head, Top, checks no phi or case features. Top may have an EPP feature, requiring that the topic move to Spec of TopP overtly.

(47) $[_{\text{ForceP}} \ldots [_{\text{TopP}} \text{Top} [\ldots [_{\text{TP}}] \ldots]]]$

Because topic-prominent languages are discourse-oriented, Ritter and Rosen (2005*a*) suggested that they have no event feature and no phi features to be checked. If this is correct, then a topic-prominent language should have no particular subject requirement (unless, of course, T has an EPP feature). We should find topic-prominent languages with no head marking (due to the lack of phi features), and with no grammaticization of the event through either the subject or direct object. In particular, if topic involves merger into the Spec of TopP, and if Top has no content, then the relevant Spec must be filled in order to identify the functional projection. This results in (i) the requirement that every sentence have a topic, (ii) the lack of thematic restriction on the topic, (iii) the lack of restriction on the number of topics a sentence can have, and (iv) the lack of any agreement-type features on the topic. In Lisu, no event information is encoded in the syntax. T and *v*/Asp have neither spatio-temporal nor case/agreement features. The language has no tense or aspect marking on the verb, no case marking on DP or agreement marking on the verb, and only lexically determined aspectual distinctions. In the absence of any event information, the organization of the clause is determined almost exclusively by discourse considerations, and not by event structure or thematic considerations. A topic is obligatory in Lisu because tense and aspect are completely lacking in inherent content, Top (not Tense) has an EPP feature, and Top (not Tense) licenses the argument.

6.3.3 Animacy-Agreement Languages

Similar to topic-oriented languages, Ritter and Rosen (2005*b*) proposed that languages with agreement rooted in animacy hierarchies lack A-movement and A-agreement. We looked at the agreement patterns in the Algonquian languages and showed that their morphosyntactic agreement patterns are most consistent with the notion that the arguments do not move to A-positions for case or agreement. In fact, we proposed that Spec of *v*P and Spec of TP are essentially inert, either lacking the D-features necessary for case and agreement checking or nonexistent entirely (see also Ritter and Wiltschko 2004 for Halkomelem and Blackfoot). The claim that Algonquian does not have A-movement is substantiated by the fact that Algonquian languages lack A-bound anaphors, passive, or other case-related movement such as subject raising and ECM. All these are operations and elements that crucially involve A-positions.

The Algonquian languages are known for their animacy-based agreement. Ritter and Rosen argued that animacy agreement is not akin to subject agreement. Animacy agreement in the Algonquian languages works roughly as follows. Suffixes on the verb agree with both the internal argument and the external argument. However, the verb has one prefix that agrees with one animate argument. The animacy hierarchy determines which argument is referenced by prefix:[7]

[7] For animacy hierarchies, see also Silverstein (1976). As Bruening (2001) and others point out, it is not necessarily the case that first and second person are distinguished in terms of animacy in Algonquian. The agreement patterns for first and second person are more complicated than is

(48) Animacy Hierarchy (Branigan and MacKenzie 2000)
Second > first > third human > third animate > inanimate

Algonquian exhibits different agreement patterns for transitive and intransitive predicates, animate, and inanimate arguments. For the transitive animate agreement pattern, the argument that is higher on the animacy hierarchy triggers an agreement prefix on the verb. All other agreement markers are suffixed. The grammatical function (subject/external argument or object/internal argument) of the more animate argument is determined by the so-called "theme" suffix; if the theme suffix is DIRECT, then the it is the external argument. If the theme suffix is INVERSE, prefixed argument is the internal argument. Examples from Blackfoot are given in (49). Notice in these examples that the first person argument is in the prefixed position, whether it is interpreted as the external (experiencer) argument or the internal (theme) argument. When the first person argument is the external argument, the direct suffix is used; when it is the internal argument, the inverse suffix is used. In these examples, the theme suffix is underlined and the agreement markers are in bold.

(49) a. ***nit***-*sikákomimm-a*-***wa*** *nitána.*
1-love-DIRECT-**3sg** my.daughter
'I love my daughter.'

b. ***nit***-*sikákomimm-a*-***yi*** *nitániksi.*
1-love-DIRECT-**3pl** my.daughters
'I love my daughters.'

c. ***nit***-*sikákomimm-ok*-***a*** *nitána.*
1-love-INVERSE-**3sg** my.daughter
'My daughter loves me.'

d. ***nit***-*sikákomimm-ok*-***i*** *nitániksi*
1-love-INVERSE-**3pl** my.daughters
'My daughters love me.' (Frantz 1991: 55)

The combination of agreement and theme marker, then, provides all the information that is necessary to determine who did what to whom in the Algonquian clause. The transitive animate verbs are inflected to agree with both external and internal argument, but the realization of the agreement markers is determined by animacy, not by the grammatical relations of subject and object. The theme marker determines the grammatical relations: the direct theme marker indicates that the most animate argument is the external argument; the inverse theme marker, that it is the internal argument.

necessary to discuss here. See Bruening for a thorough discussion of the interaction between first and second person in Passammaquoddy.

What about the A-positions for case and agreement? Algonquian has no overt case morphemes. It also has no apparent passive construction, raising construction, or ECM. Thus, it shows no obvious sign of A-movement. There are, however, two constructions in Algonquian that might be—and have been—argued to constitute A-movement. One is the so-called cross-clausal agreement construction (CCA) and the other is the inverse agreement pattern (described above) that these languages are known for. I will discuss each of these and show how Ritter and Rosen (2005*b*) argued that neither construction should be construed as A-movement.

Cross-clausal agreement occurs when a verb that selects a clausal complement optionally agrees with an animate argument of the clausal complement. Verbs that select clausal complements normally appear in the transitive inanimate (TI) form, but in CCA, they are realized in their transitive animate (TA) form. The argument that triggers object agreement on the matrix verb is either the subject or the object of the embedded clause. Some examples of CCA appear in (50) and (51) from Innu-aimûn, a Central Algonquian language. The data are from Branigan and McKenzie (2002: 388). CCA is reflected in the form of the matrix verb. It does not affect the morphology of the embedded verb; the embedded verb still obligatorily agrees with its arguments. Notice in these examples, that the agreement that appears on the embedded verb is unchanged in the CCA examples; only the agreement on the matrix verb changes.

(50)	*a.*	*Ni-tshissenit-**ânân***	*mûpishtuât*	*Shûshepa*	*Tshân*	*mâk*	*Mânî.*
		1PL-know-**TI.1PL**	visit	Joseph	John	and	Marie
		'We know that John and Marie visited Joseph.'					
	b.	*Ni-tshissenit-ânân-**at***	*mûpishtuât*	*Shûshepa*	*Tshân*	*mâk*	*Mânî.*
		1PL-know-1PL.**3PL**	visit	Joseph	John	and	Marie
		'We know that John and Marie visited Joseph.'					
(51)	*a.*	*Ni-tshissît-**en***	*kâ-uîtshî-shk*	*Pûn*	*ûtâuia.*		
		1-remember-**TI**	PRT-helped-3/2PL	Paul	father		
		'I remember that Paul's father helped you.'					
	b.	***Tshi**-tshissît-**âtin***	*kâ-uîtshî-shk*	*Pûn*	*ûtâuia.*		
		2-remember-1/2PL	PRT-helped-3/2PL	Paul	father		
		'I remember that Paul's father helped you.'					

Cross-clausal agreement is similar to ECM, but does not share the critical properties of ECM. ECM is motivated by case considerations (the embedded infinitival verb is unable to check nominative case of its subject). In contrast, the embedded verb in CCA obligatorily agrees with the argument regardless of whether the matrix verb does. Secondly, ECM targets only the subject of the embedded clause. In Innu-aimûn, CCA may target either the subject or the object of the embedded clause, as in (50*b*) versus (51*b*) (Branigan and McKenzie 2002).[8] Finally, the embedded clause in ECM is a TP, with no evidence of a CP layer. But in CCA, the embedded clause is clearly a CP. The trigger for matrix object agreement may be a wh-phrase, a focus DP, or a topic, all of which obligatorily raise to Spec of CP. The Innu-aimûn data in (52) are from Branigan and McKenzie (2002: 399, 2000: 8). We concluded that CCA is A-bar agreement and not ECM.

(52) a. *Tshitshissenim-**âu**-â auen ka-pâpîtaka?* Question
2-know-**3**-Q who is.laughing
'Do you know who is laughing?'

b. *Ni-tshissîtu-**âu** Mânî muk^u uîtsheiepan Ânîua.* Focus
1-remember-**1/3** Marie only helped Annie
'I remember that only Marie helped Annie.'

c. *Ni-tshissîtu-**âu** Mânî tshekuânnû kuet itûtet Mûniânit.* Topic
1-remember-**1/3** Marie why go-3 Montreal
'I remember why Marie went to Montreal.'

The second construction that has been claimed to constitute A-movement is the inverse. In particular, Bruening (2001) has argued that Passamaquoddy (Eastern Algonquian) inverse TA verbs are associated with passive-like A-movement to a functional projection above *v*P, which he calls HP, containing the feature proximate [P]. He suggests that DPs carry the [P] feature, where the value of the DP's [P] feature is determined by the animacy hierarchy. First and second person DPs are inherently [+P], inanimates are inherently [−P], and all else is unspecified for [P]. An argument that is not valued for [P] becomes valued in comparison with the other argument in the clause. A [+P] DP moves to HP; if the internal argument is [+P], then inverse marking results.

Bruening argues HP is an A-position because movement from HP to CP fails to produce a weak cross-over effect. However, it is well known that WCO effects do not obtain in all forms of A-bar movement, in particular, movement of a discourse linked (d-linked) DP (Hornstein 1995). In addition, CCA can trigger the inverse and has been established to be an A-bar phenomenon. If the inverse position, HP, is an A-position, then the argument that triggers CCA is already in an A-bar position before it moves to HP. If HP is an A-position, movement from the CCA position to HP constitutes improper movement. In the example (53), *Maliw* triggers CCA, and because the external argument of the matrix clause is impersonal, the matrix verb appears in the inverse and the prefix agrees with *Maliw*. Ritter and Rosen (2005*b*) concluded that Bruening's HP must be an A-bar position.

[8] But see Dahlstrom (1991) for an argument that in Plains Cree only the subject is targeted for CCA. There appears to be some language variation in the target of CCA across the Algonquian languages.

(53) *Psi=te wen ’-kosiciy-**uku**-l Maliw-ol eli nucitqonket nomiy-at.*
all=EMPH someone **3**-know.**TA**-INV.OBV Mary-OBV C policeman see-3CONJ
‘Everyone is known by Mary that a policeman saw.’ (Bruening 2001: 256)

Finally, the Algonquian languages show no signs of A-binding. The languages have no true reflexives, but rather a de-transitivizing suffix that is added to the verb stem. The example in (54) is from Blackfoot (Frantz 1991: 107). The AI mark in the gloss refers to the animate intransitive agreement paradigm.

(54) *Isskonákatohsiwa.*
*i-sskonákat-**o:his**-wa*
PAST-shoot(TA)-REFL(**AI**)-3SG
‘He shot himself.’

Branigan and McKenzie analysed CCA in Algonquian as A-bar agreement. Ritter and Rosen extended this treatment to all agreement phenomena in Algonquian, proposing that verb agreement in these languages serves to identify a point of view (POV) role, or in the case of CCA, a topic or focus, but not a particular grammatical relation such as subject or object.

In the Algonquian languages arguments are licensed in the CP layer, using Topic, Focus, and Point of View. These are discourse roles rather than event roles. It would appear that the event structure is not involved in argument licensing in these languages, but rather they use the discourse roles to license and interpret the arguments of the clause.

6.4 Conclusion

Some languages organize their arguments according to the type of event denoted by the clause. Some Event languages grammaticize telicity, while others grammaticize agentivity or initiation. I conclude from this that the inflectional projections that license subjects and objects are event-related. *v*P/AspP licenses objects by checking case and agreement; it also contains a quantity feature that checks quantized or quantity objects. In some languages the quantity feature is an aspectual feature and will only check quantity objects of telic events; in others, the feature is not aspectual and will check only the quantity of the object. TP licenses subjects by checking case and agreement; in some languages only animate or agentive subjects have agreement features that are checked in Spec of TP. Other subjects must check their features (e.g. gender features) elsewhere. Event languages will show subject and object splits of the kinds exemplified in section 6.2.

Projections in the complementizer layer license topic, focus, point of view, and other such discourse-related phenomena that are not event-related. As Rizzi (1997) points out, elements in the complementizer layer do not bear agreement or case marking. Topic-oriented languages organize their arguments around the discourse topic. Point of view is also a discourse phenomenon, encoded in the CP layer. Languages with animacy-based agreement like Algonquian organize the arguments around POV. POV and topic-oriented languages do not show any signs of using the functional structure of T/*v* to mark or identify the arguments. In such languages there are no argument splits, and the arguments bear no case or agreement marking.

The variation across languages observed here suggests substantial differences, not in the functional architecture of the languages, but in the layer of functional structure that licenses the arguments. I have suggested that the architectures are fundamentally the same across languages, including the *v*P or lexical layer, the TP or event layer, and the CP or discourse layer; the difference is in the licensing and interpretation of the arguments as event or discourse determined. A tripartite structure of the clause,[9] including the lexical layer (*v*P) for the initial merge of lexical material, the inflectional layer (TP) for event interpretation and case/agreement checking, and the discourse layer (CP) for discourse interpretation, are all potentially vital for argument interpretation and argument licensing; the variation across languages appears in the reliance that the language places in one over the others for argument interpretation and argument licensing.

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[9] See, for example, Grohmann (2003) and work cited therein for an exposition of the tripartite architecture of the clause.

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CHAPTER 7

ON THE RELATION BETWEEN MORPHOLOGY AND SYNTAX

MARIT JULIEN

7.1 Introduction

According to the traditional view, the relation between morphology and syntax is the following: while morphology builds up word forms—typically by combining roots with other roots and with affixes, but also by applying other operations to them—syntax takes fully inflected words as input and combines them into phrases and sentences. The division of labour between morphology and syntax is thus perfect: morphology only operates below the word level whereas syntax only operates above the word level. Moreover, these two components of grammar are ordered in strict sequence, such that the syntax takes over after the morphology has done its work. This model has formed, implicitly or explicitly, the basis of so many descriptive grammatical works that there is no point in mentioning any one of them here. Under the name of *lexicalism* it has also made its way into more recent theorizing.

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The lexicalist view has not gone uncontested, though. Already Jespersen (1924) said that for the syntax as he conceived of it, it makes no difference whether a given category is expressed as a part of a word or as a separate word. Jespersen's insight was picked up by Chomsky (1957), who proposed that verbs combine with verbal inflectional markers in the syntax. Chomsky also extended the syntactic analysis to the derivational domain, arguing that nominalizations are formed from sentences by transformation rules essentially similar to the rules that convert base sentences to derived sentences (a view developed in detail by Lees 1960).

Taken together, the proposals in Chomsky (1957) implied that the atoms of syntax are morphemes, not entire words, and, consequently, that transformations operating on these atoms can have both morphological and syntactic effects. The general idea of this analysis was to become a standard assumption in generative syntax for the next decades, although the details were understood in various ways over the years.

The next milestone in the present context was Chomsky (1970), who argued that at least some of the relations that had for some time been viewed as transformational belonged instead in the lexicon.[1] While still assuming that inflectional markers were manipulated in the syntax, Chomsky now took the types of complex word formation traditionally referred to as "derivation" to be performed in the lexicon—that is, in a pre-syntactic component of grammar. Thus, what he argued for was a weak version of lexicalism.

Stronger versions of lexicalism have later been formulated, some of them claiming that the internal structure of words is never visible to or manipulated by syntax. Among the prominent lexicalist works are Lapointe (1980), Selkirk (1982), Di Sciullo and Williams (1987), Anderson (1992), and Chomsky (1993, 1995).

On the other side of the controversy, the syntactic view on word formation has been defended in Baker (1988), where derived words of various types are dealt with, and in Halle and Marantz (1993, 1994), which are attempts to formulate a general and complete theory of complex words based on the idea that every morphological element is also a syntactic element. The theory, called Distributed Morphology, is further developed by, among others, Halle (1997) and Marantz (1997).

In this chapter, I will, however, claim that the discussion of whether complex words are formed in the syntax or prior to syntax is futile, because words as such are not formed in the grammar at all. They are not grammatical entities. Below the phrase level, syntax operates on morphemes and gives certain arrangements of these morphemes as output. Some of the resulting morpheme sequences are called words, but crucially, these sequences do not as a class correspond to one particular syntactic representation. Rather, as I argue in section 7.2, words are characterized by their distributional properties. In section 7.3 I show that these properties are

[1] But see Marantz (1997) for an updated reading of Chomsky (1970) in the light of Bare Phrase Structure (Chomsky 1995).

compatible with a number of syntactic configurations. In section 7.4 I deal with agreement markers, which I see as exceptional as they do not represent syntactic heads. Section 7.5 turns to an apparent counterexample to the idea that morpheme order is always determined by the syntax, namely, the Scandinavian -*s*(*t*) suffix that is used to form passives, among other things. I demonstrate that given the right syntactic analysis, -*s*(*t*) is not necessarily a counter-example after all. The chapter is rounded off in section 7.6 with a comment on the reality of words.

7.2 The Characteristic Properties of Words

The plausibility of the claim that words are not grammatical entities is best seen if we try to define what a word is. It then appears that although it may be easy to pick out the words in a given language, it is much more difficult to characterize them in grammatical terms. Even if we put aside the notions of "phonological word" and "lexical word", and concentrate only on what we may refer to as "grammatical words" or "morphosyntactic words", the task does not get much easier.

In the current linguistic literature one often comes across such statements as "words are morphological objects" and "words are the basic building blocks of syntax". But strikingly, these definitions cannot be used to determine the status of elements that may or may not be separate words—they apply only after the words have been identified.

Let us look at an example. Sylvain (1936) states that the markers of tense, aspect, and modality in Haitian Creole are prefixes on the verb, as shown in (1). In Spears (1990), on the other hand, all preverbal markers in Haitian Creole are analysed as auxiliaries, and they are written as separate words, as in (2). (In addition, the two authors gloss the markers differently, as we see, but that is of less importance here.)

(1) *N' té-kwè u t'-a-vini.* Haitian Creole
1PL PAST-think 2SG PAST-FUT-come
'We thought that you would come.' (Sylvain 1936: 87)

(2) *M te di m t a pati.* Haitian Creole
1SG ANT say 1SG ANT IRR leave
'I said that I would leave.' (Spears 1990: 124)

Now, how do we know whether (1) or (2) is more correct, from a grammatical point of view? According to the criteria just mentioned, the preverbal markers in

Haitian Creole form a word with the verb if their position is determined by the morphology, but they are words themselves if their position is determined by the syntax. Further, they are words if they have their own syntactic representations, but not if they constitute a syntactic terminal node together with the verb. This line of reasoning could also be reversed: if the preverbal markers belong to the verbal word, they are not visible to the syntax and their positions are determined by the morphology, but if they are separate words, they are minimal syntactic units. Thus, the argumentation is going in a circle, getting us nowhere.

What we really should ask is how words are recognized in the first place. Why are some morpheme sequences taken to be words, while others are not? The answer, I would claim, is that wordhood has to do with distribution. That is, morpheme sequences that have certain distributional properties tend to be seen as words.

One of the relevant properties is *independent distribution*. Boas (1911) already pointed out that when a certain sequence can appear, without substantial modifications, in a variety of positions relative to other elements in the sentence, "we are inclined to consider it as a separate word", as he put it (Boas 1911: 30). Thus, their independent distribution distinguishes grammatical words from smaller elements.

As for the upward delimitation of words, Bloomfield (1933) argued that *internal cohesion* is the property that separates compounds and phrasal words from phrases. More precisely, even if both words and phrases can be built from words, with phrases it is normally the case that they can be broken up by additional words and phrases, whereas words that consist of words can be interrupted much less freely, if at all.

Bloomfield (1933) also proposed another criterion for wordhood, namely, that a word is a *minimal free form*. However, while this is a sufficient criterion for wordhood, it is not strictly necessary. The necessary criteria appear to be independent distribution and internal cohesion, since forms that meet these two criteria tend to be regarded as words whether or not they can appear in isolation. But crucially, if a given morpheme string has independent distribution and internal cohesion, so that it stands out as a word, it does not follow that the string is also a single terminal node in the syntax. Neither does it follow that it is more than one syntactic terminal node. What I argue is that there is no single specific syntactic configuration that corresponds to words. This means that the concept "word" has no theoretical significance in the grammar at all.

It cannot then be the case that the grammar contains a word-forming morphological module. Arguably, the syntax alone determines the hierarchical and linear relations between morphemes. It does not, however, determine the realization of each individual morpheme. Hence, it must be the morphology that deals with the spelling out of morphemes and with allomorphic variation. But notably, words are not necessarily relevant in this context. Although the realization of a given morpheme may be dependent on the feature content of neighbouring morphemes, the conditioning factor is not always contained in the same word as the morpheme that undergoes the alternation. The *a/an* alternation in English is an obvious example; more examples are found in Julien (2002).

When the trigger for a conditioned allomorphic alternation nevertheless often belongs to the same word as the target, the reason is that morphemes belonging to the same word regularly appear together. Hence, if the conditioning factor is contained in the same word as the element that undergoes alternation, each alternant will occur relatively frequently, and the alternation has a good chance of surviving. If, on the other hand, a morpheme has an allomorph whose appearance is dependent on some other morpheme not in the same word, it is possible that the alternation is seen relatively infrequently, and it will more easily get lost.

A related fact is that words are often listed in the lexicon (but note that they can also be produced online), alongside the individual morphemes that they are built from, whereas phrases are listed less often and sentences only occasionally (cf. Jackendoff 1997).

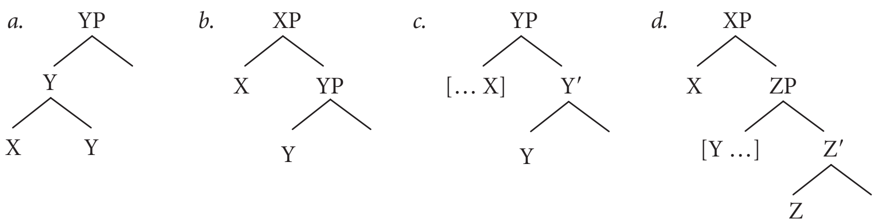
If we now go back to the problem illustrated in (1) and (2), it should be clear that it is impossible to tell what the words are, simply by inspecting the morpheme strings that we see in these examples. We need to know which permutations are possible and where additional material can be inserted. However, the primary value of such information lies in its syntactic relevance. The question of which morpheme strings are words is not really important since from the point of view of grammar, the word is merely an epiphenomenon.

7.3 The Syntax of Words

If it is true that words are nothing but distributional units, we would nevertheless like to know what the syntactic description of a word could be. In the following, I will make an attempt at answering that question. After presenting some fundamental assumptions in section 7.3.1, and showing the base-generated order of tense, aspect, and verb root in section 7.3.2, I go on to give some examples of how various orders of tense marker, aspect marker, and verb can be derived. In section 7.3.3 we see how head movement can lead to suffixing of tense and aspect markers, in section 7.3.4 we see how phrasal movement can yield a similar result, in section 7.3.5 we look at the syntax of prefixed tense and aspect markers, and in section 7.3.6 we deal with a language that has prefixed tense but suffixed aspect. My conclusions concerning the syntax of complex words are spelled out in section 7.3.7.

7.3.1 Preliminaries

On the assumption that the left-to-right linear order corresponds to the top-down hierarchical relations, as Kayne (1994) proposed, there are four syntactic configurations that could cause the morphemes X and Y to form a word [XY]. X and Y could be parts of one complex syntactic head, as in (3*a*); X could be the next head up from Y, as in (3*b*); X could be the final element in the specifier of Y, as in (3*c*); and finally, Y could be the initial element in the specifier of the complement of X, as in (3*d*).

(3)


In each of these configurations, the sequence XY can have word properties. Internal cohesion is guaranteed in (3*a*), (3*c*), and (3*d*). In (3*b*) it follows if no phrase surfaces in Spec of YP. As for independent distribution, a complex head, as in (3a), will move as a whole if it moves at all, since excorporation is arguably not possible (Julien 2002). Hence, a complex head comes across as either a word or a part of a word (and for this reason its syntactic properties are often taken to be characteristic of the word). In the other three configurations it is less likely that XY will move as a unit, but it would be possible if YP in (3*b*) and (3*c*) and ZP in (3*d*) only contains Y at the point where the relevant movement takes place. Note, however, that if other constituents move around XY, XY will have independent distribution relative to those other constituents even if the sequence XY itself does not move. In short, in all the configurations in (3) the sequence XY could have the distributional properties that characterize words.

What I will claim is that every morphologically complex word corresponds to one of the configurations shown in (3), or to a combination of these configurations. In the following, I will illustrate my point by presenting some examples of morphologically complex words taken from the domain of verbal inflection.

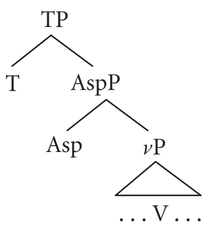
7.3.2 The Base-Generated Order of Tense, Aspect, and Verb

In the examples in (4) and (5), the markers of tense and aspect are morphologically free elements. Moreover, in both cases they precede the verb, and the order is tense marker > aspect marker > verb root.

(4) *Mə á ŋgə wíiŋg òmpyə.* Makaa
1SG REM.PAST PROG chase.away dogs
'I was chasing the dogs away.' (Heath 1991: 11)

(5) *Lapli ti pe toñbe.* Mauritian Creole
rain PAST IMPF fall
'Rain was falling.' (Adone 1994: 44)

After surveying 530 languages, Julien (2002) concludes that the pattern shown here is by far the most common one when tense and aspect markers are realized as free elements. I take this to mean that universally, temporal heads are higher in the clause than aspectual heads, which in turn are higher than the verb, as illustrated in (6).[2]

(6)


Now let us assume, for the sake of the argument, that tense and aspect markers are always realizations of tense and aspect heads, and not base-generated on the verb. It then appears that various orders of tense marker, aspect marker, and verb can be explained on the basis of the syntactic structure in (6). This is what I will go on to demonstrate.

7.3.3 Suffixed Inflectional Markers Resulting from Head Movement

Consider first example (7), from Macushi, a language where the unmarked word order is OVS, and markers of tense and aspect are suffixed to the verb, such that the morpheme order is verb root–aspect marker–tense marker (Abbott 1991).

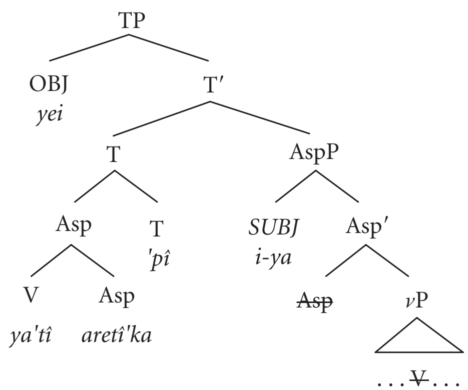
(7) *Yei ya'tî-aretî'ka-'pî-i-ya.* Macushi
wood cut-TERM-PAST-3-ERG
'He finished cutting the wood.' (Abbott 1991: 121)

If the object surfaces above the Tense head while the subject surfaces below it, then both the OVS order and the suffixing of aspect and tense markers can be derived by

[2] Most likely, there are many more heads in the IP-domain—see Cinque (1999). However, for the present purpose inflectional heads other than Tense and Aspect are ignored.

moving the verb to the Asp head and the [V Asp] complex to the Tense head, as sketched in (8).[3] If adjunction is always to the left (Kayne 1994), the order of elements inside the verbal word follows.

(8)



As for the subject pronoun in (7), it is phonologically weak and cliticizes onto the verb (Abbott 1991). A phonologically strong alternative is shown in (9).

(9) *Mîrîrî koneka-'pî mîîkîrî-ya.* Macushi
that make-PAST 3-ERG
'He made that.' (Abbott 1991: 24)

Here it seems clear that the pronominal subject is sitting in a Spec below the verbal word. In the absence of evidence to the contrary, I assume that the phonologically weak pronoun in (7) is also situated in a Spec below Tense, as indicated in (8). It follows that in (7) we have a word that is made up of a complex syntactic head and an element sitting in a Spec position below that head. The stable part of that word is however the complex head, which necessarily has word properties.

7.3.4 Suffixed Inflectional Markers Resulting from Phrasal Movement

Turning now to Evenki, an SOV language, we see that the order of elements inside the verbal word here is also verb root–aspect marker–tense marker.

(10) *Bu: dolboni:-βa haβal-ža-ča-βun.* Evenki
1PL.EX night-ACC work-IMPF-PAST-1PL
'We worked all night.' (Bulatova and Grenoble 1999: 8)

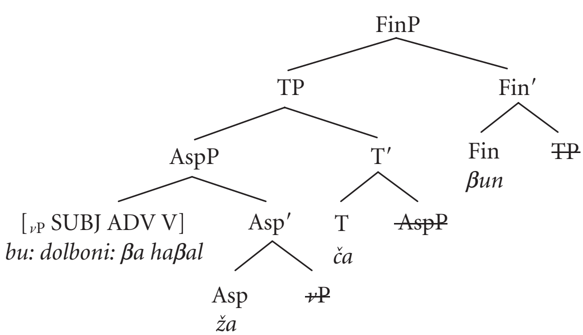
[3] With intransitive verbs the unmarked constituent order is SV (Abbott 1991). That is, Macushi shows an ergative pattern in the syntax as well as in the case marking of arguments. Given this, the structure in (8) seems rather plausible.

One might guess that the complex verbal word in Evenki is formed by head movement, just as I have proposed for Macushi. However, the overall syntax of Evenki clauses is rather different from that of Macushi. Evenki is a head-final language—that is, every head in the clausal projection line is preceded by its complement. This means not only that bound inflectional markers appear in an order which is the reverse of the base-generated order, but also that lower verbs precede higher verbs, as illustrated in (11).

(11) *Kuŋaka:n* *žəb-də:-βi:* *əjə:t-čə-rə-n.* Evenki
child eat-PURP-REFL want-IMPF-AOR-3SG
'The child wants to eat.' (Bulatova and Grenoble 1999: 39)

Julien (2002) proposes that the head-finality of many SOV languages is the result of every clausal head above *v*P having attracted its complement to its Spec. On this analysis, the syntactic structure of (10) is as shown in (12). Note that the agreement marker that is the last element of the verbal word in (10) is tentatively placed in the Finite head, which is where subject agreement markers appear to be located in many languages (Julien 2002).[4]

(12)



We see here that the movement of each complement to the nearest Spec has made every projection in the IP-domain head-final. Since the verb is also the final element in the *v*P, we get a sequence of linearly adjacent morphemes, starting with the verb root, where each morpheme is the final element of the constituent in the Spec of the next morpheme. For the example in (11), an analysis along similar lines would mean that the iterative movement of complement to Spec starts from the most deeply embedded verb and goes all the way up to the highest Finite head. (The purposive marker probably represents a Mood head, while the marker glossed as REFL appears to be an agreement marker, since it indicates that the subject of the higher verb is also the subject of the lower verb—see Bulatova and Grenoble 1999.)

Note that the subject and the temporal adverbial in (10) are taken to be sitting inside *v*P. Concerning the adverbial, its being located inside *v*P is consistent with Pereltsvaig's (2001) proposal that adverbials with accusative case are licensed in the

[4] See Rizzi (1997) and Platzack (1998) on the Finite head.

Spec of a *v*P-internal aspectual head (the Inner Aspect of Travis 1992, 2000). This position is otherwise where direct objects are licensed if they serve as delimiters of the event. However, Pereltsvaig argues that certain adverbials can appear in the same position and have the same function as event-delimiting direct objects, and consequently show up with the same case. The adverbial in (10) seems to be a good example of this. As for the subject, it has been claimed by Yanagida (1996) and Nakajima (1999) that arguments can be licensed inside *v*P in Japanese. Julien (2002) takes it to hold for all head-final languages.

But although the arguments of the verb in head-final languages arguably do not move out of *v*P for case reasons, they can move to focus and topic positions in the CP-domain, above FinP. These movements can alter the order of constituents in the clause considerably, as in the following Evenki example.

(13) *Adul-il-va* *si* *gene-che-s?* Evenki
fish.net-PL-DEF.ACC you bring-PAST-2SG
'Did YOU bring the fish nets?' (Nedjalkov 1997: 4)

As we see, the order here is OSV, and the subject is focused. I take this to mean that the object has moved to the Spec of a Top head in the CP-domain while the subject has moved to the Spec of a Foc head below Top (see Rizzi 1997). Since adverbial phrases, and arguably even the IP, too, can move to the CP-domain, many head-final languages display a wide range of word-order alternations having to do with discourse functions. The sequence of heads in IP remains unchanged, though. The consequence is that the morpheme sequence consisting of the verb root and the verbal inflectional markers has word properties.

7.3.5 Prefixed Inflectional Markers

Now consider the examples in (14) and (15), where the markers of tense and aspect precede the verb root. Strikingly, these markers appear in the order that we would take to be the base-generated one, given (4) and (5). So how come they are included in a word with the verb root?

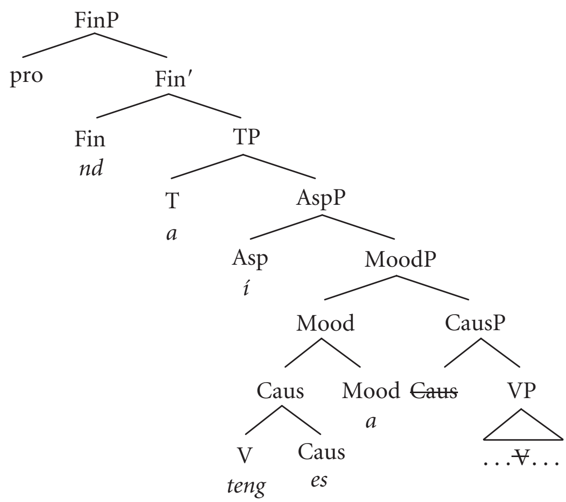
(14) *A-ni-ndatu-rí* *uù* *órá.* Chalcatongo Mixtec
TENSE-COMPL-wait-I two hour
'I've already been waiting for two hours.' (Macaulay 1993: 73)

(15) *Nd-a-i-teng-es-a.*
1S-PAST-HAB-buy-CAUS-REAL[5] Shona
'I used to sell.' (Myers 1990)

[5] Myers (1990) glosses the final vowel in Shona verbs simply as Final Vowel. However, his description suggests that it encodes [±realis] mood, since it is *-e* in the subjunctive, potential, and negative, and *-a* elsewhere.

For Shona, Myers (1990) argues that the verbal word is a phonological unit and not a morphological or syntactic constituent. From a grammatical point of view, the verb root forms a constituent with the suffixes, but not with the prefixes. Myers's statements about the verbal word in Shona are compatible with assigning to (15) the syntactic structure shown in (16). Here, the verb has moved to the Caus head and then to the Mood head, thereby forming a complex head with the causative marker and the mood marker, both suffixed to the verb. The markers of subject agreement, tense, and aspect remain in their base-generated positions in front of the verb.

(16)



The reason why they are nevertheless taken to belong to the verbal word is, first, that they are included in a phonological word with the verb (see Myers 1990), and secondly, that the sequence beginning with the subject-agreement marker and ending with the mood marker has the distributional properties of a word. It has independent distribution—phrasal arguments and adverbials may precede or follow it—and it cannot be interrupted by phrases, only by non-phrasal adverbials, such as *chimbidzó* 'quickly' in (17). As we see, such interrupting adverbials are included in the verbal word, necessarily for distributional reasons.

(17) *Ndi-chá-to-chimbidzó-dzok-a.* Shona
1SG-FUT-must-quickly-return-REAL
'I'll have to come back quickly.' (Myers 1990: 90)

For (14), an analysis parallel to (16) goes through, except that the subject marker in (14) is probably sitting in a Spec below the surface position of the verb. Macaulay (1993) shows that enclitic subject pronouns in Chalcatongo Mixtec are in complementary distribution with postverbal DP subjects, and she takes subjects of both types to be located in Spec of VP. This means that the verb in (14) must have moved out of VP, and that the verbal word is made up of a sequence of syntactic heads—the Tense head, the Aspect head, and a head containing V—followed by a Spec element—the subject marker.

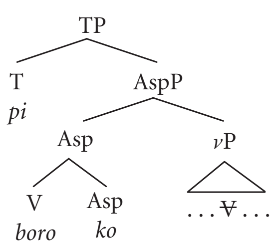
7.3.6 A Mixed Case

While the languages we have looked at so far all have aspect markers inside tense markers in the verbal word, there are also languages where tense and aspect appear on opposite sides of the verb root. Typically, the tense marker then precedes the root while the aspect marker follows it, as in (18).

(18) *Ka-zo* *pitsi* *pi-boro-ko.* Rikbaktsa
1SG-father cashew NONPAST-eat-CONT
'My father is eating cashew nuts.' (Boswood 1978: 22)

On my analysis, the verbal word in (18) is the result of moving the verb to the Aspect head—see (19). The [V Asp] complex is preceded by the Tense head, which is not affected by any movement operations.

(19)



This means that just as in Shona, the verb root in Rikbaktsa forms a syntactic constituent with the suffixes, whereas the prefixes have a more distant structural relation to the root.

7.3.7 The Syntactic Nature of Word Formation

The brief discussion of a few selected examples that I have presented here can of course not do justice to the full range of variation that we see in the verbal morphology of the world's languages. It can only give an idea of what the underlying syntactic structure of a morphologically complex word might be. Still, the fact that the verbal morphology of the languages under consideration can get a syntactic explanation is no proof that syntax is the basis of all word formation.

However, in Julien (2002) a survey of 530 languages from 280 genetic groups is presented, and the conclusion is that languages conform to an overwhelming degree to the hypothesis that the order of morphemes in morphologically complex words is determined by the syntax alone. At least in the domain of verb morphology, the morpheme orders attested in the 530 languages in the survey can all be derived from one single underlying syntactic structure by a syntax where movement and adjunction are always to the left (see also Julien 2003). Closer investigations of alleged exceptions reveal that in these cases, too, an analysis is possible which is in accordance with the idea that every morpheme is a syntactic element and its position in the surface order is a matter of syntax. If the attested morpheme orders are compatible with the hypothesis that they are derived in the syntax, the most economical grammar would be one where morpheme ordering, inside and outside words, *is* in fact determined by the syntax.[6] Hence, I assume that this is the case.

It should also be noted that in the approach I am sketching here there is no principled difference between affixes and clitics. Elements of both types are positioned by the syntax. However, if the syntactic frame that a given element appears in causes that element always to end up in close relation to another element of one particular category, the first element will be seen as an affix. By contrast, an element that appears next to elements of various categories will be seen as a clitic. For example, an element that is always preceded by a verb-final VP, such as the aspect marker in (12), is seen as a suffix on that verb. Now imagine a structure that is similar to (12) except that the VP is not necessarily verb-final. In that case the aspect marker will follow whatever is the last element in the VP. The aspect marker will then be seen as a clitic. But crucially, the syntactic properties of the aspect marker will not differ from what we see in (12). This suggests that the distinction between clitics and affixes does not go very deep and is not very interesting to the theory of grammar.

7.4 Agreement Markers

Having claimed that morpheme order is always determined by the syntax, I must now point out that there is one inflectional category that does not fit into the relatively rigid framework that the syntactic approach provides. This category is agreement. For example, subject-agreement markers can be located higher than the Tense head, as in (20), where the subject-agreement marker has moved with the negation to a position in front of the question marker, leaving the tense marker and the verb root behind.

(20)	*I-t*	*go*	*manna-n*	*Oslo-i*?	Northern Saami
	NEG-2SG	Q	GO-PAST	Oslo-ILL	
	'Didn't you go to Oslo?'				

[6] See Drijkoningen (1994) on this point.

In (21), by contrast, the subject agreement marker follows the tense marker and the marker of grammatical mood, and we would take it to be located low down in the IP.

(21) *sɛh* *ya* *k-ɛ-m* *ɛtɛ* *u.* Loniu
3PL FUT POT-NONSG-come ANIM.GOAL 1.DU.EX
'They will come to (visit) us.' (Hamel 1994: 113)

Taken together, these examples indicate that subject-agreement markers are not in a fixed position universally. Moreover, the example in (22), where one subject-agreement marker is prefixed to the negation while another is prefixed to the verb, shows that subject-agreement markers are not necessarily associated with a unique head, not even within one single clause.

(22) *Án* *à-pé* *à-wótò* *kàmpálà.* Lango
I 1SG-NEG 1SG-go.PERF Kampala
'I didn't go to Kampala.' (Noonan 1992: 142)

If object agreement is also considered, the picture becomes even more complicated. As noted in Julien (2002), of the 24 theoretically possible orderings of verb root, tense marker, subject agreement, and object agreement, only four are not attested; these are OAgr–T–SAgr–V, T–OAgr–V–SAgr, OAgr–T–V–SAgr, and SAgr–V–OAgr–T. The 20 other orderings can all be found in one or more languages.

The variation that we find in the positioning of agreement markers is such that we have to give up the idea put forth in Chomsky (1993) that clauses contain a subject-agreement head and an object-agreement head which are located in fixed positions universally.[7] Moreover, it appears that the absence of Agr heads does not only hold for languages with weak Agr, as proposed by Chomsky (1995), but most likely for all languages. Thus, my proposal is that agreement markers, unlike markers of other categories, do not in themselves represent syntactic heads. Instead, agreement features are added to heads that also have some other content.

Related ideas have been put forward by Halle and Marantz (1993), who assume that subject-agreement features are added to tense heads, and by Baker (1997), who proposes that at least in polysynthetic languages, subject-agreement markers are adjoined to I, object agreement markers to Asp. However, these proposals cannot capture the full range of variation with respect to the positioning of agreement markers that we find in the world's languages (see Julien 2002 for details). Rather, the location of agreement features must be subject to crosslinguistic variation.

[7] Cf. Iatridou (1990), Speas (1991), Spencer (1992), Mitchell (1994), and Holmberg and Platzack (1995), among others.

7.5 An Apparent Counterexample

In section 7.3 I presented some examples of morpheme orders that are all in accordance with the syntactic approach to word formation. Countless other examples could have been mentioned from languages all over the world. It is more interesting, though, to look at cases that appear to pose problems for the syntactic hypothesis, and see if they can be explained in syntactic terms.

In the following, I will deal with an element that has been pointed to as a counterexample to the syntactic approach to word formation, namely, the *-s* or *-st* that can be suffixed to verbs in the Scandinavian languages,[8] and that is customarily analysed as a passive marker, besides being a marker of reflexive, reciprocal, and inchoative verbs.[9]

In section 7.5.1 I show that the position of passive *-s*(*t*) is unexpected on the syntactic approach to complex words. Section 7.5.2 compares the *-s*(*t*)-passive to the periphrastic passive, and I conclude that the two are syntactically different. Then, in section 7.5.3, I present my analysis of *-s*(*t*), according to which *-s*(*t*) is an argument. In section 7.5.4 I deal with the question that this analysis raises concerning V2 word order, and in section 7.5.5 I point out some welcome consequences of my analysis. Finally, section 7.5.6 looks briefly at some elements outside Scandinavian that could be taken to have the same syntax as *-s*(*t*).

7.5.1 The Problem

Consider first the three examples of the Scandinavian *-s*(*t*)-passive shown below.

(23) *Vi plag-de-s av mygg-en.* Norwegian
we annoy-PAST-*s* by mosquito-DEF
'We were annoyed by the mosquitoes.'

(24) *Hus-et måla-de-s av* Kalle. Swedish
house-DEF paint-PAST-*s* by Kalle
'The house was painted by Kalle.' (Hedlund 1992: 124)

(25) *Keisar-inn klæ-dd-i-st ný-jum föt-um.* Icelandic
emperor-DEF.NOM dress-PAST-3SG-*st* new-DAT.PL cloth-DAT.PL
'The emperor was dressed in new clothes.' (Anderson 1990: 235)

As we see, the passive *-s*(*t*) follows the tense marker, and in Icelandic, even the subject agreement marker. This is unusual—the normal position for affixed passive markers is close to the verb root, inside tense and aspect, as in (26), (27), and (28).

[8] See, e.g. Holmberg and Platzack (1995: 28, n. 26).

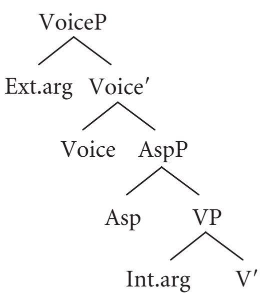
[9] The form of this marker is *-s* in Danish, Swedish, and in some varieties of Norwegian, but *-st* in Faroese, Icelandic, and other varieties of Norwegian.

(26) *Uluki hurkeken-du va:-p-cha-n.* Evenki
squirrel boy-DAT kill-PASS-PAST-3SG
'The squirrel was killed by the boy.' (Nedjalkov 1997: 218)

(27) *Makiináa-n ní tolf-am-t-a.* Oromo
car-NOM FOC repair-PASS-3FEM-IMPF
'The car will be repaired.' (Owens 1985: 172)

(28) Tóm *kiʔ ʔp-yo-m-p-e:.* Seri
money DEF 1SG-DIST.REAL-NEG-PASS-give
'I was not given the money.' (Marlett 1990: 516)

Passive markers inside tense and aspect are compatible with the proposal of Rivero (1990), Travis (1992, 2000), and Kratzer (1996) that the active–passive distinction is encoded in a Voice head which is located below the heads in the IP-domain. In (29), I show the structure proposed by Travis, which includes an Inner Aspect head, encoding telicity, between the Voice head and the VP.

(29)


In accordance with the proposals just mentioned, I assume that external arguments are generated in the Spec of the Voice head, which could be identified with the *v* head shown in some of the preceding examples. In the passive, a [passive] feature in the Voice head precludes the insertion of a visible argument DP in Spec of VoiceP.

In this light, the position of the suffixed -*s*(*t*) in (23), (24), and (25) is a problem. If it is a realization of the Voice head, the syntactic approach to morpheme order predicts that it should be positioned inside the tense marker, not outside it. Alternatively, it is not a realization of the Voice head. This is what I will argue in the following.

7.5.2 The Two Passives in Scandinavian

In Scandinavian, besides the -*s*(*t*)-passive there is also a periphrastic passive construction, which clearly involves the Voice head since it only affects verbs that have an external argument (see Åfarli 1992). In Norwegian, the periphrastic passive is thus grammatical with the transitive agentive verb *skrive* 'write' in (30*a*) and with the transitive perception verb *se* 'see' in (30*b*).

(30) a. *Brev-et ble skrev-et av meg.* Norwegian
letter-DEF became write-PTC by me
'The letter was written by me.'

b. *Katt-en ble se-tt av Lina.*
cat-DEF became see-PTC by Lina
'The cat was seen by Lina.'

The periphrastic passive also goes well with unergative verbs, like *banke* 'knock' in (31). However, as (32*a*) shows, it is ungrammatical with *få* 'get', although *få* is fully acceptable with the -*s*(*t*)-passive, as (32*b*) demonstrates.

(31) *Det bli-r bank-a på dør-a.* Norwegian
EXPL become-PRES knock-PTC on door-DEF
'There is knocking on the door.' (Åfarli 1992: 107)

(32) a. **Tomat-er bli-r nå få-tt år-et rundt.* Norwegian
tomato-PL become-PRES now get-PTC year-DEF round

b. *Tomat-er få-s nå år-et rundt.*
tomato-PL get-*s* now year-DEF round
'Tomatoes are now available all year round.'

More generally, two-place verbs with benefactive subjects and two-place stative verbs with experiencer subjects allow the -*s*(*t*)-passive but not the periphrastic passive (Lødrup 2000). A verb of the latter type is *føle* 'feel', shown in (33).

(33) a. *Bulk-en føle-s ikke i det hele tatt.* Norwegian
dent-DEF feel-*s* not at all
'The dent is not noticeable at all.' (Lødrup 2000: 47)

b. **Bulk-en blir ikke føl-t i det hele tatt.*
dent-DEF becomes not feel-PTC at all

Furthermore, an unaccusative verb like *dø* 'die' can be used with the -*s*(*t*)-passive and still retain its non-agentive meaning. An example is given in (34).

(34) *Det dø-s altfor mye her i sogn-et.* Norwegian
EXPL die-*s* too much here in parish-DEF
'People die too much in this parish.' (Enger 2000: 11)

When used in a participial passive, the same verb can only have an agentive reading, as in the example in (35).

(35) *I denne opera-en blir det dø-dd flere gang-er*
in this opera-DEF becomes EXPL die-PTC several time-PL
hver kveld. Norwegian
every night
'In this opera, there is dying several times every night.'

I take the contrast between the agentive *dø* and the non-agentive *dø* to mean that some intransitive verbs allow their single argument to be generated either as an external argument or as an internal argument. That is, I assume with Baker (1997) and contra Borer (1998) that there is a tight connection between thematic roles and syntactic structure, as indicated earlier in (29). It follows that in (35), *dø* has unergative syntax.

The generalization that can be drawn from the above facts is that the -*s*(*t*)-passive but not the periphrastic passive is compatible with verbs that lack an external argument. Unaccusative verbs obviously lack external arguments. Concerning verbs with benefactive subjects (i.e. verbs of possession and the like), Kayne (1993) proposed that *have* is a raising verb, and I assume that its inchoative counterpart *få* 'get' and other verbs of possession have basically the same syntax. As for stative verbs with experiencer subjects, Pylkkänen (2000) argues that stative psych causatives have two internal arguments.

I conclude that the passive -*s*(*t*) is not a realization of the Voice head. Hence, I claim, contra Åfarli (1992), that the -*s*(*t*)-passive has an entirely different syntax from the periphrastic passive, which involves a [passive] Voice head. If this is correct, the position of -*s*(*t*) outside the tense marker need not be a problem.

7.5.3 The Syntax of -*s*(*t*)

Let us then consider the syntax of the element -*s*(*t*) in more detail. We have seen that when it appears on a finite verb it is the last element of the verbal word, following tense and agreement markers. If -*s*(*t*) represents a syntactic head, its position in finite verbs suggests that the head in question is at least higher than Tense—recall that agreement markers arguably do not represent separate syntactic heads. However, if an auxiliary is present in a construction with -*s*(*t*), the auxiliary carries tense while -*s*(*t*) attaches to the main verb, as shown in (36).

(36)	*Genser-en*	*må-tte*	*prøve-s*	*på.*	Norwegian
	sweater-DEF	must-PAST	try-*s*	on	
	'The sweater had to be tried on.'				

The morpheme order in this example suggests that -*s*(*t*) is below Tense as well as below the auxiliary. The paradox just presented forces the conclusion that -*s*(*t*) does not represent a head in the verbal projection line. If -*s*(*t*) has a syntactic reality at all, it must receive an analysis along the lines of Hedlund (1992), who proposes that the passive -*s*(*t*) is a subject, sitting in Spec of VP.

My proposal is that -*s*(*t*) is a pronoun-like element which can, in principle, be inserted in any argument position in *v*P (which I use as a cover term for extended VPs of all types, including VoicePs). However, its features must be defective, since it is syntactically inert—it does not enter into agreement or attraction relations.

As for its reference, when it is generated as the highest argument it gets a default arbitrary interpretation, comparable to arbitrary PRO or the Mainland Scandinavian non-specific pronoun *man* 'one'. Thus, as many authors have noted, 'passives' formed with -*s*(*t*) can be paraphrased with the corresponding active clause featuring *man* as subject.

Many authors have also noted that -*s*(*t*) apparently absorbs a theta role. This follows if -*s*(*t*) occupies an argument position. It is less clear whether -*s*(*t*) gets structural case. If it does, the case in question must be accusative, since another argument (or argument chain) will get nominative. The following Icelandic example, which seems to indicate that both nominative and accusative are available to elements other than -*s*(*t*) in -*s*(*t*)-constructions, must then receive some other explanation—for example, that the accusative case seen here is not structural.

(37)	*Hann*	*otta-st*	*mann-inn.*	Icelandic
	he.NOM	fear-*st*	man.ACC-DEF.ACC	
	'He fears the man.' (cf. Anderson 1990: 246)			

A consequence of the poor feature content of -*s*(*t*) is that it will not be attracted to the surface subject position even if it is generated as a thematic subject. Instead, some other argument will become the surface subject, as in the examples already given, or alternatively, an expletive will be inserted, as in the examples below.

(38)	*a.*	*Det*	*hør-te-s*	*en*	*gjøk.*	Norwegian
		EXPL	hear-PAST-*s*	a	cuckoo	
		'A cuckoo was heard.'				
	b.	*Det*	*danse-s*	*ofte*	*der.*	
		EXPL	dance-*s*	often	there	
		'People often dance there.'				

It is also possible for -*s*(*t*) to be inserted in a lower argument position, so that it is c-commanded by a higher argument inside the same *v*P. In such cases, the reference of -*s*(*t*) is determined by the higher argument, and the result is a reciprocal construction, as in (39a), or a reflexive construction, as in (40a)—compare these constructions to the alternative formulations in (39*b*) and (40*b*).

(39)	*a.*	*De*	*møt-te-s*	*hver*	*onsdag.*		Norwegian
		they	meet-PAST-*s*	every	Wednesday		
		'They met every Wednesday.'					
	b.	*De*	*møt-te*	*hverandre*	*hver*	*onsdag.*	
		they	meet-PAST	each.other	every	Wednesday	
		'They met every Wednesday.'					

(40)	*a.*	*Vi*	*skjemme-s.*	Norwegian
		we	shame-*s*	
		'We are ashamed.'		

b. *Vi skamme-r oss.*
we shame-PRES us(REFL)
'We are ashamed.'

In Swedish, a few verbs even allow for an -*s*(*t*) object with independent reference. An example is given in (41).

(41) *Hund-en bit-s.* Swedish
dog-DEF bite-*s*
'The dog bites (people).'

In these cases, the -*s*(*t*) argument is necessarily [+human] (Hedlund 1992). It is therefore possible that -*s*(*t*) here is endowed with a [+human] feature, and that this is what prevents it from picking up the reference of the subject. It must then be a lexical property of the verbs in question that they accept a [+human] -*s*(*t*) object.

Finally, there are verbs where an added -*s*(*t*) appears to be non-thematic (Anderson 1990; Hedlund 1992). Some of these verbs are inchoative, as in (42), while others are psych verbs, as the example in (43).

(42) *Han har elde-s.* Norwegian
he has age.PTC-*s*
'He has aged.'

(43) *Kalle vånda-s inför tenta-n.* Swedish
Kalle dread-*s* before exam-DEF
'Kalle dreads the exam.' (Hedlund 1992: 140)

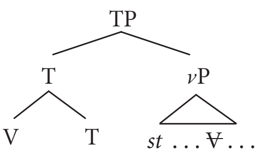
I will nevertheless suggest that -*s*(*t*) fills an argument position even here. Note that the verbs in question do not have counterparts without -*s*(*t*). For the inchoative verbs, it is possible that -*s*(*t*) represents an unspecified causer, which must be present for the verb to be inchoative. Concerning psych verbs, they are known to have a rather complicated syntax (see, e.g., Pylkkänen 2000 for a recent treatment). Sometimes nominal elements show up whose function is rather unclear. Compare, for example, the two constructions in (44). While (44*a*) involves a subject theme and an object experiencer argument, (44*b*), with a subject experiencer, contains an additional reflexive pronoun that appears to have syntactic relevance for the argument structure since the theme is now realized as a PP.

(44) a. *Hun bekymre-r meg.* Norwegian
she worry-PRES me
'She worries me.'

b. *Jeg bekymrer meg for henne.*
I worry-PRES me(REFL) for her
'I worry about her.'

Leaving details aside, I therefore assume that -*s*(*t*) always fills a nominal position in *v*P, and that it cliticizes onto the verb after the verb has moved out of that *v*P. More precisely, I take the verb to move to the Tense head, so that the tense marker ends up as a suffix to the verb. With invisible projections omitted, the situation is then as in (45).

(45)



Anderson (1990) argues that the inflectional markers in -*s*(*t*)-verbs are added after-*s*(*t*), since certain inflectional markers are deleted in front of -*s*(*t*)—in particular, the -*r* that marks present tense in Mainland Scandinavian and that appears in various places in the verbal paradigms of Faroese and Icelandic. However, although this is a reasonable conclusion from a Lexical Phonology point of view, according to which an element added postlexically should not influence elements that are added on an earlier cycle, it does not follow if we assume that phonological features are introduced at Spell-Out (Halle and Marantz 1993, 1994). On the latter approach, the form of a morpheme can be affected by any other morpheme in its environment.

7.5.4 The Derivation of Verb Second in Scandinavian

An apparent problem with the analysis of -*s*(*t*) that I have just sketched is that -*s*(*t*) moves with the verb to the second position, as (46) demonstrates.

(46)	*Klokk-a*	*sju*	*åpne-s*	*dør-e-ne*	*her.*	Norwegian
	clock-DEF	seven	open.PRES-*s*	door-PL-DEF	here	
	'At seven o'clock the doors are opened here.'					

However, so do reflexive particles in Swedish; see (47).

(47)	*Då*	*satte*	*sig*	*Kalle*	*i*	*soffa-n.*	Swedish
	then	sat.PAST	3.REFL	Kalle	in	sofa-DEF	
	'Then Kalle sat down in the sofa.'						

Moreover, several focus sensitive adverbs are known to yield exceptions to the verb-second order (see Nilsen 2002); an example is given in (48*a*). It seems clear that the sequence intervening between the first constituent and the verb here is too big to be a clitic on the verb, which is how Egerland (1998) analyses the focus element *bare* 'only'. But notably, when *bare* precedes the finite verb, as it does here, it only takes scope over that verb. Thus, [*rett og slett bare varma*] appears to be a constituent in this case. Also compare (48*a*) to (48*b*), where *bare* takes scope over the object or over the whole IP.

(48) a. *Da rett og slett bare varm-a hun supp-a.* Norwegian
then simply only heat-PAST she soup-DEF
'Then she simply just *heated* the soup (i.e. she didn't *make* the soup).'

b. *Da varm-a hun rett og slett bare supp-a.*
then heat-PAST she simply only soup-DEF
'The only thing she heated then was simply the soup.'
or 'All she did then was simply heat the soup.'

These facts indicate that V2 in Scandinavian is the result of fronting a phrase that contains the verb and, optionally, focus elements and reflexive particles (Nilsen 2002 draws a similar conclusion).[10] I would suggest that the fronted constituent is TP. Since arguments are not moved along, Scandinavian must then underlyingly be like Dutch and German, where arguments and adverbials precede the infinitival marker, which probably is no lower than T (cf. Kayne 1994: 52). The Dutch example in (49) illustrates this point.

(49) *Jan probeert elke dag {een/de} kikker te kuss-en.* Dutch
Jan tries every day a/the frog to kiss-INF
'Jan tries to kiss a/the frog every day.'

In the corresponding Scandinavian construction, the infinitival marker and the verb precede the object, as in (50).

(50) *Jan prøv-er å kysse {en frosk/frosk-en} hver dag.* Norwegian
Jan try-PRES to kiss a frog/frog-DEF every day
'Jan tries to kiss a/the frog every day.'

That is, the fronted phrase minimally crosses over the objects. In embedded clauses it moves no further, but in root clauses it moves up to the position following the topic. That is, unless a finite auxiliary is present, in which case the auxiliary moves, as can be seen in (36) and in (51).

7.5.5 Some Welcome Consequences of the Analysis

Several properties of the so-called -*s*(*t*)-passive can be explained on the assumption that -*s*(*t*) is the thematic subject. *Inter alia*, the -*s*(*t*)-passive is known to have modal effects. For example, the auxiliary *skal* 'shall' has a deontic modal reading in the -*s*(*t*)-passive in (51*a*) but a future reading in the periphrastic passive in (51*b*).

[10] This idea is also reminiscent of the proposals put forth by Hróarsdóttir (2000*a*, *b*) for Icelandic and by Taraldsen (2000) for Norwegian that the VO order results from remnant VP-fronting.

(51) a. *Brev-et skal sende-s.* Norwegian
letter-DEF shall send-*s*
'The letter must be sent.'

b. *Brev-et skal bli send-t.*
letter-DEF shall become send-PTC
'The letter will be sent.' (Vinje 1987: 136)

On the deontic reading of *shall*, there must be a bearer of the obligation. In the -*s*(*t*)-construction in (51*a*), the thematic subject -*s*(*t*) is a suitable candidate.[11] In the periphrastic passive in (51*b*), by contrast, there is no potential bearer of the obligation, and consequently, *skal* gets a future interpretation.[12]

The auxiliary *vil* 'will' is also ambiguous between a temporal and a modal reading in Norwegian. This is illustrated in (52a). However, future *vil* is necessarily a raising verb. When *vil* has its own external argument, only the modal reading survives, as (52*b*) shows.

(52) a. *Hun vil overføre penge-ne til min konto.* Norwegian
she will transfer money-DEF to my account
'She will/wants to transfer the money to my account.'

b. *Hun vil at penge-ne skal overføre-s til min konto.*
she wants that money-DEF shall transfer-*s* to my account
'She wants the money to be transferred to my account.'

In (53*a*) *vil* can be seen as a raising verb, with its surface subject originating as an argument of the lower verb. Consequently, *vil* can be interpreted as a tense marker here. As indicated, a modal interpretation, with the surface subject of *vil* as the controller of a lower argument, is also possible, but for pragmatic reasons this is not the most natural interpretation in this case. But interestingly, when the complement of *vil* is headed by a verb with -*s*(*t*), as in (53*b*), the modal interpretation of *vil* is forced upon us.

(53) a. *Penge-ne vil bli overfør-t til din konto.* Norwegian
money-DEF will become transfer-PTC to your account
'The money will (or *wants to*) be transferred to your account.'
(after Hegge 2004)

b. *Penge-ne vil overføre-s til din konto.*
money-DEF will transfer-*s* to your account
'The money wants to be transferred to your account.'

[11] In Nynorsk Norwegian, the -*s*(*t*)-passive is only considered good after modals. The reason may be that the arbitrary reference of the -*s*(*t*)-subject requires an intensional context in this variety.

[12] The presence of a 'non-speaker intention' in -*s*(*t*)-passives that Heltoft and Falster-Jacobsen (1995) point to can probably be explained along similar lines.

Apparently, the presence of -*s*(*t*) on the lower verb blocks the raising analysis of *vil*, which goes with the future tense interpretation. More precisely, either the surface subject of future *vil* must be the thematic subject of the lower verb, as is the case when *vil* gets a future tense interpretation in (52*a*), or else the thematic subject of the lower verb must be absent, as in the future tense interpretation of (53*a*). Now if the thematic subject of the lower verb is actually present in (53*b*), in the form of the clitic -*s*, we have an explanation for the fact that only the modal reading of *vil* is possible here.

A similar effect of the argument nature of -*s*(*t*) is seen in (54). It seems clear that in (54*a*), the surface subject of the higher verb *försökte* 'tried' controls the surface subject and thematic object of the embedded predicate *bli omvald* 'be re-elected', since the thematic subject of that predicate is missing. But in (54*b*), the thematic subject of the embedded predicate is -*s*, and consequently, the reading we get is something like 'the representative tried people to re-elect him', which is incoherent.

(54)	a.	*Representant-en*	*försök-te*	*bli*	*om-val-d.*	Swedish
		representative-DEF	try-PAST	become	re-elect-PTC	
		'The representative tried to be re-elected.' (Engdahl 1999: 7)				
	b.	*??Representant-en*	*försök-te*	*om-välja-s.*		
		representative-DEF	try-PAST	re-elect-*s*		
		'The representative tried to be re-elected.'				

Moreover, as Hedlund (1992) notes, there is no imperative with the -*s*(*t*)-passive, although the imperative is compatible with the periphrastic passive—witness the contrast between (55*a*) and (55*b*).

(55)	a.	*Bli*	*inte*	*rån-ad*	*i*	*Chicago*!	Swedish
		become	not	rob-PTC	in	Chicago	
		'Don't get robbed in Chicago!' (Hedlund 1992: 125)					
	b.	* *Råna-s*	*inte*	*i*	*Chicago*!		
		rob-*s*	not	in	Chicago		

The imperative requires a second-person recipient of the command. This requirement is met in (55*a*), but not in (55*b*), where -*s* interferes, so that the reading we get is comparable to 'Don't they rob you in Chicago!'. Hence, the imperative is not felicitous here.

I conclude that -*s*(*t*) has certain subject properties in -*s*(*t*)-passives. This is also suggested by the fact that subject-oriented adverbs in these constructions appear to target -*s*(*t*), while in periphrastic passives they target the surface subject, if they are possible at all (see Hedlund 1992; Engdahl 1999). As for the agentive PP that is seen in some of the -*s*(*t*)-passives above, I would suggest that the relation between -*s*(*t*) and the PP is comparable to clitic doubling. For space reasons I cannot go into that here, however.

7.5.6 A Look Outside Scandinavian

Allegedly, passive elements appearing outside the verbal inflection is not only found in Scandinavian. The *sja*-marker in Russian, for example, has properties which might be taken to suggest that it is syntactically similar to the Scandinavian -*s*(*t*). In (56), we see that -*sja* comes last in the verbal word and that it allows an agent-oriented adverb.

(56) *Dver' spesial'no ne otkry-va-la-s'.* Russian
door on.purpose not open-IMPF-PAST-*sja*
'The door was not opened on purpose.' (Borik 1998: 18)

And indeed, Borik (1998) suggests, albeit somewhat hesitantly, that -*sja* could be analysed as an argument. On my view, the example in (57) supports this analysis, since -*sja* here appears to represent an internal [+human] argument that is not coreferential with the subject, just like the Swedish -*s* in (41).

(57) *Sobaka kusa-et-sja.* Russian
dog bite-PRES.3SG-*sja*
'The dog bites (people).' (Enger and Nesset 1999: 37)

The argument analysis is also mentioned by Noonan (1994) in his discussion of the so-called impersonal passive in Irish, which is formed by adding to the verb an agreement marker that is different from any other marker in the paradigm and that appears to represent an unspecified subject; see (58).

(58) *Buail-eadh le buidéal é.* Irish
hit-PAST.PERF.IMPERS with bottle him
'He was hit with a bottle.' (Noonan 1994: 286)
or 'Someone hit him with a bottle.'

Noonan rejects the argument analysis, though, on the grounds that the impersonal marker cannot be an antecedent for pronouns and anaphors, as (59) demonstrates.

(59) **Glan-tar an duine féin.* Irish
wash-PRES.IMPERS the person self
(Intended meaning: 'One washes oneself.' (Noonan 1994: 288)

Now in Scandinavian, too, we see a contrast in this respect between the passive -*s*(*t*), which cannot be the antecedent of an anaphor—see (60*a*)—and arbitrary PRO, which can—see (60*b*). This is unexpected if the passive -*s*(*t*) is an argument with arbitrary reference.

(60) a. **Det vask-es seg sjøl.* Norwegian
EXPL wash-*s* 3.REFL self
b. *Det er best PRO å vaske seg sjøl.*
EXPL is best to wash 3.REFL self
'Washing oneself is best.'

It can be explained, however, if we assume with Frampton and Gutmann (2000) that a Tense head can attract a default phi feature if necessary. Thus, the non-finite embedded T in (60b) attracts a third-person feature, shares it with PRO, and ultimately with the reflexive. The reference of the passive -*s*(*t*), which bears no relation to Tense heads, cannot be narrowed down in this way, and consequently, it is not specific enough to be shared with an anaphor. The same reasoning is valid, I believe, for the Irish impersonal passive marker. Hence, it is possible that this marker represents a non-specific argument after all.

7.6 The Reality of Words

I have argued in this chapter that words are simply morpheme sequences that happen to share certain distributional properties. In principle, these properties are accidental—there is no component of the grammar that specifically produces words. Nor does the grammar make reference to words as such. Below the phrase level, grammar makes reference only to morphemes. Starting with individual morphemes, the grammar can produce complex syntactic heads, which necessarily have word properties, but it can also produce other morpheme sequences that we may or may not see as words.

Still, there seems to be no doubt that words do somehow exist. Notably, the term "word" is perfectly meaningful even to those who have no linguistic training. As pointed out by Sapir (1921) and by numerous researchers after him, words are psychologically real. (There are, however, languages where no word corresponding to the English *word* is part of the everyday vocabulary—see Dixon and Aikhenvald 2002.)

However, the psychological reality of words, and the lack of awareness of word-internal morphemes that is also often noticed, need not mean that the elements that are commonly termed words are grammatical entities or that they form a homogeneous class in any theoretically interesting way. Popular classifications are not necessarily tenable in science—recall that whales and fish were once taken to form a class. In my view, the class of words is just as spurious.

The psychological reality of words is probably a consequence of their distributional properties: since words are the minimal morpheme strings that can be used as utterances and that may be permuted more or less freely, words are the minimal linguistic units that speakers can manipulate consciously. It is therefore no surprise that speakers are generally aware of words. Word-internal morphemes, by contrast, cannot be consciously manipulated in the same way, and consequently, word-internal morphemes are less salient than words in the awareness of speakers.

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CHAPTER 8

1 . . . 3–2

PETER SVENONIUS

8.1 Introduction

This chapter is about basic word order, morphology, and their relationship to movement. I examine some cross-linguistically pervasive word-order tendencies in which the hierarchical structure is reflected in left-to-right order (1-2-3) or right-to-left order (3-2-1) or in a mix of the two (1-3-2). I show that for a wide variety of constructions in a wide variety of languages, there are basic asymmetries in these patterns, for example the relative scarcity of 2-3-1 orders and the tendency for right-to-left orders (2-1 and 3-2) to involve obligatory adjacency: optional adjoined material may intervene in left-right orders, but not in right-left orders, so that for example an adjunct X may appear in the pattern 1-X-3–2 but not in *1–3-X-2; hence the title of the paper, 1 . . . 3–2.

There are different ways to try to capture these ordering patterns; I explore one way, which is to extend the Minimalist theory of phrasal movement, involving probes and goals and feature-checking. This necessitates the introduction of strong features to drive overt movement, and sometimes the postulation of null functional heads to bear those features. I suggest that there are some positive consequences to these results, as opposed to the alternatives. One such positive consequence is a set of correct predictions about word-order typology, especially in conjunction with observed patterns of morphology.

Thanks to Gillian Ramchand and Kristine Bentzen for discussion and comments on an earlier draft. I have also benefited from conversations with Klaus Abels. Thanks also to an audience in Umeå where some of this material was presented in spring 2005.

8.1.1 Phrase Structure and Movement

Mainstream work has long recognized three types of movement, namely A-movement, A′-movement, and head-movement (cf. e.g. Rizzi 1990). Recent developments, however, have seen an increasing simplification of the base phrase structure rules (Kayne 1994; Chomsky 1995; Brody 1997) and, concomitantly, an increasing reliance on movement to derive basic word orders. The relationship of these movements to classical A, A′, and head-movement has generally remained unclear. For example, the basic word order of Dutch embedded clauses in many cases involves O–Aux–V, as illustrated in (1); if the base-generation rules are maximally simple, then the object is underlyingly adjacent to its selecting verb, so something has moved.[1]

(1) ... *dat Jan het boek kan lezen.* Dutch
that Jan the book can read
'... that Jan can read the book.'

Another example which raises related questions for the canonical analyses of movement is that given in (2).

(2) ... *at Jens helt må forstå oppgaven.* Norwegian
that Jens completely must understand the.assignment
'*... that Jens must completely understand the assignment.*'

Here, the adverb *helt* 'completely' modifies the VP 'understand the assignment', and does not include the modal *må* 'must' within its scope; but it precedes the modal. An analysis which moves the adverb to the left from an English-like position would not clearly fall into the classical typology of movements.[2]

In fact, if the core empirical claims of Kayne (1994) are correct, then there are no specifiers, adjuncts, or heads to the right; this has led to a great number of analyses postulating remnant and roll-up movements which are not clearly A, A′, or head-movements. For example, the German V–Aux order in (3) must involve VP-movement to the left of the auxiliary.

(3) ... *weil er das Buch gekauft hat.* German
because he the book bought has
'... because he has bought the book.'

Here I will suggest that a Minimalist theory of movement can elegantly handle all these cases, given one simple assumption: there are licensing probes for selec-

[1] Cf. Evers (1975) and Haegeman and van Riemsdijk (1986) for early analyses in terms of verb movement; see Koster (1994), Zwart (1996, 1997), Koopman and Szabolcsi (2000) for antisymmetric analyses involving DP-movement; see É. Kiss and van Riemsdijk (2004) and Wurmbrand (to appear) for an overview and additional references.

[2] See Nilsen (2003) and Bentzen (2005), discussed in more detail in section 8.4.2.

tional features which are postulated by the learner in cases where canonical positions involve surface adjacency of a functional head and the head of its selected complement. That is, a learner exposed to a string X–Y will under certain conditions assume a strong feature on a head F which ensures surface adjacency of X and Y in canonical configurations (or in some cases a pair of functional heads F and G). The strong feature will then always be present, even if X or Y happens to be null, and may have discernible effects on word order. This is crucially different from a surface adjacency constraint on X and Y. The natural assumption, then, is that learners are not at liberty to postulate surface-adjacency constraints; apparent surface-adjacency constraints are always the result of overt feature-checking. I return to the question of where adjacency holds in section 8.5.

8.1.2 An Itemization of Orderings

Given any three hierarchically ordered elements, where 1 is the highest and 3 the lowest, there are six logically possible orderings. For example, C[omplementizer] universally dominates T[ense], and T universally dominates V[erb], within a single clause, so that a language exhibiting C–T–V order (as in English *that (it) will rain*) can be characterized as exhibiting 1–2–3 order for these three elements (but without obligatory adjacency, so that one could also write 1 . . . 2 . . . 3). A language like German has 1–3–2 (or 1 . . . 3–2; *dass (es) regnen wird* 'that (it) rain will'), and a language like Japanese has 3–2–1 (*(ame ga) fu-ru to* '(rain NOM) fall-NONPAST C').

The logical possibilities are given labels as in (4).

(4) *a.* 1–2–3 Straight
b. 1–3–2 Curl
c. 3–2–1 Roll-up
d. 3–1–2 Skipping
e. 2–3–1 Constituent Fronting or Sinking
f. 2–1–3 Hopping

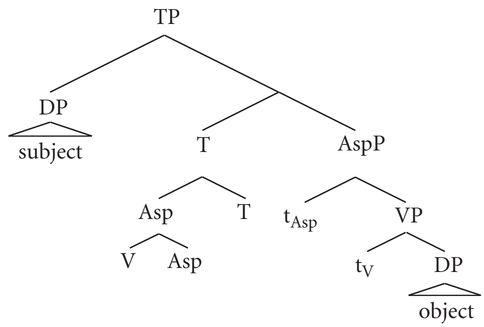
All these options exist in natural languages. For example, a simple *wh*-extraction in English like *What time will it start?* involves, at the same time, Skipping, 3–1–2 (3 being the *wh*-expression, and 1–2 being *it start*); Constituent Fronting, 2–3–1 (where 2–3 is *what time* and 1 is any of the elements crossed); and Hopping, 2–1–3 (where 2 is the modal *will* and 1 is the subject), among other orders.

However, these examples involve A′-movement, which is not the focus of this chapter. I concentrate here on what Greenberg (1963) called basic or "dominant" word orders, the most information-neutral word orders. When these are examined carefully, certain patterns emerge in which the Straight, Curl, and Roll-up orders have a special status.

8.1.3 Suffixes and Head Movement

It is widely assumed that suffixal morphology may attach to a verb through head-movement (see Julien 2002*b*, ch. 2 for extensive discussion).[3] Such movement leaves unaltered the relative order of other material in the clause; hence a language in which the verb moves to T would have the basic order VO if the object is licensed lower than T, as illustrated in (5).

(5)



Other assumptions about morphology make different predictions concerning basic word order. Bobaljik (1995, 2003) argues that morphology can be realized on an adjacent head (by morphological merger, cf. Embick and Noyer, in this volume), where Asp and V would be adjacent without movement in a tree like the one underlying (5), but T and V would not. On Bobaljik's proposal, suffixal Asp would not require V-movement, but suffixal T would be possible only after movement at least to Asp.

Adger (2003: 170) suggests that English verbal inflection is the realization on a low head (*v*) of inflectional features which are checked by an Agree operation. The effects are broadly compatible with the empirical motivations behind Bobaljik's proposal: if the agreeing features are subject to locality, so that, for example, tense features cannot be checked on V across an intervening aspectual node, then Bobaljik's results are preserved in that a verb will not be able to bear both T and Asp suffixes without movement. The idea that verbal inflectional features can be instantiated under an Agree relation is strongly supported by the study in Wiklund (2005) of tense-and aspect-copying constructions in Swedish. She shows that a tense or aspect feature can be copied from one verb to the next, but never across an intervening verb which does not share the same tense or aspect feature, as shown in (6), from Wiklund (2005: 29) (using her abbreviations, PPC for past participle and INF for infinitive).

(6) a. *Han hade velat hinna komma hit.*
he had wanted.PPC manage.INF come.INF here
'He had wanted to manage to come here.'

b. *Han hade velat hunnit komma hit.*
he had wanted.PPC managed.PPC come.INF here

[3] Head-movement has come under great scrutiny recently; see e.g. Koopman and Szabolcsi (2000) and Mahajan (2003) for discussion. I will return to alternatives in section 8.1.7.

c.	*Han*	*hade*	*velat*	*hunnit*	*kommit*	*hit.*
	he	had	wanted.PPC	managed.PPC	come.PPC	here
d.	**Han*	*hade*	*velat*	*hinna*	*kommit*	*hit.*
	he	had	wanted.PPC	manage.INF	come.PPC	here

Each of these examples means the same thing; the participial morphology only reflects a single perfect operator, even when it is repeated on two or three heads. Despite such examples, I assume that morphemes are normally direct reflections of the functors that they reveal to be present; evidence is provided throughout this chapter. However, examples like (6) suggest that other options are possible, in morphology, and at times in what follows I will suggest that something like Agree (or morphological merger) is responsible for morphological marking on a head, as it apparently is in (6*b*–*c*), at least.

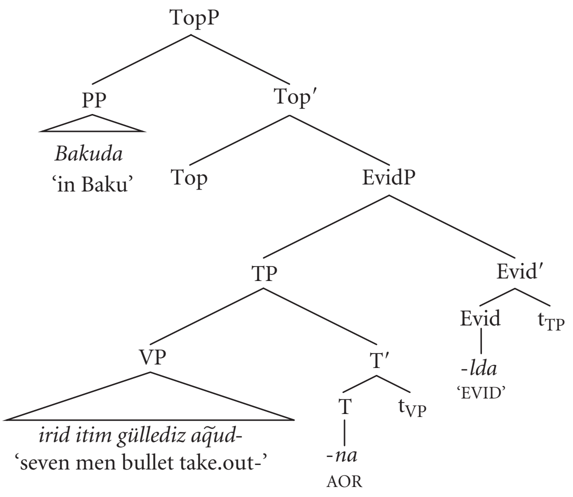
8.1.4 Suffixes in OV Languages

Julien (2000, 2001*b*, 2002*b*, this volume) and Holmberg (2000) propose phrasal-movement analyses for certain cases of suffixal morphology, analyses which are compatible only with OV word order. Specifically, they argue that many cases of suffixation involve phrasal movement to the left of a functional head. For example, Julien's (2002*b*: 116) analysis of the Lezgian sentence in (7) is depicted in (8).[4]

(7)	*Baku.d-a*	*irid*	*itim*	*gülle.di-z*	*aq̃ud-na-lda.*	Lezgian
	Baku-INESS	seven	man.ABS	bullet-DAT	take.out-AOR-EVID	

‘They say that in Baku seven men were shot.’

(8)



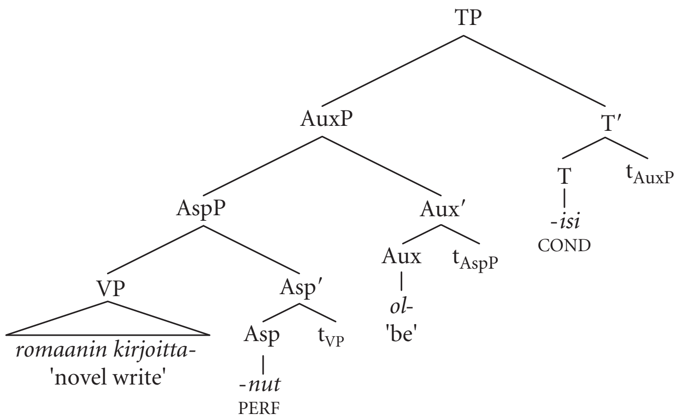
[4] Retaining Julien's glosses, which are retained from Haspelmath (1993: 148), for INESS[ive], ABS[olutive], DAT[ive], AOR[ist], and EVID[ential].

The tense marker will be adjacent to the verb only if independent factors conspire to make the verb phrase head-final; thus, a language in which the object normally follows the verb in VP cannot avail itself of this option. Parallel considerations hold for the adjacency of the tense marker and the evidentiality marker.

Similarly, in Holmberg's (2000) analysis of Finnish, auxiliaries may follow the verbs they select only if the verb phrase is verb-final, as illustrated in (10) for the sentence in (9) (from Holmberg 2000: 141–2).[5]

(9) *Milloin Jussi romaanin kirjoitta-nut ol-isi?*
when Jussi novel write-PERF be-COND
'When would Jussi have written a novel?'

(10)



If the participial affix -*nut* must be adjacent to a verb, then a language will only have this sort of option if the object (and other material to the right of the verb) moves (or stays) out of the way. Alternatively, there might be a combination: head-movement, morphological merger, or feature-checking to combine the inflectional suffixes with the verbal stems, but phrasal movement to place the inflected verbs to the left of their auxiliaries.

Here I develop a related account. However, note that the adjacency condition between an auxiliary and its complement is not absolute; it is disrupted by V2, for example, or by VP-fronting. This motivates a kind of feature-checking analysis over a morphological analysis, at least for the auxiliaries. Surface adjacency is important at least as the cue that checking is overt. Otherwise, in a language like English, where an auxiliary is regularly non-adjacent to the verb at the surface (whenever there is an adverb in between), checking between the verb and the auxiliary might be considered to be covert.

These selectional feature-checking movements can then be largely unified with classical A-movement; for example, only a verb with the correct morphosyntactic features can be attracted, and only the nearest such verb can be attracted. Differences between checking of selectional features and classical A-movement, I suggest,

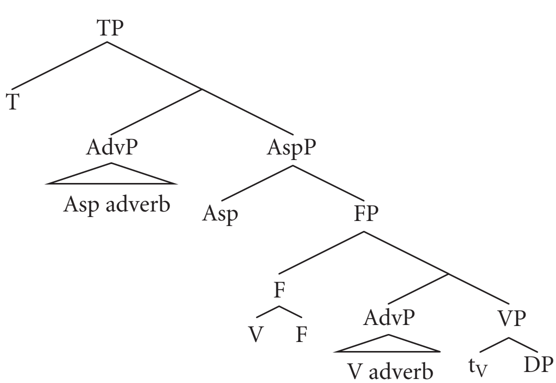
[5] Glossing the tense–mood and participial suffixes with COND[itional] and PERF[ective], respectively; cf. Holmberg et al. (1993).

have to do with differences between case and tense–aspect features. For example, in a sequence of auxiliaries, each can be considered to check the morphosyntactic features of its verbal complement, leading to a strict locality in which no verb crosses two auxiliaries; but a DP object might find its case-licenser relatively high up in the *Mittelfeld* (cf. Haeberli 2002), in which case it might cross several auxiliaries to get there.

8.1.5 Prefixes and VO

If a language has a functional head that is proclitic to the verb (suppose for the moment that that simply means "left-adjacent"), and if it has adverbs or other material which merge in the functional space between the prefix and the verb, then it must develop strategies to get the verb past that material. One possibility would be head-movement to a position just below the functional head in question. For example, if an aspectual head were prefixal, this might motivate a functional head F attracting the verb, as illustrated in (11); the Asp–V sequence would not be a constituent, and could not head-move further. The label "Asp adverb" is meant to suggest "adverb which must merge above Asp, in the space between Asp and T"; similarly for "V adverb".

(11)

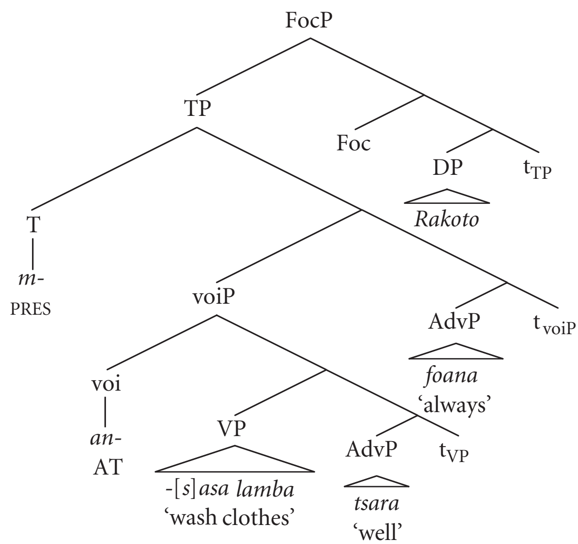


If right-adjunction is not an option for head-movement, then sequences of more than one prefix would have to be combined through phrasal movement. For example, F in (11) might attract the whole VP, and then another functional head below T could attract the AspP.

On independent grounds, Rackowski and Travis (2000) and Pearson (2000) propose analyses of Malagasy clause structure in which phrasal projections of the verb move leftward, as sketched in (13) for the sentence in (12); Malagasy has prefixal morphology, so these movements might actually be motivated, at least ontogenetically, by the prefixes.[6]

(12) *M-an-asa* *lamba* *tsara* *foana* *Rakoto.* Malagasy
PRES-AT-wash clothes well always Rakoto
'Rakoto always washes clothes well' (Rackowski and Travis 2000: 120)

(13)



The idea here is that the prefixal morphology signals to the learner that there are functional heads below the prefixes, attracting the selected feature. I have not depicted the heads responsible for movement. They would be "strong" heads of the sort standardly assumed to force overt movement. They would attract the categorial feature selected for. The strong value of the head I have labelled "Foc" does not seem to be associated with a prefix and therefore falls outside the discussion.

As Rackowski and Travis and Pearson note, higher adverbs such as *generally* and *already* precede the verbal complex and show left–right order, with the higher preceding the less high. If the order of adverbs in Italian is represented as in (14), then that in Malagasy can be schematized as in (15) (orders must generally be determined pairwise, and sentences with very many adverbs are typically degraded).

(14) Italian adverb order (Cinque 1999)

1		2		3		4		5		6
generalemente	>	*già*	>	*più*	>	*sempre*	>	*completamente*	>	*bene*
generally		already		anymore		always		completely		well

[6] The verb *sasa* 'wash' is prefixed by a prefix *an-* which indicates that the topic is an agent (cf. Guilfoyle et al. 1992; Travis 2000), hence the gloss 'AT,' and by an inflectional prefix *m-*, which I gloss 'PRES' for 'present', following Keenan (2000). The assumptions made here about the exact position of the adverbs can be questioned; what is important is that each verbal head becomes adjacent to the one below it, without changing relative order with it, by virtue of the F heads (not depicted) below the verbal heads.

(15) Malagasy adverb order (Pearson 2000; Rackowski and Travis 2000)

1		2				6		5		4		3
matetika	>	*efa*	>	*V*	<	*tsara*	<	*tanteraka*	<	*foana*	<	*intsony*
generally		already				well		completely		always		anymore

Clearly, this represents the three most common orders, 1–2–3 (if only the highest part of the sequence is considered), 3–2–1 (if only the lowest part is considered), and 1–3–2 (a sequence in which 1 is a high adverb, 2 is a medium-level adverb, and 3 is a low adverb). On the analysis here, the adverb sequences are epiphenomenal, the result of feature-checking-driven movement of verbal projections. Not every finite Malagasy verb has two overt prefixes; since the adverb orders remain the same even when the inflectional morphology is null, it must be assumed that the language learner sets the value of the functional heads (Fs below voice and Tense, in the depiction in (13)); in other words, movement is not driven directly by the prefixes, but the prefixes might provide cues to the learner that strong attracting heads are present (cf. Bobaljik 2003 for recent discussion of this matter).

Note that I have postulated just two functional projections in the middle field in Malagasy, whereas (15) identifies four adverbs in that same region. My analysis, as it stands, would predict that if two adverbs occurred in the same region, for example between V and voice, then they should not be reordered. That is not how the facts have been reported, though orders were, as noted above, always tested pairwise.[7] If ordering is strictly reversed postverbally, then either there are additional "strong" functional heads, unseen (as assumed by Pearson and Rackowski and Travis), or else the adverbs themselves motivate order-reversing movements.[8]

8.1.6 Typological patterns

The account makes certain successful typological predictions along the lines pioneered by Marit Julien. First, take the correlation between the order of auxiliaries and verbs with the order of verb and object (Greenberg's 1963: 85 Universal 16): the auxiliary precedes the verb in VO languages, and follows it in OV languages (see Dryer 1992: 100 for support from a larger sample). If the only factors at play in determining basic order are the location of licensing positions,

[7] There seems to be some variability in exactly where adverbs attach; cf. Ernst (2002) and Svenonius (2002). If there is a preference for at most one adverb in each space, then the most natural order for any pair of adverbs might be the reverse one, even if there are only two movements.

[8] It should be noted that Malagasy does employ suffixes, and a more complete account would have to handle these as well.

and if the default is Aux–V–O, then only overt checking of V against Aux under adjacency will lead to V–Aux order, and this can only happen in a language that is OV. Rare examples of O–Aux–V will be discussed below.

As Julien (2002*b*) argues, the sort of account of inflectional morphology outlined above makes some further predictions not made by other accounts. For example, free tense and aspect particles which do not require verbal adjacency strongly tend to be preverbal (Julien 2002*b*: 109).

If suffixes can be attached either by head-movement or phrasal movement, then suffixal languages might be VO or OV. But if a language has prefixal tense or aspect morphology, then there are limits to what head-movement can do, as outlined above; and phrasal movement will only be possible if each V-projection moving is head-initial. This means that prefixes are likely to develop only in VO languages, another fact which is borne out by the data. For example, a search in the *World Atlas of Language Structures* (Haspelmath et al. 2005) indicates that 82 per cent of the world's OV languages have exclusively suffixal tense and aspect marking, while only 31 per cent of the world's VO languages do; the rest have particles, prefixes, tone, or some mixture, for example both prefixes and suffixes. This is shown in the table in (16).[9]

(16)

	Verb before object	Object before verb
Suffixes	135 (31%)	414 (82%)
Prefixes	115 (26%)	23 (4.5%)
No affixes	96 (22%)	33 (6.5%)
Tone	7 (2%)	2 (<0.5%)
Mixed	83 (19%)	35 (7%)
TOTAL	436	507

The derivations outlined above predict that prefixal tense and aspect morphology could be combined with OV order if a language had a licensing position for the object which was higher than tense, and otherwise looked like Malagasy. This is rare; I conjecture that it is because objects are not normally licensed higher than tense. More discussion of object licensing positions follows in the next section.

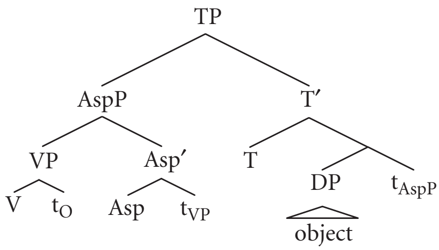
8.1.7 Phrasal Movement, Suffixes, and VO

I have shown how phrasal movement for the checking of selectional features under adjacency can lead to suffixes in OV languages and prefixes in VO languages.

[9] I have omitted from the calculations another 70 languages which were listed as having no dominant order of verb and object. See also the figures in Julien (2002*b*: 106–10).

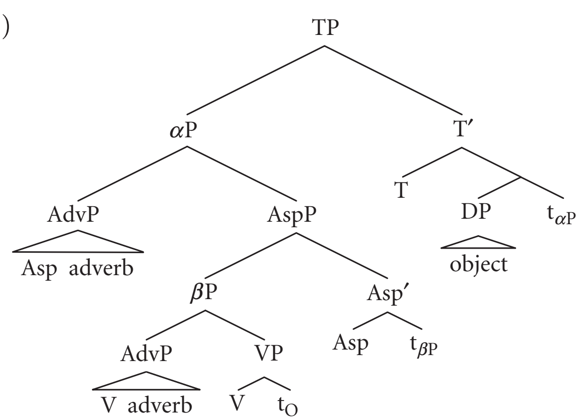
As noted, Julien and Holmberg assume that head-movement is an important mechanism in deriving suffixal morphology in VO languages. However, phrasal movement analyses are certainly possible for suffixal morphology in VO languages. Suppose, for example, that there is a licensing position for the object somewhere above an aspectual head but below a tense head. If VP moves to the left of Asp and AspP moves to the left of T, then T and Asp will be suffixal, and the resultant word order will be VO.

(17)



If a prefixing language had a licensing position for the object between T and Asp, the object would prevent adjacency of the T to its selected head, in any transitive clause. So on the plausible assumption that there are no licensing positions for objects higher than T, languages with prefixal T are correctly predicted to be VO. Of course, additional movements can be assumed, allowing additional word orders (cf. Koopman and Szabolcsi 2000).[10] I will discuss some such cases later. But if additional movements come at a cost, for example in being difficult to learn, then languages employing them are predicted to be rare. In the simplest case, the projections moving in (17) will be relatively large. Consider the same structure, but with adverbs above V and Asp. αP and βP are labels for whatever constituent includes the adverb and the verbal projection.

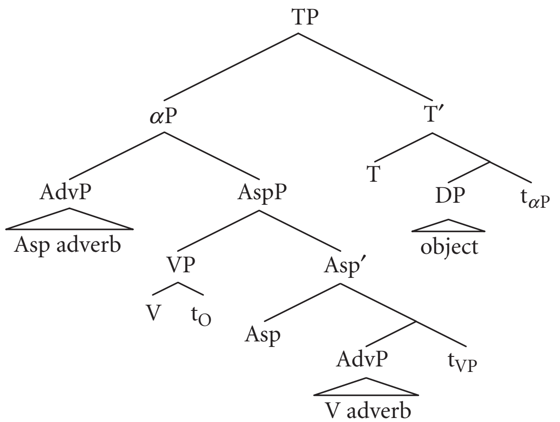
(18)



[10] Assuming Koopman and Szabolcsi's assumption that movement from within a specifier is impossible, plus the Extension Condition (Chomsky 1993), there would be an additional trace of the object in (17), between AspP and Asp′. This is also true of (18).

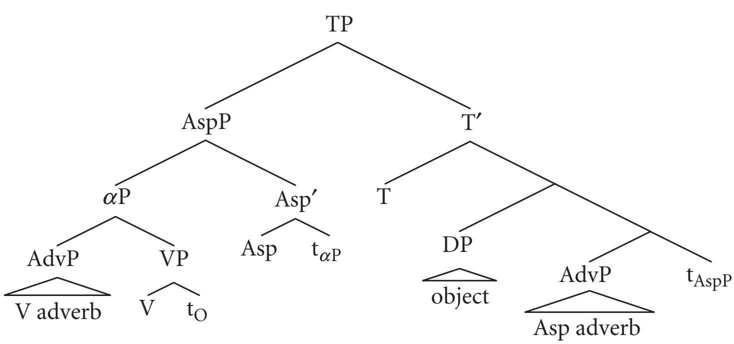
Had there been only one step of movement, then a larger or smaller V projection might have moved. But if a first step in which a smaller projection of V is moved is followed by a second step, then the lower adverb would be stranded below Asp, making it impossible for Asp to be adjacent to T. This is illustrated in (19), presumably an impossible structure (corresponding to an unattested language with an aspectual suffix on the verb and a postverbal tense particle which can be separated from the verb by adverbs).

(19)



A language which chose the option of attracting a small VP to Asp would have to have an additional step of movement to remove the adverb if it were to also suffix T by phrasal movement. The opposite set of choices, however, would not lead to such complications; assume a large projection of V moves, but a small projection of Asp; See (20).

(20)



This would lead to a VO structure in which certain *Mittelfeld* adverbs were VP-final (something along the lines of *completely read the book already*). Again, depending on what projections move for morphological reasons, adverbs may become reordered as a side effect, just as was seen above for the prefixal case. Here, the 3–2–1 order of V–Asp–T derives a 1–3–2 order of the adverbs: T–adverb (not shown), V–adverb, Asp–adverb (as in *probably completely read the book already*). Just as with Malagasy, adverb orderings in these structures tend to show the characteristic 1–2–3, 1–3–2, 3–2–1 orders, but as a side effect of the movement of verbal projections for licensing.

8.1.8 Directionality and Headedness

The idea so far is that there are two different ways in which a language can overtly check selectional features. Consider a simple example: in English, a modal requires an infinitive complement, while the auxiliary *have* requires a participial complement; and this requirement extends across intervening material.

(21) *a.* They must occasionally notice.
b. They have occasionally noticed.

By assumption, adverbs merge in the positions in which they are interpreted, and in projections with their own categorial features (Cinque 1999). By assumption, the auxiliary in each case must check selectional features on its complement (cf. Svenonius 1994). In English, we might assume that this happens by Agree or at LF. But what I am proposing here is that languages may check selectional features overtly in either of two ways. (1) They have a strong head F which attracts the category selected. This head is below the overt functor, prefix, or auxiliary that does the selecting. Adjacency between the prefix and the selected category follows only when the selected category happens not to have a filled specifier. (2) They attract a larger category to the left of the functor, suffix, or auxiliary that does the selecting. This only happens when the rightmost element in the constituent moved bears the morphosyntactic feature selected for, so that the selector and the selectee wind up adjacent to each other. I discuss the nature of the adjacency requirement further in section 8.5.

An analysis which rejects Kayne (1994) makes predictions different from those made here. For the German case sketched above, verbs could be claimed to be head-final; and for the Malagasy case, the adverbs could be claimed to be adjoined on the right. But I will show how the observed asymmetries of adjacency requirements follow from a movement account.

Of course, an analysis with right-headed projections could be combined with adjacency statements, but it would remain a mystery why V–Aux, but not Aux–V, is universally subject to an adjacency requirement.[11]

[11] See Svenonius (2000) and Holmberg (2000) for discussion of the fact that there seem to be virtually no V–O–Aux languages, and virtually no languages in which V–Aux can be interrupted by

On the account here, adjacency is the acquisitional cue for strong features leading to overt movement, and only movement leads to obligatory adjacency. V–Aux can be derived *only* by movement, whereas Aux–V could arise either from no movement, or from VP movement to immediately below the Aux. Furthermore, a directionality-of-headedness analysis does not predict the Norwegian pattern, but it is straightforwardly predicted by the analysis here as a combination of the kind of checker needed for head-final languages and the kind of checker needed for prefixal languages.

More specifically, given that a functional head, to ensure adjacency with its selected complement, may either have a strong feature or have a feature-checking head immediately below, as sketched in the preceding subsections, the possibility emerges that a language might have both. This, I argue in section 8.4.2, can lead to Constituent Fronting or Sinking sequences like those seen in Norwegian (cf. example (2)). The motivation for the learner would be Aux–V sequences as are typical of VO languages, but with low adjuncts to the left of the auxiliary, unlike the Malagasy case.

8.2 Morphology and the Mirror Principle

Much of the discussion above presupposes that we can confidently identify individual morphemes with specific positions in the functional structure of the clause, as argued by Cinque (1999). In this section I review the evidence that such assumptions are well founded.

The Mirror Principle has its origin in Baker (1985), where it was argued that a wide range of morphological facts suggested a syntactic solution. Baker's formulation of the Mirror Principle was as stated in (22).

(22) The Mirror Principle
Morphological derivations must directly reflect syntactic derivations (and vice versa). (Baker 1985: 375)

More recent work has generally identified the Mirror Principle with the idea that a morphological structure of the form X–Y–Z, where X is a head and Y and Z are suffixes, corresponds to a syntactic structure in which X is the complement of Y and Y the complement of Z (e.g. Belletti 1990 on V–T–Agr motivating a tree in which Agr dominates T). Brody (2000) states the idea as in (23).

adjuncts. Furthermore, in languages which allow multiple orders, Aux–V can be interrupted but not V–Aux. This is even true during tumultuous periods of language change; Hróarsdóttir (2000*a*,*b*) documents the change from OV to VO in the history of Icelandic and finds attested all possible combinations of V, O, and Aux except V–O–Aux.

(23) The Mirror Hypothesis
In syntactic representations, complementation expresses morphological structure:
X is the complement of Y only if Y-X form a morphological unit—a word.
(Brody 2000: 29)

The usual assumption is that there are complements which are not morphologically incorporated, that is, most people would have left out the word *only* from (23). Brody assumes that a non-incorporated dependent is always part of a specifier of some projection.

In any case, some version of Mirror is widely assumed. In this section I review some of its strengths and limitations.

8.2.1 Tense and Aspect

The languages of the world present a rich array of temporal and aspectual operators which comport themselves in revealingly orderly patterns (cf. Bybee 1985). This is plainly seen when expressions of Tense (T), such as future, present, or past, combine with expressions of aspect (Asp), such as perfective, imperfective, progressive, durative, or habitual; if T is numbered 1, Asp 2, and the verb 3, we see the patterns 1–2–3 as in (24*a*) (from Julien 2002*b*: 202), 1–3–2 as in (24*b*) (from Julien 2002*b*: 238), and 3–2–1 as in (24*c*) (from Brockaway 1979: 179).

(24) *a.* *n-kà-láá-boomba* Chibemba
1sS-FUT-PROG-work
'I'll be working tomorrow.' (Cinque 1999 (citing Givón))

b. *a wa kap-a tun.* Berbice Dutch Creole
he PAST cut-IMPF field
'He was cutting a field.'

c. *ni-k-kak-to-s* North Puebla Nahuatl
1sS-3sO-hear-DUR-FUT
'I will be hearing it.'

Julien (2002*b* app. 2) lists morpheme and function word order for 530 languages, organized into 280 different genera. Of those, 63 languages belonging to 47 genera are indicated as having both Tense and Aspect suffixes (counting "Perf[ective]" as Aspect and "Fut[ure]" as Tense). In all but three cases, Aspect is closer to the stem than Tense.[12]

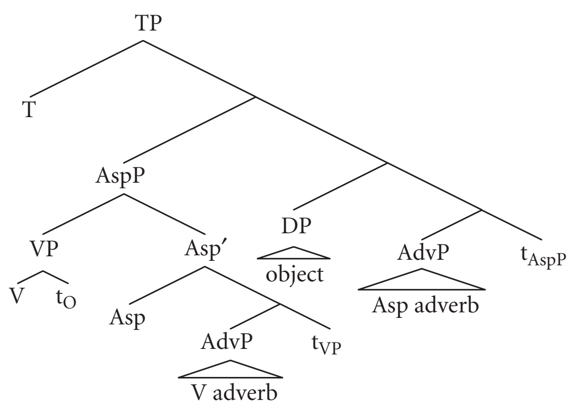
[12] Julien examines the putative counterexamples and concludes that they have been misanalysed, and do not constitute real counterexamples. Compare also the discussion of Athabaskan in Speas (1991), Hale (1997), and Rice (2000).

This strongly confirms the observations of Bybee (1985) and Cinque (1999) regarding the rigid ordering of morphemes. For present purposes it is immaterial whether the rigid order reflects an irreduceable syntactic template or independently motivated semantic compositionality, as long as it is recognized that the morphemes reflect syntactic positions. A morphological treatment of word structure which does not directly interact with syntax/semantics cannot explain these facts.

Going beyond the observations of Cinque and Bybee and others, Julien (2002*b*) also finds that the 1–3–2 pattern (T–V–Asp) is relatively common, while 2–3–1 (Asp–V–T) is rare.

1 . . . 3–2 (without adjacency of tense and the verb) is straightforwardly derived by movement of a verb-final projection to the left of Asp. The complex consisting of V and Asp might then also move to a position below T. Assuming that obligatory movement of clausal projections is driven by selectional features, and movement to the right of a selecting head is always by categorial selection, it would be AspP which moved to the position immediately below T, even though this does not lead to T–Asp adjacency in this case, since T is only adjacent to V; see the diagram in (25) (as with previous examples, an intermediate trace of the object would be necessary between AspP and Asp′ if extraction from within a specifier is not permitted; see n. 10).

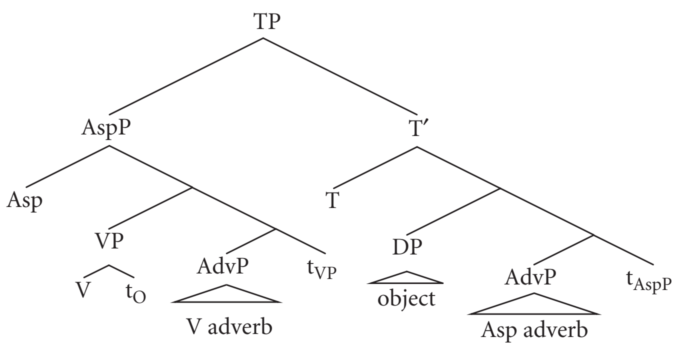
(25)



This structure would derive a 1–3–2 order for T–V–Asp, and a 1–3–2 order for T adverb (not shown), V adverb, Asp adverb. Apart from different possible positions for the object, no other combination of licensing movements would give the desired T–V–Asp adjacency. The surface adjacency of the [V–Asp] complex to T could be considered a sufficient cue that selectional features of T are checked overtly.

The assumptions made here can also explain Julien's observation that 2–3–1 order (Asp–V–T) is rare. First of all, it would involve a 2–3 complex moving across 1; by assumption, checking of selectional features to the left is under adjacency, and a [2–3] complex to the left of 1 does not strictly satisfy adjacency of 1 with its selected category, 2. Further evidence for the strictness of left-adjacency of a selected complement, compared with right-adjacency, is discussed below. Furthermore, even if it were assumed that adjacency to the [2–3] complex could satisfy T's checking requirements, further complications will be introduced by any V-adverbs the language might have. Assuming that the 2–3 complex is formed by V movement to the right of Asp, the first step of movement must be of a relatively small constituent, excluding all complements and adverbs. The second movement will almost surely necessitate an additional step of remnant movement: if a V-adverb is stranded by VP-movement, as in (26), then it will intervene between V and T, so that T will not be adjacent to the [2–3] complex; if the adverb had been carried along in the first step, then it would have disrupted Asp–V adjacency.

(26)



Thus, if basic word order is generally driven by checking of basic morphosyntactic features in the two ways discussed here, then Asp–V–T orders will be rare because they require movements that are not straightforwardly driven by such features (especially if the language has any overt material that merges between Asp and V).[13]

8.2.2 3–1–2: Skipping

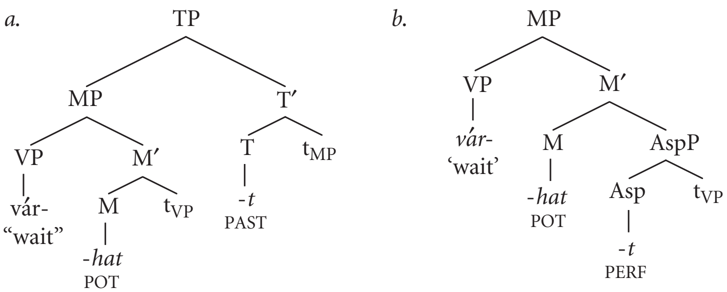
There are occasional cases where a position appears to be skipped, leading to 3–1–2 order ("Skipping" in the terms of (4)). Bartos (2004) provides two examples of 3–1–2 order in the verbal morphology of Hungarian. The examples involve the scope of a past or anterior marker, -*t*, relative to conditional mood, -*na*, and to potential modality, -*hat*.

[13] Russian is a language which appears to have the order Asp–V–T. Tense is suffixal (*pisu* '[I] write (present),' *pisal* 'wrote') but prefixes correlate strongly with perfectivity (*pisatj* 'write (imperfective, infinitive),' *napisatj* 'write (perfective, infinitive)'). See Svenonius (2004*b*,*c*) for a detailed analysis in which the aspectual prefix is phrasal, and each movement is motivated by an independently necessary feature.

(27) *a.* Vár-t-am vol-na. Hungarian
wait-PAST-1SG AUX-COND
'I would have waited' (M > T) or 'I wished to wait' (T > M)

b. *Vár-hat-t-ak.*
wait-POT-PAST-3PL
'They were allowed to wait' (T > Mod) or 'They may (possibly) have waited' (Mod > T) (Bartos 2004: 396)

Each form is ambiguous, so that both the 3–2–1 order and the 3–1–2 order are possible. The phonological form is invariant; an auxiliary stem is inserted in (27*a*) on either reading. Schematically, the second example might be sketched as follows.

(28)


When tense is interpreted inside modality, I label it "Asp"; the point is that in the second construction, corresponding to the reading 'they may have waited', the verb has apparently been attracted by M, which selects Asp rather than V directly (though the verb could have moved first to SpecAspP). This could not be a case of selectional feature checking. In fact, it might even be said to violate locality, if the AspP is of the right category to be an intervener between M and V. Possibly, the syntactic structure is a perfect Roll-up, and a metathesis occurs at some morpho-phonological level.

Descriptively, it is as if the morphemes themselves have a preferred order, a phenomenon documented for several cases of Bantu morphology by Hyman (2003). Supporting the metathesis idea is the fact that in some of Hyman's cases, the misplaced morpheme is repeated, appearing both in its Mirror position and in its "preferred" position, though only interpreted once. In any case, such examples of 3–1–2 order are relatively rare among sequences of selecting heads, and simple rules for deriving basic orders should not derive them.

More common cases of 3–1–2 occur when arguments of a verb move to a position to the left of a low auxiliary, as for example in Dutch O–Aux–V order; I will assume licensing positions for complements in the Mittelfeld along the lines of Zwart (1997) (see Haegeman 2000 for arguments that in some cases, a larger constituent moves across the verb, carrying various material along with licensing positions internal to that constituent).

8.2.3 2–1–3: Hopping

Auxiliaries are elements associated with tense, mood, or aspect, without the lexical content of main verbs but bearing verbal morphology (Steele 1978; 1981). Auxiliaries in V–Aux order pose no new problems for the ordering of morphemes since they are almost always suffixal, leading to 3–2–1 orders (e.g. V–Aux–T; cf. the Finnish example in (9)). Auxiliaries in Aux–V order, with suffixes, however, constitute cases of 2–1–3 order, if the auxiliary originates below the inflection it bears. Consider the Aux–V sequences in English (29a) or Northern Saami (29b).

(29) a. *We ha-d be-en ask-ing.*
1PL have-PAST be-PERF ask-PROG

b. *Le-i-mme lea-maš jearra-min.* Northern Saami
be-PAST-2DU be-PERF ask-PROG
'We (two) had been asking.' (Nickel 1990: 58)

This is the order that was called "Hopping" in (4), after Affix Hopping (as the analysis of English auxiliaries in Chomsky 1957 has come to be known). With relatively contentless auxiliaries like 'have' and 'be' in (29), one might assume that they are not ordered in the underlying sequence below their inflection,[14] but at least modal auxiliaries do seem to exhibit 2–1–3 order. Consider for example the Norwegian sentences in (30), especially the last one which displays an inflected modal.

(30) a. *Vi les-er boka.* Norwegian
we read-PRES the.book
'We read the book.'

b. *Vi ha-r les-t boka.*
we have-PRES read-PERF the.book
'We have read the book.'

c. *Vi ha-r kunne-t les-e boka.*
we have-PRES be.able-PERF read-INF the.book
'We have been able to read the book.'

However, there are other possible interpretations of the morphology even here. For one thing, at most one affix appears on the modal; for another, the modal paradigm is irregular. Even worse, it is not entirely clear where the semantic contribution of the perfective is introduced in the tree; perfective in Norwegian is expressed by a combination of 'have' and the participle, and the participle is also

[14] See Julien (2001*a*, 2002*a*) on the relationship of auxiliary 'have' to the functional structure.

used in the passive. Thus, it is difficult to be confident that the modal in (30) has really moved to the left of a perfective head.

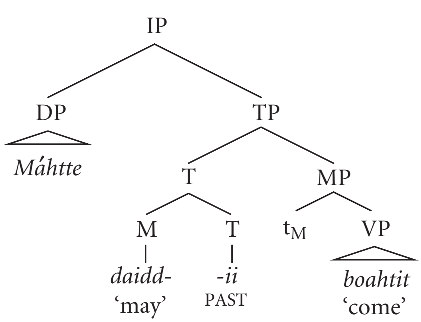
A less problematic case can be found in Northern Saami, as exemplified in (31). The modal *dáidit* (epistemic possibility) is completely regular. Forms with and without auxiliaries are given to show that the same verbal morphology appears on the modal as on the main verb.[15]

(31) a. *Moai* *bođ-ii-me.* Northern Saami
we.DUAL come-PAST-1DU
'We (two) came.'

b. *Moai* *dáidd-ii-me* *boaht-it.*
we.DUAL may-PAST-1DU come-INF
'It would have been possible for us (two) to come.'

At least this example, then, appears to involve at least one case of 2–1–3, or Hopping (and possibly two, if the infinitive ending on the main verb also projects). The head-movement analysis of this is sketched in (32). I use a third-person singular subject (a name) in the tree, to avoid the complication of agreement, which is discussed further in section 8.3.2.

(32)

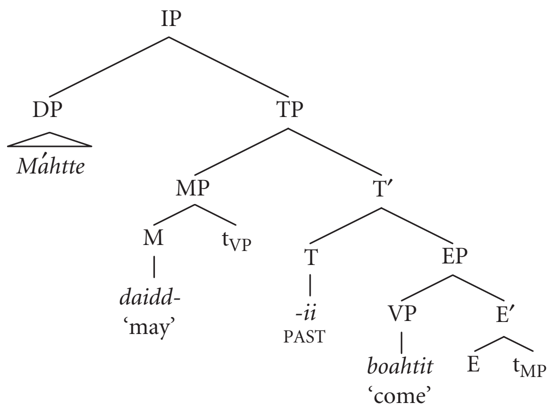


Pending the analysis of agreement, even this much morphology might be handled without movement in one of the ways discussed in section 8.1.3. But if the crucial step of combining the modal with the aspectual suffix is a case of phrasal movement, rather than morphology or head movement, this would entail a step of "evacuation", in which the complement of the modal is first lifted to a position just below that of the perfective suffix.[16]

[15] The stem change in the Northern Saami verb *boaht-*∼*bođ-* in 'come' is regular consonant gradation, and occurs in the modal as well: *dáid-*∼*dáidd-*; cf. Svenonius (to appear) for a detailed analysis. For arguments that *dáidit* is a modal verb, see Magga (1982); he prefers the participial form on the main verb (see his p. 75), but some other speakers accept the infinitive, as indicated here (thanks to Inger Anne Gaup and Kristine Bentzen for assistance).

[16] Compare Brody (1998, 2000), where non-morphologically integrated complements always occupy specifier positions, but where head-movement is mimicked by rules of morphological spell-out.

(33)



Here, I have labelled the evacuator for the ModalP "E", for Evacuator (compare Koopman and Szabolcsi's 2000 "stacking position" L). Any functional head that has such an E immediately below it will be able to suffix to a lower projection that it specifically attracts, as long as E attracts the complement category of that lower head. In essence, it makes sense to think of a functional head like this one as consisting of two parts, here T and E. This is what has come to be known as a Remnant-movement analysis, and can be thought of, in the derivation of 2–1–3 order, as an alternative to head movement. I will return to Remnant movement analyses in section 8.4.2.[17]

But now there is a puzzle. Julien (2002*b*) assumes that prefixal morphology, in general, is just a matter of functional heads in situ, interpreted as prefixes. Given the possibilities for head movement, or its equivalent, the question arises why her survey turned up (virtually) no examples of Asp–T–V order. Another way of phrasing the question would be to ask: why are auxiliaries like the Northern Saami ones not interpreted as prefixes? I propose an answer below.

8.2.4 Other Verbal Features: Cause

Further confirmation for the Mirror Principle comes from patterns of causative morphemes. Nearly half of the languages in Julien's (2002*b*) appendix with V-Asp-T morphology (29 of 63) explicitly identify a Causative morpheme between the root and the Aspect suffix: V-Caus-Asp-T, and none have a Causative suffix after Asp or T.[18]

[17] See also Müller (1998) for discussion of the formal properties of Remnant movement.

[18] There is a partial counterexample in Zuni, which Julien lists as having Aspectual morphemes before and after Caus; the full morpheme order she lists is:

OPl+Appl+SPl+V+Neg+Asp+Caus+Asp+SPl+T/M

T/M is a fused Tense–Mood morpheme, cf. Julien (2002*b*: 348) for other abbreviations.

(34) a. V+Caus+Asp+T (e.g. Mohawk, Turkish, Yidiɲ, Eastern Pomo, Guaraní, Georgian, ...)

b. *V+Asp+Caus+T (none)

c. *V+Asp+T+Caus (none)

Thus, even if the apparent T–Asp order were simply a matter of labelling (i.e. subordinate Tense is labelled 'Aspect'), the Asp–Caus order could not be.

An interesting wrinkle appears if we consider the relative order of V, Caus, and T or Asp with respect to the six orders given in (4). As expected, the orders 1–2–3, 1–3–2, and 3–2–1 are common enough. Nor is it surprising that we do not find any examples of Skipping of V (V–T–Caus) or Hopping of Cause (Caus–T–V).[19] However, there are surprisingly many examples of the Constituent Fronting order (Caus–V–T); I counted at least eleven in Julien's sample.

A possible factor leading to Caus–V–T order would be that the causative morpheme typically introduces an argument, an agent or causer, in its specifier. If each head has at most one specifier (Kayne 1994), then a causative head which introduced an agent could not also check selectional features on a complement. If Cause is a subtype of category V, however, a higher T or Asp node which checks V features could attract it. Furthermore, an attracting head which required adjacency to a verbal complement would become adjacent to a verb after attracting the 2–3 sequence.

Another potential factor may be that there is a significant constituent boundary above Caus, below Asp, namely the *v*P phase (Chomsky 2000, 2001; see Svenonius 2004*a* for arguments specifically motivating the *v*P phase boundary). For example, the opacity of the phase might lead to selectional features being invisible to further checking from outside.

8.2.5 Mirror in Nominal Morphology

Strong universal ordering tendencies have been manifest in the noun phrase since Greenberg's original (1963) observations; compare Hawkins's (1983) and Dryer's (1992) larger surveys, or Rijkhoff (2002) for a recent confirmation of, for example, the order Demonstrative–Numeral–Adjective–Noun, discussed below. What has not been discussed in as much detail is the fact that those categories which often arise as bound morphemes can be shown to exhibit mirror effects.

[19] A language like English, with an infinitive-taking causative verb (*make*), could be thought of as exhibiting Caus–T... V, or 2–1–3 (Hopping). On an analysis along the lines of Cinque's (2004) approach to Italian restructuring, this would be parallel to examples with auxiliaries.

For example, examining articles and plural markers, the order Art–Pl–N is easy to discern (cf. Dryer 1989 on the distinction between determiners and demonstratives); typical orders are 1–2–3, 1–3–2, and 3–2–1.

(35) a. *hun-lii-šta̰a̰n* Misantla Totonac
DEF-PL-armadillo
'the armadillos' (from MacKay 1999:312)

b. *in coyō-meh* Nahuatl
the coyote-PL
'the coyotes' (cf. Andrews 1975)

c. *dàr-ì-dé* Kotoko
gun-PL-DEF
'the guns' (cf. Demeke 2002)

There are some cases of other orders as well, but they are rare, as predicted by this model (see Svenonius 2006 for discussion).

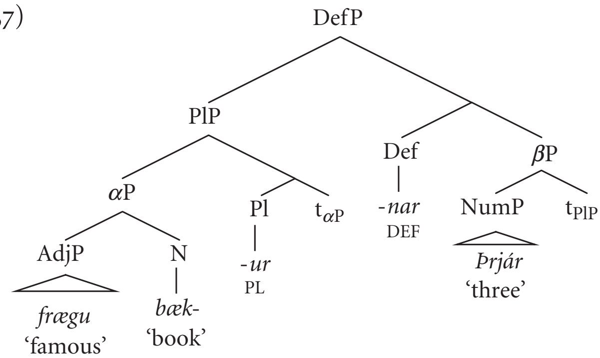
Dependents in the noun phrase, especially numerals and adjectives, can also be shown to fall into patterns reminiscent of the situation discussed above for adverbs in the clause. Greenberg's (1963) Universal 20 identifies the basic order Demonstrative–Numeral–Adjective–Noun, and further work has shown that these elements order themselves along the lines expected by a roll-up analysis of word order (see Hawkins 1983 and Dryer 1992 for the typological facts; Cinque 2005 and Svenonius 2006 for the roll-up analysis). As an example, consider the fact that in Icelandic, an overt demonstrative gives rise to the Straight Dem–Num–Adj–N order, while a definite noun phrase with a numeral but no demonstrative shows a Constituent Fronting order Adj–N–Dem, with roll-up of the plural and definite suffixes (Sigurðsson 1992; Vangsnes 1999).

(36) a. *þessar þrjár frægu bæk-ur*
these three famous book-PL
'these three famous books'

b. *frægu bæk-ur-nar þrjár*
famous book-PL-DEF three
'the three famous books'

This is what would be expected if Pl attracts a large constituent, for checking of the N under adjacency, and Def attracts a relatively small constituent, perhaps even the PlP itself, as illustrated in (37). The fact that the movement only occurs in the presence of the definite suffix suggests that they are connected, as on this analysis.

(37)



Compare the analysis in section 8.1.7 of a VO language in which a large constituent is attracted by Asp, but a small one by T, depicted in (20). There, Asp-adverbs were postverbal, like the numeral here being postnominal, while V-adverbs were preverbal, akin to the preverbal adjective here.

8.2.6 C, T, and the Verb

A final example of ordering that can be mentioned here is the ordering of relatively high functional structure in the clause, relative to the medium and low elements. For example, complementizers tend strongly to be initial in Aux–V languages (C...T...V, or 1...2...3), and tend (more weakly) to be final in V–Aux languages (V–T–C, or 3–2–1), as illustrated in (38*c*) with Japanese. Initial complementizers are also possible in V–Aux languages (C...V–T, or 1...3–2), as illustrated with German in (38*b*).

(38) *a.* ... *that it will rain.*

b. ... *dass* *es* *regnen* *wird.* German
that it rain will
'... that it will rain.'

c. ... *ame* *ga* *fu-ru* *to.* Japanese
rain NOM fall-NONPAST C
'... that it will rain.'

Head-final complementizers are extremely rare in languages that are not head-final in the V and T domains.

Question markers also give clues as to the location of the C-domain. In head-final sequences, they do not intervene between T or Asp and the verb, but appear furthest out from the stem (I label them "C_Q" here, assuming them to reflect a part of the C domain). (This observation draws again on Julien 2002*b*.)

(39) *a.* V+Asp+T+C_Q (e.g. Dongolese Nubian, Asmat, Aguaruna, Laz, Warao, Burmese, . . .)

b. *V+Asp+C_Q+T (none)

c. *V+C_Q+Asp+T (none)

This is consistent with the hierarchy of functional projections, C–T–Asp–V, and suggests that TP may front across C, in order to achieve T–C adjacency.

However, as Julien (2002*b*: 172) points out, it is not completely unknown to find question particles following an otherwise head-initial verb phrase, as illustrated in (40). Such languages manifest the order 2–3–1, assuming that the question particles are underlyingly higher in the clause than tense.

(40) *a.* *Ko ɔ yɔ rʌ-pɔl rʌmu a?* Temne
what s/he do the-rope yours Q
'What did s/he do to your rope?' (Sullay Kanu, p.c.)

b. *Khay lɔt hə Səgòn ʔə?* Sre
he go to Saigon Q
'Is he going to Saigon?' (Julien 2002b: 172)

c. *Ni neng xie Zhongguo zi ma?* Mandarin Chinese
you can write Chinese character Q
'Can you write Chinese characters?' Li and Thompson 1981: 547)

This appears to be more common than V–O–Aux order, suggesting that Constituent Fronting of TP across C is more common than Constituent Fronting of VP across Aux. The movement does not seem to derive adjacency of anything in particular and is therefore not accounted for by the mechanisms discussed here.

8.2.7 Summary of morpheme ordering

I have shown that there is very strong support for a T > Asp > V hierarchy, and for widespread Curling and Rolling-up of these elements, with far less Skipping, Hopping, and Constituent Fronting. The same is generally true for C > T > Asp > Cause > V and for Art > Pl > N. Negation and universal quantification are manifested in many different places in the clausal structure, and Agreement appears to behave somewhat differently from the semantically interpretable categories.

(41)

	C–T–V	T–Asp–V	T–Cause–V	Art–Pl–N
1–2–3	typical	typical	typical	typical
1–3–2	typical	typical	typical	typical
3–2–1	typical	typical	typical	typical
3–1–2	rare	rare	rare	rare
2–3–1	occasional	rare	occasional	rare(?)
2–1–3	rare	rare	rare	rare

I have suggested that the patterns can largely be explained in terms of checking of selectional features: either by attraction of the selected category to a position immediately below the selecting head, or by adjacency to the left. The learner posits whatever strong features are needed to ensure that one of these two configurations obtains; in nearly all the cases discussed, there were plausible analyses in terms of a single strong feature.

Some examples of Curl and Roll-up orders, for example those among modifiers, were explained as epiphenomenal, a side effect of the way the functional projections roll up.

Examples of Skipping, Hopping, and Constituent Fronting are all exceptional and require additional assumptions. For example, Hopping was seen to require an E projection below the selecting head, to evacuate the target of movement. Such structures are therefore correctly expected to be rare. Skipping and Constituent Fronting structures are typical of A′ attraction and of case-licensing; thus they may in general involve categories that have a more complex semantic interpretation and which can enter into argumental or quantificational relations, in addition to simple selectional feature-checking.

8.3 Neg and Agr in the Functional Sequence

I have focused on the selectional relationships among overt morphemes in the clause which express modal, temporal, and aspectual notions, and suggested that they enter into selectional relations which ignore intervening phrasal elements such as adverbs. Negation is another overt morpheme in the clause which plays an important role and is very salient; but I argue here (in agreement with Julien and Cinque) that the position of negation varies so much across languages that it is not a good indicator of syntactic structure in broad, cross-linguistic surveys such as this one.

I also show (again following in essence the conclusions of previous work such as that of Julien and Cinque) that agreement is not a good indicator of clause structure, when working with patterns of data across many languages.

Agreement and negation may have fixed positions in the clause structure in an individual language, but unlike the rigid order of Tense over Aspect, they do not have a cross-linguistically stable position in the hierarchy of functional projections, or what Starke (2004) calls *fseq*, the functional sequence.

8.3.1 Negation

Orders of T–Asp–V, T–Caus–V, and so on were demonstrated earlier to show considerable cross-linguistic regularities. Negation provides a startlingly different picture. In Julien's (2002*b*) sample, we find suffixal negation within Aspect, between Aspect and Tense, or outside Tense.

(42) *a.* V+Neg+Asp+T (e.g. Guraní, Turkish, Nivkh, Zuni, Mikir, . . .)
b. V+Asp+Neg+T (e.g. Aguaruna, Dongolese Nubian, Garo, Haruai, . . .)
c. V+Asp+T+Neg (Warao)

Suffixal examples of Negation outside Tense are relatively scarce in the sample. This might suggest that, as with the few cases of Aspect outside Tense, the examples bear closer scrutiny. However, preverbal Negation is very commonly outside Tense, whether as a prefix, an auxiliary, or a particle, in stark contrast to preverbal Aspect.

Zanuttini (1997), examining the location of negation words in Romance languages, finds the same striking range of variation, ultimately postulating four distinct Negation heads in the clausal structure. Cinque (1999) also fails to find any system in the location of Negation: "the evidence points to the possibility of generating a NegP on top of every adverb-related functional projection, even simultaneously, up to a certain point" (Cinque 1999: 126).

This suggests that unlike Force, Tense, Aspect, and Cause, the category Negation is not a fixed part of the functional sequence. The idea would be that Negation may be part of an operator which applies to Tense, or to Aspect, or even to the Event below the Aspect. Ramchand (2004) proposes just such an account for Bengali; there, two different negation markers appear, one which is only compatible with perfective aspect, and another which is used everywhere else. Ramchand proposes that the two Negations are different kinds of operator, and shows that they give rise to subtly different effects.

A similar situation can be observed in certain northern Swedish dialects, where the prefixal negation *o-* can be used in the perfect tense only (as noted in Marklund 1976). In standard Swedish, *o-* appears productively on adjectives; therefore I gloss it 'un-'.

(43) *a.* *I hæ inte skrive breve.* — Northern Swedish Skellefteå dialect
I have not written the.letter
'I have not written the letter.'

b. *I hæ o-skrive breve.*
I have un-written the.letter
'I have not written the letter yet.'

The meaning of these two variants is subtly different; the prefixal form can be used only if there is a reasonable expectation that the event will occur, or if it is conventional that it should occur as suggested by 'yet' in the translation. This is consistent with the prefixal negation actually being interpreted in the aspectual system, where it is expressed.

Another candidate for a feature of heads which is not ordered in a universal functional sequence is Universal Quantification. Universal Quantification appears to be a component of the meaning of various elements in the nominal domain, such as *each*, *every*, and *all*, but also of various adverbs such as *always* and *necessarily* and modals like *must*. Just as with Negation, the elements which include Universal Quantification as part of their meaning are ordered by other factors; so that the temporal adverbial *always* is located as a temporal adverbial, and the modal *must* will be located according to whether it is a universal quantification over possibilities (epistemic modality, relatively high) or obligations (deontic modality, relatively low).

8.3.2 Agreement

Another category which has proved challenging for an explication of *fseq* is that of agreement. As with negation, we find agreement suffixes inside aspect, between aspect and tense, and outside tense; in fact, there are far more examples of each, as affixal agreement is far more common than affixal negation. The usual position for subject agreement is outside tense, but this is only a tendency; for instance, for suffixal tense and agreement, Julien (2002*b*: 249) counts 64 languages with V–T–S Agr and 16 languages with V–SAgr–T order.

It may be that as with negation, the different patterns will turn out to have subtly different effects; for example, if agreement outside tense correlates with a specificity requirement on subjects, and agreement inside tense does not. However, I know of no evidence that this is the case.

One detailed study has shown something quite different. Trommer (2003) examined 100 languages in which it is possible to discern separate morphemes for subject person-agreement and subject number-agreement. He found a strong tendency for person to *precede* number; in other words, the pattern in (44) is far more frequent than that in (45).[20]

[20] In 24 cases in Trommer's sample, a language has one morpheme which solely identifies either person or number, and another which combines both features. For example, Nahuatl verbs sport a person-number prefix and, if the subject is plural, a plural suffix; Trommer counted such examples as Pers+V+Num, on the grounds that the suffix is solely number. However, he also shows that the pattern seen in (44) and (45) also holds of those 56 cases in which each morpheme expresses only person or only number.

(44) Normal: person precedes number
a. Pers+Num+V: 9 languages
b. Pers+V+Num: 39 languages
c. V+Pers+Num: 22 languages

(45) Unusual: number precedes person
a. Num+Pers+V: 1 language
b. Num+V+Pers: 1 language
c. V+Num+Pers: 8 languages

Trommer examines the counterexamples and suggests that at least in most cases, there are mitigating factors (e.g. the number suffix is not really number, but a distributive marker; or the agreement affix has some special properties). The pattern cannot straightforwardly be accounted for by a Mirror Principle-type approach. Pers > Num > V would yield (44*a*) (1–2–3) and correctly predicts (44*b*) (1–3–2) to be common, but wrongly predicts (45*c*) (3–2–1) to be a more natural order, and more seriously, fails to explain why (44*c*) (3–1–2, Skipping) is so common. Number above Person would get (44*c*) right, but wrongly predict (45*a*) and (45*b*).

There is one hazard in Trommer's methodology which might lead to under-reporting of pattern (45*c*). Compare the Icelandic pattern for the verb *heyra* 'hear' (in the preterite) in (46), to that of the made-up language "Nicelandic".

(46) Icelandic preterite, weak verb

	Icelandic	Nicelandic
1sg	heyrði	heyrði
2sg	heyrðir	heyrðri
3sg	heyrði	heyrði
1pl	heyrðum	heyrðmu
2pl	heyrðuð	heyrððu
3pl	heyrðu	heyrðu
	'hear'	'hear'

The real Icelandic paradigm, if parsed into V–T–Num–Pers/Num, is an example of the somewhat unusual pattern (45*c*) (Icelandic was not in Trommer's sample). The made-up language Nicelandic is an example of the common pattern (44*c*). I wonder, though, if a grammar writer is not more likely to parse an example like Nicelandic into two agreement suffixes, because the final number morpheme is salient, whereas in the Icelandic example, it is easier to regard the whole sequence after tense as a single Pers/Num portmanteau. That is, the pattern in (44*c*) might *seem* more common than the one in (45*c*) because grammar writers identify it more frequently.

In any case, such under-reporting, if it has occurred, is unlikely to account for the whole of Trommer's observation, and leaves unaffected the surprising commonness of (44*b*), so it seems to be true that there is a left–right asymmetry here. In one sense the result is completely expected on the approach taken here. Reordering of clausal constituents is driven largely by issues of formal licensing. Different modal and temporal functors license each other, but the relationship of these functors to arguments and to agreement is very different.

Another left–right order asymmetry is in the order of subject and object agreement: subject agreement is more likely, cross-linguistically, to precede object agreement, though not to the same extent that subjects tend to precede objects, as illustrated in the table below with data from Haspelmath et al. (2005).[21]

(47)

SUBJECT AND OBJECT			AGREEMENT AFFIXES		
S before O	1017	(83%)	S before O	96	(56%)
O before S	39	(3%)	O before S	57	(33%)
both possible	172	(14%)	both possible	19	(11%)
TOTAL	1228		TOTAL	172	

To conclude this section, the position of agreement morphology or of negation does not seem to give the same sort of direct evidence for clause structure as is given by the position of functor morphemes expressing causation, tense, aspect, modality, and other concepts.

8.4 Verb Clusters

The general pattern for verbal clusters is adequately described as Curling and Rolling-up of a universal hierarchy of functional heads along the lines of Cinque (1999). A few cases of Hopping, Skipping, and Constituent Fronting are encountered.

The overall pattern for Germanic languages is neatly summed up in Wurmbrand (2004, to appear), roughly as given in (48). Some OV languages have 1–3–2 (examples are provided in this section). Straight, Roll-up, and Curl orders are the most widely attested ones for sequences of verbs.

(48) *a.* 1–2–3 Very widespread: Afrikaans, Dutch, Swiss German, West Flemish, usually only if 2 is Modal; English, Mainland Scandinavian, Faroese, Icelandic;

[21] The main criterion used in Haspelmath et al. (2005) for identifying Subject and Object is thematic role; in fact, the agreement map there is actually labelled in terms of A[gent] and P[atient] agreement, which I have changed here to S and O simply for consistency with the labels for word order, which use the traditional S and O. There is data in the Atlas on S–O order for many more languages than there is on S–O agreement; furthermore, the figures in the right half of the table here omit another 187 languages which do not simultaneously express both S and O agreement on the verb and 20 languages with “fused” S and O agreement.

b. 1–3–2 Common: various German and Austrian dialects; Afrikaans and Dutch if 2 is Auxiliary 'have';
c. 3–2–1 Typical for OV: Standard German, Frisian, various Swiss, Austrian, and German dialects;
d. 3–1–2 Very restricted: Dutch, Afrikaans, West Flemish if 1 is Modal and 2 is non-modal Auxiliary; some other dialects in other situations;
e. 2–3–1 Very restricted: Afrikaans and West Flemish in *infinitivus pro participio* context;
f. 2–1–3: Unattested.

The similarity to morphological patterns is apparent. As shown in section 8.2, the general pattern for morphological exponents of modality, tense, and aspect abides quite strictly by the Mirror Principle; Straight, Curl, and Roll-up orders are by far the most common, and unusual Hopping, Skipping, and Constituent-Fronting orders indicate more complex derivations. A few cases of Hopping, Skipping, and Constituent Fronting were encountered. In those cases, it was suggested that factors other than the simple requirements of categorial feature-checking must be at play.

In this section, I show how verb clusters shed some additional light on the mechanisms responsible for word order variation.

8.4.1 3–2–1 Verb Clusters

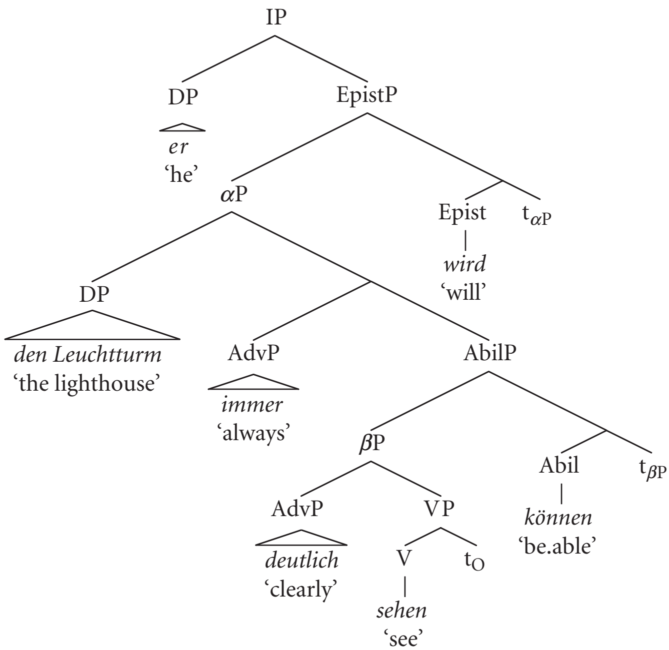
OV languages tend to have V–Aux order, as noted. Sequences of two auxiliaries give rise to 3–2–1 order, for examples like the German one in (49).

(49) . . . *weil er den Leuchtturm immer deutlich sehen können wird.* German
because he the lighthouse always clearly see be.able will
'. . . because he will always be able to clearly see the lighthouse.'

All else being equal, this 3–2–1 order should be the result of verbal projections moving leftward for checking under adjacency of their selectional features.[22] If a language can have such sequences, then there must not be material stranded after the first movement; such material would block adjacency after the second step of movement. For example, the clause in (49) might be assumed to have a structure like that displayed in (50).

[22] See Hinterhölzl (1997, 1999, 2000) for detailed phrasal movement analyses of German verb clusters and clausal complementation structures.

(50)



Note that the checking relation, by hypothesis, is between *wird* (which I label "Epist" above, for Epistemic modal) and its infinitive complement (here headed by *können*, which I label "Abil" here, for Ability modal); but what is attracted is a much larger structure, the complement of *wird* itself. The same is true of the attraction of the infinitive verb *sehen* by the ability modal; I label it βP, just to have a label. If the modals attracted the infinitive-headed projections, then the adverbs would be stranded to the right; for instance, *sehen* would leave *deutlich* 'clearly' to the right of *können*, and *können* would leave *immer* 'always' (along with *deutlich*) to the right of *wird*. The movements indicated here either mean that an attracted infinitive pied-pipes the adverbial material above it, or that attractors in German specifically target the complement of the modal.

This structure, like a head-final one (assuming object movement to the left), displays the constituency sketched in (51).

(51)	… *weil*	*er*	*den*	*Leuchtturm*	*immer*	*deutlich*	*sehen*	*können*	*wird.*
	because	he	the	lighthouse	[always	[[clearly	see]	be.able]]	will

Constituency tests confirm that this constituency is indeed natural (though there are other possibilities as well, including a lower position for the object, if indefinite, and certain alternative positions for the adverbs).[23]

[23] For example, *immer* may attach lower, and thereby front with *sehen*, stranding *können* (*Immer deutlich sehen wird er*. . . .), but then with a different meaning, one in which 'always' is interpreted inside the scope of *können*. Thanks to Klaus Abels for discussion of the German data.

(52) *a.* *Deutlich sehen wird er den Leuchtturm nicht unbedingt immer*
clearly see will he the lighthouse not necessarily always
können.
be.able German
'To clearly see the lighthouse, he will not necessarily always be able.'

b. *Immer deutlich sehen können wird er den Leuchtturm nicht*
always clearly see be.able will he the lighthouse not
unbedingt.
necessarily
'Always clearly be able to see the lighthouse, he won't necessarily'

Thus, although other analyses are certainly possible, a fairly straightforward analysis is available in terms of movement to basic positions of licensing under adjacency, which are directly motivated on the basis of easily perceptible evidence, if something like Kayne's (1994) LCA holds. In the next sections I turn to some more complex cases.

8.4.2 Sinking: The Surprisingly Low "1"

Note that the above analysis presupposes that all VP-internal material is independently moved leftward, by overt licensing requirements (as in Zwart 1997). If the language has no adverbial material that would naturally appear between V and Aux, then the only difference between overt checking of the verb's selectional features and covert checking would be the difference between V-Aux and Aux-V order. In other words, if something occurred to prevent overt checking from occurring, the word order might not turn out appreciably differently. Consider, in this light, the *infinitivus pro participio* (IPP) construction in the German example in (53): the modal resists participial morphology, and fails to move to the left of the participle-seeking auxiliary.

(53) . . . *daß er vor der Abreise die Blumen noch hätte gießen sollen.*
that he before the departure the flowers still had$_1$ water$_3$ should$_2$
'. . . that he had still been supposed to water the flowers before leaving.'

Here, the object is in a higher licensing position for independent reasons. Thus, it is not immediately clear whether the complement of 'have' has moved at all. In fact, certain "small" elements occasionally do surface between the auxiliary and the main verb in this construction, in the so-called "Verb projection raising" construction (example from Wurmbrand, to appear).

(54) . . . *daß er vor der Abreise noch hätte Blumen gießen sollen.*
that he before the departure still had$_1$ flowers water$_3$ should$_2$
'. . . that he had still been supposed to water the flowers before leaving.'

As Wurmbrand notes, only "small" complements can appear this low; the object here can be thought of as a part of a predicate, 'to do flower-watering'. An object with any modifier, or one which is referential, would move to a higher licensing position, as in (53) above.

If the IPP complement of the auxiliary did not move at all, then the prediction would be that any adverb which is lower than tense should intervene between 'have' and the main verb. VP-modifying adverbs such as *vorsichtig* 'carefully', may occur to the right of the first auxiliary, with or without the object also remaining there.

(55) a. . . . *daß er vor der Abreise die Blumen hätte vorsichtig gießen*
that he before the departure the flowers had_1 carefully water_3
sollen.
should_2
'. . . that he had been supposed to carefully water the flowers before leaving.'

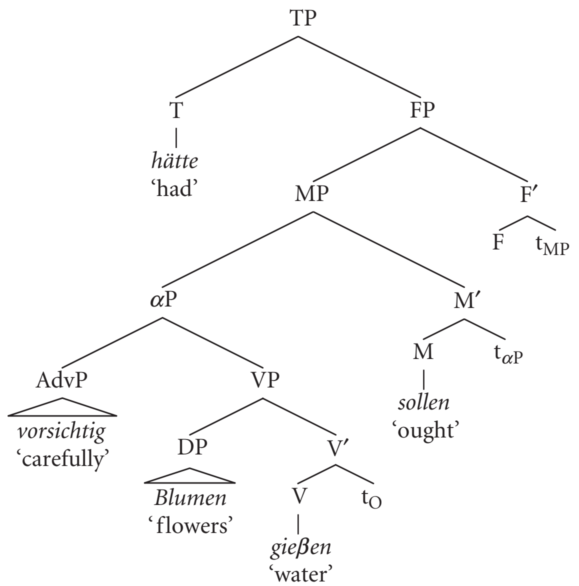
b. . . . *daß er vor der Abreise hätte vorsichtig Blumen gießen*
that he before the departure had_1 carefully flowers water_3
sollen.
should_2
'. . . that he had been supposed to carefully water the flowers before leaving.'

In cases like this, we may conclude that there is no surface-adjacency constraint on the auxiliary 'have' and the VP following it. Mostly, the verb-cluster effect here comes from the adjacency of the main verb and the modal, facilitated by the fact that this OV language has relatively high licensing positions for VP-internal material.

However, there are reasons to believe that the complement of 'have' is not simply in situ. Consider the assumption made earlier that licensing positions for objects are not ordinarily above T. Here, the neutral licensing position for a full DP object is to the left of the finite auxiliary. Furthermore, various *Mittelfeld* adverbs do show up before *hätte* 'have', for example *noch* 'still' in Wurmbrand's original example in (54). If *noch* is merged between the modal *sollen* 'ought' and the tense, as would be appropriate for its interpretation, then it would follow 'have'; and if the projection of the modal moved to a position right after 'have', then *noch* would either be carried along (intervening) or stranded (to the right of the modal). To help see this, I provide a partial structure in (56); neither of the two plausible merge positions for the temporal adverb are possible, in terms of linear order.[24] The adverb, like a full DP object, must move to the left of 'have'.

[24] The two positions would be those structurally between *sollen* and *vorsichtig*: above the trace of α, to the right of *sollen*, or inside αP, to the left of *vorsichtig*.

(56)



What is attracted by F, the functional head just below the auxiliary, is the category selected by the auxiliary. This predicts that the only material that can intervene linearly between 1 (*hätte*) and 2 (*sollen*) is material in the specifier of 2.

The prohibition here of Asp adverbs is not an isolated fact about IPP; 1–3–2 and 1–2–3 orders in verb clusters in OV languages show a stricter adjacency than would have been expected on an account in which the complement of the highest auxiliary did not move at all. In many cases, adverbs precede the highest auxiliary, even relatively low "verb phrase" adverbs. Consider the Dutch example in (57), in which a modal is "1" in a Straight order, and is preceded by an adverb over which it takes scope.[25]

(57) . . . *omdat Jan het probleem helemaal moet hebben begrepen.*
because Jan the problem completely must$_1$ have$_2$ understood$_3$
'. . . because Jan must have completely understood the problem.'

The adverb *helemaal* 'completely' modifies the degree of understanding, not the degree of modal necessity (compare the Norwegian example in (2), nearly identical except for VO order). In a language like English, which does not overtly form verb clusters, this relationship is seen directly, as the modal precedes the adverb. In Dutch, however, adverbs necessarily precede the verbal cluster. Thus we can infer that a licensing movement has taken place, removing a constituent containing the adverb from the space to the right of the modal. Descriptively, the phenomenon

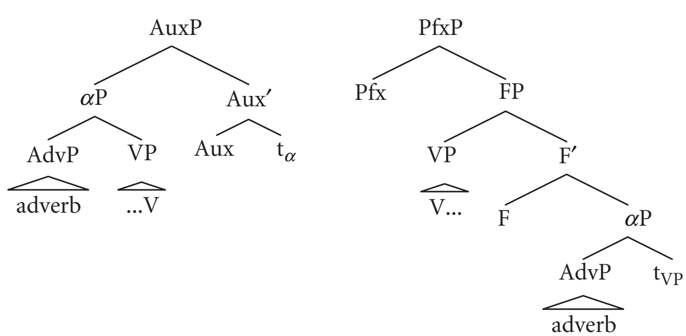
[25] Thanks to Marleen van de Vate for assistance with the Dutch examples.

can be called "Sinking" (cf. (4)), as the modal Sinks below adverbs which start out below it, giving 2–3–1 order in case of two adverbs 2 and 3, if the modal is 1.

The German case of 3–2–1 depicted in (50) suggested that functional heads can attract their complement category, even when that is not the category singled out for selectional feature-checking; for instance, in the German example, the higher modal which was to check an infinitive verb had to attract αP, and the lower modal attracted βP. I left it open there whether that was a case of pied-piping (i.e. an infinitive is attracted, but αP is carried along) or whether it was a case of attraction of the complement of a particular category (i.e. the complement of the epistemic modal is targeted for movement). In the Dutch situation, only the latter option makes sense. That is, what is needed for the Dutch case is a combination of something like Malagasy, in which the selected category moves to a space below the selecting head, plus something like German, where a complement of a designated category is targeted for movement.

Here is a schematic of the Malagasy and German cases, letting F be a category that attracts VP to a space below the prefixal head.[26]

(58) *a.* German modal/auxiliary *b.* Malagasy prefix



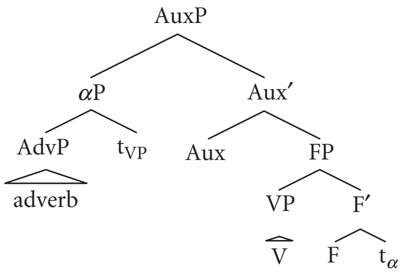
Abels (2003) argues that a head cannot attract its own complement to its specifier. If that is correct, then each example of the German type must be complex, involving a head G which attracts α dominating some other head which has α as a complement.[27]

[26] The German auxiliary checks participial features under adjacency. Modals which do not have participial forms (probably because deontic modality is higher than perfectivity in the functional sequence; cf. Cinque 1999) cannot satisfy this requirement. Recall that I suggested above that German has adopted a Malagasy-like solution for selectional feature-checking in IPP: an F head which attracts the MP, headed by the modal.

[27] The only complication would be for my explanation of prefixal causative morphemes in 2–3–1 orders, where I suggested that they might not attract their VP complements because they already had a filled specifier. On this new line of thinking, they would have to lack G projections, which would not obviously follow from anything.

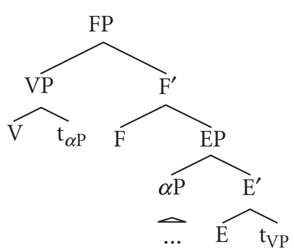
Here is the combination of the two, which is necessary to explain the placement of Dutch modals (and Norwegian auxiliaries in general, as argued by Nilsen 2003 and Bentzen 2005; see example (2) above).

(59) Dutch modal/Norwegian auxiliary (Sinking)



The tree in (59) represents of course another "remnant movement" situation, one slightly different from the one presented in section 8.2.3 as an alternative to head movement. That structure, schematically, looked as follows, where F is the suffixal head and E is the Evacuator, attracting the complement of V (labelled αP).

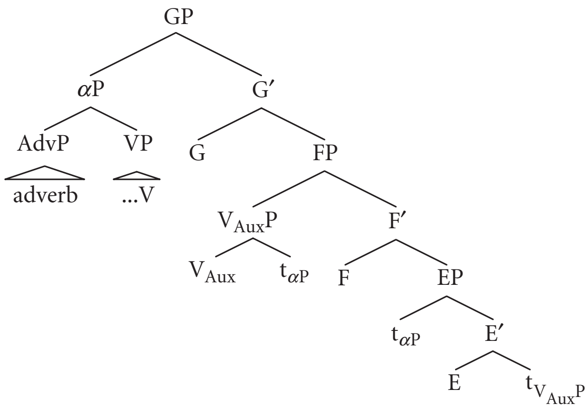
(60) Affix-Hopping structure (N. Saami past tense)



In a V–Aux language with Affix Hopping on auxiliaries, a structure like the one in (60) would be combined with the structure in (58). Suppose that (61) is the structure for the Finnish auxiliary *ol-isi* from Holmberg's (10). The stem of the auxiliary is labelled here as V_{Aux}, and the inflectional suffix on it is F. The head G is the head motivated by adjacency of V to the auxiliary (optional in Finnish), and the head E is the evacuator, motivated by the affixal nature of F.[28]

[28] The analyses in Koopman and Szabolcsi (2000) and Bentzen (2005) posit similar structures, but in which the constituent moving to SpecGP would be EP, rather than its dependent αP. That assumption could also be made here. I have depicted the specifier of EP as being extracted to increase parallelism with the structure in (62).

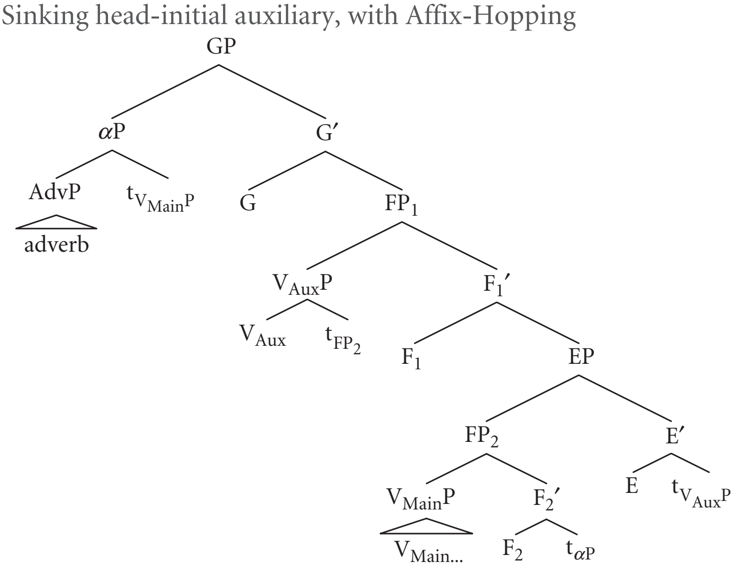
(61) Head-final auxiliary, with Affix-Hopping (Finnish, optionally)



That is, the auxiliary here is decomposed into G–F–E–V_{Aux}. In a sense, F–E is the affix, for example the tense operator which attracts a verbal element and the evacuator which attracts the complement of that verbal element, while G . . . V_{Aux} is the stem of the auxiliary, for example a modal operator or predicate plus the G which attracts the complement of V_{Aux}. The sequence might be bundled together like an idiom, possibly leading to morphological and semantic idiosyncracies.

If Norwegian and Dutch auxiliaries involve Affix Hopping, then the affix-hopping structure with F–E–V_{Aux} in (60) should also replace Aux in the diagram in (59), as indicated below. Dutch and Norwegian differ in whether the licensing position for objects is in VP (in Norwegian) or higher up, in αP (in Dutch).

(62) Sinking head-initial auxiliary, with Affix-Hopping



The F–E–V_{Aux} sequences are necessary only if the auxiliaries really consist of two syntactic parts, F (the inflectional suffix) and V_{Aux} (the stem of the auxiliary); otherwise the auxiliaries are syntactically particles and can be represented as a single head, as before (recall also that to allow head-movement, or some equivalent, would also render the F_1—E—V_{Aux} structure unnecessary). Recall that the F_2 below V_{Aux} ensures that V_{Aux} is adjacent to V_{Main}; the whole hierarchy, without movement, is G—F_1—E—V_{Aux}—F_2, dominating an αP which contains the main verb phrase. I will suggest it is not a possible structure.

The Aux–V structure in (62) introduces two locality problems which do not arise in the V–Aux counterpart in (61). First, the higher F, which attracts a verbal stem, must attract V_{Aux} across the V_{Main}P in the Spec of the lower FP_2. V_{Main} is the right category to combine with a tense affix, and so might function as a defective intervener, depending on what other assumptions are made. Secondly, and more seriously, G must extract αP from within FP2. Up until now, I have assumed that G simply took the largest complement possible below the selecting head; here, it would have to target a specific category within a specifier. Mechanically, the problem can be alleviated by postulating an intermediate G projection between E and V_{Aux}, as a "stacking position" for αP, but unlike other G projections this one could not be motivated by surface adjacency. On the assumption that the extraction of αP depicted in (62) is impossible, and that the extra G projection necessary to enable it is unlearnable, I conclude that Norwegian and Dutch auxiliaries cannot involve an Affix-Hopping complex; and furthermore that no language with Affix-Hopping in auxiliaries will have adverbial Sinking of the type seen in Norwegian and Dutch.

This will also explain the problem raised in section 8.2.3, of why there are no Asp–T–V languages. It is now explained, because the complexity of the Hopping structure needed to derive Asp–T order cannot be combined with the Sinking structure needed to make that [Asp–T] sequence strictly adjacent to V. Thus, 2–1–3 sequences of T, Asp, and V will show a 2–1 . . . 3 pattern, and be analysed as auxiliaries. This furthermore resolves the puzzle that there are no Caus–T–V languages, and no Caus–Asp–T languages. The movement of Caus across Asp or T makes it impossible to guarantee adjacency of the [Caus–T] complex to V, so they will not be analysed as 2–1–3 prefixal structures.

To avoid structures with two specifiers, I postulated G projections in case a morphologically complex head attracted a complement to its left. I will henceforth refer to the kind of selectional feature that attracts a large complement to the left as a G-feature, whether that implies a distinct G head or not.

The G-feature in German was postulated by the learner, I argued, in case a selected head (for example a non-finite main verb) was immediately adjacent to its selector (in this case an auxiliary) in the basic order in the input data. The question therefore arises whether the same properties hold of the G-feature in the Norwegian and Dutch case (depicted in (59) with a simple auxiliary). Because of the F projections which attract the verbs, the αP attracted by G in the Norwegian and Dutch case will only contain material merged between the auxiliary and the verb, in general adverbs. These do not take complements; thus it might be held that G in Dutch and Norwegian requires adjacency to an adverb. There are two complications; one is the question of where adjunct PPs are merged,[29] since they can be preverbal but are not head-final, and the other is what happens if there are no adverbs. I leave these problems unresolved for now; see Bentzen (2005).

To sum up, attraction is always of specific categories, and one of the main relations deriving basic word order is the selection relation. There are F heads, normally placed immediately below the position in which the selecting head is pronounced, and normally attracting the selected category itself; and there are G-features, which are normally on or immediately above the position in which a selecting head is pronounced, and which typically attract a much larger category, but one which consistently ends with the selected category. The "Evacuator" E does not seem to have this property, and was only postulated in cases which could otherwise have been handled by head movement.

Functional elements can now be thought of as consisting of several parts each. Some of the examples of functional elements postulated here include the following. Fs are subscripted with the category they attract: F_V attracts V, $F_{V_{Aux}}$ attracts V_{Aux}. Adjacency of prefixes follows from the fact that the attracted category is normally head-initial.

(63) *a.* Aux (preverbal auxiliary particle (English modals));
b. Aux–F_V (clustering pre-verbal auxiliary particle (Malagasy prefixes));
c. G–Aux–F_V (Sinking pre-verbal auxiliary particle (Norwegian and Dutch pre-V auxiliaries)).

(64) *a.* F_V–E (verbal suffix (e.g. past tense in Sámi));
b. $F_{V_{Aux}}$–E–V_{Aux} (Pre-verbal inflected auxiliary (Sámi modal verbs)).

(65) *a.* G–Aux (post-verbal auxiliary particle (Lezgian suffixes));
b. G–$F_{V_{Aux}}$–E–V_{Aux} (post-verbal inflected auxiliary (possibly, Finnish auxiliaries)).

The assumption has been that patterns of adjacency provide cues to the learner regarding which selectional features are checked overtly (possibly, the default assumption is that all are checked overtly, and non-adjacency is the cue that they are not).

[29] See Barbiers (1995) for an analysis of PP placement in Dutch; see Schweikert (2005) on the positioning of PPs in the German clause.

8.5 Adjacency

So far, I have assumed that G-features attract a particular category, and that adjacency is the result of independent factors, a conspiracy as it were of strong features. The German IPP case seemed to provide strong confirmation for that assumption. Given that most material would be drawn up above the highest auxiliary in most cases, there seems to be ample evidence for the learner for MP attraction to an F just below the auxiliary 'have,' leading to 1–3–2 order. Just in case VP-internal material is exceptionally left behind in the lowest verbal projection, adjacency is foiled, but checking is successful.

However, there are indications that this is not the whole story. For one thing, verb-projection-raising cases show elements intervening between unreversed elements, never between reversed ones (see examples in Wurmbrand, to appear). It is as if the adjacency induced by F is less strict than the adjacency induced by G. Here I provide an example of the strictness of this kind of adjacency and an interpretation of it.

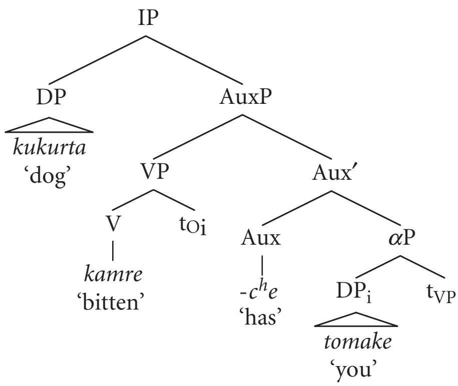
Bayer et al. (2005) show that certain complements in Bengali can be either pre- or post-verbal, for example the pronominal object in the embedded clause in (66).[30]

(66) a. *Ami ʃune-c^h^ilam paʃer baɽir kukurʈa tomake kamre-c^h^e.*
I heard-have [next house dog you bitten-has]
'I heard the next door neighbour's dog has bitten you.'

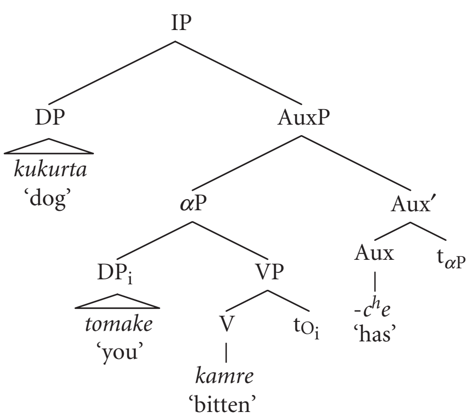
b. *Ami ʃune-c^h^ilam paʃer baɽ kukurʈa kamre-c^h^e tomake.*
I heard-have [next house dog bitten-has you]
'I heard the next door neighbour's dog has bitten you.'

The V–Aux order could mean either of two things: F-features on the Aux, attracting the VP, or G features on Aux, attracting the entire complement of Aux. The object-final order would be the result of the first choice, as displayed in (67) (there might be an E projection below Aux, but it would not change the word order, assuming a licensing position for the object above the verb, in αP).

[30] To simplify the gloss, I have ignored the case markers (genitive on 'next' and 'door,' accusative on 'you,' a classifier-determiner on 'dog'). Brackets in the gloss mark the embedded clause boundary. I set aside the question of whether the auxiliaries involve Affix-Hopping.

(67)


The second option, the G-feature, would attract the entire complement of the auxiliary, as shown in (68).

(68)


Bayer et al. (2005) also show that clausal complements in Bengali can be pre- or post-verbal.

(69) a. *Ami ʃune-c^hilam paʃer baɽir kukurʈa tomake kamre-c^he.*
I heard-have [next house dog you bitten-has]
'I heard the next door neighbour's dog has bitten you.'

b. *Ami paʃer baɽir kukurʈa tomake kamre-c^he ʃune-c^hilam.*
I [next house dog you bitten-has] heard-have
'I heard the next door neighbour's dog has bitten you.'

Since this kind of clausal complement is normally V-final, suppose that there is enough evidence from V–V adjacency for speakers to assume a G feature on the verb meaning 'hear' (though only optionally, which is a potential problem for the learnability of the feature). Suppose, then, that 'hear' attracts IP, its complement.

Given that IP is usually V-final, this would usually lead to V–V adjacency. But the examples in (66) show that some IPs are not V-final. The account developed so far would predict that these IPs should nonetheless be attracted when G-features on V are strong. However, the object-final clause is not permitted preverbally (examples again from Bayer et al. 2005).

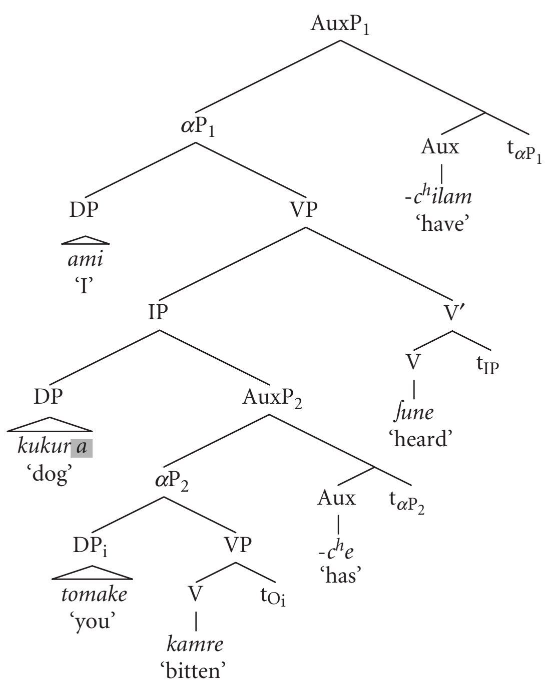
(70) a. *Ami paʃer baɽir kukurʈa tomake kamre-cʰe ʃune-cʰilam.*
I [next house dog you bitten-has] heard-have
'I heard the next door's dog has bitten you.'

b. **Ami paʃer baɽir kukurʈa kamre-cʰe tomake ʃune-cʰilam.*
I [next house dog bitten-has you] heard-have

Assuming Cyclicity,[31] movement in the embedded clause takes place before movement in the main clause. If movement is driven by attraction of features, then G attracts some feature, α; movement itself cannot be driven by the need for adjacency. However, on a copy theory of movement (or a multidominance theory), the position in which the object is pronounced might be a matter of linearization of phonological structure; in any case, it seems to be the surface non-adjacency of the two verbs which makes (70b) bad.

The acceptable structure is sketched in (71); G features on both auxiliaries attract α, a complement below the auxiliary; G on the verb 'hear' attracts IP, the complement of V (in this way, 'hear' behaves like an auxiliary). I have included the subject inside αP just to show that additional material could be there; in fact the main clause subject probably moves outside αP.

(71)



[31] See Chomsky (1965: 134; 1973: 273; 1993: 22) for the version known as the Extension Condition.

The obligatory adjacency here of V and V is typical of inverse structures. It is not explained by simply saying that G attracts α. Interestingly, it is precisely when the heads in the complement have G-features that the matrix verb may have G-features. This suggests an alternative approach to the adjacency constraint: perhaps G-features percolate, and the feature attracted by G is always G. This would require a G to be inserted at the very bottom somehow; suppose for the sake of argument that there is a G-feature on 'bitten' here. Then, if the G option is chosen for the embedded auxiliary (as opposed to the option of attracting VP, stranding the object), then there is a G-feature on the auxiliary. If this percolates to IP, then if the verb 'hear' has G-features, it can attract IP. If IP has no G-features (because the embedded Aux attracted VP rather than αP), then selecting the G option for 'hear' will not lead to a convergent derivation.

Bayer et al. (2005) also show similar examples from German: certain PPs can be postverbal, but not in a complement which is preverbal.

(72) a. *Ich habe ihn aufgefordert sich zu entscheiden dafür.*
I have him asked [RFX to decide for.it]
'I have asked him to decide on it.'

b. *Ich habe ihn sich dafür zu entscheiden aufgefordert.*
I have him [RFX for.it to decide] asked
'I have asked him to decide on it.'

c. **Ich habe ihn sich zu entscheiden dafür aufgefordert.*
I have him [RFX to decide for.it] asked

The situation is very similar to the Bengali one: a Roll-up structure must not be interrupted. Again, we could assume that German has two options in the most deeply embedded VP, distinct licensing positions for the different arguments, or a G-feature which moves the entire verbal complement to the left. If the latter option is chosen, the VP has G-features, and G-features percolate up to the top of the embedded clause, where they can be attracted by a G-feature on the matrix verb.

Such structures give important clues to the nature of adjacency and to the nature of the G-features forcing movement. Additional examples must be studied in depth to resolve the issues raised here.

8.6 Conclusion

In this chapter, I have discussed basic word-order patterns and their relationship to basic patterns of morphology. Based on the Antisymmetry hypothesis of Kayne (1994) and the functional hierarchy of Cinque (1999), combined with the syntactic approach to word-structure building of Julien (2002*b*), an interesting picture emerges in which many functional heads consist of several pieces, including three important types. F is an attractor for a particular category, which may or may not be morphologically overt. It always attracts categories to its specifier, so when it is overt, it may appear as a suffix or enclitic. The existence of strong functional categories which attract specific categories to their specifiers is a very general assumption and nothing new here.

In addition to functional heads of the F type, I was also led to postulate features of type G, which have the property that they attract one category (usually one quite close by) but require linear adjacency with another category, one which can be embedded inside the moved phrase and at its right edge. These are unusual assumptions and raise interesting questions about the role that adjacency can play in the grammar. I suggested that the adjacency requirement was part of a condition on learning the G-features, rather than on the G-features themselves. In section 8.5 I examined challenges for that point of view but proposed that it could be maintained if what G-features attract is other G-features.

Finally, I have postulated on a couple of occasions elements which I have labelled E, attractors of convenience which eliminate complement material in order to allow Affix-Hopping to occur; these do not seem consistently to display adjacency properties of the type manifested by G heads, but nor is it clear that they consistently attract a particular category the way the F heads do. There are so few clear examples that it is difficult to know whether E can be collapsed with either of F or G. The examples which have been postulated of E have been phonologically null. Both overt and covert F have been postulated. For G, I have sometimes depicted G as phonologically overt, attracting α directly to its specifier, and other times depicted it as systematically null, an extra head immediately dominating the auxiliary or other head-final projection. The choice between these two is not clear at this point (cf. Koopman 1996 for relevant considerations).

What I hope to have shown is that a movement approach to basic word order can be explanatory. The problem with movement approaches is overgeneration; Koopman and Szabolcsi (2000) make a number of suggestions regarding how to constrain movement, and I here offer some modifications and alternatives.

A central constraint assumed here has been that each feature postulated should have clear motivation from the input to which the learner is exposed. For example, V–Aux adjacency was taken to be the cue for G-features in German, and Aux–V adjacency the cue for F in Norwegian (or, failure of Aux–V adjacency is the cue that F can be checked by Agree without movement). Possibly, this kind of constraint could explain or replace the Complexity Constraints postulated by Koopman and Szabolcsi (2000). Further investigation is needed to determine whether this is so.

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CHAPTER 9

DISTRIBUTED MORPHOLOGY AND THE SYNTAX–MORPHOLOGY INTERFACE

DAVID EMBICK AND ROLF NOYER

9.1 Introduction: The Syntax–Morphology Interface

A theory of the syntax/morphology interface is, first, a theory of how "words" and their internal structure—the traditional domain of morphology—relate to the structures generated by the syntax, and second, a theory of how the rules for deriving complex words relate to the rules for deriving syntactic structures. A prominent line of research in this area consists of approaches assuming some version of the Lexicalist Hypothesis. For present purposes, this is the claim that (at least some) words are special in ways that phrases, for instance, are not, and that this "specialness" calls for an architecture in which the derivation of words and the derivation of syntactic objects occur in different modules of the grammar (the lexicon versus the syntax).[1] While the "words" derived in the lexicon serve as the terminals in the syntactic derivation, there is a sharp division between syntax and morphology according to Lexicalist approaches of this type. In this way, the interface between syntax and morphology in such a theory is *opaque* or *indirect*: there is no reason to expect the structure and composition of "words" to relate to the structure and composition of syntactic objects in any transparent or for that matter systematic fashion.

A second line of research advances the hypothesis that "words" are assembled by rules of the syntax. Thus "word" is not a privileged derivational object as far as the architecture of the grammar is concerned, since all complex objects, whether words and phrases, are treated as the output of the same generative system (the syntax). According to this view, which we assume here, the theory of the syntax–morphology interface might better be said to be a theory of (1) the primitive elements of the syntactic derivation (the traditional question of the *morpheme*); (2) the principles governing the assembly of these primitives into complex objects (the question of what structures the syntax and perhaps PF rules can derive); and (3) the manner in which phonological forms relate to the primitives and to the complex objects constructed from the primitives. Such an approach allows for a transparent (or "direct") interface between syntax and morphology, because it hypothesizes that the same generative system derives all complex objects.[2] In the default case, then, the principles that govern the composition of "words" are the same as those that govern the composition of larger syntactic objects.

The theory of Distributed Morphology proposes an architecture of grammar in which a single generative system is responsible both for word structure and phrase structure. In particular, Distributed Morphology attempts to make precise the claim that all derivation of complex objects is syntactic. In this way, this approach has much in common with other syntactic approaches to morphology, such as those advanced by Baker (1988), Pesetsky (1995), and Borer (2004) and related work. In respect to the interface between syntax and morphology, this architecture has a clear consequence: since the only mode of combination in the grammar is syntactic, it follows that in the default case, morphological structure simply is syntactic structure. This is the primary focus of our discussion below.

For reasons of space, we will simply assume this non-lexicalist perspective. Nevertheless, some clarifications are called for regarding this aspect of Distributed Morphology. It is often objected in discussions of non-lexicalist versus lexicalist analyses that the patterns analysed syntactically in the former type of approach

[1] There are many senses of the term "Lexical/-ism/-ist" (see Aronoff 1994 for some discussion); our focus here is on the specific architectural claim that there exists a generative lexicon in addition to a generative syntax.

[2] Phrasing this somewhat differently, there is a sense in which there is no "interface" between syntax and morphology on this view, since there are not two distinct domains at play; see below.

could be stated in a theory with a lexicon. This point is almost certainly correct, but at the same time never at issue. The arguments against the generative lexicon are not arguments about generative capacity, or the formal power of the Lexicalist approach to state a pattern. Rather, they are arguments against the central thesis of Lexicalism, which is a thesis about modularity, and the claim that the "word" is a special object as far as the grammar is concerned. The lexicalist position, which posits two distinct generative systems in the grammar, can be supported only to the extent that there is clear evidence that lexical derivations and syntactic derivations must be distinct. Ultimately, this is an empirical question; all theories under discussion recognize objects that are "privileged", and it must then be asked whether taking the "word" to be privileged makes correct predictions. Thus, specific arguments that are intended to support the Lexicalist position must show that a particular phenomenon must not be treated syntactically; the demonstration that a pattern *can* be stated in a Lexicalist framework simply does not suffice. This is not an argument that the Lexicalist theory is a priori subject to more stringent burdens of proof than the non-lexicalist theory. Rather, the claim is that in the current context—where arguments have been presented that the syntactic approach makes correct predictions and the Lexicalist approach does not—it does not sharpen the issues to simply claim that a Lexicalist analysis could be appealed to.

A number of the central issues for this question are found in the area of operations on argument structure and related areas. Much of the impetus behind lexicalist approaches to grammar stems from an interpretation of Chomsky (1970), in particular the idea (not actually advanced in that paper) that certain nominalizations must be created by rules that apply "in the Lexicon", and not by syntacic transformation. However, as discussed in Marantz (1997), the analysis of nominalizations constitutes a case in which a Lexicalist account is forced to stipulate a pattern which follows naturally from a syntactic treatment.[3] Again, whether or not the relevant patterns could be stated in the Lexicalist approach is not a matter of great interest: clearly, the necessary stipulations can be made. The question is why—all other things being equal—one would maintain separate generative systems in the face of such an argument, and given that the other functions of the lexicon (mostly related to listing certain types of information) can easily be redistributed in the grammar (for specific proposals, see section 9.2).

Thus while much of the current discussion of morphology and syntax is framed against a Lexicalist background, it should be stressed that this is for historical reasons primarily, having to do with the development of the Lexicalist Hypothesis as a research programme. At the same time, there is no reason to suspect a priori

[3] A related argument is advanced in Embick (2004*a*) with reference to the verbal/adjectival passive distinction, a distinction which is taken in lexicalist approaches to grammar to be the result of syntactic versus lexical derivation.

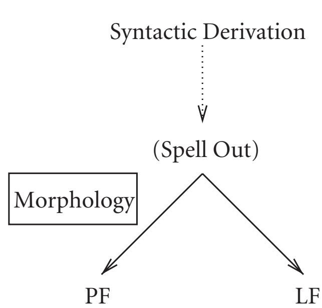
that the theory would be better if it contained two distinct generative systems as opposed to one, although general parsimony and probably the strictures imposed by the Minimalist Program (Chomsky 1993 and subsequent work) support the "one generative system" view.[4] The move to non-lexicalist theories like Distributed Morphology is motivated by empirical arguments, and it is of course in that domain that the issues will be settled.

In the final analysis, the two-module architectural stance reduces to the claim that sound–meaning connections for "words" are derived in a way that is special with respect to how the syntax derives such connections. Articulated lexicalist approaches make a number of precise empirical predictions, some of which we take to have been disconfirmed. In conjunction with the idea that there is no conceptual argument in favour of a grammar with two generative systems, these empirical results argue in favour of the architecture in which word formation is syntactic. We outline here the basic principles of one such syntactic approach.

9.2 Essentials of Distributed Morphology

The architecture of the model of grammar that we adopt here is illustrated in (1). The syntax consists of a set of rules that generate syntactic structures, which are then subjected to further operations in the derivation of the PF and LF interface levels.

(1) The Grammar



[4] From the programmatic Minimalist perspective, the grammar must contain (1) a set of primitives, (2) a derivational system for combining these primitives into (a discrete infinity of) complex objects, (3) an interface with the conceptual/intentional system (LF), and (4) an interface with the articulatory/perceptual system (PF). Anything beyond this, including a generative lexicon beyond a generative syntactic system, becomes suspect from this perspective.

We assume that every word is formed by syntactic operations (Merge, Move). The principles of morphology are therefore to a large extent the principles of syntax, because in the default case, the morphological structure at PF is simply the syntactic structure.

Nevertheless, in more complex cases additional PF processes may modify and elaborate syntactic structure in limited ways (see section 9.4). For example, language-specific PF requirements may force the introduction of features and terminal nodes into the syntactic structure. We use the term "morphology" to designate the set of such processes that are relevant for word formation; correspondingly, we sometimes employ the term "morphological structure" to refer to structures that are found at the PF stage of the derivation, where PF is understood as a sequential derivation that terminates in a phonological representation.[5] Thus in the syntactic approach to morphology adopted here some aspects of word formation arise from syntactic operations such as head movement, which occur in the syntax proper, while other aspects of word formation are accounted for by operations that occur on the PF branch. It is this fact that has given rise to the name Distributed Morphology.[6]

While PF processes may be possible for certain aspects of word formation broadly construed, the important point is that such PF processes do not constitute a separate generative system for deriving words. Rather, PF processes effect modifications to the structures generated by the syntax, modifications that are limited to minor operations that manipulate nodes in a sharply constrained fashion.

9.2.1 PF: Minimal Requirements

The syntax generates hierarchical structures from a finite set of primitive elements. Linear ordering of nodes in this hierarchical structure is, however, plausibly a relation that is defined by operations on the PF branch (cf. Chomsky 1995: 334 for some comments). Linear order is a property imposed on the syntax by the external requirement that the grammar be instantiated in real time; that is to say, the syntax must ultimately be processed via a serial interface, whether the ultimate modality is speech or gesture. Assuming that linear order is not included in the syntactic representation, PF operations, because they are responsible for creating the interface level that mediates between syntax and the articulatory/perceptual systems, must at the very minimum be responsible for linearizing hierarchical structures. To a first

[5] i.e. we use PF as a term for a set of operations, not just for the final output of this set of operations.

[6] For earlier overviews of this framework, see Halle and Marantz (1993) and Harley and Noyer (1999).

approximation, linear order is a binary operator—represented by '*'—imposed by an operation Lin:

(2) Lin [X Y] → (X*Y) or (Y*X)

This relationship is one of immediate (left-)adjacency; subsequent steps concatenate terminal nodes (cf. Sproat 1985; Marantz 1984). Other types of conditions might be imposed by distinct linearization operations, a point we discuss in section 9.4.

In addition to linearization, operations that occur on the PF branch prepare the syntactic structure for the interface in other ways, such as by constructing prosodic domains. In this way it seems clear that PF operations violate the Inclusiveness Condition (cf. Chomsky 1995, 2000), a principle intended to prevent the introduction of novel material in the course of a derivation:

(3) **The Inclusiveness Condition**
No new features are introduced by C_{HL}.

Of interest for the present discussion is the observation that operations at PF apparently do not comply with this property:

> A "perfect language" should meet the condition of inclusiveness: any structure formed by the computation (in particular, π and λ [i.e. PF/LF, de/rn]) is constituted of elements already present in the lexical items selected for N [the numeration de/rn]; no new objects are added in the course of computation apart from rearrangements of lexical properties... Let us assume that this condition holds (virtually) of the computation from N to LF... standard theories take it to be radically false for the computation to PF. (Chomsky 1995: 228)

As Chomsky notes, it is usually assumed that various morphophonological operations, such as those relating to syllabification, prosodic structure, and a great deal of the phonology, introduce elements not present in lexical items. Moreover, the addition of phonological features to nodes at PF (Late Insertion; see below for details) violates this condition as well. While it appears that PF must violate Inclusiveness in at least some respects, it is also clear that PF does not have the power to add absolutely any type of feature. Thus the exact extent to which PF processes may add material to the syntactic structure is an empirical question; this is discussed further in section 9.4.1.

Even accepting the fact that PF operations apparently violate the Inclusiveness Condition, it is important to stress that the move to Late Insertion—and to other operations performed by PF—is not motivated conceptually. Rather, these additions to the mechanism of PF require significant motivation, as they constitute departures from the minimal requirements on PF as an interface level.[7] A question

[7] It has been suggested (see e.g. Chomsky 2001) that PF also performs movement operations such as phrasal movement. We take it that it is at best inelegant to hypothesize a system in which both the

of interest is whether these violations of Inclusiveness and other principles are forced by properties of the interface—that is, imposed by requirements "external" to language. For instance, the introduction of information concerning linear order by operations like Lin in (2) clearly adds information not present in the syntactic structure. However, this information is forced by the requirements of the articulatory–perceptual interface: language has a serial interface, and this requires a unique linear ordering. As such, this complication to the simplest picture has an external motivation. Whether other complications such as late insertion and the addition of other features/nodes at PF can be reduced similarly is an open question.

9.2.2 Primitives of the Syntax

We call the units that are subject to the syntactic operations Move and Merge "morphemes": these are the terminal nodes of the tree diagrams ordinarily used to illustrate syntactic constituent structure. Each morpheme is a complex of features, of which there are two kinds: phonological and grammatical/syntactico-semantic. The basic inventory of syntactic terminals is divided into the abstract morphemes and the Roots:

(4) Terminals

a. **Abstract morphemes.** These are composed exclusively of non-phonetic features, such as [Past] or [pl], or features that make up the determiner node D of the English definite article eventuating as *the*.

b. **Roots.** These include items such as $\sqrt{\text{Cat}}$, $\sqrt{\text{Ox}}$, or $\sqrt{\text{Sit}}$, which are sequences of complexes of phonological features, along with, in some cases, non-phonological diacritic features. As a working hypothesis, we assume that the Roots do not contain or possess grammatical (syntactico-semantic) features.

Whereas the features that make up abstract morphemes are universal, Roots are language-specific combinations of sound and meaning. In other words, Roots are open-class, and new Roots can be added to an individual's grammar at any time. The distinction in (4) is thus related to that between the functional categories and the lexical categories.

syntax and PF have the ability to effect the full range of movement operations. Such a stance clearly increases the power of PF by potentially making it a second syntax as far as movement is concerned, a move that should be avoided if at all possible.

A related question is whether head movement should be considered a PF phenomenon; we assume that it is not, although the basic principles of Distributed Morphology—a piece-based theory with some late insertion—are compatible with the "head-movement at PF" alternative (or with other alternatives in which head-movement is replaced by other operations).

As a general assumption, we take it that Roots never appear "bare"; they must always be categorized by virtue of being in a local relationship with one of the category-defining functional heads (*v*, *n*, etc.; see e.g. Marantz 1995):

(5) **Categorization Assumption**
Roots cannot appear without being categorized; Roots are categorized by combining with category-defining functional heads.

In this way, Roots surface as members of the so-called lexical categories, traditional parts of speech such as nouns, verbs, and adjectives. However, such categories are always syntactically complex, consisting minimally of a Root and a category-defining functional head. Because Roots do not contain or possess any grammatical features, our approach does not allow lexical decomposition, by which we mean decomposition of the lexical vocabulary into feature complexes. While complex words—and even superficially unaffixed words such as *ox*—appear in complex syntactic structures, it is the functional structure in which Roots appear that is decomposed, not the Roots themselves.

On the other hand, abstract morphemes such as [pl] or [Past] are the (contents of the) familiar *functional categories* of syntactic theory.[8] By the end of the computations that are described here each morpheme is supplied with a set of phonological features (including the phonological null element or zero -∅-) which serve as instructions for actions to be performed by the articulatory/perceptual system.

As noted in (4), functional heads do not have phonetic content in the syntactic derivation. We use the adjective "abstract" to designate such morphemes, and one of the basic functions of morphology is to supply phonological features to abstract morphemes. By contrast, we assume Roots to be present with all their features throughout the derivation, with no such insertion process.[9] In this assumption we follow results from Embick (2000); see also Chomsky (2001) for some discussion.

The different morphemes in (4) are stored in a list of syntactic terminals that the learner acquires during the development of language. Thus speakers of English memorize Roots such as $\sqrt{\textsc{Cat}}$ or $\sqrt{\textsc{Sit}}$, as well as the fact that abstract morphemes such as [pl] and [past], which are drawn from a universal feature inventory, are active in their language. As the primitives of syntax and hence of morphology, the items in these lists are the ultimate elements out of which words, phrases, and sentences are composed.

The lists of morphemes sketched here are fundamentally different from the lists of words or lexical items that make up the lexicon of (some) lexicalist approaches to morphology. The items that figure in a typical lexicon combine a meaning with a sound. This is not true of all morphemes in the present approach. For example,

[8] For this reason, we use "abstract morpheme" and "functional head" to refer to the same objects.

[9] Because Roots are not subject to late insertion, it follows that there can be no suppletion in the case of Roots. See Embick and Halle (forthcoming) for some discussion.

abstract morphemes like [pl] or [past] are morphemes without phonetic features, and must be supplied with such features in the course of a derivation in the grammar in (1). Morphemes of this type are not found in theories in which the primitives must be lexical items in the traditional sense: combinations of syntactic, semantic, and morphophonological features.[10]

The move to Late Insertion amounts to accepting a version of the *Separation* Hypothesis (cf. Beard 1966, 1995). According to this hypothesis, the components of the traditional morpheme are separated from one another; that is, morphemes do not contain syntax, semantics, and phonology. Rather, the morphophonological component of the morpheme is underspecified with respect to the syntactico-semantic environments in which it appears. Theories that admit Separation in this way are non-lexicalist, but in a sense different from the way in which "non-lexicalist" is used above; recall that "lexicalist" has many distinct senses. Some theories are called "lexicalist" because they assume that the primitives of the grammar must be lexical items in the sense defined above. It is this claim that Separation rejects. Other theories are lexicalist because, as discussed in section 9.1, they posit a generative lexicon. However, it is important to note that there is no necessary connection between Lexicalist-1 = "theory with a generative lexicon" and Lexicalist-2 "theory with lexical items".[11]

For theories like Distributed Morphology that admit Separation, the mechanisms of Late Insertion must be specified; this is addressed in the next section.

9.2.3 Vocabulary Insertion

The mechanism supplying phonological features to the abstract morphemes is called "Vocabulary Insertion". The Vocabulary is the list of the phonological exponents of the different abstract morphemes of the language, paired with conditions on insertion. Each such pairing of a phonological exponent with information about the grammatical (i.e. syntactic and morphological) context in which the exponent is inserted is called a vocabulary item.

As an illustration of the nature of these vocabulary items, consider the formation of plural nouns in English. Vocabulary Insertion supplies phonological features to the abstract [pl] morpheme, which has combined with a noun in the syntax. We take the [pl] feature to be present on a head which is represented as # for "Number".

[10] Clearly the abstract morphemes are not signs in the sense of Saussure. Whether or not the Roots are signs in this sense is another matter.

[11] Indeed, there are theories that are lexicalist in one sense but not the other. For instance, some approaches assume the lexical item but not a separate generative lexicon, for example, Lieber (1992). For details concerning possible Lexicalist-2 approaches to underspecification and syncretism, see Noyer (2001). A further possibility is that separation is admitted only when necessary, in other words, only for abstract morphemes that show allomorphy, but not in the general case; see Halle (1990).

The regular phonological exponent of the English plural is /-*z*/, and this is formally expressed by the vocabulary item in (6):

(6) z $\leftrightarrow$ [pl]

The effect of (6) is to add /-z/ to that node. While Vocabulary Insertion adds phonological features to a node, we assume that it does not automatically delete or erase the abstract features present on that node.[12]

Among a set of vocabulary items specified for insertion at a particular terminal node, it will arise quite typically that more than one meets the conditions for application. Because—under normal circumstances[13]—only a single exponent may be inserted at any terminal, these Vocabulary Items can be understood to be in competition for application to that morpheme. The Subset Principle (7) controls the application of vocabulary items and resolves (most) cases of competition of this sort.[14]

(7) **Subset Principle**

The phonological exponent of a vocabulary item is inserted into a position if the item matches all or a subset of the features specified in that position. Insertion does not take place if the vocabulary item contains features not present in the morpheme. Where several vocabulary items meet the conditions for insertion, the item matching the greatest number of features specified in the terminal morpheme must be chosen (Halle 1997).

Continuing with example (6) above, we note that the node with the feature [pl] for "plural" in English also has the exponents -∅ (as in *moose*-∅) and -*en* (as in *oxen*). That is, while there is a single abstract morpheme [pl] in all of the plural environments in English, this morpheme has different phonological exponents whose appearance is determined by the Root in the local context of [pl].

As already observed, Vocabulary Insertion takes place in structures that have been assembled by the syntax. In the example with noun plurals, this means in a constituent containing a noun ($\sqrt{\text{Root}}$-*n*) and the abstract morpheme [pl]. Since [pl] is in a local relationship with the Root when Vocabulary Insertion occurs, the identity of the Root can be a contextual condition on the choice of exponent for the [pl] node. The resulting effect of such a condition is called "contextual allomorphy",

[12] Although it is possible in some cases that such deletion or erasure could be motivated, we assume that such additional operations have to be justified by explicit argument. See section 9.5.2 and Noyer (1997, 1998) for some pertinent discussion.

[13] See section 9.4.2.2 for details

[14] The Subset Principle does not resolve all cases of potential conflict. Specifically, where two vocabulary items are both applicable and both contain the same number of features some additional criterion must resolve the competition. Explicit stipulation of ordering (Halle and Marantz 1993) or appeal to a hierarchy of morphosyntactic features (Noyer 1997) are two possible solutions.

and its effects are reflected formally by adding to Vocabulary Items like (6) an additional condition on insertion, in the form of a list of elements associated with each contextual allomorph:[15]

(8) $[\text{pl}] \leftrightarrow$ -en/{ $\sqrt{\text{Ox}}$,$\sqrt{\text{Child}}$, ... }—
$[\text{pl}] \leftrightarrow$ -∅/{$\sqrt{\text{Moose}}$,$\sqrt{\text{Foot}}$, ... }—

The familiar notation /...__...indicates that the rule applies only when the morpheme in question occurs in the environments specified by...; in case of the English plural, this means that [pl] is spelled out as -∅ in the context of $\sqrt{\text{Moose}}$, and as -*en* in the context of $\sqrt{\text{Ox}}$, and so on.

Each of the vocabulary items in (8) is more specific than that in (6), in that each contains a contextual condition on insertion in addition to referring to the feature [pl]. Thus in cases in which any of the Roots on the lists in (8) are present, [pl] is realized as -∅ or -*en*, and not -*z*.

9.2.4 Underspecification of Vocabulary Items

Given the assumptions about Vocabulary Insertion outlined above, (systematic) syncretism occurs when a single vocabulary item inserts the same exponent into two distinct syntactico-semantic nodes. The primary motivation for the separation of phonology from syntax and semantics in Distributed Morphology (and realizational theories of morphology in general) is that such a separation allows morphological syncretisms to be stated systematically. The basis for the systematic analysis of syncretisms lies in the fact that the phonological exponent of a vocabulary item is underspecified relative to any given context in which it is inserted. The terminal nodes that are the sites for insertion are fully specified; that is to say, they contain a full complement of syntactico-semantic features.[16] However, the vocabulary items that apply to these positions need not be fully specified, with the result that a single phonological exponent may appear in more than one syntactico-semantic context.

To take a simple example, consider the Person/Number prefixes for objects and subjects found in the Athabascan language Hupa (data from Golla 1970):[17]

[15] What properties of the environment are visible for contextual allomorphy—i.e. can appear as conditions in rules like those in (8)—is an empirical question. For some proposals concerning different aspects of this issue, see Bobaljik (2000) and Embick (2003).

[16] Of course, the nature and identity of such features is the topic of an active research programme.

[17] The forms here are only for first- and second-person arguments; third-person and other types of argument are not included for the sake of clarity.

(9) Subject and Object Markers

Subject	Object	
1S	W-	Wɨ-
2S	n-	nɨ-
1PL	dɨ-	noh-
2PL	oh-	noh-

In the plural forms, while the exponents *dɨ*- and *oh*- appear in the subject position, and distinguish first-from second-person plurals, the distinction is not made in the object position, where there is a single exponent, *noh*-. As noted above, the theory assumes that morphosyntactic positions are fully specified when Vocabulary Insertion takes place. The plural nodes from the example above are represented as follows:

(10) Feature bundles

$$a.\ \begin{bmatrix} +1 \\ +\mathrm{PL} \\ +\mathrm{SUBJ} \end{bmatrix} \quad b.\ \begin{bmatrix} +2 \\ +\mathrm{PL} \\ +\mathrm{SUBJ} \end{bmatrix} \quad c.\ \begin{bmatrix} +1 \\ +\mathrm{PL} \\ +\mathrm{OBJ} \end{bmatrix} \quad d.\ \begin{bmatrix} +2 \\ +\mathrm{PL} \\ +\mathrm{OBJ} \end{bmatrix}$$

Consider now the following vocabulary items, which spell out the plural part of (9):

(11) *a.* [+1 +PL +Subj] ↔ dɨ
b. [+2+PL+Subj] ↔ oh
c. [+PL +Obj] ↔ noh

While the first- and second-person plural in subject position are realized via distinct vocabulary items (11*a*) and (11*b*), realization in the plural is effected by a single vocabulary item, (11*c*). The vocabulary item (11*c*) does not refer to the features [1] or [2], and so is underspecified with respect to the feature bundles to which it applies, (10*c*) and (10*d*). The fact that the first- and second-person plural are non-distinct in object position is systematic on this account, with the syncretism being captured via the single vocabulary item in (11*c*). Put slightly differently, there is a single *noh*-, despite the fact that this *noh*- appears in more than one plural context.

9.2.5 Synopsis: Architecture, Features, and Lists

To summarize the primary aspects of the approach we have presented above, all derivations are performed in the grammar in (1). In these derivations, three distinct lists are accessed. These lists are as follows:

(12) Lists

a. The syntactic terminals. The list containing the Roots and the abstract morphemes.

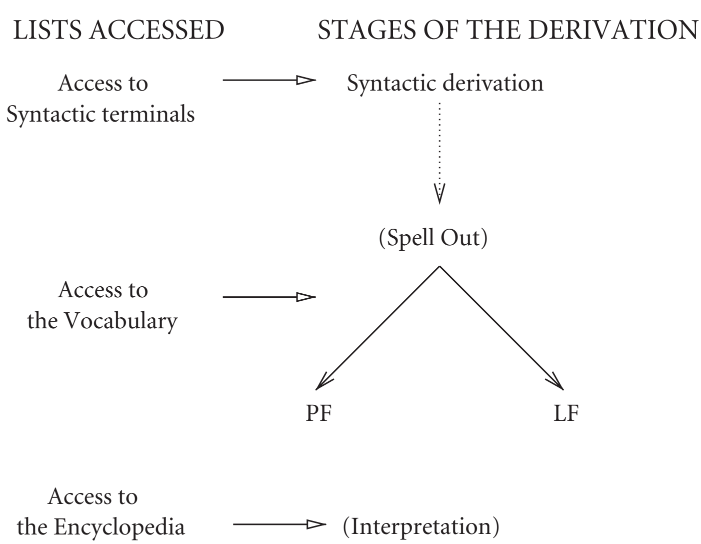
b. The vocabulary. The list of vocabulary items, rules that provide phonological content to abstract morphemes.

c. The encyclopedia. The list of semantic information that must be listed as either a property of a Root, or of a syntactically constructed object (idioms like *kick the bucket*).

These lists are accessed at distinct stages of the derivation. Two of these lists have been discussed extensively above. Items are drawn from the list of Syntactic Terminals in the syntactic derivation. The Vocabulary is consulted at PF, and contains the rules that supply the phonological exponents to abstract morphemes.

A third list, not discussed above, is the repository for "special" meanings, whether the meanings of Roots or of larger objects. This component, the Encyclopedia, is consulted subsequent to the output of PF/LF, which we abbreviate simply as "interpretation".[18] This is represented in the modified grammar in (13).

(13) The Grammar, with Lists



In this revised architecture, information that is included in the lexicon of lexicalist approaches is accessed at distinct stages of the derivation. Crucially, these lists are not generative; the only generative component of the grammar is the syntax.

[18] For a view on the Encyclopedia see Marantz (1997).

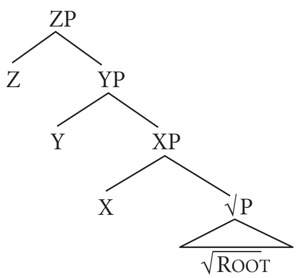
9.3 A Transparent Interface between Syntax and Morphology

In its essence the Distributed Morphology approach to morphology is syntactic. As a consequence of the architecture of the grammar, in the simplest case, morphological structure and syntactic structure are the same. Because there is no lexicon in which complex objects are assembled according to rules distinct from the rules of syntax, the generation of all complex forms must be performed in the syntax. PF processes add information to the structure that is derived in the syntax, in the form of morphologically relevant operations such as Vocabulary Insertion, but beyond this (and the PF mechanisms discussed in section 9.4) the structure of words is syntactic structure.

If this hypothesis is correct, then—strictly speaking—there is no syntax–morphology interface. Words and phrases are assembled by the same generative system, and there is thus no sense in which words must interface with the syntax; rather, they are derived by the rules of syntax (with PF understood as operating on the output of the syntax). Thus while we may continue to use term "syntax–morphology interface" to refer to a range of issues that connect with the traditional domain of morphology or word formation, such as the structure of complex heads, inflection, etc., this is a *façon de parler* given the theoretical context that we assume, and not a theoretically motivated partition of linguistic phenomena. There is no definable domain— e.g. the "word"— that can be singled out as the subject matter for morphology on any principled basis. This result, though it runs contrary to some intutions, should not be surprising. There is no reason to suspect that our intuitive or traditional notions like "word" should correspond in any way to a natural class of objects in the theory of grammar. Rather, these pre-theoretic notions are replaced by a theory of primitives (e.g. Roots and abstract morphemes), a theory of relevant structures (e.g. syntactic terminal, complex head, phrase), and explicit claims about derivational mechanics. While, for example, complex heads and phrases may show different morphophonological properties, these differences do not imply that they must be constructed in different modules, any more than the fact that DPs and TPs have different properties is an argument for two distinct modules for assembling those objects.

Concerning the specific derivational mechanics at play in word formation broadly construed, we assume that in the normal case, complex heads are created by the syntactic process of head movement. A complex head created by head movement in the structure in (14) has the form $\sqrt{\text{Root}}$–X–Y–Z, assuming that these functional heads are linearized on the right, that is to say, as suffixes:

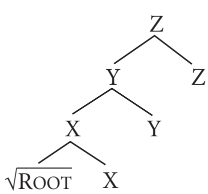
(14) Example structure



In principle, each of X, Y, or Z could be linearized as a prefix or a suffix. Head movement in the structure (14) is therefore capable of producing Z–Y–X–$\sqrt{\text{Root}}$, Z–$\sqrt{\text{Root}}$–X–Y, and so on.

Using the uniformly suffixal case for illustration, the reason that the derived word has the structure $\sqrt{\text{Root}}$–X–Y–Z and not $\sqrt{\text{Root}}$–Y–X–Z (for example) is syntactic. Head movement operates in terms of successive adjunction, and the only possibility for syntactic head movement is to create (15) from movement in (14):[19]

(15) Complex Head



The internal structure of the word—i.e. the complex head (15)—faithfully recapitulates the syntactic structure. The linearization of such complex heads is constrained by the hierarchical structure. Thus in cases in which the functional heads are linearized in the same direction, the order of the affixes mirrors the syntactic hierarchy of projections. This pattern is the basis for the Mirror Principle, often taken as a condition on how syntactic structure and morphological structure relate to one another (cf. Baker 1985, 1988). In our terms, however, it is misleading to speak of the Mirror Principle as a condition on (relationships between) representations; rather, the Mirror Principle amounts to the observation that word-internal structure mirrors syntactic structure. In other words, because these effects are derived from the architecture of the theory, as presented in (1) above, Distributed Morphology has in fact no need to state the Mirror Principle as a principle of the grammar.

[19] This is the standard conception of head movement, derivative of work by Travis (1984) and Baker (1988), and much subsequent research.

The generalization that is expressed by the Mirror Principle is empirically very robust, a fact that has important architectural consequences. An approach with a lexicon in which complex words are derived, or an affixless view of morphology in which there simply are no pieces (e.g. Anderson 1992), is forced to stipulate the effects of the Mirror Principle (see Halle and Marantz 1993 for discussion).

Nevertheless, there are special cases in which the attested order of morphological elements is not equivalent to the order that is expected on syntactico-semantic grounds; that is to say, the relationship between syntactic structure and morphological form is more complex than the picture outlined above predicts. An analysis of such data may proceed along two lines. One possibility is that the syntactic structure that predicts the non-occurring morphological form has been misanalysed. Because it maintains the simplest interaction between syntax and morphology, this option represents the null hypothesis.

The other option is that the syntactic analysis is correct, and that the surface order does in fact seem to contradict what syntactic movement alone would predict. In such cases, and in the case of true syntax–morphology mismatches more generally, we assume that one of the primary tasks of morphological theory is to identify the set of PF operations that are responsible for these deviations from the default case. Although this option weakens the theory by allowing PF to alter syntactic structures, it does so in a way that maintains the most direct possible correspondence between syntactic and morphological (i.e. PF) structures.

9.4 PF Processes: Syntax–Morphology Mismatches

While much research in the syntax–morphology interface is devoted to the study of mismatches of the type mentioned above, it is essential to emphasize that this study is only meaningful against the background of a theory in which syntax–morphology connections are by default transparent. Faced with such mismatches, research within Distributed Morphology aims to isolate and identify these PF readjustment processes and to identify the conditions under which these processes apply. By admitting such operations at PF, the approach is flexible enough to analyse cases in which such mismatches arise. At the same time, admitting such operations does not abandon the central architectural premise of the theory, namely, that syntactic structure and morphological structure are, in the default case, the same. It must be stressed that the operations that apply at PF are minimal readjustments, motivated by language-particular requirements. Unlike the syntax, which is a generative system, PF is an interpretive component, and the rules that alter syntactic structures do not apply freely. Rather, each rule is triggered by a language-specific requirement that must be learned by speakers of that language.

9.4.1 "Ornamental" Morphology: Insertion of Nodes/Features

Assuming that syntax provides the input to semantic interpretation, it follows naturally that all properties which are essential to semantic interpretation— all 'interpretable' features— are present in syntax. Because the mapping to PF does not delete featural information, all such features are present at PF. Nevertheless, while all morphemes and interpretable features are present at PF, not all morphemes that are found at PF are necessarily present in the syntactic derivation. Specifically, depending on language-specific well-formedness requirements, certain morphemes are added at PF. Such morphemes are never essential to semantic interpretation, since the derivation diverges onto PF and LF branches prior to the insertion of these morphemes. Thus, we speak of the reflexes of any morphemes inserted at PF as being "ornamental": they merely introduce syntactico-semantically unmotivated structure and features which "ornament" the syntactic representation.

Because ornamental morphology has an overt effect at PF, the requirements which eventuate in the insertion of "extra" material are, although language-specific, sufficiently tranparent that speakers of the language may infer them without special difficulty during acquisition.

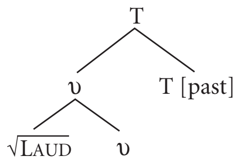
Agreement (AGR) nodes present a common example of the type of morphemes added after syntax. We assume that the structure of the clause contains Tense (and in some cases Aspect) nodes with interpretable features, but no AGR projections in the syntax (see Iatridou 1990; Marantz 1992; Chomsky 1995 for some motivations for this position.) At the same time, the morphosyntactic structure of verbs in many languages contains a piece that is clearly representative of an AGR node. Consider, for example, the Latin Imperfect 1PL form of the verb *laudō* 'praise', which, to a first approximation, has the pieces in (16); TH is for the Theme position; TNS is for Tense, AGR for Agreement:

(16) *laud-ā-bā-mus.*
ROOT-TH-TNS-AGR
'We were praising.'

The underlined piece *-mus* here is an exponent of an AGR node. However, the syntactic structure for (16) involves no AGR node, in accordance with the assumption that we outlined earlier:[20]

[20] It also contains no Theme node position for the *-ā-* that characterizes verbs of the first conjugation; see below.

(17) Structure for (16)

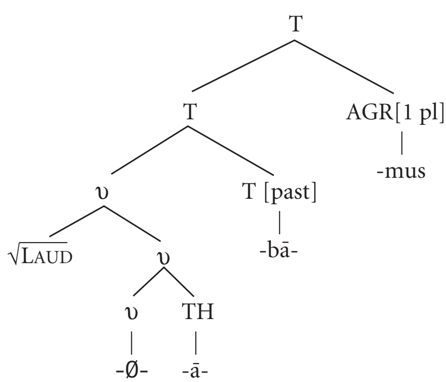


The AGR node is added to Tense in accordance with a morphological requirement in Latin an AGR node must appear on (among other things) finite Tense:

(18) $\mathrm{T}_{\text{finite}} \rightarrow$ [T AGR]

The rule (18) introduces an AGR node, resulting in the structure (19). This node, which possesses the features of the subject [1 pl], is subsequently spelled out as -*mus* (in (19) we have added a Theme position TH as well):

(19) Structure for *laudābāmus*



Crucially, the process that adds the AGR node applies at PF, prior to Vocabulary Insertion.[21] Structurally, we assume that this type of process has the properties of adjunction.

Addition of nodes in this way introduces one kind of syntax–morphology mismatch, in the sense that there are more positions in the morphological (PF) structure than there are in the syntactic structure. A further, and closely related, kind of mismatch involves the introduction of *features* at PF. The primary mechanism introducing features at PF is Vocabulary Insertion, where the phonological features of Vocabulary Items—i.e. the exponents—are added to abstract morphemes. Beyond this operation, there are in addition cases in which PF rules add non-phonological features which then have an impact on Vocabulary Insertion.

[21] For the manner in which the AGR node acquires the person/number features of the subject, see below.

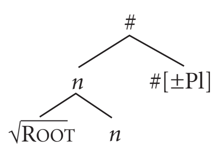
One example of this type involves morphological case features, which, while absent in syntax according to an assumption we adopt here, are inserted at PF and then condition the choice of vocabulary items expressing case. For instance, Latin nouns are found in nominative, genitive, dative, accusative, vocative, and ablative forms. The Declension I noun *femina* 'woman' is used to illustrate these cases in (20).[22]

(20) Case forms for a Latin noun

	Singular	Plural
Nominative	fēmina	fēminae
Genitive	fēminae	fēminārum
Dative	fēminae	fēminīs
Accusative	fēminam	fēminās
Vocative	fēmina	fēminae
Ablative	fēminā	fēminīs

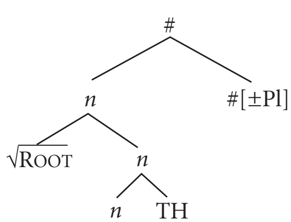
We take it that the forms in (20) are structurally composed of a Root and a nominalizing head *n*, along with a number head #. The # head contains the features [±Pl], for singular and plural number:

(21) Structur e of nouns



At PF, a theme node TH is added to *n*; this TH node is realized as the traditional theme vowel, which, in Declension I, is -*a*-:

(22) Structure of nouns, with TH position



The structure in (22) does not contain morphological case features. Instead, we assume here that each of the different cases of the noun is formally represented by a complex of abstract features. We present in (23) an illustration of this type of decomposition, that of Halle (1997):

[22] For a treatment of Latin declension, see Halle and Vaux (1998).

(23) Latin Case Decomposition (Halle 1997)

	Nom.	Acc	Gen.	Dat.	Abl.
Oblique	−	−	+	+	+
Structural	+	+	+	+	−
Superior	+	−	−	+	+

We put aside the important question of how the values of the different features are determined.[23] For the purposes of the present discussion we note that while case features of the type presented in (23) might refer to properties of syntactic structures, the features themselves are not syntactic features. These features are added to nodes at PF under specific conditions; they do not figure in the syntax (narrowly defined).[24]

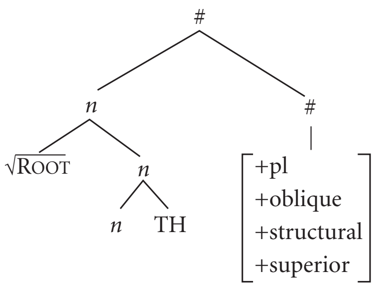
Syntactically, nouns like those in (20) appear within DPs. At PF, case features are added to DPs (or to their D heads), based on the syntactic structure that the DP appears in (see Marantz 1992 and McFadden 2004 for some proposals concerning such rules):

(24) D → D[case features]

These features are then copied onto hosts in the DP like the noun we have examined earlier. In Latin, case and number are realized in the same position. One possibility is that the case features are added directly to the # node, as in (25).[25]

While much remains to be said about case features and the rules that are responsible for agreement within DPs, the point of this example is the status of the case features themselves. These features are added at PF, and are not present in the syntactic derivation.

(25) Addition of case features



[23] The nature of the case features required for spelling out nominal inflections has been an active topic of research since Jakobson (1936). As Halle (1997) stresses, some motivation must be given for the features in a decomposition like that in (23). Without strong criteria for what constitutes possible features, it would be possible to stipulate a feature decomposition that provides the required natural classes. But unlike phonological features, the features involved in such a decomposition would have no independent status.

[24] For a recent discussion of the relationship between syntactic Case features and morphological case features see McFadden (2004).

[25] Another possibility is that a case node is added to the structure, and fused with the # node. In either case, the point is that features not present in the syntax are introduced into the representation.

Summarizing the discussion to this point, there are instances in which both morphemes and features that are not present in the syntax are inserted by rules of PF. These ornamentations of the syntactic structure introduce redundancy into the PF expression but do not eliminate or alter information which is crucial for semantic intepretation.

Employing terminology from Embick (1997, 1998), we refer to material (features or terminal nodes) added in the PF component as "dissociated", a term which emphasizes that such material is an indirect reflection of certain syntactic morphemes, features, or configurations, and not the actual spell-out of these.

(26) *a.* **Dissociated features.** A feature is dissociated iff it is added to a node under specified conditions at PF.
b. **Dissociated nodes.** A node is dissociated iff it is added to a structure under specified conditions at PF.[26]

Nodes that are featureless get their features through contextually determined rules, referred to as "agreement" or "concord" processes. Regarding such concord processes, it is important to note that the *copying* of features at PF might have a different status from the *introduction* of features:

(27) *a.* **Feature copying.** A feature is present on a node *X* in the narrow syntax is copied onto another node *Y* at PF.
b. **Feature introduction.** A feature that is not present in narrow syntax is added at PF.

Because syntactico-semantic features must be visible at PF for the purposes of Vocabulary Insertion, holding that an operation at PF can copy these features does not constitute a large departure from the simplest model of syntax–morphology interactions. Feature Introduction, on the other hand, results in the introduction of (non-phonological) features that are not present in the syntactic derivation at all—a significant extension of the simplest model—and should therefore be treated with caution. The introduction of case features in the examples above constitutes a case of feature introduction. As a working hypothesis, it has been suggested that only features irrelevant to semantic interpretation, that is, features that are not interpretable, can be introduced at PF (Embick 1997, 2000). This point about feature type and the distinction between copying and introduction in the first place clearly relates to the question concerning PF and the Inclusiveness Condition raised in section 9.2.1.

To summarize, our approach acknowledges four types of feature. In line with standard treatments of features in the syntax, we assume that the syntax manipulates nodes containing both uninterpretable and interpretable features (cf.

[26] Evidently, dissociated nodes may be assigned both to entire complex heads (M-Words) and to terminals within a complex head (subwords) (see Embick and Noyer 2001).

Chomsky 1995 and subsequent work.) We take it that this division is one between features that have no semantic interpretation, for example, EPP features or their equivalent, and those that do: our abstract morphemes, that is, the contents of functional heads. The grammar also makes reference to diacritic features, arbitrary features that must simply be memorized as belonging to particular Roots (and perhaps exponents/abstract morphemes as well). Features relating to Conjugation or Declension class are features of this type. Such features are relevant for morphological spell-out, but do not have any semantic interpretation. A fourth type of feature was introduced immediately above. Because many languages show discrete pieces in morphology that evidently do not correspond to heads present in the syntactic derivation, it has been proposed that nodes and features are added at PF by language-specific rules. The alternative—requiring that all pieces be syntactic—is a stronger position since it admits no non-syntactic pieces at all. However, this alternative would require the presence of functional heads in the syntax that possess no semantic content, an undesirable move inasmuch as it complicates the syntactic derivation with objects that play (by hypothesis) no role in syntax or semantics.[27]

9.4.2 Operations on Nodes

Certain additional operations occurring prior to spell-out may complicate the direct reflection of syntactic structure in the phonological forms which interpret this structure. Impoverishment (for an initial formulation, see Bonet 1991) eliminates features from morphemes prior to Vocabulary Insertion and creates certain types of systematic syncretisms. *Fission* occurs concomitantly with spell-out and permits the insertion of more than one vocabulary item at a single syntactic terminal.

9.4.2.1 *Impoverishment*

As discussed in section 9.2.4, the same exponent may be inserted into several morphosyntactically distinct morphemes when the vocabulary item introducing this exponent is underspecified in its context of insertion. Moreover, the principled ordering of vocabulary items in the competition for insertion (section 9.2.3) ensures that the exponents in less specified items will acquire a default or "elsewhere" distribution. Such distributions are typically not natural classes of categories, but are instead all the categories remaining after exponents with more specific contexts of insertion have been inserted.

[27] A related view is expressed as a minimalist desideratum by Chomsky (2001: 43, n. 12): "Functional categories lacking semantic features require complication of phrase structure theory... a departure from good design to be avoided unless forced." It remains to be seen if there are clear empirical reasons forcing the exclusion (or inclusion) of such features in the syntax.

Impoverishment allows for the expression of further systematic syncretisms. When Impoverishment occurs, a feature of a morpheme is deleted in a specific context; after deletion the morpheme in question escapes the insertion of any vocabulary item requiring that feature. The effects of Impoverishment are usually seen when in some particular circumstance a category fails to exhibit the expected exponent but instead exhibits a default exponent. This gives the effect of forms which "appear to be what they are not".

A simple example of Impoverishment can be seen in the substantival declension of classical Arabic (Haywood and Nahmad 1965). Arabic nouns and adjectives inflect for three cases (nominative, genitive, and accusative) and for definiteness. We will make use of the following two features to express this three-way distinction:

(28) Case features for Arabic

	Nom.	Acc.	Gen.
Oblique	−	−	+
Superior	+	−	−

Examples of the two types of declension of interest here are given below.

(29) Some Arabic declensions

	Nom. Indef.	Gen. Indef.	Acc. Indef.	Nom. Def.	Gen. Def.	Acc. Def.
rajul- 'man'	-u-n	-i-n	-a-n	-u	-i	-a
rijāl- 'men'	-u-n	-i-n	-a-n	-u	-i	-a
hāšim- 'Hashim'	-u-n	-i-n	-a-n			
hārūn- 'Aaron'	-u	-a	-a			
madāʔin- 'cities'	-u	-a	-a	-u	-i	-a

In the ordinary or "triptote" pattern of declension, as in *rajul-* 'man', *rijāl-* 'men', and *hāšim-* 'Hashim', all three case forms have distinct suffixes and indefiniteness is expressed by the addition of *-n*. (Note that proper names are normally declined as indefinites in Arabic.) The following vocabulary items, competing for insertion in the Case morpheme, introduce the exponents for these suffixes.

(30) *a.* u ↔ [+superior]
b. i ↔ [+oblique]
c. a *elsewhere*

Definiteness is expressed by:

(31) n ↔ [−definite]
(32) ∅ *elsewhere*

In certain so-called "diptote" substantives, such as *hārūn-* 'Aaron' or *madāʔin-* 'cities', the three cases are expressed by only two distinct affixes when the noun is indefinite.[28] Specifically, the genitive *-i* does not appear but is replaced by *-a*, normally the default suffix used in the accusative. In addition, diptote nouns systematically lack the indefinite *-n* seen in triptotes. Both types of exceptional behaviour involve a loss of distinctions and a replacement of more specific exponents by default ones *-a* and ∅. To permit diptotes to escape insertion of unwanted *-i* and *-n* the grammar must contain Impoverishment rules deleting the features which condition the insertion of these exponents:[29]

(33) Arabic diptote Impoverishment
a. [+oblique] ⟶ ∅ / [diptote] + _____ + [−definite]
b. [−definite] ⟶ ∅ / [diptote] + case/number + _____

Once the values [+oblique] and [−definite] are removed, neither *-i* nor *-n* can be inserted, and default *-a* and ∅ are inserted instead.

The declension of weak adjectives in Old English provides a slightly more complex example of Impoverishment:

(34) Old English weak adjectival declension

til- 'good'	masc sg	neut sg	fem sg	Plural (all genders)
Nom.	til-a	til-e	til-e	til-an
Acc.	til-an	til-e	til-an	til-an
Gen.	til-an	til-an	til-an	til-ra
Dat.	til-an	til-an	til-an	til-um

Clearly the suffix *-an* has an elsewhere distribution: it appears in the direct (nominative and accusative) cases of the plural, the oblique cases of the masculine and neuter singular, and all but the nominative case of the feminine singular. On the other hand, the suffixes *-a*, *-ra*, and *-um* have very specific contexts of insertion. Leaving aside the suffix *-e* for the moment, the vocabulary items for the remaining suffixes are clearly:[30]

(35) *a.* um ↔ [+structural +superior +oblique +plural]
b. ra ↔ [+oblique +plural]
c. *a* ↔ [−oblique +superior masculine]
d. *an* ↔ (elsewhere)

[28] Although certain generalizations, some exceptionless, exist regarding whether a given stem will be diptote or triptote, in many cases the choice is unpredictable. For example, the proper name *hind-* can inflect diptote or triptote (Haywood and Nahmad 1965: 384–8). Regardless of how predictable the diptote property is, however, it remains clear that the diptotes as a class must be marked with a diacritic class feature of some kind. The feature [diptote] is used here for this purpose.

[29] Note that these rules must apply in the order shown since [−definite] deleted by the second rule is part of the conditioning environment for the first rule, a counterbleeding ordering relation. This ordering is however a principled one inasmuch as (33*a*) refers to a more specific environment than (33*b*).

[30] The case features used here are the same as those used in the Latin example above.

Because -*an* is specified for no features, it is inserted only in contexts where the more specified affixes -*um*, -*ra*, and -*a* are not.

The distribution of -*e* illustrates the effects of Impoverishment in the grammar. Specifically, note that -*e* appears in the nominative in the feminine, but in both the nominative and the accusative in the neuter. The systematic syncretism of the nominative and accusative forms is not, however, unique to this declension but is a pervasive pattern throughout the inflection of Old English. To treat this pattern as a mere accident of the vocabulary items would miss the generalization that the neuter direct cases are never distinct. To express this systematic neutralization of distinction, an Impoverishment rule deletes the property [−superior] from the neuter case-number morpheme:

(36) [−superior] → ∅ / [neuter ———]

When a feature is deleted by Impoverishment two possible scenarios result, depending on the markedness status of the features. We assume that the grammar contains markedness statements expressing the default values for various morphosyntactic features. Among such statements Old English will contain the following:

(37) *a.* [ ] → [+structural]
b. [ ] → [−oblique]
c. [−oblique] → [+superior]

These markedness statements serve to evaluate the complexity of a given case category and define the nominative case as the least marked.

When unmarked values are deleted by Impoverishment, no further process occurs and the morpheme in question remains unspecified for the deleted feature. However, when a marked value is deleted, markedness rules automatically supply the unmarked value in its place (Noyer 1996). Thus, when (36) deletes [−superior] from the neuter case suffix, (37*c*) immediately supplies the default value [+superior]. Effectively, the neuter accusative morphemes are reduced in markedness, becoming identical to nominative morphemes.[31]

The existence of these independently necessary markedness statements and Impoverishment rule now makes the distribution of the suffix -*e* entirely normal:

(38) e ↔ [+superior +structural −plural]

Because -*a* is inserted in the nominative masculine singular, -*e* appears in the remaining nominative singular categories, viz. feminine nominative singular and neuter nominative singular, which now includes the accusative. If Impoverishment

[31] Elsewhere in Old English the neuter singular forms are usually distinct from masculine and feminine and exhibit a special -*t* suffix. In the strong adjectival inflection, however, the neuter forms—both accusative and nominative—are identical to the masculine nominative singular; the masculine accusative singular has a specific affix -*ne*. Thus there is no evidence from inflectional patterning to suggest that the nominative case is more marked than the accusative.

had not taken place, the final elsewhere *-an* would be incorrectly inserted into the neuter accusative (just as it appears in all other accusative contexts).

In sum, systematic syncretisms arise either through underspecification of vocabulary items and the ordering of vocabulary items in the competition for insertion, or through Impoverishment rules expressing pervasive neutralization of distinctions such as the nominative/accusative opposition in the Old English neuters, or the accusative/genitive opposition in the Arabic diptotes. When Impoverishment rules delete marked feature values, markedness statements insert unmarked values. Viewed most generally, Impoverishment expresses a retreat to the general case, that is, the expression of a category in the same manner as a less marked one.[32]

9.4.2.2 *Fission*

Under normal circumstances each morphosyntactic terminal (morpheme) has a single phonological reflection or "piece" at PF; that is to say, a single node is subject to the application of a single vocabulary item. To capture this generalization directly, Halle (1990) proposed that an abstract morpheme originates syntactically as an ordered pair (F, Q) where F is a matrix of morphosyntactic features and Q is a placeholder for the exponent to be inserted at PF. The effects of Vocabulary Insertion are illustrated in (39), where /x/, /y/, /z/ are phonological exponents:

(39) Normal circumstances

Syntax	$[[(F_1, Q)$	$(F_2, Q)]$	$(F_3, Q)]$
	$\Downarrow$	$\Downarrow$	$\Downarrow$
PF	$(\,(\,(F_1, /x/)^*$	$(F_2, /y/))^*$	$(F_3, /z/))$

Positional blocking follows automatically on this model because each morpheme's Q can be replaced by at most one exponent. Inversely, because each morpheme's Q must be replaced by at least one exponent, provision is made for "final" elsewhere affixes whose distribution can be understood only as a residue of cases not covered by more specific vocabulary items.

Nevertheless, exceptions to this one-to-one relation are not infrequent. Specifically, there are numerous cases in which a single morpheme appears to "split" into several independent pieces, a phenomenon we refer to as morpheme "fission". The verbal conjugation from San Mateo Huave (isolate, Mexico; Stairs and Hollenbach 1981) illustrates such splitting:[33]

[32] The present discussion has concentrated on the Impoverishment of morphological case features, that is, dissociated features in the sense of section 9.4.1. Interpretable features and diacritic features may also be subject to Impoverishment. For example, Noyer (2005) explores cases in which syncretisms across inflectional classes result from Impoverishment of inflectional class features. Whether Impoverishment operates in the same manner for all varieties of features remains to be investigated.

[33] Apostrophe indicates secondary palatalization; 1 = first-person exclusive, 12 = first inclusive, 2 = second person, 3 = third person. The feature [plural] is used here for simplicity; because 12 [−plural] is

(40) Huave verbal conjugation: present (atemporal) tense of -*rang* 'make, do'

	[−pl]	[+pl]
1	s-a-rang	s-a-rang-an
12	a-rang-ar	a-rang-aac
2	i-rang	i-rang-an
3	a-rang	a-rang-aw'

These verb forms consist of a verbal root (here, *rang*) prefixed by a theme vowel *i* in the second person, *a* elsewhere, and various prefixes and suffixes expressing person and number. Of particular interest here is the distribution of -*an*, which appears as a default marker of plural where not pre-empted by more specific -*aac* in 12 and -*aw'* in 3. Remarkably, where these more specific suffixes express person properties, no person marking appears in the prefix position; instead the prefix is simply null (followed by the theme vowel *a*-). Inversely, where the suffix is the default -*an* and thus expresses no person properties, the prefix position expresses these person properties instead: *s*- in the first person exclusive, and in the second person a floating [−back] feature which ablauts the theme vowel to *i*-.[34] Thus, we see that person properties are expressed either in the prefix position or in the suffix position but not in both at once.

Two modifications of the theory are required to derive this blocking across string positions. First, more than one vocabulary item must apply to a single AGR morpheme. Second, some mechanism must ensure that once a feature of AGR has been referred to by a vocabulary item, it must become unavailable for spell-out at the other string position. Operationally several options exist for obtaining these effects (see Halle 1997 and Noyer 1997). For present purposes we will simply assume that vocabulary insertion does not rewrite the placeholder *Q* in each terminal, but rather cyclically constructs a phonological "image" of the syntactic structure by mapping each terminal to one or more exponents. This is illustrated schematically in (41), where Greek letters stand for abstract features, and elements in slashes are phonological exponents:

(41)				
	Syntax	[[X	Y]	Z]
		$\Downarrow$	$\Downarrow$	$\Downarrow$
	PF image	((X[α, /x/]*	Y[β, /y/])*	Z[γ, δ, /a/, /b/])

While the syntactic structure provides the skeletal framework for the PF image, the mapping between syntactic positions and PF positions need not be one-to-one in every instance. Each terminal (*X*, *Y*, *Z*) could in principle have more than one

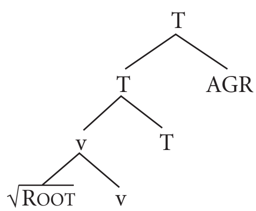
minimally 2 and 12 [+plural] minimally 3 individuals, it would be more correct to characterize the "plural" categories as non-restricted, that is, being one more in cardinality than the corresponding restricted ones.

[34] Here *i*- replaces expected *e*-by a general rule raising word-initial front vowels.

exponent as its phonological image; in this particular example, the abstract morpheme Z has two phonological exponents as its phonological image. The ordering and hierarchical relations among these sets of pieces is determined by the hierarchical structure of the syntactic terminals. Thus in the ultimate linearization of (41), exponents inserted into Z must either be left- or right-adjacent to the entire (X * Y) complex.

Returning to the analysis of (40), we assume that the Huave verbal forms in (40) have the hierarchical structure shown in (42):

(42) Hierarchical structure



As discussed above, exponents of AGR appear both prefixally and suffixally in the verb. At the same time, for the purposes of blocking the prefix and suffix positions are not independent of each other—application of a highly specified Vocabulary Insertion can result in the appearance of a suffix, but no prefix (e.g. 12 P1 and 3 P1). We take it that this effect derives in part from the manner in which the structure in (42) is linearized. Because Tense has no overt exponent in this example, we ignore it for the purposes of linearization. The head v, where we assume that the Theme Vowel appears, is linearized as left-adjacent to the Root:

(43) (v* $\sqrt{\text{Root}}$)

The special property of AGR in Huave is that it is linearized with the requirement that it be adjacent to (v* $\sqrt{\text{Root}}$). However, the operator defining this relationship specifies merely immediate adjacency, not immediate left-adjacency like the * operator. We notate this with $\circledast$:

(44) ((v* $\sqrt{\text{Root}}$) $\circledast$ AGR)

While (44) requires that any exponent of AGR must be immediately adjacent to (v* $\sqrt{\text{Root}}$), it is compatible with either a prefixal or suffixal realization, since both would be immediately adjacent (v* $\sqrt{\text{Root}}$). A consequence of the manner in which this relation is defined is that there can be at most one affix position on each side of the v* ($\sqrt{\text{Root}}$); if there were two, one AGR position would not be adjacent to the relevant object, in other words, it would violate (44). Insertion of exponents into AGR thus proceeds until at most two exponents are inserted (see the discussion of featural blocking immediately below), subject to the further requirements imposed by (44). The ultimate linearization of AGR exponents with respect to (v* $\sqrt{\text{Root}}$) then depends on the exponents in question; these are inherently specified as being either prefixal or suffixal, as seen in the vocabulary items in (45).

(45) Exponents of AGR

-aac	$\leftrightarrow$	[+I +you +pl]
-ar	$\leftrightarrow$	[+I +you]
s-	$\leftrightarrow$	[+I]
[–back]-	$\leftrightarrow$	[+you]
-aw'	$\leftrightarrow$	[−I −you +pl]
-an	$\leftrightarrow$	[+pl]

In this way, linearization operations apply successively; initial operations impose weak constraints of adjacency like that represented by $\circledast$, while later operations derive the final left–right order based on properties of exponents.

Two types of blocking effects are seen in these data: featural and positional. In featural blocking, the spell-out of a feature at one position prevents the spell-out of that same feature again even when in another string position. For example, insertion of -*aac* in the 12 plural not only pre-empts the insertion of -*ar*, -*an*, and -*aw*' at the position immediately to the right of the (image of the) v-$\sqrt{\text{Root}}$, that is, at the suffix position, but also pre-empts the insertion of *s*- and [−back] at the prefix position. To derive this variety of blocking, we require that once a feature has conditioned the insertion of a vocabulary item, it is marked as discharged. Because Vocabulary Insertion may not again discharge the same feature, disjunctivity effects may occur across string positions.[35] For example, the insertion of -*ar* in the 12 singular discharges [+I] and [+you]; all remaining vocabulary items mentioning these feature values automatically become unavailable for insertion, regardless of string position.

Positional blocking occurs where the insertion of one vocabulary item prevents the insertion of another at the same string position: this is the familiar variety of disjunction which motivated the *Q* placeholder. Where several distinct string positions may be filled by the phonological image of a morpheme, however, positional blocking is no longer automatic; in principle, vocabulary items will be inserted continuously until all features are discharged or no vocabulary items remain. Positional blocking may, however, arise when linearization requirements

[35] Discharged features may, however, continue to condition Vocabulary Insertion, but only where the vocabulary item's structural description does not require an undischarged feature. This provision provides the flexibility to capture cross-positional blocking without requiring it in every instance.

like that imposed on AGR in (44) prevent more than one exponent from appearing on the same side of the v-$\sqrt{\text{Root}}$ complex.

In sum, fission processes present a last complication to the direct one-to-one mapping between syntactic terminals and phonological pieces. To derive both positional and featural varieties of blocking we have proposed that spell-out does not directly replace string positions occupied by syntactic terminals, but rather, constructs a phonological image of the syntactic structure by introducing one or more vocabulary items for each syntactic terminal, discharging morphosyntactic features of the syntax in the process. While this move represents a relaxation of the prediction that morphological structure is simply syntactic structure, it is a minimal departure inasmuch as the phonological image of the syntax contains only further ramification of the constituent structure already built prior to spell-out.

9.4.3 Movement in the PF Derivation

A further type of mismatch between syntax and morphology involves cases in which the morphological structure is one that seems to have been derived from the syntactic structure via a movement operation. The types of movement operation that we assign to the PF branch are extremely limited in nature; they are local readjustments, not syntactic movements in the true sense.

A general process for resolving mismatches of this type is the device of Morphological Merger, introduced in Marantz (1984) and developed in a number of subsequent investigations (for instance Marantz 1988, also Bobaljik 1994 and Embick and Noyer 2001). The original idea behind this operation is that mappings between different levels of grammatical representation are constrained to obey certain relationships, although some relationships can be "traded" for others. For example, under certain conditions a relationship of linear adjacency like (X * Y) could be converted into an affixation relationship, Y–X, which could (potentially) reverse the original linear order. Marantz's formulation allows for Merger to operate either in terms of linear order or in terms of hierarchical structure, a position that is maintained in the approach to Merger presented in Embick and Noyer (2001).

In terms of the operations that comprise the PF derivation, a basic distinction depends upon whether an operation applies in the pre-Vocabulary Insertion structure, or in the structure after Vocabulary Insertion and Linearization have taken place. In terms of this basic distinction, there are two points at which Merger can operate: prior to linearization, in which case it operates in terms of hierarchical structures, or after, in which case it is defined in terms of linear adjacency:

(46) Two operations at PF
a. Before linearization: The derivation operates in terms of hierarchical structures. Consequently, a movement operation that applies at this stage is defined hierarchically. This movement is Lowering; it lowers a head to the head of its complement.
b. After linearization: The derivation operates in terms of linear order. The movement operation that occurs at this stage, Local Dislocation, operates only in terms of linear adjacency, not hierarchical structure.

An example of Lowering is found in the movement of Tense in English to the verb, as mentioned above. This type of movement skips intervening adverbials (the hallmark of a process that is defined hierarchically), as shown in (47), where *t* marks the original, syntactic, position of Tense:

(47) John *t* quickly play-ed the trumpet.

The rule that derives (47) is stated as follows:[36]

(48) Lowering: T lowers to *v*

Assuming that the adverb is adoined to vP, the resulting structure is one in which T[past] has been lowered to the head of vP, that is, to the head of its complement (the Root moves to v in the syntax, prior to Lowering). The tree in (49) illustrates the vP for (47) after the Lowering operation has applied (for simplicity, the trace of the subject DP has been omitted).

(50) Local Dislocation
X * Y → Y-X

Lowering can skip intervening material like adverbs because it is defined in hierarchical terms: it lowers a head to the head of its complement.

The other post-syntactic movement process, Local Dislocation, is unlike Lowering in that it makes reference to linear adjacency rather than to hierarchical structure. Under specified conditions, this operation effects affixation under adjacency, which can potentially reverse the order of the elements involved:

Operations of this type sometimes occur within complex heads, where hierarchically defined operations like head-movement or lowering are not relevant. For example, in Huave the reflexive affix -*ay* appears directly before the final inflectional affix of a verb, if any. Consider the following examples (Stairs and Hollenbach 1981; reflexive affix in bold):

[36] Further aspects of this rule, and its interaction with *do*-support, are discussed in Embick and Noyer (2001).

(51) a. *S-a-kohč-**ay**.*
1-TH-cut-REFL
'I cut myself.'
b. *S-a-kohč-**ay**-on.*
1-TH-cut-REFL-PL
'We cut ourselves.'

(52) a. *T-e-kohč-**ay**-os.*
PAST-TH-cut-REFL-1
'I cut (past) myself.'
b. **T-e-kohč-as-**ay**.*
PAST-TH-cut-1-REFL

(53) a. *T-e-kohč-as-**ay**-on.*
past-TH-cut-1-REFL-PL
'We cut (past) ourselves.'
b. **T-e-kohč-**ay**-os-on.*
PAST-TH-cut-REFL-1-PL

We take it that this pattern derives from a morphological well-formedness condition that applies to complex verbs in Huave:

(54) Refl must precede post-Root X, X a non-Root node.

When no Xs are linearized following the Root, no operation applies. When the Root is followed by at least one inflectional affix, a Local Dislocation operation applies.

Although -*ay* directly follows the root and precedes -*Vs* 'first person' in (52a), -*ay* 'reflexive' follows -*Vs* 'first person' in (53a).[37] We can account for these facts by assuming that -*ay* is structurally peripheral to the verb+inflection complex, but undergoes a Local Dislocation to left-adjoin to the rightmost inflectional affix:[38]

(55) a. (((s-a-kohč)* on)* **ay**) → ((s-a-kohč)* **ay**+on)
b. ((((s-a-kohč)* as)* on) * **ay**) → (((s-a-kohč)* as)* **ay**+on)

In this way, the REFL exponent shows a second-position effect at the right edge of the verb, with respect to any other discrete pieces that are present.

9.4.4 Summary

The operations discussed in this section are means of accounting for what appear to be mismatches between syntactic structure and morphological structure, where by the latter we mean the structure that appears at PF. In many cases of apparent mismatches, there is an analytical tension between modifying (and perhaps

[37] The first-person suffix shows an alternation -*as*∼-*os*∼*iəs*.

[38] We have simplified some of these structures for expository purposes. For instance, according to one view, rebracketing applies prior to the local dislocation of cases in this type, so that (55a) goes through two steps:

(i) (((s-a-kohč) * on) * **ay**) $\xrightarrow{\textit{rebracketing}}$ ((s-a-kohč) * (on * **ay**)) $\xrightarrow{\textit{local dislocation}}$ ((s-a-kohč) * **ay**+on)

An alternative would be to say that the process is defined in terms of a concatenation relationship instead of adjacency.

complicating) the syntactic analysis on the one hand, and positing a PF operation that modifies the syntactic structure on the other. As a general conceptual point, the strongest hypothesis is that PF is sharply constrained in its power to modify the syntactic structure. Given this, a syntactic analysis must be considered the default option, all other things being equal. This is the assumption that allows for the most direct connection between syntactic structure and morphological structure.

In cases in which a syntactic analysis seems arbitary, unmotivated, or unduly complex, PF operations of the type that we have outlined above have been appealed to. Two points must be emphasized with respect to these operations. First, they are only appealed to in instances in which the syntactic analysis is unworkable. Second, they arise only as departures from the ideal case, in which the syntactic structure is not significantly altered at PF.[39]

9.5 Concluding Remarks

The approach to the syntax–morphology interface that we have provided here is based on the idea that there is a single generative component (the syntax) responsible for the construction of complex objects. According to this approach, syntactic structure serves as the skeleton on which all complex forms are based. In the default case, these structures are linearized and the abstract morphemes are subject to Vocabulary Insertion. In more complex cases, language-specific PF rules perform minimal alterations to the syntactic structure in the ways outlined above. These PF operations are introduced to account for cases in which there are mismatches between syntactic structure and morphological structure, or, more precisely, between the syntactic structure and the structure that is relevant for further computations in the construction of PF.

An additional point to be stressed concerns how our approach stands in relation to other treatments of morphology, in particular those that hold that word-formation is special and distinct from syntax. As discussed in light of the direct comparisons that have been made between syntactic and lexical approaches to morphology, the burden of proof is on lexicalist theories of grammar in the following way: it does not suffice in any particular instance to show that a phenomenon could be stated in a lexicalist architecture. Rather, what is required is a demonstration that a pattern *must* be stated in such an architecture, that is to say that the syntactic

[39] Some additional questions worth examining concern the nature of PF requirements. A working hypothesis is that such requirements are motivated by properties of the input to the learner that are readily visible as well-formedness requirements, but the precise manner in which such conditions are stated has yet to be determined.

approach misses crucial generalizations. We are not aware of any arguments of this type that withstand scrutiny. It remains to be seen exactly how the syntactic approach can be implemented across the wide range of phenomena traditionally thought of as being the domain of the syntax–morphology interface; but there is no reason to suspect at present that the syntactic approach cannot be extended in this way. Further empirical investigation in terms of the framework outlined above promises to sharpen the issues and our understanding of how a number of different aspects of linguistic competence relate to one another.

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CHAPTER 10

MORPHOLOGY ≠ SYNTAX

PETER ACKEMA AND AD NEELEMAN

10.1 Introduction

In this chapter we sketch a model of grammar that is developed in detail in Ackema and Neeleman (2004). We focus on the relation between syntax and morphology, and more specifically on the question whether there is a generative system for word formation separate from syntax. This is quite often denied: various authors argue that word formation is the result of syntactic operations. We will argue that adopting a morphological module avoids serious complications in syntax.[1]

The issue we are primarily interested in is the one in (1*a*). However, this issue tends to get mixed up in the literature with the related issues in (1*b*–*d*).

(1) *a.* Are the generative systems that produce words and phrases identical or distinct?
b. Do syntactic terminals contain phonological material or do they only contain syntactically relevant features, realized "later" through spell-out rules?

[1] Overviews of the issues that pertain to the relation between syntax and morphology can be found in Borer (1998) and Spencer (2000), amongst others.

c. To what extent are the principles that govern the well-formedness of words identical to the principles that govern the well-formedness of phrases?
d. Is there a special "lexical" aspect to word formation? For example, is word formation never fully productive, in contrast to the formation of phrases? Are words perhaps formed in the lexicon?

A title like "No Escape from Syntax: Don't Try Morphological Analysis in the Privacy of Your Own Lexicon" (Marantz 1997) seems to imply, for example, that morphological structure must be generated either in the syntax or in the lexicon. Thus, the answer to (1*a*) is linked to that to (1*d*). Similarly, evidence in favour of "late insertion" of phonological forms is sometimes taken as evidence against there being separate generative systems for words and phrases, which amounts to linking (1*a*) and (1*b*). Finally, similarities in the principles that govern the structure of words and phrases are sometimes taken as evidence against the "two separate generative systems" view (linking (1*a*) and (1*c*)). In fact, the issues in (1*a*) through (1*d*) are independent. In principle, any combination of answers is possible, without this resulting in an incoherent model of grammar.

We will defend the view that, in addition to the phrasal syntactic generative module, there is a word-syntactic module, which produces the structures of morphological complexes. At the same time, we assume that only syntactically relevant features are inserted in syntactic terminals, not phonological forms. Hence, we show that a positive answer to the question whether there is a distinct morphological module does not imply a negative stance to "late insertion". In fact, we will show that certain difficulties that a model with two generative systems would seem to run into are solved by late insertion. The position we will argue for has much in common, both in spirit and execution, with that of Williams (in this volume), although there are various differences in the details.

We cannot go into questions (1*c*) and (1*d*), but in the next section we will briefly outline why they do not bear on the issue in (1*a*).

10.2 The Place of Morphology in Grammar

The question in (1*d*) has, in our view, been answered conclusively by Di Sciullo and Williams (1987) and Jackendoff (1997), amongst others. There is no special relationship between morphology and the lexicon—the relationship between words and the lexicon is not different from the relationship between phrases and the lexicon. Any complex word with fully predictable properties (predictable from the principles of grammar, that is), just like any complex phrase with fully predictable properties, will not be listed in the lexicon.[2] Conversely, any phrase with some unpredictable property, just like any word with some unpredictable property, is listed. The number of such phrases is not qualitatively different from the number of words with unpredictable properties (see Jackendoff 1997).

This, of course, does not mean that syntax is the locus of word formation. More surprisingly, perhaps, even the question in (1*c*) does not bear on this issue. Consider the architecture of grammar in (2) (cf. Jackendoff 1997: 113).

(2)

SEMANTICS		SYNTAX		PHONOLOGY
Phrasal Semantics		Phrasal Syntax		Phrasal Phonology
↕		↕		↕
Phrasal semantic structure		Phrasal syntactic structure		Phrasal phonological structure
INSERTION	↔	INSERTION	↔	INSERTION
Word semantic structure		Word syntactic structure		Word phonological structure
↕		↕		↕
Word Semantics		Word Syntax		Word Phonology

The "big" syntax, semantics, and phonology modules each contain submodules that generate phrasal and word-level representations, respectively. What is usually referred to as "syntax" is, on this view, a submodule of the syntax that we may call "phrasal syntax". The syntax also contains a distinct submodule, word syntax, that generates hierarchical structures for words. In the same vein, we can distinguish phrasal phonology (prosodic phonology) from word phonology (lexical phonology), and phrasal semantics from word semantics (lexical semantics). For ease of exposition, we use "morphology" and "syntax" rather than the less familiar "word syntax" and "phrasal syntax". But when we argue that morphological structures are not the product of syntactic operations, it should be kept in mind that we mean "phrasal syntactic" operations by the latter.

The existence of a separate submodule responsible for the generation of morphological structures has been denied by a number of syntacticians. One argument for this is that word syntax and phrasal syntax share a number of properties (issue (1*c*)). For example, as pointed out by Starke (2002), there is considerable overlap in the features

[2] Experiments involving retrieval of regular complex words have shown that their structure is not always computed on line (see, among others, Baayen et al. 2002). We assume that such items are stored without internal structure. This is supported by the well-known phenomenon that compounds receive word stress rather than compound stress when they are very frequent.

manipulated by the two systems. In both, categorial features, case features, tense features, and phi features occur. Similarly, both share the operation of merger, resulting in hierarchical structures that allow for thematic relations, relations of binding, and so on. Finally, there are systematic correspondences between word syntactic and phrasal syntactic structures. The best known of these are expressed by the mirror principle (Baker 1985), according to which the order of affixation in word syntax mirrors the order of application of corresponding operations in phrasal syntax, and by Cinque's (1999) functional sequence, which governs the order of attachment of adverbs in phrasal syntax and of semantically related affixes in word syntax.

At first sight, the fact that syntax and morphology share vocabulary and principles undermines a model in which the two are distinct, because it seems we then need to duplicate the relevant vocabulary and principles in the two separate systems, which is conceptually inelegant. However, this argument is valid only if the claim is that morphology is a module of grammar on a par with semantics, phonology, and syntax (the "big" boxes in (2)). However, we claim that morphology is a set of submodules within these bigger modules. Word syntax is a submodule of syntax, just like phrasal syntax. These submodules can have their own vocabulary and principles, but as a matter of course they also inherit the vocabulary and principles of the bigger module in which they are contained. Therefore, much will be shared by the word-level and phrase-level submodules. For example, notions like *nominal*, *verbal*, *head*, *merge*, *c-command*, *argument*, *complement*, etc., belong to the big syntax module in (2), and hence are shared by phrasal syntax and word syntax. In contrast, notions like *EPP*, wh-*movement*, and *scrambling* exclusively belong to the phrasal syntactic submodule, while notions like *Germanic* versus *Latinate* and the features that encode declension classes restrict merger in word syntax, but not phrasal syntax. Such a combination of more general and more specialized notions ties in naturally with the model in (2). The question of how much vocabulary and how many principles are shared, and how much vocabulary and how many principles are particular to the submodules, is interesting in its own right, but it does not bear on the issue of whether the submodules generate their own representations (for further discussion, see Sproat 1985, Lieber 1992, and Ackema 1999).

The model in (2) also gives a handle on generalizations that seem to relate phrasal syntax to word syntax, such as Cinque's functional sequence and Baker's mirror principle. Since both phrasal syntax and word syntax generate hierarchical structures, both can be said to express scope. That is to say, if scope relations are the result of compositional interpretation of hierarchical structures, the rules of scope assignment in the semantic module will apply to both phrasal syntactic and word syntactic representations. This accounts for the mirror principle. For instance, when an applicative morpheme is attached higher than a passive morpheme, it will take scope over the passive morpheme and the applicative of a passive is derived. If the order of affixation is reversed, so is the scopal relation between the two, and the passive of an applicative is derived. (This argument presupposes that "passive" and "applicative" are rules that manipulate argument structure and that can be expressed in either word syntax or phrasal syntax; they are not specifically phrasal rules that trigger insertion of an affix; see Grimshaw 1986, Di Sciullo and Williams 1987: 56ff., and Alsina 1999 for related discussion.)

Shared effects of Cinque's functional sequence can be accounted for in similar terms. This sequence expresses preferred scopal relations between adverbs and between affixes that encode notions like modality, aspect, and tense. Suppose that such preferences are stated in some way either in the macro-module of semantics or in the macro-module of syntax (see Rice 2000 and Nilsen 2003). In that case, both word syntax and phrasal syntax will reflect them when multiple adverbs or affixes are attached. Thus, a modal affix will be attached outside an aspectual affix and a modal adverb will be attached outside an aspectual adverb. Notice that this is achieved without any duplication of principles anywhere in the grammar.

Another argument sometimes made in support of collapsing word syntax and phrasal syntax is that it makes the mapping between (morpho)syntactic structures and semantics more transparent. This holds in particular of structures involving thematic role assignment. Consider the following Southern Tiwa data (cf. Baker 1988: 77).

(3) a. *Seuan-ide ti-mũ-ban.*
man-SUF 1.SG-AOR-see-PAST
'I saw the/a man.'
b. *Ti-seuan-mũ-ban.*
1.SG.AOR-man-see-PAST

The same thematic relation between the verb *ban* 'see' and the argument *seuan* 'man' holds in both examples, even though the two elements form a phrase in (3*a*) and a complex word in (3*b*). Given the model in (2), this implies that assignment of the verb's internal θ-role can take place in two distinct structures. If word syntax is an instance of phrasal syntax, however, (3*b*) can be derived from an underlying representation containing a VP identical to the one that occurs in (3*a*):

(4) $[_{VP}$ $[_{NP}$ t_i] $[_{V}$ *Ti-seuan*$_i$*-mũ-ban*]].
1.SG.AOR-man-see-PAST

On this analysis, then, there is a unique configuration for internal θ-role assignment, namely, one of syntactic complementation. The argument that this is more parsimonious is explicitly made by Baker (1988).

This is a strong argument if all else is equal. However, it seems to us that there is a conceptual trade-off between the syntactic and morphological accounts of word formation. In general, the price paid for a more transparent mapping to semantics and for the abolition of nonsyntactic word formation is a complication of the syntactic structures that must be assumed. The representation in (4) is more complex than the one in (5), in that it contains more structure and a movement operation absent in (5), and the complexity of the syntactic representation will increase in this way with every additional morpheme a word contains.

(5) [$_{VP}$ [$_V$ *Ti-seuan-mũ-ban*]].
1.SG.AOR-man-see-PAST

This increase in complexity potentially entails a more complex grammar, because triggers must be assumed for each movement, as well as licensing mechanisms for the additional heads and complements.

For affixed words, the trigger for incorporation is sometimes claimed to be the selectional demands of the affix (cf. Ouhalla 1991; Lieber 1992). But if the selectional properties of an affix are satisfied through movement, a qualitative extension of the theory of grammar must be admitted. Standard cases of syntactic selection hold between chain roots (see Brody 1995 and Jackendoff 1997). The possibility of satisfying selectional requirements after movement hence weakens restrictions on syntactic selection.[3]

Complications are also necessary with respect to the licensing of phrases whose head is assumed to incorporate. Take synthetic compounds like *truck driver*. If these are derived by incorporation in phrasal syntax (on the argument that the same thematic relation holds between *truck* and *drive* in this compound as in the associated NP *driver of a truck*), this raises the question why *truck* must be licensed by *of* when it remains in situ, but not when it adjoins to a higher head. Baker (1988) proposes that incorporation of its head is in itself sufficient to license a syntactic complement in certain languages, but this is a qualitative extension of the theory that deals with the licensing of arguments.

As things stand, then, there is no reason to prefer a theory that collapes morphology and syntax over one that does not on conceptual grounds like these. A decision between the two models must be based on other arguments. In the next section we will consider what kind of arguments may be relevant.

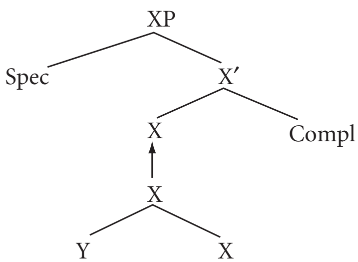
10.3 Arguments for a Distinct Word-Syntax Module

If there are separate generative modules for morphological and syntactic structures, the fact that morphological complexes can appear inside syntactic structures must be due to some operation that connects the top node of a morphological

[3] One might try to avoid this problem by arguing that movement to an affix is not triggered by m-selectional requirements, but by some feature on the affix that needs to be checked. Since checking can involve heads of chains, no extension of syntactic theory seems required. However, all instances of feature checking known to us are supposed to have an instantiation in covert as well as in overt syntax (or an instantiation as feature movement, or AGREE without displacement), at least cross-linguistically. But there are no affixes that allow covert raising of their host: this is precisely why the stray-affix filter is taken to be a surface-structure condition. Thus, Germanic shows variation with respect to overt movement of V to C or I, but in all Germanic languages V has to move to deverbal affixes like *-ion*, *-able*, *-er*, and *-ing*, if movement is taken to be the means by which derived words are formed.

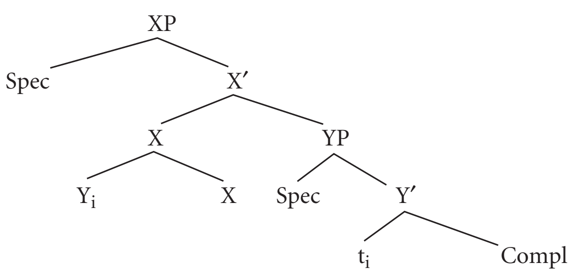
representation with a node in the phrasal syntactic representation, an operation usually referred to as "insertion". Thus, a syntactic phrase containing a morphologically complex word will have the structure in (6), where the arrow represents the insertion relation.[4] The internal structure of the complex head is generated in morphology, while the structure dominating the syntactic terminal is, obviously, syntactic.

(6)



In theories of word formation based on syntactic movement, the constituent parts of a complex word are not merged directly. Rather, the head X takes a YP as its syntactic complement and the head of this phrase moves and adjoins to X, as in (7).[5]

(7)



In section 10.2 we argued that there is no reason to prefer one theory over the other on conceptual grounds. We will now discuss a number of arguments that, in our opinion, do distinguish between the two approaches. These suggest that the structure of complex words is as in (6) rather than (7).

[4] See Ackema and Neeleman (2004) for details on how insertion works, in particular on how it restricts possible relations between parts of words and parts of phrases. Crucially, we do not adopt the more or less classical view of insertion according to which it consists of an *en bloc* process that involves phonological forms as well morphosyntactic structure. We assume insertion in syntax does not involve phonological material (see section 10.4).

[5] To be sure, head-to-head movement is not the only mechanism by which syntactic heads can be combined into a word. For example, given a separationist view on the syntax–phonology interface, it may be assumed that distinct syntactic heads can be spelled out as one word in phonology under certain circumstances; compare Bobaljik (1995, 2002); Embick and Noyer (2001). This does not affect the argumentation in this section, since the question we will be concerned with most is whether parts of words head separate syntactic projections to begin with.

10.3.1 Stranding

To begin with, the two theories make clear predictions about the material that can accompany a complex word. On the incorporation analysis, depicted in (7), the trace of the non-head Y should license the same material as Y does in isolation. In contrast, Y in the structure in (6) does not project outside the Y–X complex and therefore can not license additional syntactic positions. The two theories thus make opposite predictions with respect to stranding. We will argue that, despite some apparent counterexamples, stranding by the movements hypothesized for syntactic word formation does not occur at all (cf. Neeleman 1994; Ackema 1995; Bresnan and Mchombo 1995; and others).

For simple nominal compounding in languages like English, the impossibility of such stranding is uncontroversial. The material present in the DP complement in (8*a*) must be omitted if a compound is formed, as in (8*b*). (Simple verbal and adjectival compounding display the same pattern.)

(8) *a.* the centre [of [a [prosperous medieval [city [in Northern Italy]]]]]
b. *the [city$_i$ centre] [of [a [prosperous medieval [t$_i$ [in Northern Italy]]]]]

Similarly, the vast majority of derivational affixes do not allow stranding in a language like English. We give three examples here:

(9) *a.* *[parent$_i$ hood] [(of) [a [responsible [t$_i$ [from Glasgow]]]]]
b. *[wash$_i$ able] [carefully [t$_i$ [by dipping repeatedly in hot water]]]
c. *[central$_i$ ize] [more [t$_i$ [to our arguments] [than we thought]]]

Some of the material that must be omitted under word formation is obligatory if no incorporation takes place. For example, verbs which obligatorily select certain arguments may remain without these in many compounds and derivations. The Dutch verb *proberen* 'try out' must take a subject and object in isolation, but these are omitted when it appears in a V–N compound or a deverbal derivation:

(11) *a.* *dat* [*(*de dichter*) *(*nieuwe ganzeveren*) *probeert*]]
that the poet new quills out-tries
'that the poet tries out new quills'
b. **Dit is het* [*probeer*$_i$ *papier*] [[(*door*) [*de dichter*]] [(*van*) [*nieuwe ganzeveren* t$_i$]]]
this is the try-out paper (by) the poet (of) new quills
'This is the paper on which the poet tries out new quills.'

The problem takes on a different form if the functional part of syntactic trees is as large as suggested by Cinque (1999) and others. Suppose that all dependents of a head are generated externally to the first projection of that head, call it the root phrase or $\sqrt{}$P (see Marantz 1997). If we further assume that an affix takes $\sqrt{}$P, rather than any larger constituent, as its complement, the lack of stranding observed above is accounted for. However, this account makes vacuous the claim that word formation involves phrasal syntactic structure, since the portion of the tree that contains $\sqrt{}$P and the projection of the affix is exclusively used for word formation. Since it is syntactically inert otherwise, the resulting theory is equivalent to the one defended here, but only as the result of the stipulation that affixes, as opposed to any other selecting head, combine exclusively with $\sqrt{}$Ps.

Stranding has been claimed to occur in certain cases of derivation. Fu, Roeper, and Borer (2001) maintain that it can be observed in English deverbal process nominalizations, while Den Dikken (2003) develops a similar argument for de-adjectival nominalizations in Dutch. In both instances, the argument is based on contrasts in acceptability with respect to the material that can accompany a derived noun and a simplex noun, respectively. Some of the examples given by Fu et al. are quoted in (11), with their grammaticality judgements:[6]

(11) *a.* *[Kim's version of the event thoroughly] was a big help.
b. ?[Kim's explanation of the event thoroughly] was a big help.

Native speakers we have consulted find the contrast in (11) quite subtle; in fact, they reject both examples as clearly ungrammatical. On the other hand, native speakers experience a very sharp contrast between (11*a*, *b*) and verbal projections that are the complement of a nominal free morpheme, as in (12). This remains unexplained by the syntactic word-formation analysis, which, after all, assumes that, as in (12), a VP is present in (11*b*). The contrast does follow from the morphological account, given that adverbials do not normally combine felicitously with nominal projections.

(12) Kim's idea to explain the event thoroughly was a big mistake.

Moreover, the fact that (11*b*) is marginally better than (11*a*) does not require the assumption that the verbal base of a process nominalization is the moved head of a VP. It seems that DPs containing an adverbial improve marginally if the nominal head receives the kind of interpretation usually associated with verbs. This phenomenon can also be observed with underived nouns or nouns that do not have a verbal base. For example, (13*a*) is comparable in status to (13*b*) if *Nobel prize* is interpreted as 'receiving the Nobel prize'.[7]

(13) *a.* ?[The physicist's Nobel prize so clearly undeservedly] surprised the academic world.
b. ?[The physicist's promotion so clearly undeservedly] surprised the academic world.

[6] We will not discuss Den Dikken's data, but the problems we will identify with respect to Fu et al.'s analysis carry over to his.

[7] See Ackema and Neeleman (2004) for further discussion of Fu et al.'s argumentation.

In conclusion, the data in English and comparable languages show that there is no phrasal complement out of which the non-head of complex words is moved. This supports the idea that complex words are generated in an independent morphological submodule.[8]

The obligatory omission of syntactic material is not the only fact that supports a morphological analysis of complex words. Consider a subject name such as *driver*. The two rival analyses also make different predictions with respect to the way in which the internal argument of this derived noun is realized. According to the morphological analysis, *driver* is a complex noun, which, like any other noun, projects an NP in syntax. Its arguments should consequently be licensed through *of* insertion, just like arguments of a noun. This is, of course, correct:

(14) $[_{NP}$ $[_{N}$ drive er] of a truck]

The syntactic analysis of *driver* starts out from a structure featuring a VP. Since case is available for the complements of verbs, the argument is incorrectly predicted to appear in the accusative:[9]

(15) *$[_{NP}$ $[_{N}$ $[_{V}$ drive] er] $[_{VP}$ t_{V} $[_{NP}$ a truck]]]

The syntactic approach could tackle this problem, as well as the absence of stranding, by assuming that incorporated heads lose the licensing capacities they have when not incorporated. Although this would be empirically adequate, it begs the question why this loss of licensing capacities should obtain. This question is especially awkward since not all material in, say, a VP is licensed in the same way. If an incorporated verb loses its capability to case-mark, for instance, then arguments either must be licensed by *of* insertion or cannot appear at all, but the impossibility of stranding adverbials remains unexplained. One therefore has to assume a total loss of all licensing capacity in incorporated heads. This renders vacuous the claim that such heads project a full phrase prior to incorporation.

Similar objections apply to the related view that lexical heads have no licensing capacity to begin with. Suppose that licensing uniformly involves feature checking in functional projections (a claim consonant with the idea mentioned above that lexical heads start out in a $\sqrt{}$P that is the smallest projection of a tree with an elaborate functional structure). On this view, a VP that is the complement to a nominal affix can contain *of* phrases licensed in the functional projections

[8] In languages with noun incorporation there is apparent stranding of nominal modifiers, which has been taken as evidence for word formation through syntactic movement (see in particular Baker 1988). But as Rosen (1989) has shown, such stranding is independent from noun incorporation and occurs in the complement of morphologically simplex verbs just the same.

[9] Inheritance of accusative arguments under nominalization seems to occur in so-called mixed categories, such as the English gerund: *John's singing the Marseillaise drives us crazy*. In Ackema and Neeleman (2002) we argue that such examples in fact involve neither syntactic head movement of *sing* to *-ing*, nor inheritance of an accusative argument, but rather zero derivation of a verb phrase (see also Yoon 1996).

dominating this affix. Conversely, NPs may contain accusative arguments when they are the complement of a verbal affix, as the functional projections associated with that affix will license them.

The derivation of *driver of a truck* would then involve the following steps. The verb *drive* takes an *of* phrase as its complement in (16*a*). It then incorporates into the higher nominal affix, as in (16*b*). The *of* phrase is subsequently licensed by movement to an appropriate checking position in the extended nominal projection, as in (16c). Finally, *driver* undergoes successive head-to-head movement across the *of* phrase to derive the correct surface order, as in (16d). Alternatively, raising of the *of* phrase takes place after spell-out.

(16) *a.* $[_{FP1}$ F1 $[_{FP2}$ F2 $[_{NP}$ er $[_{VP}$ drive $[_{PP}$ of a truck$]]]]]$
b. $[_{FP1}$ F1 $[_{FP2}$ F2 $[_{NP}$ $[_{N}$ $[_{V}$ drive$]_i$ er$]$ $[_{VP}$ t_i $[_{PP}$ of a truck$]]]]]$
c. $[_{FP1}$ F1 $[_{FP2}$ $[_{PP}$ of a truck$]_j$ $[_{F2}$ $[_{N}$ $[_{V}$ drive$]_i$ er$]_k$ F2$]$ $[_{NP}$ t_k $[_{VP}$ t_i $t_j]]]]$
d. $[_{FP1}$ $[_{F1}$ $[_{F2}$ $[_{N}$ $[_{V}$ drive$]_i$ er$]_k$ F2$]_l$ F1$]$ $[_{FP2}$ $[_{PP}$ of a truck$]_j$ t_l $[_{NP}$ t_k $[_{VP}$ t_i $t_j]]]]$

Note that the availability of this derivation must be linked to the formation of a morphological complex in the nominal head position. There are no structures in which a noun licenses the complement of its verbal complement (or vice versa) if the higher head is a free morpheme (that is, when the lower head does not incorporate). If this assumption is made, the derivation in (16) yields the desired empirical results. It is equivalent to its morphological counterpart in that all licensing relations in the structure in (16*d*) are dependent on the nominal affix. This follows immediately in the morphological analysis, since the affix is the head of the morphological complex. However, the syntactic analysis in addition posits a more complex structure and a head movement operation for which, given the constellation of assumptions, no independent evidence can be given. This becomes especially clear when we remove from (16*d*) all structure that is there for theory-internal reasons, but does not have empirical effects. The resulting structure, given in (17), is isomorphic to the structure directly generated in the morphological account.

(17) $[_{FP1}$ $[_{N}$ $[_{V}$ drive$]$ er$]$ $[_{PP}$ of a truck$]]$

We conclude that there is no reason to assume that the complement of a morphological complex like *driver* is generated as the complement of the non-head. Instead, the *of* phrase is directly generated as the complement of the entire morphological complex.[10]

[10] It is of course thematically related to the non-head, given that it is interpreted as the internal argument of *drive*. The phenomenon that arguments of the non-head of a derived word are realized in the projection of that word is known as "inheritance". In Ackema and Neeleman (2004) we argue that inheritance is even more problematic for the syntactic approach to word formation than the mere contrast between (14) and (15) suggests, because the affixal head of the complex word determines which of the arguments of its base are realized. For reasons of space we cannot go into this here, however.

10.3.2 Syntactic Versus Morphological Complex Heads

The view that word formation is dealt with by a distinct generative system does not imply that syntax has no means of forming complex X^0 categories. Head-to-head movement as such is not excluded (nor is base generation of such categories). If complex X^0 categories can be generated by two distinct systems, one might expect the resulting heads to show contrasting behaviour. Complex heads derived in syntax must satisfy syntactic principles, while complex heads derived in morphology are subject to morphological conditions.

In contrast, syntactic theories of word formation acknowledge only a single means of creating complex heads. Although such theories can assume a syntactic module that deals specifically with the well-formedness of X^0 categories (cf. Baker 1988), this module cannot distinguish between two different types of complex X^0s: all complex heads are generated in syntax, so all are subject to whatever extra restrictions the syntactic "X^0 module" imposes. Such theories therefore predict that complex heads display unitary behaviour.

As we will show, there are various phenomena that distinguish syntactic and morphological complex heads, thereby confirming the two-systems approach. Note that this is not the type of argument which we argued in section 10.2 to be invalid. We claimed there that differences and similarities between the principles governing phrases (XPs) and words (X^0s) cannot provide evidence either for or against the existence of an independent generative system for morphology. What we will argue for here is that there are two qualitatively different types of complex X^0s, something that the syntactic approach to word formation cannot easily accommodate.

The structures we will compare with complex words are Dutch verb clusters, and particle-verb and resultative-verb combinations. It would take us too far afield to argue here that these structures are indeed complex syntactic heads, but for relevant discussion see Evers (1975, 2003), van Riemsdijk (1998) (for verb clusters), Johnson (1991), Neeleman and Weerman (1993), and Neeleman and van de Koot (2002*a*) (for particles and resultatives).

A first difference between syntactic and morphological complex X^0 categories concerns the position of their heads. Quite simply, the regularities with respect to headedness that can be observed in complex words in a particular language do not extend to complex syntactic heads, and vice versa. For example, Dutch, English, and Swedish morphological complexes are all right-headed.[11] In contrast, the position of a particle with respect to a verb in these languages is determined by the syntactic parameter dealing with the position of the head in VPs. Thus, in the OV language Dutch, particle-verb constructions are right-headed, whereas in the VO-languages English and Swedish, the verb precedes the particle.

[11] Some apparent counterexamples to this are discussed in Booij (1990) and Neeleman and Schipper (1992).

(18) *a.* *Jan zal het feit* [$_V$ *op*$_P$ *zoeken*$_V$] Dutch
John will the fact up look
b. John [$_V$ sat$_V$ down$_P$] slowly. English
c. *Jag* [$_V$ *bryter*$_V$ *av*$_P$] *kvisten.* Swedish
I break off the-branch

A second difference between syntactic and morphological complex X°s concerns a restriction on the internal structure of their heads. There is strong evidence that particle–verb and resultative–verb combinations form complex predicates in Dutch: the argument structure of such complex heads is derived from the argument structures of their constituent parts. As it turns out, complex predicate formation is non-recursive. It is blocked when the head is a complex predicate itself (see Neeleman and van de Koot 2002*a* for an explanation of this "complexity constraint"). A particle verb, for example, cannot head a resultative complex predicate:

(19) **Ik geloof dat Jan en Piet zich* [*kapot* [*samen werken*]]
I think that John and Pete themselves to-pieces together-work
'I think that John and Pete cooperate so much that it exhausts them.'

In addition to particle verbs like *samenwerken* 'together-work', Dutch has complex verbal heads which are uncontroversially derived by morphological processes. These fall into three groups: verbs derived by compounding (such as *stijldansen* 'style-dance'), verbs derived by prefixation (*vergroten* 'en-large'), and verbs derived by suffixation (*analyseren* 'analysis-ize'). As it turns out, none of these verbs is barred from occurring in the head position of a complex predicate. We illustrate this for compounds only:

(20) ... *dat Jan zich* [*suf* [*stijl danst*]]
that John himself drowsy style dances
'... that John ballroom-dances so much that he becomes drowsy.'

It seems, then, that there are two types of complex predicate. The syntactic ones are subject to the complexity constraint, whereas the internal structure of morphological complex predicates does not block further complex predicate formation in syntax.

The third way in which syntactically and morphologically complex X°s differ has to do with the kind of elements that appear as non-heads. Consider for example infinitives marked with *te* 'to' in Dutch. These cannot function as the non-head in Dutch morphological complexes (see (21*a*)), but they do appear as non-head in syntactic verb clusters (see (21*b*)).

(21) *a.* [[(**te*) *staan*] *plaats*]
(to) stand place
'standing room'

b. ... *dat hij haar* [*heeft* [*proberen te verstaan*]].
that he her has try to understand
'... that he has tried to understand her.'

Conversely, the typical form in which verbs appear inside morphological complexes is their stem form (see (22*a*)). In complex syntactic heads, verbs must be inflected and can never appear in the stem form (see (22*b*)).

(22) a. [[*fonkel* (**en*)] *nieuw*]
twinkle (INF) new
'brand new'
b. ... *dat hij de diamant* [*ziet* [*fonkel* *(*en*)]]
that he the diamond sees sparkle (INF)
'... that he sees the diamond sparkle.'

A final difference to be mentioned here between syntactic and morphological complex heads is that constituent parts of complex words cannot be moved (an instance of lexical integrity, cf. Bresnan and Mcombo 1995; Ackema and Neeleman 2003*b*), whereas movement of parts of syntactic complex heads is unproblematic. For example, the left-hand part of a compound does not allow fronting to Spec of CP in Dutch (not even when phrasal), but resultatives and particles can be topicalized in appropriate contexts, namely, when they receive a contrastive reading (cf. Hoeksema 1991).

In the same vein, head movement cannot target parts of morphological complexes. Norwegian, for example, has N-to-D movement, as the data in (23*a*, *b*) (from Taraldsen 1990) show. However, such movement cannot strand the left-hand part of a nominal compound, witness (23*c*–*e*). In contrast to this, head movement *can* strand the non-head of a syntactic complex predicate, as shown by the separation of verbs and particles under verb second in Dutch, as in (23*f*).

(23) a. $[_{NP}$ *hans* $[_{N'}$ *bøker om syntaks*]] Norwegian
his books about syntax
b. $[_{DP}$ [*bøke*]$_i$-*ne* $[_{NP}$ *hans* $[_{N'}$ t_i *om syntaks*]]
books-the his about syntax
c. $[_{NP}$ *hans* [*syntaks bøker*]]
his syntax books
d. $[_{dp}$ [*syntaks bøke*]$_i$-*ne* $[_{NP}$ *hans* t_i]]
syntax books-the his
e. *$[_{DP}$ [*bøke*]$_i$-*ne* $[_{NP}$ *hans* [*syntaks* t_i]]]
books-the his syntax
f. *Jan belde*$_i$ *zijn moeder* [*op* t_i] Dutch
John called his mother up

There seems to be ample evidence, then, for the existence of two different types of complex X^0, a morphological one and a syntactic one.

The coexistence of syntactically and morphologically complex heads poses a challenge to the idea that both are derived in the same, syntactic, way. We know of one account that deals with this issue. Rizzi and Roberts (1989) argue that head-to-head movement gives rise to a morphological complex in case the higher head selects for an incorporated element. If there is no selectional relation, the result is a syntactic complex. In Roberts 1991, this difference is expressed structurally: heads that select for an incorporated element are X^{-1}s, which project an empty slot into which a head must move by substitution. Head-to-head movement that results in syntactic complexes is adjunction to X^0, rather than substitution.

It is unclear whether this approach extends to compounds, which are morphological but in which the left-hand part is not selected by the head. More importantly, this theory in effect assumes a distinct morphological component, though as part of the phrasal syntax. In Roberts's proposal, the set of complex heads subject to the principles of morphology is defined as exactly those in which the head selects the non-head. Moreover, exactly these same complex heads are opaque for further syntactic operations (for example, no excorporation is possible). This means that, in effect, a morphological component is proposed that deals exactly with those complex heads that do not yield straightforwardly to a syntactic analysis.

10.3.3 Undergeneration by the Movement Account

The two theories of word formation also diverge in the predictions they make with respect to the possible functions of non-heads of complex words. If the non-head is adjoined to the head by movement, independently motivated restrictions on this operation should preclude incorporation of certain syntactic elements. In particular, subjects and adjuncts are islands for extraction (Huang 1982) and on standard assumptions neither are c-commanded by the verb. Incorporation of (the head of) such elements should hence be impossible (see Baker 1988). In contrast, if morphological complexes are formed by direct merger in a separate submodule, there is no reason why such restrictions on interpretation should obtain.

Consider in this light the free interpretation of nominal compounds (compare Allen 1978 and Carstairs-McCarthy 1992). A hypothetical example like *table bath* can have a range of possible interpretations (a bath in the shape of a table, a bath to put on a table, a bath for washing tables, a bath to use before sitting at a table, etc.). It will be clear that the position of *table* in these paraphrases is not one which can be related to *bath* by movement. Thus, a syntactic analysis of examples like *table bath* is implausible, as is of course hardly controversial. There must be an independent means of forming nominal compounds—but that is what the two-systems theory maintains for compounding in general.

The semantic freedom of compound structures in principle allows their left-hand part to function as an adjunct modifying the head, contrary to what the syntactic theory predicts. As Spencer (1995) notes, incorporation of adjuncts is freely allowed in Chukchi. An example is given in (24*a*). Similarly, it has been noted that Greek allows verbal compounds whose nonhead functions as a modifier, as in (24*b*) (see Rivero 1992: 300).

(24) *a. Mən-nəki-ure-qepl-uwicwen-mək.*
1PL.IMPER-night-long-ball-play-1PL
'Let's play ball for a long time at night.'

b. To fagitó tha sigo-vrási.
the food will slowly-boil
'The food will boil slowly.'

Dutch, too, has compound verbs with the relevant interpretation. Even incorporation of two adjuncts is possible:

(25) [*Nacht* [[*wind surf*] *en*]] *is gevaarlijk.*
night wind surf INF is dangerous
'Windsurfing at night is dangerous.'

With respect to the incorporation of subjects, the situation is more complex. Subjects are plausibly defined as external arguments: the subject of a head X is located externally to XP (Williams 1980; Neeleman and van de Koot 2002*a*). The left-hand part of a compound is contained within the projection of the head. As Di Sciullo and Williams (1987) note, this implies that the subject of X cannot form a compound with X (see also Selkirk 1982). It seems, then, that the morphological and syntactic approaches make the same prediction in this domain. This prediction is correct as such; despite the fact that Dutch allows constructions without a syntactic subject argument (namely, impersonal passives), the following is ungrammatical:

(26) **dat* (*er*) *de hele nacht* [*honde blaft*]
that (there) the whole night dog-barks
'that dogs are barking all night'

Interestingly, however, the morphological theory allows for incorporation of a subject under specific circumstances. In (27*a*) Y cannot be the subject of X, since it is contained in X's projection. But the situation is different in (27*b*), where X combines with Z before Y is merged. Y is now located externally to X's maximal projection (which coincides with X). In principle, then, X's external role can now be assigned to Y.[12] Examples of such structures can indeed be found, as has been

[12] This is not always possible, as it depends on the thematic properties of the head Z of the morphological complex as well. For example, Z may be an affix that binds the external role of X (e.g. agentive *-er* in English).

pointed out by Williams (1984), Hoeksema (1984), and others. This is illustrated for Dutch and English in (28).[13]

(27) *a.* $[_X$ Y X$]$
b. $[_Z$ Y $[_Z$ X Z$]]$

(28) *a.* $[_N$ *honden* $[_N$ *ge*$_N$ *blaf*$_V]]$
dogs GE *bark*
'barking by dogs'
b. $[_N$ student $[_N$ rioting$_V$ ø$_N]]$

It would take us too far afield to discuss to what extent a head-movement approach to word formation can account for the data in (28), but we may conclude that the morphological approach makes the correct predictions without complications.

10.4 Late Insertion

In our view, the arguments in the previous section provide a solid case for the hypothesis that the systems that generate the syntax of words and the syntax of phrases must be separated. This does not mean, however, that this hypothesis is entirely unproblematic. In particular, it predicts that certain interactions between word syntax and phrasal syntax are impossible, even though some of these interactions seem to occur.

To begin with, although the phrasal syntax may require that an inserted word has certain features, the internal syntax of the word should be insensitive to the syntax of the phrase into which it is inserted. This prediction is to a large extent corroborated by the data, but there are a number of potential counterexamples. In Dutch, for instance, the form of the agreement for the second-person singular seems to be sensitive to the syntactic position of verb and subject. If the subject precedes the verb, agreement is realized as -*t*; in structures with inversion, the verb does not carry overt agreement:

(29) *a.* Jij leest het boek.
you read-2sg the book
b. Lees jij het boek?
read you the book

[13] We assume that English gerunds are zero-derived, so the nominalizing affix in (28b) is not -*ing* but a null affix (see Ackema and Neeleman 2002), but for the argument given here this is irrelevant.

An account of these data seems to require that the morphology of inflected words is sensitive to their position with respect to the subject in phrasal syntax.

A similar issue arises when we turn to phrases that are inserted into words (as in $[_N[_{NP}$ red letter] day]). Although the word syntax may require that the inserted phrase has certain features, the internal syntax of that phrase should be autonomous, that is, insensitive to the morphological environment in which it appears. Again, this seems to be largely true, but there are various counterexamples. For instance, if a phrase is inserted as the complement of a suffix, it must be head-final. Thus, bracketing paradoxes like (30*a*) can be argued to have the morphosyntactic structure indicated, but there are no comparable structures in which the derived phrase is head-initial (cf. (30*b*)). This seems to be due to the suffixal nature of the morphological head, as (30*c*) is grammatical.

(30) *a.* $[_N [_{NP}$ classical guitar] ist]
b. *$[_N [_{NP}$ history of science] ist]
c. $[_N [_{NP}$ history of science] lecture]

An account of these data seems to require that the syntax of derived phrases is sensitive to their morphological context.

It is clear that problems of this type need to be addressed if we want to maintain the separation of phrasal syntax and word syntax. We think that the interactions in (29) and (30) can be accounted for in terms of the mapping between the syntactic macro-module in (2) and the phonology. We adopt the separationist hypothesis, according to which the syntactic and phonological form of words do not form an indivisible unit for insertion. Rather, the syntactic information is inserted in syntax, while the phonological information is inserted in phonology. The relation between the two is captured by a set of correspondence rules, which state that particular elements in syntax correspond to particular other elements in phonology.

For example, English has a mapping rule according to which $[_D$ 3 Sg Fem] is realized as /her/. This is an example of an idiosyncratic mapping rule, which in a model such as (2) replaces the notion of lexical item (see Jackendoff 1997 for discussion). However, there are a number of regularities in the mapping between syntax and phonology that require more general mapping principles. For example, the formation of prosodic phrases is sensitive to syntactic structure: there are mapping principles that require the alignment of edges of syntactic and prosodic domains (see Selkirk 1986).

The interaction between general and idiosyncratic mapping principles is responsible for data like those in (29) and (30). As we will argue later, these mapping principles suppress the spell-out of the second-person singular agreement in (29*b*) and require that the affix in (30) is realized adjacent to the head of the phrase to which it attaches. For these accounts to work, it is crucial that the correspondence rules operate between the macro-modules of syntax and phonology in (2): they must have access to both phrasal and word syntax (and to both phrasal and word-level phonology). This does not weaken our claim that word syntax and phrasal syntax only interact through insertion. As a matter of logic, the fact that system A (correspondence rules between the syntactic and the phonological macromodules) has access to the output of systems B and C (the sub-modules of word syntax and phrasal syntax) does not imply that systems B and C can access each other's output. Thus, our proposal that the system of spell-out can see the structure of words and phrases simultaneously is compatible with the separation of word syntax and phrasal syntax.

In the remainder of this chapter we will spell out our approach to the data in (29) and (30) in more detail.

10.4.1 Phrasal Affixation

It is traditionally assumed that affixes select for an X° of a particular category. For example, the affix -*able* selects a V°. Such statements mention two different properties of the selected element. One is its category, the other its bar-level. The former type of selection varies per affix, but the latter type holds of all affixes: it partially defines the notion "affix" as commonly understood. Given that the two types of selection are qualitatively different, it would be desirable to distinguish them formally.

The separationist hypothesis implies that there is no such thing as the selectional requirements of "an" affix, since affixes are not monolithic entities, but rather the combination of morphosyntactic and morphophonological properties. This means that a distinction must be made between what the morphosyntactic part of the affix selects in the morphosyntactic representation and what its morphophonological part selects in the morphophonological representation. We assume that selection for category is associated with the morphosyntactic part of an affix, while the selection for bar-level is a by-product of its morphophonology. The morphophonological part of an affix is a dependent category, which requires a base to form a phonological word with. Hence, what is normally referred to as an affix is really a morphosyntactic category that selects a complement (an AFFIX), a dependent morphophonological category (an /affix/), and an idiosyncratic mapping rule that associates the two:

(31) AFFIX ↔ /affix/

In addition to idiosyncratic mapping rules of the type in (31), we must consider some general mapping principles. To begin with, there seems to be a principle that disfavours "crossing correspondences" between morphosyntactic and morphophonological structures (see Marantz 1984 and Sproat 1985). This constraint, which we will refer to as "linear correspondence", can be formulated as follows (compare Sproat 1985: 82):

(32) If X is structurally external to Y,
X is phonologically realized as /x/, and
Y is phonologically realized as /y/
then /x/ is linearly external to /y/.

Linear correspondence determines the linear position of an /affix/ given the structural position of its counterpart in morphosyntax. A second mapping principle, which we will call "input correspondence", states which host an /affix/ can attach to. More specifically, an /affix/ usually combines with the phonological correspondent of (the head of) the category that the AFFIX combines with (compare Sadock's 1991 strong constructional integrity):

(33) If an AFFIX selects (a category headed by) X,
the AFFIX is phonologically realized as /affix/, and
X is phonologically realized as /x/,
then /affix/ takes /x/ as its host.

If an AFFIX selects a complex structure, (33) demands that the corresponding /affix/ forms a phonological word with the phonological realization of the head of that structure. In other words, (33) favours a mapping of the left-branching morphosyntactic structure in (34*a*) onto the right-branching morphophonological structure in (34*b*).

(34) *a.* [[$_X$ Y X] AFFIX] ↔
b. [/y/ [/x/ /affix/]]

There are situations in which (32) and (33) are in conflict. Suppose a complex left-headed category is selected by an AFFIX that is spelled out by a /suffix/ (see (35*a*)). For such structures, linear correspondence would favour mapping to (35*b*), whereas input correspondence would favour mapping to (35*b′*).

(35) *a.* [[$_X$ X Y] AFFIX] ↔
b. [/x/ [/y/ /affix/]]
b′. [[/x/ /affix/] /y/]

This means that in the general case morphosyntactic representations like (35*a*) cannot be successfully mapped onto a morphophonological form, and will consequently be ungrammatical. Consider, for example, the case of left- headed Italian compounds:

(36) *carta regalo*
paper gift
'wrapping paper for presents'

These compounds resist further word formation with most, if not all, derivational suffixes. Although *carta* can be derived by *-iere*, *-aio*, and *-ista*, the forms in (37) are ungrammatical (Vieri Samek-Lodovici, pers. comm.).

(37) *a.* *carta regal-iere
a′. *cart-iere regalo
b. *carta regal-aio
b′. *cart-aio regalo
c. ??carta regal-ista
c′. *cart-ista regalo

These are examples of morphosyntactically well-formed words ruled out in the mapping to phonology. But with a small adjustment the same principles explain the observation based on (30) that derived phrases must be head-final (if the affix in question is a suffix). Recall that correspondence rules have access to both word-level and phrasal syntax. This means that the notions of selection and head as mentioned by (33) must be understood in an extended sense. For "head" and "select" in (33), one should read "e-head" and "e- select", defined as follows:

(38) *a.* **Extended selection** (e- selection)
α e-selects β iff (i) α selects β or (ii) α selects γ and β is inserted in γ.
b. **Extended head** (e- head)
α is the e-head of β iff (i) α is the head of β (ii) α is the head of γ and γ is inserted in the head position of β.

It now follows that phrasal affixation will be problematic if the AFFIX corresponds to a /suffix/ and the phrase is not head-final. Consider (39*a*). Input correspondence requires that the /affix/ be combined with the correspondent of X, as in (39*b*). This, however, is only possible at the cost of violating linear correspondence, which favors (39*c*). Hence the structure is ruled out.

(39) *a.* $[_{XP}$ X YP] AFFIX
b. /x/ /affix/ /yp/
c. /x/ /yp/ /affix/

However, if XP is head-final, spell-out is unproblematic:

(40) *a.* $[_{XP}$ YP X] AFFIX
b. /yp/ /x/ /affix/

This explains the pattern in (30*a*, *b*). It also explains why compounding can freely take non-head-final phrases as its input. As the principle in (33) specifically refers to phonologically dependent elements, it is vacuously satisfied in structures like (30*c*). A more interesting prediction is made with respect to AFFIXes whose phonological counterparts happen not to have selectional properties, i.e. are /word/s rather than /affix/es. Arguably, this is the case for the Dutch suffix -*achtig* '-like'. It seems to have selectional properties in morphosyntax, given that it cannot occur as a free form:

(41) *Vind jij dat groen? *Nou, hooguit achtig.*
find you this green? well, at-best like
'Do you think that is green? Well, somewhat like it at best.'

On the other hand, van Beurden (1987: 24) notes that "words derived by -*achtig* [. . .] share characteristics with compounds rather than affixed structures". In particular, (i) -*achtig* is not stress-attracting, in contrast to other adjectival suffixes in Dutch (see also de Haas and Trommelen 1993: 312 ff.); (ii) it does not trigger resyllabification like other adjectival suffixes do, with the consequence that it feeds final devoicing of its host (see also Booij 1977); and (iii) like the right-hand part of compounds, but unlike suffixes, it allows a preceding diminutive or a linking *s*.

If /*achtig*/ is a /word/ rather than an /affix/, we predict that it can attach to non-head-final phrases without violating either (32) or (33). In particular, (33) is satisfied vacuously. Its structural description mentions an /affix/—hence, if we are dealing with a /word/, the condition does not apply. This prediction is borne out:

(42) *a.* *zo'n* $[_{\text{A}}$ $[_{\text{CP}}$ *waar gaat dat heen*] *achtig*] *gevoel*
'such a where goes that to like feeling
a somewhat worried feeling'
b. *een* $[_{\text{A}}$ $[_{\text{PP}}$ *uit je bol*] *achtig*] *gevoel*
a out-of your head like feeling
'a rather euphoric feeling'

In view of these data, it seems reasonable to claim that the pattern in (30) follows from the mapping between syntax and phonology, rather than from a direct (illegal) interaction between word-level and phrasal syntax.

10.4.2 Context-Sensitive Spell-Out

The pattern in (29), we believe, should also be captured by rules that operate at the PF interface. However, whereas the rules considered in section 10.4.1 determine the linear position in which terminals are spelled out, the rules relevant to (29) determine what phonological form will be associated with a given terminal. The rules in question are to a large degree arbitrary (like the idiosyncratic mapping rules that make up the lexicon), but their domain of application is not—they are sensitive to prosodic domains.

We assume that an initial prosodic structure is determined by alignment conditions that associate boundaries of syntactic categories with boundaries of phonological categories (see Selkirk 1986; McCarthy and Prince 1993; Truckenbrodt 1995; amongst others). In predominantly head-initial languages, like English and Dutch, the right edges of syntactic XPs correspond to the right edges of prosodic phrases (φs):

(43) Align (<right edge, XP>, <right edge, φ>)

Thus, the syntactic structure in (44*a*) corresponds to the prosodic structure in (44*b*). (φ boundaries are indicated by braces.)

(44) *a.* [[A friend [of Mary's]] [showed [some pictures] [to John]]].
b. {A friend of Mary's} {showed some pictures} {to John}.

Initial prosodic structures are input to later readjustment rules that are concerned with things like proper weight distribution. This is irrelevant here, because spell-out takes place before these readjustment rules apply (since they operate on the basis of the overt phonological material present; for related discussion, see Ghini 1993 and Monachesi 2005).

Let us consider how this helps us explain the pattern in (29). Dutch has verb second in root clauses, a fact traditionally analysed in terms of V-to-C raising followed by the fronting of an arbitrary constituent to Spec of CP (see den Besten 1983). Thus, when a constituent other than the subject is fronted, the net effect is subject–verb inversion. Although agreement is not in general sensitive to this type of inversion, the *-t* ending that marks the second-person singular is omitted in inversion structures. This results in a form homophonous with the first-person singular, without an overt ending:

(45) *a.* ... [$_{CP}$ *dat* [*jij dagelijks met een hondje over straat loopt*]]
that you daily with a dog in the street walk-2SG
'... that you walk with a dog in the street every day.'
b. [$_{CP}$ *Jij* [$_{C'}$ *loopt* [t$_{DP}$ *dagelijks met een hondje over straat* t$_V$]]].
you walk-2SG daily with a dog in the street
c. [$_{CP}$ *Dagelijks* [$_{C'}$ *loop* [*jij* t$_{AdvP}$ *met een hondje over straat* t$_V$]]].
daily walk you with a dog in the street

It follows from (43) that when there is subject–verb inversion, the subject DP is realized in the same prosodic phrase as the verb. This is illustrated in (46*c*), the prosodic structure corresponding to (45*c*). In contrast, in (46*b*) the subject's right XP-boundary induces a φ-boundary between it and the verb. In the embedded clause in (46*a*) even more φ-boundaries intervene.

(46) *a.* {*dat jij*} {*dagelijks*} {*met een hondje*} {*over straat*} {*loopt*}
that you daily with a dog in the street walk-2SG
b. {*Jij*} {*loopt dagelijks*} {*met een hondje*} {*over straat*}.
you walk-2SG daily with a dog in the street
c. {*Dagelijks*} {*loop jij*} {*met een hondje*} {*over straat*}.
daily walk you with a dog in the street

This means that we can make sense of the pattern in (29) (and (45) if the rule that suppresses the *-t* ending requires the agreeing verb to be in the same prosodic domain as the subject. Such a rule can indeed be formulated. The Dutch regular present tense endings are illustrated in (47):

(47)	*ik loop*	*jij loop-t*	*hij loop-t*
	I walk	you walk-2SG	he walk-3SG
	wij loop-en	*jullie loop-en*	*zij loop-en*
	we walk-PL	you walk-PL	they walk-PL

This paradigm is captured by the rules in (48). The features [Prt], [Add], and [Plr] are unitary and stand for participant (in the speech act), addressee, and plural, respectively. Which rule applies is dictated by the elsewhere condition.

(48) *a.* [Prt] : ø
b. [Prt, Add] : /-t/
c. [Plr] : /-en/
d. elsewhere form: /-t/

The agreement alternation in (45) and (46) can now be captured by an allomorphy rule that mentions prosodic phrases as its domain of application:

(49) Dutch Agreement Weakening
{[V Prt Add] [D Prt Add]} → {[V Prt] [D Prt Add]}

This rule states that the verb's [Add] feature is not realized if the verb is in the same prosodic domain as a second-person DP. Consequently, the verb appears in its [Prt] form, that is, as the first-person singular. If the alternation in (45) and (46) is due to such context-sensitive spell-out, it is predicted that a verb agreeing with a [Prt, Add] subject can only appear in its [Prt] form if no XP intervenes between the two. Intervention of an XP would have the consequence that the verb and the subject are no longer in the same prosodic phrase, in contrast to what the structural description of the rule in (49) demands. Indeed, fronting a constituent to a position between a verb in C and the subject is generally possible, except if the used form of the verb depends on this rule:

(50) *a.* {*Volgens mij*} {*gaat op de heetste dag van 't jaar*} {*zelfs hij*} {*naar het park*}.
according-to me go-3SG on the hottest day of the year even he to the park
b. {*Volgens mij*} {*ging op de heetste dag van 't jaar*} {*zelfs jij*} {*naar het park*}.
according-to me went on the hottest day of the year even you to the park
c. *{*Volgens mij*} {*ga op de heetste dag van 't jaar*} {*zelfs jij*} {*naar het park*}.
according-to me go on the hottest day of the year even you to the park

It may seem that Dutch agreement weakening presents an isolated case, but in fact there is a wide range of phenomena that can be analysed in terms of spell-out rules sensitive to initial prosodic domains. These include agreement weakening in modern Standard Arabic, pro-drop in Old French, Irish, Welsh, and Arabic, and various cliticization phenomena, as well as complementizer agreement in Germanic (see

Ackema and Neeleman 2003*a* for further discussion). We conclude therefore that the existence of rules like (49) is well motivated.

The crucial aspect of the proposed analysis for our present purposes is that the alternation in (29) does not involve a morphological rule that is sensitive to the syntactic context (as proposed by Zwart 1997, for example). Instead, it involves a rule that operates at the PF interface and that affects the phonological realization of a fully specified morphological unit. Hence, the data in (29) are fully compatible with a model of grammar in which syntax and morphology are separate generative systems, as long as the system of spell-out has access to the output of both modules.

The general conclusion, therefore, is that there are no direct interactions between word syntax and phrasal syntax. They interact only indirectly, via the process of insertion that connects structures from both submodules, and via the rules that connect morphosyntactic structures with morphophonological ones. It is therefore unnecessary to assume that word formation takes place in the same submodule that deals with phrasal syntax. Given arguments such as those presented in section 10.3, we think it is actually disadvantageous to do so.

Further Reading

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CHAPTER 11

DUMPING LEXICALISM

EDWIN WILLIAMS

11.1 The Lexical Hypothesis

The Lexical Hypothesis is about the organization of the grammar into modules. It suggests that the system of words in a language is independent of the system of phrases in a language in a particular way. It is independent of it, but communicates with it through a narrow channel—the "top-level" properties of words. The system of words determines what the words of a language are and what their properties are. The system of phrases determines how words form phrases, based on the properties of words.

The essence of the hypothesis is the separation of the two systems and the asymmetric relation between them. The word system determines that *construct* + -*ion* is a singular noun pronounced "constrUkshn". The phrasal system can use that information to build the phrase *my construction* because all it needs to know is that "constrUkshn" is a singular noun. No feature of the behaviour of *construction* in the phrasal system can depend on the fact that *construction* is built from *construct*, for example, even though that property of the word was crucial to the building of *construction* by the word system. Perhaps most of the information about the structure of a word as determined by the word system is "hidden" from the phrasal system, so we have "information encapsulation". Moreover, the channel of communication is asymmetrical, by virtue of the fact that phrases are made out of words, but not vice versa.

The encapsulation prevents analyses. It narrows the scope of word–phrase interaction. For example, the *parts* of a word are not accessible in the phrasal system, nor is even whether the word *has* parts. From this flows many mundane but important facts, such as the following: although *how* can modify *complete*, as in (1*a*), it cannot do so when *complete* is a part of *completeness*, as in (1*b*):

(1) *a.* How complete are your results?
b. *How completeness do you admire?
c. [how complete]-ness do you admire?
d. What degree of completeness do you admire?
e. How complete a record do you admire?

The reason that (1*b*) fails is that (1*c*), is impossible; in (1*c*), a "rule" of the phrasal system, the rule that adjoins (or merges) *how*, has accessed a part of a word, the left part of *completeness*. Examples (1*d*) and (1*e*) are included to show first that the question that (1*b*) means to ask is a reasonable one (that is, it is the same as (1*d*)), and second that adjectives can be targeted by *how* in a nominal environment (the object of (1*e*)), so (1*b*) has no ready explanation apart from what is afforded by the Lexical Hypothesis.

So, the phrasal system does not know that the adjective *complete* is a part of *completeness*. The lexical derivation is "encapsulated", that is, hidden from outside view. If the channel of communication between the lexical and phrasal systems is narrow enough, the Lexical Hypothesis will make a strong mark on language just by virtue of this encapsulation. But in fact there is another feature of the arrangement: the word system and the phrasal system are different in their internal properties as well.

The systems are not entirely different. They share a vocabulary (noun, singular, etc.) and some important notions (derivation, head). But some properties are not shared. The phrasal system has a property that I will call "delayed resolution" that is not found in the word system. Phrasal anaphors, for example, need close-by antecedents, but the antecedent need not be a sister:

(2) John told stories about the destruction of himself

The anaphor is contained in a number of phrases that do not contain the antecedent (PP, N′, NP, PP, NP, VP). Such a situation cannot arise in the lexical system; corresponding lexical anaphors must find their antecedents in the immediate constituent in which they are introduced. That is shown by the following examples:

(3) *a.* self-destruction
b. [self-destruction] stories
c. John told self-destruction stories.
d. John told stories about the destruction of himself.
e. John told stories about one's destruction of oneself.

In (3*a*), the antecedency of *self-* is immediately resolved by being identified with the agent of the predicate *destruction*, to which it is immediately attached. Of course, in (3*a*) there are no other available antecedents anyway. But there are in (3*b*), and yet the same narrow choice is enforced. In (3*b*) *self-* could in principle take as its antecedent an argument of *stories*, for example, the "teller" argument, yielding a different interpretation. But in fact the arguments of *stories* are not available as antecedents of *self-*; as a result, (3*c*) is unambiguous, having only an interpretation parallel to (3*e*); the interpretation indicated in (3*d*) is not possible. Simply put, *self-* cannot take a distant antecedent. *Himself*, on the other hand, as (3*d*, *e*) show, can take a near or a distant antecedent. Quite specifically, it appears that *self-* must take as its antecedent one of the arguments of the word that it is immediately attached to.

I think that this illustrates a fundamental difference between the lexical and phrasal systems. The lexical system has no delayed resolution, but the phrasal system does. This is responsible for some gross differences between the two systems: the phrasal system has no movement, no NP movement, no *wh* movement, no QR. The relations it instantiates are therefore a subset of the relations instantiated in the phrasal system, as it has only those which are not underpinned by "delayed resolution". So it has the "argument of" relation, and the adjunct relation, but not the other relations of phrasal syntax. The property of "immediate resolution" was called "lexical atomicity" in Williams (1981); this term is dropped here as it collapses two different notions: the atomicity of words in the phrasal system, and the atomicity of units *within* the word system. The distinction is drawn here for expository reasons only, but of course one can imagine a system which has one, but not the other, of these two properties.

If we look at adjuncts we find another manifestation of the limitations imposed by the Lexical Hypothesis. Many prefixes in the word system mirror adjuncts in the phrasal system; for example, *re-* means approximately what *again* means. But we find sharp limits on how the meaning of *re-* enters into the meaning of the sentence in which it occurs:

(4) *a.* John re-washed the dishes on Tuesday. (not ambiguous)
b. John again washed the dishes on Tuesday. (ambiguous)

re- in (4*a*) cannot include *on Tuesday* in its scope, in that the presupposition invoked by *re-* does not include the time adverb. So (4*a*) means that a dish washing precedes the event announced in (4*a*), but not necessarily a Tuesday dish washing. The sentence at (4*b*) on the other hand is ambiguous, in that *on Tuesday* can be a part of the presupposition associated with *again*.

This difference between *re-* and *again* is a direct reflection of the Lexical architecture. The full story on *re-*, and for that matter any other prefix, is that it can have scope only over the arguments of the item that it adjoins to in the word system. Why the arguments and not the adjuncts? Because the arguments of a lexical item are represented on the item itself in some way, but adjuncts are not. When a word prefixed with *re-* is used in a sentence, its scope is already fixed in the lexical system. The word *again* enters in the phrasal system, and so can interact scopally with other elements in the phrasal system.

A theory in which *re-* and *again* are treated in fundamentally the same way, with only some superficial difference forcing one to be a bound morpheme and the other not, will not have any explanation of the difference in behaviour. What is needed is an explanation of why the prefixal status should be connected with the difference in scope behaviour. The Lexical Hypothesis provides that.

We find a further difference between the two systems in their internal syntax. In many languages, English for example, we find that the head is positioned differently in the two systems. English words are head-final, whereas English phrases are head-initial. While there is no necessity that such differences exist, they underline the deep joint that the Lexical Hypothesis identifies. Added to the other differences, we have the following set of properties that appear to robustly correlate with one another.

(5) The word system provides input objects to the phrasal system (asymmetry).

(6) The objects of the word system are atomic in the phrasal system (atomicity).

(7) The word system and the phrasal system can have different internal syntax (internal constitution).

(8) The word system is subject to a condition of "immediate resolution" (locality, or word-internal atomicity) which is irrelevant in the phrasal system.

Now, either this is *not* the situation, or we need something like the Lexical Hypothesis. That at least was the position of Williams (1981) and Di Sciullo and Williams (1986), and it is the position I would like to take as the reference point in the present discussion.

The arguments against the Lexical Hypothesis, so understood, consist in showing that there is some slippage between the different notions of word; for example, that the domain in which "immediate resolution" holds is different from the domain in which head-finality holds. But there have really been no serious systematic efforts to carry out such refutation; that is, to show that at least one of the properties in (5)–(8) diverges from the rest in nontrivial ways.

11.2 "The Lexicon" is Irrelevant to the Lexical Hypothesis

I have carefully used the terms "word system" and "phrase system" instead of the more usual designations "morphology/lexicon", "syntax". I have avoided these latter terms because they are misleading with respect to the nature of the things they refer to.

Furthermore, the literature on the Lexical Hypothesis has inflamed the confusion inherent in the terms, especially the literature that opposes the word–phrase distinction.

"Syntax" is simply too general a term to use in this context. Both words and phrases have syntax—that is, they have parts, and there are rules and principles for putting the parts together and for determining the properties of the resulting constructs. Narrowly to use the term "syntax" as the name of the rules of phrasal composition may be useful in some contexts, such as when the discussion is about phrasal syntax; but it is simply a source of confusion to use it that way in a discussion of the lexical–phrasal interface.

Unfortunately, a lot of the discussion of the Lexical Hypothesis turns on the confusion that the terminology gives rise to. So Marantz (1997), for example, opposes syntax to "the lexicon", which he calls "a place": "words are created in the lexicon . . . by processes distinct from the syntactic processes of putting morphemes/words together". What is troubling in this remark is not the doubts expressed about the clear empirical question (are the processes the same or not?), but rather the phrase "in the lexicon". There is no "in the lexicon" any more than there is a "in the syntax". The problem is that the phrase tends to identify the storage place for idiosyncratic information with the word system.

Di Sciullo and Williams (1987) tried to clear this up, apparently unsuccessfully. We invented the term "listeme" to designate items in the storage house specifically in order to emphasize the lack of any privileged connection between that notion of lexicon and what I am here calling the word system. We made the further point that the storage place contained phrases as well ("idiomatic" phrases), and speculated that, if anything, there were probably more phrases than words there. In fact, further types of items need to be listed as well. English has a sizeable number of intonation patterns, and they have properties, even meanings. They must be listed. So, there is absolutely no reason to maintain any special connection between the word system and the lexicon conceived of as a list of memorized forms with their properties.

The real question has not changed since Di Sciullo and Williams (1987). It is whether there are two systems (the word system and the phrase system) with a narrow interface, or a single system, a question independent of the so far meaningless question of what structure or properties the list, or lists, of listemes might have.[1]

[1] As a consequence of the difference in what the unit of insertion is, the lexicon of course plays a different role in Distributed Morphology (DM).

11.3 Distributed Morphology

Marantz (1997) writes, "Distributed Morphology (DM) is . . . the alternative that allows us to dump lexicalism once and for all" and, "lexicalism is dead, deceased, demised, no more, passed on . . .". What exactly is different about DM, and what about it makes it better than a theory with the Lexical Hypothesis? I think that it is less distinctive than is claimed, but in the end, what makes it distinctive is its denial of the Lexical Hypothesis.

11.3.1 What Is Not Distinctive About Distributed Morphology

Harley and Noyer (1999) present what they call the three distinctive properties of DM:

(9) *a.* Late Insertion
b. Underspecification
c. Syntactic Hierarchical Structure All the Way Down

Neither Late Insertion nor Underspecification are distinctive—both have been parts of previous accounts, including lexical ones. Late Insertion was a feature of Generative Semantics, and of the work of den Besten (1977); it is also necessarily a feature of non-derivational theories such as Koster (1986) and Brody (1995). Underspecification (and its companion, Competition) are truly ancient ideas, used in a modern treatment of inflection in, for example, Williams (1981).

That leaves (9*c*). I have already said that there is no argument over the point of whether words have syntactic structure or not, in the general sense. Everybody says so, and has said so for 25 years. So the only point of discussion can be over whether words and phrases have the same syntactic structure; and this indeed seems to be what Harley and Noyer have in mind: "elements within syntax and within morphology enter into the same types of constituent structures (such as can be diagrammed through binary branching trees)" (1999: 3). Likewise, as mentioned earlier, Marantz characterizes Lexicalism as the hypothesis that "words are created in the lexicon . . . by processes distinct from the syntactic processes of putting morphemes/words together" (p. 201).

The contentful interpretation of (9*c*) is in fact the explicit denial of the Lexical Hypothesis—under (9*c*), the structure of a sentence is a structure that has morphemes as its terminals, instead of words.

Harley and Noyer supply a further trio of distinguishing features: DM is *piece-based*, uses *competition*, and uses *impoverishment*. The first refers to the notion that the syntax of words takes morphemes as basic, rather than "morphological operations". Since that is the traditional view, and only rejected in some particular works (such as Anderson 1992), it is surely not distinctive. The other two notions, competition and impoverishment, were both features of the already mentioned inflectional theory of Williams (1981).

11.3.2 What *Is* Distinctive About DM

So we are left with this central idea whereby DM distinguishes itself:

(10) Phrases are built (directly) out of morphemes, with no intervening notion of *word*.

There are a several consequences of (10). First, the properties (5)–(8) that were cited in section 11.1 as characteristic of words cannot be maintained—there are no units which are opaque to syntactic operations, no domain within which "delayed resolution" is not possible, no principle of asymmetric construction.

From this point of view, DM is the *null hypothesis*. That is, everyone must say that sentences are built out of morphemes. The Lexical Hypothesis says that sentences are built out of morphemes indirectly: first build words, then build phrases from them, which is to add something substantive, and possibly wrong, to the null hypothesis. But then it is nonsensical to say that DM is "the alternative that allows us to dump Lexicalism once and for all". Rather, one should say, "there are some empirical problems with the Lexical Hypothesis, so we must retreat to DM".

11.3.2.1 *Idioms are Not Things*

Another consequence of (10) is that there can be no list of composed words—words literally do not exist, so there can be no list of them. Likewise, there can be no list of phrasal idioms either—by (10), the only unit of "insertion" is the morpheme. Idiomatic or non-compositional meaning is consequently handled in a different way: as Marantz says, "The Encyclopedia lists the special meanings of particular roots, relative to the syntactic context of the roots, within local domains" (1997, section 1) and Harley and Noyer (1999) give the following example: "the encyclopedia entry for 'kick', for example, will specify that in the environment of the direct object 'the bucket' 'kick' may be interpreted as 'die' " (p. 4).

A traditional view of idioms is that they are "things", that is, linguistic units. For example, *to get one's goat* is a VP listed in the lexicon:

(11) $[\text{get } [\text{X's goat}]_{NP}]_{VP}$: 'to make X mad'

The idiom, a VP, itself has a meaning. It has a "free" position in it, a position which is referenced by the meaning of the idiom; this free position gives the idiom the meaning that a transitive verb would have. Perhaps some day there will be a theory about what a word-meaning can be; it can then be determined whether the meanings of phrasal idioms can fall under the same theory.

The situation is quite different in DM. Idioms are not things; rather, idiomatic meaning arises because:

(12) roots may have special meanings in the (syntactic) context of other elements within a locality domain. (Marantz 1997: section 2.2)

Thus the remark about *kick* meaning *die*. The DM story about *kick the bucket* is incomplete in an important respect. When *kick* means *die*, *the bucket* means 'nothing', otherwise *the bucket* would violate the theta criterion (as it would in *die the bucket*). This presumably takes another contextually determined rule for special meanings, which in the environment of *kick*, *the*, and *bucket* have no meaning. Somehow, these rules must be coordinated in such a way that they all apply at the same time, or none at all, since it is only when *kick* means *die* that *bucket* means nothing, and vice versa. These awkwardnesses all stem from the idea that idiomatic meanings can all be fixed on the "roots" that occur in the idiom, and not on the idiom itself; and that stems from the decision that the lexicon(s) in DM do not list any derived forms, and that in turn stems from the decision that morphemes are the sole units of insertion.

If, on the other hand, idioms are things (in fact, insertable things) then the coordination of these aspects of meaning lies simply in the fact that the idiom itself *has a meaning*, rather than its parts. This is not to say that the parts might not have meaning themselves, making the idiom partially compositional; the difference between *cross those bridges* and *kick the bucket* is exactly that, as suggested in Williams (1994)—the former has a compositionally assigned theta structure, the latter does not.

Since DM has special rules where Lexicalism has things, there is another potential difference in the treatment of idioms. Rules that operate over some stretch of linguistic material are subject to locality constraints, so we would expect to find locality effects in the assignment of special meanings in DM. In Lexicalism the analogue to locality constraints on idiomatic meaning would be a constraint on the sheer size of the idiom; but since the idiom is listed once and for all, there would be no principled reason for it to be smaller than a given size, though of course general constraints prefer the short to the long. In particular, it seems that nothing like "subjacency" can be enforced, because of examples such as (13).

(13) To dance on X's grandmother's grave: 'to show disrespect for X'

Although I cannot think of idioms like this, this one seems very learnable and useable to me, and so I submit it as relevant; if I am wrong, you may dance on my grandmother's grave.

Marantz in fact suggests a locality constraint on assigning *die* to *kick* and the like. He suggests that the "little v" that introduces the agentivity of the clausal subject is a barrier to the assignment of special meaning—that is, no idiomatic meaning can have the target of the rule (*kick*) on one side of *v* and the context (*the bucket*) on the other.

He finds two consequences: first, there should be no agentive VP idioms with fixed (that is, idiomatic) subjects, and cites *the shit hit the fan* as an example of a fixed subject idiom which has a non-agentive subject. But it seems to me that in the following:

(14) *The cat has got your tongue*: 'You are speechless'

the cat is an agentive acquirer and keeper of your tongue, and so *v* occurs within the idiom; or rather, in DM terms, between the morpheme to which a special meaning is assigned (*got*?) and some part of the triggering context (*the cat*). At least, if this is not such a case, then I do not know what such a case would look like, and do not know what the prediction is meant to be.

The other consequence is that an idiom should not include an embedded agentive subject as an open position. The following would seem to be such a case, with *me* as the embedded agentive subject of *do it*:

(15) *The devil made me do it*: 'I am not responsible for doing it'.

A further argument can be given that idioms are "things". The idioms discussed so far all have, in DM, a head verb which undergoes the assignment of a special meaning in a context. But in fact there is at least one idiom which has an empty verb, and hence no verbal root, in it:

(16) *a.* $[[\,]_{V}$ this!$]_{VP}$: 'as far as V-ing goes, screw you!'
b. Format this!

When uttered, the idiom is accompanied by the middle-finger gesture, which occurs in its literal meaning. What is the special meaning assigned to here? Not to whatever occupies the empty V position—whatever that verb is, it also occurs in its literal meaning in the idiom (see paraphrase). But then to what? DM does not have a story to tell. Such cases strongly support the notion that idioms are things, and are assigned meanings as wholes, even where the meaning is partly supported compositionally. But if so, then idioms are surely candidates for insertion.

And if idioms are things (insertable things), then so are complex words, because the arguments are the same, and if they have any unpredictable properties they (the things) must be listed with a specification of those properties.

11.3.2.2 *The Fragmentation of Competition*

A further consequence of the way in which DM goes about denying the Lexical Hypothesis is a narrowing of the domain in which the principle of competition operates, a narrowing that excludes important applications of the principle.

Every grammatical model these days has some notion of competition—two forms vie for a certain role and, on general grounds, one wins, excluding the other from that role. Its ancient roots are well known. Its role in modern morphology begins with Aronoff's Blocking and Kiparsky's Elsewhere principles. Competition implies competitors, and while the rules of competition are usually simple ("most specific", "best"), the selection of the competitors, and for that matter the issue to be competed over, are difficult, and essentially unidentified. In any case, though, the role competed for must admit more than one form.

As already mentioned, Williams (1981) applies competition to inflectional morphology in a particular way. Inflectional features are ranked ($F1 \ldots F_n$). Forms are assigned to particular values of particular sets of features (e.g. to [$+F_{12}$, $+F_{17}$]). If F_k is the lowest feature marked on a morpheme M, and there are no morphemes marked just like M but with values for lower features specified, then M is the form used for all configurations which are consistent with the marking on M. In a given language, particular feature sets are identified for spell-out independent of particular verbs; these I called "entry points". So, for example, English verbs would have the following description:

(17) *a.* Feature hierarchy: Tense > number > person
b. Entry points: [+3 +singular +present] [+past] [+present]
c. Forms:
i. talks [+3 +singular +present]
ii. talked [+past]
iii. talk.

For a configuration that calls for [+2 +singular +present], for example, the form chosen is *talk*, according to the selection principle; it has no features, but is nevertheless the most specified form that matches; and so forth. See Williams (1981) for further application.

This system uses competition, underspecification, and, to use a term that has become popular in DM, impoverishment: any case in which a language has an entry point that is not fully specified is a case of impoverishment. Hence, for example, [+past] is an entry point which has this property, and so there is no expression of lower features in the past tense.

I think any theory will have some analogue of these ideas; it just seems inescapable. As it turns out, the hard problem is to demarcate the arenas in which competition etc. will play out. DM has competition, but I think that the structure of DM, especially what follows from the denial of the Lexical Hypothesis, prevents it from addressing anything like the full range of applicability of competition in language. Essentially, if there are no listed complex words or listed complex phrases, then lexical insertion will always be of morphemes. *But this means that if insertion is the locus of competition, that competition will always be a competition of one morpheme with another.* DM advocates this principle in a thoroughgoing way, but it is a great obstacle to achieving an understanding of many things.

For simple cases, it does not matter. Where Williams (1981) had *run* competing with *runs*, DM will have *-o* (the null morpheme) competing with *-s*. But for any other cases the DM setup precludes analysis in terms of competition, leading to a proliferation of other grammatical devices.

In a large number of cases, a lexical readjustment rule must be postulated in order to account for what otherwise could be treated as a case of competition. The English *more/-er/better* allomorphy is representative.

There are three ways to form the comparative of an adjective: adjoin *more* in the phrasal system, adjoin *-er* in the word system, or have a special form (e.g. *better*). The *-er* adjunction is subject to a prosodic constraint: the adjective must be less than two full syllables. By general principles, we can rank these possibilities in terms of generality:

(18) *a.* more A
b. A-er, with prosodic constraint
c. special form for A

Under the Pāṇinian dictum "use the most specific form" (*a*)>(*b*) because (*a*) has a constraint that (*b*) does not have; (*b*)>(*c*) because special forms are clearly less general than even restricted rules. On general grounds, then, we can predict that if there is a special form, then that form is the comparative, no matter what; if the adjective is short and there is no special form then *A-er* is the comparative; if an adjective is not short and there is no special form then *more A* is the form. So, * *gooder* because (*b*)>(*c*); **more tall* because (*a*)>(*b*); and so forth. In other words, to predict the outcomes, all we need is the *existence* of *more* and its properties, the *existence* of the morpheme *-er* with its properties, and the *existence* of special forms.

Unfortunately for DM, the competition in (18) is not a competition between morphemes; it is in fact a competition between full forms: *more good/gooder/better*. So DM cannot treat it as a competition. Special context-dependent rules must create the *-er* forms and even the special forms from the "basic" *more A* case (Embick and Noyer 2001; Marantz 1997). The operations of these rules is not governed by competition, and so the various outcomes must be stipulated. In other words, there is no explanation from the existence of various items. In fact, in DM, the morpheme *-er* does not exist as a lexical item of any kind; rather, it is introduced by a readjustment rule. This is an odd conclusion for an approach that advertises itself as "piece-based". But in fact, *-er* is just like other morphemes in its behaviour, except in its role in these special competitions.

It is important to note that the notion of "exist" that is needed for the competition theory of these forms does not entail membership of a closed list of items. *Glopper* exists, for the purposes of competition, if *glop* and *-er* exist, and in fact it will be the chosen form even if it has never been used before. So existence and listedness are not the same concept.

What I have just outlined about the comparative applies equally to a host of other cases that are naturally treated by competition among existing items. Many intransitive/causative pairs have the same form (e.g. *boil* intrans. /*boil* trans.); for some (*rise*) the transitive form is different (*raise*). In a competition theory, the existence of *raise*, as a special form, will block the transitive use of *rise*; in DM, *raise* arises from the application of a special context-dependent allomorphy rule (Marantz 1997). Similar conclusions arise for *goed/went*. Another case: *yesterday* beats *the day before today*, making the latter expression almost unusable. Here, we have a lexical item (perhaps complex: *yester-day*) beating a non-trivial phrase; clearly such things will lie outside the bounds of DM, except as special rules of allomorphy. But if there is a special rule of allomorphy for this, then we must ask: could a language have a word like *yesterday* that was *not* the result of a special rule of allomorphy? It would be a language in which there was a word meaning *yesterday*, but at the same time *the day before today* was well-formed in general contexts. I think the DM theory is unable to explain why such languages could not exist.

The restriction of competition to morphemes has a further unwelcome consequence. It forecloses the possibility of relating grammatical competition to the broader semantic notions that fall under Grice's theory. There is an enormous similarity between the Pāṇinian maxim "use the most specific form" and the Gricean maxim "use the most informative mode of expression". The similarity is so great that for some cases it is impossible to know which is operative. As Horn (1989) points out, we have ten fingers, but if I tell you that John put a finger in his ear, no one imagines that he put in a thumb. Why? Grice's answer: if he put a thumb in, I should have said so, instead of using the less informative *finger*. Pāṇini's answer: in a meaning context appropriate for *thumb*, *thumb* beats out *finger* because *finger*>*thumb*. If I had to choose, I would say that this was Gricean rather than Pāṇinian; that is, it is the same reasoning that forbids saying *Some of you passed the exam* when it is true that *All of you passed the exam*. But perhaps we should consider the possibility that the Pāṇinian principle is a projection of the Gricean principle onto grammar. If it is, then the Pāṇinian principle cannot be limited to refereeing morpheme vs. morpheme contests. As DM stands, all applications of the Pāṇinian principle which are not morpheme vs. morpheme contests must be recast as one or another kind of rule of special allomorphy, turning gold into clay.

11.3.2.3 *Allomorphy Run Wild*

An analysis of nominalization in Marantz (1997) shows the enormous role played by allomorphy rules. There Marantz seeks to explain the fact that *destroy*, but not *grow*, has a transitive nominalization (*John's destruction of the city* vs. **John's growth of tomatoes*). The explanation is built on the fact that *destroy* denotes events with external agents, whereas *grow* denotes events with only an internal agent (something inside the plant). The transitive use of *grow* and *destroy* both rely on the presence of "little v", the bearer of the subject's agentivity:

(19) *a.* [v [destroy…]
b. [v [grow…]

Marantz supposes further that the roots *destroy* and *grow* are categoriless; the category of the VP is determined by v, not the verbal root. Being categoriless, these roots can also occur in a nominal environment, but in a nominal environment, neither v nor anything else with its properties occurs, by stipulation, so we have:

(20) *a.* [NP's$_{\mathrm{D}}$ [destroy]]$_{\mathrm{DP}}$
b. [NP's$_{\mathrm{D}}$ [grow]]$_{\mathrm{DP}}$

The absence of v in NP leaves nothing to assign agentivity to the possessive, so the two should be treated similarly, but of course they are not similar. To explain the difference, Marantz appeals to a well-known property of the possessive, namely, that it can range over a large range of relations, and in this case in particular, it can be understood to instantiate a relation between the possessor NP and the "external agentivity" role of the head noun. This would be an innocent stipulation, except that at the same time, it is stipulated that the possessive *cannot* instantiate the relation otherwise denoted by v. If it could, then again the two cases would have to come out the same, and the explanation is lost. But, apart from the matter at hand, there is no particular reason to make such a sharp discrimination in what relations the possessive can instantiate. It is hard not to conclude that the sought explanation lies hidden in this stipulated discrimination.

Marantz notes *break*, a further case like *growth*:

(21) *John's break of the dishes

And he hypothesizes that *break*, like *grow*(*th*), has a meaning that determines that it will enter syntax with no implied agent, so agentivity can come only from v. The same objection that applies to the DM analysis of *grow* applies here as well.

But in fact, there is another kind of explanation for the observed facts. If we survey the English nominalizing affixes, it turns out that most of them do not produce transparent transitive nominalization of the kind like *destruction*. The ones that do include -*ion*, -*ing*, and -*ment*:

(22) *a.* the destruction of the city
b. the containment of the oil
c. the killing of Mary

But other affixes, (-*ence*, -*ϕ*, "devoicing") do not:

(23) *a.* *the endurance of the play
b. *the breath of the air (where air is breathed)
c. *the kick of John (where John gets kicked)

So perhaps what needs explanation is not *growth*, but *destruction*, and -*ion* in particular.

Marantz accounts for the transitivity of the nominal gerund (22*c*) by positing that -*ing* nominalization has v in it. This is peculiar, though, because these gerunds have no other verbal properties; in particular, they do not have unmediated direct objects (and so differ from verbal gerunds), and take adjectives instead of adverbs:

(24) *a.* John's *recent/recently killing Mary
b. John's recent/*recently killing of Mary

Furthermore, there is a blocking relation between -*ion* and -*ing*: if a verb has an -*ion* nominalization, it does not have a nominal gerund nominalization:

(25) *a.* ??the constructing of the natural numbers,
b. ??the eradicating of the mice

On the view that -*ion* and -*ing* occur in different contexts this blocking is unexpected. Furthermore, as detailed below, -*ion* is not even a morpheme, and so the blocking is in fact impossible to state in DM when it is filled in with the further assumptions that Marantz has made about these nominalizations. As far as I can tell there is absolutely no reason to give -*ion* and -*ing* such radically different treatment, even in the context of DM.

The -*ø* nominalization is particularly damaging to the hypothesis of categoriless roots. *Kick* is like *destroy* in that it denotes an event with an external agent, but it does not nominalize like *destroy*. Rather, it nominalizes like *growth*, or, even more pointedly, like *break*. In fact the real generalization seems very surfacy, and not related to the semantic type of verb involved at all: -ϕ-nominalization is among those nominalizers in English that do not produce transparent transitives, regardless of what verbs they attach to.

Most likely the -*th* does not produce transparent transitives either, though there are too few cases to tell for sure. About *growth* itself, we can note the following— there is a new use of transitive *grow* which simply means "increase", as in *grow the economy*. In this new use *grow* denotes an event with an external agent, like *destroy*; but it still lacks a transitive nominalization:

(26) *Bush's growth of the economy.

Some synonyms of this use of *growth* have transitive nominalizations, but some do not, and again, it seems to be the affix that explains the difference:

(27) *a.* *Bush's increase of the economy.
b. Bush's augmentation of the economy.

In contrast, *cultivate*, comparable in meaning to transitive *grow*, does have a transitive nominalization, probably because it takes the right kind of affix, not because of what it means:

(28) John's cultivation of tomatoes.

Similar remarks apply to Marantz's explanation of **John's raise of cattle*—the -ϕ- nominalizer is not among the very few English nominalizers that are transparently transitive.

If this review of the arguments is correct, there is no reason to accept any part of Marantz's analysis of nominalization. But the arguments aside, there is a strong reason not to accept the way the analysis is implemented. The notion that *destroy* is categoriless, and gets its category in syntax, leads Marantz to include *destroy–destruction* among the cases of allomorphy: *destruction* is the way *destroy* is "spelled" in the environment of D. There is a little bit of confusion with this particular example, because everyone must acknowledge the *destruct–destroy* allomorphy, but Marantz's proposal is about something different; all cases of *V-ion*, including ones with no obvious root allomorphy, are treated as allomorphic, e.g. *construct–construction.* The upshot is that *-ion* is not a morpheme, but an unanalysable subpart of various allomorphs, the allomorphs of some roots appearing in the D context. In the light of *-ion*'s unexceptional behaviour as a suffix, I think this is an unacceptable conclusion on grounds quite independent of how *growth of tomatoes* is analysed.

11.4 The Clitic/Affix Distinction

There is a raw fact about bound forms that every theory must get: some clearly attach to the heads of the expressions that they are relevant to (the affixes) and some others attach to the edges of expressions that that they are relevant to, or in fact sometimes to the edges of expressions that they are not relevant to (the clitics). The plural vs. the possessive is the simplest contrast in English: the plural of an NP is formed by pluralizing its head, whereas the possessive of an NP is formed by attaching *'s* to the right edge of the constituent:

(29) *a.* the boys on the corner
b. * the boy on the corners
c. the boy on the corner's hat
d. * the boy's on the corner hat

The distinction seems inescapable, so the only question is: how are you going to implement it? Lexicalism has classically implemented the distinction as a difference between the word system and the phrase system. DM clearly cannot do that, and so needs a different means of implementing it. We will take up each in turn.

11.4.1 The Clitic/Affix Distinction under the Lexical Hypothesis

Bound forms, that is, forms needing phonological hosts, are found in both the word system and the phrase system. Success is achieved if the different behaviours of the two kinds of bound form are rightly characterized by virtue of membership of one or the other system.

Specifically, under Lexicalism, one expects various properties of bound forms to correlate according to the principles (5)–(8). Words are subject to the principle of "immediate resolution", phrases are not; words are right-headed, phrases are not. Constructs of the word system are opaque to the phrase system, constructs of the phrase system are not. These distinctions offer a rich set of possibilities to falsify Lexicalism, which says that any given unit must line up consistently on one or the other side of these divides. In the absence of Lexicalism, there is no reason to think that any particular bound form will have more than a random relation to these ways of dividing things up.

Note carefully that there is *nothing* to do with idiosyncrasy or idiomaticity that distinguishes the bound forms in the word system and the bound forms in the phrasal system. As in the previous discussion, the listedness of some finite number of not-completely-rule-governed forms is a general feature of language having no particular relation to wordhood.

As an example, consider the two bound negative elements, *-n't* and *un-*: *un-* is a word system prefix, and *-n't* is a phrasal-level bound morpheme. *n't* does not really modify the thing that it is attached to, and in fact bears no consistent scopal relation to its host. It is always suffixal; but when it attaches to *must* it is semantically subordinate to its host, and when it attaches to *can*, it is superordinate to its host: *can't* means 'not[can' whereas *mustn't* means 'must[not'. Clearly, the relative scopes are sorted out in phrasal syntax, not in word structure. *Un-*, on the other hand, has a uniform effect on its host—it "immediately" negates it. By "immediately" I mean that no other items can be interpretively interleaved between the prefix and its host. Consequently, we find the kinds of distinctions cited in section 11.1:

(30) *a.* John was unafraid of anyone.
b. John wasn't afraid of anyone.
c. John wasn't afraid because anyone scared him.
d. * John was unafraid because anyone scared him.

Put simply, the scope of *-n't* is some stretch of the sentence in which it occurs; but the scope of *un-* is just its host. The problem with (30*d*) is that *un-* cannot have scope over the *because* clause, because such clauses are not part of the argument structure of the host, and so are unavailable when the lexical rule attaches the prefix to the host. Hence, the negative-polarity item cannot be licensed.

From the point of view of the Lexical Hypothesis, the first distinction entails the second. That is, if a bound form bears no fixed interpretive relation to its host, then it follows that its scope is determined in phrasal syntax; if its scope is determined in phrasal syntax, then its scope can potentially be the whole sentence. This entailment crucially depends on the Lexical Hypothesis, and without it, this alignment of properties is accidental.

The mechanism that the word system uses to connect heads to their projections is X-bar inheritance, and the distribution of affixes is determined by this. The distribution of clitics must be accomplished in a different way. Nothing in the Lexical Hypothesis determines how that should proceed, but in fact there have been a number of suggestions. To my mind the most interesting is the proposal of Klavans (1985), which stems from the widely recognized import of "second position" for clitics. Specifically, Klavans proposes that there are three parameters governing the distribution of clitics. Assuming that a clitic is attached in the phrasal system to a unit defined in that system, there are three choices that must be made to determine the actual realization of the clitic: it attaches either on the left edge or the right edge of the phrase; it attaches either to the left or right of the element that is on the edge it is attaching to; and it will be phonologically dependent either to the left or the right. Ignoring the last parameter, this gives us four positions for clitics in a phrase:

(31) [1 leftmost element 2 . . . 3 rightmost element 4]

Position 2 is Wackernagel's position; position 4 is the position of the English possessive affix.

The important feature of placement with respect to edges is that there will be no assumption that the clitic is related at all (semantically or any other way) to what turns out to be its phonological host. In *the boy on the corner's hat*, there is nothing possessive about *corner*.

So, if we think of bound forms as occurring in two species, one of which targets heads and the other of which targets edges, Lexicalism instantiates that distinction in this way: X-bar inheritance, both in the word system and in the phrase system, licenses affixes; but something like Klavans's edge-placement parameters licenses clitics in the phrasal system.

11.4.2 The Clitic/Affix Distinction in DM

The characterization of clitics vs. affixes in Embick and Noyer (2001) and other DM literature is partly forced by the abandonment of Lexicalism, and partly not, and at least for the purposes of evaluating the abandonment of Lexicalism, it is worthwhile to separate things out a bit. The part that is forced derives directly from the notion that morphemes are the units of insertion. In Lexicalism, a nominative noun is derived by the word system, and is inserted into syntax as the head of what ultimately becomes a nominative NP, by virtue of inheritance in X-bar, however that is effected. So certain affixes ride on the "head–whole" relation that is the essence of X-bar. Clitics do not do this—a clitic may be attached to a phrase, but has no particular relation to the head of it.

In DM, the mechanism of X-bar inheritance through heads is put aside, but the difference between affixes and clitics is empirically robust and must show up in any theory. The developers of what looks like the main line of DM have offered a "timing" account of the difference: rules before morpheme insertion target heads; rules after morpheme insertion target edges. The principal rule of pre-insertion morphology is *lowering*—it moves an item at the edge of a phrase onto the head of the phrase. This is "affix hopping"; in the DM literature it has also been called "merger"; in some varieties of Minimalism it corresponds to "covert" raising. The principal rule of post-insertion morphology is called by Embick and Noyer "Local Dislocation". It corresponds closely in its effects with the treatment of clitics in Klavans (1985).

It is not a logical, or even empirical, necessity in DM that pre-insertion movement targets heads and post-insertion movement targets edges. It is possible to give up Lexicalism, and still make the head/edge distinction, but not instantiate it as the distinction between pre- and post-insertion; one could simply have two different kinds of rule. The DM account is more interesting than this, because it ties properties together, and the most interesting arguments for DM capitalize on this. There is a further unforced development: it is even possible to give up Lexicalism (that is, to assume that the sole unit of syntactic insertion is the morpheme) and still use X-bar inheritance for the positioning of what have traditionally been called affixes. That is, one might assume that the deep structure (or derivation under merge) of (32*a*) was (32*b*):

(32) *a.* John discouraged Mary
b. [John [[discourage + ed]$_V$]Mary]$_{VP}$]$_S$

where V, VP, and S inherit the property of tensedness from the affix -*ed* by X-bar inheritance. I assume, though I have never seen it discussed, that DM intends entirely to give up inheritance in favour of lowering; otherwise, there is an unattractive duplication of mechanisms in the system. But the main point I want to make is that the decision about the nature of the unit of insertion is conceptually independent of whether the phrase–head relation is instantiated by inheritance or lowering.

To return to the clitic–affix distinction: in both views, clitics are to be treated differently from affixes, in a fundamental way; and in both cases, it is a timing issue. In Lexicalism the difference is between the word system and the phrase system: affixes are attached to words and determine their properties (by inheritance; though not necessarily), whereas clitics are attached to edges of the units of phrasal systems. In DM, clitics are also distinguished by timing: clitics are distributed by post-insertion rules, and affixes by pre-insertion rules.

So we actually have three questions at play here:

(33) *a.* What is the unit of insertion in the phrasal system? (insertion)
b. How is the phrase–head relation established? (inheritance/lowering)
c. How is the clitic/affix distinction instantiated? (timing w.r.t. insertion)

Although these are logically distinct questions, I think the most interesting arguments for DM turn on the particular bundle of answers that is associated with DM ((*a*): morphemes; (*b*): lowering; (*c*): pre- post-insertion) and so will treat the bundle as though it were a single empirical proposition. The bundling gives sharp differences in expectations, and is therefore worth taking seriously.

Embick and Noyer give a couple of simple arguments for the DM *a–c* bundle, based on some real facts in need of explanation. The arguments fail, but for empirical reasons. First, as mentioned in an earlier context, *smartest* is derived in DM by movement from *most smart*. Since the application of the rule is governed by features of the phonology of the target (c.f. **intelligentest*) the relevant rule must be post-insertion, and so must be the the Dislocation rule, and not the lowering rule. This predicts that it does not target the head of the AP, but rather its edge; hence, it cannot derive (34*a*):

(34) *a.* *Mary is the [amazingly smartest] person.
b. Mary is the most [amazingly smart α] person.

Amazingly blocks the movement of *most* to the position marked by α. Hence, the example is explained. However, the explanation is flawed in the following way. Other Germanic languages, such as Swedish and German, have the same superlative morpheme -*est* but without the prosodic limitation (so, for example, *intelligentest* is grammatical). There is no necessity therefore for the relevant rule to be the Dislocation rule. Since lowering is not subject to intervention effects, examples like (34*a*) are expected to be grammatical in those languages, but they are not:

(35) **den forbausende intelligenteste mannen* Norwegian
the amazingly intelligent-est man
'the amazingly most intelligent man'

So the explanation does not stand, though the observed fact remains an interesting one. I think a further additional fact is:

(36) *Mary is very amazingly smart.

This example is easy to explain if we understand *amazingly* to occupy the specifier position of the adjective, thus excluding *very* from it. But then *most* in (34*b*) does not occupy the adjective specifier position either, and so will not be equivalent to the affix, which is limited to degree specification. But if it is not in the specifier, where is it, and how is it interpreted? I think some idea about it can be got from examples like the following:

(37) *a.* John is more sad than tired.
b. *John is sadder than tired.

In saying (37*a*), one is not specifying the degree of sadness involved, but rather the applicability of the term *sad* in the first place, as compared with the applicability of another term. In this kind of interpretation, one is speaking metalinguistically, and one is reminded of Horn's "metalinguistic" uses of negation (*This isn't warm, it's hot*). Here, as in the superlative case, the affixal form is barred. But in this case it cannot be attributed to the intervention of an adverb. Rather, it must follow directly from the meaning that the comparison is not one of degree intensity, but rather of applicability. What we would have in (34*b*) then is another case of "metalinguistic comparison", and what it really says is, "Mary is the person to whom the term 'amazingly smart' is most applicable".

Another argument Embick and Noyer give for their particular implementation of the clitic/affix distinction is based on the interaction of lowering and rules of phrasal syntax. They argue that lowering cannot feed movement rules of the phrasal syntax, and give the following as an example (p. 562):

(38) *a.* and Mary played her trumpet →
*and [played her trumpet] Mary t
b. and Mary T play her trumpet

By their hypothesis, at the time of VP movement the structure is the one in (38*b*), in which T is not incorporated into the VP, and so (38*a*) is underivable.

However, the observed restriction only obtains with Tense; all other applications of lowering do feed this kind of VP movement:

(39) and Mary was -en [see drooling] → and Mary was seen drooling → and [seen drooling]$_{VP}$ Mary was

The -*en* affix (or some abstract featural equivalent of it) targets *see* in (39) in exactly the same way that T targets *play* in (38), so there is no reason to expect a special behaviour. So again, explanation is lacking.

I want to conclude this section by bringing to light a unique prediction of DM that has a chance of being true. Both Lexicalism as we are taking it and DM as Embick and Noyer are taking it have two kinds of rules for the affix/clitic distinction, and this rule distinction aligns itself with the architecture of the grammar differently in the two theories. The prediction I have in mind stems from the fact that DM does not allow any chaining together of applications of these rules. There is no such thing as lowering an item to a head position once, and then lowering it again to a different (lower) head position. It also does not allow a chaining together of Dislocations. And especially, it does not allow a Dislocation, followed by a lowering, as in the following:

(40) *a.* α [... [a, y b]$_{y0}$ ... X ...]$_{XP}$ → *Dislocation*
b. [... [[a y b]$_{y0}$ α] ... X ...]$_{XP}$ → *lowering*
c. [... [[*a* [*y* α]*b*]$_{y0}$] ... X ...]$_{XP}$

The derivation here is barred by the timing implicit in the architecture—the pre-insertion lowering cannot apply after the post-insertion Dislocation. This is in fact quite an interesting prediction, and I think should be investigated. The upshot is that according to DM, an affix can attach to a phrase or word that it is not semantically related to, but it cannot be realized on the head of that phrase. Strictly speaking, the Lexicalism we have discussed here does not allow this either, but a slight adjustment in Klavans's conception of clitics would allow it. In connection with her second parameter, if instead of saying that the affix could be attached either to the left or the right of the edge element, one said that it simply had to be realized on that element, then nothing would prevent inheritance from the head of that first element counting as such a realization, in addition to left or right attachment. This would be the equivalent of chaining a lowering to a Dislocation in DM.

Embick and Noyer do not discuss this prediction, but a different analysis from the one they give of Bulgarian definite clitic would at least raise the question. The definite article is realized as a suffix according to the following pattern:

(41) *a.* N-suffix
b. A-suffix N
c. Adv A-suffix N

Somewhat arbitrarily, Embick and Noyer conclude that the definite affix is a lowering affix, instead of a Dislocation one; on the basis of the first two facts it could be either. It seems to be the third fact which forces their hand—if Dislocation can target only words, and not phrases, then (c) must be taken to show that the repositioning rule is not Dislocation. But if it is not Dislocation then it must be lowering, and that leads to the unusual conclusion that in an [A N] combination, the A must be the head. On what grounds can this be justified? It cannot be that modifiers are always heads with respect to their modifiees, as in the same example, we must take the A as the head in the [Adv A] combination; but the disanalogy between the two modifications does not seem worry the authors.

If, on the other hand, these facts were analysed in terms of the DM rule of Dislocation, we might develop a situation in which DM makes the already mentioned unique prediction. For (c) we must allow that Dislocation targets phrases (as well as words); Schütze's (1994) analysis of Serbo-Croatian seems to call for this anyway. Then the rule which positions the Bulgarian definite could be Dislocation, rather than lowering. In the examples given it is impossible to tell whether the suffix is on the A or on the AP, and so we can draw no conclusion. But suppose other cases were clear, and we found, for example, patterns like the following:

(42) [Adv A-suffix PP] N

The generalization would then be that the affix is realized on the head of the first element, and that is an impossible description in DM.

A similar case, but unfortunately no more determinate, is the distribution of "strong" Adjective marking in German. There are two inflections for adjectives, a "weak" one which does not show case-marking and a "strong" one, which does. The two are distributed according to the following pattern:

(43) *a.* A_{strong} A_{weak} N
b. det_{strong} A_{weak} N
c. det_{weak} A_{strong} N
d. NP is A_{weak}

The generalization is that the "strong" feature attaches to the first element in the NP which can bear the feature (i.e. excluding the weak determiners). The (*c*) case stands in the way of a strict edge-attacking rule—it attacks not the absolutely first item in the NP, but rather the first "relevant" one. The case markings associated with strong marking show up as suffixes on the adjective, and one can raise the question whether the affix is realized on the head of the AP, or the last element; if the last element, then we have an attack on the head of the first element, impossible in DM. Unfortunately, as in Bulgarian, it is hard to distinguish these two possibilities, as in prenominal position modifiers must be head-final anyway, and it is only prenominally that Adjectives take strong endings.

11.4.2.1 "Movement after Syntax"

The somewhat paradoxical-sounding title of the Embick and Noyer (2001) article "Movement Operations after Syntax" stems from the mild abuse of terminology already alluded to. Since the word and phrase systems are not distinguished, the term "syntax" is given a different use in their theory, and in DM generally: "syntax" is what happens before lexical insertion, and (part of) "morphology" is what happens after lexical insertion. But, as we have seen, there must be movements before and after lexical insertion, hence the title.

An idea of the richness of the model can be gained from the following diagram:

(44) The DM Model in Embick and Noyer

features	→	syntax	→	morphology	→	insertion	→	more morphology	→	phonology
		↑		↑		↑		↑		↑
		raising		fusion fission dissociated morpheme insertion		conditions on insertion		Dislocation		readjustment filters

The complexity of the model allows for two different kinds of abuse. First, provisions are easily added to it that recapture parts, but only arbitrary parts, of the Lexical Hypothesis. And second, at several joints in the model there are implicit general rule and filter writing systems for the composition of language-particular descriptions, and these systems are of large, or at least unknown, power. Disassociated morpheme insertion, conditions on insertion, and late readjustments and filters are all categories of variation of the most general type.

11.4.2.2 *Recapturing the Lexical Hypothesis*

In the course of analysing various affix–clitic interactions in terms of this model, Embick and Noyer make a series of surprising proposals having no other purpose than to nullify the main idea of DM: the idea that, as Harley and Noyer wrote, word structure is "syntax all the way down". I will discuss now the various analyses and proposals offered by Embick and Noyer that lead me to this conclusion.

For example, the Latin conjunction -*que* appears after the first word of the second conjunct. Embick and Noyer's use of a Dislocation operation after "syntax" approximates Klavans's (1991) analysis of the same phenomenon.

(45) *a.* Latin -*que*: [X Y]-*que* [W Z] → X Y W-*que* Z
b. *boni pueri-que bonae puellae* → *boni pueri bonaeque puellae*
'good boys and good girls'

The problem is with the word "word". There are not supposed to be any words in DM. But "morpheme" cannot be substituted for "word" because of the following:

(46) boni pueri bonaeque puellae → *boni pueri bon-que-ae puellae

Here, *que* has been put inside the word *bonae.*

In a Lexicalist theory this cannot arise. -*que* is a bound form of the phrasal system, like the English possessive '*s*, and so, by the Lexical Hypothesis, cannot see inside of words. The case endings are added in the word system, and so are invisible in the phrasal system, except for their effects on the properties of the word they are a part of.

Embick and Noyer add a principle to DM which simulates this effect. They define two notions, Maximal Word (MWd) and Submaximal Word (SWd). An MWd is an X^o not dominated by other X^os, and an SWd is an X^o that is dominated by other X^os. They then propose, "when an MWd is moved by Local Dislocation it adjoins to an adjacent MWd, and when an SWd is moved, it adjoins to an adjacent SWd". Another way to put this is: "a part of a word can move within a word, but cannot move out of that word, and nothing can be moved into a word." Oddly, the principle occurs in the middle of a paragraph of text in the paper and is never given a name; let us call it the Maximal Word Principle.

But the Maximal Word Principle (MWP) is the Lexical Hypothesis. It is the part we called "atomicity" of words in the phrasal system (see (5–8)). The MWP (just like the Lexical Hypothesis) allows an effective partition of "syntax" into two parts:

the part below maximal X°s (what we have called "the word system"), and a part above; and these will communicate in the narrowest possible way—via the top-level properties of maximal X°s. It is somewhat disappointing to learn that at least this version of DM does not deny the Lexical Hypothesis, but has instead demoted part of it from a speculation about the architecture of the system to an unnamed locality restriction, one of a series in fact, including Marantz's locality condition on the assigment of "special meanings" discussed in section 11.3.2.1 and further conditions discussed below.

It is important to realize that the SWd/MWd distinction and the MWP are needed *in addition to* the lowering/Dislocation distinction, and the architectural positioning of insertion in DM, which were themselves meant to do the work of distinguishing affixes (-*ae*) from clitics (-*que*).

Moreover, the MWP depends on a very particular interpretation of phrase structure, one not compatible with bare phrase structure, as complex X°s must be distinguished from other projections of X, a distinction that bare phrase structure has the virtue of doing without. So, for example, Head-to-head movement derives complex X°s, not complex Xs. Embick and Noyer even use the term "terminal" to refer to a complex X° (p. 574, definition of Subword); but of course these are not terminals in the theory, and as it is the main idea of the theory that such things are not terminals, it is a revealingly inapt designation.

By the Lexical Hypothesis, the atomicity of words in syntax carries over to the atomicity of sub-units within words (5–8). The rule of Dislocation in DM, on the other hand, denies the atomicity of sub-parts of words, since it can move morphemes into sub-parts of words from without. But in fact there indubitably are opaque parts of sub-words. In their treatment of Lithuanian reflexives Embick and Noyer acknowlege that, and expose the apparatus needed to account for it (string-vacuous Dislocation); but the resulting system no longer has the local character that they intend.

Embick and Noyer describe Dislocation as an operation that can only work between two "string-adjacent" elements, and in fact they call it "Local Dislocation" to emphasize this aspect of the rule. But in fact even such a narrow rule could potentially operate ambiguously, as in the following:

(47) $[\ X\ [_{\mathrm{SWd1}}\ [_{\mathrm{SWd2}}\ \mathrm{a}_{\mathrm{SWd3}}\ \alpha\ \mathrm{b}]\ \beta]\ \mathrm{c}\ \gamma]$.

The rule could target any one of the positions α, β, or γ, as SWd1, SWd2, and SWd3 are all string-adjacent to X. I judge from the discussion of various cases that Embick and Noyer have in mind a rule that would target only SWd3, the smallest of the items string-adjacent to X, so in the following I will assume that that is what they intend.

But in the analysis of the Lithuanian reflexive morpheme, Embick and Noyer outline a technique whereby in fact a locally Dislocated element may be repositioned into any spot in the interior of the word that you like, and any notion of locality is gone.

The reflexive in Lithuanian is an affix in the verb form. Embick and Noyer assume that it starts out life as a phrasal direct object, but is inserted into the verb form by a rule (and so is a "disassociated morpheme").[2] After the reflexive is inserted into the verb form, it is moved into the verb by the rule of Dislocation. The puzzle that then arises is why it moves over some affixes, but never in such a way as to separate the V from the tense affix:

(48) -si [V T] → *V+si T

Embick and Noyer's answer to this is to propose a language-particular readjustment: "we propose that T in Lithuanian always undergoes string-vacuous Local Dislocation, adjoining to its left neighbor V" (p. 580):

(49) $[\mathrm{V} * \mathrm{T}] \rightarrow [[_{\mathrm{Vo}}\, \mathrm{V} + \mathrm{T}]]$

But this is not enough by itself, as it is not at all clear why -*si* could not still move between V and T, since the relevant rule is Dislocation, and *si* is adjacent to V. That requires a further stipulation: that the resulting structure must be understood as a single SWd, and not as two. Why? "Because SWd status is defined before Local Dislocation" (p. 580), and in addition, the rules apply cyclically.

This is an arbitrary stipulation, and it doesn't actually work.[3] Why is SWd status determined before Local Dislocation, but not recalculated after? And how are SWds that arise after dislocation to be distinguished from original ones? SWd is defined purely configurationally, and so there is no way to prevent the configurational definition determining a new set of SWds after Dislocation; thus a kind of "gamma marking" will be needed to enforce the exclusive privilege of the original set of SWds. This inelegance has one clear purpose: it gives us the capacity to create opaque sub-domains in words, but at will, not in a general way.

But the resulting apparatus now yields some surprising and, I think, unanticipated results. Specifically, it is possible now to "Locally Dislocate" an item X into any arbitrarily chosen position in the following word, so long as one is allowed the mechanism of string-vacuous Dislocation. For example, suppose one wanted to move α to β in structure (50*a*)—first one would do the restructurings indicated in (50*b*) and (*c*), and then the way is paved for α to move to β:

(50) *a*. [α[a [b[c β [d [e f]]]]]] → restructuring →
b. [α[a[[{b c} β [d [e f]]]]]]→ restructuring →
c. [α[[[{a{b c} } β [d [e f]]]]]]

[2] No reason is given for this conclusion; the alternative of course is that the reflexive is simply an affix that attaches to the verb like the others, especially since it appears that the reflexive only attaches to verb forms it is relevant to (that is to say, that it is an argument of).

[3] Embick and Noyer say: "Because SWd status is defined before Local Dislocation, if the SWd T^{o} $\oplus$-adjoins to the SWd V^{o} as in (57), the result is a single complex SWd and not two SWds." But in fact there are *three* SWds here, T, V, and [T V], and in particular, V's * SWD Status must be *erased*, so let us so assume.

Here {} braces are used to mark constituents which contain no SWds, according to the stipulation of the previous paragraph.

The net result is that "Local" Dislocation, which sounds like a constrained operation (only the immediately adjacent element), operates in an environment that guarantees the availability of arbitrary movement operations into words.

I do not want to pretend that it follows from Lexicalist principles that the reflexive cannot appear between T and V in Lithuanian. I have suggested elsewhere what I think are the right mechanisms for expressing such restrictions (Williams 2003, forthcoming), and I will not repeat them here, except to say that the atomicity of the derived units of the word system, even for further derivation in it, is axiomatic. Essentially, the word system defines not just words but other objects as well (including, for example, the roots and stems of Selkirk 1981); the V+T unit of Lithuanian would be a small, directly derived unit in such a system, and given the atomicity of units in the word system it must remain intact in further derivation. The Embick and Noyer device for mimicking that atomicity in fact reduces the "adjacency" property of Local Dislocation, its only property, to vacuity. Perhaps this is what Embick and Noyer mean when the say that the Lithuanian reflexive "provides an important showcase for the interaction of Local Dislocations at the SWd level" (p. 578).

11.4.2.3 *Language-Particular Rules and Filters*

All analyses in linguistics involve both principles and stipulations. The analyses are given to illustrate and add support for the principles, but the stipulations are needed to get things off the ground, in that one must make sometimes arbitrary choices about things that lie outside the focus of interest. But a number of the analyses presented in Embick and Noyer are unsettling in that one has the impression that the character of the phenomena being described arises almost entirely from the stipulations, and not at all from the DM principles. Furthermore, when the stipulations are language-particular they imply that the theory must contain one or more rule-writing systems for stating them, systems with perhaps large descriptive power of their own, and so we cannot judge what space of possibilities the offered analyses find themselves in. I will discuss two such cases below. In both, it seems that such rich descriptive adjuncts to the primary DM principles are needed, but they are not sketched, or in fact acknowleged.

In the analysis of Swedish determiners, four language-particular requirements are stipulated:

(51) *a.* The head N must be marked with definiteness when D is [+def].
b. D_{def} must have a host.
c. N moves to D if possible.
d. D-marking on N is in some cases "a 'disassociated morpheme', a kind of agreement".

These are needed to explain why in a [Det N] construction the Det shows up as a suffix on the N (N-*en*), but if an adjective intervenes, you get both the affix and the determiner: [D-*en* A N-*en*]. The problem with these stipulations is not that there are so many of them for one simple contrast. The real problem is that each of them is language-particular, and there is no indication given of what the descriptive power is of the system from which they are drawn. And while the four stipulations pretty much characterize the two facts, they more or less make the principles of DM redundant. Furthermore, the suffix -*en* turns out the be ambiguous in the analysis, even though it is obviously phonologically and semantically the same element: it is the determiner itself in [N-*en*], but it is an agreement morpheme in [Det A N-*en*]. Maybe this is the right analysis. But if even if it were, an analysis in which two facts are explained by four language-particular stipulations and a suspicious ambiguity cannot be put forward as evidence for DM, or anything else.

The analysis of English *do*-support proceeds in the same way. Here are the language-particular stipulations:

(52) *a.* T must be in an immediately local relation with v.
b. v is *syntactically* merged onto T when T does not have a vP complement.

The problem, as usual, is why *do*-support applies only when needed; that is,

(53) *John did go.

This is the fact that provoked Chomsky's (1991) "Some Notes on Economy of Derivation and Representation". Useless *do* is not allowed.

But Embick and Noyer declare that *do*-support is not "a morphological rescue strategy". The reason is a further stipulation, this time presumably universal, but a stipulation nevertheless:

(54) "On the assumption that morphology interprets the output of syntax, v is simply not the type of object that Morphology can insert." (p. 586)

These three stipulations are in the service of explaining a single further fact of interest: that *do*-support is impossible with constituent negation:

(55) *He did always not agree.

The two language-particular stipulations in (52) cover ordinary *do*-support; if T is moved to C, then (52*a*) is violated, and so (*b*) rescues it. Likewise when Neg intervenes between T and v. So the interesting case is the last one, the context of stipulation (54). But to explain it, further intricate stipulations are needed, so that the notion that anything has been explained evaporates. It goes like this: constituent negation is not a phrase, but just a "head"; as a "head", it intervenes on the lowering path from T to v:

(56) [T [DP [Neg^o [v VP]]]]

Lowering always targets heads, but the presence of the "head" Neg "prohibits successful lowering" (Embick and Noyer 2001: 589): Neg, as a "head", prevents T from lowering to v. This language plays on the notion of head as an absolute and as a relative term (as in *head of*). But in fact, it does not really work; it simply predicts that T should attach to Neg. So a further stipulation is required to prevent that: [T +Neg] is "a morphologically illegitimate object" (p. 589). That is an odd thing to say of a construction derived by the rules and principles of morphology applying to the morphemes of English. It implies that there is a notion of "morphological legitimacy" that lies beyond the rules and principles under discussion.

So an explanation of the fact of interest (55) is arrived at, but only by invoking an unnatural "absolute" notion of head (in place of "head of"), in addition to the language-particular stipulations. Again, I don't want to pretend that Lexicalism predicts the fact of interest. I think, though, that the fact can be naturally linked to the original "economy" example:

(57) *a.* John did go.
b. John did [not go]].

Sentence (57*a*) is out for some reason, maybe Chomsky's original economy idea: *do* is not needed. Perhaps (57*b*) could fall under the same explanation. There are two alternatives to it:

(58) *a.* *John not went.
b. John didn't go.

Example (58*a*) is ungrammatical because *not* never precedes T, for whatever reason. That leaves (58*b*). At first glance it would not seem to be in competition with (57*b*) because the negations are not the same. But in fact maybe they are the same; perhaps constituent negation is exactly the same thing as sentential negation, only lower down in the functional hierarchy. If that were correct, then *John did [not go]* would have exactly the same status as *John did go*—useless *do*.

I don't want to press the point too much about this analysis, as I mean simply to gesture towards a different sort of approach to the fact of interest. Rather, I want to raise this question: how can a theory gain support from an analysis of a single new fact, when that analysis includes two language-particular stipulations, an eccentric definition of "head", and an unexplored filter of "morphological legitimacy"? And of course the constant question: what is the character of the further unexplored morphological capacities which must be postulated to provide a source for the stipulations in the first place? Would it be possible, for example, for a language to have a stipulation that is the opposite of the second one, a stipulation that would read: "v is syntactically merged onto T when T *has* a vP complement"? From the point of view of DM as elaborated by Embick and Noyer that would seem to be no more complicated than the one that is invoked. But from the point of view of an "economy" account of these things, it would of course make no sense at all.

Further Reading

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CHAPTER 12

PARADIGM FUNCTION MORPHOLOGY AND THE MORPHOLOGY–SYNTAX INTERFACE

THOMAS STEWART AND GREGORY STUMP

12.1 A Word-Based Interface Between Morphology and Syntax

Syntactic representations of the phrases and sentences of a language accommodate the insertion of morpholexical (= morphological or lexical) expressions drawn or projected from its lexicon. Morphologists disagree about the types of morpholexical expression that are inserted and about the types of node into which insertion takes place. Some argue that stems and affixes are inserted into separate nodes, so that the syntactic representation of a single word may involve several instances of morpholexical insertion; in such an approach, words have the status of syntactic complexes, so that a word's interaction with rules of syntax is mediated by the constellation of nodes ("morphemes") of which it is constituted.[1] Others argue that words are syntactic atoms instead—that they are inserted into syntactic structure as wholes and that their own internal morphological structure is unavailable to syntactic manipulation; in this approach, a word's interaction with rules of syntax is entirely determined by the unordered[2] set of morphosyntactic properties associated with the node that it occupies. Scrutiny of the empirical evidence reveals that the latter, WORD-BASED conception of the morphology–syntax interface is more compatible with the range of behaviours exhibited by natural-language morphology than the former, MORPHEME-BASED conception of this interface.

One pertinent sort of evidence is the fact that words which are completely alike in their external syntax may differ in their morphology. In the word-based approach, the syntactic behaviour of a word is associated with the unordered set of morphosyntactic properties situated at the node that it occupies; this approach therefore draws no connection between a word's syntactic behaviour and the exponence[3] of its properties. In the morpheme-based approach, by contrast, a word's syntactic behaviour is directly tied to the configuration of morphemes of which it is constituted; thus, the morpheme-based approach, unlike the word-based approach, predicts that words that are alike in their syntax should show similar exponence. This prediction is not borne out. English past-tense verb forms, for example, exhibit suffixal exponence (*tossed*), apophonic exponence (*threw*), extended exponence (*sold*), and null exponence (*hit*). In order to accommodate examples of the latter three types, proponents of the morpheme-based approach must assume that words that are alike in their syntax have similar morphology at some abstract level of representation but that this similarity is obscured by superficial operations; for instance, one might assume that *tossed*, *threw*, *sold*, and *hit* share an abstract structure of the form [V Tns] but that in the latter three cases, this structure is obscured by the transformational fusion of the V and Tns nodes or by the insertion of a zero suffix. There is no independent syntactic motivation for the postulation of such operations, whose sole rationale would be to get the morphology to fit the

[1] Indeed, the very notion "word" is epiphenomenal in a morpheme-based approach of this type.

[2] In this type of approach, a word's morphosyntactic properties are linearly unordered. Nevertheless, we assume that there may be at least two sorts of hierarchical relation among morphosyntactic properties. First, a morphosyntactic feature may be set-valued, so that its values include specifications for other features, e.g. AGR:{PER:1, NUM:sg}. Second, we leave open the possibility that grammatical principles might be sensitive to a ranking relation over morphosyntactic properties; see e.g. Stump (2001: 238 ff).

[3] In the morphology of a word *w* possessing a morphosyntactic property (or property set) *p*, the EXPONENTS of *p* are those morphological markings in *w* whose presence is associated with that of *p*. EXPONENCE is the relation between a property (or property set) and its exponent(s).

syntax; nor is there a shred of independent evidence even given their common morphosyntactic content that *threw* has an underlyingly affixational structure like that of *tossed*. As this example suggests, the morpheme-based approach (unlike the word-based approach) is committed to the assumption that trees are as suitable for representing a word's morphology as for representing phrasal syntax; on this approach, all morphology is seen as fundamentally affixational, notwithstanding the prima facie counterevidence of non-concatenative morphology of diverse sorts.

Another kind of evidence favouring the word-based conception of the morphology–syntax interface is the fact that words which differ in their external syntax do so in ways which correlate with their content, not with their form. This fact follows from the assumptions of the word-based approach, according to which syntax may be sensitive to a word's morphosyntactic properties but is in any event blind to its morphological form. In the morpheme-based approach, by contrast, the possibility is left open that words' morphological structure might correlate with differences in their external syntax that are not simply predictable from differences in their morphosyntactic content. The morpheme-based conception of the morphology–syntax interface is therefore unmotivatedly permissive. For instance, the external syntax of the Fula verbs in Table 12.1 is fully determined by the unordered sets of morphosyntactic properties with which they are associated. The syntax is simply blind to whether these verbs inflect prefixally or suffixally; the third-person singular, first-person plural, and third-person plural forms do not function as a natural class with respect to any syntactic behaviour, nor do the complementary, suffixed forms. This is not an oddity of Fula; all human languages are like this.

A third type of evidence favouring the word-based conception of the morphology–syntax interface is the fact that languages differ morphologically in ways which cannot be attributed to independently motivated differences in their syntax. Thus, as Stump (2001: 25 ff) points out, the morphological expressions of tense and voice are in opposite orders in Albanian *lahesha* and Latin *lavābar* (both 'I was

Table 12.1 Some relative past active forms of the Fula verb LOOT 'wash'

	Singular	Plural
1	lootu-mi'	min-looti'
2	lootu-ɗaa'	lootu-ɗen' (inclusive) lootu-ɗon' (exclusive)
3	'o-looti'	ɓe-looti'

Source: Arnott 1970: 191

washed'), yet there is no independent justification for claiming that the operators of tense and voice participate in contrasting relations of c-command in these two languages; similarly, the morphological expressions of tense and subject agreement are in opposite orders in Latin *amābam* and Welsh Romany *kamávas* (both 'I loved'), yet there is no syntactic evidence for any difference in the nesting of TP and AgrP in these languages; and so on. The fact that the ordering of a word's affixes often corresponds to an assumed nesting of functional categories has sometimes been used to argue for the morpheme-based approach to the morphology–syntax interface (cf. Embick and Noyer, in this volume). But this tendency can be seen simply as the effect of relevance on diachronic processes of morphologization (Bybee 1985: 38ff); indeed, the latter explanation is easier to reconcile with the frequent incidence of "exceptions" such as *lavābar* or *kamávas.*

We conclude from this type of evidence that the interface between morphology and syntax is, in the terminology of Zwicky (1992: 356), a featural rather a formative interface—that the morphology and syntax of a language have only a limited shared vocabulary, which includes lexical categories and morphosyntactic properties but excludes such notions as affix or inflectional morpheme (Stump 2001: 18ff). Accordingly, we believe that the adequacy of a morphological theory is, in part, a function of the extent to which it accommodates this conception of the morphology–syntax interface.

Here, we present an overview of Paradigm Function Morphology, a formally explicit morphological theory which presupposes a word-based interface between morphology and syntax. We begin by situating Paradigm Function Morphology within the general landscape of current morphological theories (sections 12.2 and 12.3), then proceed to a discussion of its central premises: the need to distinguish between content paradigms and form paradigms (sections 12.4 and 12.5), the need for both paradigm functions and realization rules in the definition of a language's morphology (sections 12.6 and 12.7), and the centrality of Pāṇini's principle (section 12.8). In section 12.9, we return to and elaborate on the word-based conception of the morphology–syntax interface afforded by PFM; we contrast this conception with the morpheme-based conception postulated by theories such as Distributed Morphology in order to highlight the significant empirical and descriptive advantages of the PFM approach (section 12.10). We summarize our conclusions in section 12.11.

12.2 What is PFM?

Paradigm Function Morphology (PFM) is an inferential–realizational theory of inflectional morphology which takes as its central premise the assumption that paradigms are essential to the very definition of a language's inflectional system.

It is REALIZATIONAL because it presumes that a word's inflectional markings are determined by the morphosyntactic properties which it carries; that is, it rejects the assumption, characteristic of INCREMENTAL theories, that words acquire their morphosyntactic properties only as an effect of acquiring the exponents of those properties. In addition, PFM is INFERENTIAL because it presumes that word forms are deduced from more basic forms (roots and stems) by means of rules associating particular morphological operations with particular morphosyntactic properties; that is, it rejects the assumption, characteristic of LEXICAL theories, that morphosyntactic properties are associated with inflectional markings just as lexico-semantic properties are associated with lexemes—in lexical entries or as "vocabulary items".[4]

The incremental–realizational distinction and the cross-cutting lexical–inferential distinction define theories of inflectional morphology of four logically possible types. As Stump (2001: 2f) shows, all four types are instantiated among current approaches to inflectional morphology: the lexical–incremental type is embodied by the theory advocated by Lieber (1992); the inferential–incremental type, by the theory of Articulated Morphology (Steele 1995); the lexical–realizational type, by Distributed Morphology (hereafter DM; Noyer 1992; Halle and Marantz 1993); and the inferential–realizational type, by the general approach of Word-and-Paradigm morphology (Matthews 1972; Zwicky 1985), A-morphous Morphology (Anderson 1992), Network Morphology (Corbett and Fraser 1993; Brown, Corbett, Fraser, Hippisley, and Timberlake 1996), as well as PFM.

12.3 Why an Inferential–Realizational Theory?

Semiotically oriented theories of morphology such as Natural Morphology (Dressler, Mayerthaler, Panagl, and Wurzel 1987) emphasize the cognitive value of isomorphism between units of content and units of form in morphological structure. From this perspective an ideal system would have one and only one distinct, phonologically invariant morpheme paired with each possible distinct morphosyntactic property. The ideal is not achieved in natural human language, however, not even in highly agglutinative language types. Languages commonly and successfully exploit all kinds of deviation from the canonical one-to-one pairing of form with content. This by no means undercuts the Natural Morphology

[4] Lexical theories of morphology may, however, maintain a distinction between stems and affixes, e.g. by assuming that affixes are inserted into syntactic structure later than stems (see Embick and Noyer, in this volume).

position; rather, it serves to point out that whatever the cognitive ideal, the morphological descriptive framework must be ready and able to allow for a range of morphological exponence beyond unifunctional, phonologically invariant, and consistently placed segmentable affixes. PFM, by insisting on the principled separation of content and exponence, allows for the range of observed morphological behaviours without necessitating structural zeroes, ad hoc hierarchical configurations, or treating some types of exponence as more or less "normal" in absolute terms. Incremental and lexical theories are less well suited to structures that are not built up in a monotonic increasing fashion out of discrete, intrinsically meaningful pieces.

Therefore, theoretical approaches that take affixation as basic and all other exponence as somehow deficient (e.g. segmentally underspecified reduplicants, floating mutation features) are hard-pressed to accommodate such non-canonical exponence in the morphological description. Canonical inflection is compatible with a variety of theoretical approaches; it is the non-canonical phenomena that provide the basis for choosing among them.

Incremental theories are based on the sometimes tacit assumption that inflectional markings are added to words in order to allow them to acquire their full set of morphosyntactic properties; accordingly, this type of theory implies that extended exponence (the appearance of more than one marking for the same property or property set) should never arise, for the simple reason that it is never motivated by the need to augment a word's morphosyntactic property set. Yet, extended exponence is widespread in inflectional morphology (Stump 2001: 3ff). For instance, the default plural suffix -*où* appears twice in Breton *bagoùigoù* 'little boats': contrary to the basic premise of incremental theories, the addition of the second -*où* is not motivated by the need to supplement the word's morphosyntactic property set, nor is the stem *bagoùig*- (whose morphosyntactic property set is, if anything, already fully specified) acceptable, in itself, as a word for 'little boats' in Breton (**bagigoù* is likewise ungrammatical.) Under the assumptions of an inferential–realizational theory, there is no expectation that extended exponence should not arise, since there is no reason, a priori, why the morphology of a language should not contain two or more rules realizing the same property.

Because they portray inflectional markings as the source of a word's morphosyntactic properties, incremental theories imply that every one of a word's morphosyntactic properties should be interpretable as the contribution of a particular marking. But this, too, is an unsatisfied expectation in morphology: a word's morphological form may underdetermine morphosyntactic content. Consider an example from Sora (Austroasiatic; India). In Sora, the second-person plural affirmative non-past form of the verb DE 'get up' is *ədeten* 'you (pl.) get up'; see Table 12.2. This form has an overt marking for tense (the nonpast suffix -*te*), a conjugation-class marker -*n*, and a default plural prefix ə-; nowhere does it exhibit an overt exponent of second person. Yet it is unmistakably the second-person plural form: its first-person plural inclusive counterpart is *detenbe* (in which the appearance of the first-person plural inclusive suffix *-be* overrides that of ə-); its first-person plural exclusive counterpart is *ədetenay* (which contains the first-person exclusive suffix *-ay* also appearing in *detenay* 'I get up'); and its third-person plural counterpart is *detenji* (in which the appearance of the third-person plural suffix *-ji* overrides that of ə-).[5] Thus, not all of the morphosyntactic content of *ədeten* can be seen as the contribution of an inflectional marking; nor could one say that Sora verb forms receive a second-person interpretation by default, since both the second- and third-person singular counterparts of *ədeten* (*deten* 'you (sg.)/s/he gets up') lack any overt expression of person. At this juncture, proponents of incremental theories might propose that Sora possesses one or more phonologically empty person markers.

Table 12.2 Affirmative paradigms of the Sora verb DE 'get up'

		Nonpast	Past
Singular	1	de-te-n-ay	de-le-n-ay
	2	de-te-n	de-le-n
	3	de-te-n	de-le-n
Plural	1 incl	de-te-n-be	de-le-n-be
	1 excl	əə-de-te-n-ay	əə-de-le-n-ay
	2	əə-de-te-n	əə-de-le-n
	3	de-te-n-ji	de-le-n-ji

Source: Biligiri 1965: 232 ff

While the use of phonetically null affixes is not new, it is nevertheless a questionable formal device, if only because the putative distribution of such affixes is hard to demonstrate empirically. Often, zero affixes arise in a Structuralist implication on analogy with the distribution of one or more overt affixes with comparable but contrastive meaning. The incremental position in general implies that any content found in a word beyond the lexical meaning of the root is added either through a discrete operation with no phonological effect (Steele 1995) or through the concatenation of a phonetically null but contentful affix at some morpheme boundary. Taken to its logical conclusion, this move engenders either a large

[5] The fact that the suffixation of *-be* or *-ji* overrides the prefixation of ə- shows that these affixes are members of an ambifixal position class (one whose members include both prefixes and suffixes); for discussion, see Stump (1993*b*, 2001: 133, 284f).

population of homophonous null affixes or a potentially long derivation of string-vacuous rule applications. In either case, the argument is developed theory-internally, and it is therefore unfalsifiable. In inferential–realizational theories, however, nothing so exotic as zero affixes is needed to account for the Sora facts; instead, one need only assume that in the inflection of Sora verbs of the DE type, there happens not to be any rule explicitly realizing the property "second person".[6]

Lexical theories also carry unwarranted implications about morphological form; in particular, they imply that inflectional markings are like lexically listed words in at least two ways. First, they imply that inflectional markings are inserted from the lexicon into phrase-structural nodes, and are therefore always linearly ordered with respect to the expressions with which they combine. Second, they imply that two types of relation may hold between an inflectional marking and a morphosyntactic property (or property set): an inflectional marking may express a particular morphosyntactic property (set), or it may be restricted to the context of a particular property (set). Neither of these implications is well motivated. First, inflectional markings do not necessarily combine with other expressions in the same ways that words do. The pluralization of Somali *díbi* 'bull', for example, is effected by a prosodic inflectional marking (*dibí* 'bulls'); representing the morphology of *dibí* as an affixational structure is at fundamental odds with any observable evidence. Second, there is no empirical motivation for assuming that an inflectional marking must be seen as expressing one set of morphosyntactic properties but as selecting for some other set of such properties; instead, one may always simply assume that the only relation between an inflectional marking and a set of morphosyntactic properties is the relation of exponence. In the inflection of Swahili verbs, for instance, the default mark of negative polarity is a prefix *ha*-, as in *hatutataka* 'we will not want'. In the inflection of negative past-tense verb forms, the default past-tense prefix *li*- is overridden by a special suffix *ku*-: *tulitaka* 'we wanted', but *hatukutaka* 'we did not want'. Although one could certainly treat *ku*- as expressing past tense but selecting for a negative context, there is no evidence to favour this approach over the simpler approach treating *ku*- as an exponent of both past tense and negation. An inferential–realizational theory of morphology such as PFM is fully compatible with this simpler approach.

We conclude on the basis of these considerations that the most adequate theory of morphology is both inferential and realizational. Logically, a realizational theory requires an explicit account of the association of morphosyntactic properties with their exponents, and an inferential theory requires an explicit account of the principles regulating the ways in which morphological rules compete or combine in the definition of inflected forms; PFM furnishes both of these, as we show in sections 12.6–8. First, however, we discuss a third distinctive aspect of PFM, namely its theory of paradigms (sections 12.4 and 12.5).

[6] For a detailed analysis of Sora verb morphology in an inferential–realization framework, see Stump (2005).

12.4 Content Paradigms and Form Paradigms

Paradigms participate in the definition of two different grammatical domains (Stump 2002, 2006; Ackerman and Stump 2004). On the one hand, a lexeme's paradigm distinguishes the various ways in which it can enter into the definition of phrase structure. In the syntax of Latin, noun phrases and their heads are specified for three morphosyntactic properties: a property of GENDER (masculine, feminine, or neuter), which is lexically stipulated for each noun lexeme, and thus invariant within a given noun paradigm; one of six properties of CASE, as listed in (1) below; and a property of NUMBER (singular or plural). The paradigm of a Latin noun therefore canonically contains twelve cells, one for each of the twelve sorts of N nodes into which it might be inserted. The masculine nominal lexeme AMĪCUS 'friend', for example, provides the paradigm schematized in (1); each cell in this paradigm is schematized as the pairing of AMĪCUS with a different gender–case–number specification. (The paradigm itself need not, of course, be listed lexically; it need only be accessible by projection from information specified in the lexeme's entry.) Seen as a response to the needs of syntax, (1) constitutes a CONTENT PARADIGM.

(1) Content paradigm of the lexeme AMĪCUS 'friend'

a.	⟨ AMĪCUS, {MASC NOM SG} ⟩	*g.*	⟨ AMĪCUS, {MASC NOM PL} ⟩
b.	⟨ AMĪCUS, {MASC VOC SG} ⟩	*h.*	⟨ AMĪCUS, {MASC VOC PL} ⟩
c.	⟨ AMĪCUS, {MASC GEN SG} ⟩	*i.*	⟨ AMĪCUS, {MASC GEN PL} ⟩
d.	⟨ AMĪCUS, {MASC DAT SG} ⟩	*j.*	⟨ AMĪCUS, {MASC DAT PL} ⟩
e.	⟨ AMĪCUS, {MASC ACC SG} ⟩	*k.*	⟨ AMĪCUS, {MASC ACC PL} ⟩
f.	⟨ AMĪCUS, {MASC ABL SG} ⟩	*l.*	⟨ AMĪCUS, {MASC ABL PL} ⟩

Besides entering into the definition of phrase structure, paradigms participate in the definition of a language's morphological forms. In a realizational theory of morphology, rules of inflection apply to the pairing of a root[7] with a morphosyntactic property set; the paradigm of a Latin noun therefore provides an inventory of twelve such pairings, as in (2). Realization rules such as those in (4) apply to the pairings in (2) to determine the realizations listed in (3). Seen as a response to the needs of morphology, (2) constitutes a FORM PARADIGM.

[7] Here and below, we adhere to the following terminological usage: a WORD FORM is a synthetic realization of a cell in a paradigm; a STEM is a morphological form which undergoes one or more morphological rules in the realization of a cell in a paradigm; and a lexeme's ROOT is its default stem.

(2) Form paradigm of the root *amīc* 'friend':
a. ⟨ amīc, {masc nom sg} ⟩
b. ⟨ amīc, {masc voc sg} ⟩
c. ⟨ amīc, {masc gen sg} ⟩
d. ⟨ amīc, {masc dat sg} ⟩
e. ⟨ amīc, {masc acc sg} ⟩
f. ⟨ amīc, {masc abl sg} ⟩
g. ⟨ amīc, {masc nom pl} ⟩
h. ⟨ amīc, {masc voc pl} ⟩
i. ⟨ amīc, {masc gen pl} ⟩
j. ⟨ amīc, {masc dat pl} ⟩
k. ⟨ amīc, {masc acc pl} ⟩
l. ⟨ amīc, {masc abl pl} ⟩

(3) Realizations of the cells in (1) and (2)
a. amīcus
b. amīce
c. amīcī
d. amīcō
e. amīcum
f. amīcō
g. amīcī
h. amīcī
i. amīcōrum
j. amīcīs
k. amīcōs
l. amīcīs

(4) Some Latin morphological rules
a. **Stem-formation rule**
Where root R is a second-declension nominal, R's thematized stem is R*u*.
b. **Realization rules**
Where X is the thematized stem of a second-declension root R and R is an adjective or masculine noun,
i. cell ⟨ R,{masc nom sg}⟩ is realized as X*s*;
ii. cell ⟨ R,{masc voc sg}⟩ is realized as R*e*;
. . .

There is, of course, a close connection between a language's content paradigms and its form paradigms. In particular, each cell in a content paradigm (i.e. each CONTENT CELL) normally corresponds to a particular cell in a particular form paradigm (i.e. to a particular FORM CELL); this form cell is its FORM CORRESPONDENT. In general, the realization of a content cell is that of its form correspondent. Thus, because the content cell in (1*a*) has the form cell in (2*a*) as its form correspondent, they share the realization in (3*a*).

In the canonical case, there is an isomorphic relation between a language's content and form paradigms: a lexeme L has a single root R, and for each morphosyntactic property set σ with which L is paired in some cell ⟨L, σ⟩ of its content paradigm, the form correspondent of ⟨L, σ⟩ is ⟨R, σ⟩ (so that the realization of ⟨L, σ⟩ is that of ⟨R, σ⟩). This isomorphic relation might be formulated as the RULE OF PARADIGM LINKAGE in (5), in which ⇒ is the form correspondence operator.

(5) **The universal default rule of paradigm linkage**
Where R is L's root, ⟨L, σ⟩ ⇒ ⟨R, σ⟩

One might question whether it is actually critical to make a distinction between content and form paradigms. In those instances in which the default rule in (5) has effect, the distinction seems genuinely redundant. But as we show in the following section, (5) is sometimes overridden, and it is precisely such instances that make it necessary to distinguish the two types of paradigm.

12.5 Why Two Types of Paradigm?

Deviations from the default relation of paradigm linkage in (5) are of diverse kinds; some of the more common types of deviation are listed in Table 12.3. We consider each of these in turn.

12.5.1 Deponency

In instances of DEPONENCY[8] (Table 12.3, row 1), the realization of a content cell $\langle L, \sigma\rangle$ is that of a form cell $\langle X, \sigma'\rangle$, where $\sigma \neq \sigma'$. Latin furnishes the standard example of this phenomenon. In Latin, certain verbs—the deponents—are special

Table 12.3 Common deviations from (5)

Deviation	Paradigm linkage
1. Deponency	$\langle L,\sigma\rangle \Rightarrow \langle X,\sigma'\rangle$, where $\sigma \neq \sigma'$ and normally, $\langle L_1,\sigma\rangle \Rightarrow \langle X_1,\sigma\rangle$ and $\langle L_1,\sigma'\rangle \Rightarrow \langle X_1,\sigma'\rangle$
2. Syncretism	$\langle L,\{\tau\ldots\}\rangle, \langle L,\{\tau'\ldots\}\rangle \Rightarrow \langle X,\{\tau \vee \tau'\ldots\}\rangle$
3. A single content paradigm's realization	$\langle L,\sigma\rangle \Rightarrow \langle X,\sigma\rangle$
conditioned by multiple inflection classes	$\langle L,\sigma'\rangle \Rightarrow \langle Y,\sigma'\rangle$
(a) principal parts phenomenon;	
(b) systematically associated inflection classes;	
(c) heteroclisis	

[8] Although the term "deponency" is frequently associated with exceptional verb morphology in the classical Indo-European languages, we use this term in a more general way to refer to any instance in which a word's morphology is at odds with its morphosyntactic content. Construed in this way, deponency takes in a range of phenomena in a wide range of languages.

Table 12.4 Paradigm linkage in the inflection of non-deponent, deponent, and semideponent verbs in Latin

Lexemes	Content cells	Form correspondents	Realizations
MONĒRE	⟨ MONĒRE, {1 sg pres act indic} ⟩	⟨ mon, {1 sg pres act indic} ⟩	moneō
'advise'	⟨ MONĒRE, {1 sg perf act indic} ⟩	⟨ mon, {1 sg perf act indic} ⟩	monuī
	⟨ MONĒRE, {1 sg pres pass indic} ⟩	⟨ mon, {1 sg pres pass indic} ⟩	moneor
	⟨ MONĒRE, {1 sg perf pass indic} ⟩	⟨ mon, {1 sg perf pass indic} ⟩	monitus sum
FATĒRĪ	⟨ FATĒRĪ, {1 sg pres act indic} ⟩	⟨ fat, {1 sg pres pass indic} ⟩	fateor
'confess'	⟨ FATĒRĪ, {1 sg perf act indic} ⟩	⟨ fat, {1 sg perf pass indic} ⟩	fassus sum
AUDĒRE	⟨ AUDĒRE, {1 sg pres act indic} ⟩	⟨ aud, {1 sg pres act indic} ⟩	audeō
'dare'	⟨ AUDĒRE, {1 sg perf act indic} ⟩	⟨ aud, {1 sg perf pass indic} ⟩	ausus sum

in that their active forms exhibit the morphology typical of passive forms; certain other verbs—the semideponents—are special in that their perfect active forms exhibit the morphology typical of perfect passive forms. Verbs of both types involve a deviation from (5) in which active content cells have passive form cells as their form correspondents; Table 12.4 illustrates this with selected cells from the paradigms of the non-deponent verb MONĒRE 'advise', the deponent verb FATĒRĪ 'confess', and the semi-deponent verb AUDĒRE 'dare'.

To account for the inflection of deponents and semideponents, we assume that in Latin, the default rule of paradigm linkage in (5) is overridden by the more specific rules of paradigm linkage in (6).

(6) *a.* Where L is a deponent verb having root R, ⟨L,{active . . . }⟩ ⇒⟨R,{passive . . . }⟩
b. Where L is a semi-deponent verb having root R,
⟨L,{perfect active . . . }⟩ ⇒ ⟨R,{perfect passive . . . }⟩

12.5.2 Syncretism

In instances of SYNCRETISM (Table 12.3, row 2), two or more content cells share their form correspondent, hence also their realization. Because the pattern of paradigm linkage in such instances involves a many-to-one mapping from content cells to form cells, these are instances in which a content paradigm has more cells than the form paradigm by which it is realized. The Sanskrit paradigms in Table 12.5 illustrate. In Sanskrit, a neuter noun has identical forms in the nominative and accusative. This syncretism is directional, since the nominative singular form patterns after the accusative singular form; thus, the suffix *-m* shared by the accusative singular forms *aśvam* and *dānam* in Table 12.5 also appears in the

Table 12.5 Inflectional paradigms of two Sanskrit nouns

		AŚVA 'horse' (masc.)	DĀNA 'gift' (neut.)
Singular	Nom	aśvaḥ	dānam
	Voc	aśva	dāna
	Acc	aśvam	dānam
	Instr	aśvena	dānena
	Dat	aśvāya	dānāya
	Abl	aśvāt	dānāt
	Gen	aśvasya	dānasya
	Loc	aśve	dāne
Dual	Nom, Voc, Acc	aśvau	dāne
	Instr, Dat, Abl	aśvābhyām	dānābhyām
	Gen, Loc	aśvayoḥ	dānayoḥ
Plural	Nom, Voc	aśvāḥ	dānāni
	Acc	aśvān	dānāni
	Instr	aśvaiḥ	dānaiḥ
	Dat, Abl	aśvebhyaḥ	dānebhyaḥ
	Gen	aśvānām	dānānām
	Loc	aśveṣu	dāneṣu

nominative singular form *dānam*. A second instance of syncretism appearing in Table 12.5 (and indeed, in all nominal paradigms in Sanskrit) is that of the genitive and locative cases in the dual. Unlike the syncretism of the nominative and accusative cases of neuter nouns, the genitive–locative dual syncretism is non-directional: there is no good basis for saying that the realization of either case patterns after that of the other.

To account for the first of these syncretisms, we assume that in Sanskrit, a neuter noun does not have separate nominative and accusative cells in its form paradigm; instead, it has three form cells (one singular, one dual, and one plural) whose case property is represented as nom$\vee$acc, and each of these cells is the form correspondent of both a nominative and an accusative cell in the noun's content paradigm (as in row (*c*) of Table 12.6). The operator $\vee$ is defined as combining with two properties τ, τ' to yield a third property $\tau \vee \tau'$ such that any rule applicable in the realization of τ or τ' is also applicable in the realization of $\tau \vee \tau'$; the existence of a rule realizing the accusative singular through the suffixation of -*m* therefore produces a directional effect in the inflection of neuter nouns. To account for the genitive–locative dual syncretism in the paradigms of Sanskrit nominals, we

Table 12.6 Paradigm linkage in the inflection of two Sanskrit nouns

	Lexeme	Content cell	Form correspondent	Realization
a.	AŚVA	⟨ AŚVA, {masc nom sg} ⟩	⟨ aśva, {masc nom sg} ⟩	aśvaḥ
	'horse'	⟨ AŚVA, {masc acc sg} ⟩	⟨ aśva, {masc acc sg} ⟩	aśvam
b.		⟨ AŚVA, {masc gen du} ⟩ ⟨ AŚVA, {masc loc du} ⟩	⟨ aśva, {masc gen∨loc du} ⟩	aśvayoḥ
c.	DĀNA 'gift'	⟨ DĀNA, {neut nom sg} ⟩ ⟨ DĀNA, {neut acc sg} ⟩	⟨ dāna, {neut nom∨acc sg} ⟩	dānam
d.		⟨ DĀNA, {neut gen du ⟩ ⟨ DĀNA, {neut loc du} ⟩	⟨ dāna, {neut gen∨loc du} ⟩	dānayoḥ

assume that a given nominal lacks distinct genitive dual and locative dual cells in its form paradigm; instead, it has a single form cell whose case property is gen∨loc, and this cell is the form correspondent of both the genitive dual and the locative dual cells in its content paradigm (as in rows (*b*) and (*d*) of Table 12.6). Because all nominals participate in this pattern of paradigm linkage and case and number are always expressed cumulatively in Sanskrit, no directional effects can arise in instances of the genitive–locative dual syncretism. We assume that the patterns of paradigm linkage in rows (*b*)–(*d*) of Table 12.6 are produced by the rules of paradigm linkage in (7), both of which override the default rule of paradigm linkage in (5).[9]

(7) Where L has R as its root, α = sg, du, or pl, and β = masc, fem, or neut,
a. ⟨L,{neut nom α}⟩, ⟨L,{neut acc α}⟩ ⇒ ⟨R,{neut nom∨acc α}⟩
b. ⟨L,{gen du β}⟩, ⟨L,{loc du β}⟩ ⇒ ⟨R,{gen∨loc du β}⟩

12.5.3 A Single Content Paradigm's Realization Conditioned by Multiple Inflection Classes

The formulation of the default rule of paradigm linkage in (5) entails that each lexeme L has a root R and that for any relevant property set σ, the realization of $\langle L,\sigma\rangle$ is that of $\langle R,\sigma\rangle$. But the inflectional realization of a lexeme L sometimes involves two or more distinct stems (Table 12.3, row 3): that is, the form correspondent of $\langle L,\sigma\rangle$ may be $\langle X,\sigma\rangle$ while that of $\langle L,\sigma'\rangle$ is instead $\langle Y,\sigma'\rangle$, where $X \neq Y$. The clearest instances of this sort are those in which X and Y belong to distinct inflection classes. At least three classes of such instances can be distinguished; we discuss these in the next three sections.

[9] The account of syncretism presented here is based on that of Baerman (2004).

12.5.3.1 *Principal Parts*

In many languages, a lexeme L is realized through the inflection of distinct stems (belonging to distinct inflection classes) in different parts of its paradigm. Very often in such cases, the lexeme's stems are independent, in the sense that one stem's form and inflection-class membership may neither determine nor be determined by those of another stem. Traditionally, a lexeme of this type is said to have several PRINCIPAL PARTS, which simply have to be memorized as idiosyncratic lexical properties. In Sanskrit, for example, a verb's present-system inflection comprises its present indicative, optative, and imperative paradigms as well as its imperfect paradigm, and its aorist-system inflection comprises its aorist and injunctive paradigms; there are ten present-system conjugations and seven aorist-system conjugations. A verb's present-system conjugation is, in general, neither predicted by nor predictive of its aorist-system conjugation. Thus, although the verb PRACH 'ask' follows the sixth present-system conjugation and the *s*-aorist conjugation, membership in the sixth present-system conjugation class neither entails nor is entailed by membership in the *s*-aorist conjugation class, as the examples in Table 12.7 show. Thus, the lexicon of Sanskrit must typically stipulate at least two principal parts for a given verb: a present-system and an aorist-system form.

Traditionally, a word's principal parts are assumed to be fully inflected words, but this is not necessary; one could just as well assume that a principal part is simply a stem belonging to a particular inflection class. The inflection of the Sanskrit verb PRACH 'ask' might then be assumed to involve instances of paradigm linkage such as those in Table 12.8, in which the form correspondent for a

Table 12.7 Present-system and aorist-system conjugations of ten Sanskrit verbs

Verbal lexeme		Conjugation class	
		Present-system	Aorist-system
RAKṢ	'protect'	first	*s*-aorist
DRĀ	'run'	second	*s*-aorist
HĀ	'go forth'	third	*s*-aorist
MṚC	'injure'	fourth	*s*-aorist
VLĪ	'crush'	ninth	*s*-aorist
GUR	'greet'	sixth	root-aorist
SIC	'pour out'	sixth	*a*-aorist
KṢIP	'throw'	sixth	reduplicating aorist
SPHṚ	'jerk'	sixth	*iṣ*-aorist
LIH	'lick'	sixth	*sa*-aorist

Table 12.8 Paradigm linkage in the inflection of Sanskrit PRACH 'ask'

Content cell	Form correspondent	Realization
⟨ PRACH, {3 sg pres indic act} ⟩	⟨ pṛccha$_{[VI]}$, {3 sg pres indic act} ⟩	pṛcchati
⟨ PRACH, {3 sg aor indic act} ⟩	⟨ aprākṣ$_{[s\text{-}Aorist]}$, {3 sg aor indic act} ⟩	aprākṣīt

present-system content cell contains the principal part *pṛccha* (ϵ sixth conjugation), while the form correspondent for an aorist-system content-cell contains the distinct principal part *aprākṣ* (ϵ s-aorist conjugation). On this analysis, the default rule of paradigm linkage in (5) is overridden by the more specific rule in (8).

(8) Given a verbal lexeme having X (a member of conjugation class [α]) as a principal part, $\langle L, \sigma\rangle \Rightarrow \langle X, \sigma\rangle$ provided that
a. present or imperfect ϵ σ and α = I, II, III, IV, V, VI, VII, VIII, IX, or X; or
b. aorist ϵ σ and α = root-aorist, *a*-aorist, reduplicated aorist, *s*-aorist, *iṣ*-aorist, *sa*-aorist, or *siṣ*-aorist.

12.5.3.2 *Systematically Associated Inflection Classes*

In instances of the principal parts phenomenon, the realizations of a lexeme are built on two or more stems belonging to distinct and mutually unpredictable inflection classes. There are, however, instances in which a lexeme's realizations are based on multiple stems belonging to distinct but mutually predictable inflection classes. Consider, for example, the Sanskrit paradigms in Tables 12.5 and 12.9. Nouns belonging to the *a*-stem declension (exemplified in Table 12.5 by the nouns AŚVA 'horse' and DĀNA 'gift') are never feminine, while nouns belonging to the derivative *ā*-stem declension (exemplified by SENĀ 'army' in Table 12.9) are all feminine. Accordingly, the inflection of the adjective PĀPA 'evil' in Table 12.9 involves two stems, belonging to two distinct declension classes: the stem *pāpa-* 'evil' follows the *a*-stem declension and is used for masculine and neuter forms, while the stem *pāpā-* follows the derivative *ā*-stem declension and is used for feminine forms. Unlike the association of the sixth present-system conjugation and the *s*-aorist conjugation in the inflection of Sanskrit PRACH, the association of the *a*-stem and derivative *ā*-stem declensions in the inflection of Sanskrit adjectives is highly systematic (Whitney 1889: §332). We assume that this association is effected by the rule of paradigm linkage in (9), which—overriding the default rule (5)—entails that if an adjectival lexeme has *a*-stem form correspondents, then

Table 12.9 Inflectional paradigms of two Sanskrit nominals

<table>
<tr><th></th><th></th><th>SENĀ 'army'</th><th colspan="2">PĀPA 'evil'</th><th></th></tr>
<tr><th></th><th></th><th>(fem.)</th><th>Masc</th><th>Neut</th><th>Fem</th></tr>
<tr><td>Singular</td><td>Nom</td><td>senā</td><td>pāpaḥ</td><td>pāpam</td><td>pāpā</td></tr>
<tr><td></td><td>Voc</td><td>sene</td><td colspan="2">pāpa</td><td>pāpe</td></tr>
<tr><td></td><td>Acc</td><td>senām</td><td colspan="2">pāpam</td><td>pāpām</td></tr>
<tr><td></td><td>Instr</td><td>senayā</td><td colspan="2">pāpena</td><td>pāpayā</td></tr>
<tr><td></td><td>Dat</td><td>senāyai</td><td colspan="2">pāpāya</td><td>pāpāyāi</td></tr>
<tr><td></td><td>Abl</td><td>senāyāḥ</td><td colspan="2">pāpāt</td><td>pāpāyāḥ</td></tr>
<tr><td></td><td>Gen</td><td>senāyāḥ</td><td colspan="2">pāpasya</td><td>pāpāyāḥ</td></tr>
<tr><td></td><td>Loc</td><td>senāyām</td><td colspan="2">pāpe</td><td>pāpāyām</td></tr>
<tr><td>Dual</td><td>Nom, Voc, Acc</td><td>sene</td><td>pāpāu</td><td>pāpe</td><td>pāpe</td></tr>
<tr><td></td><td>Instr, Dat, Abl</td><td>senābhyām</td><td colspan="2">pāpābhyām</td><td>pāpābhyām</td></tr>
<tr><td></td><td>Gen, Loc</td><td>senayoḥ</td><td colspan="2">pāpayoḥ</td><td>pāpayoḥ</td></tr>
<tr><td>Plural</td><td>Nom, Voc</td><td>senāḥ</td><td>pāpāḥ</td><td>pāpāni</td><td>pāpāḥ</td></tr>
<tr><td></td><td>Acc</td><td>senāḥ</td><td>pāpān</td><td>pāpāni</td><td>pāpāḥ</td></tr>
<tr><td></td><td>Instr</td><td>senābhiḥ</td><td colspan="2">pāpāiḥ</td><td>pāpābhiḥ</td></tr>
<tr><td></td><td>Dat, Abl</td><td>senābhyaḥ</td><td colspan="2">pāpebhyaḥ</td><td>pāpābhyaḥ</td></tr>
<tr><td></td><td>Gen</td><td>senānām</td><td colspan="2">pāpānām</td><td>pāpānām</td></tr>
<tr><td></td><td>Loc</td><td>senāsu</td><td colspan="2">pāpeṣu</td><td>pāpāsu</td></tr>
</table>

Table 12.10 Paradigm linkage in the inflection of Sanskrit PĀPA 'evil'

Content cell	Form correspondent	Realization
⟨ PĀPA, {masc nom sg} ⟩	⟨ pāpa, {masc nom sg} ⟩	pāpaḥ
⟨ PĀPA, {neut nom sg} ⟩	⟨ pāpa, {neut nom sg} ⟩	pāpam
⟨ PĀPA, {fem nom sg} ⟩	⟨ pāpā, {fem nom sg} ⟩	pāpā

the feminine cells in its content paradigm have *ā*-stem form correspondents; accordingly, (9) licenses the instances of paradigm linkage in Table 12.10.

(9) Given an adjectival lexeme having X*a* ($\in$ *a*-stem declension) as its root, then there is a stem X*ā* ($\in$ *ā*-stem declension) such that $\langle L, \sigma\rangle \Rightarrow \langle X\bar{a}, \sigma\rangle$ if feminine $\in \sigma$.

12.5.3.3 *Heteroclisis*

In instances of both the principal parts phenomenon (e.g. the present- and aorist-system inflection of Sanskrit verbs) and that of systematically associated inflection classes (e.g. the gender inflection of Sanskrit adjectives), lexemes belonging to a particular category characteristically depend on two or more distinct stems for their inflection. In instances of HETEROCLISIS, by contrast, the cells of a lexeme's content paradigm are exceptional precisely because they have form correspondents whose stems are distinct and indeed belong to distinct inflection classes. In Sanskrit, for example, the lexeme HṚD(AYA) 'heart' inflects as an *a*-stem nominal *hṛdaya-* in the direct (i.e. nominative, vocative, and accusative) cases, but as a consonant-stem nominal *hṛd-* in the remaining, oblique cases (see the paradigms in Table 12.11); that is, the cells in HṚD(AYA)'s content-paradigm have the divergent pattern of form correspondence exemplified in Table 12.12. The heteroclisis of Sanskrit HṚD(AYA) follows from the assumption that HṚD(AYA) has *hṛd-* as its root

Table 12.11 The heteroclite inflection of Sanskrit HṚD(AYA) 'heart'

		ĀSYA 'mouth'	HṚD(AYA) 'heart'		TRIVṚT 'threefold' (neuter forms)
	Stem	āsya	hṛdaya	hṛd	trivṛt
	Declension	neuter *a*-stem		neuter C-stem	
Singular	Nom	āsyam	hṛdayam		trivṛt
	Voc	āsya	hṛdaya		trivṛt
	Acc	āsyam	hṛdayam		trivṛt
	Instr	āsyena		hṛdā	trivṛtā
	Dat	āsyāya		hṛde	trivṛte
	Abl	āsyāt		hṛdaḥ	trivṛtaḥ
	Gen	āsyasya		hṛdaḥ	trivṛtaḥ
	Loc	āsye		hṛdi	trivṛti
Dual	Nom, Voc, Acc	āsye	hṛdaye		trivṛtī
	Instr, Dat, Abl	āsyābhyām		hṛdbhyām	trivṛdbhyām
	Gen, Loc	āsyayoḥ		hṛdoḥ	trivṛtoḥ
Plural	Nom, Voc, Acc	āsyāni	hṛdayāni		trivṛnti
	Instr	āsyāiḥ		hṛdbhiḥ	trivṛdbhiḥ
	Dat, Abl	āsyebhyaḥ		hṛdbhyaḥ	trivṛdbhyaḥ
	Gen	āsyānām		hṛdām	trivṛtām
	Loc	āsyeṣu		hṛtsu	trivṛtsu

Source: Whitney 1889: 149

Table 12.12 Paradigm linkage in the inflection of Sanskrit HṚD 'heart'

Content cell	Form correspondent	Realization
⟨ HṚD, {neut nom sg} ⟩	⟨ hṛdaya, {neut nom sg} ⟩	hṛdaya-m
⟨ HṚD, {neut loc sg} ⟩	⟨ hṛd, {neut loc sg} ⟩	hṛd-i

and that the rule of paradigm linkage in (10) overrides the default rule (5) in the definition of HṚD(AYA)'s direct-case forms; in the definition of its oblique-case forms, (5) remains unoverridden.

(10) For any direct case α, if $\alpha \in \sigma$, then ⟨HṚD, σ⟩ $\Rightarrow$ ⟨*hṛdaya*, σ⟩.

The notion of paradigm linkage is quite powerful, but there are numerous imaginable ways in which it might be systematically restricted. Pending the completion of thorough typological investigations of the phenomena of deponency, syncretism, and multiple inflection-class conditioning, we have no specific restrictions to propose at present, but hope eventually to do so in light of ongoing research; see for example Stump (2006) and Baerman, Brown, and Corbett (2005).

12.6 Paradigm Functions and Realization Rules

Paradigm Function Morphology gets its name from a theoretical construct central to the realizational definition of a language's inflectional morphology. Intuitively, a PARADIGM FUNCTION is a function from cells to realizations. More precisely, for any form cell ⟨X, σ⟩ having Y as its realization in some language ℓ, the paradigm function PF_ℓ of language ℓ is a function from ⟨X, σ⟩ to ⟨Y, σ⟩; and for any content cell ⟨L, σ⟩ such that ⟨L, σ⟩ $\Rightarrow$ ⟨X, σ'⟩ in some language ℓ (where σ may or may not equal σ'), the value of PF_ℓ(⟨L, σ⟩) is that of PF_ℓ(⟨X, σ'⟩). Thus,

PF_{English}(⟨LIKE, {third-person singular present indicative}⟩)
= PF_{English}(⟨*like*, {third-person singular present indicative}⟩)
= ⟨*likes*, {third-person singular present indicative}⟩,

and so on. (We will see momentarily why a paradigm function's value is the pairing of a realization with a property set rather than simply the realization alone.)

Table 12.13 Future- and past-tense forms of Swahili TAKA 'want'

		Positive	Negative
Future tense	1sg	ni-ta-taka	si-ta-taka
	2sg	u-ta-taka	ha-u-ta-taka (→ hutataka)
	3sg (class 1)	a-ta-taka	ha-a-ta-taka (→ hatataka)
	1pl	tu-ta-taka	ha-tu-ta-taka
	2pl	m-ta-taka	ha-m-ta-taka
	3pl (class 2)	wa-ta-taka	ha-wa-ta-taka
Past tense	1sg	ni-li-taka	si-ku-taka
	2sg	u-li-taka	ha-u-ku-taka (→ hukutaka)
	3sg (class 1)	a-li-taka	ha-a-ku-taka (→ hakutaka)
	1pl	tu-li-taka	ha-tu-ku-taka
	2pl	m-li-taka	ha-m-ku-taka
	3pl (class 2)	wa-li-taka	ha-wa-ku-taka

The paradigm function of a language is defined in terms of its more specific realization rules. Realization rules are of two types: RULES OF EXPONENCE associate specific morphological operations with specific morphosyntactic property sets; RULES OF REFERRAL specify instances in which the realization of some property set by one rule is systematically identical to that of some (possibly distinct) property set by some other rule or rules. In the notational system of Ackerman and Stump (2004), realization rules take the form in (11):

(11) $X_C, \sigma{:}\tau \rightarrow Y$

This should be read as follows. Where $\langle X, \sigma \rangle$ is a pairing such that $\tau \subseteq \sigma$ and X belongs to class C, $\langle X, \sigma \rangle$ is realized as $\langle Y, \sigma \rangle$. Thus, consider the fragment of Swahili inflectional morphology in Table 12.13.

In order to account for this set of forms in a realizational analysis of Swahili inflection, the twelve realization rules in (12) must be postulated. These rules are organized into four rule blocks; since the morphology of the forms in Table 12.13 is purely affixal, each of the four blocks in (12) can be seen as housing an affix position class. The rules within a given block are disjunctive in their application: if one applies, the others do not.

(12) Some Swahili realization rules

Block A:	*a.* $X_V,\sigma{:}\{\text{TNS:fut}\}$	$\rightarrow$ *ta*X
	b. $X_V,\sigma{:}\{\text{TNS:past}\}$	$\rightarrow$ *li*X
	c. $X_V,\sigma{:}\{\text{POL:neg, TNS:past}\}$	$\rightarrow$ *ku*X

Block B:	*d.* $X_V,\sigma:\{\textsc{agr}(su):\{\textsc{per}:1, \textsc{num}:sg\}\}$	$\rightarrow$ *ni*X
	e. $X_V,\sigma:\{\textsc{agr}(su):\{\textsc{per}:2, \textsc{num}:sg\}\}$	$\rightarrow$ *u*X
	f. $X_V,\sigma:\{\textsc{agr}(su):\{\textsc{per}:3, \textsc{num}:sg, \textsc{gen}:\{1,2\}\}\}$	$\rightarrow$ *a*X
	g. $X_V,\sigma:\{\textsc{agr}(su):\{\textsc{per}:1, \textsc{num}:pl\}\}$	$\rightarrow$ *tu*X
	h. $X_V,\sigma:\{\textsc{agr}(su):\{\textsc{per}:2, \textsc{num}:pl\}\}$	$\rightarrow$ *m*X
	i. $X_V,\sigma:\{\textsc{agr}(su):\{\textsc{per}:3, \textsc{num}:pl, \textsc{gen}:\{1,2\}\}\}$	$\rightarrow$ *wa*X
Block C:	*j.* $X_V,\sigma:\{\textsc{pol}:neg\}$	$\rightarrow$ *ha*X
Block D:	*k.* $X_V,\sigma:\{\textsc{pol}:neg, \textsc{agr}(su):\{\textsc{per}:1, \textsc{num}:sg\}\}$	$\rightarrow$ *si*X
	l. $X_V,\sigma:\{\}$	$\rightarrow (\langle X, \sigma\rangle : B) : C$

Pāṇini's principle determines which of a block's rules applies in the realization of a pairing $\langle X, \sigma\rangle$: without exception, it is the narrowest of the applicable rules in that block. Rule (13*a*) is narrower than rule (13*b*): (i) if class C is a proper subset of class C′; or (ii) if C = C′ and the morphosyntactic property set τ_2 is a proper subset of τ_1. (We discuss the centrality of Pāṇini's principle in PFM in Section 12.8.)

(13) *a.* $X_C, \sigma:\tau_1 \rightarrow Y$
b. $X_{C'}, \sigma:\tau_2 \rightarrow Z$

There is no intrinsic ordering among a language's blocks of realization rules; rather, the interaction among rule blocks is determined by a language's paradigm function. Thus, in order to account for the rule-block interactions embodied by the forms in Table 12.13, one might propose the following provisional definition of the Swahili paradigm function:

(14) Provisional definition of the Swahili paradigm function

$PF_{Swahili}(\langle r, \sigma\rangle) = ((\langle r, \sigma\rangle : A) : B) : C$

N.B.: The notation "$\langle X, \sigma\rangle$: Block *n*" means "the result of applying the narrowest applicable rule in Block *n* to the pairing $\langle X, \sigma\rangle$".

This definition accounts for most of the negative forms in Table 12.13, whose definitions each involve the application of a rule from Block A, a rule from Block B, and a rule from Block C; the definition of *hatutataka* 'we will not want', for example, involves the application of *ta*-prefixation (12*a*), *tu*-prefixation (12*g*), and *ha*-prefixation (12*j*). This definition shows why a paradigm function's value is the pairing of a realization with its property set rather than simply the realization alone: because a realization rule is defined as applying to a pairing of the type ⟨morphological expression, morphosyntactic property set⟩, it must yield a value of this same type if a subsequent realization rule is to apply directly to its output; and because a paradigm function's value is defined as the result of applying a particular succession of realization rules, this value must likewise be of the same type.

Although the definition in (14) suffices to account for most of the negative forms in Table 12.13, the first-person singular negative forms present a problem: these involve the portmanteau rule of *si*-prefixation in (12*k*). To account for the fact that the *si*- rule is a portmanteau, we have situated it in a special block D; by virtue of its default rule (12*l*), Block D is paradigmatically opposed to Blocks B and C together. By virtue of (12*l*), the Swahili paradigm function may be reformulated as in (15).

(15) Improved definition of the Swahili paradigm function
$PF_{Swahili}(\langle r,\sigma\rangle) = (\langle r, \sigma\rangle : A) : D$

This definition accounts for all of the negative forms in Table 12.13, whose definitions each involve the application of a rule from Block A and a rule from Block D: the definition of a first-person singular negative form involves the Block D rule of *si*-prefixation (12*k*); the definition of all other negative forms instead involves the default Block D rule in (12*l*), whose application entails the application of a Block B rule and a Block C rule.

Although definition (15) of the Swahili paradigm function accounts for the negative forms in Table 12.13, the positive forms seem to present another problem, since Block C in (12) provides no rule for the realization of positive forms. Such instances fall within the compass of the Identity Function Default (16), according to which every rule block in every language has an identity function as its least narrow rule. Once this is assumed, the definition in (15) accounts for the full range of forms in Table 12.13.

(16) Identity Function Default
Universally, the following rule acts as the least narrow member of any rule block:

$X_{any}, \sigma:\{\} \rightarrow X$

Thus, suppose that we wish to know the realization of the form cell ⟨*taka*, σ⟩, where σ is the property set {1 pl future affirmative}. By definition (15), this is the form defined by the evaluation of (⟨*taka*, σ⟩ : A) : D. By Pāṇini's principle, this value is the result of applying rule (12*l*) to ⟨*tataka*, σ⟩ (itself the result of applying rule (12a) to ⟨*taka*, σ⟩). The result of applying (12*l*) to ⟨*tataka*, σ⟩ is, by Pāṇini's principle, the result of applying (16) to the result of applying rule (12*g*) to ⟨*tataka*, σ⟩. The final value ⟨*tutataka*, σ⟩ identifies *tutataka* as the realization of ⟨*taka*, σ⟩. Similar proofs are possible for all of the forms in Table 12.13.

12.7 Why Paradigm Functions?

One of the clearest points of contrast between the formalism of PFM and that of other morphological theories is the extensive reference to paradigm functions in PFM. Despite the fact that they are unique to PFM, paradigm functions are, we claim, essential to the definition of the morphology of a language. Here we present some of the central reasons for their postulation.

12.7.1 *Rule-Block Interactions*

One might suppose, naively, that all interactions among a language's rule blocks in the definition of its word forms are the effect of a strict linear ordering of its rule blocks. In actuality, rule blocks interact in complex ways, and this is one of the reasons for postulating paradigm functions. For instance, one rule block may be paradigmatically opposed to a combination of two or more other rule blocks, as we have already seen: in Swahili, the exponent *ni-* of first-person singular subject agreement and the exponent *ha-* of negation are introduced by blocks B and C, respectively; but in the definition of a verb's first-person singular negative forms, the application of *ni*-prefixation and that of *ha*-prefixation are excluded by the application of the rule introducing the first-person singular negative prefix *si-*. In view of the fact that *si-* pre-empts both *ha-* and *ni-*, the rule of *si*-prefixation cannot be plausibly situated in either Block B or Block C; instead, it must be assumed to occupy a distinct block D, as in (12*k*).[10] The relation of paradigmatic opposition between Block D and the combination of blocks B and C can then be attributed to the paradigm function in (15) together with the rule of referral in (12*l*): according to (15), a verb draws its inflectional markings from Blocks A and D; by rule (12*l*), a verb draws inflectional markings from Blocks B and C only in the absence of any applicable rule of exponence in Block D.

Paradigm functions are also necessary for specifying other types of complex rule-block interaction (Stump 1993*c*, 2001: ch. 5). For instance, a single rule block may participate in the instantiation of more than one of a word's affix positions; that is, it may define PARALLEL position classes. Thus, in Lingala, the rules expressing subject agreement in the affix position labelled I in Table 12.14 are, with only a few exceptions, identical to the rules expressing object agreement in the affix position labelled III; this identity can be accounted for by defining the Lingala paradigm function as in (17) (where each roman numeral names the rule block responsible for the corresponding affix position in Table 12.14) and postulating a single, additional rule block to which Blocks I and III both default (Stump 2001: 144ff).

(17) Definition of the Lingala paradigm function

$$PF_{Lingala}(\langle r,\sigma\rangle) = (((((\langle r, \sigma\rangle : \text{IV}) : \text{V}) : \text{III}) : \text{II}) : \text{I})$$

Rule blocks may also be REVERSIBLE, applying in one sequence in the realization of some morphosyntactic property sets but in the opposite sequence in the

[10] By virtue of its default rule (12*l*), Block D is an example of what Stump (2001: 141) terms a PORTMANTEAU rule block.

Table 12.14 Position-class analysis of some Lingala verb forms

Affix position						Gloss
I	II	III	(root)	IV	V	
na-	ko-		sál	-ak	-a	'I always work' (2nd habitual present)
ba-		m-	bet	-ak	-í	'they hit me' (historical past)
na-	ko-	mí-	sukol	-ak	-a	'I often wash myself' (2nd habitual present)
to-	ko-		kɛnd		-ɛ	'we are leaving' (present continuative)

Note: cf. Dzokanga 1979: 232

realization of other property sets. Thus, in the realization of Fula verb forms in the relative tenses, the application of the rule block realizing subject agreement ordinarily precedes that of the rule block realizing object agreement, as in the definition of (18*a*) *mball-u-mi-ɓe'* 'I helped them'; but in instances in which a first-person singular subject coincides with a second- or third-person singular (class 1) object, the application of these two rule blocks is reversed, as in (18*b*, *c*). This relationship between the two rule blocks can be accounted for by postulating a paradigm function whose evaluation involves applying the subject-agreement block before the object-agreement block in the default case but involves the opposite order of application in the realization of certain morphosyntactic property sets (Stump 2001: 149ff).

(18) *a.* *mball-u-mi-ɓe'*
help-REL:PAST:ACT-I-them:CLASS.2
'I helped them.'

b. *mball-u-maa-mi'*
help-REL:PAST:ACT-you:SG-I
'I helped you (sg.).'

c. *mball-u-moo-mi'*
help-REL:PAST:ACT-him:CLASS.1-I
'I helped him.' (Arnott 1970: appendix 15)

Examples of this type embody one kind of motivation for the postulation of paradigm functions—namely, the need to specify the different ways in which rule blocks may interact in the definition of a language's inflected word forms. There is, however, an additional type of motivation: a paradigm function makes it possible to refer to the realization of a paradigm's cells independently of the particular morphological operations by which their realization is defined; for this reason, any rule that must refer to a cell's realization without referring to the specific morphology of this realization necessitates the postulation of a paradigm function. There are several examples of this type of motivation; we discuss three of these in sections 12.7.2 to 12.7.4.

12.7.2 Head Marking

A matter of recurring interest in the morphological literature is the question of whether morphological expressions, like phrases, have heads. This question has been answered in different ways by different people. Our view is that of Stump (1993*a*, 1995, 2001): that a morphological expression is HEADED if and only if it arises through the application of a category-preserving rule of word formation. A CATEGORY-PRESERVING rule of derivation or compounding is one which allows one or more morphosyntactic properties of a base to persist as properties of its derivative. Thus, the Sanskrit rule producing preverb–verb compounds is category-preserving since it applies to verbs to yield verbs: *vi* 'away' + *gam* 'go' (v.) → *vi-gam* 'go away' (v.).

Morphological HEAD-MARKING is the inflection of a headed morphological expression on its head; thus, the Sanskrit preverb–verb compound *vi-gam* exhibits head-marking because it inflects on its head *gam*: *vy-a-gacchat* 's/he goes away'. Interestingly, not all headed morphological expressions exhibit head-marking; in Breton, for example, headed derivatives in *-ad* '-ful' inflect at their periphery: *tiad* 'houseful' (← *ti* 'house' + *-ad*), plural *tiadoù*, **tiezad* (cf. *tiez* 'houses'). Whether or not a headed morphological expression exhibits head-marking is determined by the category-preserving rule by which it arises. WORD-TO-WORD rules are category-preserving rules that give rise to headed expressions that exhibit head-marking; ROOT-TO-ROOT rules are category-preserving rules that give rise to headed expressions that do not exhibit head-marking. Thus, the Sanskrit rule of preverb–verb compounding is a word-to-word rule; the Breton rule of *-ad* suffixation is a root-to-root rule.

In PFM, the relation between word-to-word rules and head-marking is captured by means of the universal principle in (19). As Stump (1995, 2001: ch. 4) shows, this principle entails both empirical generalizations in (20); for this reason, it is preferable to approaches that attribute head marking to feature percolation or to head operations (inflectional operations which are stipulated as applying to a headed expression's head), which fail to account for these generalizations.

(19) **Head-Application Principle**
If a headed morphological expression x_2 arises from a morphological expression x_1 through the application of a word-to-word rule r such that $x_2 = r(x_1)$, then for each cell $\langle \mathrm{x}_1, \sigma \rangle$ in x_1's form-paradigm and its counterpart $\langle \mathrm{x}_2, \sigma \rangle$ in x_2's form-paradigm, $\mathrm{PF}(\langle \mathrm{x}_1, \sigma \rangle) = \langle y, \sigma \rangle$ if and only if $\mathrm{PF}\,(\langle \mathrm{x}_2, \sigma \rangle) = \langle r(y), \sigma \rangle$.

(20) *a.* **The Coderivative Uniformity Generalization**
Headed roots arising through the application of the same category-preserving rule are alike in exhibiting or in failing to exhibit head marking.

b. **The Paradigm Uniformity Generalization**
Roots that exhibit head marking do so categorically, throughout their paradigm of inflected forms.

The definition of the Head-Application Principle must refer to the realization of a paradigm's cells independently of the particular morphological operations by which their realization is defined; it therefore provides additional motivation for the postulation of paradigm functions in morphological theory.

12.7.3 Periphrasis

Much recent work suggests that periphrasis is a kind of morphological exponence; see Börjars, Vincent, and Chapman (1997), Sadler and Spencer (2001), Ackerman and Stump (2004), and Stump (to appear). Accordingly, we assume that in instances of PERIPHRASIS, the realization of a cell in some paradigm consists of two or more words. Consider, for example, the second-person past forms of the Eastern Mari verb KOL 'die' in Table 12.15: the affirmative forms are synthetic, but the negative forms are periphrastic, consisting of KOL's affirmative gerundial stem *kolen* together with a negative, present-tense form of the copula UL. Like many instances of periphrasis, those in Table 12.15 are non-compositional: for instance, the morphosyntactic properties associated with the periphrase *kolen omə̂l* 'I did not die' are not the sum of those associated with its individual parts; in particular, neither *kolen* nor *omə̂l* has a past-tense property. Ackerman and Stump (2004) argue that the realization of negative second-person past forms in Eastern Mari involves a rule of exponence that applies to a form cell ⟨X,{TNS:2past, POL:negative, ...}⟩ to produce a periphrase consisting of X's affirmative gerundial stem combined with $\mathrm{PF}_{\mathrm{Mari}}$(⟨UL, {TNS:present, POL:negative, ...}⟩); because this rule must refer to the realization the auxiliary UL independently of the particular morphological operations by means of which its realization is defined, it provides additional motivation for the postulation of paradigm functions. The same is true of many rules of periphrastic realization.[11]

12.7.4 Paradigm Linkage

By assumption, a paradigm function yields the same value when applied to a content cell as when it applies to that cell's form correspondent (section 12.6). For this reason, the rules of paradigm linkage in a language can be formulated as

[11] The recognition that periphrasis is a form of morphological exponence gives rise to a new conception of morphology: a language's morphology can no longer be seen merely as a system defining that language's individual word forms; instead, it must be seen as defining that language's paradigms, some of whose cells are realized as synthetic expressions (as in the case of Latin *laudor* 'I am praised') but others of which might be realized as periphrases (as in the case of *laudātus sum* 'I have been praised'). An important issue for this conception of morphology is that of distinguishing true periphrases (those defined by a language's morphology) from ordinary, syntactically defined word combinations; see Ackerman and Stump (2004) for a discussion of some relevant criteria.

Table 12.15 Second-past realizations of the Mari *em*-conjugation verb KOL 'die' (Eastern dialects)

		Affirmative	Negative
Singular	1	kol-en-am 'I died'	kolen omə̂l 'I didn't die'
	2	kol-en-at	kolen otə̂l
	3	kol-en	kolen oγə̂l
Plural	1	kol-en-na	kolen onal
	2	kol-en-da	kolen oδal
	3	kol-en-ə̂t	kolen oγə̂tə̂l

Source: Alhoniemi 1985: 110,116

clauses in the definition of that language's paradigm function—specifically, as those clauses defining its evaluation when it applies to content cells. For instance, the default rule of paradigm linkage in (5) might be reformulated as in (21); the Latin rule of paradigm linkage in (6*a*) might be reformulated as in (22); and so on. This way of formulating rules of paradigm linkage eliminates the need to define relations of form correspondence independently of the definition of a language's paradigm function. Because these formulations must make reference to the shared realization of form cells and content cells without referring to the specific morphology of this realization, they provide additional motivation for the postulation of paradigm functions in morphological theory.

(21) **The universal default rule of paradigm linkage**
Where R is L's root, $PF(\langle L,\sigma\rangle) = PF(\langle R,\sigma\rangle)$

(22) Where L is a deponent verb having R as its root,
$PF_{Latin}(\langle L,\{active\ldots\}\rangle) = PF_{Latin}(\langle R,\{passive\ldots\}\rangle)$

12.8 The Centrality of Pāṇini's Principle

A theory of rule interaction is not well served if the outcome of any given interaction is not predictable on principled grounds. That is, the more a theory relies on outcomes imposed by stipulation, rather than having outcomes follow from more general, predictive principles, the less highly valued that theory of rule interaction should be. Pāṇini's principle has a long history in linguistic theorizing, having played a central role in the metatheory of the pre-eminent grammarian of

Classical Sanskrit whose name it bears. According to this principle, competition between two applicable rules is resolved in favour of the narrower rule (i.e. that rule whose domain is a proper subset of the other rule's domain). Later instantiations of this principle have been invoked by Anderson (1969, but cf. 1986) and Kiparsky (1973) and popularized in modern times as the so-called Elsewhere Condition.

Paradigm Function Morphology relies on the original Pāṇinian insight, avoiding later redefinitions that introduce caveats and riders that weaken the overall predictiveness of the principle. In PFM, the claim is (as mentioned above) that if a rule block is invoked in the definition of a cell's realization, the narrowest applicable rule in that block will apply to the exclusion of all other rules in the same block. Just in case there is no explicit realization rule in the block that applies, the Identity Function Default (16) applies instead. PFM makes the strong claim that Pāṇini's principle is sufficient, in every case, to decide the evaluation of each block of realization rules; this claim is the PĀṆINIAN DETERMINISM HYPOTHESIS (Stump 2001: 62ff).

In order to identify the narrowest applicable rule in a block, it is necessary first to select those rules in the block that are indeed applicable in the realization of the cell in question, and then to determine which of those rules is the narrowest. (Inapplicable rules are naturally irrelevant to the definition of a cell's realization.) Both the applicability and the relative narrowness of a given realization rule are determined with reference to two fundamental aspects of its formulation: the rule's PROPERTY-SET INDEX (represented as τ in schema 11), which identifies the set of morphosyntactic properties realized by the application of the rule; and its CLASS INDEX (represented as C in schema 11), which identifies the inflection class of the forms to which the rule applies.

Given a realization rule r in the format '$X_C, \sigma{:}\,\tau \rightarrow Y$', the applicability of r to a form–property-set pairing $\langle X, \sigma \rangle$ is determined (*a*) by comparing the indexed property set τ to the fully specified property set σ appearing in $\langle X, \sigma \rangle$, and (*b*) by establishing the relationship between the indexed inflection class C and the expression X appearing in $\langle X, \sigma \rangle$. In order for r to be applicable to $\langle X, \sigma \rangle$, σ must be an EXTENSION[12] of τ and X must be a member of C. If τ includes any property not included in σ or if C excludes X, then r is inapplicable to $\langle X, \sigma \rangle$. If two rules r_1, r_2 belonging to the same rule block are both applicable to $\langle X, \sigma \rangle$, then the relative narrowness of r_1 and r_2 is determined by comparing their property-set indices and their class indices: if r_1 and r_2 have the same class index but the property-set index of r_1 is an extension of that of r_2, then r_1 is narrower than r_2; if the class designated by r_1's class index designates a subset of that designated by r_2's class index, then r_1 is narrower than r_2. In either instance, the narrower of the two applicable rules applies to the exclusion of its competitor, in accordance with Pāṇini's principle.

[12] For present purposes, an extension can be thought of as a superset; for a more precise definition, see Stump (2001: 41).

Note that the "winning" rule in such instances is not necessarily narrower than its competitors with respect to both its property-set index and its class index; indeed, our formulation of narrowness allows the property-set index of a losing rule r_2 to be an extension of that of the winning rule r_1 if the class designated by r_1's class index is a subset of that designated by r_2's class index.

But what of the logical possibility that two rules belonging to the same rule block might both be applicable to $\langle X, \sigma \rangle$ but might be such that neither is narrower than the other? In that case, Pāṇini's principle would logically fail to resolve the competition between the two rules. Our assumption is that instances of this sort are excluded by a universal well-formedness condition on the constitution of inflectional rule blocks; see Stump (2001: 23f, 73ff). This assumption makes it possible to maintain the Pāṇinian Determinism Hypothesis, according to which a rule's applicability and its relative narrowness always suffice to determine whether it participates in the realization of a given cell; under this hypothesis, there is never any appeal to stipulated, unprincipled, or extrinsic ordering of realization rules.

The Pāṇinian Determinism Hypothesis is a more parsimonious conception of the resolution of rule competition than is assumed in other current morphological theories. In DM, the closest thing to a rule block is a list of vocabulary items that are in competition insofar as they realize specifications of the same features; the vocabulary items in a "rule block" of this sort do not necessarily belong to the same position class, nor is their insertion necessarily disjunctive if they are semantically compatible. Thus, competition among vocabulary items in DM is regulated not only by the Subset Principle (essentially the equivalent of Pāṇini's principle) but also by extrinsic ordering relations among vocabulary items and a feature-discharge principle, according to which a feature which has been realized once cannot be realized again by a subsequent rule.[13]

12.9 The Morphology–Syntax Interface in PFM

We now return to the question of how morphology interfaces with syntax. PFM affords a word-based interface, allowing words to be inserted as units into terminal nodes. We assume that in the syntactic representations of a language, every node

[13] Embick and Noyer (this volume) make no mention of arguments against the feature-discharge hypothesis that have appeared in the literature (e.g. Stump 2001: 156–66), but tacitly acknowledge the force of such arguments by admitting that vocabulary insertion isn't always sensitive to whether a feature has been discharged; oddly, they don't seem to recognize that this admission reduces the feature-discharge hypothesis to vacuity.

belonging to a lexical category is fully specified for the morphosyntactic features accessible to it (in that language); we also assume that a terminal node X may be associated with a lexeme L provided that (*a*) L belongs to category X and (*b*) L's lexical properties (e.g. its argument structure) unify with those of node X. On that assumption, the simplest cases of lexical insertion satisfy the following condition:

(23) If a node of category X has the morphosyntactic property set σ and is associated with lexeme L, then the (synthetic) realization of the content cell ⟨L, σ⟩ is inserted into X.

For instance, if node V has the morphosyntactic property set {1 pl future affirmative} and is associated with the Swahili verbal lexeme TAKA 'want', then (23) allows the realization of the content cell (namely the word form *tutataka*) to be inserted into V. In this conception of lexical insertion, the terminal node into which a word form is inserted determines the content cell which that word form realizes.[14] The condition in (23) suffices to account for canonical instances of lexical insertion in all languages. There are, however, certain phenomena that necessitate a somewhat more complicated conception of lexical insertion; nevertheless, even these phenomena are compatible with the assumption of a word-based interface between morphology and syntax.

One type of complication arises in instances in which the realization of a cell is a combination of two or more words. We assume that the words constituting a periphrase are inserted interdependently—that, for instance, the parts of the Latin periphrase *laudātus sum* 'I am praised' are inserted into two V nodes in such a way that *laudātus* heads *sum*'s complement. Numerous questions arise for the proper formulation of this sort of interdependent insertion. How do the two V nodes participate in determining the content cell ⟨LAUDĀRE, {1 sg pres perf pass indic}⟩ which *laudātus sum* realizes?[15] Is the syntactic relation between the nodes into which the parts of a periphrase are inserted subject to universal constraints? How—if at all—does the syntactic relation between the parts of a periphrase enter into its semantic interpretation? Pending further research, we shall defer proposing specific answers to these questions; for the moment, we assume that the lexical insertion of periphrases is subject to language-specific restrictions.

A second complication for the canonical conception of lexical insertion in (23) is the incidence of shape alternations (Zwicky 1992). While there is little in the way of compelling justification for the claim that syntax is sensitive to phonological

[14] On the assumption (*a*) that the syntax of English situates the morphosyntactic property "genitive" on the final word (rather than on the head) of a genitive noun phrase, and (*b*) that the morphology of English defines a genitive realization for any word that may end a noun phrase, (23) suffices to account for the insertion of the word *else's* in a phrase such as *someone else's hat*. See Lapointe (1990), Miller (1991), Halpern (1992), and Stump (2001: 126–30) for relevant discussion.

[15] The difficulty of this question emerges particularly clearly in instances of non-compositional periphrasis.

constituents, there is abundant evidence that syntax sometimes determines a word's phonological shape; in particular, conditions on the phonological shape of word forms are sometimes imposed in the context of other specific words or in particular syntactic constructions. We assume that conditions of this kind are enforced through the distribution of SHAPE PROPERTIES, whose requirements must be satisfied, to the degree possible, by any word or constituent appearing in the relevant context. Word forms sometimes have an idiosyncratic shape set from which one or another shape is selected according to shape properties of the contexts in which they appear; the English indefinite article, for example, has the shape set {*a*, *an*}, whose members are used in preconsonantal and prevocalic contexts, respectively.[16] On the other hand, shape alternations sometimes operate more systematically, as a class behaviour. Certain (but not all) instances of Celtic initial consonant mutation may be analysed as the spelling out of shape properties distributed by particular grammatical words or constructions (see Stewart 2004 for Scottish Gaelic in particular). In Scottish Gaelic, interrogative modality is marked by an interrogative particle at the left edge of the sentence, and the first word following the particle appears in its nasalized shape: *Am bris thu e?* 'Will you break it?' (Here the initial /b/ in *bris* is pronounced as a prenasalized [^{m}b] or as a plain nasal [m].) While the preceding nasal segment can be identified as the diachronic source of the nasalizing mutation, it is not the case that a preceding nasal is a sufficient condition for selecting a word form's NASALIZED shape; instead, interrogative modality must be seen as having two expressions in this example—the interrogative particle *am* and the shape property associated with the nasalizing mutation.

The word-based morphology–syntax interface afforded by PFM is fully consistent with the observed separation of morphological structure from syntactic structure (section 12.1) and accommodates both canonical instances of lexical insertion subject to condition (23) and more complicated instances involving periphrasis and shape alternations. This is an important basis for preferring PFM to theories such as DM: because PFM accommodates a word-based interface, it is in that respect much more restrictive than a theory necessitating a morpheme-based interface, since a theory of this latter sort allows for much more extensive interaction between a word's morphological structure (as distinguished from its morphosyntactic content) and its syntactic context. In the section which follows, we show that this is very far from the only reason for preferring PFM as a theory of morphology.

[16] Although similar alternate shapes were formerly available for some possessive adjectives (*my* ~ *mine*, *thy* ~ *thine*), this alternation is restricted to the indefinite article in modern English; that is to say, a shape distinction has undergone a retreat in its generality over time, but its effects remain as a residue, limited to one word of the language (and are thus of questionable status as a synchronic rule, rather than as a stipulated fact about *a* ~ *an* alone).

12.10 The Nature of General and Specific Patterns in Morphology

Zwicky (1986) distinguishes two different ways in which linguists formulate the relation between a general pattern and a special deviation from that pattern. In what he calls the "General as Basic" (or BASI) approach, the deviation has the general pattern as its underlying form and derives from it through the application of one or more rules; in the "General as Default" (or DEFO) approach, the deviation simply excludes the general pattern, which therefore has no role at all in its formation.[17] Although the two approaches might appear to be notational variants, they are not:

> What is crucial is that a BASI analysis is *derivational*, while a DEFO analysis is *monostratal*: rules of the former type map representations into representations and so induce a series of representations, each of which is available as the locus for the statement of other generalizations (that is, as a stratum . . . at which conditions can be stated or to which rules can apply), while the rules of the latter specify a set of conditions, some of them overridden by others, but all holding for a single stratum of representations. (Zwicky 1986: 307)

PFM is resolutely a DEFO theory of morphological form—a declarative theory having neither "underlying structures" nor "derivations", whose rules are nothing more than definitions; as such, it affords a word-based interface between morphology and syntax. DM, by contrast, is just as resolutely BASI—a non-declarative theory in which words have "underlying structures" which undergo multi-stage syntactic derivations; as such, it necessitates a morpheme-based interface. Which approach is right for morphology? Zwicky observes that while

> BASI can be extended easily to give analyses for phenomena covered by DEFO, . . . no simple tinkering will extend DEFO to cover characteristically BASI phenomena, in particular feeding interactions. It follows that DEFO is the more constrained view of rule interaction within a component of grammar and so has a prior claim on our attention. That is, DEFO ought itself to be the default view of how rules work in a component of grammar, with the more powerful BASI view adopted only on the basis of evidence that DEFO is inadequate for that component. (p. 308)

No evidence has ever been presented which decisively excludes a DEFO theory of morphology such as PFM.[18] Nevertheless, proponents of DM argue that no

[17] See Pullum and Scholz (2001) for relevant discussion from a computational perspective.

[18] Without so much as a reference, Embick and Noyer (this volume) assert that "[a]rticulated Lexicalist approaches make a number of precise empirical predictions, predictions which we take to have been disconfirmed", then say nothing more on the subject. In place of this facile dismissal, we (and, we suspect, most readers) would have preferred to know which predictions are at issue and the evaluative criteria by which these predictions have been assessed; we have no doubt that the reports of lexicalism's demise are exaggerated.

justification is necessary for adopting a BASI approach to morphology; their rationale is that this move keeps the number of generative mechanisms in their theory to a desired minimum. This isn't a cogent justification, however. As a theory of inflectional morphology, there is no meaningful sense in which PFM is generative: it simply assigns morphological realizations to content cells, which we equate with terminal nodes in syntax; that is, PFM simply interprets terminal nodes as realizations. Moreover, this is true in one fashion or another of all realizational theories of inflection; only incremental theories of inflection (see section 12.2) can be seen as generative in the sense intended by Embick and Noyer.

The central argument advanced in favour of DM is the fact that in at least the simplest cases, the claim in (24) holds true.

(24) The morphological structure of a word is precisely what it is predicted to be by the operation of head-movement through a nested succession of functional categories.

But if we restrict our consideration to language's simplest cases, we miss much of the evidence that is most useful for distinguishing adequate theories from inadequate ones. And the fact is that once we move beyond the simplest cases, the claim in (24) is wildly disconfirmed—by portmanteau affixes (sections 12.6 and 12.7.1), by reversible position classes (section 12.7.1), by head marking (section 12.7.2), by syncretism (section 12.5.2), and so on. Proponents of DM must therefore resort to the postulation of a range of PF operations (rules of fission, fusion, rebracketing, local dislocation, and impoverishment) whose sole motivation is the desire to equate affix positions in a word's morphology with functional heads in syntax. But every recourse to such rules casts doubt on the leading premise that morphology is just syntax. Indeed, many morphologists feel that rules of this sort effectively render the theory unfalsifiable: if morphological patterns consistent with (24) are taken as confirming the theory but patterns inconsistent with (24) are not seen as disconfirming it (being instead attributed to otherwise unmotivated PF movements), what could possibly disconfirm the theory? Proponents of DM counter this conclusion by insisting (in Embick and Noyer's words) "that the operations that apply at PF are minimal readjustments, motivated by language-particular requirements". But this is far from clear; through a creative combination of rebracketings and local dislocations, one can, for example, permute the members of a finite string at will, and it has never been shown how the principles of DM could manage to restrict this process. (See Williams, in this volume, for discussion.)

Moreover, not even minimal readjustments of the sort countenanced in DM are needed in a DEFO theory such as PFM. Thus, consider again the Swahili examples in Table 12.13. In DM, each of the negative verb forms in Table 12.13 would have the structure in (25); in the case of the first-singular negative form *sitataka* 'I will not want', however, the POL and AGR nodes would have to undergo a fusion operation to accommodate the insertion of the portmanteau prefix *si*-, an exponent of both first-person singular subject agreement and negative polarity. In PFM, by contrast, the definition of *sitataka* involves no fusion operation at all: *sitataka* doesn't arise from an abstract structure in which polarity and agreement appear as distinct "morphemes"; instead, it is directly defined as the realization of the form cell ⟨*taka*, {1 sg neg fut}⟩. This is the better analysis, since there is no empirical evidence from either syntax or morpology that *si-ta-taka* arises from a three-prefix structure. Similar remarks hold true for a range of phenomena. In the analysis of (18*c*) (Fula *mball-u-moo-mi*' 'I helped him'), for example, DM would require a local dislocation of the object-agreement morpheme in an abstract structure such as (26); but as was seen above, the DEFO analysis of reversible position classes afforded by PFM depends neither upon any dislocation operation nor upon the empirically unmotivated assumption that *mball-u-moo-mi*' arises from an abstract representation in which object agreement follows subject agreement.[19]

(25) (POL * (AGR * (TNS * (V * √ROOT))))
(26) ((((V * √ROOT) * TNS) * SUBJ-AGR) * OBJ-AGR)

The assumption that all words have abstract morphological structures in which each of the relevant functional heads constitutes an affixal morpheme engenders a number of undesirable consequences in DM. Prominent among these is a heavy reliance on zero affixes—for plural number in *moose*-Ø, for past tense in *cut*-Ø, for past participial status in *come*-Ø, and so on. But the postulation of zero affixes in DM is suspicious. Not only are they without empirical justification (a fact proven by the possibility of dispensing with them altogether in inferential theories of morphology); they also exhibit a distribution that is different from that of any real (empirically motivated) affix. In DM, non-concatenative operations do not constitute vocabulary items, but are instead treated as effects triggered by vocabulary items. Accordingly, the assumptions of DM entail that English morphology (and that of most languages) evinces two rather amazing coincidences. First, default suffixes such as plural -*s*, past-tense -*ed*, comparative -*er* (and so on) are overridden by suffixes that are identical in their phonological form: thus, *men*-Ø, *sang*-Ø, and *worse*-Ø all have a suffix with zero phonology. Second, these zero suffixes all have the effect of triggering non-concatenative operations of apophony or stem suppletion: *man* → *men*, *sing* → *sang*, *bad* → *worse*. Again and again, DM analyses involve sets of competing vocabulary items whose default member is overridden by an affix having zero phonology; again and

[19] Besides being questionable on theoretical grounds, some of Embick and Noyer's claims are dubious at a purely observational level. For instance, in arguing that the Huave reflexive suffix -*ay* exhibits local dislocation, they assert that it is subject to a morphological well-formedness condition which requires it to appear "directly before the final inflectional affix of a verb, if any". In support of this assertion, they allege the ungrammaticality of forms such as *t-e-kohč-ay-os-on* 'we cut ourselves', attributing their data to Stairs and Hollenbach (1981). But this source doesn't actually say that *t-e-kohč-ay-os-on* is ungrammatical; in fact, Stairs and Hollenbach (1969: 40) cite the incidence of forms such as *ta-kohc-ay-os-on* 'we cut [past] each other', in which -*ay* precedes two suffixes.

again, this zero affix triggers a non-concatenative operation. DM portrays these coincidences as purely accidental, stipulating them over and over in one set of vocabulary items after another. In inferential theories of inflection such as PFM, by contrast, the affixation operations are in direct paradigmatic opposition to non-con-catenative operations. For this reason, neither of the suspicious coincidences arises: words like *men*, *sang*, and *worse* are not alike in their suffixal phonology because they have no affixes, nor are their various non-concatenative operations conditioned by the presence of any affix.

The assumption that affixes basically correspond to functional heads also leads to the expectation that a word's affix positions and its morphosyntactic features will stand in a one-to-one correspondence. While this sort of correspondence can be found in some languages, it is far from the norm. In Kabyle Berber, for example, a finite verb expresses subject agreement in three affix positions, and it agrees with respect to three morphosyntactic features, those of person, number, and gender; see Table 12.16. Yet there is no one-to-one correspondence between affix positions and features; on the contrary, the prefix *i-* in *i-wala* 'he saw' expresses third person, singular number, and masculine gender; the first suffix *-m* in *t-wala-m-t* 'you (fem.) saw' expresses second person and plural number; and the second suffix in *t-wala-m-t* expresses plural number and feminine gender.

The problems which such instances of extended and overlapping exponence present for the claim in (24) are widely recognized. But the counterevidence to (24) is in fact much more extensive than has been widely appreciated. The phenomenon of syncretism (section 12.5.2), for example, poses serious problems for maintaining the claim in (24). Proponents of DM have claimed that analyses exploiting under-specified vocabulary items and rules of impoverishment suffice to reconcile this claim with the incidence of syncretism, but they do not suffice: some types of syncretism (e.g. bidirectional syncretisms: Stump 1993b, 2001: 212ff; Baerman 2004) do not submit to either type of analysis. The phenomenon of deponency (section

Table 12.16 Completive paradigm of Kabyle Berber WALI 'see'

		Singular	Plural
1		wala-γ	n-wala
2	masc	t-wala-ḍ	t-wala-m
	fem	t-wala-ḍ	t-wala-m-t
3	masc	i-wala	wala-n
	fem	t-wala	wala-n-t

Sources: Hamouma n.d.: 79; Chaker 1983: 112

12.5.1) disconfirms the claim in (24) in the most dramatic way possible: a deponent word exhibits the morphology appropriate to a set of morphosyntactic properties which it manifestly does not possess. Non-compositional periphrasis (section 12.7.3) is similarly problematic for DM: here a periphrastic expression's morphosyntactic properties are distinct from the sum of those of its individual parts. It is perhaps not surprising that some of these phenomena have yet to figure with any prominence in the DM literature; all, however, have been shown to be compatible with the assumptions of PFM.

12.11 Conclusions

In the preceding discussion, we have identified a range of criteria for evaluating theories of morphology and its interface with syntax. Empirically, the best-motivated theory of morphology must be both inferential and realizational (section 12.3); the best-motivated theory of the morphology–syntax interface must be word-based rather than morpheme-based (section 12.1); and all else being equal, a DEFO theory is preferable to a BASI theory because of the greater restrictiveness inherent in DEFO analyses (section 12.10). By these criteria, PFM must clearly be preferred to a number of existing alternatives.

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PART III

MEANING

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CHAPTER 13

REMARKS ON COMPOSITIONALITY

JAMES HIGGINBOTHAM

I consider in this chapter a number of methodological and empirical issues surrounding the notion of the compositionality of meaning in human languages, with an eye to a proper formulation of this notion within a referential (or truth-conditional) semantics. Sections 13.1–13.3 are chiefly occupied with the empirical project. Besides interpreting compositionality within semantics proper, I consider the intertwining of compositional semantics with such matters as making provision for context dependence; the relations between syntax and semantics where human first languages are concerned; and assumptions as to the logic of the metalanguage, within which the semantics is formulated. On the critical and methodological side, in section 13.4 I argue that the requirement of compositionality is by no means trivially satisfiable (but also that it cannot of itself be grounds for rejecting accounts of meaning other than the referential). In section 13.5, I take up an account of classical opaque contexts that I have defended elsewhere, one that fails compositionality at least in a narrow sense, arguing that it is not after all vulnerable to certain classical objections, at least as these have so far been formulated.

Most of the considerations in this chapter have been presented in various public forums and colloquia over the past three years or so. Besides being appreciative of comments and criticisms that I received from the audiences at these occasions, I am grateful to Paul Horwich for sending me his draft discussion, considered in section 13.4, and to Wilfrid Hodges for correcting my misunderstanding of the point of his examples of non-interchangeability.

13.1 Preliminary Distinctions: Semantics and Pragmatics

The question of the compositionality of human language, and more generally of the nature of the computation of semantic values from syntactic and lexical structures, including prosodic features of speech, is at once highly abstract and, once definite hypotheses are in place, robustly empirical. According to the view advanced here, which is intended to be in harmony with recent empirical studies, the thesis that the semantics of human first languages is compositional should be taken as imposing a locality requirement on the computation of semantic values. So understood, the hypothesis of compositionality may form part of a restrictive theory of semantics, intended to contribute to an account of human linguistic competence, and first-language acquisition.[1]

Compositionality, in a very broad sense, holds for a given language if the interpretation of every sentence (or discourse) in that language is determined by the interpretations of its parts, and the way they are combined. Understood in this way, however, the compositionality thesis verges on the trivial. For, there being nothing else but the parts of a sentence or discourse, and the way they are combined, to *give* its interpretation, or the linguistic constraints on its interpretation, compositionality simply follows. The compositionality thesis is not entirely trivial, however: it presupposes that there are constraints on the interpretation of a sentence or discourse in a proper, context-independent sense. By way of preliminary, therefore, I consider in this section some aspects of the division of labour between the semantic, context-independent and the pragmatic, context-dependent elements of meaning, turning afterwards to the formulation of compositionality as a restrictive empirical hypothesis.

Suppose, as suggested in Robyn Carston (2004), that "what was said" in an utterance using demonstratives or indexicals is underdetermined by linguistic form. On this view, you do not know what was said by an utterance of, say, *I am standing* unless you know (in some appropriate sense) what time it is, and who (again, in some appropriate sense) is speaking. Even so, we may ask whether the semantics for the sentence *I am standing*, or particular utterances thereof, is compositional. Suppose that what English semantics delivers for a particular utterance u by speaker s of *I am standing* as a sentence of English is just that, if s uses 'I' to refer to herself, and uses the present tense to refer to the actual time $\tau(u)$ of u, then s speaks truly just in case there is an event of s's standing whose time

[1] The path suggested follows more or less directly the interpretations of syntax and phonology first suggested by Chomsky (1965, 1975). The view I take here of semantics, however, differs from Chomsky's in several respects.

surrounds the actual time of u (or, in some cases, another contextually fixed time).[2] Assuming that the antecedent of this complex conditional is satisfied, what is to be known about the truth conditions of u is as in (1):

(1) $(\exists e)\ [\tau(e)\approx\tau(u)\ \&\ \text{stand}(s,e)]$

with u and s being assigned to the utterance and speaker in question. (So, for example, the existential closure of (1) is what you or I would know, assuming the antecedent, about the truth conditions of an overheard utterance of *I am standing* coming from just outside a closed door.) If we take the semantics for *I am standing* as given above, then compositionality is not undermined, whatever we may say about "what is said". The first person and the present tense combine in an orderly way to deliver the context-independent aspects of the interpretation delivered by (1), or its existential closure.

Besides the examples of demonstratives and indexical expressions, there are plenty of other cases where the semantics closes off with a free variable which context, somehow, fills in. So, to take some representative if old illustrations, expressions such as those in (2)–(4) all call for contextual supplementation:

(2) John's belief

(3) John finished a cigarette.

(4) One more can of beer and Mary will leave.

John's belief can be the belief that he has, or the belief he relinquished, or the one he is to inculcate in the Pope, and so forth. John can "finish" a cigarette by finishing smoking it, or rolling it, or using it as an inkblot. Expressions like (4) are conditionals, or statements about what happens when or after. Thus (4) could be understood as, 'After she drinks one more can of beer Mary will leave', but equally as, 'If you throw one more can of beer at the giraffe then Mary will leave'. The semantics for these delivers (5)–(7), respectively:

(5) the x: belief(x) & R(x,John)

(6) finish(John,φ(a cigarette))

(7) if φ(one more can of beer), then Mary will leave

To use an old terminology, (2)–(4) all behave as though they were "non-recoverable deletions", where the deleted material, marked by the free variables R and φ, is contextually recovered, if all goes well.

Other examples to the same effect include (8) and (9):

(8) It's raining.

[2] This formulation adheres to the account in Higginbotham (1996), following Burge (1974). I note in passing that the account has the effect of ruling out what David Kaplan called "monsters"; that is, indexical and demonstrative expressions that shift their reference in embedded contexts.

(9) What did John do with the chopsticks?
He ate the rice, but he won't do it again.

In (8) no place is specified, but a place or places can be intended, and intended to be understood as intended; and in (9), suppose, the speaker may intend the pronoun *it* to mean *eat rice with chopsticks*, something which is not the meaning of any constituent in the dialogue. More complex examples can be given, and recently there has been considerable discussion over whether one should apply the semantics for instance in (9) to a representation that is syntactically articulated according to clear principles, or should leave it in the pragmatic domain. For the purposes of this chapter, however, it does not matter. The formal semantic theory cannot do everything; but that does not impugn the results that it does deliver.

With the above questions of context dependency out of the way, or anyway put to one side, we are back where we started. Semantics must be broadly compositional, in the sense that the properties of a syntactic structure (including its lexical items) set autonomous constraints on the interpretation of any utterance of it. For all that has been said, however, these constraints could be set in any old way. I turn, then, to the question of how to restrict compositionality in such a way that it becomes an empirical hypothesis.

13.2 Compositionality as Locality

The autonomy of semantics, indeed a kind of existence proof for the subject, consists in this: that the space of interpretations of a linguistic form is unaffected by contextual considerations, degree of plausibility that it might be meant, and so forth, so that (*a*) the availability of elements of this space remains even when they would be ridiculous things to say, and (*b*) interpretations that the semantics rules out do not become available merely because they are plausible. Not only that, but in case (*a*), an ordinary native speaker can see upon reflection that the ridiculous elements *are* in fact available as interpretations, and in case (*b*) *cannot* make them available. The question of what properly lies in semantics is the question of the extent of this autonomous domain.

Suppose then that semantic interpretation, or, more precisely, those aspects of interpretation that are strictly determined by linguistic form, takes for its input standard structures, trees with labels on the points, and with certain relations between the points. Let **T** be such a structure. What is it for the semantics of **T** to be "compositional" in something other than the trivial sense? And what is it for the semantics of a whole language to be compositional?

We consider local compositionality as a property of grammars **G**, in effect stating that there is a function f_G such that for every syntactic structure **T** (not necessarily grammatical) licensed by **G**, and every constituent X in **T**, where X immediately dominates just the constituents $Y_1, \ldots, Y_n$, these elements themselves being possibly complex, and X possibly embedded in larger structures up to **T** itself, the family $M(X)$ of meanings borne by X in **T** is the result of applying $f_{\mathbf{G}}$ to the n+1-tuple $(F_X, (F_1,M(Y_1) \text{ in } \mathbf{T}), \ldots, (F_n,M(Y_n) \text{ in } \mathbf{T}))$, where F_X is the bundle of formal features on the point X, and F_i for each i is the bundle of formal features associated with Y_i. Formally, we have (10):

(10) $(\exists f_{\mathbf{G}})\ (\forall \mathbf{T})\ (\forall X \text{ in } \mathbf{T})\ [M(X) \text{ in } \mathbf{T} = f_{\mathbf{G}}(F_X, (F_1,M(Y_1) \text{ in } \mathbf{T}), \ldots, (F_n,M(Y_n) \text{ in } \mathbf{T}))]$.

If the meanings of lexical items are invariant, and the formal features of no complex X are also those of a lexical item, then the qualifier "in **T**" to the various $M(X)$ can be dropped. I will assume both of these propositions. The invariance of a lexical item is, one would expect, part of what is intended by calling it *one* lexical item in the first place; and the formal features of lexical items can always be distinguished, say by marking them and no others as "+lexical".

We can impose further conditions on compositionality by supposing that meaning is DETERMINISTIC, that is to say that for each point X in a tree **T**, X has just one meaning. The assumption of determinism has immediate syntactic consequences inasmuch as ambiguities of scope will have to be syntactically represented. Moreover, their representation cannot take any simple form: at least for liberal speakers like me, it is pretty easy to construct, for any n, a sentence having scope-bearing elements $A_1, \ldots, A_n$ such that, if we go by apparent surface constituency, A_j is within the scope of A_i iff $i < j$; but from the point of view of interpretation A_j is within the scope of A_i iff $j < i$. (Of course, intuitions give out as n gets bigger: but even simple examples with $n = 4$, such as *Everybody didn't answer many questions about each book*, meaning that for each book, there are many questions about it that not everybody answered, suffice to make the point.) I will assume determinism in what follows, and, I hope without loss of generality, that relative scope is determined in one standard way, by c-command at the level LF of Logical Form in Chomsky's sense.[3]

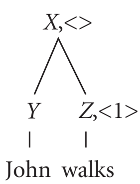
Thus far I have spoken fast and loose about the meaning or range of meanings $M(X)$ of a point X. To spell out further what is meant: I assume, as in other work, that what is crucial is not "meanings", but rather what it is to know the meaning of an expression. As is customary, even if surely an idealization, we may assume that knowledge of the meaning of an expression takes the form of knowledge of a certain condition on its reference (possibly given various parameters) that is uniform across speakers; that is, that we can sum up what is required to know the meaning of an expression in a single statement; and that we do not adjust that

[3] The theory involves the raising, by adjunction, of scope-bearing elements. See for instance Heim and Kratzer (1998) and references cited there.

statement so as to reflect, for instance, the different demands that may be placed upon speakers, depending upon their age, profession, or duties.[4]

The form that conditions on knowledge of reference will take varies depending upon the categories of lexical items, and the categories of X, and $Y_1, \ldots, Y_n$ in complex structures as above. Assume for simplicity that $n = 2$. For any tree **T** and any point P in **T**, let **T**(P) be the subtree of **T** with root P. Given **T**, with X, Y, and Z points in **T** such that X immediately dominates just Y and Z, we have subtrees **T**(Y) and **T**(Z) of **T**, with the root Y of **T**(Y) having formal features $F(Y)$, and the root Z of **T**(Z) having formal features $F(Z)$. **T**(X) with formal features $F(X)$ is the result of combining, or "merging", **T**(Y) and **T**(Z). For this we put **T**(X)=**T**(Y)–**T**(Z). For example (ignoring tense): suppose Y = *John*, Z = *walks*, and our tree **T**, in relevant detail, looks like this:

(11)



where the sole formal feature of Z is the thematic grid represented by $<1>$, announcing that Z is a one-place predicate, and the sole formal features of X are the indication of discharge of the θ-position $<1>$ by the θ-marking of Y by Z, and the empty thematic grid $< >$ appropriate for a closed sentence. We may then rehearse the familiar litany of referential semantics, the crucial combinatorial statement being that X (strictly, the tree **T**(X) with root X) is true just in case the reference of Y satisfies Z. Assuming as we do that the speaker knows (at least) that *John* refers to John, and that *walks* is true of just the things that walk, we derive what the speaker certainly knows from knowing that *John walks* is a sentence, namely, that it is true just in case John walks; but also, in further elaboration of the theory, somewhat more than this, as for instance that it is a consequence of this sentence that someone walks.

In a semantics that purports to characterize, in a finite theory, what we actually know about language, the elements that were called the meanings of constituents above are replaced by statements giving what someone knows who knows the meanings of those constituents. So I am assuming here, as in other work, that the questions of the theory of meaning are, first: what does someone know who knows the meaning of an expression? and: how was that knowledge come by? A further specification about knowledge of meaning is: what one knows when one knows the meaning of an expression must include any conditions on its reference

[4] Knowledge of meaning includes, besides knowledge of conditions on reference, also conditions on usage, colloquiality, and other matters, here put aside.

that one is expected to know. In a simplified form, the proposal would be that for every expression, simple or complex, there is a target condition that constitutes knowledge of conditions on reference. Our first problem, then, is the systematization of the whole family of target conditions in terms of a finite theory that is faithful to the speaker's organization of their linguistic knowledge. The second problem is the embedding of various systematizations such as might be preferred for this or that human language, or language fragment, within an account of the basis for the acquisition of language, on the basis of perceptual and other experience.

Research on neither of the above questions proceeds in isolation from the other. The situation is typically more theory-laden even than I have suggested, however, because the very formulation of target conditions requires substantial, even if tentative, hypotheses about such matters as the logic of the metalanguage, the nature of syntactic and lexical information, the distinction between what is linguistically represented and what is drawn upon in context, and so forth. Furthermore, in looking at language in the first instance as a system of knowledge, we are supposing that a more direct assault on human language, in terms of conditions on observed or hypothetical use, is, if not beyond our grasp, at least properly held in abeyance. Our linguistic capacities may fruitfully be seen as stemming from a grasp of an organized system of knowledge, brought to bear in behaviour, but standing behind it, in the way that, say, my knowledge of the geography of Manhattan is brought to bear as I make my way around town. With this much to hand, I turn to some entanglements with syntax and the logic of the metalanguage taken to express the speaker's knowledge.

13.3 Interacting Factors

13.3.1 Meaningfulness and Grammaticality

The model for some recent discussions of compositionality, taken from formal language theory and indebted to the work of Richard Montague, may be misleading with respect to ongoing linguistic practice.[5] Thus Hendricks (2001), in a recent discussion carrying on that tradition, commences from a point of view that takes the syntactic inputs to be given by a term algebra over some alphabet; the interpretation of expressions not generated by the algebra is not considered. In a similar vein, Hodges (2001) adopts the axiom (p. 11) that only *grammatical*

[5] See especially Montague (1974), and particularly his discussion of the mappings between syntax and semantics, where the inductive definitions of the syntax are matched by recursive clauses in the semantics.

expressions are meaningful. But it would be a mistake to adopt this axiom for natural languages. Hodges gives the quartet (12)–(15) (taken from Gazdar, Klein, Pullum, and Sag 1985):

(12) It is likely that Alex will leave.

(13) It is probable that Alex will leave.

(14) Alex is likely to leave.

(15) *Alex is probable to leave.

I am not sure what moral Hodges intends to draw from the example; perhaps simply, and contrary to Tarski, a counterexample to the thesis that synonyms must be grammatically interchangeable. But any semantic consequences of (12)–(15) would seem to require the premiss that (15), being ungrammatical, is not meaningful, or anyway is excluded from consideration. I think this would be the wrong move: ungrammatical as it is, (15) is perfectly meaningful, and in fact synonymous (nearly enough) with (14). All that is going on is that *likely*, but not *probable*, does not admit raising, or syntactic movement from the subject of the complement infinitive to the higher subject position. Nothing about compositionality is at stake.

There are many similar examples. One discussed in Pustejovsky (1995) is given in (16)–(19):

(16) The beast ate the meat.

(17) The beast devoured the meat.

(18) The beast ate.

(19) *The beast devoured.

The pair (16) and (17) are close to synonymous, *devour* differing from *eat* at most in manner. But whereas (18) is routine English, (19) is out. What could be inferred from this fact? Nothing much, or so I would suggest. The verbs *eat* and *devour*, considered as single words, are not synonymous, because *devour* is inherently telic, being an accomplishment verb in Zeno Vendler's terminology; but *eat* is not. For this reason we have *the beast ate at the meat*, but not **the beast devoured at the meat*, and *John ate up the apple sauce*, but not **John devoured up the apple sauce*. The ambiguous behaviour of *eat* is a matter for discussion, with Krifka (1992), for instance, arguing for a single, underspecified lexical entry, whereas Higginbotham (2000) took the view that the V itself was ambiguous. On either view there is still an issue in the distinction between *eat* and *devour*, because (18) admits a telic interpretation (as shown, for example, by the acceptability of *John ate in ten minutes*), and the V of (16) is of course telic. Stripping away as irrelevant to our purposes the haze of usage or colouration that distinguishes the verbs, as for instance that *devour* is a learned word whereas *eat* is not, we are left with something of a defensible synonymy between *devour* and telic *eat*. The distinction between them is just that telic *eat* admits object deletion (like *read* and *study*), whereas *devour* does not (like *wear* and *arrange*). Again, nothing about compositionality is affected by the examples.

To put the matter in general terms, we might say that, where Tarski was interested in a conception of syntactic and semantic categories for languages for which semantic interchangeability implied syntactic interchangeability, it turns out that English (or other human first languages) do not have this property. The property converse to Tarski's would be: whenever expressions are syntactically interchangeable, they generate meanings differing only in the contribution that those expressions themselves make. One reading of Chomsky's famous example, *colourless green ideas sleep furiously*, could be taken to challenge this principle, as it appears to show that something "meaningless" can be freely, and grammatically, generated from the syntax: for we can interchange expressions in the example so as to arrive at, say, *colourful green gremlins perspire freely*, which evidently has a perfectly robust meaning. But a referential semantics would not draw this conclusion. Chomsky's example is "meaningless", no doubt, in several senses. But semantically opaque it is not (nor, as I understand him, did Chomsky argue it was). In sum, it appears that we should allow into the semantics both expressions that are not grammatical (owing to purely syntactic factors) and those that, while not at all sensible, are grammatically fine and feed the same principles of interpretation that apply in other cases. The principles of compositionality remain open for discussion as before, and are not prejudiced by either case.

13.3.2 Combinatorial Principles

The formulation in section 13.2 of local compositionality left entirely open the nature of the principles that deliver the meaning of superordinate X in terms of the meanings of subordinates Y and Z, and such formal features as happen to be around. Constraints on these principles, such as those suggested in Higginbotham (1985), will interact with whatever conditions there may be on the logic of the metalanguage. Roughly speaking, if the logic is comparatively weak, then extra information must be imported; and if it is strong, then more uniform, but possibly less informative, principles can be employed.

A semantic principle that has been suggested, for instance in the textbook by Heim and Kratzer (1998) is that the modes of semantic combination should be restricted to just function and argument. In their setting, however, which assumes a logic of order ω, this principle, for a language that is locally compositional, can always be satisfied. For, suppose that $\mathrm{T}(X)=\mathrm{T}(Y)\text{–}\mathrm{T}(Z)$, and that $M(X) = f_G(F,M(Y),M(Z))$, as above. Then the formal features F together with f_G give us some function, f_{127} say, so that where $M(Y) = P$ and $M(Z) = Q$, $M(X) = f_{127}(P,Q)$. We may then define a function P^* by: $P^*(Q) = f_{127}(P,Q)$, and set $M(Y) = P^*$ instead of P. (Carried out recursively, this will mean adjusting interpretations all the way down to the leaves of the tree with root Y.) The proposed principle therefore does not add anything, being a consequence of the logic employed in the metalanguage.

The construction of P^* depends upon the availability of functions of higher order, so that if these are not available the principle acquires force. Then, however, it is false, even for trivial examples such as adjectival modification: in an expression such as *black cat*, neither element is an argument of the other, both being simple predicates. It is also false for other cases where what Otto Jespersen called the "nexus" between constituents is inexplicit, as it is for instance in explanatory, purposive, resultative, or possessive contexts, illustrated in (20)–(23).

(20) Having unusually long arms, John can touch the ceiling. [explanatory nexus]

(21) I bought bones [*O* [PRO to give *t* to the dog]]. [purposive nexus]

(22) John ran himself ragged. [resultative nexus]

(23) John's boat [possessive nexus]

These combinatory types form an inventory that one may hope to be universal, and fixed in advance for the learner of a first language.

It would take us too far afield to consider what evidence might be brought to bear in favour of an extension of the logic of the metalanguage beyond the first order. In any case, the matter must be argued for.

13.3.3 Syntactic Relations

The notion of local compositionality may be extended so as to take account of the fact that the features of a syntactic structure include not only the formal features of points in that structure (these are, in effect, predicates true of the points: for the earliest exposition, see Chomsky 1975: 177 on the "*X* is a *Y*" relation) but also relations between the points. Here we confine the discussion to a particular case, where the relations in question are all binary, and may be thought of as relations of IMMEDIATE ANTECEDENCE, that is to say, a relation of antecedence $A \rightarrow B$ where there is no C such that $A \rightarrow C \rightarrow B$, and where A is to be thought of as inheriting its (entire) interpretation from B. The elements having antecedents are to be taken as free variables; in other words, in structures in which their antecedents have so to speak not yet appeared, they will have values on *assignments* of some appropriate sort.[6]

[6] If we are dealing with routine cases of pronominal anaphora, as in *John loves his mother*, with *his* anaphoric to *John*, then the value of the pronoun *his* on an assignment can be any object. But in VP-deletion, as for instance in *John's mother doesn't Ø*, the interpretation is ultimately recovered through

One way of thinking of the syntactic trigger for anaphoric interpretation is through assignment of INDICES to anaphoric and other elements, as originally suggested in Chomsky (1965); or, perhaps more perspicuously, the assignment of equivalence relations to the points in the syntactic tree. On this procedure, an assignment will be an assignment of values to a given index; the semantics will then be constrained through a system of equations, and we may call an assignment "appropriate" for an index just in case the value of all elements with that index is the same. So in *John*$_i$ *loves his*$_i$ *mother*, for example, the reference of *John*$_i$ on any assignment is John; that of *his*$_i$ is whatever the assignment $\boldsymbol{a}$ assigned to i; and the condition to be satisfied for appropriateness is that $\boldsymbol{a}(i)$=John.

The indicial view, however, does not distinguish between those cases where A and B are intended to have the same reference (and meant to be understood as so intended) from those cases in which it is not intended that A is to have the reference of B. As Howard Lasnik originally observed, the distinction between these cases correlates with the availability of "sloppy identity", that is, with the distinction between *His father hates John, but not Bill*, or *His father hates John, but the man doesn't hate Bill*, where the reference of *his father* must be preserved (so the identity is rigid), and *John hates his father, but Bill doesn't*, or *John hates his father, but Bill doesn't hate him*, where the reference may shift (so the identity is flaccid). (Or try *USC loves its football team, while MIT is indifferent to it.*) On the indicial view, it is straightforward to stipulate that an assignment be appropriate; and the stipulations can be carried out piecemeal, moving interpretively up the tree, as originally outlined in work by Jon Barwise from some years ago (Barwise 1987). But if anaphoric relations are asymmetric, then we shall want to track, for instance in the case where Z contains an element whose immediate antecedent lies in Y, the effect on the meaning of Z as it enters the construction $X=Y–Z$. It may be a formal feature of a point P in $\mathbf{T}$ that it has an immediate antecedent somewhere in $\mathbf{T}$: this much "global lookup" has to be tolerated so as to distinguish anaphoric from non-anaphoric uses of the same forms. But as the antecedent may be arbitrarily far away from P, it may not be visible, not only to P itself, but also to any number of constituents properly containing P. Hence, appropriateness of assignments must be tracked independently, as meaning is built up. For the case we are considering, it appears sufficient to specify (24):

(24) $\boldsymbol{a}$ is appropriate for $\mathbf{T}=\mathbf{T}_1–\mathbf{T}_2$ iff (i) $\boldsymbol{a}$ is appropriate for $\mathbf{T}_1$ and $\mathbf{T}_2$, and (ii) for every α in $\mathbf{T}$ having an immediate antecedent W in $\mathbf{T}$, $\boldsymbol{a}\,(\alpha)=M(W)$.

an expression. As Tanya Reinhart pointed out long ago, we must be able to distinguish *John wants to become a doctor, but his mother doesn't want that* (i.e. doesn't want him, or perhaps herself, to become a doctor) from *John wants to become a doctor, but his mother doesn't Ø*, whose second clause means only that his mother does not want to become a doctor. To put it another way, VP-deletion appears to be a "copying" rule, and it is perhaps simplest if feasible to suppose that copying is done before interpretation comes along.

Rule (24) does not exclude some syntactic conditions that generally prohibit anaphoric relations; for example, the condition that an anaphoric element cannot seek its antecedent within its own c-command domain. Nor does it rule out cases of "circular reference". Examples such as *His wife saw her husband* receive truth values on appropriate assignments, specifically those ***a*** that assign to *his* whatever the reference of *her husband* is on ***a***, at the same time assigning to *her* on ***a*** whatever the reference of *his wife* is on ***a***. However, the reference to assignments being ineliminable, no truth value can be determined; perhaps this will suffice without modifying the rule. We may construct hypothetical languages for which the appropriateness of an assignment of values to variables was not governed by the elementary rule (24). So it may be suggested that (24) is an appropriate counterpart to compositionality, expressing the local compositionality of anaphora.

In concluding this section, I anticipate the discussion of classical opaque contexts in section 13.5. Dummett (1973), with reference to Frege, considers anaphora in cases like (25):

(25) John thinks Mary is a spy, but she isn't.[7]

where *she* picks up its interpretation from *Mary*. On Frege's view, the term *Mary* has indirect reference in (25); hence the anaphor *she*, if simply picking up its reference from its antecedent, should refer to that as well. But of course it refers just to Mary. On a view such as that in Higginbotham (1986), we would resolve the issue this way: the expression *Mary* has one value considered within the complement clause *Mary is a spy*, namely, Mary herself, and another when considered as an element of the whole sentence *John thinks Mary is a spy*, namely, the word *Mary*, understood as if the speaker had used it. To get the right result, we have to look at the value of *Mary* within the *least* element containing it (where compositionality holds); that is, its own clause. In a certain sense, the anaphora is then non-compositional, because it is not the meaning pure and simple but the relativized meaning that must be consulted. But of course the account was going non-(locally)-compositional anyway, and the non-compositionality of the anaphora follows from this.[8]

In this section I have endeavoured to disentangle some questions of local compositionality from certain interferences in syntax and the logic of the metalanguage, and to extend the conception so as to allow at least a special case of linguistic relations, with or without syntactic indices. Arguments, however, have been offered to the effect that, if local compositionality is true, then it admits of simple statement, without the referential detail. I turn in the next section to (a continuation of) one discussion of these.

[7] I am indebted here to discussion with Gabriel Segal.

[8] The relativization is explicit in Higginbotham (1986). See also the discussion in Larson and Ludlow (1993).

13.4 Is Compositionality Trivial?

In an earlier article (Higginbotham 1999), I criticized one way of endeavouring to dismiss the problem of compositionality. The attempt I had in mind, due to Horwich (1990), simply said (in my paraphrase), "Well, if you know that (the subject) α means *A*, and (the predicate) β means *B*, then I say (26):

(26) The (predicative) combination $\alpha\beta$ means *AB*.

so the meaning of the whole $\alpha\beta$ has indeed been given in terms of the meanings of its parts." This formulation would not do, I said, not because it was wrong, but rather because it simply reproduced the mode *AB* of combination of concepts in the metalanguage, without saying what that mode was, and therefore without saying what someone knew who knew what it was. The fact that the items in (26) have been *called* "subject" and "predicate" carries no weight. It is as though one were to say, "Well, knowing as you do that 'the' means THE, 'advisability' means ADVISABILITY, etc., of course you must know that the words 'the advisability of the proposal' mean THE ADVISABILITY OF THE PROPOSAL." Knowledge of meaning obviously cannot be imparted in this manner. But then, neither can it be that the native speaker's knowledge of what she knows is constituted by it.

In a further recent draft, however, Horwich argues on somewhat different grounds that the problem of compositionality is not what it is cracked up to be, and he has a response that evades the problem that I have stated. Like Frege, Horwich proposes that the combinatorial principle linking subject and predicate is that of function application. His view would then not be the one I criticized, because the mode of combination is not given just in terms of what it produces, but in terms of something that we independently understand. The combination of subject and predicate delivers as the interpretation of the sentence just what results from the application of the predicate to the subject; but that is not in itself objectionable. On this matter, Horwich makes what I think is an apt comparison: what is it to know the conditions on reference of the arabic numerals? Here we have expressions, and therefore syntactic structures, of a somewhat different formal nature from those in the most basic parts of language; for the digits are finite, and the syntactic structures *n*-ary, for arbitrary *n*; but the point is the same. The standard recursive clause is (27):

(27) If $X = Y_1, \ldots, Y_n$, $n > 1$, and each Y_i occupied by some digit α_i, then
$\mathrm{ref}(X) = \mathrm{ref}(\alpha_1)\ 10^{n-1} + \ldots + \mathrm{ref}(\alpha_n).10^0$.

As I understand him, Horwich asks why there should be a different or more intimate specification of ref(X), $X = \alpha_1 \ldots \alpha_n$, than is given by this formula; and, by analogy, why there should be a different or more intimate specification of the interpretation of a target sentence, say *John walks*, or *Theaetetus flies*, than is given by the statement that it is what you get when you apply the interpretation of the predicate to that of the subject.

To this point, however, the analogy is superficial, as we have not yet examined what "the interpretation of" either the predicate or the subject is supposed to be. Because Horwich is taking issue with Davidson's views on Frege's account of predication, let me pursue the analogy, I trust without prejudice to the issue, and with reference to Frege's own writing. Frege held that *Theaetetus* expresses a sense S, and that *flies*, or more precisely *( ) flies*, expresses a sense S', such that $S'(S)$ expresses a thought. If we assume that the words "the sense of *Theaetetus*" and "the sense of *( ) flies*" refer to the senses in question we can put things as in (28):

(28) the sense of *Theaetetus flies* = the sense of *( ) flies* (the sense of *Theaetetus*).

How is that for imparting knowledge of the sense of *Theaetetus flies*?

The problem now, I think, is inverse to the one that I scouted in the article cited earlier: it is not that, having the interpretations of Y and Z in the combination $X = Y\text{-}Z$ to hand, we have not given the interpretations of (a) X and (b) the combinatorial mode linking Y and Z except in terms of each other; but rather that, having as we do the combinatorics, we lack any specification of what it is the combinatorics *of*. For if all we have to go on is that the combination represented by $Y\text{-}Z$ is an instance of function application, as in the hypothetical specification (29):

(29) *Theaetetus* means 'Theaetetus', and *( ) flies* means '( ) flies'.

so that we derive (30):

(30) *Theaetetus flies* means (( ) 'flies')('Theaetetus').

then we have no business assuming that any sense of predication is in question. All we know about the italicized things is that one must be some sort of function and the other must be some sort of appropriate argument for it. In particular, we have no reason to assume that *Theaetetus flies* is an expression with a truth value. To be sure, if we assume in advance that it *is* an expression with a truth value, then we might entertain the view that it should be decomposed as suggested; but that cannot be the explanation of how the native speaker knows that it is such an expression.

There is a contrast, then, with the formula (27) above for the reference of the arabic numerals. With the numerals, we knew exactly what the reference of the parts (the digits) was, and (as Horwich argues) it is perfectly correct to give their combinatorics just in terms of sums and powers of ten, assuming that we know about these things too. You could, by the means given, explain to someone who did not know it already how the arabic numerals work. But you could not explain analogously how *Theaetetus flies* works to someone who was told merely that it was the value of a certain function for a certain argument.

Well, what *is* the sense of *Theaetetus*, or *( ) flies*? Assuming a specific view for the sake of the discussion, suppose that the sense of *( ) flies* is the function that, for each context and possible world, is true of those things that, in that context and world, fly; and that the sense of *Theaetetus* is the function that, again for each context and possible world, refers from the perspective of that world and that context to Theaetetus. Frege tells us that reference is a function of sense. (I have departed from, or extended, the thesis in two ways: (i) by taking reference to be a function of sense plus context, and not in general of sense alone; and (ii) by supposing (for any fixed context) that the slogan that sense determines reference amounts to the slogan that reference is determined given sense and possible world.) Now we are off and running. We have (31) and (32):

(31) the sense of *( ) flies* = (the f) $[(\forall w,c)(\forall x)\ (f(x,w,c) = \text{Truth} \leftrightarrow \text{flies}(x,w,c))]$.

(32) the sense of *Theaetetus* = (the f) $(\forall w,c)\ (f(w,c) = \text{Theaetetus}(w,c))$.

and we intend to derive (33):

(33) the sense of *Theaetetus flies* = (the f) $[(\forall w,c)\ (f(w,c) = \text{Truth} \leftrightarrow \text{flies}(\text{Theaetetus}(w,c),w,c))]$.

where we use the general principle (34) (for structures of the sort in question):

(34) the sense of X=Y-Z, where Y=α, Z=β, and X=$\alpha\beta$ is:
(the f) $[(\forall w,c)\ (f(w,c) = \text{Truth} \leftrightarrow$ the sense of α(the sense of $\beta(w,c),w,c))]$.

Now, there are various objections regarding the sense of *( ) flies* in the way that I have used it for the sake of the example. Also, the formulation that I have given takes predication, as Frege did, quite literally to be function application, rather than merely analogous to it. However, I submit that, *pace* any issues that may arise here, the general treatment of sense is not objectionable, and indeed on Horwich's own grounds: there is no reason to ask for a closer or more intimate understanding of the sense of *Theaetetus flies*, or of the general principle needed to derive it, than what is given. Well, but the price of that solution is evident: we are back in a substantial referential semantics. I conclude, then, that at least so far we are given no way of understanding compositionality that simultaneously (*a*) satisfies the requirement that the combinatorial mode in simple sentences is given non-circularly and (*b*) satisfies that requirement that it be seen as predication or as yielding a proposition as value.

13.5 The Compositionality of Complements

One standard intensional treatment of the classic opaque contexts, of propositional attitude, epistemic state, and the like, obeys local compositionality. But an account of these contexts that cuts a little finer, and in particular one that takes these cases to involve a kind of self-reference, does not observe it. I first outline the alternative view, showing where it falls short of compositionality, and then turn to some objections to that view. Consider classic examples such as (35):

(35) Galileo believed that the earth moves.

Assuming that the complementizer *that* carries us from extension to intension (and ignoring tense), we arrive at (36):

(36) Believed(Galileo,$^\wedge$the earth moves)

The interpretation of the complement of (35) then depends only on what is locally given, its intension. The semantics is locally compositional in the strong sense of section 13.2: there is a particular way of composing the intensions of *moves* and *the earth* that delivers the intension of the sentence *the earth moves*; and, for that matter, any ordinary subject–predicate sentence.[9] In addition to this intension, however, we have also the complementized clause itself to consider. We may propose that it is a self-referential device, referring to its own syntactic structure, and that in (35) Galileo is said to believe something which matches it in content, as in (37):

(37) $(\exists X)$ [believed(Galileo,X) & $X\sim$ *the earth moves*].

We must now add that the syntactic structure is *to be understood as if said by the speaker of (35)*, so that, in particular, the words *the earth* therein refer to the earth, the predicate *moves* is true of things that by their nature move, and so forth; and the sentence as a whole may be appraised for truth value as if it were used in isolation.

An account of (35) that stops at (36) is locally compositional; but on any natural interpretation of the notion of matching in content, one that goes beyond this to (37) is not. The principle that gives the interpretation of complementized clauses is just (38):

(38) If $\mathbf{T}(X) = \mathbf{T}(Y)$–$\mathbf{T}(Z)$, $\mathbf{T}(Y)$ consists just of the complementizer *that*, and $\mathbf{T}(Z)$ is a declarative sentence,[10] then X refers to $\mathbf{T}(Z)$.

A simple enough, and broadly compositional, principle, but one that requires more information than is given in the array of formal features of the points X, Y, and Z and the meaning (which we are taking to be knowledge of the intension) of Z. We thus arrive at the familiar, even hackneyed, point that, although, say, $2 + 2 = 4$

[9] The method is one type of functional composition. Spelling out the λ-abstracts, we would have '(λw) move(w)' for the intension of the predicate, '(λw) the earth(w)' for that of the subject, and for the whole just '(λw) [(move(w))(the earth(w))]'.

[10] That is, the root Z of $\mathbf{T}(Z)$ carries a formal feature signifying that $\mathbf{T}(Z)$ is a declarative sentence. This feature might be delivered in various ways, depending upon details of the syntax of tense and mood.

and $14^2 = 196$ have the same intension, the expressions *that* $2 + 2 = 4$ and *that* $14^2 = 196$ are to be discriminated in all sorts of ways, and as objects of belief or knowledge in particular. If content-matching amounted to intensional equivalence, then (37) could be reduced to (36); but I am supposing, as this move rather violates what we take for granted in our speech, that reductive avenue is closed off.

Interpretation of the opaque context in (35) as in (37) is an example of what Stephen Schiffer (2003: 47–8) calls a "sententialist" view of the semantics of such constructions. Schiffer has various objections to (various versions of) sententialism, but one that he thinks is likely to be unanswerable in the end by any version is this:

no one can know that Galileo believed that the earth moves without knowing *what Galileo believed*, the content of his belief, but one (e.g., a monolingual speaker of Hungarian) can know that Galileo was in a belief state whose content was the same as the content of "the earth moves" without having any idea of what Galileo believed, of the content of his belief.

The semantics proposed for (37) delivers (39):

(39) If u is an utterance of (35) by s then u is true $\leftrightarrow$ $(\exists X)$ (Believed(Galileo, X) & X~*the earth moves*).

Schiffer observes that we might truly say about Zoltan, a monolingual speaker of Hungarian, both (40) and (41):

(40) Zoltan knows that something Galileo believed matches the content of *the earth moves*, understood as said by an English speaker s.
(41) Zoltan does not know that Galileo believed that the earth moves.

Now, by the semantics in question, (41) is true just in case Zoltan knows nothing that matches the content of (35), understood as if said by a speaker of English. According to the account of (40), as given by the same semantics, (40) is true just in case Zoltan knows something that matches the content of (42):

(42) $(\exists X)$ [believed(Galileo, X) & X~*the earth moves*].

A contradiction now arises if something matching the content of (42) also matches the content of (35). More fully, (43) and (44) will be equivalent:

(43) $(\exists Y)$ (Zoltan knows Y & Y~*Galileo believed that the earth moves*).
(44) $(\exists Z)$ Zoltan knows Z & Z~'$(\exists X)$ [believed(Galileo, X) & X~*the earth moves*].

Now, (35) and (42) are themselves equivalent, in the following sense: the proposed semantics for English will deliver as a theorem (45):

(45) $(\forall u)$ u is an utterance of (35) as an English sentence $\rightarrow$ [u is true $\leftrightarrow$ $(\exists X)$ (believed(Galileo,X) & X~'*the earth moves*')].

But it by no means follows that what matches an utterance of (35) in content must also match (42). If Zoltan has learned merely that a certain English sentence, *the earth moves*, expresses in English one of the beliefs of Galileo, then (44) is true, but not (43). If Zoltan has learned about Galileo from his reading in Hungarian, but knows nothing of English sentences, then (43) is true, but not (44).

Schiffer's objection perhaps arises from the reflection that where a semantics proposes that a sentence S is true if and only if p, in the standard way, then any particular use of S should be interchangeable with a use of 'p'; and, normally, this is true. But it is not true in the present context, just because a sentential relation of content-matching intervenes.[11] The self-referential account of complement clauses is broadly compositional, but not locally compositional. In any case, the failure of local compositionality is in a sense controlled, as the exception is governed by a highly particular rule. If we may adhere to such a rule, the theory as a whole remains suitably restrictive, so it would appear. In any case, I have argued here that the compositionality of semantics, either in the way I have defined and illustrated it or in some other way, be seen neither as a triviality nor as a quasi-conceptual issue, but rather as an empirical hypothesis, right or wrong, about the projection of interpretation in human languages. A good way to look at the subject, I think, is neither to insist upon some version of compositionality at all cost nor to propose that exactly this or that syntactic information is available to the interpretive component of a grammar; but rather to take compositionality in a strong form as a working hypothesis, and see what the consequences are. In this way, I hope, the question of the scope and limits of compositionality can be deflected from what seem to me the excessively a priori pronouncements that might otherwise be made about it.

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[11] Schiffer (2003) poses a number of other issues, which it would take us too far afield to consider here. Higginbotham (2005) offers further discussion.

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CHAPTER 14

SEMANTICS, INTONATION, AND INFORMATION STRUCTURE

DANIEL BÜRING

14.1 Introduction

The term "information structure" (IS) goes back to Halliday (1967) and has been widely used in the subsequent literature to refer to the partitioning of sentences into categories such as focus, background, topic, comment, etc. Related notions include Chafe's (1974) INFORMATION PACKAGING as well as the FUNCTIONAL SENTENCE PERSPECTIVE of the Prague school (Firbas 1975; Sgall et al. 1986; see Sgall 1993 for a general introduction). There is no consensus on what and how many categories of information structure should be distinguished, or how these can be identified.

In this chapter I adopt the widely accepted view that information structure is an aspect of syntactic representation, which interfaces with the phonological form by rules of IS realization, and receives its meaning via rules of IS interpretation. While for some authors IS is a level of representation in its own right at which IS-categories are distinguished in terms of structural units (Vallduví 1990;

Erteschik-Shir 1997), I will follow the lead of Jackendoff (1972) here and assume that IS categories such as focus and topic are part of the ordinary syntactic representation, represented as privative features F, T, etc. on syntactic nodes.

This chapter will concentrate on the effects IS has on intonation, which in English is the primary mode of IS realization. Some remarks on the effects of IS on constituent order will be made in section 14.4.3; other modes of realization, in particular through the use of morphemes, are widely attested across the languages of the world, but will not be discussed here.

As for IS interpretation, we will find that IS does not primarily affect the truth conditions of utterances, but more elusive aspects of their meaning such as their implicatures and felicity conditions. We will model these, however, using the tools familiar from ordinary truth-conditional semantics (whence the title of this chapter). The general picture underlying this article is depicted in Figure 14.1.

In transformational models of grammar, syntax is itself split into different levels of representation, say LF and PF, so that IS interpretation and IS realizations may connect to different syntactic representations. Here, we will not make use of this architectural option; we assume that both interfaces "see" the same representations, or at least ones with equivalent IS properties. Speaking in transformationalist terms, we assume that all IS-relevant features are present at the branch-off point ("spell-out") and are not manipulated afterwards.

This chapter is organized as follows. In sections 14.2 and 14.3, I present the two aspects of IS that have received the most attention in recent formal work on IS, focus–background and topic–comment. For each, a sketch of their realization and, more extensively, their interpretation is given. Sections 14.4.1 and 14.4.2 discuss the particular assumptions about the interfaces these approaches require. In the latter section, I also make some remarks about the influence IS might have on constituent order.

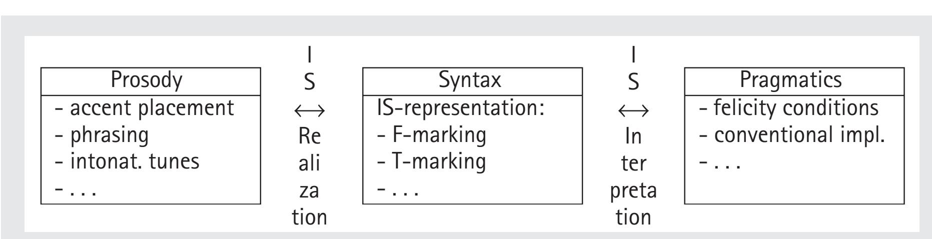


Fig. 14.1 Components of Information Structure

14.2 Focus–Background

14.2.1 Preliminaries on Focus Realization

Speakers of English (and many other languages) have intuitions about prosodic prominence within words, phrases, and sentences. The main correlate of perceived prominence in English is a pitch accent (PA), acoustically a local maximum or minimum of the fundamental frequency. Other correlates include loudness, duration, and certain changes in formant structure. Focus in declarative sentences is usually marked by a high pitch accent, though the details of the actual phonetic realization will differ, depending on other factors. Among the pitch accents within a certain domain, which for the purposes of this chapter we can equate with the sentence, the final pitch accent is invariably perceived as the most prominent one (though it is not usually phonetically more elaborate than the others), and is referred to as the nuclear pitch accent (NPA). Speakers of Germanic languages easily identify the location of the NPA within a sentence, while the detection of prenuclear or secondary PAs might require some training. In what follows, we will mark the NPA by capitals, and prenuclear PAs, where relevant, by small caps; material in parentheses is given to provide context only, with no accents indicated.

14.2.2 Introduction and Terminology

Authors differ as to whether they understand focus and background (or their counterparts to these notions) as semantic or syntactic. We will take it to be a syntactic notion and mark it with a syntactic feature F. Thus in (1), the word or NP *Kim*, not the denotation of that word, say, the person Kim, is focused. Anything that does not bear an F-mark is in the BACKGROUND:

(1) KIM$_{F}$ writes poetry in the garden.

It is common to talk about *the* focus and *the* background of a sentence (e.g. *Kim* and *writes poetry in the garden*, respectively, in (1)). But suppose we agree that *old* is the focus in (2), then what is the background?

(2) (Which book did you buy?) I BOUGHT the OLD$_{F}$ book.

Similarly, if we assume that *it* is the background in (3), we find that there is no single focus constituent in the answer:

(3) (What happened to my harp?)
a. SOMEONE$_{F}$ STOLe$_{F}$ it.
b. SOMEOne$_{F}$ SENT$_{F}$ it to NORway$_{F}$.

We conclude from this that while it makes perfect sense to speak of the F-marked vs. the non-F-marked constituents in a sentence, we cannot generally speak of "the focus" and "the background". As we will see below, we can devise a theory of focus interpretation which is perfectly happy with this situation. It thus seems unnecessary to create constituents that contain only F-marked (or F-less) elements at some level of (covert syntactic) representation.

14.2.3 Focus Interpretation

The two perhaps most persistent intuitions researchers have expressed about the background/focus distinction are the following:

- Given/New: New material is focused, Given material is not.
- Question–Answer: The material in the answer that corresponds to the *wh*-constituent in the (constituent) question is focused.

We will now provide formal implementations of both these ideas, then we discuss the relation between them.

14.2.3.1 *Given/New*

Leaving a lexical expression unaccented, which means by assumption that it is not F-marked, signals that that constituent is, in a sense to be made precise, Given. For example, the unaccented object NP *the butcher* in (4A) is interpreted anaphorically, while accenting it blocks that interpretation, as in (4A′), rendering the reply somewhat incoherent:

(4) Q: (Did you see Dr. Cremer to get your root canal?)
A: (Don't remind me.) I'd like to STRANgle the butcher.
A′:#(Don't remind me.) I'd like to STRANGLE the BUTcher.

This effect generalizes. The N *Italian* may be unaccented in (5*a*), because it is Given, even if the NP it heads is not anaphoric, and so may verbs, like *jump* in (5*b*), for which the notion of anaphoricity is not generally assumed to be relevant:

(5) *a.* (Why do you study Italian?) I'm MARried to an Italian.
b. (Don't jump!)—But I WANT to jump.

These examples show that Givenness cannot simply be equated with FAMILIAR DISCOURSE REFERENT, as used in theories about the definite/indefinite distinction. A different, more general notion that would be helpful here is that of *information*; a focused expression would be an informative part of the sentence, a backgrounded one an uninformative one. Information, however, is a propositional notion; a sentence, or the proposition it expresses, can be informative (w.r.t. a given stock of knowledge), but parts of sentences cannot (unless, of course, they are themselves propositional in nature, e.g. embedded declarative clauses).

To generalize the notion to non-proposition-denoting expressions, we introduce the mechanism of EXISTENTIAL CLOSURE (∃C) as defined in Schwarzschild (1999). Roughly speaking, existential closure "feeds" a non-propositional meaning variables until it becomes propositional, and then existentially quantifies all these variables. Thus the ∃C of *giraffe* is 'there is a giraffe', of *blue* 'there is something blue', and of *resemble* 'someone (or something) resembles someone (or something)'. Since the ∃C of any expression is a proposition, we can define Givenness of an expression E w.r.t. a set of sentences S as the case where S entails the ∃C of E.

Next we need to decide what the set of sentences S in the above sense should be. What comes to mind is of course the set of sentences that have been uttered before E. Or, put semantically, the set of propositions that are shared by speaker and hearer as part of the conversation, their common ground (Stalnaker 1978). Closer inspection reveals, however, that no commitment to the ∃C of E on the part of any party in the conversation is required to make E Given:

(6) A: Did you ever see an extraterrestrial?
B: I don't think there ARE extraterrestrials.

Certainly neither A nor B is committed—even for the purpose of the conversation—to the truth of 'there are extraterrestrials', so no such proposition will be part of their common ground. Intuitively, the mere mentioning of *extraterrestrial* in A's utterance suffices to render it Given afterwards. This is an important and general point to note, since expressions in the background are often—but inaccurately—referred to as "presuppositions", which they are not (see Rooth 1999 for convincing discussion).

Schwarzschild's (1999) definition of Givenness captures this in that it merely requires that the ∃C of some previously uttered constituent—sentential or smaller—must entail the ∃C of E to render E Given. Thus *extraterrestrials* in B is Given because its ∃C ('there are extraterrestrials') is entailed, not by the common ground, but by the ∃C of *extraterrestrial* in A. Similar remarks apply to *Italian* and *jump* in (5).

This notion of Givenness is obviously very close to one that equates Givenness with previous mentioning. The "transposition" into the semantics, however, is necessary because Givenness of E does not require the literal mention of E, but merely mention of a hyperonym of E, as in (7):

(7) (I want to learn the violin,) because I LIKE string instruments.

These cases, too, are captured by Schwarzschild's definitions, since ∃C (*violin*) 'there is a violin' entails ∃C (*string instrument*) 'there are string instruments'.

14.2.3.2 *Question–Answer Congruence*

Let us now turn to the second intuition mentioned above, that foci correspond to the *wh*-expression in a preceding constituent question:

(8) (Who did Jones's father vote for?) He voted for JONES.

To formalize this, we introduce the notion of a focus value (sometimes called alternative value or P-set). The focus value for the answer in (8), written as $[\![\text{He voted for JONES}_{\text{F}}]\!]^f$, is the set of propositions in (9*a*), roughly those expressed by sentences of the form *He voted for x*, where x is an individual (W is the set of all possible worlds, E the set of all individuals); we will informally write such sets as in (9*b*):[1]

(9) *a.* $\{\, \{w \in W \mid \text{Jones's father voted for } x \text{ in } w\} \mid x \in E\}$
b. $\{\text{Jones's father voted for } x \mid x \text{ an individual}\}$

A question–answer congruence condition makes use of the fact that question meanings, too, can be taken to be sets of propositions, roughly the set of all direct answers (Hamblin 1973; Karttunen 1977). Thus the question in (8) denotes the set of propositions indicated in (10*a*), while a question such as *Which candidate did Jones's father vote for?*, which likewise can be answered by the declarative in (8), denotes the set in (10*b*) (superscript "O" indicates that this is the *ordinary* meaning—as opposed to the focus value—of the expression in double brackets):

(10) *a.* $[\![\text{Who did J.'s father vote for?}]\!]^o = \{\text{J.'s father voted for } x \mid x \text{ is a person}\}$
b. $[\![\text{Which candidate did J.'s father vote for?}]\!]^o = \{\text{J.'s father voted for } x \mid x \text{ is a candidate}\}$
c. $[\![\text{Who voted for Jones?}]\!]^o = \{x \text{ voted for Jones} \mid x \text{ is a person}\}$

The question *Who voted for Jones?*, on the other hand, which (8) *cannot* answer, gets the interpretation in (10*c*). To derive this pattern the question–answer condition needs to be stated as in (11):

[1] Occasionally, focus values are taken to be functions, e.g. λx [Jones's father voted for x] or existentially closed propositions, $\exists x$ [Jones voted for x] (they are also sometimes *represented* as open formulae like *Jones voted for x*, but these will end up denoting one of the other objects discussed here). The latter can be derived from the focus values introduced in the main text, which in turn can be derived from the functions, but not vice versa. The question how fine-grained focus values need to be has been widely discussed in the literature, e.g. Kratzer (1991); Stechow (1991); Krifka (1992); Rooth (1996); Wold (1996).

(11) Question–Answer Congruence (QAC)
A is a felicitous answer to Q only if
a. $[\![Q]\!]^o \subseteq [\![A]\!]^f$, and
b. there is no alternative focusing A′ of A which has less F-markings and meets (11*a*).

The match required by QAC can not be perfect (i.e. identity of $[\![Q]\!]^o$ and $[\![A]\!]^f$) since the questions can, to various degrees, be more specific than the answer, as shown by the fact that both (10*a*) and (10*b*) can be answered by (8). On the other hand, the match should be as tight as possible, to block focusing of arbitrarily big constituents containing the "correct" focus (e.g. VP or S in (8)) and trivially meet (11*a*). The minimization clause (11*b*) serves to guarantee that (the notions "alternative focussing" and "less focus", of course, need to be spelled out; see e.g. Schwarzschild 1993).

QAC straightforwardly generalizes to, and in fact immediately predicts, F-markings on complex constituents such as VP (*What did x do?*), or S (*What happened?*). A common misconception is that for these cases, grammar must provide a structural rule which determines the location of the NPA realizing this focus, often thought of as focus projection rules. A closer look at theories employing such rules, however, reveals that they assume the accent placement within bigger foci to be determined mostly pragmatically, for instance by Givenness; specific structural rules at most restrict the possible relations between such Givenness foci and higher F-markings, as we will see now.

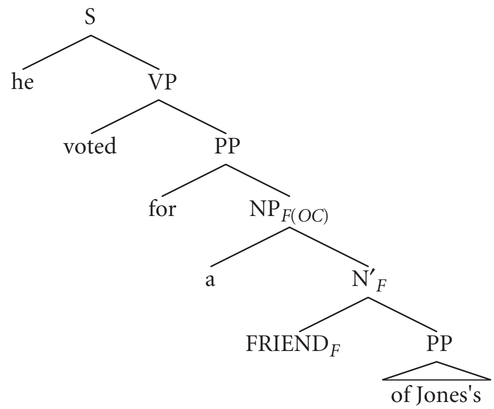
14.2.4 A Hybrid Theory

We can combine our theories of Givenness and QAC into a general theory of focus marking by nesting F-marks that signal Newness into F-marks required by QAC, along the lines of, for example, Selkirk (1995):

(12) Focus Interpretation
a. F-marks not dominated by any further F are the *FOC(s)* of S and define $[\![S]\!]^f$ for the QAC in (11);
b. all New constituents are F-marked;
c. no Given constituent is F-marked, except perhaps FOCs.

To see how this works, consider (13):

(13) (Who did Jones's father vote for?) He voted for [a FRIEND of Jones's]$_F$.



Semantically, the question is 'What person *x* did Jones's father vote for?' According to QAC, then, the focus value of the answer must be {Jones's father voted for $x \mid x \in E$}, which is achieved by marking the object NP as the FOC of the sentence (the highest F-marker in the tree). All other Fs mark Givenness-foci; since *(of) Jones* is Given, it is not F-marked (and since it is not the answer to the question, it cannot be FOC-marked), which means it will stay accent-less, whereas *friend* is New, hence F-marked, hence accented (why exactly the F on N′ is there need not concern us here).

Under this division-of-labour view, focusing really consists of two phenomena: a rather involved QAC to guide "the focus" and a rather low-level Givenness condition to determine actual F- and accent-placement. The effects of the latter are sometimes described as deaccenting, since they result in, for instance, an accentless *Jones* in (13). It should be clear, though, that on the view pursued here, this term is not to be taken literally, since no accent is ever assigned to *Jones* in the first place.

A question not addressed so far is whether just any F-marked (and accented) terminal can serve to signal FOC(us) on a node dominating it. It has been proposed, for example, that every F, including FOC, must immediately dominate another F on its head-daughter (the aforementioned FOCUS PROJECTION RULES of e.g. Rochemont 1986; Selkirk 1984, 1995), that is, accents on modifiers/adjuncts cannot license F-marking on their mother. It should be noted, though, that the effects of such constraints are rather subtle, given the independent effects of Givenness on terminal nodes. For example, claiming that an F on the root node can be licensed by a sole terminal F on a transitive V is not tantamount to saying that a single PA on V can signal an all-new sentence, but at best that it can mark a sentence which has broad focus and in which, moreover, all lexical XPs are Given (since otherwise they would need F-marks for Givenness reasons); this, arguably, is the case in (14).

(14) (Why was Sue's father upset?) [Because she CRIticized$_F$ him]$_{FOC}$.

Whether restrictions on vertical focus projection exist is somewhat controversial (see Büring 2006; Schwarzschild 1999: sec. 6 and references there), but they cannot be explored further here.

One might also ask if it could happen that a non-terminal FOC dominates Given constituents only. If it could, then either additional F-marks on Given elements must be inserted, or purely structural principles of accent placement must apply to that constituent after all; unfortunately we cannot discuss this question here for reasons of space.

14.2.5 The Relation Between Focus and Accent

14.2.5.1 *Integration*

When discussing (13), *He voted [for a FRIEND of Jones's]$_F$*, in the previous section, it was emphasized that the placement of accents within the FOC(us)—as in Germanic languages in general—is itself pragmatically, rather than structurally, determined (through embedded Givenness/F-markings), and does not require any structural accent rules. Standard accent patterns such as in (15), too, simply follow from the fact that each N within the object NP is itself New and hence in need of F-marking, and that the last PA inevitably is the NPA:

(15) (Who did Gus vote for? — Gus voted) [for a FRIEND of his NEIGHbours from LITtleville]$_F$.

We do not, however, subscribe to the view of Bolinger (1972*a*, 1985, 1987) that all accent placement is meaningful in this sense, for reasons given in Gussenhoven (1984), Jacobs (1991/2*b*), Schmerling (1976), and Stechow and Uhmann (1986), among many others. Cast in present terms, F-marks and PAs do not stand in a one-to-one relation. At a rather low level, structural factors do determine where an accent is assigned within a group of F-marked constituents. For example, functional elements such as determiners, auxiliaries, and certain adverbials typically remain accentless even when, according to QAC or Givenness, they are in focus. We can think of this in terms of HORIZONTAL FOCUS PROJECTION (Rochemont 1986; Selkirk 1984, 1995): an accent-induced F-feature on, say, an NP, can project (jump, really) to a selecting head, the Det, without Det itself being accented. Alternatively, this can be viewed in terms of FOCUS/ACCENT DOMAIN FORMATION or, as we will say, INTEGRATION (Gussenhoven 1983, 1992, 1999; Jacobs, 1991/2*b*, 1992, 1999; Uhmann, 1991): a stretch of F-marked elements, which doesn't necessarily form a syntactic constituent, forms a prosodic domain, which, as a unit, is marked by one accent.

We might be tempted to explain these cases away by assuming that all these "light words" are inherently Given. While perhaps feasible in these cases, we note that even contentful lexical expressions such as verbs can be unaccented, despite F-marking, when adjacent to an accented argument. This effect has been noticed for English (Fuchs 1976; Schmerling 1976) and, more remarkably (since it affects NPA-placement), Dutch and German (see references above):

(16) *a.* (news headline) [JOHNson$_F$ died$_F$]$_F$
b. (all new) [I went$_F$ to IREland$_F$]$_F$
c. *Ich bin nach IRland gefahren.* German
I am to Ireland driven

This integration effect is rather systematic in the Germanic languages, but not cross-linguistically (Ladd 1996: ch. 5), which again makes it likely to be a phenomenon of IS realization rather than IS interpretation (i.e. the verbs in (16) are unlikely to be simply not F-marked in the first place). Arguably, predicates integrated with their arguments are the only exception to the rule that F-marked elements must be accented.

14.2.5.2 *Nuclear Stress and Prenuclear Accents*

An inverse complication in the F-to-PA mapping regards pre-nuclear accents on F-less elements. Generally speaking, F-less material can be accented in accordance with general principles of rhythmic and prosodic organization (see section 14.4.2), provided such an "ornamental" pitch accent does not become the NPA (i.e. the last within the domain). For example, (15) will most naturally be pronounced with additional PAs on the subject and, often, the verb, even though these are not F-marked; on the other hand, *Jones* in (13) cannot receive an ornamental accent (which would, by definition, be the NPA)—that is what deaccenting is all about.

14.2.6 Focus Function and Focus Semantics

The approach to focus outlined in this section maintains that its interpretation is non-truth-conditional, and that it is uniform, in that it is exclusively related to discourse structure (see also the following subsection). Both claims are controversial. Regarding the latter, we often find the claims that there are different kinds of focus such as informational, corrective, contrastive, counter-presuppositional, etc. (Dik 1980, 1997; Gussenhoven, to appear, among many others), suggesting, in our terms, that there are various features, say F1, F2 . . . , which differ in their interpretation, and perhaps realization. While it is very possible that some of these distinctions will be shown to be grammatical in nature, one should always consider the alternative: to regard these as different uses of focusing, but not different foci. Note that the theory sketched so far is neutral about, and deliberately excludes, the intentions a speaker might have when using a particular F-pattern. It is not the meaning of focus to mark information, express contrast, or invoke alternatives; focus simply reflects certain properties of the discourse context. The relation between such contexts and speaker's intentions is assumed to be a matter of conversational pragmatics, not IS interpretation.

In a similar vein, the present view will have to be combined with a pragmatic theory to explain certain apparent truth-conditional effects of focus. Exhaustiveness, for example, can presumably be derived as an implicature, if we assume that a speaker, when answering a question, will normally give as complete an answer as (s)he can, or thinks is relevant.

Perhaps the best candidates for a true semantic effect of focus are cases of so-called ASSOCIATION WITH FOCUS, as discussed, for example, in Jackendoff (1972), Dretske (1972), Stechow (1982), Jacobs (1983), Taglicht (1984), Rooth (1985), among many others:

(17) *a.* John only introduced BILL to Sue.
b. John only introduced Bill to SUE.

Sentences (17*a*) and (17*b*) have different truth conditions, which can be paraphrased as in (18):

(18) *a.* John introduced Bill and nobody else to Sue (he may have introduced Bill to other people).
b. John introduced Bill to Sue and to nobody else (he may have introduced other people to Sue).

Similar effects can be seen with other particles (*even*, *also*), quantificational adverbials (*always*, *mostly*), negation, modal verbs, proportional determiners, and other categories.

In these cases, focus seems to enter the truth-conditional meaning through the contribution of, say, *only*, which in turn seems to be FOCUS-SENSITIVE (so no truth-conditional interpretation resides with the F-feature itself). Two strategies have been proposed in the literature. According to SEMANTIC THEORIES OF FOCUS, focus-sensitive elements such as *only* have direct access to focus-induced information, for example the alternative values described above, which restrict the domain of quantification (e.g. Stechow 1982; Rooth 1985; see also Kratzer 1991, and Stechow 1991 for surveys, and Krifka 1991/2, 1992 and Wold 1996 for refinements). According to PRAGMATIC THEORIES OF FOCUS, elements like *only* are merely context-sensitive, that is to say that their semantics depends on a contextually fixed variable which provides, for example, the domain of quantification. Focus only indirectly helps to fix the value of that variable, because it gives clues about the context via Givenness, or question–answer congruence (e.g. Taglicht 1984; Vallduví 1990; von Fintel 1994).

The latter view maintains a uniformly pragmatic analysis of focus, but has to shoulder the burden of systematically predicting the rather striking (apparent) focus effects in sentences like (18) through pragmatic reasoning (see e.g. Vallduví 1990; Schwarzschild 1997; Roberts 1996; Martí 2002), which turns out to be a rather hard task. Recently, Beaver and Clark (2003) have argued on grounds of distributional evidence that indeed *some* association with focus phenomena are semantic, while others are pragmatic, a position not previously found in the literature.

14.2.7 QAC Redux?

We have seen in example (13) that QAC alone cannot account for focusing, since it cannot determine where the accent within a complex focus will be assigned. Can we reduce the effects of QAC to Givenness in turn? On the face of it, the answer is "no", since we note that the QAC-focus will be accented, even if it is Given:

(19) (Who did Jones's father vote for?) He voted for JONES.

Every constituent in the answer in (19) is Given through the question. Accordingly, the QAC alone must determine focus assignment here (note that the conditions in (12) do not say anything about whether the FOC(us) must be Given or New). Examples like these have generally prompted researchers to give up on the idea of a unified interpretation for focus.

An alternative is explored in Schwarzschild (1999), which attempts to reduce QAC to a refined version of Givenness, thereby maintaining a uniform view of focus.

As a first step, the biconditional New↔F-marked is weakened to a mere material implication New→F-marked; this is consistent with experimental findings reported in Terken and Hirschberg (1994), that while there are many accented Given elements, New elements (new NPs in their experiment) cannot remain accentless (for similar results see Nooteboom and Kruyt 1987). We thus allow for Given foci, but, by the same token, risk allowing foci of arbitrary size (since nothing so far *blocks* F-marking). This, however, will be taken care of by a minimization condition like (11*b*) above, which in Schwarzschild (1999) is called Avoid F, which penalizes using more F-markers per sentence than absolutely necessary.

How does this work for a case like *He voted for JONES?*, in which all parts of the sentences individually are Given? While both *Jones* and *voted for* are Given (by the question), *voted for Jones* is not. One possibility is to F-mark *Jones*. Does this make *voted for Jones* Given? It does, if we treat *Jones*, once F-marked, as a "wild card" for the Givenness properties of higher constituents. At the VP level, then, we do not have to ask whether 'vote for Jones' is Given, but whether, roughly, 'vote for someone' (technically, 'vote for someone (or something)' is the trivialization of the focus value of VP, $\cup[\![\text{vote for JONES}_F]\!]^f$). The ∃C of 'vote for someone' is 'someone voted for someone', which is indeed entailed by the ∃C of *vote for* in the question.

Thus, focusing *JONES*, even though not required by the Givenness properties of the expression *Jones* itself, serves to make the VP Given (the same goes for S). The same overall result could have been achieved by F-marking VP and V for instance.

But by Avoid F we are bound to use as few F-marks as possible, which will make F-marking on *Jones* alone the only possible focusing for this answer.

Schwarzschild's version of Givenness thus accounts for many of the cases that appeared lethal to a simpler Givenness theory of focus. It is not without problems, though. First and foremost, it needs to be supplemented by a more restrictive notion of focus alternatives. Suppose that in our favourite example we had simply F-marked the V, yielding the intuitively infelicitous accenting in (20):

(20) #(Who did Jones's father vote for?) He VOted$_F$ for Jones.

To see whether this meets Givenness, we have to ask whether the trivialization of VP and S are Given (we know that *Jones* and *he* are, and, trivially, *voted for*, since it is F-marked). By definition, the focus value of *vote for* is the set of all two-place relations. The trivialization of the focus value of *He VOTED$_F$ for Jones* is thus 'he stands in some relation to Jones'. Is this Given? Unfortunately, yes, since he stands, for example, in the father-of relation to Jones. Example (20) is thus incorrectly predicted to be a felicitous question–answer sequence. The original formulation in Schwarzschild (1999) requires that for an expression to be Given, the expression whose ∃C entails it, must be "salient". Perhaps a restrictive notion of salience could yield the result that *Jones's father* is not salient in this example. A different intuitive answer to the problem is that the ∃C in (20) should not be 'he stands in some relation to Jones', but rather 'he did something to/for/with Jones', in other words, the alternatives to 'vote for' should be more akin to actual transitive verb meanings, rather than just any two-place relation. At present, the correct treatment of these cases under a pure Givenness theory à la Schwarzschild is unknown; a less parsimonious theory that assumes Givenness *and* QAC derives these cases more solidly.

14.3 Topic–Comment

14.3.1 Topic Realization

Let us now turn to a second pair of IS categories, the topic–comment distinction (sometimes called theme–rheme). While for some authors topic and background are identical, many assume that these two coexist, either as two independent bipartitions of the sentence, or with the one—focus–background—nested within the other. But Enric Vallduví, in a series of works (Vallduví 1990, 1993; Vallduví and Zacharski 1993; Vallduví and Engdahl 1996), has convincingly argued that only a tripartition is called for, which allows, optionally, for a non-focused part to be specially marked as link, or as we shall say, contrastive topic.

As the notion suggests, we do not understand contrastive topics in the sense of "what the sentence is about", which might apply to constituents in the background that do not bear any special marking, but as an intonationally marked IS category. In English, contrastive topics are characteristically marked by a fall–rise contour, what Jackendoff (1972) calls the B-ACCENT, and what has been described in its most elaborate realization as an H* or L+H* followed by a L–H% boundary sequence in Pierrehumbert's (1980) autosegmental notation. An example from Jackendoff (1972) may serve as an illustration.

(21) A: Well, what about FRED? What did HE eat?

L+H* L–H% H* L–L%
B: FRED_{CT} ate the BEANS_{F}.

As indicated, we represent contrastive topic by a different marker, CT, in the syntax. Vallduví argues that all sentences must contain a focus, while not all need to have a background or a contrastive topic. Order aside, sentences thus come as F-only, B-F, CT-B-F, and CT-F. In many languages, CTs must precede a focus (German, Italian, Korean), while in others, including English, F-CT order seems possible, as in (22):

(22) A: Well, what about the BEANS? Who ate THEM?

H* L+H* L–H%
B: FRED ate the BEANS.

English also has sentences with only a B-accent; whether this means that, contrary to Vallduví's claim, there are focus-less CT-B sentences, is an open question.

14.3.2 Topic Interpretation

What is the meaning of CT? Virtually all analyses agree that a common function of the B-accent in English is to mark contrast, often introducing an adversative implicature, as exemplified in (23):

(23) (What did the pop stars wear?) The $\text{FEmale}_{\text{CT}}$ pop stars wore $\text{KAFtans}_{\text{F}}$.

Clearly, female pop stars are contrasted with male pop stars, the implicature being that the latter wore something else. As for the meaning of CT, different analyses have been put forward: CT expresses that a new discourse referent (the female pop stars, rather than the pop stars) has become the one about which information is being provided (Vallduví 1990); it marks non-monotonic anaphora, that is to say that the female pop stars are not identical to the antecedent 'pop stars' (Hendriks 2002); it signals an additional question, "What did the *X* pop stars wear?" (Steedman 1991, 2000*a*, *b*; Roberts 1996); it indicates that a question different from the actual question asked is being answered ("What did the female pop stars wear?", Büring 1997); it requires that a different, open question, of the form 'What did the *X* pop stars wear?' be discussed next.

As with focus, CT marking is not limited to referential expressions, which argues against an interpretation in terms of the discourse-referent system. Rather, we will sketch a treatment in terms of discourse appropriateness that relies on the notion of *strategies*, that is, question–subquestion structures, as proposed in Roberts (1996) and elaborated in Büring (2003). The latter analysis builds on an extension of alternative semantics as introduced in section 14.2.3.2, which associates another semantic object with a declarative sentence S, its *CT value*, $[\![S]\!]^{ct}$. The CT value is a set of sets of propositions, that is, a set of focus values, or a set of question meanings. The CT value for the answer in (23) is the set of sets of propositions sketched in (24), or simply put, the set of questions asking "What did the *x* pop stars wear?", where *x* is an adjective meaning:

(24) $\{\ \{\text{the } x \text{ pop stars wore } y | y \in E\} | x \in \{0, 1\}^{E}\}\ \}$

The meaning of CT is discourse-related. It expresses that there is a set of questions in the discourse structure, which together form a strategy to answer a common super-question. These questions must be elements of the CT value, and the immediate question under discussion (IQUD) must be one of them.

Example (23) receives an indirect explanation under this analysis; the questions in the strategy are questions about the outfit of different pop star groups (male, female, . . .). The common super-question is the one asked overtly in (23). The IQUD is a covert or implicit question: "What did the female pop stars wear?"

The application to (21) and (22) (*Fred ate the beans*) is more straightforward. Both relate to the super-question "Who ate what?" but signal different strategies: "What did *x* eat?" for (21) (since *Fred* is the CT and *beans* is F) and "Who ate *x*?" for (22) (since *Fred* is F and *beans* is CT). In the contexts given, in which the IQUD is overt, the account explains why the two realizations of the answer cannot felicitously be swapped between the two question contexts: they each signal a different strategy.

A sense of non-monotonic anaphora, topic shift, or deviance from the question (pop stars–female pop stars) will arise whenever the IQUD is implicit and the super-question itself is asked, which is of course different from, and usually more general than, the IQUD. A sense of implicature or "new question" arises whenever the IQUD is explicit, but the presence of other questions within the strategy, and indirectly of the common super-question, is signalled by the presence of CT; see (25).

(25) (Where was the gardener at the time of the murder?) The GARdener$_{\text{CT}}$ was in the HOUSE$_{\text{F}}$. (implicates new question: Where was the chauffeur/maid/cook . . . ?)

It should be stressed that this treatment does not confine CT phenomena to question–answer pairs, nor does it imply that other configurations, which involve implicit questions, must be derived by repair strategies such as accommodation. What it does commit to is that the logical structure of any discourse is organized in terms of hierarchical question, sub-question, and answer structures, and that it is that abstract structure, rather than the overt utterances, that CT is sensitive to.

According to all the authors mentioned earlier, CT does not influence truth conditions directly, but only relates to discourse information. This can yield effects on truth conditions indirectly. Adversative implicatures, for instance that some other pop stars wore some other clothes, will arise from the fact that the relevance of questions about other pop stars' clothes in the present discourse is expressed by the strategy-indicating meaning of CT, and that general pragmatic principles lead us to expect that the super-question would not have been split up into these sub-questions, had the speaker known that the others wore kaftans too.

Other cases are more involved, but still within the limits of this theory. Example (26), with the CT-marking indicated, forces a wide-scope reading for the negation: 'It is not because I'm sad that I drank':

(26)	*Ich*	*habe*	*NICHT*$_{CT}$	*getrunken,*	*weil*	*ich*	*TRAUrig*$_{F}$	*bin.*
	I	have	not	drunk	because	I	sad	am

'I didn't drink because I'm sad.'

Strikingly, the same sentence without CT-marking on the negation allows for a second reading 'It is because I'm sad that I didn't drink'. This effect can be explained as follows. The CT-marking on *nicht* signals a strategy consisting of the questions 'Why did you drink?' and 'Why didn't you drink?' If the answer is taken on its 'I didn't drink, and that's because...' meaning, such a strategy would be contradictory (since it asks for a reason for something that did not happen); taken on its 'It is not because I'm sad, that I drank' meaning, on the other hand, it is perfectly consistent with the other sub-question: 'Why did you drink?'

On this view, then, a structurally possible, and truth-conditionally distinct, construal of a given ambiguous string may be incompatible with the implicatures of IS marking, making that reading unavailable. Yet, IS marking does not itself have truth-conditional meaning.

14.4 The Nature of the Interfaces

14.4.1 IS Interpretation

Now that we have a rough sense of what interpretations are connected to the IS categories of focus and contrastive topic, we may ask what the interface between

IS and meaning has to look like. As mentioned at the outset, I assume that there is no level of semantic representation, hence *a fortiori* no semantic level at which Fand CT are represented. On the other hand, IS meanings were argued to be non-truth conditional in nature. How, then, can they be treated?

It is well known that an update-function view on meaning—that is, one where each sentence is interpreted as an update function from contexts to contexts—can model non-truth-conditional effects of meaning. For example, following a suggestion by Karttunen (1974), Heim (1988) models contexts as sets of worlds, the context set (cx), and declarative meanings as functions from one context to another. If the presuppositions of a sentence S are not met in a context C, the update function denoted by S will simply not be defined for C.

As we have seen, focus meaning does not relate to discourse commitments. In order to model a QAC theory of focus, we have to assume that a context consists of a context set plus a question meaning, the question under discussion (QUD). A declarative update will have in its domain only contexts in which question–answer congruence w.r.t. the QUD is met. For all other contexts, the update will be undefined. Similarly for Givenness: we have to add to the context a set of salient antecedents ("sa"), either expressions or the meanings thereof. An utterance will update a context by adding its parts (or at least some of them) to the set of salient antecedents, while possibly removing others from it. An update with S will be defined on a context C only if the set of salient antecedents in C provides Givenness antecedents for all F-less constituents in S, as sketched in (27).

(27) Let $\langle$cx, QUD, sa$\rangle$ be a context, then
$[\![S]\!]$ ($\langle$cx, QUD, sa$\rangle$) = $\langle$cx $\cap$ $[\![S]\!]^o$, QUD', sa'$\rangle$, provided
a. S is minimally focused such that QUD $\subseteq$ $[\![S]\!]^f$ (QAC), and
b. for each constituent C in S, there is an element A in sa such that $\exists$C(A) $\subseteq$ $\exists C$ ($\cup[\![C]\!]^f$) (Givenness)
Else, $[\![S]\!]$ ($\langle$*cx, QUD, sa*$\rangle$) is undefined.

Obviously, a full definition must include specification of QUD′ and sa′, that is, the way S provides new salient antecedents, and changes (or removes) the QUD.

When topics enter the picture, the context representation will become even more complex. For example, if topics relate to more questions than just the immediate QUD, the QUD part of a context representation will have to be replaced by an ordered set of question meanings, such as Roberts's (1996) QUESTION-UNDER-DISCUSSION stack.

Things get yet more complex if we assume that contrastive topics have a forward-looking aspect to them, for example, that they introduce a new, open question under discussion. On the face of it, declaratives with CTs simply do what questions do, namely, set up a new QUD. Thus, *The FEMALE$_{CT}$ pop stars wore KAFTANS*$_{\mathrm{F}}$ would, among other things, map a context C onto a new context C', where the QUD in C' is 'What did the male pop stars wear?'. But note that in the general case, it is not known which question in the CT value is to become the new QUD. For example in (28), the CT marking on *the gardener* signals that another question of the form 'Where was *x* at the time of the murder?' is part of the strategy, but not which question (the chauffeur? the maid?):

(28) (Where was the gardener at the time of the murder?) The GARdener$_{\mathrm{CT}}$ was at HOME$_{\mathrm{F}}$.

To model this, we could assume that a context does not just contain *one* QUD (or QUD-stack), but a set of them, which models potential insecurity about which of a number of questions is the actual QUD.

Finally we should mention that implicit moves and non-directional meanings complicate the picture as well. The answer in (28) could be used as an answer to the super-question 'Where was everybody at the time of the murder?', or to the actual sub-question asked; in the latter case, it could be the first, the last, or a middle one within a strategy consisting of 'Where was *x*?'-type question. The update denoted by the answer must be defined for all these contexts, and must map them onto different resulting contexts.

What we see, then, is that, depending on our theory of IS interpretation, the representation of contexts gets more and more complex, and so accordingly, do the domain and range of the update functions denoted by sentences. But the general picture remains the same: IS-related meanings can be modelled in terms of update semantics, even though they do not pertain to truth conditions. The felicity conditions associated with the different IS categories can be formulated in terms of their update effects (e.g. new QUD), or restrictions on the domain of the update (QAC, Givenness etc.). Though the latter treatment is formally identical to that of presuppositions in satisfaction theories of presuppositions, it is somewhat misleading to call the IS effects presuppositional, if, as we hypothesized, IS effects regard discourse information only, not public commitments (as "ordinary" presuppositions do).

14.4.2 IS Realization

Let us now turn to the IS realization interface. We assume that the representation on the prosodic side of the interface is a prosodic structure, which comprises at the supra segmental level indications of hierarchical prosodic constituency (syllables, feet, prosodic words (PWd), phonological phrases (pP), intonational phrases (iP), etc.), various degrees of stress, and pitch events such as pitch accents and boundary tones.

It is standardly assumed that languages show a default prosody, which is defined by a regular mapping between prosodic structure and syntactic structure. Without going into the details, the default prosodic realization from the prosodic word level upward for an English sentence is illustrated in (29):

```
                                                              boundary tune
                                               nuclear pitch accent   ↓
          secondary PA         secondary PA           ↓
       (      ↓                     ↓                  *              ) iP
       (      *        ) (          *      ) (         *              ) pP
(29)   (the witness) (wrote) (a letter) (to the government)PWd
```

The sentence is exhaustively parsed into PWds, pPs, and an iP; each phrase has one head, which I marked by an asterisk at the pertinent level for pPs and iP. PAs are aligned with pP-heads, with the iP-head hosting the NPA.

The default prosodic structure is related, but, crucially, not isomorphic, to syntactic structure, partly because the latter, but not the former, is recursive, partly because of systematic mismatches such as insertion of additional boundaries, or annexation of adjacent material, on the left or right of designated elements.

It is clear that IS representation must influence the shape of this prosodic realization—in English at least—through the location and choice of pitch accents and the choice of boundary tones (in other languages, IS has clear effects on prosodic phrasing as well: see Frascarelli 2000; Nespor and Vogel 1986; Selkirk 2000; Truckenbrodt 1995, 1999, among many others).

One approach to this originates with Selkirk (1984), who assumed that IS representation in the syntax directly triggers the assignment of pitch accents (i.e. F-marking on heads must correspond to pitch accents, though not in a one-to-one fashion). Prosodic structure must then be built around the pitch accents in a way that respects certain constraints on PAs in prosodic structure. One such constraint is that pitch accents must be metrically prominent, that is, have a high degree of stress, or that the last PA in a given domain is the nuclear, strongest, one.[2]

This treatment can be generalized in an obvious way to IS models with more categories, for example, CT markings in the syntax, which are mapped onto prosodically different kinds of PAs (e.g. L+H* vs. H*).

A slightly different idea is explored in Truckenbrodt (1995, 1999), where IS representation, in particular F-marking, influences prosody only through prominence requirements. An F-marked constituent requires prosodic prominence, which means that it wants to become the head within its prosodic domain. To meet this requirement, which Truckenbrodt calls Focus Prominence (FoP), severe deviances from the default prosodic structure may be necessary, such as realignment of a head, and/or insertion or deletion of prosodic boundaries. The structure in (30) shows an example of a shifted main stress, in response to a particular focusing, which is achieved through omitting post-focal phonological phrases:

[2] Nuclear-stress algorithms such as Cinque's (1993) nuclear stress rule (NSR) constitute deprived versions of this, which only delivers the placement of one, the nuclear, PA in response to IS representation.

```
                                      nuclear PA
       secondary PA                        ↓
      (      ↓                             *                        no PA      ) iP
      (      *       ) (                   *                          ↓          ) pP
(30)  (the witness ) (wrote ) ( a letter_F ) ( to the government ) PWd
```

As can be seen, the default prosody is retained pre-focally, but not post-focally. The reason is that any post-focal pP, say around *government*, would thereby become the rightmost pP within the iP, which, by definition, must be the head of iP (= the NPA). But then *government* would, as the head of iP, be more prominent than *letter*—which is only the head of a pP—in violation of focus prominence. Example (30) sacrifices just enough default prosody to avoid this mismatch.

This view then offers an explanation for the fact, discussed in subsection 14.2.5, that de-accenting is obligatory within and after the focus, but that "ornamental accents" may occur on F-less prefocal elements. The accent on *witness* does not stop *a letter* from being the head of iP, meeting FoP.

Default prosody may also account for integration, discussed in 14.2.5, the cases where one pitch accent appears to signal focus on more than one terminal. The logic goes as follows. If there are two F-marked items, A and B, in an utterance, only one can become the head of the iP; the other one will surrender at some point. This point could be sooner—lexical heads and their functional entourage form a prosodic word together, as in *to the government*—or later—adjuncts and their modifiees always form separate pPs, but must be joint within one iP, or in the middle, as is the case for predicates and their arguments, which form separate pWds, but joint pPs (*wrote a letter*). At which level A and B merge, and which element becomes the head, then, is decided by default prosody, for instance, by what is the "normal size" for a PWd, pP, or iP (see Truckenbrodt 1995, 1999; Büring (2001*a*, *b*); Büring and Gutiérrez-Bravo 2001; Szendrői 2000, 2001; Samek-Lodovici 2002 for Optimality-Theoretic accounts along these lines).

Treatments of this kind have so far been pursued only for F-realization. While the placement of CT accents can presumably be handled in a similar fashion, the actual choice of PA requires extensions of the system. Either CT-marked terminal elements must directly be mapped onto specific pitch-accent types (but, crucially, not just metrical prominence), or metrically prominent positions will be assigned different types of pitch accent according to the marking of some larger domain which they are contained in.

In many languages, Greek (Baltazani, 2002*a*, *b*), for instance, CTs are typically realized as iPs of their own. In English, this option may exist (cf. the description of the B-accent as L+H L− H%, which is an iP tune), but does not seem to be the rule. It is tempting, though, to think of topic marking as a property of higher prosodic constituents, which influences phrase tones or boundary tones, as well as the actual shape of pitch accents within them.

A particularly straightforward implementation of this idea can be found in Steedman (1991, 2000*a*, *b*), which assumes that the prosodic, syntactic, and topic–comment structures are in fact isomorphic. Formally this is achieved in combinatorial categorial grammar, which allows all sorts of non-standard constituencies. On this view, F-marking determines accent positions (compatible with the prominence-based view presented above), while topic ("theme" in Steedman's terms) marking on a higher constituent is realized by forming an iP with a certain boundary sequence, as well as determining the shape of the pitch accents within it (in Steedman's actual system, the pitch accents and boundary categories are matched through categorial features, but this seems equivalent to a view on which the actual pitch accents shapes are locally underspecified).

In sum, we have seen that IS realization can be thought of as a set of mapping requirements, in addition to those of default prosody, between syntactic structure and prosodic structure, which make reference to the IS representations (e.g. F and CT marking) in the syntax. It should be noted that the distinction between default prosody and IS realization is a somewhat artificial one. Since there are, by assumption, no sentences without IS, there is no default or neutral prosody in any actual utterance (a point argued forcefully in e.g. Bolinger 1972*b* and Schmerling 1976). As has been argued in the literature (e.g. Höhle 1982; Jacobs 1991/2*b*), what is perceived as neutral intonation is perhaps best described as an all-new or out-of-the-blue utterance, that is, one where everything is F-marked. Such structures will, to an extent, reveal the properties of default prosody rather directly because in terms of IS, all other things are equal.

14.4.3 Constituent Order

Although this chapter is dedicated to the interface of information structure with intonation, I want to add a few words on IS-related constituent order variation. As is well known, both topic and focus may influence constituent order, or, put differently, be realized in terms of constituent structure (see the overview in Ward, Birner, and Huddleston 2002). For example, English left-dislocated constituents often serve as topics (McCawley 1988; Ward 1988), though clearly, not all topics in the sense discussed here are dislocated. Similarly, object–particle order is preferred with unaccented objects, while particle–object order is preferred with accented objects (Bolinger 1971; Chen 1986; Dehé 1999, 2000, 2002; Svenonius 1996):

(31) *a.* (What did Peter turn down?) He TURNED down the RAdio$_F$.
b. (What did Peter do with the radio?) He TURNed$_F$ the radio DOWN$_F$.

In other languages, constituent order effects of focusing are more noticeable. In Italian and Spanish, narrowly focused subjects and direct objects must occur in clause-final position, which for the subject, in particular, yields VS order. In Hungarian, as in Turkish, narrowly focused elements have to occur in an immediately preverbal position. In German, focused direct objects cannot precede unfocused indirect objects, though unfocused direct objects can precede focused indirect ones.

One line of analysis is to assume that focused elements have to occur in a phrase-structurally determined position, say SpecFocusP, the specifier of a focus phrase. What argues against such a treatment, however, is the fact that in many cases of focusing in canonical order, say O, VP or S focus in Italian, string-vacuous movements have to be postulated where no indication of such movements is to be found. Furthermore, focusing in these languages often involves movement not of the focus, but of background material "out of the way". Thus in Italian, a focused DO can be realized either through non-canonical IO–DO ordering, or through right-dislocation of the IO (double commas mark a major pause / prosodic phrase break):

(32) Q: Who did you introduce to Maria?
A: *Ho presentato a Maria GIANni.*
have-I introduced to M. G.
A′: *Ho presentato GIANni, a Maria.*
have-I introduced G. to M.

A radically different analysis, first explored in work by Maria Luisa Zubizarreta (see Zubizarreta 1998), is that focus positions are prosodically defined, for example as the position that receives the nuclear pitch accent. If the focused constituent is 'normally' in that position, no re-ordering is necessary, else non-canonical order will surface. What, then, defines the prosodic focus position? Zubizarreta's assumption was that that position is determined through a rule which, based on the syntactic structure, assigns the nuclear accent to a syntactic constituent. The general insight, however, is easily, and perhaps advantageously, recaptured under the assumption adopted here, namely, that pitch accents are citizens of prosodic structure. On this view, focus positions are typically peripheral elements within a given prosodic domain, here the right-peripheral pP within an iP. The boundaries of iPs, in turn, are (co-)determined by syntactic structure, as coinciding with the core clause (say S, IP, or AgrP). Thus, in Italian it is crucial that the (pP containing the) focus be right-peripheral within the iP, which will be the case either if it is normally the VP- (and hence clause-) final constituent, or after right-adjunction of the focus to VP around an intervening constituent, or after left- or right-dislocation of all intervening non-focused elements, which yields structures with more than one iP within an utterance phrase, uP (Samek-Lodovici 2002; Szendroi n.d.):

(*   ) iP
(*   ) (*   ) (*   ) pP
(33) *a.* (ho presentato) (a Maria) (Gianni$_F$) PWd
(*   ) uP
(*   ) (*   ) iP
(*   ) (*   ) (*   ) pP
b. (ho presentato) (Gianni) (a Maria)PWd

Similarly, focus movement in Hungarian can be thought of as bringing the focus to a peripheral position within the main clause, except that here, main prominence is assigned left-peripherally (pre-focal material such as topics, on this view, are clause-adjoined and hence not part of the main iP; cf. Szendroi 2001).

Crucially, in these cases, the peripheral position of focus, where it is not an instance of canonical order, is achieved through amending the syntax. The alternative, discussed in 14.4.2, is to amend the prosody. This can happen by creating additional boundaries (e.g. by inserting a boundary right after the focus, which makes it right-peripheral within the prosodic constituent thus delineated), or as in (30) by omitting boundaries that separate the focus from the edge of the iP. The latter strategy is more obviously found in Korean and Japanese, where focus is signalled by the systematic absence of post-focal prosodic structure; the prosodic phrase containing the focus is thus right-peripheral within the iP, though at the price of an oversized pP (Beckman and Pierrehumbert 1986; Jun 1993; Uechi 1998).

What makes this last strategy relevant to the topic of this section is that the two strategies—non-canonical constituent order and non-canonical prosodic structure—may coexist, as they appear to do in German. Here, a focused IO can become right-peripheral within the iP by either forming an oversize pP with everything to its right, or by inverting canonical IO–DO order to DO–IO and forming a pP with the final verb only:

(*   ) iP
(*   ) pP
(34) *a.* (Er hat)(dem Piloten$_F$) (die Passagiere) (vorgestellt) PWd
he has to-the pilot the passengers introduced
(*   ) iP
(*   ) (*   ) pP
b. (Er hat) (die Passagiere) (dem Piloten$_F$)(vorgestellt)PWd
'He introduced the passengers to the pilot.' (IO$_F$–DO / DO–IO$_F$)

A focused DO, on the other hand, forms a right-peripheral pP in its canonical, verb-adjacent, position, and non-canonical order would actually yield a more marked prosodic structure (one where DO, IO, and V would have to form one pP):

(*)$_{iP}$
(*) (*)$_{pP}$
(35) *a.* (Er hat) (dem Piloten) (die Passagiere$_F$) (vorgestellt)$_{PWd}$
(*)$_{iP}$
(*)$_{pP}$
b. *(Er hat)(die Passagiere$_F$)(dem Piloten)(vorgestellt)$_{PWd}$
'He introduced the passengers to the pilot.' (IO-DO$_F$/ *DO$_F$-IO)

The net effect, then, is that focus on IO yields either canonical order with marked prosody, or marked order with canonical prosody, while focus on DO freezes the canonical word order, which is unmarked in all respects (Lenerz 1977; Büring 2001*a*).

Readers accustomed to a derivational way of thinking will ask how the perspective taken in this subsection can be implemented within the theory of the syntax–prosody interface. Clearly, if the focus position is determined only in the prosodic structure, syntactic reordering processes should not be able to see focus positions as their target. And indeed, this treatment seems hardly compatible with the idea that IS-related features would actually trigger syntactic movement. A derivationalist view will have to assume either that at least some syntactic movements can react to, or anticipate, (aspects of) the prosodic structure (this is essentially Zubizarreta's 1998 view), or that reorderings take place optionally (perhaps triggered by optional formal features), and the match between prosody and IS interpretation is checked, or even created, at the syntax–prosody interface (where mismatching representations are filtered out).

This last perspective is arguably equivalent to, though perhaps not as natural as, one on which prosodic and syntactic structure (the latter including IS-marking) are related by mapping rules, without one in any sense feeding into the other. On this view, a mapping on which focus is not prominent, or prominence is not peripheral, or boundaries are inserted in syntactically wrong places, is simply not licensed by the grammar, while only those respecting these constraints are.

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CHAPTER 15

CONVENTIONAL IMPLICATURES: A DISTINGUISHED CLASS OF MEANINGS

CHRISTOPHER POTTS

15.1 A Fresh Look at an Old Definition

The history of conventional implicatures is rocky, their current status uncertain. It seems wise to return to their source and start a fresh, with an open-minded reading of the original definition (Grice 1975) and an eye open for novel support. Suppose the textbook examples (*therefore*, *even*, *but*, and synonyms) disappeared. Where would conventional implicatures be then? This chapter argues that they would still be widely attested, and, moreover, that if we move a few years forward from their genesis, we find in Karttunen and Peters's (1979) multi-dimensional semantics the basis for an ideal description logic.

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Conventional implicatures were born into neglect. Early in *Logic and Conversation*, Grice advances the term and a definition, but primarily to set such meanings aside. The pragmatic theory of Grice (1975) takes the form of an overarching cooperative principle and a set of maxims. Together, these help to shape both linguistic and non-linguistic social interactions. The theory is thus tailored to describing conversational implicatures, a class of non-lexical meanings whose presence and nature are contextually determined and negotiable. In contrast, conventional implicatures trace back to individual lexical items and have the force of entailments. General principles of cooperative social interaction are of little help with them. So it is no surprise that Grice closes his passage on conventional implicatures abruptly: "I wish to represent a certain subclass of nonconventional implicatures, which I shall call *conversational* implicatures" (p. 45).

Despite its brevity, the passage clearly identifies a class of expressions that permit speakers to comment on their assertions, to edit in the midst of asking questions and imposing demands. Such expressions are bound to be significant, both for what they can tell us about how natural-language semantic theory should look and for what they can tell us about how speakers use language. Unfortunately, Grice's definition is entwined with his example, the adverb *therefore*. Bach (1999: 330) counters that *therefore* "is not the most convincing example, for it seems that the truth of the utterance *does* require the second proposition to be a consequence of the first". Bach's assessment seems sound. It naturally leads one to wonder whether Grice has defined "what is said (in the favored sense)" too narrowly, or arbitrarily. These concerns have, I think, resulted in misplaced scepticism about the usefulness of Grice's concept.

Subsequent research added somewhat to the stock of examples (see Levinson 1983 for an account of them), but we can, and should, do without such textbook cases. In (1) I extract from Grice (1975: 44–5) the central properties of conventional implicatures (henceforth CIs).

(1) *a.* CIs are part of the conventional (lexical) meaning of words.
b. CIs are commitments, and thus give rise to entailments.
c. These commitments are made by *the speaker of the utterance* "by virtue of the meaning of" the words he chooses.
d. CIs are logically and compositionally independent of what is "*said* (in the favoured sense)", that is, the *at-issue entailments.*

Throughout, I use AT-ISSUE ENTAILMENT as a cover term for regular assertive content ("what is said"). This term sets up a useful contrast with CIs, which are secondary entailments that cooperative speakers rarely use to express controversial propositions or carry the main themes of a discourse.

It's the work of section 15.3 to explore definition (1). For now, suffice it to say that (1) picks out a class of speaker-oriented entailments that are, by clause (1*d*), independent of the at-issue entailments. This conjunction of properties characterizes no other class of meanings (presuppositions, conversational implicatures, intonational meanings, at-issue entailments). The pressing question is whether (1) picks out anything in natural language. The answer is a definitive "yes"; Potts (2005) uncovers a wide range of constructions that meet (1), and others are sure to turn up in future investigations.

The properties in (1) come right to the fore when one studies the semantics of appositive expressions, the factual basis for this chapter. I focus on nominal appositives (NAs) like those italicized in (2) (Barwise and Perry 1983: 156–8; McCawley 1998: sect. 13e; Aoun and Choueiri 2000; Aoun, Choueiri, and Hornstein 2001; Elbourne 2001: 268–9). Potts 2005 extends the analysis to a wider range of supplemental expressions.

(2) *a.* The agency interviewed Chuck, *a confirmed psychopath*, just after his release from prison.
b. Yewberry jelly, *toxic in the extreme*, will give you an awful stomachache.
c. Ed, *in trouble with the law once again*, has altered his identity.

I refer to the intonationally isolated phrase, *a confirmed psychopath* in (2*a*), as the APPOSITIVE. The nominal that is obligatorily left-adjacent to the appositive is the ANCHOR. "Nominal appositive" seems a fitting label because the anchor in this construction is always a nominal with the semantics of a referring expression. The appositive takes the anchor's meaning as an argument to return a proposition.

The examples in (2) have conjunctive paraphrases; (2*a*) expresses the proposition that Chuck is a confirmed psychopath and that the agency interviewed Chuck just after his release from prison. When NAs appear in embedded clauses, though, their distinctness from simple coordination is apparent:

(3) *a.* Sheila says that Chuck, *a confirmed psychopath*, is fit to watch the kids.
b. Ali promises that yewberry jelly, *toxic in the extreme*, is delicious.
c. The FBI reports that Ed, *in trouble with the law once again*, has fled to Florida.

We expect indirect quotations—embedded, non-quotative clauses introduced by verbs like *say*—to be attributed to the grammatical subject of the verb of saying. Yet if Sheila said merely "Chuck is fit to watch the kids", we consider (3*a*) an accurate and complete report of this utterance. The appositive *Chuck, a confirmed psychopath* contributes the proposition that Chuck is a confirmed psychopath, but (3*a*) does not commit Sheila to this. Example (3*a*) contrasts in this respect with (4), which asserts that Sheila said roughly "Chuck is fit to watch the kids and a confirmed psychopath".

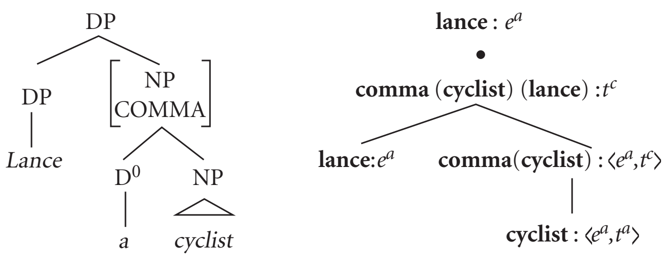
(4) Sheila says that Chuck is fit to watch the kids and that Chuck is a confirmed psychopath.

The contrast takes us back to the definition in (1). In (3*a*), the proposition that Chuck is a confirmed psychopath is a speaker-oriented contribution; in (4), this proposition is part of the indirect quotation, hence attributed to Sheila. The links with Grice's definition of CIs do not end here; NAs display the conjunction of the properties in (1). Though Grice does not mention these expressions as motivation for CIs, his description picks them out unambiguously.

Section 15.3 further supports the claim that (1) is suitable for no other class of meanings. Most of the examples are drawn from the realm of NAs, so that we arrive at a detailed picture of them as well.

Section 15.4 contains a multi-dimensional semantics for CIs. I locate the distinction between at-issue and CI content in the meaning language, after first heading off a model-theoretic division. Thus, CIs yield evidence that semantic translations are a non-dispensable part of semantic theory. If we were to move directly from natural-language expressions to model-theoretic denotations, we would lose the important distinction between at-issue and CI content. The only remaining alternative would be to locate the differences in the syntax, an approach I reject in section 15.2. On the type-theoretic conception advocated here, the syntax remains surface-true and unremarkable, as exemplified in (5).

(5)



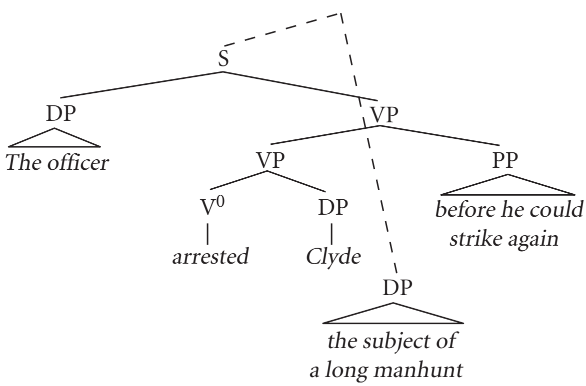
I represent natural-language objects as pairs—a syntactic structure (represented graphically on the left) and a semantic parse tree (on the right). Since the bulk of the formal reconstruction of the at-issue/CI divide rests on the nature of the types, I always provide explicit typing information in the semantic parse trees. The phrase **lance** : e^a glosses as 'the term **lance** is of the at-issue-entity type', for example. Section 15.4 provides a method for determining parse trees with the desired shape and ensuring that the above is interpreted as denoting both the individual Lance and the proposition that Lance is a cyclist.

15.2 An Integrated Syntax

In (5), the appositive is right-adjoined to the anchor, so that the NA forms a constituent. This places the burden of achieving speaker-orientation (primary scope) on the semantics. To readers familiar with the literature on appositives, it might seem preferable to attach the appositive to the root node, rather than to an embedded constituent. Versions of this analysis have been offered many times in the past, by McCawley (1982, 1987, 1989, 1998), Emonds (1976, 1979), Huddleston and Pullum (2002), and Culicover (1992). For the most part, they converge on surface structures such as the one in (6). For the purposes of this discussion, I assume that the dashed lines represent a designated supplement relation, disjoint from dominance and precedence.

(6) *a.* The officer arrested Clyde, the subject of a long manhunt, before he could strike again.

b.



To ensure that the appositive is always given semantically widest scope, one can stipulate that every ordered pair of nodes in the supplement relation is such that its first member is the root. Alternatively, the structures could involve only dominance and precedence, with the relationship between them relaxed so as to allow *manhunt* to precede *before* in (6) (McCawley 1982, 1998: 40). Either way, adjustments to the usual axioms for trees must be made (Potts 2005).

Is this an adequate basis for a theory of appositives? I feel that we can answer firmly in the negative. The syntactic evidence points unambiguously to an integrated syntax like that of (5). For instance, NAs, like many appositives, are subject to a strict adjacency requirement:

(7) *a.* *We spoke with Lance before the race, the famous cyclist, about the weather.
b. *Jan was the fastest on the course, the famous German sprinter, yesterday.
c. *Lance has, the famous cyclist, taken the lead.

The structure in (5), which right-adjoins the NA to its anchor, provides an immediate account of this when considered in the context of the logic developed in section 15.4. Roughly speaking, movement of a CI phrase would require a lambda term that takes CI meanings to CI meanings. The logic lacks such terms, though, rendering extraposition structures like (7) uninterpretable.

Strictly left-adjoining languages like Turkish provide an indirect argument in favour of right-adjunction of NAs. It seems that Turkish lacks NAs in the sense that those are construed here. The closest the language comes is (8), which more closely resembles the English construction represented by *the cyclist Lance Armstrong*. (My thanks to Jorge Hankamer for data and discussion.)

(8) *Ün-lÜ bisiklet-çi Hasan-la yariþ-tan Önce konuÞ-tu-k.*
fame-ous bicycle-ist Hasan-with race.ABL before speak.PAST-we
'We spoke with the famous bicyclist Hasan before the race.'

Turkish seems not to have syntactically, morphologically, or intonationally distinguished appositive relatives either. Both gaps are expected on the present view (and that of Potts 2002*a*): if NAs and appositive relatives invariably right-adjoin, then a language that forbids right-adjunction cannot have them. On the view based on the supplement relation, the gaps seem accidental.

Perhaps the strongest evidence for an integrated NA syntax comes from German, which displays a case-matching requirement between anchor and appositive. Though exceptions are found, the appositive generally shares the case assigned to the anchor by the predicate (Durrell 1995: sect. 2.6):

(9) *Ich sah meinen Freund, den Pfarrer.*
I saw my.ACC friend the.ACC parson
'I saw my friend, the parson.' (Durrell 1995: 37)

If we assume structures like the one in (5), then it is easy to state this case-matching requirement as sharing of features between the appositive and its sister: if an NP with the feature COMMA is adjoined to a DP, then the case-marking features of DP appear on NP.

When one studies other appositive and parenthetical expressions, the case for an integrated syntax grows stronger (Potts, 2002*a*, *b*, 2005). It quickly becomes clear that scope facts provide the only evidence for root-level adjunction. Because we can achieve the requisite widest scoping without complicating the natural-language syntax or compromising our ability to state the necessary generalizations, root-level adjunction seems an unneeded complication.

It is worth pointing out that structures like (6) implicitly call upon new semantic composition rules. We require a principle that places on the root node the result of applying the supplement-adjoined expression to a phrase to its immediate left. The condition is of course within reach (Potts 2005), but it shows that we should not favour an analysis like (6) over the description offered below on the assumption that (6) permits us to do without new semantic definitions. This assumption is false.

15.3 CIs vs. Other Meanings

At this stage in the history of CIs, it would be unwise of me to presuppose that Grice's definition, (1), deserves a place in linguistic theory. The existence of CIs has been denied explicitly (Bach 1999) as well as implicitly, in the use of "conventional implicature" as a synonym for "presupposition" (Cooper 1983; Heim 1983; Gamut 1991: 188; Beaver 1997, 2001; Krahmer 1998; Dekker 2002). Krahmer (1998: 143) even goes so far as to say that "In this system, [. . .] the choice between *presuppositions* and *conventional implicatures* is just a matter of names." The statement is meant to convey only that one can move fairly freely between certain three- and four-valued logics, a mathematical fact that can have no bearing on the question of whether presuppositions and conventional implicatures are distinguished in natural language. But its rhetorical effect is to cast doubt on the usefulness of separating the two concepts. Thus, this section pursues two related goals: I seek to build a case that (1) is not merely a new, perhaps partial, encoding of a more accepted kind of meaning, and I seek to establish that it picks out some natural language facts. I use NAs to pursue the second end.

The tree in Figure 15.1 summarizes the view of meanings described in this section. The only entailments—non-negotiable meanings—are at-issue entailments and CIs. Thus, when proposing that a certain construction manifests CI content, the most threatening alternative appears to be an at-issue classification. The presuppositional viewpoint, too, can be tricky to dispel, since the definition of presupposition is not a settled matter, and many have used the term interchangeably with "conventional implicature". The next few sections seek to show that NAs provide solid evidence for the linguistic reality of the CI branch.

15.3.1 CIs vs. Conversational Implicatures

Grice seems to have intended (1) to be obviously disjoint from the class of conversational implicatures. Clauses (1*b*) and (1*c*) achieve this split; conversational implicatures are not entailments at all, as evidenced by their absence in certain contexts, and conversational implicatures are not invariably speaker-oriented (Chierchia 2004).

At the heart of the difference between the two classes of implicature lies the notion of DENIABILITY. The question, "Is p deniable in C?" should be read as a shorthand for the question, "Is it possible that p is a potential, but not an actual, contribution to C?" Non-entailments are deniable: it is often the case that the context conspires to alter or eliminate a potential non-entailment. In contrast, entailments are not deniable; there is no substantive distinction in this area between potential and actual meaning.

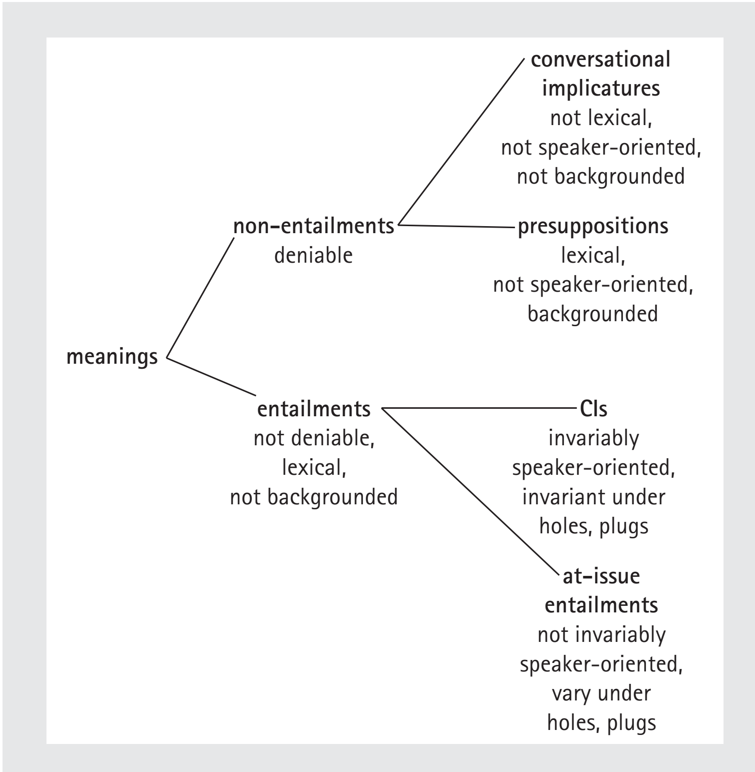


Fig. 15.1 A Meaning tree

It is worth reviewing some examples to sharpen the point. It is a (generalized) conversational implicature of (10) that the speaker wishes to have the salt.

(10) *a.* Can you pass me the salt?
b. Conversational implicature: pass the salt to me if you can

But (10*b*) arises only in contexts in which the literal answer to (10*a*) is obvious. In such situations, the literal answer fails to qualify as informative, relevant, and sufficiently brief. The hearer infers from this that the question is in fact something else, relying on general world knowledge to hear it as a request that the salt be passed to the speaker. But in other contexts, (10*b*) could easily be absent. Suppose that the addressee has recently broken both arms, or is living in a society in which people of his kind are rarely permitted to touch others' foodstuff. In such contexts, a "yes" or "no" answer provides new information, and a request that the speaker be passed the salt is unreasonable. As a result, the potential conversational implicature (10*b*) may fail to become actual.

CIs are defined to be regular logical entailments. We need not worry about sentence-external factors removing content that is usually present in different contexts. In fact, to take such contextual information into account would be to needlessly complicate the theory of CIs. NAs support this narrowly semantic conception: their content is not deniable, (11*a*), nor is it suspendible with epistemic riders, (11*b*, *c*).

(11) *a.* Edna, a fearless leader, started the descent. #Edna is not a fearless leader.
b. #Lance Armstrong, the 2002 Tour winner, is training, if Armstrong did win the 2002 Tour.
c. #If Armstrong did win the 2002 Tour, then Lance Armstrong, the 2002 Tour winner, is training.

These facts also suggest that a presuppositional treatment is not feasible. Example (11*c*) is especially useful in this regard: if the proposition that Armstrong is the 2002 Tour winner were a presupposition engendered by the NA in the consequent, then the preposed *if*-clause would work to satisfy its requirements. That is, the example would work in the same fashion as the classic example *If Eddie has a dog, then his dog is a ferocious man-eater*, which does not itself presuppose that Eddie has a dog. But (11*c*) does assert that Armstrong is the 2002 Tour winner, hence the oddness of placing this content inside the antecedent of a conditional.

For Grice, clause (1*a*) also counts as a point of contrast between the two classes of implicature. On Grice's (1975) view, conversational implicatures do not trace back to lexical items, or even to linguistic stuff. They result from relations among propositions (non-linguistic objects). Chierchia (2004) challenges these points, and develops in its place a theory in which lexical items have conversational implicature dimensions. For instance, the denotation of *or* is that of classical logical disjunction, but with a *not and* conversational implicature dimension. However, this multidimensionality in no way threatens the autonomy of CIs. The issue is again deniability. Although Chierchia's (2004) derives the meanings in (12*b*, *c*) for (12*a*), contextual factors might still conspire to prevent (12*c*) from becoming actual.

(12) *a.* Mary will run the meeting or operate the projector.
b. at-issue:
$\mathbf{run}(\mathbf{the}(\mathbf{meeting}))(\mathbf{mary}) \vee \mathbf{operate}(\mathbf{the}(\mathbf{projector}))(\mathbf{mary})$
c. conversational implicature:
$\neg\,(\mathbf{run}(\mathbf{the}(\mathbf{meeting}))(\mathbf{mary}) \wedge \mathbf{operate}(\mathbf{the}(\mathbf{projector}))(\mathbf{mary}))$

The utterance might be followed by "Hey, she'll do both!", or it might be preceded by an agreement that if Mary does one, then she does the other. The maxims of quality and quantity then conspire to ensure that (12*c*) disappears. In sum, the conversational implicature dimension is a negotiable part of denotations. Even after building conversational implicatures into the lexicon, we still call upon the maxims to determine where they actually arise.

15.3.2 CIs vs. Presuppositions

Presuppositions and CIs share the important lexicality property (1*a*), but they diverge on almost all other substantive points. Presuppositions are famously deniable (cancellable); Green (2000: 461) identifies this feature as one of the few things that all presupposition researchers agree upon. But presupposition denial seems a different affair from conversational-implicature denial. One might argue that presuppositions are not cancelled due to specific discourse factors broadly speaking, but rather due to specific structural configurations (being in the scope of a special kind of negation, for example).

Clause (1*d*), which specifies that CIs are independent of the at-issue content, articulates why these classes of meaning require different theoretical treatments. Almost all presupposition logics create a dependency between the presuppositions and the at-issue entailments. This is the guiding intuition behind the reconstruction of presuppositions in terms of partial logics: if expression *E*'s presuppositions are not true, then *E* should lack a defined value. (Karttunen and Peters 1979 might dissent from this statement; it depends on whether they intend their logic to model presuppositions in the usual sense.)

The exciting report in (13) nicely illustrates how the at-issue and CI dimensions operate independently.

(13) Lance Armstrong, an Arkansan, has won the 2002 Tour de France!

I know that Armstrong is a Texan; the CI is false. But I can still recover from (13) the information that Lance won the 2002 Tour and I need not accommodate the CI proposition to do this. In a multi-dimensional semantics, the situation is easy to describe in terms of truth values. If we stick to sentences containing one at-issue value and one CI value, we have a four-valued system akin to Herzberger's (1973) logic:

(14) $\langle 1, 1 \rangle \quad \langle 0, 1 \rangle$
$\langle 1, 0 \rangle \quad \langle 0, 0 \rangle$

In our world, the extensional value of (13) is $\langle 1, 0 \rangle$. In worlds where Armstrong is neither an Arkansan nor the 2002 Tour winner, (13) denotes $\langle 0, 0 \rangle$. Both $\langle 1, 0 \rangle$ and $\langle 0, 0 \rangle$ are the bane of a multi-dimensional theory of presuppositions. They represent situations in which a presupposition is false. One must either collapse these values to "undefined" (Beaver 1997: 956; Krahmer 1998: 143), or else admit only those valuations in which all presuppositions are true (van der Sandt 1988: 21). One or the other move is necessary to capture the intuition that *Ali doesn't realize her coat is on fire* is undefined if the presupposition that her coat is on fire is false.

The dependency of at-issue meanings on their presuppositions is the most important theoretical divide between CIs and presuppositions. The most important pretheoretical divide is this: Grice makes no provision that CI content should be backgrounded (van der Sandt 1988: 74), and, indeed, CI expressions usually offer information that is not part of the common ground when they are uttered. Although it is possible for true presupposition triggers to introduce novel information, this is accompanied by a particular discourse effect, namely, accommodation. In order to understand the utterance, the hearer must adjust his knowledge so that it entails whatever the speaker has presupposed. Outside of specialized discourse conditions, it is not possible to eschew accommodation—the adjustment is thrust upon any listener who wishes to use information provided by the utterance. As Heim (1992: 215, n. 6) says, following Soames (1989: 578–9), "there is no *de jure* accommodation" of a proposition **p** unless the context entails the negation of **p** already (and hence accommodation of **p** would "give rise to a communicative impass"; Soames 1989: 579).

Nominal appositives do not function in this way; their primary discourse function is to introduce new but de-emphasized material. Beaver (2001) makes this observation and supports it with an example so lovely it is worth repeating:

(15) "Sweden may export synthetic wolf urine—sprayed along roads to keep elk away—to Kuwait for use against camels."
(Associated Press, 19 Jan. 1995; cited in Beaver 2001: 20 (E34).)

Beaver observes that the proposition that wolf urine is sprayed along the roads to keep elk away is interpreted outside the scope of the modal, and that examples with this appositive below the other presupposition holes (negation, questioning, conditionalization) reveal the same invariance of this content. But the content is offered as new information—an aside, to be sure, but, as Beaver says, "the writer of the text very likely does not expect readers to have any previous knowledge of the subject" (p. 20). Chierchia and McConnell-Ginet (2000: 351–2) offer much the same verdict for appositive relatives.

The generalization is that NA content does not express backgrounded information. We can strengthen this claim to an anti-backgrounding requirement: in cases where the content of a supplement is part of the initial context, the result is infelicity due to redundancy, as in (16b).

(16) *a.* Lance Armstrong survived cancer.
b. When reporters interview Lance, a cancer survivor, he often talks about the disease.
c. And most riders know that Lance Armstrong is a cancer survivor.

With (16*a*) part of the context, the use of the factive predicate *know* in (16*c*) requires no accommodation of the content of its complement. But the same kind of backgrounding renders the appositive in (16*b*) infelicitous. As with at-issue content, we have an anti-backgrounding effect. In general, neither at-issue content nor CI content should be presupposed. (The exceptions to this explored by Horn (1991) show CIs and at-issue entailments patterning together.)

This suffices to establish that supplements do not meet the main pretheoretical requirements for counting as presupposed. The technical definition of "presupposition" is much more flexible, though. Recent theories of presupposition (or, at least, recent uses of the term) somewhat weaken the strength of this argument. Steedman (2000: 654) allows that "the listener rapidly and unconsciously adjusts his or her model of the domain of discourse to support the presuppositions of the speaker". If this can happen, then the difference between at-issue meanings and presuppositions is outside the bounds of detection by the usual sorts of linguistic argument. If accommodation is unconscious and freely available, then it is not distinguished from the sort of adjustments that speakers make to their models (world-views) when they accept new information. This basically assimilates presuppositions to at-issue meanings, a move that does not accord with colloquial uses of the term "presupposition".

Another compelling argument against a treatment of NAs as presupposed is that they are invariably invariant under the full range of presupposition plugs (verbs of saying and other performatives). Although Karttunen (1973: 177) observes that "all the plugs are leaky", in the sense that they sometimes allow presuppositions to escape them, it is in general the case that a plug stops presupposition inheritance. For instance, in (17), the proposition that it is raining is presupposed by *realize*, but not by the whole sentence.

(17) Ed said that Sue realized that it was raining. (Later, we found out that Ed's report was wrong. Sue cannot have realized it was raining, because it was not.)

Here again, we find that appositives behave differently. Example (3*a*) has the appositive inside the complement to *say*. But the only reading of the sentence is one in which the appositive's content escapes through this plug. This intuition is expressed in all the work on appositives known to me. (On NAs and appositive relatives, see Thorne 1972: 553; Karttunen 1976: 367; Emonds 1976: sect.II9; Emonds 1979; McCawley 1998: 451; Aoun et al. 2001; Potts 2002*a*: 83.) Boër and Lycan (1976) claim to find a small group of speakers for whom appositive content can end up in the scope of a cleft negation like *it is false that*. (I refer to Potts 2005 for a reassessment of their data and claims, which partially conflate direct and indirect quotation.) But they do not challenge the idea that appositives always scope outside of propositional attitude predicates (see Boër and Lycan 1976: 21, (45)). However, I have met speakers who claim to allow appositives to be interpreted inside propositional-attitude contexts. In assessing such claims, one must keep in mind that nothing about placing an NA inside a propositional-attitude context entails that the subject of that propositional attitude verb *disbelieves* that NA's content. In (18), we do not attribute to Sheila the proposition that Chuck is *not* a psychopath, nor do we even indicate that Sheila is agnostic about the truth of this proposition.

(18) Sheila believes that Chuck, a psychopath, is fit to watch the kids.

What is more, propositional-attitude predicates like *believe* do not impose any exhaustivity requirements, even as conversational implicatures. In saying *Sheila believes that Chuck is fit to watch the kids* one does not suggest that this is the only thing Sheila believes. So one is unlikely to arrive at the implicature that the subject of a propositional attitude verb does *not* endorse the content of an embedded NA. What one might do is draw the conversational implicature that the subject of the attitude predicate shares the speaker's beliefs. This is the most likely source of apparently embedded readings.

In light of this situation, I see just one way to test for cases of semantic embedding: follow the sentence in question with an explicit disavowal, in a main-clause utterance, of the content of the supplement. Such a continuation should reduce possible readings of the supplement to embedded ones if such exist, since the primary-scope reading is inconsistent. A relevant test case:

(19) Sheila believes that Chuck, a psychopath, should be locked up. #But Chuck isn't a psychopath.

I marked this example according to my intuitions, which are reflected in the work cited above by McCawley, Emonds, and others, which, when taken together, constitute compelling evidence that we do not have genuinely embedded readings.

15.3.3 CIs and Intonational Meanings

Any attempt to reduce CIs to intonational meaning would be a fundamental mistake; intonational meaning is not a kind of meaning like presupposition or conversational implicature, but, rather, a means for invoking additional non-at-issue content. Such content can yield conversational implicatures (focus on a phrase can suggest the falsity or irrelevance of alternatives). It can yield presuppositions (perhaps in interactions with additive modifiers like *too*; Heim 1992). And it can lead to CIs. In the analysis developed below, COMMA INTONATION plays a central role in the CI-based analysis of NAs. The initial sentences in (20*a*) and (20*b*) differ superficially only with regard to comma intonation. The continuations show that they have a contrasting semantics.

(20) *a.* Armstrong, the cyclist, is from Texas. #Armstrong, the astronaut, is from Ohio.
b. Armstrong the cyclist is from Texas. Armstrong the astronaut is from Ohio.

Speakers reliably indicate the comma intonation with dashes, parentheses, or commas. In speech, we get clear intonational-phrase boundary marks on either side of the appositive. This holds for a wide variety of appositive and parenthetical expressions that are profitably analysed as CI contributors. Huddleston and Pullum (2002: sect. 16) use the term "integrated" for constructions like *Armstrong the cyclist* in (20*b*). My proposal is that NAs, but not integrated appositives, have a special feature COMMA that can appear in syntactic structures. The semantics for this feature shift at-issue content to CI content.

15.3.4 CIs vs. At-Issue Meanings

Clause (1*d*) says, in no uncertain terms, that CIs are distinct from at-issue meanings (Grice's "what is said (in the favored sense)"). The above sections show that that clause has bite: NAs are invariant under presupposition holes and plugs, whereas at-issue content is highly sensitive to such operators.

Clause (1*c*) entails an additional split. A rigid interpretation of this clause (the one I adopt) means that a CI is never relativized to the beliefs of any entity other than the speaker. But at-issue content certainly is; in *Sue wrongly believes that it is raining*, the at-issue proposition that it is raining is asserted to hold only in *Sue's* belief worlds. Thus, this embedded proposition is not speaker-oriented, and hence not classifiable as a CI contribution, by (1*c*). We have already seen cases in which NAs are inside indirect quotations and yet interpreted relative to the beliefs of the speaker of the utterance.

However, CI and at-issue content are united in one fundamental respect: both are species of entailment. Hence, it might seem initially desirable to treat them as one. In section 15.2, I explored and rejected a syntactic alternative that could facilitate this reduction. In section 15.6, I outline a scope-shifting approach that involves only at-issue meanings. When fully articulated, such an approach duplicates the main features of the CI-based analysis reviewed in the next two sections.

15.4 A CI Logic

Most past proposals for CIs do not offer a formalism for talking about such meanings. With "conventional implicature" often merely a label, it is not surprising that many have turned to more familiar concepts in handling them. This section takes the step of formulating a description logic for natural-language expressions with CI dimensions. The approach is based on that of Karttunen and Peters (1979), though I apply their proposal to a much different factual domain.

A major innovation of Karttunen and Peters (1979) is that meaning language terms are marked as either at-issue or CI (their "extensional" and "implicature" meanings, respectively). I implement the distinction via the set of types in (21). (I provide intensional types but work almost exclusively with extensional ones.)

(21) *a.* e^a, t^a, and s^a are basic at-issue types.
b. e^c, t^c, and s^c are basic CI types.
c. If τ and σ are at-issue types, then $\langle \tau, \sigma \rangle$ is an at-issue type.
d. If τ is an at-issue type and σ is a CI type, then $\langle \tau,\sigma \rangle$ is a CI type.
e. The full set of types is the union of the at-issue and CI types.

I assume that the types serve to organize the terms of the meaning language. Thus, type distinctions need not reflect model-theoretic distinctions. For this chapter we can assume that for any $\tau \in \{e, t, s\}$, the types τ^a and τ^c have the same domains, and that for any types σ and ρ, if $\langle \sigma, \rho \rangle$ is a type, then the domain of $\langle \sigma, \rho \rangle$ is the class of functions from the domain of σ to the domain of ρ. This syntactic conception of types is rare in linguistics, where types more often serve only to organize the interpreted structure (Montague 1970; Halvorsen and Ladusaw 1979). But the job that they perform in the present chapter is familiar. They serve roughly the same purpose as syntactic categories such as N and V, which organize the natural-language lexicon. And the relationship between the types and the models resembles Montague's (1973) decision to assign different syntactic categories to common nouns ($t//e$) and intransitive verbs (t/e) while giving them the same type of translation and models. In essence, I recruit the types to do work often assigned to a categorial syntax.

The definition is asymmetric in this important sense: we have CI types in which the first member is an at-issue type and the second is an CI type. These correspond to the intuition that CIs are comments upon the at-issue core: in a sense, they borrow from the at-issue dimension. But we do not have any types in which the first member is a CI and the second an at-issue type. This would result in an at-issue composition that incorporated CI content, violating condition (1*d*) of the definition of CIs. The pair in (22) helps indicate why the distinction we are after is not model-theoretic.

(22) *a.* Lance, a cyclist, is from Texas.
b. Lance, a Texan, is a cyclist

In (22*a*), the proposition that Lance is a cyclist is expressed as a CI. In (22*b*), this same proposition is expressed as an at-issue entailment. It seems a confusion to treat these propositions as model-theoretically distinct. For instance, CI content is as capable as at-issue content of serving as the antecedent for intersentential anaphoric dependencies like verb-phrase ellipsis, verb-phrase and sentential pro-forms, and presuppositions (which are anaphoric in the sense of van der Sandt 1992). Similarly, since no at-issue operators take scope over them, NAs are often able to establish discourse referents. Once we get beyond the internal composition of sentences and consider only the context, the line between at-issue and CI content disappears. This is expected if they have the same models.

The advantage of the types is that they regulate composition via the set of well-formed lambda terms. The first tree in (23) is well formed, whereas the second is not.

(23) *a.*

$$\dfrac{\lambda p \lambda x.\, \mathbf{believe}(p)(x) : \langle t^a, \langle e^a, t^a \rangle\rangle \qquad \mathbf{cyclist}(\mathbf{lance}) : t^a}{\lambda x.\, \mathbf{believe}(\mathbf{cyclist}(\mathbf{lance}))(x) : \langle e^a, t^a \rangle}$$

b.

$$\dfrac{\lambda p \lambda x.\, \mathbf{believe}(p)(x) : \langle t^a, \langle e^a, t^a \rangle\rangle \qquad \mathbf{cyclist}(\mathbf{lance}) : t^c}{\text{undefined}}$$

Tree (23*b*) suffers a type mismatch: the functor is of a type that requires at t^a input. It is offered only a type t^c input.

The type mismatch in (23*b*) represents a desirable gap in the type-logical space defined in (21). The functor is an appropriate extensional meaning for a propositional attitude verb. The CI proposition in its complement cannot serve as its argument. Moreover, we cannot have propositional attitude verb meanings that take CI meanings as their arguments. Such a verb would have to be of type $\langle t^c, \langle e^a, t^a \rangle\rangle$, that is, it would have to have an initial member of CI type but itself be of at-issue type. Such types are not in the set defined in (21). Analogous reasoning applies to negation, conditionals, modals, and the like. This is the basis for the explanation for why CIs never form part of the argument to these operators. We also have an explanation for why CI operators never take CI meanings as their arguments. For instance, in (24), the available reading of the *As*-parenthetical (argued in Potts 2002*b* to be a CI construction) ignores the content of the NA.

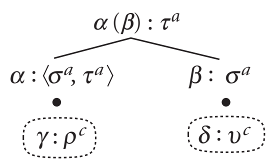
(24) *a.* As Sue said, Lance Armstrong, a cancer survivor, won this year's Tour.
b. *As*-parenthetical = Sue said that Lance Armstrong won this year's Tour
c. *As*-parenthetical ≠ Sue said that Lance Armstrong is a cancer survivor
d. *As*-parenthetical ≠ Sue said that Lance Armstrong is a cancer survivor and that he won this year's Tour.

Kratzer (1999) makes similar observations about the interaction of the German discourse particle *ja*, which means something like 'as you probably know', and epithets: *ja* ignores appositive epithets that appear to be in its scope. On the present approach, this is the behaviour we expect. We do not have any types $\langle \sigma^c, \tau^c \rangle$, and hence no way to allow such combination schemes.

The remaining logical issue I address here is the nature of semantic composition. I state the composition principles as tree-admissibility conditions, which place restrictions on singly rooted trees with a branching factor of at most two. These structures have a dominance relation, but no linear precedence relation. We can associate the semantic predictions of the theory with the set of finite parse trees consisting only of subtrees licensed by the conditions in (25), (26), (27), and (35), along with a condition that says a single-node tree decorated only with a lexical meaning is well formed.

For at-issue composition, I adopt the rule in (25), which is a version of the rule for functional application of sisters of Klein and Sag (1985: 171) and Heim and Kratzer (1998: 44), but here stated over semantic parse trees and with the specification that we are dealing only with terms of at-issue (superscript *a*) type.

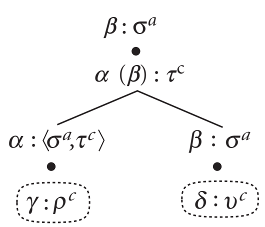
(25) At-issue application



As noted above, the terminal elements are not ordered by any linear adjacency relation. Here and in the statement of the other rules, I indicate optional material inside dotted lines. The motivation for the optional material is that we must allow that there might be CI content hanging around. The rule for parse-tree interpretation, (28) below, ensures that such material forms part of the overall interpretation. But it is not relevant to the local calculations that these rules determine. The bullet • is a metalogical symbol for graphically separating independent lambda terms; it has no interpretation.

We come now to the central tree-admissibility condition, CI application:

(26) CI application



The action of (26) is easy to describe: if a functional CI term is sister to an at-issue term in its domain, then we apply that CI term to the at-issue term to yield part of the value of their mother. But we also pass on to their mother the unmodified value of the at-issue term. In the parlance of resource-sensitive logics like linear logic and categorial grammar, we *multiply consume* the at-issue meaning. Multiple consumption is permitted only in this specific configuration; I claim that it lies at the heart of the way CI meanings interact with the at-issue semantics.

This rule functions to ensure that the at-issue dimension is always insensitive to the presence of adjoined CI operators. In other words, for any tree $\mathcal{J}$, the at-issue content of $\mathcal{J}$ is the same as the at-issue content of the tree $\mathcal{J}$ obtained from $\mathcal{J}$ by pruning all nodes dominating items with a CI semantics (i.e., translating as a term of type σ^c).

I posit a special rule, Feature semantics, for representing the semantic contribution of certain syntactic features.

(27) Feature semantics

$$\begin{array}{c} \beta(\alpha):\tau \\ | \\ \alpha:\sigma \\ \bullet \\ \boxed{\beta:\upsilon^c} \end{array} \qquad \text{(where } \beta \text{ is a designated } \textit{feature term} \text{ of type } \langle\sigma,\tau\rangle)$$

This rule sees heavy use in the analysis of CIs; in the diagram in (5), it is the rule that permits us to include the **comma** in the semantics.

A single sentence might contain multiple CIs, as in *Ed, a plumber, is married to Sue, a physicist.* One can imagine a variety of methods for ensuring the proper interpretation (a heritage function, a CI store). The most direct method, the one adopted here, simply gathers together the desired meanings:

(28) Parse-tree interpretation
Let $\mathcal{J}$ be a semantic parse tree with the at-issue term α on its root node, and distinct type t^c CI terms $\iota_1, \ldots, \iota_n$ on nodes in it. Then the interpretation of $\mathcal{J}$ is the tuple

$$\langle [\![\alpha]\!]^{\mathcal{M}}, \{[\![\iota_1]\!]^{\mathcal{M}}, \ldots, [\![\iota_n]\!]^{\mathcal{M}}\}\rangle$$

where $[\![\ ]\!]^{\mathcal{M}}$ is the interpretation function, taking formulae of the meaning language to the interpreted structure $\mathcal{M}$.

It is time now to look at the internal structures of NAs, to see how to capture the conditions on these constructions using the multidimensional logic just defined.

15.5 A Multidimensional Analysis of NAs

15.5.1 The Anchor

In general, quantified expressions are not possible anchors in NAs:

(29) *a.* *Every climber, {an/the} experienced adventurer, was found sipping hot cocoa in the lodge.
b. *No climber, {an/the} experienced adventurer, was found sipping hot cocoa in the lodge.

This is part of a broader generalization:

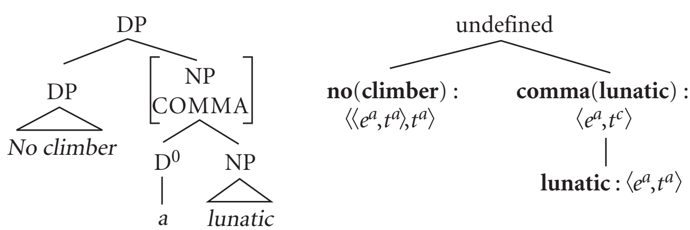
(30) Non-restrictive modifiers associate only with referring expressions (Thorne 1972: 553; Karttunen 1976: 367; McCawley 1998: 451; Potts 2002a: 83; Huddleston and Pullum 2002: 1060; and others).

(31) *a.* *Susan interviewed every senator, who is crooked.
(McCawley 1998: 451, (24b′))

b. *No person, who knows everything, is perfect.
(McCawley 1998: 451, (24c′))

c. *No candidate, who scored 40% or more, ever failed.
(Huddleston and Pullum 2002: 1060, (7i))

The CI logic (considered so as to include lexical items) cannot derive meanings for structures in which the anchor is quantified. I illustrate in (32).

(32)


The quantifier cannot take the appositive as its argument, because the appositive is of type $\langle e^a, t^c\rangle$ but the quantifier takes only meanings of type $\langle e^a, t^a\rangle$. So we have a type mismatch. To ensure that this type mismatch holds for all structures, we need to say that the appositive cannot shift to type $\langle\langle\langle e^a, t^a\rangle, t^a\rangle, t^c\rangle$, taking the quantifier meaning as its argument. The meaning we would derive for *No climber, a lunatic, survived* would be equivalent to *No climber is a lunatic; no climber survived.*

But such type-shifting is easy to prevent. Type-shifting functions are of course terms of our logic. In order to take a CI term τ of type $\langle e^a, t^c\rangle$ into a term of type $\langle\langle\langle e^a, t^a\rangle, t^a\rangle, t^c\rangle$, we would require a type-shifter with the type:

$$\langle\langle e^a, t^c\rangle, \langle\langle\langle e^a, t^a\rangle, t^a\rangle, t^c\rangle\rangle$$

Both immediate subtypes of this type are, of necessity, CI types. The type definition does not contain such types. The only remaining concern is that the type shift might happen prior to the move to CI types. To block such a composition scheme, we just need to limit the range of types that **comma** can have. For this chapter, I assume that the only possibility is (40).

So the logic itself handles a ban on quantified anchors quite nicely. But the underlying generalization is more complicated than this. An example of a grammatical anchor that has the form of a quantifier is (33*a*), which I owe to Lyn Frazier (p.c., 2/03).

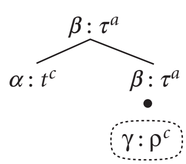
(33) *a.* Every climber, all experienced adventurers, made it to the summit.
b. Every climber, experienced adventurers all, made it to the summit.
c. *Every climber, experienced adventurers, made it to the summit.

How are these cases best handled? In locating an answer, I think we should look at examples like (34).

(34) The students, most of them linguists, missed the bus.

In this example, the appositive is semantically complete. It is a small clause of some kind. It needn't apply to the meaning of *the students*, though this appears to be its syntactic anchor. The logic developed in Potts 2005 includes the tree-admissibility condition Isolated CIs, (35), which allows this kind of appositive into semantic parsetrees.

(35) Isolated CIs



This rule licenses structures in which the CI bears no semantic function–argument relation to its anchor. If we analyse *all experienced adventurers* as:

$$\lambda w.\ \forall x[\mathbf{climber}_w(x) \rightarrow (\mathbf{experienced}_w(x) \wedge \mathbf{adventurer}_w\ (x)) : \langle s^a, t^c \rangle$$

then we can use Isolated CIs and maintain the descriptive generalization about true NAs and quantified anchors.

15.5.2 The Appositive

In most cases, the appositive is property-denoting; the result is that NAs are strongly reminiscent of predicative copular clauses with individual-denoting subjects. The syntax seems not to impose further limitations: nominal, adjectival, and prepositional phrases are all possible, as seen in (2).

In general, quantified appositives are ungrammatical (excepting cases like (34) and (33), discussed above as involving propositional appositive meanings). Some examples:

(36) *a.* *We spoke with Tanya, every assistant in the department, about the broken printer.
b. *We approached Tanya, most support staff, about the broken printer.
c. Armin, Jaye, and Junko, (*all) the tenured phonologists at UCSC, got their doctorates from UMass.

However, quantifiers that can appear in predicative positions are also fine in NAs:

(37) *a.* We spoke with Hillary, no amateur climber, about the dangers.
b. We spoke with Tanya, everything to everyone around here, about the broken printer.

The parallel between predicative copular constructions and NAs is grounded in the logic itself. In general, theories of predicative copular constructions converge on a function–argument structure in which the predicate applies to the subject. In NAs, the appositive applies to the anchor in roughly the same way.

15.5.3 Comma Intonation

A central feature of Grice's definition of CIs is that they are part of lexical meanings. It is not immediately obvious how to fit NAs into this picture. I argue that we should take a cue from the fact that comma intonation is often the only perceptible difference between appositives and their integrated counterparts. The guiding idea is that it is COMMA that enables NAs to meet the specification in Grice's (1975) definition that CIs be lexical. The shift from at-issue to CI content is achieved by the semantic reflex of the syntactic feature COMMA.

For basic NAs, we need the meaning of COMMA to take $\langle e^a, t^a \rangle$ expressions to $\langle e^a, t^c \rangle$ results:

(38) $\text{COMMA} \rightsquigarrow \lambda f \lambda x.\, f(x) : \langle \langle e^a, t^a \rangle, \langle e^a, t^c \rangle \rangle$

I henceforth write this meaning as **comma**. It works in conjunction with Feature semantics, (27), to license subtrees of the form in (39), a part of (5).

(39) $$\begin{array}{c} \textbf{comma}(\textbf{cyclist}) : \langle e^a, t^c \rangle \\ | \\ \textbf{cyclist} : \langle e^a, t^a \rangle \end{array}$$

In order to allow for COMMA to play a role in isolated CI examples like those in (33), we need a slightly more general meaning for COMMA:

(40) $\text{COMMA} \rightsquigarrow \lambda X \lambda x.X(x) : \langle \langle \sigma^a, t^a \rangle, \langle \sigma^a, t^c \rangle \rangle$, where $\sigma \in \{e, s\}$

15.5.4 There Are No Inverted Cases

It seems at first as though examples like (41*a*) are best analysed as inverted variants of (41*b*).

(41) *a.* A former linguist, Edward Witten, is now the top dog in string theory.
b. Edward Witten, a former linguist, is now the top dog in string theory.

On an inverted analysis, the semantic parse trees for the subjects in (41) would be identical to each other (recall that the leaves of the parse trees are not ordered). The differences would reside entirely in the syntactic structures.

But all the evidence known to me suggests that this is incorrect. We must state that NAs always involve right-adjunction of the appositive to the anchor in the syntax, and, moreover, that this right-adjoined item is always the functor. Clear evidence for this analysis derives from existential constructions. Consider, first, the existential-*there* environment in (42).

(42) *a.* There was a former linguist at the party.
b. There was a former linguist, Ed Witten, at the party.
c. #There was Ed Witten at the party.
d. #There was Ed Witten, a former linguist, at the party.

We see definiteness effects only when the left-hand nominal is definite. These facts suggest that the anchor—the at-issue meaning contributor that interacts with the meaning of *there be*—is always on the left. That claim is bolstered by another existential construction, the one determined by *have* (Partee 1999). This environment imposes somewhat different restrictions than existential *there*, but the prohibition on referential expressions is constant across both constructions. An inverted analysis of the complements to *have* in (43) wrongly predicts that (43*d*) is semantically identical to (43*b*).

(43) *a.* Ray had a student.
b. Ray had a student, Ed Witten.
c. #Ray had Ed Witten.
d. #Ray had Ed Witten, a student.

Finally, I offer some support from a slightly different domain: the two kinds of NA behave differently with regard to definite appositives, as seen in (44).

(44) *a.* Lance Armstrong, the cyclist, is from Texas, where he sometimes trains with fellow cyclists.
b. #The cyclist, Lance Armstrong, is from Texas, where he sometimes trains with fellow cyclists.

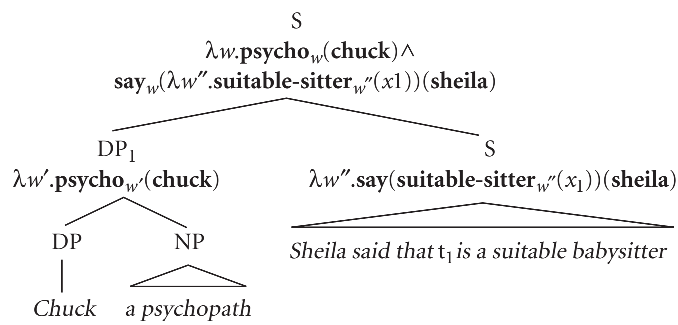
In general, speakers use a definite article in the appositive part of an NA when the NA expresses an essential or defining property of the anchor's denotation. (This property might have little to do with furthering the argument or narrative.) Speakers use an indefinite article in the appositive part of an NA when the NA expresses a proposition that is essential to furthering the argument or narrative. (The information might have little to do with fixing or understanding the meaning of the anchor.) There is not space to explore the nature of these generalizations, the free variation they predict when the appositive is essential both to the anchor and the narrative, or the question of why the options are not available for appositive relatives. I note only that we are left helpless even to describe these facts if the examples in (44) are viewed as semantically identical.

15.6 A Scope-Shifting Alternative

Given a sufficiently rich and flexible theory of intensionality, it is possible to provide a semantics for NAs that meets the definition in (1). Though such an account has not to my knowledge been formulated yet, one can see how it might go. The essential step is the stipulation that NAs are always evaluated as though they were rootlevel clauses. That is, we saturate their intensional argument with the actual world (or world–time pair, etc.). The account requires a movement operation or a type-shifting equivalent, for the simple reason that NAs have both propositional and individual components of meaning. *Chuck, a psychopath* denotes both the entity Chuck and the proposition that Chuck is a psychopath. In a one-dimensional theory, multiple components of meaning can, to a limited extent, be modelled by moving them, resulting in a kind of discontinuous constituent. In (45) and (46), the proposition-denoting NA is adjoined at the root level and syntactically associated with an individual-denoting trace.

(45) Sheila said that Chuck, a psychopath, is a suitable sitter.

(46)



In order to arrive at this structure, we must appeal to a number of extra assumptions. First, the raised NA, though proposition-denoting, must leave behind an individual-denoting trace that it does not bind in the semantic sense. A metalogical condition on admissible assignment functions must ensure that this trace denotes the same individual that the anchor in the raised appositive denotes.

A second requirement: we must stipulate that the NA always raises to adjoin to the root. As we have seen, NAs never appear in the scope of any other operator.

The CI approach achieves this by ensuring that an NA's content cannot form (part of) the argument to anything. On this scope shifting alternative, we must cash out the facts in terms of obligatory widest scope. The condition can be formulated as a statement that any NA appears as daughter to the root node syntactically, roughly as in the supplement-relation account rejected in section 15.2. But this essentially removes any genuine parallel between NA interpretations and other expressions held to undergo quantifier raising or an equivalent. The closest example is that of indefinites, which can take widest scope even when deeply embedded. But they can also take narrow and intermediate scopes (Farkas 1981; Reinhart 1997). This variability is precisely what motivates a scope-shifting account of them.

My final objection is fundamental: (46) denotes just one proposition (a single truth value in a given world). But (13) shows that NA content and at-issue content can have different values even in a single situation and utterance: the NA can be false, the at-issue content true, or the reverse. The analysis in (46) is not so flexible. If either conjunct is false, so is the whole.

We should ask what is right about the scope-shifting solution. Stepping back, we see that some essential ingredients are here, but obscured by the formalism. The special conditions we have to place on how NAs move and what they associate with are versions of the lexical marking that is achieved in a single stroke (type assignment) within the CI analysis. In order to bring the scope-shifting analysis in line with the multidimensional insight (1) expresses, we must allow that the propositional denotations of the root node's daughters remain separate. That is, the structure itself should denote a pair of meanings. This is precisely what the interpretation rule (28) achieves.

15.7 Conclusion

Until recently, conventional implicatures appeared in danger of getting dropped entirely from semantic theory, or else swallowed up (via shifts in terminology) by other mechanisms. But when we return to Grice's (1975) definition and consider its entailments closely, we find that CIs are both irreducibly distinct from other meanings and widely attested in natural language. What is more, the multidimensional approach that Karttunen and Peters (1979) introduced into linguistics provides the basis for a satisfactory formalization. By separating the at-issue and CI dimensions, we achieve the needed independence of the two classes of meaning without further stipulation.

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CHAPTER 16

ACCOMMODATION

DAVID BEAVER AND HENK ZEEVAT

16.1 What is Accommodation?

16.1.1 A Simple Example

Our heroine has landed herself in a difficult spot. From all sides dangerous criminals are approaching. She reports (1).

(1) I knew they would show no mercy.

Innocent as it may seem, this example is problematic for theories of presupposition that assume that whatever is presupposed must be known to speaker and hearer prior to utterance. Sentence (1) contains the word *know* and the use of this verb is generally assumed to presuppose its complement. But our example may well be the first time that our heroine informs us of the treatment she expects at the hands of the villains. The operation that helps us out here is ACCOMMODATION, and involves making it common ground between us and the speaker that the complement is true. Lewis (1979), who brought the term "accommodation" into use among philosophers of language and semanticists, conceived of it as a repair strategy: the hearer recognizes that something is wrong, sees that the

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day can be saved by adding the missing presupposition and proceeds to do just that.[1]

Accommodation is something you do in deference to the wishes of another. This explains why the word is used frequently in the tourist industry. More worrying is that there is also another technical linguistic use of accommodation, namely, that in sociolinguistics (Giles et al. 1987). Here it refers to conscious or unconscious attempts by interlocutors to adapt their linguistic habits (e.g. in pronunciation, choice of words and constructions, posture) to the habits of other interlocutors, typically by taking over some of the other interlocutors' behaviour. While both the sociolinguistic and semantic/pragmatic uses of "accommodation" describe adaptations made to enhance communicational success, the two coinages are distinct and historically unconnected.

For the most part, cases of accommodation discussed here pertain to presuppositions that are identifiable via a standard set of diagnostics, in particular PROJECTION TESTS. The primary evidence that (2*a*) presupposes (2*b*) is that (2*b*) follows not only from utterances of (2*a*), but also from sentences in which (2*a*) is embedded. Typically, presuppositions follow from embeddings under negation as in (2*c*), from embeddings under modals as in (2*d*), and also from embeddings involving questions, conditionals and various other constructions.[2]

(2) *a.* Mary realizes it is raining.
b. It is raining.
c. Mary does not realize that it is raining.
d. Perhaps Mary realizes that it is raining.

Examples of constructions which, according to projection tests, carry presuppositions include a huge range of constructions, such as definite descriptions, factive verbs, aspectual markers, demonstratives, politeness markers, names, and various discourse functional markers. Collectively, these are known as "presupposition triggers".

Given that accommodation happens, two questions arise: what is accommodated, and where?[3] The "where" question arises because in processing a complex

[1] Burton-Roberts (1989) and Gauker (1998, 2003) exemplify those who take the existence of cases like (1) to undermine theories of presupposition, particularly the account of pragmatic presupposition developed by Stalnaker (1972, 1973, 1974). See von Fintel (2000) for discussion of these arguments. Note that in the 1970s, both Stalnaker and Karttunen (1974) gave examples of informative presupposition, and independently described an accommodation-like process, although at the time they did not describe the process as accommodation. See also Simons (2003) for discussion of how Stalnaker's views on accommodation depart from those of Lewis. Note that Lewis also introduced the standard technical notion of common ground as mutual knowledge—see Lewis (1969) and Clark and Marshall (1981).

[2] There are by now a large number of handbook articles discussing presupposition, all of which introduce the projection tests. See e.g. the extended articles of Soames (1989), Beaver (1997), or the pithier overviews of Horn (1994, 1995) and Roberts (1999).

[3] Note that in our technical sense the verb *accommodate* takes information as its direct object i.e. information which is missing and must be added. This contrasts with the everyday use of

sentence multiple contexts may be involved—for example, a belief sentence will involve both a global context which the speaker is proposing as the new common ground and an embedded belief context. We will turn to the complexities that arise when there are a multiplicity of possible accommodation sites in section 16.2.

As will be discussed below, accommodation is an inferential process which is subject to pragmatic constraints. On the other hand, presuppositions, which accommodation operates on, are standardly (though not universally) taken to arise as a part of lexical meaning, and to engage in complex interactions with semantic operators such as quantifiers, attitudinal predicates, and conditionals. Thus the discussion in this chapter will concern one linguistic interface in particular, namely, that between semantics and pragmatics.

16.1.2 Semantic Presupposition and Pragmatic Presupposition

As regards what is accommodated, Lewis took a broad view, not limited to classic cases of presupposition. He considered also accommodation of a point of view (e.g. by using *coming* or *going* we take an implicit position near the destination or departure point, respectively), accommodation of a standard of precision in cases of vagueness (c.f. Barker 2002), accommodation of domains of possibilities involved in modal statements, and even accommodation of a getaway car during the formulation of a plan to steal plutonium. Thomason (1990) is easily read as providing a quite different answer from Lewis to the question of what is accommodated. Thomason takes accommodation to be a move a hearer can make in order that the cooperative intent of the speaker is realized. For him, accommodation is motivated by a need to "[a]djust the conversational record to eliminate obstacles to the detected plans of your interlocutor". Thus accommodated material may include not only facts about the subject matter of the discourse but also facts about the joint or individual plans of the interlocutors. In contrast, Lewis seems to suggest the simplest possible answer to the question of what is accommodated: accommodate only what is needed.

Suppose we accept the Frege-Strawson view (*contra* e.g. Gazdar 1979) that presuppositions are necessary conditions on meaningfulness associated with particular expression types ("presupposition triggers", as we now call such expressions). Then Lewis seems to suggest that hearers would accommodate whatever is the minimum information needed to satisfy those conditions. That is, if an expression presupposes p, and p is not satisfied, what we accommodate is just p. This is close to what is found in the account of van der Sandt (1992) (see also Zeevat

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accommodate for which the direct object is the person for whom we are making adaptations, not the adaptations themselves. Perhaps the contrast reflects a bias of semanticists towards propositions rather than people.

1992 and Geurts 1999 for developments of the theory). But Thomason's account implies that what is accommodated could stand in a much more nebulous relation to what is conventionally presupposed: we accommodate whatever seems most appropriate to make sense of the speaker's intentions in the light of our joint communicational goals. That is, while what we accommodate must satisfy conventionally signalled presuppositions, it may also incorporate other information. Much of what Grice calls "conversational implicature" might fall under Thomason's notion of accommodation.[4]

To adopt standard terminology, let us term necessary conditions on meaningfulness "semantic presuppositions", something close to that described by Frege (1892) and Strawson (1952). Following Stalnaker (1972), let us term what a speaker takes for granted "pragmatic presuppositions". Then the idea of accommodating more than is presupposed may be sharpened as follows: whatever is semantically presupposed is pragmatically presupposed, but semantic presuppositions are only a weak reflection of the full set of assumptions made by speakers. When a hearer detects a semantic presupposition, the hearer tries to understand what set of speaker's assumptions lie behind it. The hearer accommodates a best guess as to what these assumptions are.

This view of accommodation is compatible with that developed in the Context Change model of presupposition developed by Heim (1982, 1983), a model which builds on that of Karttunen (1973, 1974) as well as Stalnaker's and Lewis' work. In the Context Change model, semantic presupposition corresponds not to conditions on meaningfulness, but rather to conditions on appropriateness of the update. Normally, we only use a sentence to update our information state if the presuppositions of the sentence are satisfied in our existing information state. Accommodation must occur whenever our existing information state does not satisfy the presuppositions associated with the sentence being processed—a view very much in tune with Lewis's. However, Heim is not explicit as to whether what is accommodated corresponds to what is semantically presupposed or what is pragmatically presupposed (if either). Beaver (1999, 2001) argues that the Context Change model must be extended such that pragmatic presuppositions are accommodated, and ends up with a model which has much in common with Thomason's. Examples which Beaver attempts to account for include the following:

(3) If Spaceman Spiff lands on Planet X, he'll notice that he weighs more than on Earth.

[4] Hobbs's abductive account of comprehension is related to Thomason's, and subsumes accommodation and implicature within a broader computational setting. Much of the relevant work remains unpublished, but see Hobbs et al. (1990). Another inferential framework which unites implicature and accommodation is that set out by Asher and Lascarides (1998, 1999, 2003), who take presupposition accommodation to be subsumed under a more general operation they term "binding [...] to the context with a rhetorical relation".

The semantic presupposition of (3) depends upon whose theory of semantic presupposition is adopted. It might be either that Spiff weighs/will weigh more than on Earth, or that if Spiff lands on X he will weigh more than on Earth. However, Beaver maintains that what we accommodate corresponds to neither of these. Rather, it seems that the speaker might plausibly be assuming that Planet X has a particularly high gravitational field, such that whenever someone lands on X, that person weighs a lot. Beaver suggests that a hearer might accommodate this stronger, universal proposition, or some other set of assumptions which entail what is semantically presupposed.[5]

16.1.3 Accommodation and Implicature

Accommodation involves a hearer's inference. But not all hearer's inferences count as accommodation. It is worth considering to what extent accommodation is distinguished from conversational implicature, especially since work like Thomason's ties accommodation and conversational implicature closely together. When discussing conversational implicatures it is helpful to restrict attention to generalized implicatures such as those associated with scales, such as *Mary is content* implicating that Mary is not in a state of ecstasy. Thus we ignore for the moment particularized implicatures, those which follow from specific facets of a given conversational context rather than from general properties of language or the lexicon. None of the cases of accommodation we consider here are candidates for particularized implicatures, since they are inferences which regularly occur whenever certain lexical items are used. Particularized implicatures tend to be independent of specific lexical items: they are "detachable" in the terminology of Grice (1989)—see also Levinson (1983) on detachability, or Levinson (2000) for an extensive recent study of conversational implicature, though he concentrates on generalized rather than particularized implicatures. Generalized conversational implicatures resemble accommodation in that they involve inferences that go beyond the ordinary content of the sentence. The main property differentiating these two types of inference concerns the role of context and what is taken for granted. Generalized conversational implicatures concern new information: the speaker typically believes that the hearer was unaware of the content of the implicature prior to the utterance, and does not assume the implicature would have been contextually available to the hearer if there had been no utterance. On the other hand, accommodation concerns information that the speaker assumes is independently available to the hearer (or, *pace* Stalnaker 1974, that the speaker pretends to assume is available).

[5] See Geurts (1999) for critical discussion of Beaver's model. The accounts of Hobbs and of Lascarides and Asher (see n. 4) also allow that more information is accommodated than is minimally necessary to satisfy semantic presuppositions.

There is a grey area between accommodation and implicature. In the classic case of a sign like that in (4), the author of the sign need not assume that the fact that cheques are unacceptable is common ground.

(4) The management regrets that this establishment cannot accept cheques.

Similarly, once we move to particularized implicatures, there is often such a mixture of presupposition and implicature that the two cannot be cleanly distinguished. The utterer of (5) appears to presuppose ownership of a bike, but does the speaker presuppose or implicate that the bike was the method of transport that was (or would have been) used to transport the speaker? How about the implication that if the bike had been in working order, the speaker would not have been late? Quite possibly, both presupposition and implicature are involved at every stage. For example, the speaker may take it for granted that most hearers know the bike was to have been used, and yet believe that there are also further hearers who will have to infer this information.

(5) I am sorry I am late. My bike has a flat.

In spite of the existence of individual cases that are hard to classify, the bulk of inferences we will consider in this chapter clearly concern accommodation rather than Gricean implicature: they concern adaptation on the part of the hearer in the face of assumptions that the speaker has made, and are not obviously derivable using arguments based on Grice's maxims.[6]

If accommodation occurs in response to assumptions that the speaker has made, then we might expect that anything which indicates that something has been assumed could trigger accommodation. Lewis has often been taken to say as much:

> Say something that requires a missing presupposition and straightaway that presupposition springs into existence, making what you have said acceptable after all. (Lewis 1979: 339)

Contra Lewis, accommodation is a tightly constrained process. For one thing, hearers do not like to accommodate what is plainly implausible: given the opportunity they would normally express disquiet at being asked to do so. Also, hearers do not accommodate destructively, which would overwrite something which has already been accepted as the common ground—a principle we shall return to in section 16.3.2. As we shall see, constraints on what can be accommodated and where the accommodation takes place go a lot further than just a tendency to avoid contradiction.

[6] In asserting that the accommodated material could not easily be derived from Grice's maxims (Grice 1989), we are taking a standard position, but not an uncontroversial one. Rob van der Sandt (p.c.) suggests that the most obvious support for this standard position is the fact that, *contra* presuppositions "implicatures normally do not project [...] but are computed on the basis of a full utterance". Despite such *prima facie* difficulties, many authors have tried to derive presuppositional behavior using neo-Gricean argumentation. For a recent example, see Simons (2001).

The core of this chapter, section 16.2, consists of a discussion of the different contexts in which accommodation can take place and the pragmatic principles which select between those contexts. In section 16.3 we consider a puzzle. Lewisian accommodation applies equally to all presuppositional constructions, so it cannot easily explain why, as a matter of empirical fact, some presuppositions are accommodated much more easily than others. We review the data and consider some lines of explanation. Finally, in section 16.4 we draw some general conclusions about progress that has been made in understanding accommodation, discuss its significance for the study of presupposition and other phenomena, and consider what remains to be done.

16.2 Where Do We Accommodate?

16.2.1 Multiple Contexts

Consider (6), which involves a definite description *his first child*, and contexts $\boxed{1}$, $\boxed{2}$, $\boxed{3}$, and $\boxed{4}$. These contexts correspond, respectively, to what the speaker proposes (or assumes) as the common ground, what the speaker proposes John is convinced of, what the speaker proposes John considers a hypothetical possibility, and what the speaker proposes John considers to be consequences of such a hypothetical.

(6) $\boxed{1}$ John is convinced that $\boxed{2}$ if $\boxed{3}$ his first child is diligent, $\boxed{4}$ she'll grow up to become president.

A first clue as to where accommodation is possible is obtained by considering variants of the example in which the presupposition is added explicitly, as if it were part of the ordinary content of the sentence.

(7) *a.* John has one or more children, and he is convinced that if his first child is diligent, then that child will grow up to become president. (*Accommodation in* $\boxed{1}$.)

b. John is convinced that he has one or more children and that if his first child is diligent, then that child will grow up to become president. (*Accommodation in* $\boxed{2}$.)

c. John is convinced that if he has one or more children and his first child is diligent, then that child will grow up to become president. (*Accommodation in* $\boxed{3}$.)

d. ??John is convinced that if his first child is diligent, then he has one or more children and that (the first) child will grow up to become president. (*Accommodation in* $\boxed{4}$.)

What we observe is that accommodation in context $\boxed{4}$ would not produce a felicitous discourse, and it certainly would not reduce the sentence's presuppositions. However, accommodation in contexts $\boxed{1}$–$\boxed{3}$ would result in a common ground analogous to that produced directly by update with the first three sentences in (7). Consideration of the four alternatives leads us to suggest a general principle which we believe is implicit in much prior work on accommodation:

The Principle of Explicit Addition
Accommodation is only possible in contexts where explicit addition of the accommodated material would (i) produce a felicitous discourse, and (ii) result in a text which lacked the original presupposition.

This principle is of great generality. It applies not only to accommodation of standard presuppositional material, as detected by the projection tests, but also to accommodation of material which may not be explicitly presupposed. A plausible example is the form of accommodation introduced by Roberts (1987, 1989). She considered data involving modal subordination, whereby anaphoric reference between separate non-factual contexts is possible. This phenomenon is exhibited by (8), where the pronoun *she* refers back to John's hypothetical daughter in a way that would be impossible on many standard accounts of anaphoric reference such as Kamp (1981). There are various ways of understanding how this example functions, but one possibility is that the pronoun *she* is associated with a presupposition that there is a discourse marker available for a salient female. Since this presupposition is not met, accommodation must occur. Yet what is accommodated is not merely a discourse marker for an arbitrary female (the presupposition of the pronoun as given by standard projection tests), but a discourse marker for John's daughter.

(8) Perhaps John has a daughter. $\boxed{1}$ If $\boxed{2}$ she is over 18, she has probably left home.

Now note that, in principle, there are at least two places where accommodation might occur, the global context represented by $\boxed{1}$, and the local context of the trigger, given by $\boxed{2}$. Accommodation in either of these locations would satisfy the requirement of the pronoun that there is an accessible female antecedent. Accommodation at site $\boxed{1}$ would produce the infelicitous text in (9*a*), whereas accommodation at site $\boxed{2}$ produces a quite acceptable text as in (9*b*). The Principle of Explicit Addition then correctly (but not very surprisingly) predicts that, provided we could somehow narrow the choice to the two alternative interpretations in (9*a*) and (9*b*), the second must be the correct interpretation.[7]

(9) *a.* ? Perhaps John has a daughter. John has a daughter and if she is over 18, she has probably left home.

[7] For an account of modal subordination in terms of a theory of presupposition accommodation, see Geurts (1999).

b. Perhaps John has a daughter. If John has a daughter and she is over 18, she has probably left home.

16.2.2 A Global Preference

Our proposed principle of explicit addition is closely related to a generalization made explicit by van der Sandt (1982, 1988) and Seuren (1985). They observed that an utterance of a sentence leads to presupposition projection only when explicit statement of the presupposition prior to the utterance would have yielded a felicitous discourse. For example, given the fact that (7*a*) is felicitous, this generalization leads us to predict that the presupposition that John has one or more children will project from (6).

Rather than saying that the presupposition projects to produce the interpretation in (7*a*), we will say that the presupposition is globally accommodated. Similarly, we describe the interpretation in (7*c*) as involving local accommodation in the context of the trigger. The interpretation in (7*b*) involves accommodation in a context intermediary between the trigger and the global context, and we refer to the process that produces this interpretation as "intermediate accommodation".[8]

Fronting Principle
Global accommodation, or, equivalently, presupposition projection, is preferred to other forms of accommodation just in case fronted addition of the presupposition would produce a felicitous discourse.

The most developed theory governing where accommodation might take place is that of van der Sandt (1992) (and secondary literature such as Zeevat 1992, Krahmer 1998, Beaver 2002, and, especially, Geurts 1999), and we will rely heavily on van der Sandt's framework in the following discussion. First, let us return to Gazdar (1979), who is not ordinarily thought of as presenting a theory of accommodation. What Gazdar proposed is that by default presuppositions are added to the global context, otherwise they are cancelled. Being cancelled is almost like disappearing, but, crucially, not quite. Gazdar argues that almost all presupposition triggers entail what they presuppose, so when a presupposition cannot be added to the global context, its content remains in the local context of the trigger. Thus for the cases that have been most discussed in the literature, such as factives and definites, the effect of cancellation in Gazdar's theory is typically indistinguishable from the effect of local accommodation in accounts such as van der Sandt's and Heim's. Furthermore, the fact that Gazdar predicts projection by default and cancellation only under threat of inconsistency is equivalent to a general preference for global

[8] What most authors term "global accommodation" Seuren (1985) describes as "backward suppletion", and van der Sandt (1982, 1988) calls "contextualization".

above local accommodation, as Heim (1983) makes clear.[9] This takes us to a bolder statement of the above Fronting Principle:

Globality Principle
Global accommodation is preferred to local accommodation.

The preference for global accommodation, or an equivalent principle, is central to almost all accounts of presupposition: Atlas (1976), Wilson (1975), and Kempson (1975) try to derive the same effect as the Globality Principle from general considerations of conversational pragmatics; followers of Gazdar (e.g. Mercer 1987) follow him in assuming global accommodation as a default and innovate primarily by exploring alternative notions of what a default is; and van der Sandt (1992) and following work (e.g. Geurts 1999) explicitly assumes a preference for global over local accommodation. In fact, van der Sandt (1992) extrapolates from the preference for global over local accommodation, and claims that a similar principle applies when we throw intermediate accommodation into the mix, an alternative not present in any earlier work except Heim's. Van der Sandt uses a (defeasible) principle like the following:[10]

Generalized Globality Principle
One accommodation alternative is preferred to another if the first is more global (i.e. further from the site of the trigger, and nearer to the global context).

There are two issues that arise with this attractive principle. First, it is unmotivated. Indeed, the simpler preference for global over local accommodation in Gazdar's theory is also unmotivated, although plausible. Secondly, it is not clear that van der Sandt's preference describes the facts, as argued by Beaver (2001). Consider the following example in which contexts are tagged with numbers for ease of reference:

(10) I don't know whether it is raining, but $\boxed{1}$ Fred thinks that $\boxed{2}$ if $\boxed{3}$ Mary is carrying an umbrella then $\boxed{4}$ she knows that it is raining.

In (10), the use of *know* in the consequent triggers the presupposition that it is raining. Global accommodation in context $\boxed{1}$ is blocked since it would produce inconsistency. Van der Sandt's preference for maximally global accommodation would then predict that intermediate accommodation in context $\boxed{2}$ is preferred over intermediate accommodation in context $\boxed{3}$, which in turn is produced over

[9] Although Heim is correct that Gazdar's strategy (of cancelling only in the face of inconsistency) is in principle equivalent to a preference for global accommodation, this does not imply that Heim's model is equivalent to Gazdar's. Heim only explicitly considers blocking of global accommodation through inconsistency with the common ground, whereas Gazdar also considers inconsistency with implicatures.

[10] Geurts (2000) terms his procedural variant of Generalized Globality "buoyancy". As he says, "all *backgrounded* material tends to float up to the main DRS."

local accommodation (in $\boxed{4}$). So the prediction is that (10) is understood as meaning 'I don't know whether it is raining, but Fred thinks that it is raining and that if Mary is carrying an umbrella she knows that it is raining.' It is not clear to us that this prediction is right. First, in spoken form, the example seems odd unless pronounced with stress within the final *is raining*, and this oddity is unaccounted for. Secondly, even with this stress pattern the predicted reading is not available. There seems to be a preference for local accommodation over either of the intermediate possibilities. Thus the preferred reading is '... Fred thinks that if Mary is carrying an umbrella then it is raining and she knows it'.

In response to examples showing that the Generalized Globality Preference produces incorrect predictions, we might consider retreating to the basic Globality Preference, and perhaps stipulating a separate principle to decide between local and intermediate forms of accommodation when global accommodation is unavailable. However, an alternative principle has also been considered, for example, by Blutner (2000), here, as in Beaver (2001), named for Atlas who uses a similar principle as the cornerstone of all his explanations of presuppositional behaviour:[11]

The Atlas Principle
One accommodation alternative is preferred to another if the first produces a logically stronger meaning.

In many cases this principle produces reasonable results. For example, in (11), the principle correctly predicts a preference for global accommodation. And if global accommodation was blocked (e.g. by an earlier admission of the speaker's ignorance as to whether it is raining), then local accommodation would be predicted over intermediate accommodation.

(11) $\boxed{1}$ If $\boxed{2}$ Mary's carrying an umbrella then $\boxed{3}$ she knows that it is raining.

Note that slight changes in the logical properties of a sentence can produce big changes in what the Atlas principle predicts. Consider the following minimal pair:

(12) Every woman fed her cat.

(13) Not every woman fed her cat.

The Atlas Principle faces problems if we extend it from global accommodation—essentially what Atlas was considering—to local and intermediate accommodation.[12] Combined with the Trapping principle (see below), it predicts local accommodation for (12), that is 'Every woman had a cat and fed it.' But intermediate accommodation would be predicted for (13): 'Not every woman who had a

[11] Another principle favouring strong over weak readings is motivated by Dalrymple et al. (1998). An alternative, but related, idea which we will not explore here is that what must be maximized is not logical strength but informativity or relevance; see e.g. Sperber and Wilson (1984) and van Rooy (2003).

[12] For problems with the Atlas Principle, see also the discussion of Geurts (2000). Geurts considers the case of non-monotone contexts, such as the restrictor of the quantifier *most*.

cat fed it.' Thus it is predicted that (12) and (13) could both be true at the same time. Specifically, if all women who own cats feed them but not all women own cats, then, according to the predictions of the Atlas Principle, both sentences are true. While intuitions are subtle, we are dubious about this prediction: given that there are cat-owning women at all, (12) and (13) seem intuitively to contradict each other, so that at least one must be false.

The principle also does not seem to help with cases like (10), for here it makes the same incorrect prediction as the generalized Accommodation Principle. Indeed, although the Atlas Principle often predicts a preference for global accommodation, it does not even do this all of the time. In (14), no preference is predicted between global accommodation and local accommodation, since neither of (14*a*) and (14*b*), the two accommodation alternatives, is logically stronger than the other.

(14) Fred thinks Mary knows that it is raining.
a. It is raining and Fred thinks Mary knows that it is raining.
b. Fred thinks it is raining and Mary knows that it is raining.

16.2.3 Trapping

The following example from Heim (1983) is of a standard type involving what we might call "quantifying in" to a presupposition, a phenomenon first discussed by Karttunen and Peters (1979):

(15) Every man loves his king.

Here the presuppositional *his king* occurs within the scope of *Every man*. Many models of presupposition, such as Karttunen (1973, 1974) and Gazdar (1979), lack any treatment of this type of example. Other models, such as those of Heim (1983) and Karttunen and Peters (1979) suffer from well-known problems, for which the reader is referred to the discussion in Beaver (1997). Van der Sandt's account of the interaction between quantification and presupposition requires stipulation of the following absolute constraint on accommodation:[13]

The Trapping Principle
If a presupposition containing a variable x is triggered in an environment where x is bound by a quantifier Q, the presupposition will be accommodated in such a way that x remains bound by Q.

Regarding (15), the possibilities of global, intermediate, and local accommodation must be considered. The trapping constraint prevents the presupposition $[y][\text{king-of}(y, x)]$ from being accommodated globally—this would cause the variable x in the presupposition to become unbound. So we are left with only intermediate and local accommodation. Intermediate accommodation would produce the reading

[13] The Trapping Principle can be reduced to the Explicit Addition Principle, since not following it would create unbound anaphors.

Every man who has a king loves him, while local accommodation would lead to *Every man has a King and loves him*. Both readings are plausible. However, note that in the context of a previous sentence, *There are 17 men in the room*, the intermediate accommodation reading for (15) vanishes: it seems that every one of the men under discussion must have a king.[14]

16.2.4 Conversational Principles

Allowing that for current purposes we can take projection and global accommodation to be identical, there is a large body of literature suggesting that the major constraint on global accommodation is that it must respect general conversational principles such as Grice's maxims. Stalnaker (1974) used this as the basis of an informal pragmatic explanation of why certain factive presuppositions are cancelled, and Gazdar (1979), Soames (1982), and van der Sandt (1988) provided the first formal statements of how the interaction might work.[15] Note that the idea formalized by these latter three authors is distinct from the suggestion found in work such as Atlas (1976), Wilson (1975), and Simons (2001). What they suggest is not merely that presuppositions must respect conversational principles, but that many or all types of presupposition actually result from conversational principles so that no conventional stipulation of presuppositions is needed in the lexicon. Gazdar's account is based upon a principle like the following:

Gazdar's Principle
When in conflict, implicatures always prevent global accommodation (i.e. projection) of presuppositions.

As a descriptive generalization, Gazdar's Principle covers a range of standard cases, although many counterexamples are known—see e.g. Beaver (2001, forthcoming) for empirical discussion.[16] To see the principle in action, consider our now injured heroine's brave words to her comrades, as they valiantly attempt escape from the enemy's evil clutches (to be uttered with stress on *make* rather than *realize* in the antecedent, and, for example, *go* and *without* in the consequent):

[14] The objection that intermediate accommodation is not available in a properly contextualized version of (15) was made in Beaver (1994). In response, Geurts and van der Sandt (1999) detail a version of their theory which produces predictions more in line with Beaver's in this type of case.

[15] Assuming Thomason's notion of accommodation, an explanation of the significance of Gricean principles for accommodation may be attempted along the following lines. Whereas all places of accommodation are equally good for making the presupposition trigger meaningful or pragmatically appropriate, not all of them need to be consistent with the attempt to reconstruct the speaker's intentions. The Gricean maxims are part of what relates the speaker's intentions to the speaker's utterance. Presupposition accommodation therefore has to give way to Gricean maxims, at least when there is no independent reason to think that the speaker is intentionally flouting the maxims.

[16] Rob van der Sandt (p.c.) points out that Gazdar's account of presupposition cancellation relies almost entirely upon a single subtype of implicatures, namely, clausal implicatures, the inference that an embedded clause is neither known to be true nor known to be false. Gazdar himself introduced the

(16) If I realize that I can't make it, I'll need you to go on without me.

Gazdar, Stalnaker, and others take utterances of conditionals to be associated with an implication that the speaker does not know the truth value of either the antecedent or the consequent. For Gazdar, this implication is a clausal implicature. To be precise, Gazdar predicts that, unless something blocks this implicature, an utterance of (16) implicates that the speaker does not yet know whether she will realize that she cannot make it, and hence does not yet know whether she can or not. Gazdar's principle says that this implicature prevents global accommodation of the presupposition that she cannot, and so correctly predicts that an utterer of (16) does not take not making it to be a certainty.[17]

While descriptively interesting, Gazdar's principle seems, in his work, mysterious: why should implicatures defeat presuppositions rather than the other way around?[18] However, within the framework of a theory based around accommodation, Gazdar's Principle becomes more natural. For in such a framework we no longer need to claim that implicatures defeat presuppositions. Rather, we can say that presuppositions must always be satisfied for a discourse to be felicitous, independently of other conversational principles, but that implicatures help us decide on the best way to satisfy the presuppositions. Rather than saying that implicatures and presuppositions are in conflict, we can say that the same conversational principles underly both presupposition accommodation and implicature. The same principles that produce implicatures help us decide *where* to accommodate presuppositions. Such an approach forms the basis of the theory of van der Sandt (1992). In his work and its descendants, accommodation constraints are

terminology. Clausal implicatures were not isolated as a subtype in Grice's original work, although there is some antecedent to Gazdar's work: Stalnaker (1974) considers this type of inference without using the term "implicature". Clausal implicatures may be seen as arising from the maxim of quantity. However, van der Sandt points out that ignorance of the truth value of an embedded clause is typically a shared assumption of the interlocutors, and not, as would be typical for a Gricean implicature, an extra inference that the speaker intends as new information.

[17] We know of no explicit discussion in the literature showing that non-clausal implicatures can defeat presupposition. Examples would be:

(i) Mary ate two donuts, so Bill obviously doesn't *know* that she ate three.

(ii) Fred is always prompt and exhibits great penmanship, but I do not know that he will make a wonderful brain surgeon.

In (i), it could be argued that a scalar implicature (that Mary ate no more than two donuts) cancels the presupposition that she ate three. Example (ii), following in Grice's footsteps, is intended to be thought of as part of a recommendation letter. In this context a particularized implicature is generated that Fred has no skills of relevance beyond penmanship and promptness, and thus that the speaker has insufficient evidence that Fred will make a wonderful neurosurgeon. This apparently defeats the presupposition triggered by the cognitive factive *know*.

[18] Gazdar's account in fact depends on a series of interesting but theoretically unjustified principles. For example, not only are implicatures claimed to defeat presuppositions, but also clausal implicatures are claimed to defeat scalar implicatures.

stated in terms of Discourse Representations. However, we can also understand the constraints in terms of explicit addition of presupposed material to the original utterance.

Informativity Principle
Do not accommodate in such a way as to make existing parts of the sentence truth-conditionally redundant.[19]

For example, consider again (16). Ignoring the non-trivial issue of tense, we have to decide between local accommodation, as in (17*a*), and global accommodation, as in (17*b*).

(17) *a.* If I can't make it and I realize that I can't make it, I'll need you to go on without me.
b. #I can't make it, and if I realize that I can't make it, I'll need you to go on without me.
c. #I can't make it, and if $1 + 1 = 2$, I'll need you to go on without me.
d. I can't make it, and I'll need you to go on without me.

Example (17*b*), the global accommodation reading, is odd because once our heroine has asserted that she cannot make it, the question is settled of whether she realizes that she cannot. Thus the antecedent of the conditional in (17*b*) is redundant—we could replace it with any other true sentence, as in (17*c*), for instance, without changing the truth-conditional import of the utterance. Thus the informativity principle militates against global accommodation, and predicts that instead local accommodation must occur. So (16) is correctly predicted to convey the message in (17*b*).

The Informativity Principle seems at first blush to relate to Grice's Maxim of Quantity: "Make your contribution as informative as is required for the current purposes of the exchange.... Do not make your contribution more informative

[19] In van der Sandt's statement of the accommodation constraints, the Informativity Principle corresponds to several different principles, all of which are requirements on DRSs. Beaver (2001) reformulates these principles so as to solve some minor technical problems, resulting in the following formulation:

Update Informativity
If some DRS K is incremented with information from a new sentence, such that after resolution of all presuppositions the new DRS is K′, then $K \not\models K'$

Local Informativity
No sub-DRS is redundant. Formally, if K is the complete DRS structure and K′ is an arbitrarily deeply embedded sub-DRS, K′ is redundant if and only if for all admissible models M and all embeddings $f,(M,f \models K \rightarrow M,f \models K[K' / \top])$. Here $K\,[K'/\top]$ is a DRS like K except for having the instance of K′ replaced by an instance of an empty DRS, and $\models$ denotes the DRT notion of *embedding*.

Local Consistency
No sub-DRS is inconsistent. Suppose K is the complete DRS structure and K′ is an arbitrarily deeply embedded non-tautological sub-DRS. Then K′ is locally inconsistent if and only if its negation would be *redundant* (in the sense above) were it to replace K′.

than required." However, Quantity is normally taken to concern utterances of complete sentences, not sub-parts of sentences. There is no obvious sense in which utterances of (16) are likely to satisfy Quantity any better than utterances of (17*b*). Grice's "Be brief", a sub-clause of his Maxim of Manner, captures the spirit of The Informativity Principle better: a sentence with a truth-conditionally redundant part conveys the same information as would a briefer utterance without that part. So (17*a*) is odd because it conveys the same information as the briefer (17*d*), which is just another way of saying that the antecedent of the conditional is redundant in (17*a*) and (17*c*).

We can see that in cases traditionally thought of as involving presupposition cancellation, Gricean principles are not in competition with presuppositions but with the globality preference, or whatever principle we take ordinarily to favour global accommodation over local accommodation. Yet the Atlas principle may itself be thought of as a special case of Grice's Quantity maxim, so apparent cases of presupposition cancellation would be reanalysed as the result of interactions between different conversational principles. However, the above discussion seems to imply that to analyse accommodation correctly in (16), the Maxim of Manner needs to trump an (unusual) application of the Maxim of Quantity. We leave as an open line of inquiry whether Quantity really explains the preference for global accommodation, whether Manner generally beats Quantity, and, if so, why it should.

We would also note that there is no special reason why Manner and Quantity should be the main maxims that come into play when considering accommodation options. For example, consider the preference for global accommodation in (18), yielding the effect of (18*a*). Could this be explained not by a general preference for strength, but simply because both the intermediate and local accommodation options, in (18*b*) and (18*c*) respectively, yield slightly odd texts? It is quite hard to imagine a context of utterance in which (18*b*) and (18*c*) would satisfy Grice's Maxim of Relevance ("Be relevant!").

(18) If Mary is smart then her ex-husband will get nothing.
   a. Mary has an ex-husband. If Mary is smart then her ex-husband will get nothing.
   b. # If Mary has an ex-husband and is smart then her ex-husband will get nothing.
   c. # If Mary is smart then she has an ex-husband and her ex-husband will get nothing.

16.2.5 Multiple Accommodation

As discussed by Zeevat (1992) and Beaver (1997, 2001), there are two strategies for accommodation within representational approaches to interpretation. In the first approach, which is standard within DRT accounts (van der Sandt 1992; Geurts 1999; Kamp 2001*a*, 2001*b*), presuppositions are moved from the site of the trigger to a distant but anaphorically accessible site. Corresponding to each trigger there is one and only one site of accommodation. The second approach is found in the work of Fauconnier (1985), and, as argued by Zeevat (1992), is implicit in the theory of Heim (1983). This approach involves accommodation in multiple contexts, as if information that is needed to satisfy the presupposition is first added to the local context, and then spreads outwards, being copied into successively more global contexts until some barrier prevents further expansion. For extensional contexts, as created by conditionals, truth-conditional negations, and other connectives, the choice between the two strategies makes no difference. For example, if a presupposition is triggered in the consequent of an indicative conditional and is accommodated globally, it makes no truth-conditional difference whether the presupposition is also accommodated in the antecedent and/or consequent of the conditional, at least when the presupposition does not require new discourse markers.[20]

As discussed by Zeevat (1992), the choice between single and multiple accommodation can make a great difference when intensional contexts are involved. For example, consider (19), which involves the presupposition that it is raining triggered by *stop*, and let us suppose that the presupposition is globally accommodated. On the single accommodation analysis, that is the end of the story, yielding an interpretation like in (19*a*). But on the multiple accommodation analysis, we should also add the presupposition within the belief context, producing the meaning in (19*b*). Sentences (19*a*) and (19*b*) are truth-conditionally distinct. In this case the multiple accommodation strategy in (19*b*) appears to produce better results.[21]

(19) Mary thinks it unlikely that it will stop raining.
  a. It is raining and Mary thinks it unlikely that it will stop.
  b. It is raining and Mary thinks it is raining and unlikely that it is raining and will stop.

Zeevat (1992) argues that in other cases, single accommodation performs better than multiple accommodation. To take an extreme example, consider (20), involving a scalar presupposition triggered by *even* within Scrooge's mother's belief

[20] If accommodation does require addition of new discourse markers, the question of whether additional accommodation makes a difference rests on the way in which discourse markers are interpreted. According to the semantics of Heim (1983) and Kamp (1981), re-introduction of discourse markers in extensional contexts has no effect, so this is not a factor in the above discussion of the difference between single and multiple accommodation.

[21] It might be felt that the preferred reading of (19) involves accommodation in the global context and within the attitude context, but not in the scope of *unlikely*. The reading would then be: 'It is raining and Mary thinks it is raining and unlikely that it will stop.' Whether this reading is equivalent to (19*b*) depends on how the semantics of attitude contexts interact with those for *unlikely*, which is not a topic we can discuss in detail here.

context. Here, the single accommodation reading (*a*) seems much more plausible than the multiple accommodation reading (*b*).

(20) Scrooge's mother—who thinks the world of him—believed even he was generous.

(21) *a.* Scrooge was a relatively difficult person to class as generous and his mother believed that he was generous.
b. Scrooge was a relatively difficult person to class as generous and his mother believed that he was a relatively difficult person to class as generous and that he was generous.

The two cases above, (19) and (20) involve embedding of triggers under a single occurrence of a belief operator. This leads to two further questions: what happens with embeddings under multiple belief operators, and what happens with other attitude verbs? As to multiple belief operators, the data quickly become unclear as sentence complexity increases. In spite of this, we suggest that after hearing (22) it would be natural to conclude that the speaker, Mary, and John all think it is raining. Of course, it could be argued that the reason for this is not that multiple accommodation takes place, but that accommodation takes place in the common ground shared by individuals, including not only the speaker and addressee, but also John and Mary.

(22) Mary is certain that John thinks it will stop raining.

For attitudes other than belief, we find that while multiple accommodation is needed, it is not multiple accommodation in the form described above. Consider the following examples, which are related to data which Zeevat (1992) uses to argue for differences between different types of presupposition trigger:

(23) Mary hopes that it will stop raining.

(24) Mary doubts that it will stop raining.

(25) Mary doesn't doubt that it will stop raining.

According to the single accommodation strategy, there would be no requirement for Mary to hope or believe that it is raining: this prediction is clearly incorrect. According to the above multiple accommodation strategy, (23) should mean that the speaker believes (it is common ground that) it is raining, and Mary hopes that it is raining and will stop. This is also wrong. What we in fact want is to accommodate that Mary believes that it is raining, not that she hopes it is raining.

What (23) suggests is that both the speaker and Mary believe that it is raining, and that Mary hopes it will stop. Similarly, (24) does not indicate that Mary doubts it is raining, but that she believes it is raining, and doubts that it will stop. In other words, we might best describe what we see in cases of presuppositions under attitude verbs not in terms of a combination of global accommodation and local accommodation within the attitude, but in terms of multiple global accommodation. Thus these would be cases of global accommodation that the speaker takes the presupposition to be common ground, combined with further global accommodation that the agent of the attitude shares the given presupposition.[22] Note that an argument based on the plausibility of multiple global accommodation could be used to explain why in (20) we appear not to get accommodation under the attitude verb: it is explicitly denied in a parenthetical non-restrictive relative clause that Scrooge's mother shares our common ground.[23]

If single accommodation is preferred for some triggers, and multiple accommodation is preferred for others, this presumably reflects differences in the presuppositional requirements imposed by those triggers. Zeevat (1992) thus suggests using this sort of difference as the basis of a classification of trigger types. However, as regards some triggers for which single accommodation produces better results than multiple accommodation, the discussion to follow in section 16.3 casts doubt on whether there is any accommodation at all.

16.2.6 Information Structure as a Constraint on Accommodation

Strawson (1964) suggested, in effect, that a definite description is presuppositional when it is part of the sentence topic but not when it is focused. Though Strawson was naive as to English information structure, he presented examples in which focused definite descriptions (*the King of France*, naturally) failed to carry their standard presupposition. Strawson suggested that while Russell's (1905) classic (26) fails to have a truth value if there is no King of France, (27) may simply be false when the question of who visited some particular exhibition is under discussion.

(26) The King of France is bald.

(27) The Exhibition was visited yesterday by the King of France.

Hajičová (1984) (see also Partee 1996 and Hajičová, Partee, and Sgall 1998) presented examples showing an impressively clear interaction between information structure and presupposition:

(28) Our victory wasn't caused by HARRY. (*Victory projected*)

(29) Harry didn't cause our VICTORY. (*Victory can be suspended*)

[22] It was Karttunen (1974) who first suggested a mechanism by which presuppositions triggered within belief contexts could be transformed into presuppositions which themselves involve belief operators. This strategy is among those considered by Heim (1992).

[23] For further discussion of single vs. multiple accommodation of presuppositions triggered in attitude contexts, see Heim (1992) and the counter-arguments in Geurts (1998).

Partee (1996) presents an interesting alternative view on such examples: perhaps the focused items still carry their presupposition, but the location in which the presupposition is accommodated is dependent on information structure. Rather than detailing Partee's account, let us observe that examples like Hajičová's might be accounted for by either of the following principles, as well as variants which we leave to the reader's imagination:[24]

Topic Principle
Presuppositions which are marked as given must be globally accommodated or anaphorically resolved.

Focus Principle
Presuppositions which are intonationally marked as new information may not be globally accommodated.

In the case of (28), *our victory* occurs in a topical position, so the Topic Principle would force the victory to be established globally. The Focus Principle would not force the victory to be established globally, but an independent principle such as the Generalized Globality Principle would force this. For (29) *our victory* is focused. Thus the Focus Principle would force local accommodation, so that the sentence would not imply any victory. The Topic Principle allows but does not force local accommodation in this case, and so local accommodation would be predicted only if some additional factor, such as the threat of global inconsistency, prevented global accommodation.

It is worth noting that both the Topic Principle and the Focus Principle would require extra assumptions in order to predict a difference between Russell's (26) and Strawson's (27), since these examples do not involve any local context in which local accommodation could occur. One way to make the principles work in these cases would be to posit that entire sentences are interpreted within the scope of an *assert* operator. Then by the Topic Principle, (26) would require accommodation into the global context (which we might equate with the common ground) that there is a King of France, which would presumably fail, producing infelicity. On the other hand, the same principle would allow that (27) was interpreted as asserting that there is a King of France, a false assertion, but not a source of such marked infelicity.[25] The interaction between presupposition accommodation and other aspects of information structure remains an open area for further investigation.

[24] Related to this, Beaver (2004) observes that classic cases of cancellation involving factive (or so-called "semi-factive") verbs discussed by Karttunen (1971) and Stalnaker (1974) are also affected by information structure in a way not accounted for by current accounts of presupposition. A comparable observation is made by Delin (1995) for the case of *it* clefts: global accommodation of the cleft presupposition is only possible if there is an accent in the cleft complement.

[25] For recent discussion of Strawson's arguments, see von Fintel (2004).

16.3 A Puzzle: Missing Accommodation

16.3.1 Triggers That Do Not Accommodate

Accommodation fills a gap, occurring because something is missing from the context: this is the intuition present in all the literature since Lewis (1979). This leads us to a prediction. Start with a presuppositional utterance in a context which satisfies the presupposition, then alter the context so the presupposition is no longer satisfied. *Ceteris paribus*, accommodation should (paraphrasing Lewis) cause the presupposition to spring into existence, repairing the context and filling in whatever was missing. We shall now consider cases in which this prediction is incorrect.

To start with, demonstratives, pronouns, short definite descriptions, and names all seem to allow more limited possibilities for accommodation than do the triggers Lewis (1979) considered. Pronouns are the classic case; they come with an obligation of being resolved to an entity that is highly activated at that point in the discourse. If someone uttered (30) as the first exchange in a conversation, and the non-linguistic context did not contain a highly salient male person, the addressee would be confused.

(30) He is very cute.

The pattern is the same for a subclass of definite descriptions, demonstrative NPs, and certain names. The exceptions are long definite descriptions (where the descriptive content suffices uniquely to single out the unknown referent, as in Russell's *the author of Waverley* or *the king of France*) and long names (possibly including appositions, as in *my brother John* or *Peter Fleming, the brother of Ian*). In other cases, there is the requirement that the referent has been introduced before or that there is bridging to salient entity, or SUBSECTIONAL anaphora in the sense of van Deemter (1992) (reference to an element or part of a plural entity or group). But bridging and subsectional anaphora place comparable conditions on context as do other types of anaphora: they need a highly salient antecedent from which they build a bridge to the referent, or from which they take a subset. For subsectional anaphora, the new description uniquely identifies its referent as the maximal subset of the antecedent that meets the description. When there is no object to build a plausible bridge from, no object from which a subsection could be taken, the descriptive material by itself is not sufficient to guarantee unique reference, and there is no relevant entity available for deictic reference in the utterance context, the trigger NP is not interpretable.

Demonstrative NPs in English have a variety of functions, including the indexical use in which identification of the referent requires a demonstration by the speaker. Here we may say that the use of the demonstrative presupposes the demonstration by the speaker. If no such demonstration occurs, infelicity results: the hearer cannot simply accommodate a referent.[26] Names refer by virtue of the fact that there is the social fact that people and other entities can bear names. But the fact that there are bearers of the name *Tom* is not always enough for a reference to one of them by a use of *Tom*. The referent must have higher salience than others of the same name in order for the interlocutors for the reference to be successful.[27]

Further cases where accommodation fails include the following:

(31) Another man came in.

(32) John is having dinner in New York too.

(33) John is indeed having dinner in New York.

The trigger *another N* requires another N, *too* requires that somebody else is having dinner in New York, and *indeed P* requires that the suggestion that *P* holds is previously salient although *P* is not yet in the common ground. In all of these cases, the repair view of accommodation seems misguided. Kripke (n.d.) points out that many people have dinner in New York every night, yet this fact does not mean that (32) can be used out of the blue. Neither does it mean that it is easy for us to accommodate an antecedent, some particular person other than John who is having dinner in New York. That is not how these triggers are used: they require proper antecedents in the context, and when such antecedents are there the triggers are close to obligatory.[28]

The class of politeness markers is another one for which accommodation is the exception rather than than the rule. French *tu* presupposes that the speaker is familiar with the addressee, the Dutch pronoun *U*, that the addressee deserves respect or is unfamiliar. These politeness presuppositions are not part of the content of the sentence and it is problematic to say that hearers accommodate. The social relations on which the use of polite forms depends are not hard facts and the choice of the forms in question can be instrumental in changing them. But it would be incorrect to say that speakers just repair when confronted with a special form: they may feel quite unhappy when respect and unfamiliarity are not recognized or, perhaps even worse, when distance is created by the use of an inappropriate polite form. Thus, while languages and cultures vary in the rigidity of their honorific systems, the default case is that the use of a certain form will not in and of itself produce accommodation by interlocutors to ensure that the form is in fact socially appropriate.

[26] For a recent treatment of the presuppositions of demonstratives, see Roberts (2002).

[27] The Kamp and Reyle (1993) non-presuppositional development rule for names is thus problematic. It forces a new discourse referent and makes the (descriptively inadequate) assumption in the model theory that names have a unique bearer. The rule is essentially correct for long names at first mention. It is inadequate for second mention and short ambiguous names.

[28] For a longer discussion, see Zeevat (2002).

Yet another case where accommodation is highly constrained, and often impossible, is the intonational marking of focus. This is most obvious in examples such as (34) which unambiguously involve *narrow* focus, that is, focus on a word or small constituent rather than on an entire verb phrase or clause. Example (34) requires not only that it is established that Mary ate some sort of sandwich, but also that it is directly relevant to issues raised in the prior discourse what type of sandwich Mary ate. In case this relevance is not obvious, the utterance is infelicitous. The hearer cannot simply accommodate that Mary ate a sandwich and that it is in some unspecified way relevant what sort of sandwich she ate.[29]

(34) Mary ate a HAM_F sandwich.

Consider the set of presupposition triggers other than short definites, politeness markers, discourse functional markers, and intonation: what remains is a heterogeneous collection, united by little more than the fact that all members involve open-class lexical items and trigger accommodation readily. The collection includes factives (*realize*, *regret*), Karttunen's (1971) implicatives (*manage*), Fillmore's (1971) verbs of judging (*accuse*, *praise for*), aspectual verbs (*stop*, *continue*), and sortally restricted predicates of various categories (*bachelor*, presupposing 'marriageable male'; *happy*, presupposing 'sentient'), clefts, pseudo-clefts, long definite descriptions, and long names.

Although all members of this grab-bag of remaining triggers produce accommodation, even here there are awkward cases not handled by existing theories. For example, consider Klein's (1975) observation that the subject's belief is sufficient to satisfy the presuppositions of an emotive factive. Thus (35) is felicitous, even though the factive complement (that Jane's friend had Jane's keys) need not be satisfied globally.

(35) Jane's keys were sitting in her bag. However, she believed her friend had them, and she regretted that her friend had them.

On the basis of this observation, and the fact that factives in general do allow for accommodation, we should expect emotive factives to allow for accommodation concerning their subject's belief state. However, this prediction is not borne out. We do not usually accommodate the subject's belief alone, even when this is the only possibility:

(36) ?Jane's keys were sitting in her bag. However, she regretted that her friend had them.

[29] Schwarzschild (1999) provides the most explicit formalization of the requirements that utterances of examples like (34) place on context. A recent discussion of the existential nature of focal presuppositions, and the limits on accommodation of such presuppositions, is given by Geurts and van der Sandt (2004).

No current theory explains why we cannot accommodate "she believed her friend had them" in (36). Note, however, that the solution to this problem may be distinct from that for the earlier cases of missing accommodation. The solution may be linked to the broader issue of presuppositions triggered within belief contexts, as discussed by Heim (1992). A similar absence of accommodation is observed in (38). Here, the presupposition that it is raining is triggered within a report of Jane's beliefs. A comparable text (37), in which it is made explicit that Jane thinks it is raining, is felicitous. So we might expect (38) to be similarly felicitous, requiring only accommodation of the proposition that Jane thinks it is raining. The fact that (38) is infelicitous indicates that such accommodation does not occur. It seems that all such attitudinal cases might be profitably related to the discussion of multiple global accommodation of beliefs discussed in section 16.2.5, but we leave this as yet another open line of inquiry.

(37) It isn't raining, but Jane thinks it is, and thinks Bill realizes that it is.

(38) ?It isn't raining, but Jane thinks Bill realizes that it is.

16.3.2 Explanations of Missing Accommodation

We will now discuss two accounts that have been offered for missing accommodation in the non-attitudinal cases, then we speculate on a further line of research. Van der Sandt (1992) and Geurts and van der Sandt (2004) operate under the principle "presupposition is anaphora", or sometimes the reverse.[30] As already noted, antecedents for pronouns generally cannot be accommodated, whereas antecedents for factives and long definites typically can. It is crucial to the plausibility of van der Sandt's and Geurt's theory that they account for the fact that the paradigmatic case of an anaphoric form behaves quite differently from paradigmatic presupposition triggers. Their solution (Geurts and van der Sandt 2001, 2004) has been to suggest that pronouns, unlike descriptions, do not accommodate because they have too little descriptive content. We can enshrine this idea in a general principle:

The Insufficient Content Principle
Accommodation is only possible when the presupposition is descriptively rich.
If a low content presupposition cannot be resolved, infelicity results.

To the extent that we define "descriptively rich" not to include pronouns and short definites like *the man*, this principle seems reasonable. However, there are

[30] Van der Sandt (1992) does not define presupposition as anaphora, but "presupposition projection as anaphora resolution". Geurts and van der Sandt (2004) describe their theory of presupposition as an "anaphoric binding theory", and say that "pronominal anaphora is a species of presupposition". Geurts (1999) also takes "anaphora to be a special case of presupposition". Catchy variants of "presupposition(s) is/as/are anaphor(a/s)" have been used in numerous talks and papers, some having been critically evaluated by Bosch (2001).

problems, as we will see. First, there is a problem of motivation. Secondly, although the principle has been used as an explanation for non-accommodation of discourse-functional triggers like *too*, it fails for these cases. Thirdly, the principle has nothing to say about other cases of missing accommodation, such as politeness presuppositions, long demonstratives, or belief presuppositions of emotive factives.

We will now expand a little on the issue of motivation, before turning to empirical problems. Consider first how the principle could be motivated. Are presuppositions perhaps rockets powered by their descriptive material, so that if the tank is empty, the presupposition never leaves the launch pad? Lacking any such story, the obvious question is why the insufficient content principle should hold, and not a completely opposed principle. Accommodation, after all, is sometimes seen as a repair on a faulty discourse representation, and surely it should be easier to make a minor repair than a major one. The more descriptive content is present in the presupposition, the larger the repair. Hence it would be easy to justify on intuitive grounds the opposite of the Insufficient Content Principle, the descriptively false hypothesis that overly rich presuppositions cannot be accommodated. Given the equal plausibility of its converse, the Insufficient Content Principle is at best an interesting observation, not yet an explanation.

As regards empirical shortcomings, the fact is that the Insufficient Content Principle, as stated, explains very few of the cases of missing accommodation discussed in sections 16.3.1–3. Many of the triggers involved have quite elaborate descriptive contents but still do not accommodate. Consider discourse-functional triggers like *too*, for which van der Sandt and Geurts have claimed explicitly that lack of content explains lack of accommodation.

It seems at first blush surprising that anyone would even attempt to apply such a principle in the case of *too*, since the presuppositions associated with it generally have such high content. For example, in (32), repeated below, *too* is associated with a presupposition that involves having dinner in New York, an act which, while commonplace for many, is not content-free. Given the apparently non-trivial content associated with the standard presupposition, van der Sandt and Geurts are forced to claim that *too* is associated with an additional low-content presupposition. They propose that (32) carries first a presupposition that some individual (other than Bill) is salient, and second a presupposition that the salient individual is having dinner in New York. Thus (ignoring the inequality between Bill and the other salient individual) we can gloss the proposed analysis of (32) as in (39).

(32) Bill is having dinner in New York too.

(39) It is known that (s)he is having dinner in New York, and Bill is having dinner in New York.

Given that *too* supposedly carries deep in its bowels the presuppositions of a pronoun, and given that pronouns do not trigger accommodation, van der Sandt and Geurts are able to derive that *too* does not trigger accommodation either.

However, there is a serious problem with their analysis (as was first pointed out, we believe, by Nick Asher): if there is a salient individual, but the other presuppositions of *too* are not met, van der Sandt and Geurts provide no mechanism to block accommodation. Consider (40), in which Jane is salient although not established to be having dinner in New York. Van der Sandt and Geurts predict that the internal pronoun-like presupposition will simply resolve to Jane. We are then left with the remaining presupposition that the salient individual is known to be having dinner in New York. In the absence of any further, as yet unspecified constraints on accommodation, the account of van der Sandt and Geurts is quite clear about what should happen: this presupposition will be accommodated. So (40) is incorrectly predicted to be perfectly felicitous, and to imply that Jane is having dinner in New York. It seems that two things must normally be salient for a felicitous utterance of (32), both an entity other than Bill and the proposition that the entity is having dinner in New York.

(40) ?Jane likes Bill. Bill is having dinner in New York too. (*In the absence of further relevant context.*)

Another principle that might explain missing accommodation, and which makes correct predictions for a larger set of phenomena than the Insufficient Content Principle, is what Zeevat (2002) calls Blutner's Theorem.

Blutner's Theorem
If a presupposition trigger has simple expression alternatives that do not presuppose, the trigger does not accommodate.

Blutner's Theorem is based on bidirectional Optimality Theory (Blutner 2000), an extension to standard (unidirectional) Optimality Theory (Prince and Smolensky 1993). In unidirectional Optimality Theory as applied to the syntax–semantics interface, production is understood as an optimization in which alternative expressions for a given meaning are compared, and an optimal expression is chosen relative to various competing grammatical constraints. For example, *sang Mary* is ruled out because *Mary sang* better satisfies the constraints of English. Blutner's bidirectional version involves simultaneously checking that the expression is a better realization of the intended meaning than are alternative expressions, and that the expression would optimally be interpreted as having the original meaning. For example, suppose that *she sang* is in unidirectional production the optimal way of realizing the proposition that Mary sang. *She sang* could still be ruled out as an expression of this proposition if it would be misunderstood, say because Mary is not salient in the particular context of utterance.

To derive Blutner's theorem within the reconstruction of presupposition theory by Blutner and Jäger (2003) in bidirectional OT, a constraint "Do Not Accommodate" is used. Arguably, this constraint is less ad hoc than the Insufficient Content Principle in as much as it applies equally to every trigger. Since all constraints in the Blutner–Jaeger model are soft, there will still be cases when accommodation occurs. The crucial cases are those where two expression alternatives are available which are equally good with respect to basic grammatical constraints, but differ in that one carries a presupposition and the other does not. Suppose that the presupposition is already in the common ground of the interlocutors. In that case, the presuppositional form may be preferred, for instance, because it enhances textual coherence, which would presumably be reflected by another constraint. However, if the presupposition is not in the common ground of the interlocutors, then using the presuppositional form would force accommodation, and thus be sub-optimal in interpretation. For this reason, non-presuppositional forms are predicted to be preferred over presuppositional forms whenever they are equally acceptable with respect to other constraints but the presupposition would need to be accommodated, hence Blutner's Theorem.

Blutner, in unpublished work, originally explained the difficulty of accommodating intonationally marked topics in this way, where the other candidates are plausibly given by variation in the intonation. Zeevat (2002) generalizes the explanation to all presupposition triggers and uses the generalization to explain the non-accommodation of discourse functional markers where the alternative is obtained by just omitting the marker.[31] In the case of Blutner's Theorem, there is a strong theoretical motivation. The principle also makes correct predictions for *too*, and, under certain assumptions, for some other non-accommodating triggers. For example, Blutner's Theorem would predict that politeness presuppositions would not be accommodable provided there was a competing form which was unmarked for politeness. There are, however, empirical shortcomings. For example, *finish* and *manage* are potential counterexamples: their presuppositions accommodate easily, but they can be omitted to obtain suitable alternative candidates that do not trigger presuppositions.[32] Perhaps even more problematic for current applications of Blutner's Theorem is its close tie to bidirectional Optimality Theory, which comes with a host of technical problems beyond the scope of the current chapter; see Beaver and Lee (2003) for discussion.

The two current accounts of missing accommodation, the van der Sandt–Geurts account using Insufficient Content and Blutner's Theorem, are interesting descriptively and theoretically. Ultimately, we must seek a theory of missing accommodation that accounts both for when current accounts work and for when they fail.

[31] A related approach to non-accommodation of discourse functional markers is presented by Zeevat (2003).

[32] It is instructive to consider whether lexical presuppositions such as *bachelor* may also create problems for Blutner's Theorem. Suppose that *is unmarried* is an expression alternative to *is a bachelor*, and differs only with respect to a presupposition of maleness, and marriageability, then Blutner's theorem predicts that accommodation should not be triggered by *is a bachelor*. But if we consider only lexical nouns as alternatives to *bachelor*, then there is no appropriate non-presuppositional alternative, and accommodation is allowed. Clearly more needs to be said before Blutner's Theorem leads to a general predictive model of missing accommodation.

We speculate that progress might be made by sharpening Lewis's original conception of accommodation, and considering the function of accommodation in terms of common ground.

Let us suppose that accommodation is a process which resolves uncertainty about the common ground.[33] Then, we should expect accommodation to be blocked whenever it would conflict with the common ground. For example, given that the presupposition of *too* resists accommodation, we can hypothesize that its presupposition concerns something that could be in direct conflict with the common ground. An example of something that is in the common ground is the discourse record itself, the history of what has been said. So a natural hypothesis, closely related to the Kripke's suggestions, is that the presupposition of *too* involves information about what is jointly salient to the discourse participants, and that this salience is normally established by virtue of facts about the discourse record.[34] If the discourse record satisfies the presupposition, accommodation is unnecessary. But if the discourse record does not satisfy the presupposition, and nothing else establishes the salience of the relevant material, then accommodation is impossible, because accommodation only occurs when there is uncertainty and, by assumption, there is no uncertainty about the discourse record: it is in the common ground already. Therefore, *too* should not trigger accommodation. More generally, we might base an analysis of many cases of missing accommodation on principles like the following, the second being a sub-case of the first:

The Common Ground Principle
If a proposition is such that its truth or falsity is a matter of mutual knowledge between discourse participants in normal conversational situations, then the presupposition that the proposition is true (or that it is false) can never be accommodated.

[33] Beaver (2001) provides a formal model of accommodation as resolution of uncertainty about the common ground that could form the basis of an analysis such as the one we suggest here. However, Beaver's original proposal did not incorporate an account of cases of missing accommodation.

[34] It might be suggested that the presuppositon of *too* is solely concerned with the discourse record, and not with what is salient more generally. However, it is well known that *too* sometimes occurs even when there is no linguistic antecedent. For example, consider the idiom *(Hey) X have feelings too(!)*, where *X* can be e.g. *men, fish*, or *we*. A web search revealed 20,000 uses of the idiom, and a casual sample indicates that most have no explicit linguistic antecedent. We posit that in these cases the speaker is assuming that there is some *Y* (e.g. *women*, *people*, or *you*) such that *Y* has a uniquely salient contrast with *X* and such that *Y has feelings* is already in the common ground. In this case, no accommodation would be needed. This type of explanation suggests that the analysis of *too* might make use of a notion like Roberts's (2003) weak familiarity, a condition she uses in the analysis of definites: it allows a referent to be identifiable but not previously mentioned. An alternative account would be that *too* does indeed have a presupposition that explicitly concerns what has been mentioned in the discourse, and thus that cases where there is no linguistic antecedent involve accommodation after all. However, if we were to allow that *too* can sometimes trigger accommodation, we would be left with no explanation of Kripke's observation that occurrences of *too* without an explicit antecedent are often infelicitous.

The Discourse Record Principle
Presuppositions about what is in the discourse record may not be accommodated.

On this type of analysis, *too* differs from, for instance, canonical factives such as *realize* because the presuppositions of *realize* are concerned with whatever propositions or facts are under discussion, and are not intrinsically concerned with the discourse record itself. It remains a matter for future research how such an account can be formalized, and whether it can be extended to other presupposition triggers for which accommodation is missing.

16.4 Conclusion

Lewis's accommodation might have initially appeared to be all or nothing. Mostly all. That is, the hearer seemed forced to choose between putting up with a defective context or adding the failed presupposition to it to make things work. Given such a choice, adding the presupposition would be a good bet. This notion of accommodation might not have seemed destined to make a big mark on the theory of presupposition: it only solved one problem, the problem of informative presuppositions.

In the last twenty-five years, the theory of accommodation has become far more nuanced than Lewis's original conception. Contemporary theories allow (i) that what we accommodate may not be predictable from the form of the presupposition trigger alone; (ii) that we may accommodate not only globally, but in a variety of intermediate and local contexts created during the evaluation of an utterance's meaning; and (iii) that accommodation is a complex form of inference based on considerations including semantics, general principles of pragmatics, and specific calculations of the (joint) goals of discourse participants. In combination, these advances mean that accommodation is no longer merely an add-on pragmatic component designed to deal with a single special case. Rather, accommodation is at the heart of modern presupposition theory, and has resulted in theories which improve empirically on earlier accounts of presupposition, which are far better motivated than their predecessors, and which extend the reach of those theories to new phenomena like modal subordination. Indeed, it may even be said that accommodation has partially supplanted the PRESUPPOSITION PROJECTION PROBLEM of Langendoen and Savin (1971), the problem of predicting which presuppositions triggered within a complex utterance would be presuppositions of the utterance as a whole. A restatement of that question would be: given that there are presuppositions in a complex utterance, what is accommodated and in which contexts? The ideas we have discussed in this chapter suggest that accommodation bears on one of the central issues in the study of how semantics and pragmatics are related, the issue of PRAGMATIC INTRUSION. Pragmatic intrusion concerns cases in which pragmatic inference affects truth-conditional meaning: a recent case for such effects is made by Levinson (2000).[35] It is controversial whether pragmatic intrusion occurs at all, and it has certainly not been shown to be common. However, observe that local and intermediate accommodation as we have defined them are inferential processes governed by pragmatic constraints which can directly influence truth conditions. So if the models discussed in this chapter are correct, then pragmatic intrusion is not merely a marginal phenomenon occurring in special cases, but a common occurrence. For example, whenever we accommodate information necessary for a bridging definite description, and the material is accommodated in a local context, pragmatic intrusion must occur. In (41), the material bridging *the music* to *an elevator* is accommodated locally, yet this material is presumably pragmatically derived rather than lexically encoded.

(41) Every time we step in an elevator, the music soothes us.

Pragmatic intrusion is sometimes taken to imply that there really is no sharp division between semantics and pragmatics, yet that is not the view taken here. Rather, we have described models of accommodation in which compositional semantics and pragmatics do discrete tasks, and in which these tasks could even be ordered quite straightforwardly. Specifically, on the view we have described, the interaction of syntax and semantics produces an initial representation which involves unresolved presuppositions, and accommodation then acts on that representation to compute a final representation in which all the presuppositions are resolved. Pragmatic intrusion, therefore, does not necessarily imply that compositional semantics is indistinguishable from pragmatics. Rather, what it implies is that the output of compositional operations could be a representation that is not yet ready for truth-conditional interpretation. If so, compositional semantics could (but need not) still be understood as an entirely discrete grammatical module, even if it is only after applying pragmatic processes such as accommodation that truth conditions are available.[36]

[35] A standard type of example of pragmatic intrusion is based on the idea that the temporal asymmetry of *and* (noticed by Strawson 1952) is commonly analysed as a case of Gricean implicature, and yet can have truth-conditional significance when a conjunction is embedded in a comparative:

(i) It is marginally more common to get depressed and take drugs than to take drugs and get depressed.

The phenomenon was discussed by Cohen (1971) and Wilson (1975), and has become a central issue in Relevance Theory (Sperber and Wilson 1984), discussed in particular by Carston (1988). Apart from Levinson (2000), the reader is also referred to Horn (2004). Note that by default, pragmatic intrusion as discussed in the literature is taken to involve conversational implicatures, but many cases might instead be analysed as conventional implicature, for which see Potts (this volume).

[36] Note that the picture of accommodation we describe here differs in an important way from that of Gazdar (1979). In Gazdar's model, like Grice's, a hearer's pragmatics need spring into action only

A variety of open questions remain. First, we have presented in the main text of this chapter, in as general a form as we could, fourteen different principles of accommodation. All have descriptive merit, and most of them seem well motivated. The question must be: which of these principles are merely apt descriptions, and which should be seen as essential and underivable parts of the theory of accommodation? Secondly, we have observed that as to accommodation, not all presupposition triggers are equal. As we have indicated, a full account of why sometimes accommodation cannot occur, and why there should be differences between triggers, remains elusive. Thirdly, and related to the second point, most work on accommodation centres on its application to presupposition projection. Enormous progress has been made on the projection problem since it was first set out over thirty years ago. Perhaps we should not merely restate the projection problem, but ask a different question altogether. The outstanding conundrum in presupposition theory is surely what can be called the trigger problem: why are there any presuppositions and what are the specific mechanisms that produce them?

Based on the above considerations, we anticipate that scholars' interests will shift. Current solutions to the projection problem hinge on broad uniformities in accommodation behaviour across triggers. Progress on the trigger problem will require detailed observation of how accommodation varies from trigger to trigger. Indeed, there remains yet a further layer of potential variation which we have not even touched on in this chapter: variation from language to language. To our knowledge, no examples have been given in the literature evidencing cross-linguistic variation of accommodation strategies. It is quite possible that this lack of evidence results from a failure on the part of semanticists to search for such variation. But it is also possible that the principles constraining accommodation are universal. This in turn would suggest that these principles have some deep functional motivation, or are in some way intimately related to our general cognitive make-up. Yet the present state of our understanding of accommodation does not provide a firm independent functional or cognitive basis for the principles that govern accommodation. Although some principles can be functionally motivated (say, the Atlas Principle preferring stronger readings, or Blutner's Theorem preventing use of presupposition triggers when a semantically equivalent non-trigger is available), every such principle faces empirical problems. The search for general theoretical principles underlying accommodation must go on, hand in hand with empirical work that proceeds trigger by trigger, context by context, and language by language.

after semantics has produced truth conditions. Indeed, semantics was understood as no more and no less than truth conditions. The view we describe allows us to conceive of pragmatic interpretation operating after semantics, but suggests that the output of semantics might be a representation that is not yet ready for truth-conditional interpretation.

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PART IV

ARCHITECTURE

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CHAPTER 17

MINIMALISM

CEDRIC BOECKX AND JUAN URIAGEREKA

17.1 Foundations

The first explicitly minimalist paper (Chomsky 1993) was published more than a decade ago, relevant discussions for its proposals having started in the late 1980s. Everyone would agree that "there is not yet anything close to a Minimalist theory of language" (Lasnik 1999: 6), making it hard to provide an adequate survey doing justice to all aspects of minimalism. As Chomsky has stressed over the years (see e.g. Chomsky 2000: 92), the Minimalist Program (MP) is just that: a program, a mode of investigation, not a theory. To understand this program, with all its economy considerations of various types, we must first consider the Principles and Parameters (P&P) approach. It is, after all, the perceived success of this model to the central concerns—indeed, defining features—of generative grammar that minimalism grew out of. In particular, MP takes from the P&P approach the claims that: (i) that human language is to be understood in terms of a faculty in an individual's mind, and (ii) that the factors underlying its growth in the individual (language acquisition) depend on the fixation of plastic options within an open biological program. The P&P theory, first outlined in Chomsky's (1981) *Lectures on Government and Binding* (*LGB*) and refined in subsequent work, holds that the child's innate endowment includes a Universal Grammar (UG) that provides core principles of linguistic competence, as well as well-defined points of variation (parameters); these are assigned a fixed value as the child interacts with its environment. This approach grew naturally out of two major advances in the

1970s: (i) the sharpening of general conditions on transformational rules (starting with Chomsky 1973) and (ii) the uniformity discovered in comprehensive attempts to characterize languages other than English (e.g. Kayne 1975).

17.1.1 A Question of Mind

Due to its emphasis on language acquisition, the P&P model already implied a form of minimalism, if only because any hope of addressing learnability considerations must meet restrictivist demands, which in turn forces one to simplify the hypothesized system. In addition, the mere fact that linguistics is a science imposes familiar simplicity demands on its methods. As a result, it was not uncommon during the P&P years (and even earlier) to find debates in the field whose perceived solution was not in terms of data coverage or feasibility in language acquisition; rather, overall concerns pertaining to broad elegance considerations were the tilting factors to choose from competing theories. This has been the case mainly in those sub-disciplines where language was taken fundamentally as a natural phenomenon, as opposed to a social or purely formal one. To a theorist assuming this perspective, achieving descriptive adequacy (generating "all and only" a set of grammatical expressions) is considerably less important than accomplishing what one may think of as *natural* adequacy: providing a realistic picture of the language faculty within the human mind.

Admittedly, the P&P system was in that sense an inter-modular, even interdisciplinary, theory. From the beginning (explicitly in *LGB*) it was clear that linguists ought to seek not just the internal properties of the linguistic system itself, but also how they interact with the rest of the mind. This is definitely the case with respect to language acquisition (see e.g. Crain and Thornton 1998), but in principle also in terms of language use (e.g. Berwick and Weinberg 1984), language change (see Lightfoot 1999), or the place of language within brains and genomes (see Jenkins 2000). These concerns have become all the more relevant within the MP, especially because this system explores the rational conjecture that some fundamental properties of the language faculty are the way they are precisely *because* of the system's interaction with the rest of the mind. To the extent that this claim turns out to be true, it should help us understand not just the nature of language, but also what the rest of the mind is.

Some of the Minimalist considerations were central to Chomsky's approach to language from the very beginning, at a time when psychology was dominated by behaviourism and linguistic studies were the property of two schools of thought. On the one hand there was philosophical logic, philosophy of language, and mathematical logic, all of which are the result of a practice that goes back to Aristotle through the scholastics, feeding, in the twentieth century, on the remarkable results of formal logic and mathematics; from this perspective, human language was a mere imperfection reflecting logic through human limitations. On the other hand, there was structural linguistics, which wanted to separate the study of human language *as it is* from that of human thought, particularly in the form of logic, and was concerned both with the thousands of actual languages one encounters in the world and with methods for describing them; from this perspective human language was a social convention. Chomsky went against both these traditions.

First, to understand the full potential of human language, and very specifically, its creative aspect that had fascinated Descartes and Humboldt, it is very clear that one must go beyond the naive methodology of structural linguistics, in principle incapable of providing an analysis of potentially infinite behaviour via certainly finite means. To prove his point, Chomsky used mathematical devices from the philosophical tradition (Emile Post's rewrite rules), and came up with new devices of his own (transformations, inspired by Zellig Harris's inter-sentential relations). While structural linguistics took itself to be more or less a complete science, Chomsky demonstrated that a science of human language had not even begun; to this, the established field responded by taking the new claims as arcane, artificial, and untestable—at best a curious descriptive tool. The situation within the tradition of logic and mathematics was no different. Chomsky was celebrated for having shown intriguing computational properties of formal languages (what Boeckx and Hornstein 2003 call the combinatoric aspect or stage of generative grammar), but his arguments for transformations were inspected at a superficial level, as tools better to capture all and only relevant expressions. The interest on these devices came to a halt (from this perspective) once their descriptive power was shown to be equivalent to that of a Turing machine. For Chomsky this brought some impetus to work on the naturalistic conditions on transformations that presumably limit their expressive power, which would get the theory closer to its goal of understanding the workings of the human mind; for his critics it was the perfect occasion to abandon these devices as relevant grammatical operators.

Grammar	Linguistic object
Turing machine	Any computable representation
Context-sensitive transformations	Lists of phrases = chains
Context-free constituent structuring	Lists of lists of symbols = phrases
Finite-state automaton	Lists of symbols

Fig. 17.1 The Chomsky hierarchy

The reaction that Chomsky's generative grammar received within psychology ranged from nonexistent to mild interest in his negative arguments against Skinner (Chomsky 1959). Standard behaviourism did not begin to explain linguistic behaviour, but the claim that linguistic structures are innate was deemed too irrational to be worth considering. It took decades for these various fields to approach an understanding of the actual scope of what Chomsky was attempting and achieving. This happened, in part, as a generation of new philosophers and psychologists, led by Jerry Fodor, began to reflect on such notions regarding mental architecture as the language of thought or the modularity of mind, which Chomsky's ideas had made possible, thus literally creating the field of cognitive sciences (in fact revamping the Cartesian program; see Chomsky 1966; Fodor 2003).

17.1.2 Internal Debates

Two well-known, and very serious, debates took place in the field in the late 1960s, whose resolution had such a powerful impact that it can be felt in the way P&P shaped up. On one hand, a gifted generation of researchers working more or less closely with Chomsky (Bach, Lakoff, McCowley, Postal, Ross) saw a variety of holes in the specific model of syntax that was being assumed (the Standard Model), once Katz and Fodor tried to work out a semantics that would fit it nicely. So-called generative semanticists discovered (Chomsky in fact leading them) that words have internal structure; moreover, these properties can be reasonably described by syntactic devices, of the very type that at the time were being used to analyse phrases and their interactions. This finding had a clear consequence: if words have syntactic structure, they are syntactic. So in this view of things words are composed of smaller units, presumably concepts of some sort—words just being the spell-out of permissible conceptual aggregates. Linguistics should then study the parts of the aggregates, not their surface reflex. It is interesting to note that this is already a minimalist view. What matters to the argument is not language acquisition or descriptive adequacy (although more on this shortly); at stake is the best theory, the simplest one.

Unfortunately, the position maintained by the generative semanticists would mean studying "thought" directly—a difficult task. Chomsky, Fodor, and a new generation of linguists led by Ray Jackendoff, who were direct participants in this debate, argued that we should study language as we know it: that is, more or less a combination of words. In fact, interpretation, rather than being deeply entrenched in the mysterious depths from which thought is formed, can be shown to be related to something quite surfacey. For instance, *many arrows didn't hit the target* does not assert the same as the (arguably) thematically identical, but different on the surface, *the target wasn't hit by many arrows*. As a result, Surface Structure was proposed as a level of representation, and Logical Form (the interface with semantics) was moved from its input place (traditionally called Deep Structure) to an output location in the derivational flow. In addition, what was left of Deep Structure—basically, thematic relations—was deemed not deep at all (it does not interface with propositional interpretation, of the type that truth judgements can be built on), and it was renamed D-structure. Thus the Extended Standard Model was proposed, by way of entirely expected moves in a natural science where, as a result of rational debate, concepts advance and understanding deepens.

Whether understanding in fact got deeper as a result of this particular debate is itself still debated. Ultimately, the main argument against generative semanticists was empirical. Their theory was too powerful in that the nuances they proposed internal to words, and their syntactic distribution, predicted far more forms than actually exist. To this date the pages of journals are still filled with arguments over whether (a) given words should be decomposed into smaller units, and (b) their component parts obey, in their combinatorial possibilities, standard syntactic principles. The general lexicalist (ultimately, atomist) argument is that sub-lexical relations are too idiosyncratic (compare *to father* vs. *to mother*), too unsystematic (e.g. *to hospitalize* but not **to clinicize*), and too opaque to be syntactic (e.g. one cannot normally modify into the sub-events presumably represented internal to a transitive verb). Did the lexicalist alternative produce a deeper theory? In descriptive terms, it produced a more accurate theory (limiting the prediction of scores of impossible facts); on methodological grounds it provided a more workable theory, since the alternative forced linguists to look into thoughts, albeit without obvious tools (as per familiar considerations against analyticity that go back to Quine 1960). That said, lexicalists still owe the field an explanation as to why the generative engine stops at the word, particularly if they are ready to accept sub-lexical features. This is still an issue within the MP, where Chomsky went as far as to propose the possibility of direct manipulation of sub-lexical features (see section 17.3), yet he insists—for the reasons just discussed—on the lexicalist character of the system.

A second debate in the 1960s also crucially informed theorizing within the P&P approach. The formal devices used at the time to describe languages offered complete descriptive accuracy, in terms of existing data. Phrase Structure Rules (PSRs) allowed linguists to capture every subtlety one could think of regarding constituent structure; Transformational Rules (TRs) had a similar effect on the property of displacement (discontinuous constituents) that one can readily observe in all human languages. The combined apparatus was shown by Peters and Ritchie (1973) to have as much power as a Turing machine—thus in principle it allows the generation of any computable structure (see Figure 17.1). It is not surprising, then, that descriptive adequacy is reached if human languages can be modelled as computable objects. This is particularly troubling if one is interested in accounting for the fact that infants must acquire at least one human language, with all its subtlety and complexity; how can

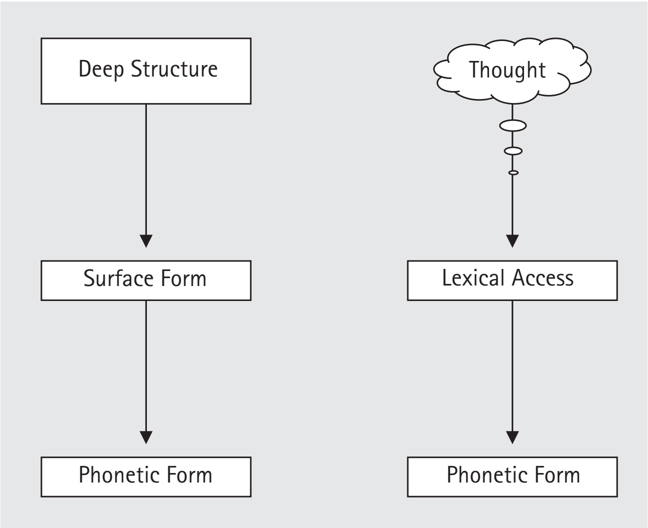

Fig. 17.2 The Aspects Model (left) and the Generative Semantics Model (right)

they perform that phenomenal task, with only positive data (i.e. without explicit instructions, an obvious point if for no other reason than that children do not speak a language to get instructions in)? If the descriptive apparatus at their disposal were a Turing machine, what would prevent children from endlessly searching for any given language across as broad a computable space as can be imagined?

A solution to that puzzle soon became evident: theorists had drastically to constrain the formal devices that the language faculty makes use of that carry it from a context-free to a context-sensitive system. The former are simple rules that operate without any concern for other rules in the derivation; in contrast, the latter are potentially very powerful mechanisms that allow all kinds of formal manipulation. At this point, considerations about *classes* of rules become central, and thus a further issue arises: what is natural, the rules that describe English, Spanish, Swahili, and so on, or, rather, the meta-system (of general conditions) that describes the rules? The question would be pertinent in structural biology, for example when studying body plans or scaling laws (see section 17.2). What is central to the field, the nature of the condition (body plan, scaling law, etc.) or the species that emerge within those natural parameters? In this case, whether one takes the perspective of a traditional evolutionary biologist or a new molecular biologist makes a difference to one's response. In linguistics, too, this divided the field. Chomsky (e.g. explicitly in 1986*a*) took the view that the science of linguistics should care about describing what he termed I-language (I standing for an "internal" mental procedure), as opposed to E-language (E standing for an "external" data collection). It is within I-language, Chomsky reasoned, that concerns about meta-mechanisms in general make sense. Linguists of a more descriptivist orientation, and especially those interested in the computational properties of natural languages (be it for computation's sake or for more practical computational linguistic reasons), literally could not be interested in this matter, as the formally elusive notion I-language is not something their computational devices could deal with.

17.1.3 Exploring I-Language

Many philosophers of mind agree that merely to worry about rules is not the way to understand a mental phenomenon, and that instead the theorist should be interested in something like Fodor's (1975) LANGUAGE OF THOUGHT (also called Mentalese) underlying such rules. However, despite its name, there is no reason to believe that I-language is even a language in any serious sense of the word. An I-language could not be anything like English (Swahili, etc.) since it is characterized by *opposition* to any definition of any natural language. But for the same reason, an I-language cannot be a formal language, in the standard, set-theoretic sense that this notion is given in mathematics. In fact, conceived as a natural phenomenon, there is not even an a priori reason to think that an I-language is even a computational procedure, characterized as some subset of what a Turing machine can perform; if that happens to be the case, it will be an empirical finding.

An I-language is, first of all, an *idealization*: a system in an ideal human mind. Second, an I-language is a *generative procedure* that, very indirectly, somehow makes linguistic behaviour possible. The concept is a competence notion, whereas the linguistic behaviour is part of human performance; so we must separate the I-language from whatever it is that humans *do* with it. For Chomsky, competence is a faculty (a system, we hope) within our minds, corresponding to the way they have evolved and developed, through interactions with the biological context—which includes input linguistic data to fix some core parametric properties. Performance, in contrast, has to do with language use here and now, not directly its evolution or development; in addition it involves competence in other spheres of mind, together with other processes, including the deployment of long-term and procedural memory, conditions on attention span, general health, and more. Understanding performance presupposes understanding competence, even if all the data that linguists have at their disposal is taken from performance. The situation was no different in late-nineteenth-century chemistry, which was assumed to reflect physical conditions although it was unclear how—and all the available data (prior to particle accelerators or the concepts behind them) were of a chemical nature. Eventually, unification (by extending physics to capture properties of the periodic table, expressing a "language" of chemistry) was possible by postulating abstract models of the atom and its parts.

Is chemistry a computational system? If by that we ask if there is (Turing computable) systematicity to it, in that it involves discrete units combined in terms of operations that correspond to the basic axioms of logic, then the answer is "yes". But this is a merely formal claim without any semantics to it. If one interprets structural units as symbols and binary states of the system as true or false, causal relations as inferential, more complex relations within contextually confined domains as quantificational, and so forth, then one would be fantasizing in the case of chemistry. More generally, modelling in terms of a Turing machine does not entail that the object of inquiry is a logical system, even if the converse is the case. This is so both for chemistry and for language. Whether language is adequately conceived as a system of symbols, inferences, valuations, etc., or is merely modelled that way, is a more subtle and difficult question than it may seem at first. Surely, there is something of all this in using language to refer, infer, speak truths and falsities, or quantify. But Chomsky's point in separating all that from linguistic competence is that a naturalistic theory of semantics is yet to be fully developed (see Higginbotham 2002 and in this volume, for the closest, foundational, attempt within this tradition). We have logical systems that code these notions, but a different task is to demonstrate that such mathematical constructs correspond to reality, as much in linguistics as it does in chemistry or elsewhere in natural science.

The last point is meant to convey the admission that a precise notion of I-language is hard to pin down, a fact that worries linguists outside the P&P tradition. In contrast, linguists within this tradition take the matter the way a physicist does with regards to hypothetical models of cosmology, the atom, or intermediate constructs of the complex dynamic sort. In both linguistics and physics, the edifice is modelled in rather precise terms, but (*a*) versions of the model are taken to change as need emerges due to scientific argumentation (i.e. there is nothing eternal, in more or less the logical sense, about intermediate models), and (*b*) it remains to be seen what it is that is ultimately modelled, which, rather than being taken as a problem, is actually seen as *the* virtue behind the approach, and the only hope of addressing the nature of linguistic systems. Again, similar issues emerge within biology, particularly as a better understanding of genetic and epigenetic considerations entails rethinking much-cherished notions such as individual, race, species, and beyond. In this take on linguistics, language is one of those pre-theoretical notions that must be given a (changing) characterization as understanding improves.

The concept I-language provides a sharp divide between construction-based and principle-based linguistics. The first type was the only one available until the P&P framework: it sought to characterize pre-theoretical notions from the linguistic tradition such as passive, relative clause, question, and so on (the classical chapters in any descriptive grammar of a language). It was clear since antiquity that these differ from language to language. If both the notion "construction" and the notion "language" are real, in principle we should find four logical combinations among these, depending on whether a given phenomenon is or is not specific to a language and it is or is not specific to a construction. However, as serious research proceeded in the 1970s and early 1980s (e.g. the seminal Kayne 1975 and subsequent work inspired by it), it was found that few, if any, grammatical procedures are specific to constructions (e.g., displacement cuts across all the known ones). The issue remains of whether there are general construction processes; this is a harder question. P&P came from a tradition suggesting that what is general in language is universal, and its ultimate cause is biological in a broad sense (to be explained in terms of UG). But then the logical next move was to propose that specific considerations too had nothing to do with constructions, leaving us with only two categories: language-general (a universal principle) or language-specific (a parametric option). An I-language can then be precisely defined as a choice of parametric options.

E-language (extensional, external)	*I-language* (intensional, internal)
A set of sentences of a certain sort (usually characterized in terms of grammaticality)	A generative procedure provided by the language-specific fixation of all parameters existing within universal principles of UG.

Fig. 17.3 E-language vs. I-language

17.1.4 Consensus in Generative Grammar

In any case, even if serious philosophical disagreements exist on these two central and divisive issues (the role of sub-lexical components and the nature of universal metalinguistic statements), the truth of the matter is that some kind of consensus has emerged over the fact that human language cannot be characterized in the way early information theory imagined (a Markovian, finite-state automaton) or even in the manner structuralist linguistics did (as some variant of a context-free constituent architecture). Language is clearly a mildly context-sensitive system, and how mildly that is, or in what way that mildness arises from more basic considerations, is what arguably separates current generative proposals. Specifically transformational proposals such P&P, and MP after it, take the view that in particular logical forms are best characterized as sets of sets of phrase markers (the technical term is "chains"). Constraints of the type first systematically discussed in Chomsky and Lasnik (1977)—the transitional piece between the Extended

Standard model and the P&P system proper—are then assumed. These condition what kinds of transformational procedure can generate such chains, and what specific representational conditions the chains themselves must meet, or otherwise be filtered out by the grammar. The sub-theories of the P&P system (Theta-theory, Case Theory, Bounding Theory, Binding Theory, Control Theory) are meant as different modules to constrain context sensitivity in this particular sense. As we will see shortly, MP attempts to go deeper, but the basic goal has not changed: it too seeks, in part at least, to predict the structural properties of linguistically relevant conditions on context sensitivity.

17.2 Beyond Explanatory Adequacy

Building upon his foundational (1955) *The Logical Structure of Linguistic Theory*, Chomsky (1965) distinguished three levels of adequacy for linguistic analysis: (i) observational adequacy; (ii) descriptive adequacy; and (iii) explanatory adequacy. Level (i) was deemed the minimum for empirical science (some disciplines classically considered linguistic, such as perhaps literary criticism, do not obviously strive systematically to achieve it). Level (ii) was intended to provide an explicit theory of the observed data; it was never crucial for the theory to describe all and only the appropriate data (what "all and only" meant was never clear, as any attempt to characterize it involved the elusive notion of "degrees of grammaticality" in speakers' minds); but it was important that the descriptive theory make an attempt to deduce a proportion of the data considered relevant in standard scientific fashion, with different theories competing in terms of data coverage. Level (iii) was taken to be the most important one, a procedure to evaluate descriptively adequate alternative theories that could be available to a human child when acquiring language; this implied an already minimalist notion: a simplicity metric. Although conceptually straightforward, this particular picture became, as a whole, considerably simplified as interest moved from E-language to I-language. In the latter instance, what matters to the theory is to determine the right set of parametric choices available to the child. That is then the explanatory theory, difficult as its details may be to fill in.

17.2.1 Natural Adequacy

It is within the confines of what was taken to be the right kind of explanatory theory—the P&P model—that minimalism emerged, and from its conception it had to go beyond explanatory adequacy, into what we called in the previous section "natural adequacy". This is simply because MP seeks to understand why the general conditions of grammar are of the type which the P&P system had roughly established. This generated confusion among researchers, who could not understand what could possibly be beyond explanatory adequacy. But the issue is no different in physics: one may have a good theory, even the right theory, of how the universe came to be; still, one can then worry about such issues as why the theory invokes the dimensions it appears to have (neither more nor less), why it presents the particular pockets of regularities that its various conservation laws define, or even why the universe it describes exists at all, as opposed to annihilating itself in perfect balance. These are not (just) philosophical questions: they are fundamental concerns that should lead to a better understanding of the universe, and which are uniformly considered essential when attempting to reconcile relativity theory and quantum mechanics, for instance. In linguistics too, initially the notion "explanatory adequacy" was technical; it meant providing an answer to the most important unknown half a century ago: how can children acquire language? Once a reasonable, testable, and (so it seems) basically correct, answer is within reach, it is entirely appropriate to raise the bar to address the nature of the system that is acquired that way, in which particular form it is encoded in the mind, presumably via neuronal interactions all the way down to proteins regulated by whichever genes turn out to be relevant (e.g. the recently found FOXP2, see Lai et al. 2001, Enard et al. 2002), or even how this system emerged and evolved in life (see e.g. Hauser, Chomsky, and Fitch 2002; Carstairs-McCarthy 2005; Delfitto, Graffi, and Scalise 2005).

17.2.1.1 *Constraining Vacuous Rule Application*

A recurring theme in the Minimalist Program is that language is optimal, in some sense to be made precise. The reasons for this empirical hypothesis are two, one technical, the other conceptual. The important technical reason had to do with the fact that the logical conclusion of the P&P model was the Lasnik and Saito (1984, 1992) project (henceforth L&S), which simplified TRs in the system to a single transformational operation, Affect α. This operation allows movement, deletion, insertion, or anything transformationally possible applied to any category anywhere in the derivational process, as long as general principles of grammar determined by the various modules (such as Subjacency and Cyclicity Conditions, The Empty Category Principle, Case and Theta Considerations, and Binding and Control relations) are appropriately satisfied. The rationale of the system allows virtually unconstrained rule application—up to some form of locality—which is then filtered out by representational conditions. As a consequence, new descriptive possibilities emerge, in particular with regards to the distribution of adjunct displacement and complementizer-trace effects (see Lasnik and Uriagereka 1988). The L&S model does appear to be the simplest, methodologically most elegant instantiation of P&P

concerns; at the same time, this system in principle allows for unrealistic, even vacuous, rule application so long as the output is of an appropriate sort. This is not immediately problematic in a competence system that does not attempt to model actual human performance, but it seems unappealing, if only because linguists hope that competence and performance eventually will be unified as each is better understood.

Chomsky, as early as (1986*a*) (where in particular the "back-and-forth" movements involved in the L&S system were not pursued), and explicitly in (1986*b*) and (1991), sought one interesting way of limiting the power of rule application. The problem was that a P&P model built on the idea of applying transformations unless some sub-theory prevents it was, on the one hand, the simplest statement of a good line of reasoning, but on the other, it allowed for the operationally most complex state of affairs; so Chomsky decided to add a measure of operational simplicity: to have rules apply only up to last-resort conditions. This is clear, for instance, in (1986*b*), when it comes to preventing an already Case-marked chain-link from further displacement, thus ruling out *John seems that* [*t is smart*] (vis-à-vis *it seems that* [*John is smart*]); the *t* in the first of these sentences is already a Case position, so further A-movement of *John* is unwarranted by last-resort considerations. Moreover, in (1989) Chomsky took a further step, when he allowed for the comparison of different derivations, A and B, each taking a number n and n' of derivational steps, respectively; if A and B are indeed comparable (see section 17.3), and $n < n'$, then the system would have A outrank B as a grammatical possibility. Both—last-resort considerations and economy comparisons—are new ideas in linguistic theorizing. While they obviously limit the expressive power of the P&P system taken to the L&S limit, they have also generated considerable controversy of their own.

That can be best illustrated by summarizing two polemical positions, namely, Johnson, Lappin, and Levin (2000*a*, *b*, 2001) (henceforth JL&L) and Pinker and Jackendoff (2004) (henceforth P&J), both of which attack economy considerations, the first on technical grounds, the second on conceptual ones. For JL&L, it is computationally unrealistic to introduce derivational comparisons. This claim confuses two things. First, the entire generative project is based on computational modelling simply as a working hypothesis (as would be the case in any other natural science, for instance computational biology or a computational interpretation of chemistry or physical interactions). In fact, a well-known argument exists to the effect that computational modelling is the wrong hypothesis: Langendoen and Postal (1985), who argue (unconvincingly, but this is immaterial) that human languages are not Turing computable. Whether that is true or false, it is entirely possible, as it would be of any other aspect of the natural universe. Put simply: if serious theorizing about linguistics (biology, chemistry, etc.) shows that the relevant part of the universe being studied cannot be modelled by a standard computational device, so much the worse for the computational device or the modelling. The scientific project will not be derailed, as twentieth-century physics showed with regard to quantum physics, which is not modellable in standard computational terms (Penrose 1989 controversially argues that the mind, more generally, cannot be modelled in such terms, and only quantum computational modelling has a realistic chance.) Secondly, the arguments JL&L construct in their essentially mathematical modelling presuppose a connection between competence and performance that has never been established. It may be accepted that if the competence system is to be directly implemented in performative terms, then massive comparison among derivations is so costly that it makes usability unrealistic. Then again, another straightforward possibility, pointed out by Chomsky (2000), is that speakers simply will not use those structures that happen to lead to computational blow-up, just as they do not use structures involving massive centre embedding, grammatically possible though they are. Grammaticality does not entail usability.

Curiously, what JL&L never address is the concern that led MP away from the L&S limit to start with: how is one supposed to constrain a system which, in its most elegant version, leads to the possibility of massive vacuous rule application? Preventing derivational comparison or similar devices (to eliminate grammatical alternatives if simpler ones exist) leaves unaddressed the fundamental question of proliferating unwanted grammatical alternatives (see Figure 17.4). That may in itself be a reason to reject the P&P model entirely, but then it is unclear how even the most basic feasibility questions (explanatory adequacy in the sense above) can begin to be addressed. Thus the JL&L remains a merely negative thesis, whose only

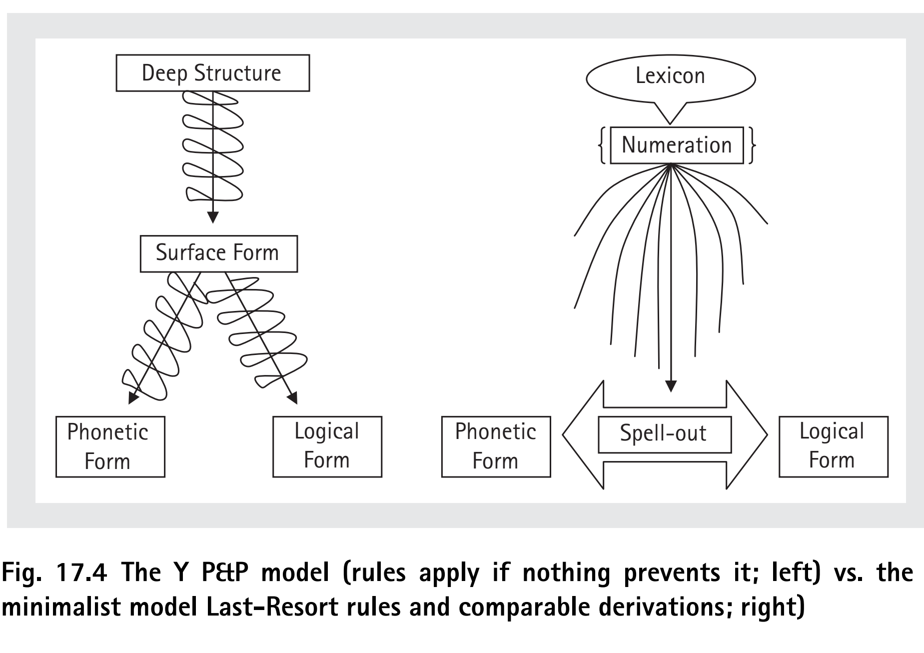

Fig. 17.4 The Y P&P model (rules apply if nothing prevents it; left) vs. the Y minimalist model Last-Resort rules and comparable derivations; right)

positive outcome has been to alert researchers to the possibility that we may be attempting to replace one computational blow-up (the possibility of vacuous rule application) by a different one (the possibility of massive derivational comparison). We will see below that this issue has concerned serious competence studies and led to important advances, although the details are far from settled.

17.2.1.2 *Structural Elegance in Nature*

A priori, another possible way out of the impasse just noted would have been to ask why P&P should be taken to the L&S limit. Even if that is the most elegant alternative, why should language be elegant? That is the main concern behind the other polemical piece, P&J, which addresses evolutionary aspects of language argued for in Hauser, Chomsky, and Fitch (2002). P&J take aim at MP on the basis of its strive for elegance allegedly being misplaced within the biological sciences. The basic argument is: if the emergence of biological systems is based on the happenstances of evolution, whose only concern is functional fitness to an environment in competitive terms, why should language have structural perfection as one of its characteristics? If it does not, there is no need to carry the P&P system in the L&S direction, and the theorist simply has to seek, in geographer fashion, whatever actually happened in the natural history of the species. P&J embrace the JL&L criticism on the basis that direct computational plausibility is, presumably, a realistic evolutionary milestone for the language faculty to have achieved. As to what architectural alternative to the P&P system P&J entertains, the only one mentioned in the text is Jackendoff (2002), a theoretical proposal which is too far from the mainstream for us to consider even briefly.

As it turns out, while it is reasonable to ask why the language faculty should be structurally elegant, it is less so to summarily dismiss the possibility that it should be. As Carstairs-McCarthy's introduction to the (2005) *Lingua* issue on evolution points out, contemporary theorizing has shown three different dynamics are compatible with the logic of natural selection in evolution: (i) adaptation of the classical Darwinian sort, (ii) exaptation as emphasized by Gould in (2002), and (iii) constraints imposed by the physical channel in which evolution takes place, going back to Thompson (1949). Chomsky explicitly constructs his MP around concerns of the third type (e.g. in Chomsky 2002), taking as his model works in the computational tradition of Turing (see Saunders 1992) or, more recently, Kaufmann (1993). This may or may not prove to be the right theoretical move, for language, speciation within blueprint and scaling considerations in biology, or complex dynamic systems more generally (see for instance Meinzer 1994). But that cannot be determined a priori, and insistence on evolutionary considerations of the first or second type seems entirely dogmatic. As Uriagereka (1998) and Boeckx and Piattelli-Palmarini (2004) have argued, while only time will tell whether this particular strong minimalist thesis (SMT) turns out to be as valid as the P&P system was, the conceptual foundations on which it sustains itself are no different from those of computational biology, or current concerns on the intricate dynamics of complex systems more broadly. In that sense, MP and in particular SMT look like a fascinating opportunity to explore such systems within a very well-understood phenomenon for which an account meeting the desideratum of explanatory adequacy already exists. Few disciplines other than linguistics can consider themselves this lucky, particularly when experiments to test relevant versions of the theory do not require the immense expense of particle accelerators and the like.

To see in detail how the conceptual reason for MP to seek structural optimality (i.e. for SMT) is appropriate, consider a recent and celebrated instance within biology which shares both the broad philosophical and arguably even some of the narrowly technical properties under discussion. As it turns out, the heart-rate of an elephant is slower than that of a mouse, while its pregnancy time is longer; there are various observations of this kind across species about which biologists know their mathematical rate: an idealized proportion of direct or inverse fourth powers involving the creature's mass, depending on the specific system, but otherwise constant across species. Why the mathematical expression should be a power of four is particularly puzzling, as entities existing in the usual three dimensions of space scale by powers of three, one per dimension. West, Brown, and Enquist (1997) provide an explanation for the fourth power starting from some abstract assumptions of the types that linguists constantly make: (i) that all eukaryotic organisms have (standard) cells of roughly the same size, (ii) that physiological functions, such as those involved in blood or oxygen distribution or the growth of tissue, are optimal in some definable sense; and (iii) that given these two initial assumptions, and a central core (a heart, lung, growth apex, etc.), the best type of geometry to describe the system would be fractal: structures whose most important property is recursion under conditions of self-similarity (see Figure 17.5). Standard recursion is familiar to linguists, but self-similar recursion is a sub-case with a curious property: it must present a kind of structural optimality that can be easily and intuitively grasped by merely observing a Fibonacci structure in nature (flower corollas, sea-shells, skin patterns in cordates, etc.). As it turns out, apparently the dimensional networks of this sort require a fourth dimension to describe them, basically reflecting the time it takes the network to grow, which accords with the initial description of scaling conditions.

At present, no theory can predict what that type of structural optimality exemplified in speciation processes ultimately follows from. This, however, seems no more problematic now than it was less than a century ago in physics, where, for example, Hamilton's Variational Principle worked, although it posed a question, at the time unresolved, as to what it was holding of. Certainly, present-day quantum physics has a different take on these issues and can be seen as the way of deducing the previous description; but that was possible only because the variational results were not summarily denied to start with, and research continued—in fact, extending the basic science (physics) to account for them. As Freidin and Vergnaud (2001)

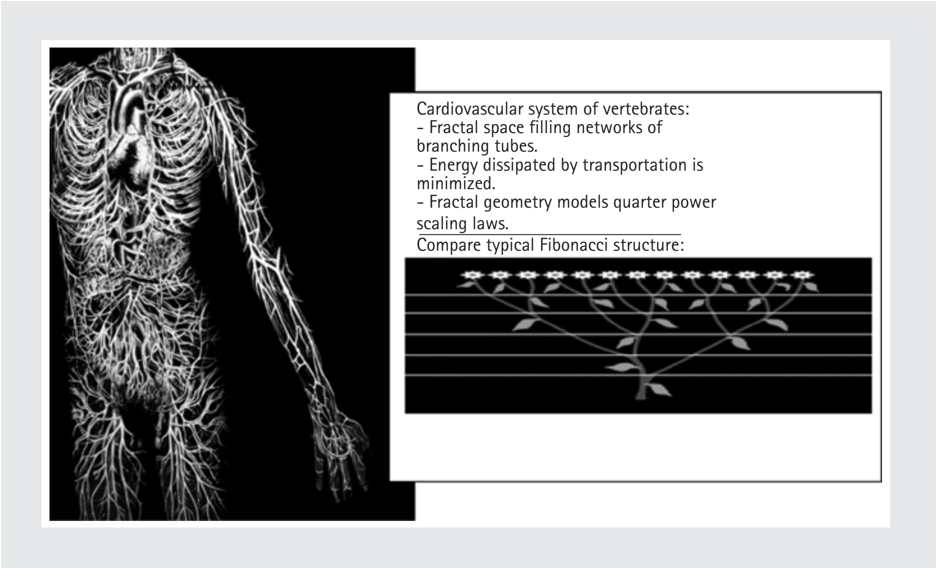

Fig. 17.5 Fractal networks in cardiovascular systems and elsewhere in nature

remind us, the situation is no different in linguistics. Serious research has both forced the field in the technical direction of last resort and derivational economy conditions, and naturally suggested similar conceptual ways of deducing other known conditions as economy desiderata. For example, Rizzi's (1990) conditions on movement of the Relativized Minimality was elegantly integrated as an essentially field-like condition demanding uninterrupted structural paths of their own sort in context-sensitive dependencies; argument-trace erasure first explored in the L&S proposal was licensed under uniformity conditions of the type explored in Browning (1987), which implements a structural conservation in the derivational mapping that in effect recasts the early results in Emonds (1976); parametric differences in the transformational mapping across languages, of the kind first thoroughly analysed in Huang (1982) were recast as conditions on the timing of derivations and how they attempt to delay work or "procrastinate" (eventually that condition itself was integrated under the rationale that late movement can involve merely features, and is thus less costly than early movement involving categories, see section 17.3). These Last Resort, Minimal Link, and Uniformity conditions—all falling under the broad rubric of "design economy"—are the present-day inheritors of a tradition seeking to constrain context sensitivity.

17.2.2 Design Economy and Virtual Conceptual Necessity

The discussion above is not meant to convey the idea that MP, or even SMT, are theories; they are merely programs. Within the confines of those programs a variety of different theories become possible. Take, for instance, the issue of comparing derivations, the basis for the JL&L criticism. Most current minimalist theories have assumed that cyclic considerations (of the type central to linguistic theorizing in the 1960s and 1970s, see e.g. Soames and Perlmutter 1979) are essential in determining viable syntactic computations (e.g. Chomsky 2000). Theories differ on how small or radical cycles may be (Epstein et al. 1998 and Epstein and Seely 2002 vs. Uriagereka 1999), but in each, derivations are drastically reduced to a few combinatorial possibilities, embedding being responsible for recursive characteristics in the spirit of the earliest proposal concerned with the matter: Chomsky (1955). As a result, even if derivational comparison were possible (the relevance of this possibility decreases with cycle size: see 17.2.3), in all instances the worst possible scenario involves no computational blow-up: there simply aren't enough alternatives. Or consider whether the computational emphasis should be on derivations (Epstein and Seely 1999), representations (Brody 2003), or both (Chomsky 2000). Theories differ in this respect, but they share general design-economy desiderata; as a result they all seek to deduce P&P principles either from derivational or from representational economy conditions.

Once design economy provided what looks like a reasonable naturalistic desideratum against which to measure theoretical tools, research suggested that various simplifications within the model(s) were possible and desirable. In this fashion the old intuition about the language faculty being sensitive to interface considerations became strengthened to the thesis that it is only a way to relate relevant interfaces (about sound or whatever physical manifestation turns out to be relevant, and meaning or whatever internal representation is ultimately involved in our understanding), indeed in an optimal way. The technical term for this move became "virtual conceptual necessity" (VCN). "Virtual" because nothing in natural science should have the validity of mathematical proof; but "conceptual necessity" because the intuition—taken essentially from concerns about the emergence of form in general within the universe as we understand it—is that form has a very small window of opportunity to emerge in a chaotic universe: it must exist in still poorly understood conditions of structural optimality. Thus, VCN forces us into design economy considerations, and to eliminate mere notational apparatuses (indices, links, bar levels, etc.) and even intermediate levels of representation, such as Surface Structure, all postulated only on the basis of empirical findings.

Of course, the findings are factual, and thus successful reduction (or unification) within MP ought to be, to the extent that this is possible, up to that factual basis. In our view, many such unifications have taken place in recent years with some success (see Lasnik and Uriagereka with Boeckx 2005 for a review). However, several authors have recently suggested that "the empirical results of the minimalist program that Chomsky can point to in [2002] do not come close to approaching his level of rhetoric about the program's degree of success" (Newmeyer 2003: 596). Indeed, Newmeyer goes as far as to suggest that "MP [does not] bring phenomena under its explanatory scope that were outside the scope of [the P&P system]" (p. 589). Furthermore, he claims that "minimalism in its purest form (the form advocated by Chomsky in [2002] and the only form in which language might conceivably be regarded as 'optimal') represented a big step backwards from [P&P] in its ability to derive constructional complexity" (p. 589). Such criticisms are by no means isolated. For instance, Levine (2002: 325) claims that minimalism is an "empirically groundless speculation" and that therefore adherence to the program amounts to an "irrational commitment" (Levine 2002: 329). (For additional comments of that ilk, see Jackendoff 1997, 2002 and Seuren 2004, among others.) Because we believe that MP not only has merit, but also a certain privilege in (linguistic) inquiry, we wish to consider in particular Newmeyer's logic further to show that his criticism is in fact unwarranted and that the pursuit of the minimalist program in syntactic theory is not only legitimate (resting as it does on solid foundations), but also rewarding.

To start with, although empirical success ranks high in the legitimization of theories, it is not the only criterion. In a series of important and detailed studies, Holton (1974) and Maxwell (2003), among others, have developed a more adequate theory of scientific practice than Popperian empiricism, one that recognizes the importance of unfalsifiable guiding "thematic" principles. Holton's and Maxwell's studies make clear that scientists must presuppose first of all that the universe is comprehensible in some way or other. What is more, modern physics, from the time of Galileo and Kepler, presupposes that the universe is comprehensible in the specific sense that there is some kind of unified pattern of physical law running through all natural phenomena, that "there is unity at the foundation" (Einstein 1938 letter, reported in Holton 1974: 241). Modern physics cannot be understood if one ignores the meta-principle of Unity, not just in the context of (empirical) discovery, but also (and, crucially, for our purposes) in the context of justification. In the words of Galileo, "we have been guided [...] by our insight into the character and properties of nature's other works, in which nature generally employs the least elaborate, the simplest and easiest of means." (cited in Chomsky 2002: 57)

With that in mind, let us address the criticism directed against MP by reproducing the following passage from Newmeyer (2003: 586).

> Belletti and Rizzi [2002: 41–4] point to the copy theory of traces and the explanation that it provides for reconstruction effects (that is, the behavior of a moved phrase as if it were in the position of its trace) as an example of "optimal design." The copy theory may or may not be empirically motivated, but it is hard to see why it is more "optimal" in some a priori sense than a theory that says when an element moves, it moves, tout court. Earlier in the introduction [to Chomsky 2002], Belletti and Rizzi endorse economy principles such as movement-as-last-resort, the idea that derivations take place in "phases" corresponding to VP and CP, and the principle of relativized minimality. These principles might be right or they might be wrong, but language would be no more or less "perfect" if movement were utterly forbidden, if DP and AP were also phases, and if minimality were not relativized.

Newmeyer's remarks betray a misunderstanding of what it means for something to be a program, not a theory. Suppose it were true that, as he claims, "no paper has ever been published within the general rubric of the minimalist program that does not stipulate a new principle" (p. 588); what would that tell us about the minimalist thesis? Surely Minimalist Syntax is not Theorematic Syntax. Axioms will always be needed, and new ones at that, since the conditions under which the axioms are needed will (one hopes) be largely uncharted territory (this would be a sign of progress towards natural adequacy). After all, "good design conditions are in part a matter of empirical discovery" (Chomsky 2001: 1), which affects the nature of the concrete proposals being made under the rubric of minimalism. In addition, one should not lose sight of the fact that language may be an optimal system, but linguists certainly are not perfect. The fact that new stipulations are being entertained simply reveals that minimalist questions are hard to answer.

17.2.3 Empirical Results

When it comes to empirical results, Newmeyer claims that language would not be less optimal in the absence, in particular, of Relativized Minimality, copies, and last resort. We disagree. Rizzi's (1990) understanding of locality was the P&P principle that received an almost immediate minimalist formulation in terms of economy (Closest Attract/Shortest Move; see section 17.3); the "relativized" part of minimality just made sense from a minimalist perspective. Relativized (as opposed to other forms of) minimality principles can be interpreted in optimal, field-like fashion: types of intervener prevent their own type of relation across them. In turn, copies provide the least stipulative way of handling reconstruction effects (which are part of the data structure in syntax). Other approaches to reconstruction in terms of lowering, indexing, multiple levels, etc. are either more complex or violate well-motivated principles, such as Inclusiveness (which bars introduction of non-lexical properties in syntax). Furthermore, copying introduces a kind of conservation principle that makes perfect sense in optimal systems (see Uriagereka 1998, and Lasnik and Uriagereka with Boeckx (2005: ch. 1) for discussion).

With respect to last-resort and other economy principles, Newmeyer notes that "Chomsky barely alludes to economy principles in [Chomsky 2002], despite the fact that they were the centerpiece of his minimalist theorizing in the 1990s" (2003: 586 note 5). This is based on two misunderstandings . First, last-resort conditions are now subsumed under mechanisms presupposing them: for instance, the notion that Case-checking in a nominal deactivates its derivational accessibility. The last-resort strategy has not disappeared—it just got deeply integrated into the system. The second misunderstanding concerns economy conditions. This issue is naturally reduced the moment cyclic considerations are introduced into the system, as possible comparison sets immediately shrink; ultimately, if radical cycles turn out to force entirely on-line transfer to PF and LF components, derivational comparison will simply have no room to actually arise. This is an empirical matter, and by no means a settled one. On one hand, Brody has shown in a series of papers how economy effects fall out (without ancillary machinery computing comparisons across derivations) once principles are properly constrained (see Brody 2003, Boeckx 2004). On the other, Uriagereka (2002) or Raposo and Uriagereka (2005)—for whom derivational cycles can be larger and more dynamic—explicitly show how some derivational comparison is useful in understanding various stylistic options in such domains as expletive–associate pairings or clitic placement. In either instance, economy conditions are alive: because they are either theorematically deduced when relevant, or still explicitly assumed.

We think that there are other significant, if naturally and healthily still controversial, results emerging from the minimalist program. The virus interpretation of checking (Uriagereka 1998, Bošković and Lasnik 1999, Lasnik 2003) led both Lasnik and Bošković to recast a variety of surface-syntax phenomena (from sheer cyclicity to ellipsis instances, in the process including matters as diverse as aspects of the distribution of WH-phrases, clitics, and others). Minimalist concerns—for instance, in terms of the Minimal Compliance of derivational conditions or regarding various notions of locality—also generated an entire industry on the distribution of multiple WH-fronting (Boeckx and Grohmann 2003, Bošković 2002*b*, Pesetsky 2000, Richards 2001). In a series of works around the notion of "the syntax of silence", Merchant has shown how ellipsis is best understood in general minimalistic terms avoiding unnecessary representational machinery (see especially Merchant 2001). The questioning of P&P principles yielding the level of D-Structure has led researchers in two directions: (i) minimalist conditions on theta relations (see e.g. Harley 2004 within the framework of Distributed Morphology and Uriagereka to appear) and (ii) the possibility of movement into theta positions, which also enables a reformulation of rules of construal such as control and binding (see Hornstein 2001 and references therein). This second move, in turn, makes it possible to consider such questions as "Why is controlled PRO obligatorily null in all languages?" Moreover, it has led to the discovery of so-called backward control (see Potsdam and Polinsky 2002) and has allowed linguists to contemplate the possibility that all syntactic relations reduce to the basic sisterhood relations (see Epstein, Groat, Kawashima, and Kitahara 1998).

MP allows an improved understanding of complex phenomena such as parasitic gaps once movement is decomposed into more basic operations such as Merge + Copy (Nunes 1995, 2001) and clitic placement, as optimal conditions on morphology and prosody are being explored (Bošković 2001, Raposo and Uriagereka 2005). MP provides us with the tools for a better understanding of why islands should emerge within derivations (see Hornstein, Lasnik, and Uriagereka 2006), and how the syntax ought to map to the interfaces (see Fox 1999 on the syntax–semantics interface). The program leads to a questioning of poorly understood principles such as the Extended Projection Principle, which results in refined hypotheses about the nature of Case and Agreement (see Boeckx 2003*b*, Bošković 2002*a*, Castillo, Drury, and Grohmann 1998, Epstein and Seely 1999, Martin 1999, Uriagereka 2002, to appear). Central P&P concepts like c-command (Epstein 1999) and labelling (Collins 2002) have also been subject to minimalist critique. At the very least, such critiques will lead us to determine the boundaries of optimal properties of grammar, telling us just how much language can be considered optimal, and thus to what extent other properties of this natural phenomenon have to be justified in ways yet to be understood.

17.3 A Case Study

To see MP at work, consider a detailed analysis of existential constructions as in (1):

(1) There is a man in the garden.

For reasons that we detail shortly, existential constructions are simple: they enable one to abstract away from the complexities involved in many other constructions found in natural language, and get to core syntactic operations for which a natural (read: minimalist) account is rather successful. Existential constructions therefore not only allow us to illustrate part of the empirical coverage of MP, but also, and most importantly, reveal how research is conducted along minimalist desiderata.

17.3.1 The Expletive Replacement Hypothesis

From a minimalist point of view, the presence of the expletive *there* in (1) is puzzling. The element itself does not have any obvious semantics; thus, Legibility Conditions on the LF side of the grammar under virtual conceptual necessity (the Principle of Full Interpretation) dictate that it be eliminated. To address this matter, Chomsky (1986*b*), building upon Burzio (1986), proposes that the associate-indefinite NP (*a man* in (1)) literally replaces the expletive *there* in the covert component, as schematized in (2).

(2) *a.* there is a man in the garden: S(urface)-Structure
b. [A man]$_i$ is [t$_i$ in the garden]: LF-expletive replacement

The Expletive Replacement Hypothesis (ERH) straightforwardly accounts for the somewhat unusual agreement configuration that obtains in existential constructions.

Descriptively, the finite verb in existential constructions agrees with the associate NP to its right, not with the element in Spec of TP, which appears to be the more common agreement configuration in English (and many other languages; so-called Spec–Head agreement). Contrast (3*a*) with (3*b*).

(3) *a.* There are/∗is three men in the car.
b. They are/∗is one and the same element.

The common agreement configuration obtains in existential constructions, albeit at LF (where by hypothesis the associate sits on the specifier of the head it overtly agrees with).

Aside from the agreement issue, by grounding expletive replacement into Full Interpretation Chomsky is also able to explain why expletives must have associate NPs (if there is no associate, the expletive can not be replaced and the sentence will be LF-deviant: ∗*there is in the garden*). More generally, this approach provides an explanation for why expletive–associate pairings pattern with chains of A-movement, as in the contrast in (4):

(4) *a.* ∗ [A man]$_i$ seems [t$_i$ has been arrested]
(cf. 'A man seems to have been arrested.')
b. ∗ There$_i$ seems [[a man]$_i$ has been arrested]
(cf. 'There seems to have been a man arrested.')

Any version of the Last Resort Condition can account for the ungrammaticality of (4*a*), as *a man* has its Case/agreement requirements met in the lower clause; if the ERH holds, by essentially the same reasoning, this type of explanation should also account for the parallel (4*b*) involving an expletive–associate pair, entailing the (this time inappropriate) displacement of the associate. Similarly, consider the contrast in (5):

(5) *a.* ∗[A man]$_i$ seems that [it is likely [t$_i$ to be arrested t$_i$]]
(cf. 'It seems that it is likely that a man was arrested.')
b. ∗There$_i$ seems that [it is likely [[a man]$_i$ to be arrested t$_i$ / to be [a man]$_i$ arrested t$_i$]]
(cf. 'It seems that there is likely to be a man arrested.')

In this instance, the Minimal Link Condition prevents (5*a*), since *a man* is illicitly moving over *it*, an element of the same kind; the same reasoning should account for (5*b*), where the expletive–associate relation is also across *it*, given the ERH.

Despite its obvious virtues, the replacement analysis was immediately criticized. As Lori Davis first observed in Chomsky's 1985 class at MIT, and many researchers following her (see Lasnik 1999 for references), the ERH gets the scope facts wrong. Typically, indefinites in subject positions are scopally ambiguous (see (6*a*)). The ERH predicts that such ambiguity should exist in existential constructions as well, contrary to fact. The associate in (6*b*) only has the narrow-scope reading.

(6) *a.* [Someone from New York]$_i$ is likely [t_i to be at the party].
(someone » likely / likely » someone)

b. There$_i$ is likely to be [[someone from New York]$_i$ at the party].
likely » someone / * someone » likely)

17.3.2 Attract F and Agree

Chomsky (1995) proposes a more satisfactory account of the facts under discussion, based on a conceptual argument that illustrates the minimalist logic, independent of existential constructions. Chomsky's starting point is the central tenet that movement is forced by Last Resort considerations. More precisely, movement is driven to check features that would otherwise be illegitimate at the interfaces. If so it is natural to expect that "the operation Move [. . .] seeks to raise just F[eature]" (Chomsky 1995: 262). We therefore expect under minimalist assumptions that, if possible, the computational component can raise just what is needed (features to carry out the checking operation), leaving behind any extra lexical material. This came to be known as the Attract-F hypothesis. Relying on it, Chomsky proposed that in existential constructions only formal (φ) features of the associate NP move (head-adjoin) to Infl, leaving all phonological and semantic features behind. Raising of φ-features immediately accounts for the fact that finite agreement in existential constructions is controlled by the feature specification of the associate.

More importantly, as Lasnik (1999) shows, the Attract-F account provides a straightforward explanation for the narrow scope of the associate NP in (6*b*), assuming that the establishment of scopal relations requires phrasal displacement. Furthermore, Lasnik points out that the Attract-F analysis captures the paradigm in (7) and (8) discussed in den Dikken (1995) (see also Lasnik and Saito 1991 for similar examples in ECM contexts) which is problematic under expletive-replacement:

(7) *a.* [Some applicants]$_i$ seem to each other [t$_i$ to be eligible for the job].
b. [No applicants]$_i$ seem to any of the deans [t$_i$ to be eligible for the job].

(8) *a.* *There$_i$ seem to each other [t$_i$ to be [some applicants]$_i$ eligible for the job].
b. *There$_i$ seem to any of the deans [t$_i$ to be [no applicants]$_i$ eligible for the job].

As the data in (8) show, the associate NP in existential constructions is incapable of licensing a reciprocal such as *each other* or a negative-polarity item such as *any* that it does not c-command in overt syntax. This is unexpected under the ERH since, according to the latter, (7) and (8) share the same LF. Lasnik takes the ungrammaticality of the sentences in (8) to mean that not only scope, but also licensing of an anaphor or a negative polarity item, require more than formal features.

The success of the Attract-F account of existential constructions invites us to revisit the validity of the Y-model explicitly put forth in Chomsky and Lasnik (1977) and assumed throughout the P&P era and in the first minimalist paper

(Chomsky 1993). Under the ERH the relevant operation (expletive replacement) took place in a distinct covert component. Attract-F opens up the possibility of doing all relevant operations overtly by letting features move (with no ancillary categorial pied-piping) in overt syntax. In other words, it opens up the possibility of dispensing with an entire component of the grammar (the Single-Output Syntax explored in various ways by Groat and O'Neil 1996, Bobaljik 1995, Brody 2002, Pesetsky 2000, and Chomsky 2000).

In 2000, Chomsky sharpened the Attract-F account. Despite its conceptual superiority over the ERH, feature movement raises a series of non-trivial technical questions. In particular, feature movement takes the form of (head-)adjunction, which violates the Minimalist conception of the Derivational Cycle known as the Extension Condition, the requirement that all operations expand a phrase marker. Chomsky 2000 proposed the operation Agree to capture the essential effects of feature movement. Agree amounts to a process of long-distance feature checking (or valuation) with no displacement. The configuration in which it obtains is very reminiscent of the notion of long-distance government under c-command (see Raposo and Uriagereka 1990). In an Agree analysis, a Probe (attractor) searches inside its c-command domain for a Goal (attractee) with a matching feature. Once the Goal is found, it checks the features of the Probe, triggering agreement. Viewed in this light, covert "movement" (long-distance agreement) is decomposable into a Matching and a Checking procedure (see Boeckx 2003*a*, 2004 for arguments that those operations are distinct), in the same way that Move is (see Chomsky 1993, 1995 for arguments that Move is a complex operation consisting of Copy and (re)Merge; and Hornstein 2001 and Nunes 2004 for detailed applications).

The presence of an expletive allows us to see the workings of Agree independently of movement (as it did under the Attract-F hypothesis), and forces us to be more precise as to what triggers overt categorial displacement in other constructions. According to Chomsky (2000, 2001), Move takes place when the Probe contains an EPP property. This is the condition that expletives satisfy. But because the EPP property is, in the words of Epstein and Seely (2002: 86), "a representational macro-tree description, demanding explanation in terms of lexical features and their mode of combination", recent research has tried to look into the nature of agreement and Case assignment in existential constructions and into the features of expletives to understand precisely what the trigger for overt categorical displacement is. In effect, several researchers are trying to eliminate the EPP (see Martin 1999, Castillo, Drury, and Grohmann 1998, Epstein and Seely 1999, Bošković 2002*a*, Boeckx 2003*b*). Although no clear results have yet emerged, this line of research prompted by the existence of expletives and the application of Agree to a wider range of constructions is representative of the current trend to be very specific about elementary syntactic relations (see Chomsky 2001, 2004 on eliminating Spec–Head relations, etc.). At the same time, existential constructions also indicate that sequencing macro-operations such as movement or even agreement enhances explanatory adequacy, and as such points toward the validity of a derivational view on the establishment of syntactic relations (see Epstein 1999 and his references).

17.3.3 Derivational Comparisons and Lexical (Sub-)Arrays

Expletive constructions have also been significant for studies exploring other conceptual issues pertaining to competing derivations, such as the idea that it is costlier to Move (context-sensitive displacement) than to Merge (context-free lexical insertion) (Chomsky 1995), or the idea that economy is locally computed (Collins 1997). Both issues were discussed in the context of the interesting pair in (9) and (10).

(9) There$_i$ seems [$_{TP}$ t$_i$ to have been [a man]$_i$ arrested]

(10) *There$_i$ seems [$_{TP}$ [a man]$_i$ to have been arrested t$_i$]

The salient difference between (9) and (10) pertains to the position of the expletive associate. In (10) *a man* has raised from its predicate-internal position to the embedded Spec of TP. This yields a bad result. One way of preventing this movement is to merge the expletive in the embedded Spec of TP, and subsequently raise it to the matrix Spec of TP, as in (9). This option, which yields a good result, has been interpreted as showing that, for a given derivational structure, and within a local domain (the embedded clause in our case), merging (an expletive) is more economical than moving (the associate). It is important to note that, for this reasoning to go through, the domain under consideration must be local, as merger of the expletive is ultimately followed by movement of the expletive to matrix Spec of TP. Indeed, globally, (9) and (10) are indistinguishable in terms of computational cost. Chomsky derives the Merge-over-Move condition by taking Move to be a more complex operation than Merge (as mentioned above, Move involves a Copying step in addition to a merging step). The local computation of economy conditions has been a major area of concentration in minimalist theorizing (see especially Collins 1997), and it already has had important repercussions, including Chomsky's 2000 proposal that derivations proceed in phases.

Developing the possibility of multiple Spell-Out conditions (see Figure 17.6), Chomsky argues that a derivation should not concentrate on the entire numeration (the set of specific lexical items chosen for computation), but instead on lexical sub-arrays that constitute derivational chunks, or "phases". The notion "phase" provides a solution to a puzzle raised independently by Alec Marantz and Juan Romero in the context of Chomsky 1995, and the Merge-over-Move condition. Consider the pair in (11) and (12).

(11) There is the fact [that someone is in the room].

(12) The fact is [that there is someone in the room].

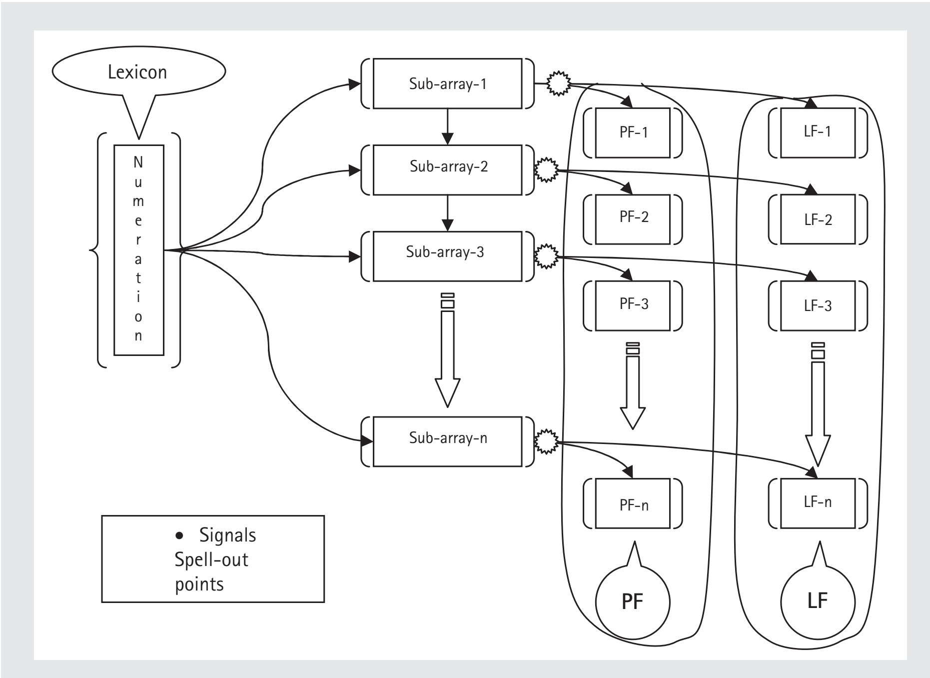

Fig. 17.6 The dynamically split model of Multiple Spell-Out

Concentrating on the *that*-clause, we can see that Merge over Move is satisfied in (12) but not in (11). In the latter case, movement of *someone* has been preferred over merger of *there*. Chomsky's (2000) solution was that there is no Merge-over-Move violation in (11) because the expletive is not available when the *that*-clause is computed. More precisely, it is not part of the lexical sub-array being computed within the phase constituted by the *that*-clause. Thus, moving *someone* is the only option within that local domain. By contrast, when the expletive is part of the same sub-array as *someone*, as in (12), Merge over Move is observed (in accordance with the findings concerning (9) and (10)). The notion of phases, and derivational/cyclic access to the interfaces, has been the focus of much recent work. In particular, several researchers have explored the idea that phases constitute opaque domains once computed, and may therefore offer a basis for understanding of barrierhood. Again, existential constructions provide empirical motivation for this theoretical construct.

17.3.4 Interactive Complexity

The existential construction, whose syntax is simple compared to other constructions involving massive movement, binding, etc., has been a major source of insights in syntactic theorizing. The ERH allows us to see the Last Resort and Minimal Link conditions at work, checking mechanisms driven by LF considerations, the involvement of mere sub-lexical features in transformational processes (either through Attract F or Agree implementations), EPP matters and the driving force behind context-sensitive dependencies, derivational comparisons in terms of Merge vs. Move, and cyclicity considerations via a proper treatment of valid comparisons among derivational competitors. What would have been analysed as a construction in pre-P&P days (so-called "*There* Insertion") has been reduced to a dynamic interplay of essentially the entire grammar. One has to appreciate the fact that none of the conditions involved in predicting the behaviour of expletive–associate pairs has been proposed exclusively for the purposes of this phenomenon. Such subtle complexity should also correlate with universality, as it is unthinkable that this array of facts could emerge other than by the deepest interdependencies among grammatical design specifications. To the best of our knowledge all languages present structures along these lines, with variation emerging only superficially (whether the pleonastic is null or pronounced or locative or nominative, whether agreement is total or partial or short or long-distance, whether the associate must take any or no stylistic step prior to PF, and similar adjustments); indeed, learners master the relevant constructions very early on, exhibiting subtle intuitions with no exposure to apparently relevant data exemplifying the central paradigms. These are the hallmarks of deeply ingrained machinery.

17.4 Conclusions

MP, and in particular the theories integrated within SMT, have provided us not just with an analysis of the kind just seen but, more importantly, with the possibility for such an analysis. Several phenomena unearthed in their full significance by the P&P model (parasitic gaps, clitic interactions, binding and control relations, etc.) have been the focus of intense scrutiny in recent years, always within the general tenets outlined above: focus on depth of explanation, rather than empirical coverage, although in some cases the latter has also emerged—indeed in new and previously unsuspected ways. Moreover, MP has provided a platform for broader studies, with already promising results in related fields like acquisition, psycholinguistics, and neurolinguistics, among others (see the contributions collected in Jenkins 2004).

That said, profound questions lie ahead. Among the deepest, purely syntactic programs ahead, one centres around the extent to which comparisons among derivational alternatives are relevant (e.g. as in Martin and Uriagereka's 2002 treatment of preferences) or, rather, derivational cycles are so small (ultimately, at the point of Merge) that no derivational backtracking is viable (Frampton and Gutman 2002), perhaps with the exception of stylistic adjustments (Chomsky 2004). Moreover, if derivations are (singly or multiply) central to the system, is the grammar sensitive to both input and output conditions (D-structure and LF residual components) or just to output conditions? If the latter is the case, how does one capture differences between conceptual (theta) relations and intentional (scope) specifications? Perhaps no question is as pressing as understanding exactly why agreed-upon design-economy metrics cluster around Last Resort, Minimality (Locality more generally), or perhaps even Uniformity conditions. Why are precisely those the ways which nature has found to constrain the transformational mapping (in particular chains)? Would other methods have been equally viable, or would virtual conceptual necessity force those as the only viable options? Are these constraints related? Do they involve the reduction of computational complexity or is their base ultimately of a more physical nature, implying conservation conditions in derivations? Implicated in this is a more controversial issue, namely: how does morphology relate to transformations and to the easily observable structural linguistic variation that apparently correlates with both? Is there a morphology–transformations–variation connection, and if so, is it architecturally significant (i.e. following from virtual conceptual necessity)?

With regard to the latter issue Chomsky himself has entertained different views. In (1995) he explicitly sought the correlation, assuming morphology, transformations, and variation to be all mysteries, regarded as human imperfections by formal languages in the tradition of logic. He also regarded the correlation as an imperfection of sorts. In later work, Chomsky suggested instead that this was no imperfection, and that in fact the system implements transformations by way of checking of the type implied in Last Resort conditions. It is to this date unclear which of these positions is preferable, and it would make a significant difference. If the system can tolerate small glitches (e.g. morphology, in this view) and react elegantly to eliminate them—the basis of the Virus Theory explored in Piattelli-Palmarini and Uriagereka (2004, 2005)—then it behaves essentially the way complex dynamic systems do. If, on the other hand, not even such glitches are tolerated, and instead the system must always entertain an option among the very best, with logical rigour—the line pursued in Boeckx (2004), for example—then the language faculty would be closer to a mathematical construct, of the kind presumably underlying physical laws: see Hinzen (2006) and Boeckx (2006) on these concerns. Both of these conceptions accord with MP practice and ultimate goals, but they entail fundamentally different views of the mind.

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CHAPTER 18

ON "THE COMPUTATION"

MARK STEEDMAN

18.1 Introduction

The Minimalist Program proposed by Chomsky (1993, 1995*a*, *b*, 2001) identifies the language system as a mapping or "computation" between two interface levels of phonetic or phonological form (PF) and logical form (LF). The interface levels correspond intuitively to representations of sound and meaning, and act as interfaces with the systems for perceiving and realizing auditory and visual forms of language on the one hand, and for establishing truth and inferential consequence on the other. The term "computation" is used in approximately the sense of Marr (1977), to denote the theory of the computation from one level to the other, as distinct from any one of a number of algorithms that might realize the computation. (Thus "computation" here means approximately the same as Chomsky's earlier term "competence", as opposed to "performance".)

These assumptions are very natural and appealing, and were embraced by a number of earlier base-generative or monostratal theories of grammar. However, a number of features of the Minimalist Program make it more complex than this simple statement might suggest. The interface level of PF incorporates some quite complex processes of re-merging or deletion under identity which seem to go beyond the transductions that one would normally refer to as an interface. Similarly, operations of covert movement such as quantifier raising intervene between the representation that determines PF and that which determines LF. The present chapter seeks to simplify this picture by refining the theory of the intervening Computation, drawing on work in other frameworks.

Questions concerning the nature of the computation come in two general forms, both first posed in early work by Chomsky (1957, 1959). The first concerns the automata-theoretic and expressive power of the system, which Chomsky convincingly argued to be greater than that of Context-Free Grammar (CFG) and the associated class of Push-Down Automata (PDA). While mainstream linguistics subsequently appeared to lose interest in the question of how much more expressive power was needed for linguistically realistic grammars, subsequent work in computational-linguistic frameworks strongly suggests that it may be only minimally greater. The second kind of question concerns empirical generalizations about universal properties of attested natural grammars, of which mainstream linguistics has been immensely productive.

The answer to questions of these two kinds has been the principal preoccupation for the past forty or fifty years of the two main formal approaches to the theory of grammar, the computational and the generative. Recently, these traditions have shown signs of converging. In what follows, it will become clear that many of the key elements of a modern theory of grammar are distinctively computational in origin.

18.2 Theory of Grammar: The State of the Art

The main problem for any theory of grammar is posed by the presence at the surface or PF level of numerous semantically discontinous constituencies and fragmentary non-constituents, arising in constructions such as relative clauses and coordinate structures, as well as more abstruse constructions such as parentheticals and intonational phrasing (Chomsky 1975: 210–11, section written *c.*1956). For example, the following are some simple cases in which verb–complement relations are discontinuous and/or various non-constituent fragments appear to behave like grammatical constituents for purposes of coordination:

(1) *a.* The theory that Monboddo proposed.
b. Monboddo proposed, and Johnson ridiculed, the theory of monogenesis.
c. Monboddo gave Johnson a book and Boswell a pamphlet.

Such phenomena have given rise to the broad range of theories known as Transformational Grammar (TG) in which the mapping from PF to LF is mediated by one or more intermediate levels of structural representation, related to the interface levels by processes of movement and/or deletion (or its inverse, copying).

Rule systems allowing movement and deletion were shown quite early on to be of essentially unlimited expressive power (Peters and Ritchie 1973). Both for reasons of theoretical parsimony and for reasons of computational complexity, this result gave rise to a search within both generative and computational frameworks for more constrained grammar formalisms.

A key insight behind this development was Kimball's (1967) and Emonds's (1970, 1976) observation that most movement rules were structure-preserving—that is, they moved elements to positions (such as the subject position) that were independently specified in the base grammar. The significance of this observation (and the related proposal by Woods 1970 to achieve the effect of certain transformations computationally using a fixed set of registers corresponding to subject, object, etc.) was that it offered a way to make movement "monotonic", in the sense of not destroying or modifying structure once built. This observation, among others, led to a number of proposals to base-generate such contructions—that is, to specify them directly in the context-free base grammar or equivalent, rather than deriving them by subsequent structural change—including Kuno (1965), Thorne, Bratley, and Dewar (1968), Woods (1970), and Brame (1978). Since the majority of these constructions were bounded—that is, defined by movements confined to the domain of a single tensed clause—there were also a number of proposals to handle base generation lexically, by associating a full specification of the local domain with the heads of constructions, and in particular with verbs, notably by Oehrle (1975), Dowty (1978), and Bresnan (1978). There were also proposals to handle the unbounded constructions—relativization and its kin, together with certain related coordination phenomena—via base generation, including Thorne, Bratley, and Dewar (1968), Woods (1973), Joshi, Levy, and Takahashi (1975), Koster (1978), Gazdar (1981), Ades and Steedman (1982), Steedman (1985), and Gazdar et al. (1985).

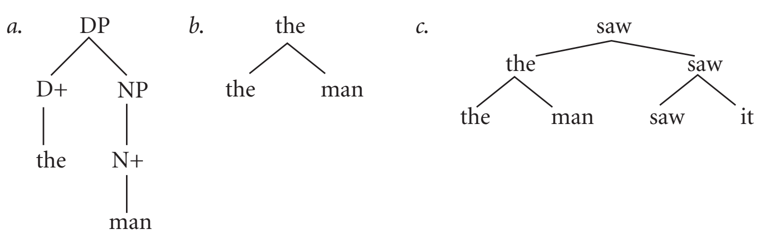
Many of these developments were rapidly assimilated by mainstream generative grammar. For example, in the Government and Binding (GB, see Chomsky 1981) version of TG that was standard from the mid-1970s through the 1980s, the mapping between PF and LF was mediated by a representational level of S-structure, itself specified generatively via a base grammar defining an underlying level of D-structure and a general rule of (overt) movement hedged around by constraints on legal output S-structures (such as the Binding Conditions). S-structure was then mapped to PF (sometimes still referred to as Surface Structure) by processes of deletion, and to LF by processes of (covert) quantifier movement. While this account preserved the derivational character of earlier versions of TG by involving movement in the generation of S-structure, and some argumentation was offered for the theoretical necessity of an autonomous level of D-structure, the very generality of the movement rule, and the fact that the essential constraints upon it were defined in terms of its structural inputs, mean that this theory was essentially monotonic, and essentially base-generative in all but name.

More recently, as the other chapters in this volume attest, the Minimalist Program has sought to modify this theory by the elimination of S-structure (and also D-structure) as autonomous structural levels of representation. The resulting theory in its present form, as presented in those chapters and elsewhere, seems to amount to the following.

First, there is a single underlying level of representation, including traces, corresponding to some form of the erstwhile S-structure, built in a single derivational process or "computation", combining operations of structural merger and movement, accompanied by (possibly multiple) events of language-specific spell-out of the elements of PF.

The details of this process are as follows.[1]

1. The sentence-level representation is derived from a Numeration or unordered multiset of lexical items, say *it*, *saw*, *the*, and *man*. These lexical items are selected at random and merged to build structure bottom-up in the process referred to as the Computation.
2. The merging operation projects head categorial information from whichever of the merged items is the head, with very little of the unary branching substructure that we have become used to from the X′-theory of the 1970s. Thus in place of trees like (*a*) we get trees like (*b*) and (*c*) (Chomsky 1995*a*, *b*: 246–7).

(2)


3. A further notion of "phase" is defined over such structures (Chomsky 2001, Svenonius 2004). The domains defined as phases correspond to the notion of (extended) projection domain of a head, such as *the* or *saw*, and are strongly reminiscent of those defined as kernel sentences in Chomsky (1957), and the elementary trees of Tree-Adjoining Grammar (TAG; Joshi, Levy, and Takahashi 1975), the Lexical–Functional specifications of LFG (Bresnan 1982), and the category domains of Combinatory Categorial Grammars (CCG, see below).
4. The processes of merging phases resemble the application of generalized or double-based transformations of Chomsky (1957), as they do the twin

[1] The Minimalist Program is a moving target, and many components are either underspecified (Merge, Phase) or are variously defined (Spell-out). All definitions are subject to change. The following summary attempts no more than to identify a consistent snapshot.

processes of substitution and adjunction of TAG, the unification apparatus of LFG, and the various combinatory reductions of CCG (although, as we shall see below, the latter differ in being purely type-driven, rather than structure-dependent as transformational and tree-adjoining rules quintessentially are.)

5. From time to time during the derivation or computation, various conditions may trigger a movement. The structuring of the developing representation into phases corresponding to the local projections of nominal and verbal heads makes these movements successive-cyclic. Move is in 1957 terms a singulary transformation: the base-generative theories by definition have no corresponding surface syntactic operation (although they must of course express the underlying LF relation in the semantics of base generation). Further processes of identifying and labelling identical substructures relevant to their subsequent deletion at the level of PF (the labelling possibly accomplished by re-merging or equating the relevant elements of the numeration) is also defined as part of this process (Chomsky 1995*b*: 252–4).
6. More recently, this latter work has been subsumed under the mechanism of multiple spell-out, as one might expect (at least in the bounded cases) from the general kinship of multiple spell-out and phase to lexicalization in the strong sense of theories like HPSG, whose notion of structure-sharing is taken over for the purpose. In this version, PF is defined without further computation. However, some important grammatical operations—notably deletion under coordination—take place at PF post-Spell-out—see Chomsky (1995*b*: 202–5.) Any further movements (such as quantifier movement) have an effect on the logical form, but are covert—that is, they do not affect PF.

The involvement of movement preserves the derivational character of the theory, but as in the earlier incarnation, the structure-preserving nature of the movement means that its effects are essentially monotonic, and limited in a very similar way to base generation.

However, there are a number of surprising features to this theory which set it apart from the base-generative relatives mentioned earlier. One arises from the involvement of the Numeration. If one regards Minimalism as a program for a generative theory of grammar—that is, one which will non-deterministically enumerate the sentences of the languages it applies to—then it seems as though we must begin by enumerating the set of all possible Numerations, applying the computational system as a filter to obtain the corresponding set of strings of the language, as seems to be proposed by Chomsky 1995*b*: 227, 237. The set of strings corresponding to a random numeration will usually be empty (as in the case of the numeration {"to", "to", "to"}), but will otherwise usually include several sentences, including some with unrelated meanings. (For example, the numeration {"loves", "John", "Mary"} will support one family of sentences in which the subject is John, and another in which it is Mary.)

Of course, there is nothing technically wrong with setting up the generative system this way. But if we are going to do *that*, why not go the whole hog and use the set of strings over the lexicon of the language as the set of Numerations, rather than multisets?

One reason is that the structures that are generated by the computational system on the way to LF are by assumption not linearly ordered (Chomsky 1995*b*: 334). Language-specific order must therefore be imposed post-Spell-out, by reference to parameter settings of the language, such as head finality, possibly with the aid of some fine-tuning via economy principles, optimality conditions, or via general principles relating command at LF to linear order, as with Kayne's (1994) Linear Correspondance Axiom. This is a feature shared with some other grammar formalisms that separate immediate-dominance and linear-precedence rules. However, in the case of Minimalist grammars it seems to be quite hard to decide whether these very general principles have been successfully applied to capture all and only the sentences of a significant fragment of a specific language without over- or under-generation, or how the number of degrees of freedom required to do so compares with those exploited in other frameworks. A key observation that has been made in other frameworks is that (*a*) such principles are usually confined to defining order among sister nodes, and (*b*) unless they are so confined, they are of very high expressive power indeed (Ojeda 1988). This in turn suggests that such principles can and should be lexicalized.

It seems worth asking if there is a way to make Minimalism a little more minimalist by drawing on proposals from within the base-generative and computational traditions, in order to specify the Computation in a way that will simplify the interface levels by clarifying the role of the Numeration and its relation to the process of multiple Spell-out and phase (all of which one might expect to be related to the process of lexical insertion), bringing word order under lexical control, and conflating Move with Merge, as has been proposed within the categorial tradition by Bach (1976), Dowty (1978), and Ades and Steedman (1982), and in the transformationalist tradition by Koster (1978), Berwick and Epstein (1995), and Epstein, Groat, Kawashima, and Kitahara (1998).

18.3 Combinatory Categorial Grammar

Combinatory Categorial Grammar (Steedman 2000*b*, hereafter *SP*, for *The Syntactic Process*), like all other varieties of categorial grammar (Ajdukiewicz 1935, Bar-Hillel 1953, Bach 1976, Dowty 1978, Oehrle, Bach, and Wheeler 1988, Buszkowski, Marciszewski, and van Benthem 1988, Wood 1993) is a form of lexicalized grammar in which the application of syntactic rules is entirely conditioned on the syntactic type, or *category*, of their inputs. No syntactic rule is structure- or derivation-dependent.

Categories identify constituents as either primitive categories or functions. Primitive categories, such as N, NP, PP, and S may be regarded as further distinguished by features, such as number, case, and inflection. Functions (such as verbs) bear categories identifying the type of their result (such as S) and that of their argument(s)/complements(s) (both may themselves be either functions or primitive categories). Function categories also define the order(s) in which the arguments must combine, and whether they must occur to the right or the left of the functor. Each syntactic category is associated with a logical form whose semantic type is entirely determined by the syntactic category.

Pure CG (Ajdukiewicz 1935, Bar-Hillel 1953) limits syntactic combination to rules of functional application of functions to arguments to the right or left. This restriction limits (weak) expressivity to the level of context-free grammar. However, CCG generalizes the context-free core by introducing further rules for combining categories. Because of their strictly type-driven character and their semantic correspondence to the simplest of the combinators identified by Curry and Feys (1958), these rules are called "combinatory rules" and are the distinctive ingredient of CCG, giving it its name. They are strictly limited to certain directionally specialized instantiations of a very few basic operations, of which the most important are TYPE-RAISING and functional COMPOSITION. A third class of combinatory rules related to SUBSTITUTION, Curry and Feys' **S** combinator, is ignored here.[2]

Though early work in CCG focused primarily on phenomena in English and Dutch, grammar fragments capturing significant cross-linguistic generalizations have been constructed more recently in the framework (e.g. Turkish, Hoffman 1995, Bozsahin 2002; Japanese, Komagata 1999; Tzotzil, Trechsel 2000; Tagalog and Toba Batak, Baldridge 2002).

18.3.1 Categorial Grammar

CCG, like all varieties of Categorial Grammar, eschews context-free production rules like (3). Instead, all language-specific syntactic information is lexicalized via lexical entries like (4):[3]

(3)
$$\begin{array}{lll} S & \rightarrow & NP\ VP \\ VP & \rightarrow & TV\ NP \\ TV & \rightarrow & \{proved,\ finds,\ \ldots\} \end{array}$$

[2] Other versions of combinatory categorial grammar have introduced further combinators, notably C (Dowty 1978, Bach 1979, Jacobson 1990).

[3] Lexicalization of the syntactic component has recently been endorsed by Hale and Keyser (1993) and by Chomsky and Lasnik (Chomsky 1995*b*: 25).

(4) proved: $:= (S\backslash NP)/NP$

This syntactic "category" identifies the transitive verb as a function and specifies the type and directionality of its arguments and the type of its result. We here use the "result leftmost" notation in which a rightward-combining functor over a domain β into a range α are written α/β, while the corresponding leftward-combining functor is written $\alpha\backslash\beta$. α and β may themselves be function categories.[4]

The transitive verb category (4) also reflects its semantic type $(e \to (e \to t))$. We can make this semantics explicit by pairing the category with a lambda term, via a colon operator:

(5) proved: $:= (S\backslash NP)/NP\colon \lambda x\lambda y.prove'xy$

(Primes mark constants, non-primes are variables. The notation uses concatenation to mean function application under a "left associative" convention, so that the expression $prove'xy$ is equivalent to $(prove'x)y$.)

In order to capture languages with freer word order, such as Turkish and Tagalog, this notation must be understood as a special case of a more general one allowing categories to be schematized over a number of orders of combination and directionalities. The present chapter follows Baldridge (2002) in using a set-CCG notation, according to which the single arguments of a rigid directional category like (4) are replaced by a multiset of one or more argument types, each bearing its own directionality slash, and allowed to combine in any order.

For example, the transitive verb category of a completely free-word-order accusative language with nominal case-marking (such as Latin) is written $S|\{NP_{nom}, NP_{acc}\}$, where $|$ indicates that either leftward or rightward combination is allowed for all arguments, and the set brackets indicate that the subject and object can combine in either order. For a language like Tagalog, which is verb-initial but otherwise freely ordered and cased, the corresponding accusative transitive category is written $S/\{NP_{nom}, NP_{acc}\}$. Verb-final Japanese accusative transitives are written $S\backslash\{NP_{nom}, NP_{acc}\}$.

In this extended notation, the English transitive verb can be written in full as $(S\backslash\{NP_{nom}\})/\{NP_{acc}\}$. However, we adopt a convention that suppresses set brackets when argument sets are singletons, so that we continue to write this category as $(S\backslash NP)/NP$, as in (4).

We can generalize the semantic notation introduced at (5) using a parallel argument set notation for lambda terms and a convention that pairs the unordered syntactic arguments with the unordered semantic arguments in the left-to-right order in which they appear on the page. The above transitive verb categories then appear as follows:[5]

[4] There is an alternative "result on top" notation due to Lambek (1958), according to which the latter category is written $\beta\backslash\alpha$.

[5] These categories are deliberately simplified for expository purposes, and certainly overstate the degree to which alternative constituent orders are semantically equivalent in these languages.

(6) *a.* English: $(S\backslash NP)/NP : \lambda x \lambda y.prove'xy$
b. Latin: $S|\{NP_{nom}, NP_{acc}\} : \lambda\{y, x\}.prove'xy$
c. Tagalog: $S/\{NP_{nom}, NP_{acc}\} : \lambda\{y, x\}.prove'xy$
d. Japanese: $S\backslash\{NP_{nom}, NP_{acc}\} : \lambda\{y, x\}.prove'xy$

All such schemata cover only a finite number of deterministic categories like (4) and can generate only the language that would be generated by compiling out the schema into explicit multiple deterministic lexical categories.[6]

The present chapter further follows Jacobson (1990, 1992), Hepple (1990), Baldridge (2002), Baldridge and Kruijff (2003), and Steedman and Baldridge (2006) in assuming that rules and function categories are modalized, as indicated by a subscript on slashes.[7] Baldridge further assumes that slash modalities are features in a type hierarchy, drawn from some finite set $\mathcal{M}$ (the modalities used here are $\mathcal{M} = \{\star, \diamond, \times, \cdot\}$). The effect of each of these modalities will be described as each of the combinatory rules and its interaction with the modalities is described. The basic intuition is as follows: the $\star$ modality is the most restricted and allows only the most basic applicative rules; $\diamond$ permits order-preserving associativity in derivations; $\times$ allows limited permutation; and $\cdot$ is the most permissive, allowing all rules to apply. The relation of these modalities to each other can be compactly represented via the hierarchy given in Figure 18.1.[8]

We will by convention write the maximally permissive slashes /. and \\. as plain slashes / and \\. This abbreviation again allows us to continue writing the categories that bear this modality, such as the English transitive verb (4), as before.

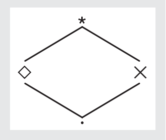


Fig. 18.1 CCG type hierarchy for slash modalities (from Baldridge and Kruijff 2003)

18.3.2 Combinatory Rules

The simplest operations for combining categories correspond to functional application, and can be written as follows:

[6] Baldridge (2002) shows that schematization of this kind does not increase the expressive power of the theory.

[7] Fuller expositions of slash-modal CCG can be found in Baldridge (2002) and Steedman and Baldridge (2003, 2006).

[8] The use of a hierarchy such as this as a formal device is optional, and instead could be replaced by multiple declarations of the combinatory rules.

(7) **The functional application rules**

a. $X/_{\star}Y\!: f \;\; Y\!: a \Rightarrow X\!: fa \quad (>)$

b. $Y\!: a \;\; X\backslash_{\star}Y\!: f \Rightarrow X\!: fa \quad (<)$

Because $\star$ is the supertype of all other modalities, the $/_{\star}$ and $\backslash_{\star}$ slashes on these rules mean that *all* categories can combine by these most basic rules.

The application rules (7) allow derivations equivalent to those of traditional PSCFG, like the following:

(8)
$$\begin{array}{ccc}
\text{Johnson} & \text{met} & \text{Monboddo} \\
\overline{NP: johnson'} & \overline{(S\backslash NP_{3SG})/NP: \lambda x\lambda y.met'xy} & \overline{NP: monboddo'} \\
 & \multicolumn{2}{c}{\underline{\hspace{12em}}{>}} \\
 & \multicolumn{2}{c}{S\backslash NP_{3SG}: \lambda y.met'monboddo'y} \\
\multicolumn{3}{c}{\underline{\hspace{22em}}{<}} \\
\multicolumn{3}{c}{S: met'monboddo'johnson'}
\end{array}$$

Because rules like (7) are written as reductions rather than the traditional productions, such a derivation resembles the selection of a Minimalist Programmatic numeration in the form of an ordered string of lexical items and the bottom-up construction of a derivation, with those rules performing the function of Merge. It is their operation that projects the head *met′* up the derivation, as in bare phrase-structural derivation (2*b*, *c*).

Tagalog transitive verbs such as *bumili* ('bought') have the following category, in which the λ notation is generalized as in (6) (see Baldridge 2002):

(9) bumili $:= S/\{NP_{nom},NP_{gen}\}: \lambda\{y,x\}.perf'(buy'xy)$

They support multiple word orders, but the derivations are otherwise similar:

(10)
$$\begin{array}{ccc}
\text{Bumili} & \text{ang=babae} & \text{ng=baro} \\
\text{PERF-AV-go} & \text{NOM-woman} & \text{GEN-dress} \\
\overline{S/\{NP_{nom},NP_{gen}\}: \lambda\{y,x\}.perf'(buy'xy)} & \overline{NP_{nom}: woman'} & \overline{NP_{gen}: dress'} \\
\multicolumn{2}{c}{\underline{\hspace{20em}}{>}} & \\
\multicolumn{2}{c}{S/NP_{nom}: \lambda x.buy'x\ woman'} & \\
\multicolumn{3}{c}{\underline{\hspace{26em}}{>}} \\
\multicolumn{3}{c}{S: buy'\ dress'\ woman'}
\end{array}$$

(11)
$$\begin{array}{ccc}
\text{Bumili} & \text{ng=baro} & \text{ang=babae} \\
\text{PERF-AV-go} & \text{GEN-dress} & \text{NOM-woman} \\
\overline{S/\{NP_{nom},NP_{gen}\}: \lambda\{y,x\}.perf'(buy'\,xy)} & \overline{NP_{gen}: dress'} & \overline{NP_{nom}: woman'} \\
\multicolumn{2}{c}{\underline{\hspace{20em}}{>}} & \\
\multicolumn{2}{c}{S/NP_{gen}: \lambda y.buy'\ dress'\ y} & \\
\multicolumn{3}{c}{\underline{\hspace{26em}}{>}} \\
\multicolumn{3}{c}{S: buy'\ dress'\ woman'}
\end{array}$$

CCG includes a number of further more restricted combinatory operations for merging or combining categories. For present purposes they can be regarded as limited to operations of type-raising (corresponding semantically to the combinator **T**) and composition (corresponding to the combinator **B**). Type-raising turns argument categories such as *NP* into functions over the functions that take them as arguments, such as the verbs above, into the results of such functions. Thus NPs like *Johnson* can take on such categories as the following:

(12) *a.* $S/(S\backslash NP_{3SG}) : \lambda p.p\ johnson'$
b. $S\backslash(S/NP) : \lambda p.p\ johnson'$
c. $(S\backslash NP)\backslash((S\backslash NP)/NP) : \lambda p.p\ johnson'$
d. etc.

This operation must be limited to ensure decidability, and in practice can be strictly limited to argument categories *NP*, *AP*, *PP*, *VP*, and *S*. One way to do this is to specify it in the lexicon, in the categories for proper names, determiners, and the like, in which case their original ground types like *NP*, *NP/N*, etc. can be eliminated. It should be clear at this point that type-raising is simply equivalent to nominal case.

The inclusion of composition rules like the following as well as simple functional application and lexicalized type-raising engenders a potentially very freely reordering-and-rebracketing calculus, engendering a generalized notion of surface or derivational constituency.

(13) *Forward composition* $(>\mathbf{B})$
$$X/_{\diamond}Y : f \quad Y/_{\diamond}Z : g \quad \Rightarrow_{B} \quad X/_{\diamond}Z : \lambda x.f(gx)$$

Rule (13) is restricted by the $\diamond$ modality, which means that it cannot apply to categories bearing the $\times$ or $\star$ modalities of Figure 18.1.

The inclusion of such rules means that the simple transitive sentence of English has two equally valid surface constituent derivations, each yielding the same logical form:

(14)
$$\begin{array}{ccc}
\text{Johnson} & \text{met} & \text{Monboddo} \\
\overline{S/(S\backslash NP_{3SG})}^{\,>\mathbf{T}} & \overline{(S\backslash NP_{3SG})/NP} & \overline{S\backslash(S/NP)}^{\,<\mathbf{T}} \\
: \lambda f.f\ johnson' & : \lambda x \lambda y.met'xy & : \lambda p.p\ monboddo' \\
\multicolumn{2}{c}{\overline{S/NP : \lambda x\ met'x\ johnson'}^{\,>\mathbf{B}}} & \\
\multicolumn{3}{c}{\overline{S : met'monboddo'\ johnson'}^{\,<}}
\end{array}$$

(15)
$$\begin{array}{ccc}
\text{Johnson} & \text{met} & \text{Monboddo} \\
\overline{S/(S\backslash NP_{3SG})}^{\,>\mathbf{T}} & \overline{(S\backslash NP_{3SG})/NP} & \overline{(S\backslash NP)\backslash((S\backslash NP)/(NP))}^{\,<\mathbf{T}} \\
: \lambda f.f\ johnson' & : \lambda x \lambda y.met'xy & : \lambda p.p\ monboddo' \\
 & \multicolumn{2}{c}{\overline{S\backslash NP_{3SG} : \lambda y.met'monboddo'y}^{\,<}} \\
\multicolumn{3}{c}{\overline{S : met'monboddo'johnson'}^{\,>}}
\end{array}$$

In the first of these, *Johnson* and *met* compose as indicated by the annotation $>\mathbf{B}$ to form a non-standard constituent of type *S/NP*. In the second, there is a more traditional derivation involving a verb phrase of type *S\NP*. Both yield identical logical forms, and both are legal surface or derivational constituent structures. More complex sentences may have many semantically equivalent derivations, a fact whose implications for processing are discussed in *SP*. (It follows that c-command-dependent phenomena such as binding and control can be (and can only be) captured at the level of logical form; see Steedman 1996.)

This theory has been applied to the linguistic analysis of coordination, relativization, and intonational structure in English and many other languages (Hoffman 1995, Steedman 1996, 2000*a*, Baldridge 1998, 2002, Bozsahin 1998, Komagata 1999). For example, since substrings such as *Johnson met* are now fully interpreted derivational *constituents*, complete with compositional semantic interpretations, they can be used to define relativization without movement or empty categories, as in (17), via the following category for the relative pronoun:

(16) that $:= (N\backslash N)/(S/NP)\ :\ \lambda p\lambda n\lambda x.(nx) \wedge (px)$

(17)
$$\begin{array}{llll}
\text{(The man)} & \text{that} & \text{Johnson} & \text{met}\\
 & (N\backslash N)/(S/NP): & S/(S\backslash NP_{3SG}):\ {>}\mathbf{T} & (S\backslash NP_{3SG})/NP:\\
 & \lambda p\lambda n\lambda x.(n\,x)\wedge(p\,x) & \lambda f.f\,johnson' & \lambda x\lambda y.\,met'xy\\
 & & \multicolumn{2}{c}{S/NP: \lambda x.met'x\,johnson' \quad {>}\mathbf{B}}\\
 & \multicolumn{3}{c}{N\backslash N: \lambda n\lambda x.(n\,x)\wedge(met'\,x\,johnson') \quad {>}}
\end{array}$$

Such extractions are correctly predicted to be unbounded, since composition can operate across clause boundaries:

(18)
$$\begin{array}{llllll}
\text{(The man)} & \text{that} & \text{Johnson} & \text{says} & \text{he} & \text{met}\\
 & (N\backslash N)/(S/NP): & S/(S\backslash NP_{3SG}):\ {>}\mathbf{T} & (S\backslash NP_{3SG})/S: & S/(S\backslash NP_{3SG}): & (S\backslash NP_{3SG})/NP:\\
 & \lambda p\lambda n\lambda x.(n\,x)\wedge(p\,x) & \lambda f.f\,johnson' & \lambda x\lambda y.say'xy & \lambda f.f\,pro' & \lambda x\lambda y.met'xy\\
 & & \multicolumn{2}{c}{S/S: \lambda x.\,say'x\,johnson' \quad {>}\mathbf{B}} & \multicolumn{2}{c}{S/NP: \lambda x.\,met'x\,pro' \quad {>}\mathbf{B}}\\
 & & \multicolumn{4}{c}{S/NP: \lambda x.say'\ (met'x\,pro')johnson' \quad {>}\mathbf{B}}\\
 & \multicolumn{5}{c}{N\backslash N: \lambda n\lambda x.(n\,x)\wedge(say'(met'x\,pro')johnson') \quad {>}}
\end{array}$$

It is the lexical category (16) of the relative pronoun that establishes the long-range dependency between noun and verb (via the variable x in the present notation). This relation too is established in the lexicon: syntactic derivation merely projects it onto the logical form, with composition and type-raising, as well as application, doing the work of Merge.

Substrings such as *Johnson met* and *Johnson says he met* can also undergo coordination via the following schematized conjunction category, in which "$S\$$" is S or any function category into S, and in the latter case $\langle\wedge\rangle$ schematises over the usual pointwise recursion over logical conjunction (Partee and Rooth 1983):

(19) and $:= (S\$\backslash_{\star}\ S\$)/_{\star}S\$\!: \lambda p\lambda q \cdot p \wedge q$

This category allows a movement- and deletion-free account of right node raising, as in (20):

(20)
$$\begin{array}{llll}
\text{[Monboddo likes]} & \text{and} & \text{[Johnson says he met]} & \text{an orangutan}\\
S/NP \quad {>}\mathbf{B} & (X\backslash_{\star}X/)_{\star}X & S/NP \quad {>}\mathbf{B} & S\backslash(S/NP) \quad {<}\mathbf{T}\\
 & \multicolumn{2}{c}{(S/NP)\backslash_{\star}(S/NP) \quad {>}} & \\
\multicolumn{3}{c}{(S/NP) \quad {<}} & \\
 & \multicolumn{3}{c}{S \quad {<}}
\end{array}$$

The $\star$ modality on the conjunction category (19) means that it can combine only like types by the application rules (7). Hence, as in GPSG (Gazdar 1981), this type-dependent account of extraction and coordination, as opposed to the standard account using structure-dependent rules, makes the across-the-board condition (ATB) on extractions from coordinate structures (including the same-case condition) a prediction or theorem, rather than a stipulation, as consideration of the types involved in the following examples will reveal:

(21) *a.* an orangutan [that$_{(N\backslash N)/(S/NP)}$ [[Johnson met]$_{S/NP}$ and [Monboddo likes]$_{S/NP}$]$_{S/NP}$]$_{N\backslash N}$
b. an orangutan [that$_{(N\backslash N)/(S\backslash NP)}$ *[[Johnson met]$_{S/NP}$ and [likes Monboddo]$_{S/NP}$] S/NP] $N\backslash N$
c. an orangutan that$_{(N\backslash N)/(S/NP)}$ *[[Johnson met]$_{S/NP}$ and [Monboddo likes him]$_{S}$]]
d. an orangutan that$_{(N\backslash N)/(S/NP)}$ *[[Johnson met him]$_{S}$ and [Monboddo likes]$_{S/NP}$]

18.3.3 An Aside on some Apparent Exceptions to the Across-the-Board Generalization

Lakoff (1986) has suggested on the basis of examples first noticed by Ross (1967) and Goldsmith (1985), such as *What did you go to the store and buy? How much beer can you drink and not get sick?*, and *This is the stuff that those guys in the Caucasus drink every day and live to be a hundred*, that the coordinate-structure constraint and the ATB exception are an illusion. This argument has recently been revived by Kehler (2002) and Asudeh and Crouch (2002). However, it has always also been argued (by Ross and Goldsmith, among others including Lakoff himself in an earlier incarnation) that these extractions involve another, non-coordinate, subordinating lexical category for *and*, and as such do not constitute counterexamples to the CSC and ATB constraints after all. Among the arguments in support of this view are the presuppositional and volitional semantics of the sentences in question (and the absence of such overtones from true coordinates), and the fact that (as Postal 1998 points out), no other conjunctions support such extractions—cf. **What did you go to the store or buy?*, **How much beer can you drink or not get sick?*, and **This is the stuff that those guys in the Caucasus drink every day or live to be a hundred*. Moreover, the ATB-violating leftward extractions are not in general mirrored by equivalent right node raising, unlike the across-the-board cases such as (20):

(22) *Those guys in the Caucasus drink every day and live to be a hundred a kind of fermented mare's milk.

It follows that the problematic extractions can naturally be handled in CCG by assigning to *and* additional independent categories supporting extraction from left and right conjunct respectively, and with an appropriate volitional/causal semantics (omitted here) of the kind discussed by Lakoff, Kehler, and Asudeh and Crouch, here written as follows:[9]

(23) *a.* and $:= ((VP/NP_{+ANT})\backslash_{\star}(VP/NP))/_{\star}VP$
b. and $:= ((VP/NP)/_{\star}(VP/NP))\backslash_{\star}VP$

The possibility of such exceptional extractions therefore does not controvert the CCG or GPSG claims that the coordinate structure structure constraint and its exceptions arise from the same-types requirement on coordinands, contrary to claims by these authors.

18.4 Quantifier Scope

One might expect that the generalized notion of surface derivation afforded by CCG, as illustrated in (14) and (15), in which the object and the subject respectively command the rest of the sentence, could be exploited to explain the fact that multiply quantified sentences like the following appear to have multiple logical forms in which either quantifier may outscope the latter, without any appeal to quantifier raising or covert movement.

(24) Everyone loves someone. $(\forall\exists/\exists\forall)$

(25) Someone loves everyone. $(\forall\exists/\exists\forall)$

However, this cannot be correct. Sentences like the following have only *one* CCG analysis, in which the right node raised object commands everything including the subjects:

(26) Every boy likes and every girl hates some novelist.

Nevertheless, such sentences have a reading in which novelists are dependent on boys and girls, as well as a reading where there is just one novelist.

[9] The feature $+ANT$ can only be bound by the relative pronoun category, and excludes right node raising as in **I eat and will live to be a hundred those apricots they grow in the Caucasus.* The precise mechanism is discussed in *SP* and need not detain us here. Baldridge (2002: 109–13) shows how the same antecedent-government feature can more elegantly be brought under the control of a slightly richer set of slash modalities, allowing these conjunctions to be simplified as versions of $(VP\backslash_{\times}VP)/_{\star}VP$ and $(VP/_{\diamond}VP)\backslash_{\star}VP$. These categories allow extraction to take place via the usual composition mechanism. They have the advantage over those in (23) of also supporting a variety of ordinary non-extracted "subordinating" VP coordinations, with the same volitional causal semantics, via simple application, as in *Eat apricots and live to be a hundred!*, and *Go to the store and buy apricots!*

However, any temptation to allow covert quantifier movement at the level of logical form should be resisted, for two reasons. First, under present Montagovian assumptions concerning transparency of syntax to semantics, having shown the appearance of overt syntactic movement to be an illusion, it would be perverse to then postulate a kind of movement to which syntax is *not* transparent. Second, the available readings for (26) are subject to a parallelism restriction first noted by Geach (1972). That is to say that, while there is a reading under which the novelists are all dependent, and a reading in which there is a single novelist that everyone either likes or hates, there are no mixed readings such as the one where the boys all like the same novelist but the girls all hate different ones. There is not even a reading where there is one novelist that the boys all like and a different novelist that the girls all hate.

This restriction does appear to reflect the CCG derivation, in the sense that *some novelist* has to take either wide or narrow scope with respect to the entire residue of right node raising, a fact that is hard to explain if quantifiers are free to covertly move independently.

In *SP*, Geach's observation is explained on the assumption that the so-called existential quantifier determiners are not quantifier determiners at all, but rather determiners of Skolem terms, which consist of a Skolem functor applied to all variables bound by universal quantifiers in whose scope the Skolem term falls. Thus, the categories for universals and existentials look quite different semantically. The universals are traditional generalized quantifiers, as, for example, in (27).

(27) every := $(S/(S\backslash NP))/N\colon \lambda n\lambda p.\forall x[nx \wedge px]$
every := $((S\backslash NP)\backslash((S\backslash NP)/NP)/N\colon \lambda n\lambda p\lambda y.\forall x[nx \wedge pxy]$
...

The logical form in such categories does the work of covert quantifier raising by giving the universal quantifier scope over the clause and relating it to an IF-commanded position via the bound variable. However, this is done lexically and statically, without movement or structural change.

By contrast, the existentials are not generalized quantifiers, but unspecified Skolem individuals, as in (28).

(28) some := $(S/(S\backslash NP))/N\colon \lambda n\lambda p.p(skolem'n)$
some := $((S\backslash NP)\backslash((S\backslash NP)/NP)/N\colon \lambda n\lambda p.p(skolem'n)$
...

This ensures that for both the left-branching derivation exemplified in (14) and the right-branching ones like (15), we get both wide- and narrow-scope readings for existentials in sentences like (24). For example, the following are the two readings for the former, left-branching, derivation (those for the latter, more standard, right-branching derivation are suggested as an exercise).

(29)

$$\begin{array}{ccc}
\text{Everyone} & \text{loves} & \text{someone.} \\
\hline
S/(S\backslash NP_{3SG}) & (S\backslash NP_{3SG})/NP & S\backslash(S\backslash NP) \\
:\lambda p.\forall y\,[person'y \rightarrow py]^{\{y\}} & \lambda x.\lambda y.love'xy & :\lambda q\,.q\,(skolem'person') \\
\hline
\multicolumn{2}{c}{S/NP : \lambda x.\forall y\,[person'y \rightarrow love'xy]^{\{y\}} \quad {>}\mathbf{B}} & \\
\hline
\multicolumn{3}{c}{S : \forall y\,[person'y \rightarrow love'(skolem'person')y]^{\{y\}} \quad {<}} \\
\cdots & \cdots & \cdots \\
\multicolumn{3}{c}{S : \forall y\,[person'y \rightarrow love'sk^{(y)}_{person'}y]^{\{y\}}}
\end{array}$$

(30)

$$\begin{array}{ccc}
\text{Everyone} & \text{loves} & \text{someone.} \\
\hline
S/(S\backslash NP_{3SG}) & (S\backslash NP_{3SG})/NP & S\backslash(S\backslash NP) \\
:\lambda p.\forall y\,[person'y \rightarrow py]^{\{y\}} & \lambda x.\lambda y.love'xy & :\lambda q\,.q\,(skolem'person') \\
\hline
\multicolumn{2}{c}{S/NP : \lambda x.\forall y\,[person'y \rightarrow love'xy]^{\{y\}} \quad {>}\mathbf{B}} & \cdots \\
 & & :\lambda q.q(sk_{person'}) \\
\hline
\multicolumn{3}{c}{S : \forall y\,[person'y \rightarrow love'(sk_{person'})y]^{\{y\}}}
\end{array}$$

In (30), the Skolem term indefinite is a constant, rather than a function term in the bound variable y in its environment.

Because universals, in contrast with existentials, are genuine quantifiers, they and they alone can truly invert scope in both right- and left-branching derivations. For example, *every* can invert as follows in sentence (25) (once again the left-branching inverting reading and the non-inverting readings for both derivations are suggested as an exercise):

(31)

$$\begin{array}{ccc}
\text{Someone} & \text{loves} & \text{everyone.} \\
\hline
S/(S\backslash NP_{3SG}) & (S\backslash NP_{3SG})/NP & (S\backslash NP)\backslash((S\backslash NP)/NP) \\
:\lambda p\,.p(skolem'person') & :\lambda x\lambda y.love'xy & :\lambda q\forall x[person'x \rightarrow qx]^{\{x\}} \\
\hline
 & \multicolumn{2}{c}{S/NP_{3SG} : \lambda y\forall x\,[person'x \rightarrow love'xy]^{\{x\}} \quad {<}} \\
\hline
\multicolumn{3}{c}{S : \forall x[person'x \rightarrow love'x(skolem'person')]^{\{x\}} \quad {>}} \\
\cdots & \cdots & \cdots \\
\multicolumn{3}{c}{S : \forall x[person'x \rightarrow love'x\,sk^{(x)}_{person'}]^{\{x\}}}
\end{array}$$

Similar derivations allow the universals *every, each*, and free-choice *any* to invert over most non-universals, such as (*at least/exactly/at most*) *two* and *several*, *many*, and *most*.

Crucially, the formation of such Skolem terms can occur before reduction of the object and the prefix in (26), in which case there are no scoping universal quantifiers and the Skolem term is a constant appearing to "take scope everywhere". But the Skolem term can also be formed after the reduction, in which case each copy of the Skolem term at the level of logical form is obligatorily dependent on its IF-commanding universal. Hence, the missing readings are excluded without appeal to otherwise unmotivated "parallelism constraints" on coordinate structures (Goodall 1987).

A number of other curious freedoms and restrictions, such as anomalous scope properties of donkey sentences and the non-ability of non-universals in sentences like (32) to invert scope in the strong sense of distributing over c-commanding existentials as universals do (cf. (25)), are explained by the treatment of existentials as Skolem terms rather than generalized quantifiers.

(32) Some linguist knows at least three languages. ($\exists 3/\#3\exists$)

This account is further developed in Steedman (2005*b*).

18.5 Universal Grammar

Even quite small sets of functional combinators, including the set {**BTS**} implicit in CCG, can yield calculi of the full expressive power of Turing machines and the simply typed λ calculus. However, CCG syntax is subject to a number of principles which make it weakly equivalent to TAG and Linear Indexed Grammar (LIG, Aho 1968, Gazdar 1988), the least more powerful natural class of languages than CFG that is known, chacterized by a generalization of the push-down automaton (PDA), the Embedded PDA (EPDA) (Vijay-Shanker and Weir 1990, Joshi, Vijay-Shanker, and Weir 1991, Vijay-Shanker and Weir 1993, 1994). This means that the theory of the computation in Marr's sense is very low-power, only just trans-context-free. This equivalence gives rise to a polynomial time worst-case complexity result, and means that standard CF parsing algorithms such as CKY (Cocke and Schwartz 1970) and standard probabilitically optimizing parsing models such as head-dependency models (Collins 1997) immediately generalize to CCG (Steedman 2000*b*). Such grammars and models have been successfully applied to wide-coverage parsing of the Penn *Wall Street Journal* corpus by Hockenmaier, and Steedman (2002), Clark, Hockenmaier, and Steedman (2002), Hockenmaier (2003), Clark and Curran (2004), and Clark, Steedman, and Curran (2004), with state-of-the-art levels of recovery of semantically significant dependencies.

The principles which limit the power of combinatory rules in this way can be summed up as a Projection Principle which says that syntax must project, and may not override, the directional information specified in the lexicon, and, conversely, that the lexicon should not do syntax's job of unbounded projection. This principle is expressed in the next section as a number of subsidiary principles.

18.5.1 The Combinatory Projection Principle

We have given examples of several rules that encode the syntactic reflex of a few basic semantic functions (combinators). However, a larger set of possible rules could be derived from the combinators, and we restrict the set to be only those which obey the following principles:

(33) **The Principle of Adjacency**
Combinatory rules may only apply to finitely many phonologically realized and string-adjacent entities.

(34) **The Principle of Consistency**
All syntactic combinatory rules must be consistent with the directionality of the principal function.

(35) **The Principle of Inheritance**
If the category that results from the application of a combinatory rule is a function category, then the slash type of a given argument in that category will be the same as the one(s) of the corresponding argument(s) in the input function(s).

The first of these principles is merely the definition of combinators themselves. The other principles say that combinatory rules may not override, but must rather "project", the directionality specified in the lexicon. More concretely, the Principle of Consistency excludes the following kind of rule:

(36) $X\backslash_{\star}Y \quad Y \Rightarrow X$ (disallowed)

The Principle of Inheritance excludes rules like the following hypothetical instances of composition:

(37) a. $X/_{\diamond}Y \quad Y/_{\diamond}Z \Rightarrow X\backslash_{\diamond}Z$ (disallowed)
b. $X/_{\diamond}Y \quad Y/_{\diamond}Z \Rightarrow X/_{\times}Z$ (disallowed)

On the other hand, these principles do allow rules such as the following:

(38) **The crossing functional composition rules**
a. $X/_{\times}Y \quad Y\backslash_{\times}Z \Rightarrow X\backslash_{\times}Z$ ($>\mathbf{B}_{\times}$)
b. $Y/_{\times}Z \quad X\backslash_{\times}Y \Rightarrow X/_{\times}Z$ ($<\mathbf{B}_{\times}$)

Such rules are not theorems of type calculi such as that of Lambek (1958) and its descendants, and in fact cause collapse of such calculi into permutation completeness if added as axioms (Moortgat 1988), a fact that has motivated the development of multi-modal varieties of categorial grammar within the type-logical tradition by Hepple (1990), Morrill (1994), and Oehrle (2000). While such rules do not cause a collapse in CCG even without the modalities, the present use of modalities to provide finer control over the rules is directly inspired by multimodal categorial grammar (see Baldridge 2002). They must be restricted by the $\times$ modality, which is incompatible with $\star$ and $\diamond$ modalities, because they have a reordering effect.

The composition rules are all generalized to cover cases where the lower function $Y \mid Z$ is of higher valency $(Y|Z)|W$, etc., up to some low value such as 4 $(((Y|Z)|W)|V)|U$, which appears to be the highest valency in the lexicon. It is the combination of crossed composition and generalized composition rules that increases the expressive power of the formalism to the lowest trans-context-free level of the mildly context-sensitive class identified by Joshi, Vijay-Shanker, and Weir (1991).

18.5.2 The Categorial Lexicon

The lexicon of a given language is a finite subset of the set of all categories subject to quite narrow restriction that ultimately stem from limitations on the variety of semantic types with which the syntactic categories are paired in the lexicon. In particular, we can assume that lexical function categories are limited to finite—in fact, very small—numbers of arguments. (For English at least, the maximum appears to be four, required for a small number of verbs like *bet*, as in *I bet you five dollars I can spit further than you.*)

The most basic assumption of the present approach is that the responsibility for specifying all dependencies, whether long-range or local, resides in the lexical specifications of syntactic categories for the "heads" of those dependencies—that is, the words corresponding to predicate-argument structural functors, such as verbs. This principle, which is related to the Projection Principle of GB, can be more formally stated as follows:[10]

(39) **The Principle of Lexical Head Government**
Both bounded and unbounded syntactic dependencies are specified by the lexical syntactic type of their head.

This is simply to say that the present theory of grammar is "lexicalized," a property that makes it akin to LFG, TAG, Head-Driven Phrase Structure Grammar (HPSG; Pollard and Sag 1994), and certain recent versions of GB (see Hale and Keyser 1993, Brody 1995, and Chomsky and Lasnik in Chomsky 1995*b*: 25).

Lexicalized grammars make the lexical entries for words do most of the grammatical work of mapping the strings of the language to their interpretations. The size of the lexicon involved is therefore an important measure of a grammar's complexity. Other things being equal, one lexical grammar is simpler than another if it captures the same pairing of strings and interpretations using a smaller lexicon.

A more distinctive property of CCG, which it shares with LFG and GB, and which sets it apart from TAG, GPSG, and HPSG (which in other respects are more closely related), is that it attempts to minimize the size of the lexicon by adhering as closely as possible to the following stronger principle:

(40) **The Principle of Head Categorial Uniqueness**
A single non-disjunctive lexical category for the head of a given construction specifies both the bounded dependencies that arise when its complements are in canonical position and the unbounded dependencies that arise when those complements are displaced under relativization, coordination, and the like.

[10] This principle and the following Principles of Head Categorial Uniqueness and Categorial Type Transparency replace the Principle of Categorial Government in Steedman (1996).

That is not to say that a given word may not be the head of more than one construction and hence be associated with more than one category. Nor (as we have seen for the case of Tagalog) does it exclude the possibility that a given word–sense pair may permit more than one canonical order, and hence have more than one category per sense, possibly schematized using the set-CCG notation of (6). The claim is simply that each of these categories specifies both canonical order and all varieties of extraction for the clause type in question. For example, a single lexical syntactic category (5) for the word *met*, which does not distinguish between antecedent, θ, or any other variety of government, is involved in all of the dependencies illustrated in (8), (17), (18), and (20).

By contrast, in both TAG and GPSG these dependencies are mediated by different initial trees or categories, and in HPSG they are mediated by a disjunctive category.

Unlike the principles defined earlier, exceptions to the Principle of Head Categorial Uniqueness are sometimes forced.[11] However, each such exception complicates the grammar by expanding the lexicon, and makes it compare less favourably with an otherwise equivalently valued grammar that requires no such exceptions. Hence, such exceptions are predicted to be rare.

Many remaining open questions in both CCG and MP concern the notion "possible lexical category". Many of them are addressed by MP principles like Full Interpretation and Shortest Move. Since the move from X′ theory to "Bare Phrase Structure" theory (Chomsky 1995*a*, *b*) exemplified in (2) looks very much like a move to a categorial, rather than phrase-structure, base grammar, it is natural to look for convergence.

Such principles look rather different when viewed from the CCG perspective. For example, it is Shortest Move that in MP terms allows bounded raising in (41*a*), and also (via A-chain formation on the controlled subjects) in (41*b*), whilst disallowing unbounded raising in (*c*) to deliver a reading where it is likely that Monboddo seems to be happy:[12]

(41) *a.* Monboddo seems to be happy.
b. Monboddo is likely to seem to be happy
c. *Monboddo is likely that it seems to be happy.

[11] An example of such a necessary exception is the treatment of subject extraction in English in Steedman (1996). It is a prediction of CCG (rather than a stipulation via a "Fixed Subject" constraint or "Empty Category Principle") that a fixed SVO word-order language like English cannot permit complement subjects to extract under the Head Categorial Uniqueness Principle, as illustrated by the anomaly of (i*a*). The exceptional possibility of extracting subjects from English bare complements, as in (i*b*), therefore requires an extra antecedent-governed category for bare-complement-taking verbs like *think*, in violation of that Principle.

(i) a. *Who do you think that met Monboddo?
b. Who do you think won?

[12] This question is investigated in somewhat more detail in Steedman (2005*a*).

The raising predicates *seems* and *likely* have the following categories (as well as categories (43), supporting the expletive predications):

(42) *a.* seems/seem: $:= (S\backslash NP)/(S_{to}\backslash NP) : \lambda p\lambda x.seemingly'(px)$
b. *likely:* $:= (S_{pred}\backslash NP)/(S_{to}/NP) : \lambda p\lambda x.probably'(px)$

(43) *a.* seems: $:= (S\backslash NP_{it})/S_{CP} : \lambda s\lambda x.seemingly's$
b. likely: $:= (S_{pred}\backslash NP_{it})/S_{CP} : \lambda s\lambda x.probably's$

Thus *likely to seem to be happy* in (41*b*) is derived as follows (combination of the copula and *to* is suppressed to aid readability):

(44)

$$\dfrac{\dfrac{\dfrac{\text{likely}}{(S_{pred}\backslash NP)/(S_{to}\backslash NP) : \lambda p\lambda x.probably'(px)} \quad \dfrac{\text{to seem}}{(S_{to}\backslash NP)/(S_{to}\backslash NP) : \lambda p\lambda x.\ seemingly'(px)}}{(S_{pred}\backslash NP)\ (S_{to}\backslash NP) : \lambda p\lambda x.probably'(seemingly'(px))}{>}\mathbf{B} \quad \dfrac{\text{to be happy}}{S_{to}\backslash NP : happy'}}{S_{pred}\backslash NP : \lambda x.probably'(seemingly'(happy'x))}{>}$$

Of course, these categories do not allow any analysis for (41*c*). Moreover, the only possibility for obtaining the intended reading is to give *likely* a completely unrelated relative pronoun-like category analogous to a tough-movement predicate like *easy* (see Steedman 1996: 29, 62), and to give *seems* a category analogous to that of a subject-extracting bare complement verb like *thinks* (ibid.: 58). One way one might think of doing this is as follows:

(45) *likely: $:= (S_{pred}\backslash NP)/(S_{CP}/NP) : \lambda p\lambda x.probably'(px)$
(46) *seems: $:= ((S\backslash NP_{it})/NP_{+ANT})/(S_{to}\backslash NP) : \lambda p\lambda x\lambda y.seemingly'p(x)$

Derivation of (41*c*) could then proceed analogously to subject extraction (Steedman 1996: 58).[13]

However, these categories will immediately overgeneralize to other unbounded dependencies, allowing relativization, tough movement, and other absurdities:

(47) a. *A woman who it seems to be happy.
b. *Monboddo is easy to believe that it seems to be happy.
c. *Monboddo is likely that Johnson likes
d. *Monboddo is likely that Johnson thinks likes him

It might seem that, as a last resort, we could rewrite the above categories as follows, using categories with a feature unique to the Shortest Move-violating categories—call it *FIXIT*—and introducing a parallel restriction $-FIXIT$ on the relative pronoun and tough-movement categories to prevent examples like (47):

[13] We pass over the expletive feature *it* and the antecedent-governed feature $+ANT$, which are needed in order to prevent overgenerations like the following:

(i) *a.* *Monboddo seems Johnson to be happy.
b. *It seems Monboddo to be happy.
c. *Monboddo is likely that Johnson seems to be happy.
d. *Monboddo is likely that it seems Johnson to be happy.

See Steedman (2005*a*) for further discussion.

(48) *likely: $:= (S_{pred}\backslash NP)/(S_{CP}/NP_{+FIXIT}) : \lambda p\lambda x.probably'(px)$

(49) *seems: $:= ((S\backslash NP_{it})/NP_{+FIXIT})/(S_{to}\backslash NP) : \lambda p\lambda x\lambda y.seemingly'p(x)$

However, such a move amounts to introducing an entirely new species of lexically specified unbounded dependency into the grammar just for this construction. Moreover, both (48) and the revised relative-pronoun and tough-movement categories would be in violation of the Principle of Lexical Head Government (39), for these categories are not the head of the dependency that they mediate. Such categories have no parallel elsewhere in the grammar of English or any other language.

Thus, Shortest Move as it applies to raising and control appears to be a consequence of categorially lexicalizing the grammar, rather than an active principle of the theory of grammar in its own right.

18.6 Three Case Studies in CCG

The following sections briefly exemplify some of the constructions that have presented difficulties for other theories of grammar, which are successfully accommodated by CCG. The reader is referred to the literature already cited for fuller accounts of these and other analyses.

18.6.1 Case Study 1: Argument-Cluster Coordination

CCG has been used to analyse a wide variety of coordination phenomena, including English argument-cluster coordination, backward gapping and verb-raising constructions in Germanic languages, and English gapping. The first of these is illustrated by the following analysis, from Dowty (1988—cf. Steedman 1985), in which the ditransitive verb category $(VP/NP)/_{\diamond}NP$ is abbreviated as DTV, and the transitive verb category VP/NP is abbreviated as TV:[14]

(50)
$$\begin{array}{cccccc}
\text{give} & \text{Walt} & \text{the salt} & \text{and} & \text{Malcolm} & \text{the talcum}\\
\overline{DTV} & \overline{TV\backslash_{\diamond}DTV}^{<\mathbf{T}} & \overline{VP\backslash TV}^{<\mathbf{T}} & \overline{(X\backslash_{\star}X)\backslash_{\star}X} & \overline{TV\backslash_{\diamond}DTV}^{<\mathbf{T}} & \overline{VP\backslash TV}^{<\mathbf{T}}\\
 & \multicolumn{2}{c}{\overline{\qquad VP\backslash_{\diamond}DTV \qquad}^{<\mathbf{B}}} & & \multicolumn{2}{c}{\overline{\qquad VP\backslash_{\diamond}DTV \qquad}^{<\mathbf{B}}}\\
 & & & \multicolumn{3}{c}{\overline{\qquad (VP\backslash_{\diamond}DTV)\backslash_{\star}(VP\backslash_{\diamond}DTV) \qquad}^{>}}\\
 & \multicolumn{5}{c}{\overline{\qquad\qquad VP\backslash_{\diamond}DTV \qquad\qquad}^{<}}\\
\multicolumn{6}{c}{\overline{\qquad\qquad\qquad VP \qquad\qquad\qquad}^{<}}
\end{array}$$

[14] In more recent work, Dowty has disowned CCG in favour of TLG because of intrinsic use of logical form to account for binding phenomena that it entails, as discussed above. See Steedman (1996) for further discussion.

Since we have assumed the previously discussed rules of forward type-raising (>**T**) and forward composition (>**B**), this construction is correctly predicted **to** exist in English by arguments of symmetry, which imply that their backward varieties, <**T** and <**B** must also be assumed.

Given independently motivated limitations on type-raising, examples like the following are still disallowed:[15]

(51) *Three mathematicians [[in ten]$_{PP}$[derive a lemma,]$_{S\backslash NP}$] and [in a hundred prove completeness.]

18.6.2 Case Study 2: English Intonation and Information Structure

We also have seen that, in order to capture coordination with rules adhering to the constituent condition, CCG generalizes surface constituency to give sub-strings like *Marcel proved* and even *Malcolm the talcum* the full status of constituents.

But if they are constitutents of coordinate constructions, they are predicted to be possible constituents of ordinary non-coordinate sentences as well. The characteristics of English intonation structure show that this prediction is correct.

Consider the following minimal pair of dialogues, in which intonational tunes are indicated both informally via parentheses and small capitals as before, and in the standard notation of Pierrehumbert (1980) and Pierrehumbert and Beckman (1988), in which prosodic phrases are specified solely in terms of two kinds of element, the pitch accent(s) and the boundary:

(52) Q: I know who proved soundness. But who proved COMPLETENESS?
A: (MARCEL) (proved COMPLETENESS).
H*L L+H* LH%

(53) Q: I know which result Marcel PREDICTED. But which result did Marcel PROVE?
A: (Marcel PROVED)(COMPLETENESS).
L+H*LH% H* LL%

In (52A), there is a prosodic phrase on MARCEL including the sharply rising pitch accent that Pierrehumbert calls H*, immediately followed by an L boundary, perceived as a rapid fall to low pitch. There is another prosodic phrase having the somewhat later-rising and (more importantly) lower-rising pitch accent called L+H* on COMPLETENESS, preceded by null tone (and therefore interpolated low pitch) on the word *proved* and immediately followed by an utterance-final rising boundary, written LH%.

[15] This appears to offer an advantage over non-type-raising accounts using the product operator • of Lambek (Pickering and Barry 1993, Dowty 1997).

In (53A), the order of the two tunes is reversed: this time, the tune with pitch accent L+H* and boundary LH% occurs on the word PROVED in one prosodic phrase, *Marcel* PROVED, and the other tune with pitch accent H* and boundary LL% is carried by a second prosodic phrase COMPLETENESS.[16]

The intuition that these tunes strongly convey systematic distinctions in discourse meaning is inescapable. (For example, exchanging the answer tunes between the two contexts in (52) and (53) makes the answers completely incomprehensible.) Prevost and Steedman (1994) claim that the tunes L+H* LH% and H* L (or H* LL%) are respectively associated with the theme and rheme of the sentence, where these terms are used in the sense of Mathesius (1929), Firbas (1964, 1966), and Bolinger (1989), and correspond roughly to a generalization of the more familiar terms "topic" and "comment", which, however, are generally restricted by definition to traditional constituents.

Informally, the theme can be thought of as corresponding to the content of a contextually available *wh*-question, which may be explicit, as in (52) and (53), or implicit in other discourse content. The position on the pitch accent, if any, in the theme, distinguishes words corresponding to focused elements of the content which distinguish this theme from other contextually available alternatives. The rheme can then be thought of as providing the answer to the implicit *wh*-question, with the pitch accent again marking focused words which distinguish this answer semantically from other potential answers. The system comprising the oppositions of theme–rheme and focus–background is known as "information structure". Steedman (2000*a*) provides a more formal definition in terms of the alternative semantics of Rooth (1985, 1992), and the related "structured meanings" of Cresswell (1973, 1985), von Stechow (1991), and others, which Steedman (2006) grounds in notions of common ground and common ground update.[17]

The fact that CCG allows alternative derivations like (14) and (15) offers an obvious way to bring intonation structure and its interpretation—information structure—into the same syntactic system as everything else. Crucially, these alternative derivations are guaranteed to yield the same predicate argument relations, as exemplified by the logical form that results from the two derivations. However, the derivations build this logical form via different routes that construct lambda terms corresponding semantically to the theme and rheme. In particular derivation (15) corresponds to the information structure associated with the intonation contour in (52), while derivation (14) corresponds to that in (53).

[16] It is clear that *Marcel proved* is a prosodic phrase in (53), unlike (52), because in (53), the Rhythm Rule shifts the lexical stress on *Marcel* from the last syllable to the first.

[17] The much-abused term "focus" is used here strictly in the narrow phonological sense of the term, to refer to the effects of contrast or emphasis on a word that ensues from the presence of a pitch-accent. Elsewhere this property of accented words is called "kontrast" (Vallduví and Vilkuna 1998, Steedman 2006).

This observation can be captured by making pitch accents mark both arguments and results of CCG lexical categories with theme/rheme markers θ/ρ, as in the following category for a verb bearing an L+H* accent:

(54) proved $:= (S_\theta \backslash NP_\theta)/NP_\theta : \lambda x \lambda y. * prove' xy$

The predicate is marked as focused or contrasted by the * marker in the logical form. θ/ρ marking is projected onto the arguments and result of constituents by combinatory derivation. The boundary tones like LH% have the effect of completing information structural constituents, and transfering theme/rheme marking to θ'/ρ' marking to constituent interpretations at logical form, as indicated in outline in Figure 12.8. We will pass over further details of exactly how this works, referring the reader to Prevost (1995) and to Steedman (2000*a*, 2006). The latter papers generalize this approach to the full range of tunes identified by Pierrehumbert, including those with multiple pitch accents and multiple or disjoint themes and rhemes.

18.6.3 Case Study 3: Crossing Dependencies

The availability of *crossed* composition (38) under the Principles of Consistency and Inheritance allows crossing dependencies in Dutch and certain Swiss dialects of German, which cannot be captured by CFG and have given rise to proposals for verb-raising transformational operations, as in the following example (Swiss German; from Shieber):

(55)

das	mer	em Hans	es huus	hälfed	aastriiche
that	we-NOM	Hans-DAT	the house-ACC	helped	paint
	$NP^{\uparrow}_{nom}$	$NP^{\uparrow}_{dat}$	$NP^{\uparrow}_{acc}$	$((S_{+SUB}\backslash NP_{nom})\backslash NP_{dat})/VP$	$VP\backslash NP_{acc}$

$$\frac{((S_{+SUB}\backslash NP_{nom})\backslash NP_{dat})/VP \quad VP\backslash NP_{acc}}{((S_{+SUB}\backslash NP_{nom})\backslash NP_{dat})/NP_{acc}}{>}\mathbf{B}_{\times}$$

$$\frac{NP^{\uparrow}_{acc} \quad ((S_{+SUB}\backslash NP_{nom})\backslash NP_{dat})/NP_{acc}}{(S_{+SUB}\backslash NP_{nom})\backslash NP_{dat}}{>}$$

$$\frac{NP^{\uparrow}_{dat} \quad (S_{+SUB}\backslash NP_{nom})\backslash NP_{dat}}{S_{+SUB}\backslash NP_{nom}}{>}$$

$$\frac{NP^{\uparrow}_{nom} \quad S_{+SUB}\backslash NP_{nom}}{S_{+SUB}}{>}$$

'that we helped Hans paint the house'

The universal · modality on the verbs *hälfed* and *aastriichte* (suppressed as usual by convention) permits the forward crossed composition rule (38*a*) to apply. (The corresponding categories for the more rigid-word-order Dutch are restricted by × modality: see Baldridge 2002 and section 18.7.1, below) The tensed verb is distinguished as the head of a subordinate clause via the feature SUB. The type-raised NP categories are abbreviated as $NP^{\uparrow}_{case}$, since the fact that they are raised is not essential to understanding the point about crossing dependencies. It is correctly predicted that the following word orders are also allowed in at least some dialects (Shieber 1985: 338–9):

(56) *a.* das mer em Hans hälfed es huus aastriiche.
b. das em Hans mer es huus hälfed aastriiche.

The construction is completely productive, so the dependencies are not only intersective but unbounded. For example, we have the following (also from Shieber):

(57)

das	mer	d'chind	em Hans	es huus	lönd	hälfe	aastriiche
that	we-NOM	the children-ACC	Hans-DAT	the house-ACC	let	help	paint
	$NP^{\uparrow}_{nom}$	$NP^{\uparrow}_{acc}$	$NP^{\uparrow}_{dat}$	$NP^{\uparrow}_{acc}$	$((S_{+SUB}\backslash NP_{nom})\backslash NP_{acc})/VP$	$(VP\backslash NP_{dat})/VP$	$VP\backslash NP_{acc}$

$>\mathbf{B}^2\times$: $(((S_{+SUB}\backslash NP_{nom})\backslash NP_{acc})\backslash NP_{dat})/VP$

$>\mathbf{B}\times$: $(((S_{+SUB}\backslash NP_{nom})\backslash NP_{acc})\backslash NP_{dat})/NP_{acc}$

$>$: $((S_{+SUB}\backslash NP_{nom})\backslash NP_{acc})\backslash NP_{dat}$

$>$: $(S_{+SUB}\backslash NP_{nom})\backslash NP_{acc}$

$>$: $S_{+SUB}\backslash NP_{nom}$

$>$: S_{+SUB}

'that we let the children help Hans paint the house'

Again, the unbounded dependencies are projected from the lexical frame of the verb, without syntactic movement, and by the same category that supports the non-verb-raised cases (56).

18.7 CCG as a Minimalist Generative Grammar: $a^n b^n$ Crossing

At first glance, because it has been presented as a system of reductions rather than productions, this theory might not look like a truly generative grammar. In fact, like standard generative grammars, it is neutral with respect to the direction of application of the rules, and can be translated into an equivalent set of productions in a number of ways. The easiest (but the least helpful in computational terms) is the one that seems to be assumed by Chomsky for the Minimalist Program—that is, to enumerate all possible strings or numerations, and use CCG to decide which numerations are sentences of the language (cf. Chomsky 1995*b*: 227, 237).

However, a more attractive alternative is to write a traditional base-generative grammar of productions for CCG logical forms, along the lines of a base-generative grammar for S-structures. To do this over the normalized logical forms is in fact the first step in providing a model theory for LF, as proposed in Steedman (2005*b*) as part of the CCG-based account of natural-language quantifier-scope alternation described in section 18.4. However, the problem of mapping such logical forms onto phonological forms is not simple, and reintroduces many of the problems of movement and copy-detection that CCG was designed to eliminate. What we need to do instead is to turn the grammar into into a system of productions for generating both unnormalized logical forms, which we have seen correspond at the top level to information structures, and syntactic types, in parallel. We can do this directly by building an equivalent Linear Indexed Grammar, compiling out the combinatory reductions into an equivalent set of productions. The next sections illustrate this process for a small artificial grammar for the language $a^n b^n$ with crossing dependencies, analogous to (but not isomorphic to) the CCG grammar for the Swiss German construction discussed in section 18.6.3. To make the grammar more linguistically intelligible, Dutch proper names are used for the *a*s and Dutch verbs are used for the *b*s (cf. Steedman 1985)

In order to simplify the translation to LIG, this version replaces λ-terms with a related notation derived from Prolog unification, in which logical forms in productions are specified in terms of variables, which become instantiated when the leaves are unified with lexical items.

Capitals are variables over syntactic or semantic terms, and lower-case symbols are constants. $X^\wedge P$ simulates $\lambda x.p$ where p is a variable over terms in x. The grammar can be directly realized as a Prolog Definite-Clause Grammar (DCG), although some care is needed because of the left recursive rules.

18.7.1 The Lexicon

This is identical to the CCG lexicon (although it is simpler than the one in section 18.6.3).

(58) $sinf\backslash np : X^\wedge fall'(X) \rightarrow$ vallen ("fall")
$(s\backslash np)/_\times sinf : P^\wedge X^\wedge see'(X,P) \rightarrow$ zag ("saw")
$(sinf\backslash np/_\times)sinf : P^\wedge X^\wedge see'(X,P) \rightarrow$ zien ("see")
$np : harry' \rightarrow$ Hendrik
$np : cecilia' \rightarrow$ Cecilia
$np : jan' \rightarrow$ Jan
...etc.

$\times$ modality ensures that only rules corresponding to *crossed* functional composition will be generated.

18.7.2 The Rules

The following linear indexed rules are generated using the same parameters as the lexicon from the universal set of combinatory rules. The variable S matches arbitrarily high valency syntactic categories and acts as the linear indexed grammar stack-valued feature (note that it passes to exactly one daughter). The first rule recursively generates n NPs and an n-ary verb category with function application as its semantics. The second rule generates an $n-1$-ary verb and the nth *vallen*-type verb. The third rule recursively generates a sequence of one *zag*- and n–2 *zien* type verb group, with function-composition semantics.

(59) $S : P \rightarrow np : X \; S\backslash np : X^\wedge P$
$(S\backslash np)\backslash np : Y^\wedge X^\wedge P \rightarrow S\backslash np/sinf : Q^\wedge X^\wedge P \; sinf\backslash np : Y^\wedge Q$
$(S\backslash np)/sinf : Q^\wedge X^\wedge P \rightarrow S/sinf : Q^\wedge P(sinf\backslash np)/sinf : R^\wedge X^\wedge Q$

This grammar thus generates all and only the strings of the verb-raising trans-context-free Dutch fragment NP^n *zag* $zien^{n-2}$ *vallen* with n crossed dependencies for $n \geq 2$.

18.7.3 "The Computation" and "Spell-out"

The tree in Figure 18.2 shows the generation of *(dat) Hendrik Jan Cecilia zag zien vallen* ("that Harry saw Jan see Cecilia fall") with crossed dependencies, up to the stage where all leaves are preterminals, with corresponding lexical entries, before lexical insertion or Spell-out. Such trees are fully ordered. They define a set of ordered numerations or strings, all of which are legal strings of the language, and all of which support the analysis implicit in the tree, and its (unordered, and as yet massively underspecified) LF.

The effect of instantiating the preterminals in such trees with lexical items is to instantaneously project specific unordered logical forms onto the entire hitherto

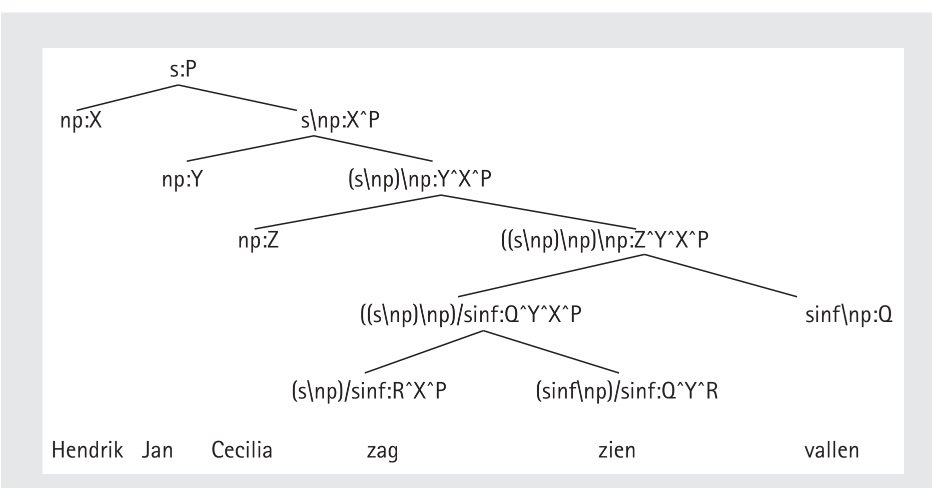


Fig. 18.2 Before Lexical Insertion

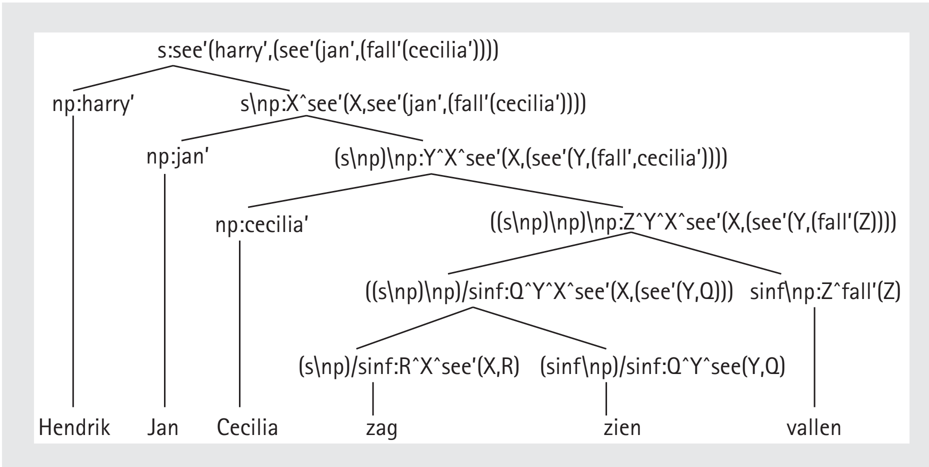


Fig. 18.3 After Lexical Insertion

underspecified derived logical form. This process is illustrated in a simplified form in Figure 18.3.[18]

Specifying the tree in this way selects one string or numerator from the set, and realizes the notion of (multiple) Spell-out simply as the process of lexical insertion. After Spell-out, no further grammatical dependencies can be established. It follows that the effects of quantifier raising must also be specified lexically and statically, as can be done using the generalized quantifier determiner categories (27) in section 18.4, rather than by post Spell-out covert movement.

18.8 Conclusion

Combinatory Categorial Grammar abandons traditional notions of surface constituency in favour of flexible surface structure, in which most contiguous substrings of a grammatical sentence are potential constituents, complete with a monotonically composed semantic interpretation, for the purposes of the application of grammatical rules. This move achieves the following simplifications, of interest to any Minimalist Program for the theory of Grammar.

1. All covert and overt "movement" reduces to strictly type-driven (not structure-dependent) merger of string-adjacent syntactic types and logical forms projected from the lexicon by combinatory derivation.

[18] In a real DCG all instances of variables like $Q^{\wedge}$ ... would be instantiated at the same time with values like *fall′* (*Z*).

2. The notions phase and transformational cycle reduce to the notion lexically headed domain at the level of logical form.
3. The notion of Spell-out or occasion when information is sent from syntax to phonology, whether single or multiple, is reduced to the notion of lexical insertion. Since there is no movement, there is no point in the derivation after which overt movement is prohibited, or covert movement is allowed. The relation between syntax and phonology is completely determined by the language-specific lexicon and universal combinatory projection.
4. Remaining conditions on interface levels, such as articulatory conditions, Binding Condition C, and the island conditions are essentially external to grammar proper.
5. The availability of predominantly left-branching derivations such as (14) allows assembly of phonological and logical forms to be incremental or on-line rather than at a single stage in the computation, without any additional imposition of interface conditions, supporting dynamic approaches to Binding Conditions B and C.

Seen in this light, most remaining open questions in both CCG and MP concern the notion possible language-specific lexical category.

In eliminating all levels of representation intervening between phonetic/phonological form and logical form, CCG is in broad accord with the more recently announced principles of the Minimalist Program, and in particular the version proposed by Epstein et al. (1998) (cf. Kitahara 1995), in which it is proposed to equate (via an unspecified mechanism) Chomsky's operations Merge and Move as a single operation. To the extent that both relativization (and other so-called movements) and in situ argument reduction are effected in CCG by the same type-driven operation of functional application, it can be seen as providing such a mechanism. However, it should be noted that in other respects the frameworks are quite different. In particular, the meaning of the term "derivation" as used by Chomsky and Epstein et al. is quite different from the sense of that term used here and in *SP*.

It is worth emphasizing the point, because on occasion Chomsky has defined transformations very generally indeed, as devices "that appear to be unavoidable in one or another form, whether taken to be operations forming derivations or relations established on representations" (1995*b*: 25). Of course, every theory of language has to define the same semantic relations for sentences at the level of logical form. However, there is a big difference between establishing those relations via a general rule of movement "freely applicable to arbitrary expressions" (ibid.), and establishing them by the equivalent of Merge over linear indexed rules or CCG. The latter is much less expressive (for example, it is incapable of recognizing such simple but unnatural languages as $a^n b^n c^n d^n$ and a^{2^n}).

There are other improvements that the non-movement, type-driven, structure-independent, lexicalized interpretation of the Minimalist Program affords (see

Chomsky 1995*b*: 25). The role of the Numeration is now performed by the string itself, or equivalently by the notion of lexical insertion. The logical form associated with the lexical entries for heads defines the notion of Phase or local domain, and ensures that the head is projected (via the logical form) to the root node of that local domain, as required by the bare phrase structures illustrated in example (2). This way of formulating the computation means that linear precedence (LP) can be determined by the same grammatical module as immediate dominance (ID) or semantic dependency. The properties of weak LIG-equivalence and linearized categories together guarantee the existence of efficient performance mechanisms.

Spell-out is correspondingly simplified. It merely means that the lexicon for the language in question and the universal mechanism of combinatory projection support a mapping between a particular logical form and the string or PF in question. All specifics, such as whether V-raising is overt, as in French, or covert, as in English, are determined by their respective lexicons, and in particular whether the V-raising process is manifested in the lexical syntactic type of verbs, as in French *faire*, or only in the corresponding lexical logical form, as in English *make*. The fact that the equivalent of covert movement can be achieved statically in CCG, via the lexical logical form of quantifier determiners like (27), also provides a way to handle the phenomenon of quantifier raising without post-Spell-out covert movement.

The architecture of the theory that results can be summarized in a version of the T- or Y-diagram standardly used in the transformationalist framework, as shown in Figure 18.4. The level of PF is now a true interface level, representing only the information necessary to specify speech or orthography. The level of LF is now

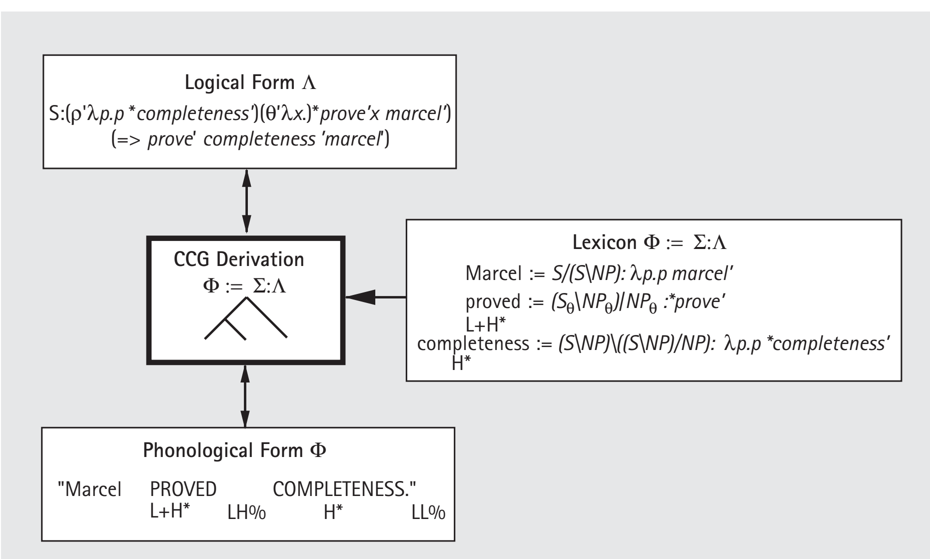


Fig. 18.4 Architecture of CCG

the sole structural level of representation, and is identified with Information Structure, a level which contains all the information that is needed for processes of verification and inference in the context of discourse. While the traditional propositional structure that is more usually associated with the notion of logical form can be trivially obtained by β-normalization of the information structure, and may be needed in order to provide a model theoretic semantics, such a representation is redundant, and not part of the theory itself.[19]

The lexicon statically assigns a triple consisting of a phonological form Φ, a syntactic type Σ, and a logical form Λ to all lexical items, and is the sole locus of language-specific information in the grammar. The combinatory rules and the process of lexical insertion map monotonically between PF and LF, also assigning a triple $\Phi := \Sigma : \Lambda$ to all elements in the derivation. These elements define a purely monotonic computation between the interface levels, of just trans-context-free automata-theoretic power, supporting standard algorithms and models for efficient application to practical tasks and realistic psychological theories. CCG thus offers not only a theory of the Computation in the sense of Marr and Chomsky, but also a way in which it can actually be practically computed.

Further Reading

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CHAPTER 19

INTERFACES IN CONSTRAINT-BASED THEORIES OF GRAMMAR

JONAS KUHN

Non-derivational, constraint-based theories of grammar such as Lexical–Functional Grammar (LFG) and Head-driven Phrase Structure Grammar (HPSG) do not assume any grammar modules in the sense of encapsulated transformational devices. So, if we understand "grammatical interface" in a narrow sense as referring to the input and output representations of such a derivational module (where the module-internal input–output relation is predetermined by the derivational process posited), then constraint-based grammar is not concerned with grammatical interfaces at all. But under a more theory-neutral construal of the term interface, constraint-based grammar is all about grammatical interfaces: by rejecting the assumption of particular derivational devices which transform representations, questions about the relation between the various dimensions or levels of linguistic representation *gain* in prominence. The predictive power of a constraint-based grammar lies exclusively in the explicit declarative constraining of several parallel dimensions of representation for linguistic utterances. For instance, certain syntactic constraints describe the relation between a lexico-semantic interface representation (argument structure) and a surface-based phrase structure representation.

While constraint-based grammar does not posit strict autonomy of the module of syntax (or of any other part of linguistic knowledge), it does put high emphasis on modular design principles in the systematic formulation of grammatical constraints. In order to make generalizations explicit, constraint-based grammar seeks to identify intermediate representations that allow us to break down the space between the observable external boundary interfaces of knowledge of language—a sound representation and meaning representations for lexical units and for complete utterances—into modular units of description. Since the arising "modules" are just units of description, information is assumed to flow between them freely. The overall architecture does not (necessarily) consist of a pipeline of modules, with one module feeding the next, but the most adequate modularization of descriptions may be based on a network of mutually interfacing sets of constraints, or partial theories. As theories of linguistic competence, the modular units imply no claims about a modular organization of the corresponding performance system.[1] Hence, constraint-based grammar is fully compatible with psycholinguistic results showing that there is early interaction of syntactic and semantic sources of information in incremental parsing.

This chapter reviews how the system of representational interfaces between modular units of description has shaped the linguistic and formal work in the frameworks of LFG and HPSG.[2] I will draw many parallels between various accounts from both frameworks in order to emphasize common methodological assumptions and modelling ideas, at the potential cost of oversimplifying some differences in detail.

The chapter is organized as follows: section 19.1 introduces the basic assumptions of constraint-based theories of grammar, contrasting them with transformational approaches. In section 19.2, the main dimensions of representation—or interfaces—assumed in constraint-based theories are motivated; section 19.3

[1] In fact, most algorithmic implementations of a parser for constraint-based grammar interleave information from various constraint modules during processing—regardless of whether the parsing algorithms are aimed at cognitive modelling or not.

[2] Although a large proportion of the linguistic work on constraint-based grammar employs either the LFG and or the HPSG formalism, the two are certainly not the only examples of constraint-based grammar frameworks. Other constraint-based approaches include Relational Grammar; Generalized Phrase Structure Grammar; Role and Reference Grammar; Categorial Unification Grammar; Combinatory Categorial Grammar (see the chapter by Steedman in this volume); Tree-Adjoining Grammar. Due to space limitations, this chapter can address only LFG and HPSG.

A different, although not unrelated, conception of CONSTRAINTS has been adopted in the framework of Optimality Theory (OT). In OT, constraints are construed as being violable, so not every well-formed structure has to satisfy all constraints. Constraints can then be ranked according to their language-specific importance, which predicts different ways of resolving conflicts between constraints. A formalization of Optimality-Theoretic Syntax has been proposed that is based on LFG representations (Bresnan 1996, 2000, Kuhn 2003). However, here we will concentrate on the "classical" inviolable conception of constraints in constraint-based grammar.

introduces them somewhat more technically for the frameworks of LFG and HPSG. Section 19.4 is divided into four subsections, each of which addresses what one might call a module of a constraint-based grammar, that is, a family of constraints describing the correspondence relation between two particular dimensions of representation in a grammar. Section 19.5 draws a conclusion about the status of interfaces in constraint-based grammar. Throughout the chapter I try to avoid overly technical discussions of the accounts presented. Also, to provide a starting point for an exploration of further work in the constraint-based frameworks I focus mostly on the more established approaches.

19.1 Constraints in a Non-Derivational Grammar

Constraints, that is, partial descriptions, are used in all linguistic frameworks in order to restrict the set of well-formed structures at a particular level of a linguistic representation. For instance, we may have constraints saying what a possible phrase marker/phrase-structure tree is and what is not. In this section, we will see that a key insight of constraint-based grammar is that we do not need any other devices apart from declarative constraints to formulate a formally rigorous theory of linguistic knowledge. Hence constraint-based grammars have been argued to be conceptually simpler than transformation-based accounts.

Stated more technically, constraints are propositions in some (formal) description language, referring to the primitives and relations of the structure described. Examples of phrase-structure constraints would be "An X′ category dominates the respective X category", or "A moved constituent c-commands its trace". If we assume several levels of representation, such as a ("deep") level of argument structure and a level of surface constituent structure, we can formulate constraints at each of these levels.

It is a fact about language that if we look across different levels of representation, many obvious generalizations from one level are not reflected in a direct way at other levels—we find mismatches of generalizations across levels of representation. For instance, at the level of argument structure it is clear that sentences (1*a*) and (1*b*) are closely related. But their English surface strings are quite different, with *this book* being in the structural position for objects in the first case, and in the one for subjects in the second case.

(1) *a.* Ann wrote this book in 1999.
b. This book was written in 1999.

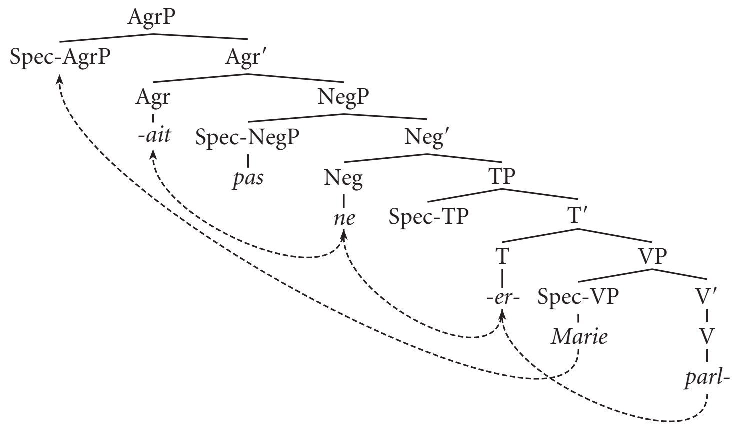
In the Chomskyan tradition of generative grammar, the response to such mismatches across levels has been the following: the different levels of representation are related to one another by a process of transformation (movement of constituents in a tree representation). In some cases, the underlying representation is transformed to a lesser degree in order to arrive at the surface representation, in other cases it is transformed to a higher degree. So, the argument-structure-level affinity between (1*a*) and (1*b*) is captured by the fact that both sentences start out with a very similar underlying representation: *this book* is in the underlying object position of the verb *write*. For (1*a*), it stays in this position, whereas for (1*b*), the surface structure arises through a transformation. The phrase *this book* is moved from the underlying object position into the subject position.

In a transformational theory, well-formedness constraints on the intermediate representations are used to restrict the possible ways of transforming a given structure. The assumed representation includes features such as case or inflectional marking that are used to constrain the positioning of constituents at particular levels of transformation. So the predictions of a grammatical account in this type of framework arises through the interplay of (i) the (non-)transformation of the representation from one derivational stage to the next and (ii) constraints on the representation at particular stages: constraints will trigger or prohibit certain transformations. Moreover, in the Minimalist Program, transformations are associated with a certain cost (depending, for instance, on the distance of movement of a constituent), so when there is a choice, the most economical option is to be preferred.

While a transformational approach to syntax captures generalizations at the underlying level of argument structure in a fairly intuitive way, the fact that movement transformations are the only way of modelling cross-level discrepancies has far-reaching consequences for the representations one has to assume in general. On predominantly theory-internal grounds, the need arises to posit highly articulate underlying tree representations. The representations are required for the formulation of constraints restricting a sequence of movement transformation ultimately leading to the surface form one can observe (and the logical form, which reflects the interpretation of the utterance). An often-cited example of this trend towards indirectly motivated representations is the proliferation of functional categories posited as hosting affixes (or, in the Minimalist Program, abstract features to be "checked"), as in (3) for the French example (2) (cf. Pollock 1989).

(2) *Marie ne parlera pas.*
M. NEG speak.FUT.3SG NEG
'Marie will not speak.'

(3)



Essentially, the functional categories T(ense), Neg(ation), Agr(eement)—provided in the underlying (d-)structure—come into play after earlier transformations have produced the appropriate type of representation to move an element into this position (as sketched by the arrows in (3)). Thus, representing these categories at particular positions in d-structure serves as a kind of look-ahead for the derivational process. What can be actually observed in the surface string is of course only the result of moving a verbal stem through the various positions, as is seen in (2), the surface string for (3). By giving priority to a simple derivational account of the underlying argument structure relations, the account for surface-level word formation has been complicated considerably.[3]

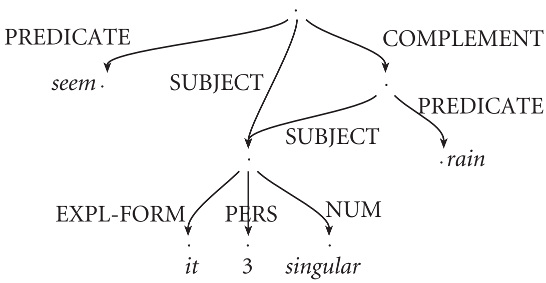
Constraint-based theories of grammar reject the mechanism of transformational derivation: the relation *across* different levels of representation can be captured by declarative constraints too—just like the well-formedness within individual representation levels. The various levels of representation are not viewed as different stages of a derivational process, but as parallel structural entities whose mutual relation we can restrict by interacting partial descriptions. Consequently, one can enforce higher standards of independent motivation for the representations assumed at each level: there is no need to make representational stipulations just in order to anticipate any derivation-related changes in the representation. In particular, the phrase-structure representation can be strictly based on the observed surface string, with the words being encapsulated units whose internal structure is opaque to syntax. This modular separation of word structure and phrases structure—the principle of Lexical Integrity or *Strong* Lexicalism—is one of the most central methodological principles in constraint-based grammar.

[3] Compare also the original argumentation for a lexical treatment of passive by Bresnan (1978) (repeated in Bresnan 2001, sec. 3.2): passive can feed the lexical process of derivational morphology (e.g. *an uninhabited island*), so a syntactic treatment of passive means an unnecessary duplication of passivization devices in the theory and thus misses a generalization.

Moreover, the non-transformational setting of constraint-based grammar eliminates the need to assume a uniform type of representation (such as a tree structure) for all levels of representation. While constraint-based grammar does assume trees for the surface phrase structure,[4] a more general graph structure is used to represent predicate–argument selection, agreement, and other instances of interaction between linguistic units. In these directed acyclic graphs, or complex feature structures, the arcs are labelled with attributes or, synonymously, features (see (4*a*)). Most commonly, such graphs are depicted in attribute value matrix notation, as shown in (4*b*).[5]

(4) Simple feature structure representation for the sentence It *seems to rain*

a. Directed acyclic graph



b. Attribute value matrix notation

$$\begin{bmatrix} \text{PREDICATE} & \textit{seem} \\ \text{SUBJECT} & \boxed{1}\begin{bmatrix}\text{EXPL-FORM} & \textit{it}\\ \text{PERS} & 3 \\ \text{NUM} & \textit{singular}\end{bmatrix} \\ \text{COMPLEMENT} & \begin{bmatrix}\text{PREDICATE} & \textit{rain}\\ \text{SUBJECT} & \boxed{1}\end{bmatrix}\end{bmatrix}$$

Crucially, two different paths of features can point to the same object. This is indicated in the attribute value notation by coindexation, as shown by the use of $\boxed{1}$–$\boxed{1}$ in (4*b*): a numbered box preceding an attribute value matrix provides a reference to the sub-matrix that may appear elsewhere in the notation. Whatever is said by linguistic constraints using one feature path has to be compatible with what is said using the other path. This concept of structure-sharing is the basis for modelling the interaction of linguistic generalizations from different sources: each generalization is formalized by one or more constraints, each of which may pertain to the same structural object. For instance, the feature structure with the index $\boxed{1}$ in (4*b*) has two "addresses": it is the SUBJECT in the feature structure of the

4 In the case of HPSG, these phrase-structure trees are encoded as part of a single complex feature structure that captures all dimensions of representation.

5 Not all formalizations of constraint-based theories of grammars do actually assume the graph interpretation of attribute value matrices; but for our purposes it is safe to think of them in this way.

predicate *seem*, and it is at the same time embedded under the longer path COMPLEMENT SUBJECT. The features inside the feature structure $\boxed{1}$ (EXPL-FORM, PERS, NUM) originate from different sources, but they all come together in a single structural object (note in particular that it is the verb *rain* that selects for the expletive form of the subject):

(5) *a.* **Constraint introduced by the lexeme** *seem*
My SUBJECT and my COMPLEMENT SUBJECT value are identical.
b. **Constraint introduced by the inflection on** *seems*
The SUBJECT of the inflected verb is [PERS 3, NUM *singular*].
c. **Constraint introduced by the lexeme** *rain*
My SUBJECT has the EXPL-FORM (expletive form) feature *it*.

In order technically to compute the effect of interacting constraints, the operation of unification is applied (in some implementations) to construct a graph model that satisfies all the requirements. For this reason, the framework of constraint-based grammar is also known under the name of unification-based grammar.

19.2 Methodology and the Main Representations

Constraint-based theories are committed to rigorous formalization of all notions posited—following the tradition of early generative grammar (e.g. Chomsky 1966: 12), but in contrast to the Government and Binding (GB) approach and the Minimalist Program (MP). This commitment is seen as a prerequisite for validating descriptive adequacy of a grammatical analysis: with notions that leave space for intuitive interpretation, the empirical predictions of an account remain vague, and an apparent simplification of a set of grammatical principles may be unwarranted. Related to this, proponents of constraint-based grammar (see e.g. Ginzburg and Sag 2000: ch. 1) criticize the methodological driving force of the GB/MP framework—the attempt to reduce as many principles as possible to more basic ones which will derive a set of core phenomena. There is no independent criterion of what constitutes a core phenomenon, so there is a danger of selecting the data according to the theory rather than developing a theory for the data. In the constraint-based frameworks, many researchers attempt to base their accounts on non-subjective sources of data, such as text corpora. Empirical coverage (and learnability) are the ultimate criteria for assessing a constraint-based grammatical theory. Related to this, it is acknowledged that idiosyncrasies (i.e. non-reducible lexeme- or construction-specific information that has to be learned) are part of the system of grammatical knowledge, and should not be deferred to some subordinate, non-core part of the theory.

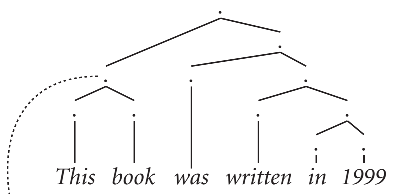
A key element of constraint-based theorizing is the definition of particular representation structures for capturing generalizations at the various levels. The assumption of representation structures that are situated at the boundaries of what we view as the scope of grammatical knowledge is not difficult to motivate: we clearly need an interface with the articulatory/perceptory system, that is, some surface representation of speech sounds, and an interface with the conceptual system—some semantically interpretable representation. For both external boundary interfaces we need representation structures in our grammar that allow us to systematically describe their internal structure and the interaction between them.

Leaving the study of the relation between the actual stream of sounds and an abstract symbolic representation to phonetics and phonology, the relevant surface representation for a morphosyntactic grammar is a phonological representation, in the simplest case a sequence of phonemes. For a generalized account of the internal structure of phoneme sequences forming utterances, a key intermediate unit is the unit of a word. On one hand, we can describe word-internal principles that govern the systematic formation of word forms based on lexically listed (i.e. learned) roots and affixes. On the other hand, we can describe the combinatorial potential of word forms to form larger units—phrases—given their part of speech and inflectional class, but abstracting away from all other aspects of word-internal structure. Thus we can view word structure and phrase structure as two related, but distinguishable, representation structures, where the former determines the units and the latter their pattern of combination.

For the other external boundary interface, the one with the conceptual–semantic system, there are two aspects that interact with morphosyntax in different ways: (i) the structural assembly of meaning representations for complex linguistic units, given their parts (as addressed by compositional semantics); (ii) regularities in argument selection of lexical items, given the semantic entailments of the concepts denoted by these items (as addressed by lexical semantics). The two aspects are again related, but we may posit two separate interface representations to account for their respective interaction with morphosyntax and the lexicon.

The mentioned representations that are assumed to model the external boundary interfaces of grammar delimit the space that a constraint-based theory of grammar has to cover. However, if we were to express constraints relating the elements of these representations directly (in particular relating argument structure and phrase structure directly), we would miss important generalizations. In order to capture the active–passive alternation (as in (1)), the phrase-structure position to the left of the finite verb (the position occupied by *this book* in (6*a*); let us call it X) has to be optionally related to the lexicosemantic agent role (for active) or theme role (in the presence of passive morphology). (There are good reasons to assume that we have indeed the same phrase structure position X in active and passive. For instance, the phrase occupying X agrees with the finite verb in person and number, and we can have coordination of the constituent to its right: *Ann wrote a book and was awarded a prize.*)

(6) *a.* (Surface-based) Phrase Structure Representation



b. Lexicosemantic representation for *write* (simple version)

$$\begin{bmatrix} \text{RELATION} & \textit{write} \\ \text{AGENT} & \varnothing \\ \text{THEME} & [\text{“}\textit{this book}\text{”}] \end{bmatrix}$$

Now, in order to capture the phenomenon of raising (as with the raising adjective *unlikely* in (7)), we have to add the additional option that if we have a raising predicate, position X is related to an embedded verb's (unrealized) argument: in (7*a*), *Ann* is the agent argument of the embedded *write* relation; in (7*b*), *the proposed book* is the theme of the embedded relation.

(7) *a.* Ann is unlikely to write the proposed book.
b. The proposed book is unlikely to be written.

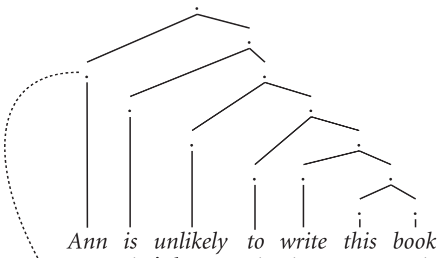
But as the contrast between (7) and (8) shows, not an arbitrary embedded argument can be realized in our position X: in the presence of passive morphology it *again* has to be the theme role, in the absence of passive morphology it has to be the agent.

(8) *a.* ∗The proposed book is unlikely to (Ann) write.
b. ∗Ann is unlikely to be written (the proposed book).
[where Ann is under discussion as the writer, as in (7*a*)]

So there is a generalization about the raising phenomenon that can neither be made explicit at the level of surface-oriented phrase structure, nor at the level of argument structure: it is generally the *subject* that undergoes raising.[6] So, we can capture the generalizations easily if we introduce an intermediate representation—subcategorization structure—to encode the selected syntactic arguments and their grammatical functions explicitly.

[6] Note that contrary to GB/MP, *defining* subject in terms of phrase structure configuration (i.e. as our position X) is not an option with a surface-based notion of phrase structure: it would force us to assume that *the proposed book* in (7*b*) occupies not only the X position next to *is*, but also some embedded occurrence of X (contrasting with (8*a*)). So, we would be forced to adopt a transformational view of phrase structure.

(9) *a.* (Surface-based) phrase structure representation



b. Syntactic subcategorization: grammatical functions

$$\begin{bmatrix} \text{PREDICATE} & \textit{unlikely} \\ \text{SUBJECT} & \boxed{1}\ [\text{“}\textit{Ann}\text{”}] \\ \text{COMPLEMENT} & \begin{bmatrix} \text{PREDICATE} & \textit{write} \\ \text{SUBJECT} & \boxed{1} \\ \text{OBJECT} & [\text{“}\textit{this book}\text{”}] \end{bmatrix} \end{bmatrix}$$

c. Lexicosemantic representation

$$\begin{bmatrix} \text{RELATION} & \textit{unlikely} \\ \text{STATE-OF-AFFAIRS} & \begin{bmatrix} \text{RELATION} & \textit{write} \\ \text{AGENT} & [\text{“}\textit{Ann}\text{”}] \\ \text{THEME} & [\text{“}\textit{this book}\text{”}] \end{bmatrix} \end{bmatrix}$$

In English, position X (if realized) uniformly corresponds to the SUBJECT function in this new representational dimension: we can formulate a constraint to this effect on the correspondence relation between phrase structure (9*a*) and subcategorization structure (9*b*) (a specific formulation will be provided in section 19.4.2). Now, raising is also sensitive to the grammatical function of the embedded argument—it has to be the SUBJECT (compare the constraint in (5*a*), which is essentially a raising constraint, internal to subcategorization structure). The facts in (7) and (8) are ultimately due to the fact that the SUBJECT function corresponds to different lexicosemantic arguments in active and passive (driven by constraints on the relation between subcategorization structure (9*b*) and lexicosemantic argument structure (9*c*)).

This illustrates how it is possible to capture argument-structural generalizations without positing a transformational mechanism, and it motivates the assumption of an intermediate syntactic representation, which we call subcategorization structure here (for lack of an established theory-neutral term). It is at this level that we can identify the grammatical function of the arguments: subject, object, predicative complement, etc. Other phenomena besides the subject-sensitivity of raising in which grammatical functions play a crucial role include control phenomena and binding theory.

The diagram in Figure 19.1 shows the main representation structures assumed in constraint-based grammar, as introduced in this section.[7] Recall that the various

[7] Note that this is a meta-theoretical generalization (or simplification) that we made here in this article. Not every practitioner of constraint-based grammar may agree.

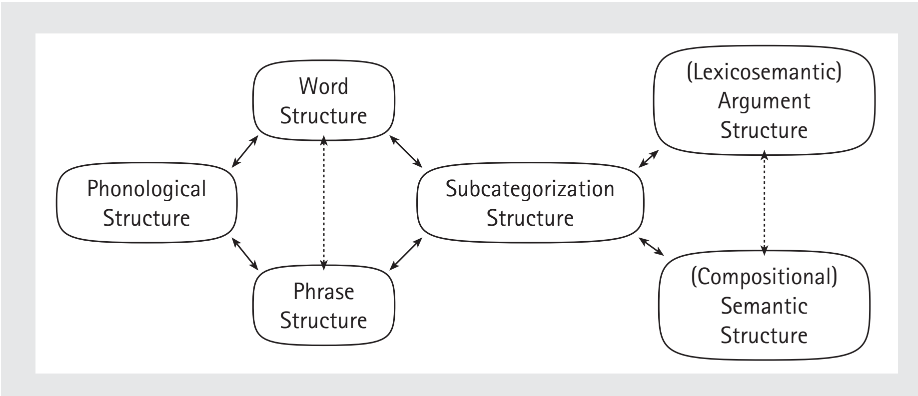


Fig. 19.1 Main dimensions of representation in constraint-based grammar

structures are related in a non-transformational way; they are in parallel correspondence. Both the internals of a representation structure and their mutual relation are described by *declarative* constraints. If we call the representations "interface representations", it is important to bear in mind that they are not motivated as the output/input of two or more modules in the sense of (concrete or abstract) devices or processes. But still, a family of constraints that describe the relation between two representations *does* form a module in an informational sense, as known from modules in programming: the modules and interfaces of a constraint-based theory of grammar are chosen in a way that allows us to express constraints in general and perspicuous terms. Details irrelevant outside a module should not be part of the interface representation.

Hence, each of the double arrows between the interface representations in Figure 19.1 can be viewed as a constraint module; collectively, the modules interact to restrict the well-formed combination of structures.

Given the network architecture of representational interfaces (as opposed to a pipeline architecture of sequential transformational modules), it does not come as a surprise that a more exhaustive account of grammatical knowledge will include additional levels of representations, interfacing with various other levels of representation. For instance, the level of information structure or discourse structure—capturing notions like the sentence topic and focus—interfaces at least with phonological structure (prosody), phrase structure, and semantic structure; in addition, it requires a context representation, which is not shown in the diagram in Figure 19.1.

19.3 Linguistic Representations in LFG and HPSG

Although there are a number of technical differences between LFG and HPSG, we can identify the main representation structures of Figure 19.1 in both frameworks (based on their motivation as the locus for certain constraints). This chapter cannot offer a full exposition of the LFG and HPSG formalization of linguistic constraints, but for the further discussion of constraints on the interface representations in section 19.4 it will be useful to take the exploration of the representations to a slightly more technical level. The table in (10) lists the main representation structures, setting up a tentative correspondence between the major representation structures of LFG and the key attributes or features in the HPSG representation. LFG employs different mathematical structures for the different levels of representation; the relation across levels is expressed by projection functions, setting the structural elements in correspondence. HPSG uses a single representation structure, a comprehensive (typed) feature structure, to model all aspects of an utterance. Conceptually, however, the various sub-graph structures under the HPSG features listed in (10) are comparable to the distinct formal representation structures of LFG in that each such substructure establishes a different structural relation between its representational units.[8]

(10) Representational means for the main levels in syntax

Type of information	*LFG representation*	*HPSG representation*
Surface constituent structure	C-Structure (constituent/ category structure): tree structure	DTRS (daughters attribute): feature structure encoding of tree structure
Subcategorization structure	F-Structure (functional structure): feature structure based on grammatical functions SUBJ, OBJ, OBJ_θ, OBL_θ	ARG-ST attribute: list of syntactic arguments
(Lexicosemantic) argument structure	A-Structure: ordered list of semantic arguments	CONTENT|NUCLEUS attribute (lexically determined)
(Compositional) semantic structure	Semantic structure/Meaning representation	CONTENT attribute

[8] I will throughout speak of *correspondence* between the units of the various dimensions, even if this may mean *identity* in the HPSG formalization.

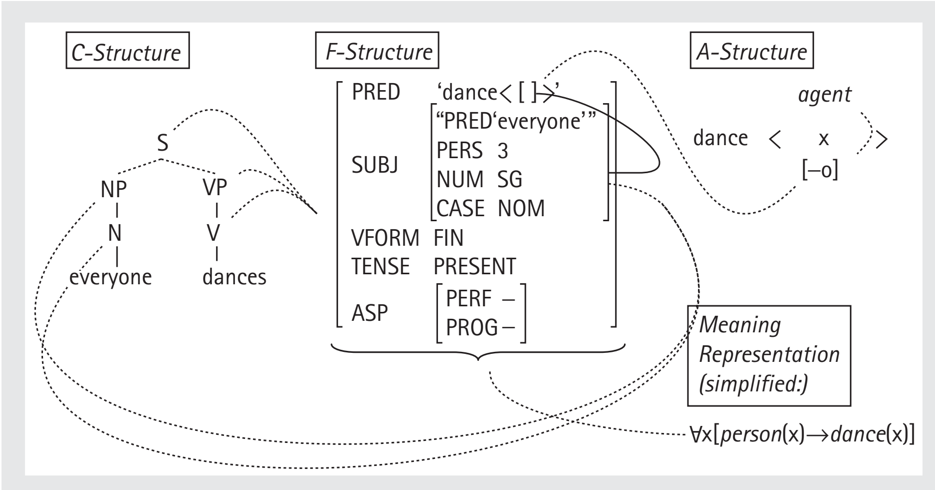


Fig. 19.2 LFG Representation Structures and Projections for *everyone dances*

Note a common source for terminological confusion: in HPSG, the attribute ARG-ST (short for argument structure) is used for the syntactically selected arguments, i.e., for what we call subcategorization structure here,[9] while in LFG, a-structure (short for argument structure too) is the representation for the interface with lexical semantics. For instance, in the active–passive alternation, ARG-ST of HPSG varies (like the f-structure with the grammatical functions of LFG), while the a-structure of LFG is invariant (like the CONTENT|NUCLEUS of HPSG).

For concreteness, the respective representational means are illustrated for a simple example in Figure 19.2 for LFG and Figure 19.3 for HPSG (Figure 19.4 shows a translation of the feature-encoded phrase structure of Figure 19.3 into the more familiar tree format). Some of the details are irrelevant for the present comparison. But note that the subcategorization structure is the key interface between syntactic constraints referring to the lexicosemantic argument structure and constraints dealing with its (morpho-)syntactic realization: in LFG, the crucial part of this interface representation are the grammatical functions listed under the PRED(icate) value in the f-structure: PRED ‘dance⟨ SUBJ ⟩’.[10] A-structure determines the number and kind of grammatical functions in the list under PRED (in Figure 19.2, it is just the

[9] An attribute named SUBCAT was in use in early HPSG work, serving a slightly more technical purpose: the bookkeeping over argument realization in a Categorial-Grammar-style argument cancellation scheme. More recently (following Pollard and Sag 1994: ch. 9), this role is taken over by the "valence" features SUBJ, COMPS, and SPR (see the discussion of Figure 19.3). The attribute ARG-ST contains the full list of morphosyntactically selected arguments, including non-locally and morphologically realized arguments (compare sections 19.4.2 and 19.4.2).

[10] The solid-line arch is the LFG notation for identity of subgraphs (compare the coindexation notation $\boxed{1}$–$\boxed{1}$). The value of the attribute SUBJ and the element in angle brackets under PRED are the same entity.

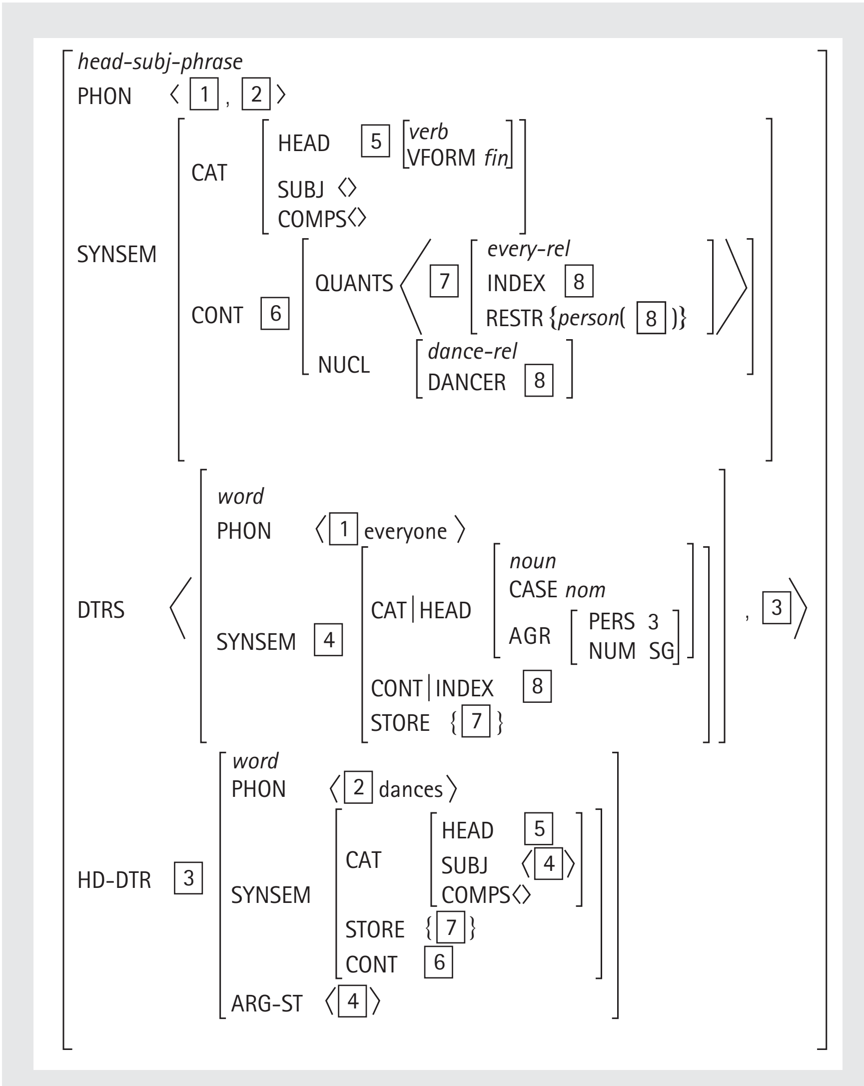


Fig. 19.3 HPSG Representation for *everyone dances* (simplified)

SUBJ(ect)). F-structure internal constraints (Completeness and Coherence) ensure that these grammatical functions are actually realized in c-structure.

In HPSG, the key interface between lexicosemantic information and morphosyntactic realization is the lexical feature ARG-ST (see the substructure for *dances*, marked $\boxed{3}$ in Figure 19.3 and appearing under VP in Figure 19.4). The lexical semantics determines a lexical element's ARG-ST list. For (morpho-)syntactic realization, the arguments are either mapped to the item's valence lists (SUBJ (subject), COMPS (complements), and SPR (specifier)), or they trigger a feature representation for non-canonical argument realization (see section 19.4.2). In the

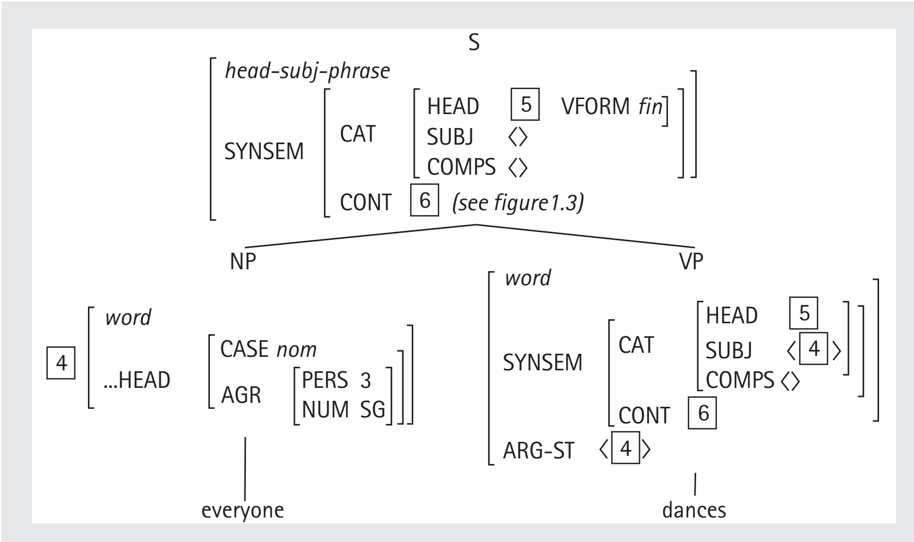


Fig. 19.4 Abbreviated tree diagram for HPSG representation in Figure 19.3

example, the only argument is lexically mapped to the SUBJ list (⟨$\boxed{4}$⟩), and is then realized canonically in a *head-subject-phrase*, with $\boxed{4}$ surfacing as a subject NP.

The HPSG representation makes the close relation between lexical semantics and compositional semantics explicit. The lexicosemantic information necessary to determine the grammatical argument structure is embedded in the CONT(ent) representation under the feature NUCL(eus) (note that $\boxed{6}$ is identical for the entire sentence and its semantic head, the lexical verb *dances*); compositional semantics adds quantifier and other information under CONT.[11] The meaning construction in LFG will be addressed in section 19.4.4.

A notable difference between the LFG and HPSG representations is the following: in LFG morphosyntactic features such as case and agreement, but also tense and aspect marking, are represented at f-structure—along with the grammatical function information. The contribution of several c-structure categories is collapsed into a single f-structural element, representing the sharing of the morphosyntactic features. In HPSG, on the other hand, this morphosyntactic information is more closely tied to phrase structure, forming part of the HEAD information under the feature CAT(egory). The difference is more subtle than it may first appear, since a general constraint on the HEAD feature in HPSG ensures

[11] In the version of HPSG depicted here (in essence, Ginzburg and Sag 2000—following the account of Pollard and Yoo 1998 in most relevant respects), the actual construction of compositional semantics is technically mediated through the lexical verb. But note that at this level the (post-lexical) syntactic exponence of the arguments is reflected, which crucially determines the compositional semantics.

that it is identical for all X-bar(-like) projections from word to maximal phrase level (compare the identity of the HEAD values in the example: $\boxed{5}$). Thus, HPSG captures the invariance of the morphosyntactic marking across X-bar projections in a way comparable to the identification of the f-structure correspondents of V, VP, and S in the LFG structure in Figure 19.2 (note the dotted lines between c-structure and f-structure denoting a projection function ø: all three nodes are mapped to the same f-structure).

However, in LFG this identification of morphosyntactic contribution is taken a step further: not only are subsequent X-bar projections identified at the level of f-structure, but also combinations of non-lexical categories (determiners, auxiliaries, complementizers) with lexical categories (nouns, verbs, etc.), together forming an Extended Projection in the terminology of Grimshaw (1991). In accordance with the GB/MP terminology, the non-lexical categories are called functional categories (where "functional" is used without suggesting reference to grammatical functions). Lexical categories and their matching functional categories are said to form f-structural co-heads (for a detailed exposition, see Bresnan 2001: ch. 6). Hence, for a sentence like *The girl has danced*, we get an f-structure quite similar to the one in Figure 19.2, although the c-structure is much more articulate, as seen in Figure 19.5: the determiner *the* contributes to the f-structure of *girl*; the auxiliary *has* contributes to the f-structure of the full verb *danced*.

With this decoupling of a finely articulate phrase structure (c-structure) and the more abstract syntactic representation of f-structure, LFG captures the fact that languages can employ a variety of means of morphosyntactic exponence for

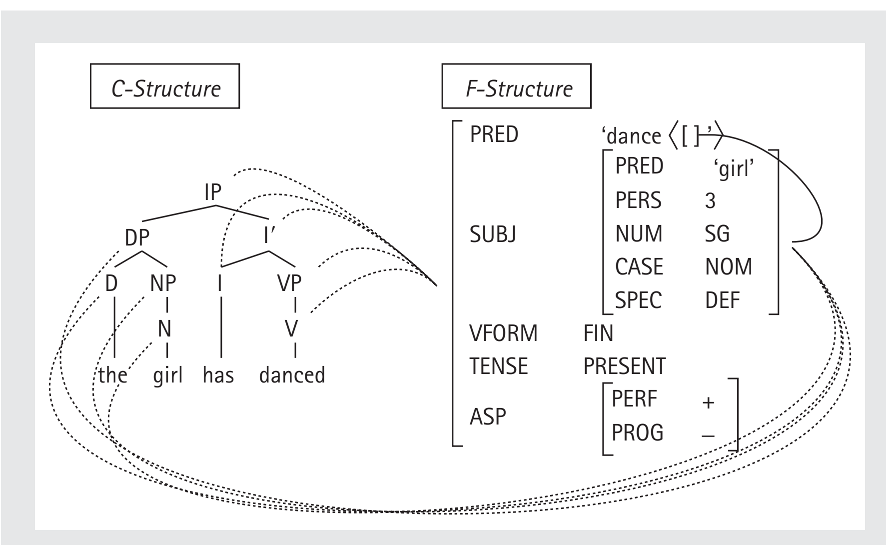


Fig. 19.5 LFG c-structure and f-structure for The girl has danced

realizing a particular content: rather than using a determiner, many languages express definiteness at the word level with special morphology (like the Swedish example (11*a*)); likewise, tense and aspect can be expressed synthetically or analytically—often a single language displays both options (as in the active paradigm (11*b*) vs. the passive paradigm (11*c*) of the perfect in Latin). Outside the "modules" of local morphosyntactic realization it is irrelevant what particular option is chosen; hence the interface representation of f-structure hides these details from the rest of the grammar.

(11) *a.* *hus-et* (Swedish)
house-DEF
'the house'

b. *lauda-v-it* (Latin)
praise-PERFECT/ACTIVE-3SG
'He/she praised...'

c. *lauda-t-a* *est*
praise-PASS-PPC-FEM/SG is
'She was praised.'

Note that the assumption of functional categories (i.e. defective categories in the sense that they are not semantically independent and hence do not introduce a PRED value of their own) is fully compatible with Lexical Integrity and the non-derivational status of phrase structure (as discussed in section 19.1): in LFG, a functional category is posited only when a separate word contributing certain morphosyntactic features appears in the surface string. Recall that here, in contrast to a transformational setting, the reverse argumentation—that even in the absence of a word-shaped exponent, some (empty) functional head category must be assumed since the interpretation of a clause contains the corresponding feature—is invalid, since phrase structure (c-structure) is motivated by surface constituency, not as a level for which underlying uniformity of representation is aspired to; the generalization is already explicit in f-structure.

19.4 Constraining the Interface Representations

This section provides an overview of the main grammar modules that serve to constrain the interface representations assumed in a constraint-based theory of syntax (compare the diagram in Figure 19.1). Space limitations make it impossible to include a detailed discussion of the role of further levels of representation, such as morphology and information structure. In sections 19.4.1–3, the three interfaces along the path Phonological Structure—Phrase Structure—Subcategorization Structure—Lexicosemantic Argument Structure through the diagram in Figure 9.1 are discussed. This path has been the backbone of most syntactic work in constraint-based theories. In section 19.4.4, the interface to (Compositional) Semantic Structure is discussed.

19.4.1 Phonological Structure and Phrase Structure/Word Structure

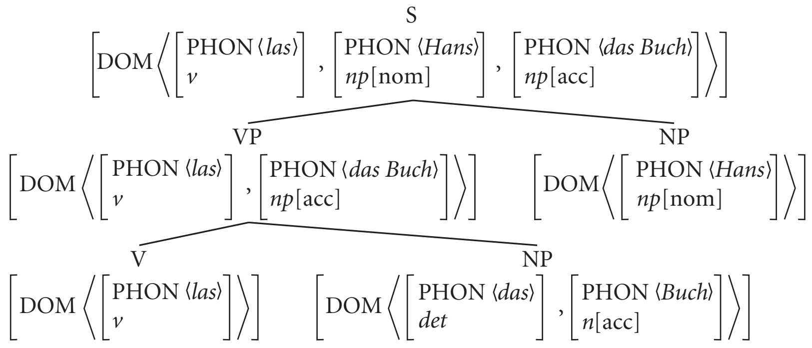
Generalizations about the combination of words are captured by a tree-shaped phrase-structure representation. What is the relation between phrase structure and the surface sequence of words? One possibility is to define the word sequence defined by a phrase-structure tree as the trivial left-to-right traversal of the tree's terminal or leaf nodes (and for the remaining sections of this chapter I de facto follow this view). However, in constraint-based grammar two aspects of phrase structure are usually discerned and handled by separate constraints: immediate dominance and linear precedence. Thus broad generalizations about immediate dominance can be expressed without interference of the often more idiosyncratic character of precedence relations (compare prepositions vs. postpositions in many languages, e.g. German, and pre- vs. postnominal adjectives in Romance).

In one sub-tradition of HPSG, linearization HPSG, the power of precedence or ordering constraints is increased by introducing the intermediate representation of a so-called ordering domain. Although we will revert to the "standard" constraint-based tradition after this section, it is illustrative of constraint-based theorizing to look at the linearization technique.

An ordering domain (represented under a feature DOM) is a set whose elements can be freely ordered, subject to the ordering constraints. Crucially, an ordering domain can be more fine-grained than the set of daughters in a local phrase structure subtree. The analysis in (13) (modified from Kathol 1995) for the word-order variants (12) in German illustrates the technique.

(12)	*Hans las das Buch.*	*Las Hans das Buch?*	*Das Buch las Hans.*
	Hans read the book	read Hans the book	the book read Hans
	'Hans read the book.'	'Did Hans see the book?'	'The book, Hans read.'

(13)



Working bottom up, constraints on domain formation can cause the order of a subdomain to be "frozen": in (13), this happens at the NP level (in particular for *das Buch*, which cannot be reordered further up in the tree, excluding ungrammatical serializations such as ∗*Buch Hans das las*). However, the domain elements of the daughters can also be left transparent at the mother node, so they can be linearized independently in the higher domain. With suitable linearization constraints, the various word-order variants of German in (12) can be captured. The application of ordering domains was pioneered by Reape (1993), and has been widely applied in a sub-tradition of HPSG (see e.g. Kathol 1995, Müller 2002).

In the light of the discussion of the representational means for the main levels of representation in section 19.3, it should be noted that the tree structure of linearization HPSG no longer plays the role of a surface-based representation of constituent structure, but a role more similar to LFG's f-structure, representing syntactic predicate–argument relations (for a more detailed comparison, see Manning 1995). This shift may have considerable effects on the status of other representational devices assumed; therefore we will subsequently focus attention on the "non-linearization" tradition of HPSG.

Following the methodological principle of Strong Lexicalism, the internal structure of words is opaque to syntactic constraints. Implicitly or explicitly, constraint-based accounts have often assumed a word-internal tree structure or bracketing structure (see e.g. Manning 1996), based on morphemes as the basic units—that is, lexically listed form–meaning pairs that are combined compositionally. In contrast to this, some more recent work follows the framework of Paradigm Function Morphology (Stump 2001), addressing the relation between roots and the inflected forms that fill paradigm cells without breaking the forms up into a configurational structure of lexically listed morphemic units (compare also the chapter by Stewart and Stump in this volume).

19.4.2 Phrase Structure/Word Structure and Subcategorization Structure

There are many ways in which languages realize and identify the arguments in a predicator's (i.e. verb's or preposition's, etc.) subcategorization structure. Argument realization can be at the word-structure level (by incorporation, see (14*a*))[12] or at the phrase-structure level. In the latter case, the identification of the different grammatical functions of arguments can rely on a variety of morphosyntactic means: specific grammatical functions may be marked by phrase-structure configuration (14*b*) and/or by morphological marking of the dependents (case) or the head (agreement) (14c).[13]

(14) a. *Zy-ná-wá-lúm-a.* (Chicheŵa)
10SUBJ-PAST-2OBJ-bite-INDICATIVE
'They bit them.'

b. *John saw Mary* (English)

c. *aaynaye kuṭṭi kaṇṭu* (Malayalam)
elephant.ACC child.NOM see.PAST
'The child saw the elephant.'

Recall from section 19.2 that constraint-based grammar abandons the need to represent the relation between a head and each of its syntactic argument tree-structurally (at some stage of a derivation). Rather, the head–argument relation is expressed in a separate representation structure (subcategorization structure) which is in some correspondence relation with the phrase-structure and word-structure representation. This has the effect of avoiding a representational bias towards syntactic realization of arguments, with a configurational marking of grammatical function (as in English). The entire cross-linguistic spectrum of argument realization and function marking is captured by a number of constraints partially describing the relation between subcategorization structure and phrase structure, as will be discussed in subsections 19.4.2.1–4.

19.4.2.1 *Syntactic Argument Realization With Configurational Function Marking*

In (phrase-structure-)configurational function marking, the systematic structure of phrase-structure projections (described by versions of X-bar theory) is exploited to mark specific grammatical functions. Based on a standard X-bar account, we can distinguish two main phrase-structural patterns: syntactic complementation and a specifier–head configuration. The configurational type of function marking is then captured by constraints as sketched in the following (the sketches abstract away

[12] The example is taken from Bresnan (2001: 304).

[13] The example is taken from Falk (2001: 19), who attributes it to K. P. Mohanan.

from many important details and the differences between the standard LFG and the standard HPSG account):[14]

(15) *a.* X′ → X YP*

In the phrase X′, X corresponds to the predicate; each YP corresponds to an argument with a *complement function.*

b. XP → YP X′

In the phrase XP, X′ corresponds to the predicate; YP corresponds to an argument with a specifier or *subject function.*

Here, the Kleene star on YP in pattern (15*a*) makes possible a multiple-branching structure, so that more than one complement function can be selected. Alternatively, many accounts assume a binary pattern with a possible recursion of X′ categories, each introducing one argument with a complement function.

The effect of the *subject–function* correspondence constraint in (15*b*) could be seen in Figures 19.4 for HPSG (S is an X-bar projection of VP, $\boxed{4}$ corresponds to the subject) and 19.5 for LFG (the DP daughter of IP corresponds to the structure embedded under SUBJECT in f-structure, while I′ corresponds to the same f-structure as IP, based on the predicator *danced*).[15]

It is important to note that the patterns in (15) are not definitions of a derived notion of grammatical functions (as in GB), but constraints on the correspondence relation between two independent representation structures. The various functions can also exist in the absence of the phrase structure patterns, as we will see below.

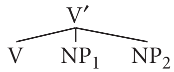
In some languages (such as English), configurational marking of specific grammatical functions goes very far: the verb-adjacent object NP in English ditransitives like *John gave Mary flowers* is tied to a specific "thematically" restricted grammatical function, an oblique object for the lexicosemantic argument of the (intended) recipient. In constraint-based grammar, we may assume that more specific function-marking patterns than the ones in (15) are learned for a specific language, for instance (16) for English.[16]

[14] In particular, we ignore here how it is ensured that all and only the selected arguments of the predicate are actually realized. In LFG, this is done by the meta-constraints of Completeness and Coherence on f-structure representations. HPSG uses an argument-cancellation technique inspired by Categorial Grammar.

[15] In the LFG theory of the structure-function mapping (discussed in Bresnan 2001: ch. 6), there are two different configurational patterns to mark an argument as SUBJECT: pattern (15*b*): IP → NP I′, and a special clause pattern, combining the subject NP with a maximal predicate phrase (VP, AP, PP, NP), forming a nonprojective clausal category S: S → NP XP. The examples in Figures 19.2 and 19.5 illustrate these two options.

[16] Technically, it is not necessarily a phrase-structure pattern that is learned; Wechsler (1995: 76) assumes that the English-specific constraint is expressed on the shape of SUBCAT lists (corresponding to the COMPS list in the version of HPSG laid out here). But indirectly, this has the same effect.

(16) English-specific specialization of pattern (15*a*)



NP$_1$ corresponds to the (intended) recipient argument.
(For the remaining elements, (15*a*) holds.)

A systematic technique for capturing the specialization relation holding between general patterns like (15*a*) and language-specific instances like (16) has been integrated into HPSG (Sag 1997, Ginzburg and Sag 2000), drawing on work from the framework of Construction Grammar. The crucial technical prerequisite for a formal account of such specializations is the organization of grammatical constraints (i.e. partial descriptions) in an inheritance hierarchy. Each partial description is associated with a type, and the types are organized in a specialization lattice based on the subtype–supertype relation (see Figure 19.6; the CLAUSALITY and HEADEDNESS boxes denote dimensions of classification, they are not types themselves). Each type inherits the partial descriptions from each of its supertypes: thus, an entity described as *finite-vp* will inherit the constraints from *non-clause* and *head–comp-phrase*. The described entities (i.e. the structures in our model of grammatically well-formed linguistic utterances) have to satisfy all constraints of some maximally specific subtype in the hierarchy (such as *decl-clause* or *ditrans-vp*). The English-specific restriction on the verb-adjacent NP (as sketched in (16)) can be described as a type constraint on the type *ditrans-vp*. (The *ditrans-vp* example given here is a simplification meant to illustrate the general idea.)

Inheritance hierarchies were originally developed for a systematic organization of lexical information (Pollard and Sag 1987, Flickinger et al. 1987), but this organization scheme for constraints has been extended to constraints on the interface representations in modular accounts of syntax, as discussed here. This is facilitated by HPSG's choice to encode all constraints uniformly by (typed) feature structures, including the actually tree-shaped phrase structure (recall that Figure 19.4 was just a convenient re-encoding of the actual HPSG notation in Figure 19.3).

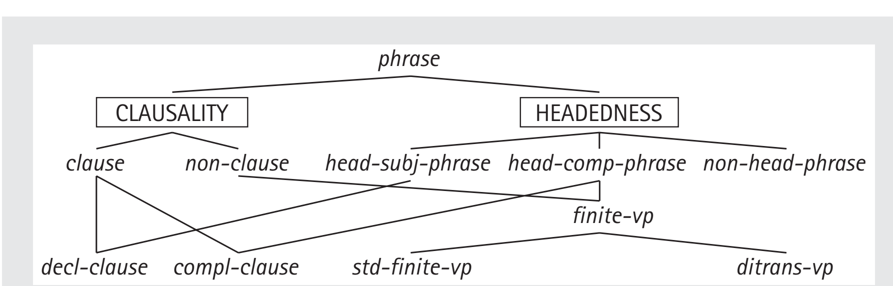


Fig. 19.6 (Simplified) illustration of an HPSG inheritance hierarchy

19.4.2.2 *Syntactic Argument Realization With Non-Configurational Function Marking*

Not all languages use the phrase-structural configuration to identify the function of a syntactically realized argument. Some languages, like the Dravidian language Malayalam and the Australian languages Warlpiri and Wambaya, have a virtually free word order, lacking evidence for a VP constituent (see e.g. Bresnan 2001: 5ff, 136, Falk 2001: 19ff). Other languages, such as German and Russian, do contain evidence for a configurational X-bar projection structure in the verbal domain, but they allow for a large degree of re-ordering ("scrambling") of arguments.

With the surface-based conception of phrase structure and its decoupling from subcategorization structure, the relation between phrase-structure configuration and grammatical functions for such languages can be left largely unconstrained or underspecified. Constraints referring to other, morphological information will restrict the allowable correspondence relations between the syntactically realized arguments and the slots in the subcategorization structure (see Bresnan 2001: 109ff).

In LFG, a non-projective, "exocentric", clausal category S is assumed for non-configurational languages, which may rewrite as an arbitrary sequence of X or XP categories. The grammatical function for each element is left open by the phrase-structural pattern (17).

(17) **Exocentric clause schema**

$$\begin{array}{c} \text{S} \\ | \\ [\text{X/XP}]* \end{array}$$

In the clause S, each [X/XP] corresponds either to the predicate or to an argument with *some* grammatical function.

There are two types of *morphological* restriction on the phrase-structure–subcategorization-structure correspondence: (i) morphological marking on the argument (or, more generally, the dependent), that is, case; and (ii) marking on the head, that is, agreement in person, number, and/or gender. A language often uses a mixture of both strategies.

Morphological function specification can be described by the constraint schemata in (18) interacting with pattern (17).[17] (Clauses (18*a*) and (18*b*) are constraint *schemata* in that κ and γ have to be instantiated to a specific case/grammatical function; for instance, in (18*a*), we may instantiate κ as ACCUSATIVE and γ as OBJECT.)[18]

[17] An alternative formulation of the constraints governing dependent-marking is the Constructive Morphology approach proposed by Nordlinger (1998). Here it is the case affix that lexically introduces constraints on the possible embedding of a dependent.

[18] Sometimes the implications (18*a*) and (18*b*) are formulated in the reverse direction, intuitively suggesting the order of reasoning one would apply to determine the grammatical functions in a clause, given some morphological marking on the dependents and/or head. (This will work reliably only

(18) Morphological function specification schemata

a. Dependent marking

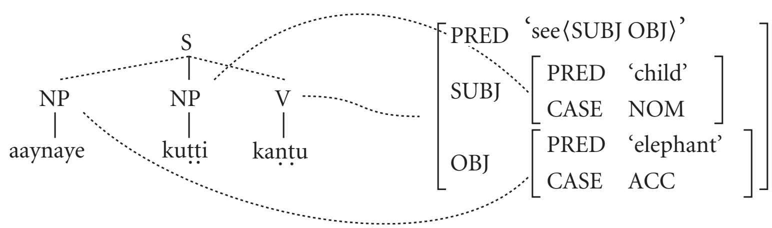
A syntactic dependent is marked with case κ if it corresponds to a predicate's argument with the grammatical function γ.

b. Head marking

The predicator agrees with an argument phrase (in person, number and/ or gender) if the predicator embeds this argument under the grammatical function γ.

With (17) and suitable instances of (18*a*), the function identification for a Malayalam sentence like (19) (= (14*c*)) (and any other permutation of the three words, all of which are grammatical) is explained.

(19) *aanaye kuṭṭi kaṇṭu.*
elephant.ACC child.NOM see.PAST
'The child saw the elephant.'

(20)


Note that the interaction of grammatical constraints like the ones for function marking need not necessarily lead to a unique result in every case. Languages tolerate a considerable amount of ambiguity, which speakers can deal with by referring to pragmatic clues. For instance, in the German scrambling example (21), there is no overt case distinction, and the subject agreement on the verb is also compatible with both phrases. Only world knowledge can disambiguate such a sentence.

(21) *... weil dieses Buch Peter gekauft hat.* (German)
because this book Peter bought has
Literally '... because this book bought Peter' or '... because Peter bought this book'

---

if there is no ambiguity. For instance, a clause with two arguments bearing the same person–number–gender marking and with an agreeing head (as in (21)) would give us an inconsistency, with the reverse implication of (18*b*).) Logically, the implications have to be stated as in (18). The intuitive reasoning follows their contraposition and exploits the fact that each argument phrase has *some* unique function.

19.4.2.3 *Non-Local Realization of Arguments*

An important variant of syntactic argument realization that every grammatical theory must address is the non-local realization in long-distance structures, as exemplified in (22).

(22) *a.* Ann I think he likes.
b. Ann I think John said he likes.

The existence of this type of phenomenon was originally seen as clear evidence for the need of a transformational theory of syntax, involving the movement of an argument phrase (*Ann*) away from its underlying position (as the structural object of *likes*); however, there have been a host of proposals dealing with long-distance structures in a constraint-based, non-transformational way.

The HPSG account is a feature-based encoding of the original technique of Generalized Phrase Structure Grammar (GPSG; Gazdar et al. 1985). GPSG uses the phrase-structure category symbols to encode the presence of a gap in a constituent, the so-called "slash" mechanism (after the original slash notation "S/NP", for an S category with a gap of category type NP; compare the sketch in Figure 19.7). The slash annotation is percolated up through the tree (subject to grammatical constraints). Higher up in the tree, a special phrase structure pattern has to combine an instance of the lacking category type (the filler) with the slashed category (e.g. S → NP S/NP).

With this technique, the phrase-structure representation is fully surface-based, but the non-local dependency can be traced back down through the chain of slashed categories to the site of the gap, where constraints on the predicate–argument combination can be expressed in parallel with the canonical, local argument realization. Most of the more recent HPSG accounts do not posit actual "gap categories" like NP/NP, but assume a lexical introduction of the slash representation in the local predicator category (here the verb *likes*), so the upward

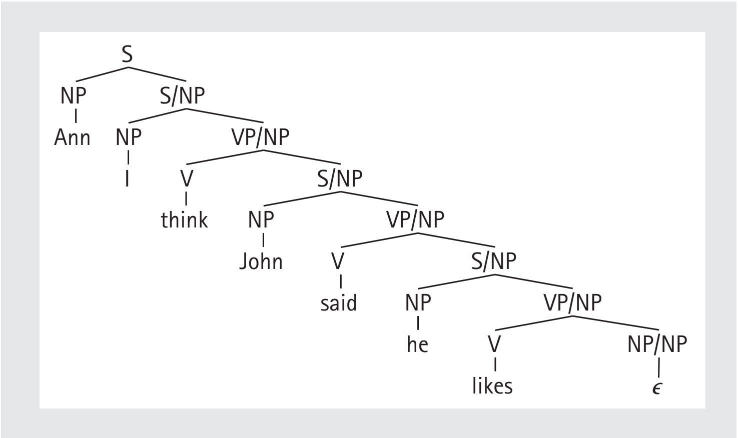


Fig. 19.7 Sketch of the non-local slash mechanism of GPSG (and HPSG)

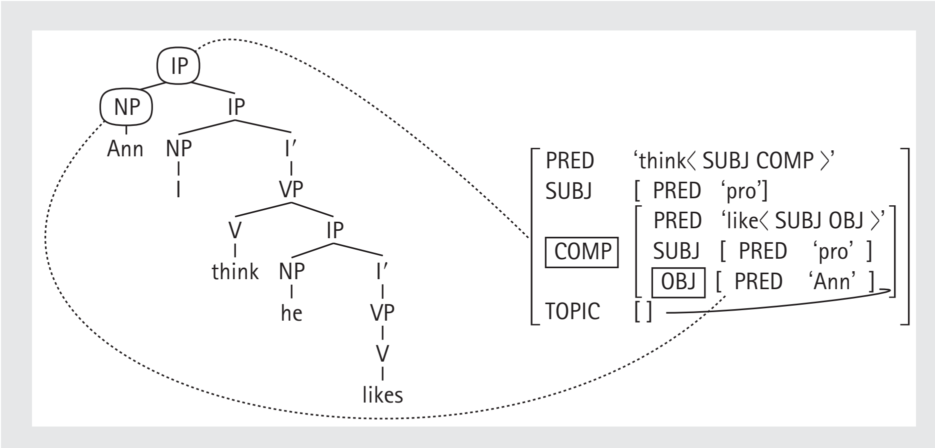


Fig. 19.8 LFG: F-structure path described by constraint (23)

percolation is initiated by (a feature representation corresponding to) a lexical category V/NP.

LFG adopts a different approach, the functional-uncertainty approach, originally proposed by Kaplan and Zaenen (1995). One might call this a description-based approach (as opposed to the representation-based slash mechanism of HPSG). The phrase-structure representation (c-structure) is again entirely surface-based, but even without any annotation of gaps. C-structurally, phrases can be freely introduced (or omitted), independent of local availability of suitable predicate-argument combinations. This freedom is restricted by constraints on the c-structure–f-structure correspondence. We have already seen the constraints dealing with local argument realization (the patterns in (15) etc.). Now, phrases in certain c-structure positions do not correspond to any arguments of the *local* predicate. In Figure 19.8, *Ann* in the IP-adjoined position does not correspond to an argument of *think*, it is merely introduced under the non-argument function TOPIC. But such phrases do correspond to some argument of an *embedded predicate* (at f-structure, *Ann* is the OBJECT of *like*).

The c-structure–f-structure correspondence for phrases like the topicalized NP in Figure 19.8 is described by the functionally uncertain constraint (23).

(23) The f-structure argument to which NP corresponds is embedded in the f-structure to which IP corresponds under a path [COMP* ARG_FUNC].

The constraint says only that the phrase must correspond to *some* argument function of *some* embedded predicate (of course the path of function embedding in f-structure may be subject to certain grammatical constraints).[19] This uncertainty

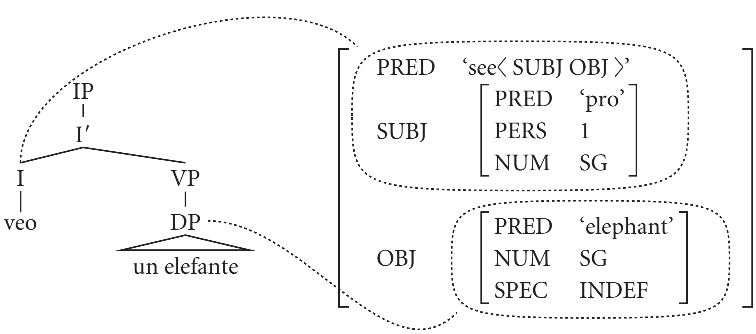
[19] Here the "outside-in" version of functional uncertainty is described; Bresnan (2001: 180ff) uses the "inside-out" version.

leaves open the possibility of an arbitrarily deep embedding: in Figure 19.8, we have the embedding path COMP OBJ, but for (22*b*) we would get COMP COMP OBJ, and generally there can be arbitrarily many COMP embeddings. Technically, functionally uncertain constraints contain regular expressions like COMP∗ to refer to an infinite set of possible f-structure paths. Overgeneration of this mechanism is excluded since there are independent constraints controlling the unique argument selection by predicates (cf. fn. 14), so a topic like *Ann* is compatible only with an embedded predicate lacking the respective argument locally.

19.4.2.4 *Morphological Argument Realization*

In a framework that captures the syntactic predicate–argument relation at a level of description distinct from phrase structure, it does not come as a surprise that some languages can realize arguments in a non-syntactic way, i.e., word-internally, using pronominal affixes (see Bresnan and Mchombo 1987). *Pro-drop* languages like Spanish show that the subcategorization structure/phrase structure correspondence has to be liberal enough to allow for the combination of a predicate and one (or more) of its arguments to be expressed by a single word form, as shown in (24). The upper oval in the f-structure representation indicates what information originates from the inflected verb form *veo*; note that this includes the PRED value of the SUBJ function (which acts like a pronoun semantically, therefore "pro").

(24) *Veo* *un* *elefante.* (Spanish)
see.PRES.1SG a elephant
'I see an elephant.'



Similar to this word-structure level introduction of a predicate's subject argument, Miller (1992) and Miller and Sag (1997) argue for a morphological analysis of object clitics in French. So, *le lui donne* (as in (25*a*)) is treated as a single syntactic word, with the clitics being pronominal affixes lexically filling the object-argument slots. This lexical treatment explains idiosyncrasies observed in the combination, ordering, and morphophonological shape of object clitics in French, which are unaccounted for in a syntactic analysis of argument realization.

(25) a. *Marie le lui donne.* (French)
Marie it.ACC.MASC her/him.DAT give.PRES.3 SG
'Marie gives it to her/him.'

b. *Marie lui a donné le cadeau.*
Marie her/him.DAT has give.PAST_PARTICIPLE the present
'Marie gave her/him the present.'

Miller and Sag (1997) also present a surface-based analysis of clitic climbing—that is the presence of the pronominal affixes on the tense auxiliary as in (25*b*) (or, similarly, on causative verbs), rather than on the full verb where the argument selection is semantically rooted. The phenomenon is analysed as an effect of lexical argument attraction by the auxiliary (cf. Moortgat 1989, Hinrichs and Nakazawa 1994): the auxiliary's subcategorization-structure representation, the ARG-ST list, not only contains the participle but also the entire list of the participle's (unrealized) arguments. Following phrase-structure pattern (15*a*), all arguments are then realized in one local tree; [VP *lui-a donné* [*le cadeau*]] is a single flat VP, headed by the auxiliary which takes the participle and the NP as two complements. For each of the object arguments of *donner* ('give'), there is a choice of realizing it by pronominal affixation on the auxiliary (*lui-a* is again a single syntactic word) or by a full NP following the participle. This correctly predicts the climbing effect observed if the affixation option is chosen.

The constraint-based, lexical introduction of affixal (or "incorporated") pronouns displays an affinity with agreement inflection: as in the lexical introduction of a pronominal argument, agreement marking on a verb is modelled as the specification of certain features of a particular argument—for instance, the subject's person and number (see (5*b*)). But the constraint-based formalisms capture a clear distinction, which speakers have to learn for a given language: agreement information alone does not suffice to fill the predicate's argument slot, whereas pronominal affixation does. (The technical formulation of this distinction varies between LFG and HPSG, but the distinction is invariably captured by the constraints describing the interface between the subcategorization representation and the phrase-/word-structure realization.) With respect to subjects, this distinction determines whether a language is pro-drop (compare (24)). For the pronominal object affixes in French, there exists also a contrasting counterpart in which the affix acts only as an agreement marker: the verbal affix (*lo*) in clitic doubling as in the Spanish example in (26), which doubles the full object phrase *a él* (see Andrews 1990).

(26) *Lo veo a él.* (Spanish)
him see.PRES.1 SG to he
'I see him.'

19.4.3 Subcategorization Structure and (Lexicosemantic) Argument Structure

In section 19.4.2 we saw the role that subcategorization structure with the representation of grammatical function plays as the cross-linguistically invariant basis for argument realization.[20] How does it relate to the lexicosemantic interface representation of argument structure? There is a significant body of literature both in LFG and in HPSG devoted to linking or mapping theory, as systematic accounts of the constraints on these two interfaces are often called.

The main objective of a linking theory is to capture the fact that the mapping of underlying arguments to the grammatical functions at the level of subcategorization structure is to a large extent predictable from conceptual, lexicosemantic knowledge; moreover, alternatives in the mapping (argument alternations, or instances of diathesis) should be predicted, and the account should provide the means to express lexical idiosyncrasies not predicted by the general principles. So, more technically, a mapping account has to resolve two issues:

(27) *a.* What is an adequate interface representation of argument structure, capturing the grammatically relevant semantic properties of arguments and providing a place for the marking of lexical idiosyncrasy?

b. What are the constraints that describe the systematic relation between this argument structure representation and the subcategorization structure?

Most accounts build the solution to issue (27*b*) around the idea of a bi-unique, order-preserving alignment of two ordered sets. A many-to-one mapping or a reversal of the order of two corresponding elements is typically excluded:[21]

(28) Schematic illustration of mapping relations

Argument structure	$\langle a_1\ a_2\ a_3 \rangle$	$^*\langle a_1\ a_2\ a_3\ a_4 \rangle$
Subcategorization structure	$\langle x_1\ x_2\ x_3 \rangle$	$\langle x_1\ x_2\ x_3 \rangle$

The elements of the subcategorization structure are ordered according to an obliqueness hierarchy of subcategorized phrases (in HPSG) or a (partial) hierarchy of grammatical functions (in LFG: SUBJ $>$ OBJ, OBL$_\theta$ $>$ OBJ$_\theta$; Bresnan 2001: 309). In order to be able to exploit the mapping scheme sketched in (28), the argument structure representation (i.e. the solution to issue (27*a*)) should also yield an ordered set of arguments, as will be discussed in the following.

For the representational issue (27*a*), we can distinguish between thematic-role, lexical-entailment, and lexical-decomposition approaches. In the first case, the semantic arguments of a lexeme are classified according to a set of thematic

[20] This chapter cannot address the additional role that subcategorization structure plays in binding theory.

[21] Wechsler (1995) relativizes the exclusion of reversal to thematically *unrestricted* arguments, that is, a reversal is possible with restricted arguments like the recipient in a ditransitive verb in English.

roles, such as agent, beneficiary, experiencer, and theme/patient, so a universal thematic hierarchy can be used to establish a relative prominence order among a given predicator's arguments. This approach underlies the original LFG account of mapping, known as Lexical Mapping Theory (LMT; Bresnan and Kanerva 1989; see Bresnan 2001: ch. 14, Falk 2001: sec. 4.3, Dalrymple 2001: ch. 8). To a first approximation, the alternative constraint-based approaches to issue (27*a*) that have been proposed can be viewed as other ways of motivating an ordering on the arguments; some of the alternatives will be discussed after a more detailed discussion of LMT.

19.4.3.1 *Lexical Mapping Theory*

The LMT representation of argument structure (a-structure) contains two major types of information: (i) the relative ordering of a predicator's arguments, which is derived from an assumed universal thematic hierarchy; and (ii), a syntactically motivated classification feature for each argument (sometimes called the "intrinsic classification"). This feature is determined based on the type of thematic role (and in some cases based on lexical idiosyncrasies): patient-like roles are marked as *unrestricted* ($[-r]$), secondary patient-like roles as *objective* ($[+o]$) other roles as *non-objective* ($[-o]$). For instance, the transitive verb *kick* has the following a-structure representation:

(29) **A-structure representation in Lexical Mapping Theory**

(*Thematic roles*)		*agent*	*patient*	
A-structure	kick ⟨	x	y	⟩
		$[-o]$	$[-r]$	

The LMT mapping principles (addressing the constraint issue (27*b*)) constrain the correspondence between a-structure elements and the grammatical functions in the subcategorization structure (f-structure):

(30) **Constraints on A-structure/F-Structure Mapping**

a. *Subject Mapping Principle*
  (i) The most prominent role marked $[-o]$ is mapped onto SUBJ when initial in the a-structure, otherwise:
  (ii) a role marked $[-r]$ is mapped onto SUBJ.

b. Roles are mapped according to the following full classification of grammatical functions, adding $[+]$ values whenever possible:

	$[-r]$	$[+r]$
$[-o]$	SUBJ	OBL$_\theta$
$[+o]$	OBJ	OBJ$_\theta$

c. *Function-Argument Bi-uniqueness*
Each a-structure role must be associated with a unique function, and conversely.

d. The Subject Condition
Every predicator must have a subject.

For example, when applied to the a-structure representation (29), principle (30*a*(i)) ensures that the agent role is mapped to SUBJ; by adding a $[+o]$ marking according to (30*b*) the patient is mapped to OBJ: (31*a*). In the passive (31*b*), the passive morphology triggers a suppression of the most prominent role. This leaves the $[-r]$ role, which is mapped to SUBJ, following (30*a*(ii)).

$$\begin{array}{llcc} \text{(31)}\ \textit{a.} & \textit{a-str.}\ \text{kick} & \langle\ x & y\ \rangle \\ & & [-o] & [-r] \\ & & \vdots & \vdots \\ & \textit{f-str.} & \text{SUBJ} & \text{OBJ} \end{array} \qquad \begin{array}{lcc} \textit{b.}\ \textit{a-str:}\ \text{kick} & \langle\ x & y\ \rangle \\ & [-o] & [-r] \\ & \emptyset & \vdots \\ \textit{f-str.} & & \text{SUBJ} \end{array}$$

In LMT, differences between unaccusative verbs (such as *freeze*) and unergative verbs (like *bark*) have a representational reflex in a-structure: the intrinsic marking is $[-r]$ and $[-o]$, respectively (see Bresnan 2001: 312ff; Falk 2001: 110).

19.4.3.2 *Alternative Linking Theories*

Providing a general semantic definition for each of the thematic roles turns out to be very difficult. In some approaches, the thematic roles are derived from the configuration of a decompositional representation of lexical semantics, based on primitive semantic functions such as CAUSE, GO, and HAVE (Jackendoff 1990); however, it is hard to find independent motivation for a particular decompositional representation and for a particular set of primitives.

Another line of research in linking theories does not aim at a full role classification in the interface representation between lexical semantics and syntax, but tries to derive just the syntactically relevant ordering over a predicate's arguments (to feed an order-preserving mapping to subcategorization structure). Proto-role approaches following Dowty (1991) use lexical entailments about arguments for this: a number of semantic entailment properties typical for agent-like arguments are identified on the one hand, and a number of typical entailments of patient-like arguments on the other hand. The size of the cluster of entailments that a particular argument actually has is then decisive for a proto-role classification. Zaenen (1994) adapts LMT to this approach, essentially identifying $[-o]$ with proto-agent, and $[-r]$ with proto-patient.

Wechsler (1995) proposes a semantic entailment-based grounding of mapping principles that does not rely on a numerical comparison of cluster properties. In his HPSG account, he attempts to identify specific fine-grained entailment properties that constrain an ordered list of arguments sufficiently to directly predict the correct mapping to subcategorization structure. Beyond this, no classification of arguments according to role labels is done. An example for an entailment-based constraint is the following: if an argument *A* of a predicate necessarily has a notion of another argument *B*, then *B* cannot precede *A* in the ordered argument set. With this entailment, the linking pattern is covered for psychological predicates (*like*, *hate*), perception verbs (*see*, *hear*), and verbs of volitional action (*murder*, *chase*) (in each of these verb classes the argument realized as subject in active necessarily has a notion of the object argument, but not vice versa).

In HPSG, constraints are organized in an inheritance hierarchy, as was illustrated in Figure 19.6 for constraints on phrases. The original application of such a hierarchy was in the systematic structuring of lexical knowledge. Now, a speaker's knowledge about the lexical entailments for individual verbs can be explicitly encoded by organizing the relations denoted by verbs in an inheritance hierarchy. More general types are used for introducing entailment properties shared by all verbs in a certain semantic class; the individual entries for verbal lexemes inherit all properties from supertypes and may add their own specific properties. To the extent that the linking is semantically determined, the linking constraints can follow this verb class hierarchy; idiosyncrasies in mapping can be specified as an exception to this general scheme.[22] A linking theory based on a hierarchy of lexical constraints is discussed by Wechsler (1995: ch. 4) and explored in detail by Davis (2001). Davis proposes an argument structure representation for the semantic class hierarchy that combines proto-roles—actor and undergoer—with a limited degree of decompositional structure, where, for instance, the representation for causative predicates involves an embedded relation (for the effect), which will itself contain a number of proto-roles. This configurational aspect of argument structure representations is grammatically motivated (as permitting generalizations about linking and diathesis), so the representation attempts to clarify the specific requirements at the grammatical–conceptual interface (this is in contrast with accounts that draw freely from some general conceptual representation, such as the decompositional structure of Jackendoff 1990—which is difficult to motivate independently).

19.4.4 Syntax and Compositional Semantics

The interface between syntax and non-lexical semantics has been addressed extensively in the LFG and HPSG literature. A syntax–semantics interface account must in particular address the potential of quantifiers to take scope beyond their surface-syntactical position. The HPSG approach to the syntax–semantics interface follows the basic architectural assumption that a single typed feature structure is used as the representation of all dimensions of an utterance. The semantic representation is a feature-structure representation under the attribute CONTENT, standardly based on the framework of situation semantics. (A model-theoretic interpretation is

[22] In a strictly monotonic inheritance hierarchy such exceptions require a relative decoupling of the semantic class hierarchy and a hierarchy of subcategorization types.

developed in Ginzburg and Sag (2000), covering not only standard propositional semantics, but a rich ontology of propositions, questions, and facts.)

There are two major HPSG approaches to semantic composition within this feature-based framework. In the standard approach—the quantifier storage or "Cooper storage" approach (after Cooper 1975), quantifiers introduce their contribution to a set-valued storage feature STORE (see Figure 19.3; compare Pollard and Sag 1994: ch. 8, Pollard and Yoo 1998, Ginzburg and Sag 2000: sec. 5.3). The value of STORE is projected in a different way from the nucleus of the semantic representation. The latter is essentially shared along the head projection line. In contrast to this, the STORE value of a phrase is the set union of all daughters' STORE values. The members of this set can (and ultimately have to) be retrieved and added to a scope-marking list within the CONTENT representation of the verbal projections, allowing for different scope options.

An alternative HPSG account of semantic construction—Minimal Recursion Semantics (Copestake et al. 1999)—implements the idea of underspecification of scope (cf. e.g. Reyle 1993). The CONTENT representation is a flat set of sub-units of a semantic representation, plus a potentially incomplete set of descriptors of the scope relations among these sub-units. The denotation may be any of the possible combinations of units satisfying the descriptors.

In LFG, there have been a number of approaches to semantic construction; the most influential one is a relatively recent development: the "glue language" account proposed by Mary Dalrymple and co-workers (see Dalrymple 1999, 2001). This approach employs a non-classical logic, *linear logic*, in order to account for the resource-sensitive nature of semantic composition, illustrated in the following.

The characteristics of semantic composition are in contrast with the interplay of sources of morphosyntactic information: through agreement, morphosyntactic information like case may be multiply realized in a linguistic form (e.g. in a complex nominal phrase, involving agreeing adjectives). A unification analysis, with all surface exponents contributing to the same representation, does justice to this character. With the realization of semantic arguments, the situation is different: even when there are a number of alternative structural ways of expressing an argument—in any given utterance only one of the alternatives may actually be instantiated:

(32) *a.* John sold me his car
b. John sold his car to me
c. ∗John sold me his car to me

If we assume that both optional sites of exponence contribute to the same generalized representation (which is desirable from the point of view of capturing generalizations), a classical-logic-based account will not exclude a unification analysis, as in the case-agreement example. So it will wrongly predict (32*c*) to be well-formed.

Our model of the syntax–semantics interface has to have a way of capturing the resource-sensitivity of argument selection. Classical LFG explicitly marks every semantic form (introduced in the lexicon) with a unique implicit index, thus excluding an unwanted unification. HPSG generally models the satisfaction of argument selection explicitly in the representations (spelling out a Categorial Grammar-style argument cancellation technique), but occasionally issues of resource sensitivity have arisen in HPSG (see e.g. Ginzburg and Sag 2000: 208, n. 33, Davis 2001: 262ff).

The glue-language semantics approach in LFG leaves the classical, generalized-modelling technique intact for morphosyntax; it anchors the resource-sensitivity in the semantics. Contentful items introduce linear-logic premises, which specify the item's semantic contribution and the relation to other contributions. The semantics for the entire utterance is obtained by a linear-logic derivation, in which, contrary to classical logic, all premises have to be used up, and each of them can be used only once. As as in Minimal Recursion Semantics, the set of glue language premises is an underspecified representation of possible scoping alternatives, each of which is obtained by a different derivation with these premises. The approach has been applied to a variety of phenomena; for an introduction and overview, see Dalrymple (2001: chs. 9ff) (many important contributions are collected in Dalrymple 1999; Kuhn 2001 presents an analysis of the German Split-NP construction).

19.4.5 Other Modules and Interfaces

Due to space limitations, this chapter could address only the most central levels of representation and the associated constraint modules in a theory of syntax. Much work in constraint-based grammar has been devoted to further interactions between levels of representation, in particular to the role of information structure (see e.g. King 1995, Vallduví and Engdahl 1996, de Kuthy 2002).

19.5 Conclusion: Interfaces and Modules in Constraint-Based Grammar

It is uncommon in work on constraint-based grammar to employ the term "module" for a family of constraints describing the relation between the theory-internal representational levels (which one would otherwise quite naturally call the interfaces between the constraint modules). This is presumably in part due to connotations of a narrower notion of "module" as a (concrete or abstract) derivational device with a defined input and output representation that will interface with other modules/devices in a pipeline architecture. This notion is obviously incompatible with a non-derivational approach to grammar that has the objective of providing a general declarative account of the relation between the various observable "external boundary interfaces" of the language faculty—the phoneme sequence, lexicosemantic argument structure, and (compositional) interpretation—without positing an underlying transformational process that operates on a tree-structure representation throughout all levels of description. Since the relation between the observable boundary levels is too complex to be modelled by a simple, direct transformation process or relation, constraint-based grammars assume a network of interacting families of constraints—where constraints are partial descriptions of the relation between formal representations. In addition to representations modelling the boundaries of knowledge of language, intermediate representations (such as what we called subcategorization structure in section 19.2) are posited in order to capture generalizations, in other words, to allow for a more compact and modular statement of the constraints.

Thus, with a purely informational notion of "module" in mind, it *is* a central goal of constraint-based theorizing to find an adequate modularization of the complex system of constraints needed to capture the empirical language facts. The main difference between possible modularizations lies in the assumed interface representations. In the design of these interface representations, non-derivational theories are in the favourable position that considerations of informational modularity are the *only* design criteria, besides empirical adequacy: outside a strict pipeline architecture, an interface representation can participate in various parallel correspondence relations, which will collaboratively determine the required interface representation. In transformational theories, on the other hand, the representations carry the additional burden of having to record all distinctions that may become relevant at any later stage of derivation; this is due to the fact that each derivational stage can "view" only the present state of the representation. As discussed in section 19.1, this burden may lead to considerably inflated interface representations which can be motivated only rather indirectly. In contrast with this, a constraint-based theory with its more flexible network architecture of modules can adopt strict criteria of direct empirical justification for each of the interface representations.

Since constraint-based grammar is not one homogeneous and authoritative research paradigm, there is no single module architecture underlying all constraint-based work—not even a consensus boundary line for the most central intermediate interfaces like "subcategorization" structure (although in this chapter I have attempted to identify such a consensus at a certain level of simplification in order to have a common ground for the discussion in sections 19.3 and 19.4). Note that this state of the field is natural in view of the flexibility of the network architecture of constraint modules; competing ways of drawing boundaries and stating families of constraints based on these boundaries have to be explored before one can decide at a higher level of abstraction which is the more general theory. At the same time, one has to acknowledge that there are limitations to the empirical distinguishability of such competing accounts: since there is no access to direct evidence for most of the representational details assumed, the question for the most adequate account is often empirically underdetermined. Hence, without additional theory-internal criteria it is impossible to identify a single account as being superior to all others.

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