The Handbook of **Morphology**

Edited by

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The Handbook of Morphology

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Introduction

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Morphology is at the conceptual centre of linguistics. This is not because it is the dominant subdiscipline, but because morphology is the study of word structure, and words are at the interface between phonology, syntax and semantics. Words have phonological properties, they articulate together to form phrases and sentences, their form often reflects their syntactic function, and their parts are often composed of meaningful smaller pieces. In addition, words contract relationships with each other by virtue of their form; that is, they form paradigms and lexical groupings. For this reason, morphology is something all linguists have to know about. The centrality of the word brings with it two important challenges. First, there is the question of what governs morphological form: how is allomorphy to be described? The second is the question of what governs the syntactic and semantic function of morphological units, and how these interact with syntax and semantics proper.

There is a less enviable aspect to this centrality. Morphology has been called 'the Poland of linguistics' – at the mercy of imperialistically minded neighbours. In the heyday of American structuralism, morphology and phonology were the principal objects of study. Monographs entitled 'The Grammar of L', for some language L, would frequently turn out to consist of the phoneme system of L and its morphology. However, the study of morphology in generative linguistics was largely eclipsed by phonology and syntax in the early days (though it is up to historians of linguistics to say exactly why). Ultimately, it came to be that when morphology was considered at all, it was regarded as essentially either a part of phonology or a part of syntax. True, there were a number of important works on morphology, mainly inflectional morphology, such as Kiefer's (1973) work on Swedish, Bierwisch's (1967) study of German and Warburton's (1973) paper on Greek inflection; but it was not until Halle's (1973) short programmatic statement that linguistics at large began to appreciate that there was a vacuum in linguistic theory where morphology should be. This was followed in 1974 by two particularly influential MIT dissertations, later published as Aronoff (1976) and Siegel (1979), proposing radically different approaches to the subject.

Siegel's theory of Level Ordering brought with it a new way of looking at the phonology—morphology interface, which ultimately grew into Kiparsky's (1982a) Lexical Phonology. Siegel argued that those affixes in English which never affect stress (and which do not trigger other lexical phonological alternations) such as *-ness* are attached after stress rules have applied. These are the # boundary affixes of *SPE* (Chomsky and Halle 1968), renamed Class II. The + boundary (Class I) affixes are those which do affect stress, such as *-ity*, and they are attached before the stress rules. This led to an interesting prediction about the linear order of affixes: Class I affixes appear nearer the root than Class II affixes. This generalization is largely true, though it has been regularly pointed out since Aronoff (1976) that it is not entirely true. Fabb (1988) has argued that even if it is true, the Level Ordering Hypothesis is not sufficient to explain affix ordering in its entirety, and that alternative conceptions which do give reasonably broad coverage can also handle the Level Ordering phenomena.

Lexical Phonology is generally associated with Level Ordering (though a number of lexical phonologists have distanced themselves from it; cf. Booij and Rubach 1987). However, the leading

ideas of the model do not actually require Level Ordering. The main thrust of Kiparsky's theory is to emphasize the traditional distinction between morphophonemic alternations and automatic alternations. The morphophonemic alternations are generally mappings from sets of phonemes into sets of phonemes (Structure Preservation), apply in contexts which are not defined in purely phonological terms, often have lexical exceptions, can be 'cancelled' by native speakers (e.g. in loan phonology), and generally apply only within words. The automatic alternations are generally allophonic (non-Structure Preserving), speakers are generally not aware of them, they apply to monomorphemic forms, and they often apply across words. Kiparsky argued that morphophonemic alternations are actually triggered by morphological operations of affixation. As an affix is added (or a cycle of affixation with a level is completed), the battery of lexical phonological rules applies. This gives rise to various types of cyclic effect, and accounts for a good many of the properties of the two types of rule.

This innovation was more significant for the development of phonology than for that of morphology, except that it (a) began to draw the attention of phonologists to morphology, and (b) tended to strengthen the view that morphology was the poor relation to phonology. Lexical Phonology retains the assumptions of *SPE* that every microgram of phonological regularity has to be squeezed out of the system before we have to throw in the towel and admit that it's 'mere allomorphy'. As a result, there have been very few attempts to examine the extent to which the alternations might themselves have a morphological function. To some extent this is addressed in Spencer's chapter, MORPHOPHONOLOGICAL OPERATIONS and also in Carstairs-McCarthy's PHONOLOGICAL CONSTRAINTS ON MORPHOLOGICAL RULES.

While Chomsky's original syntactic theorizing overturned structuralist thinking about that discipline, seminal studies in morphology from MIT served to strengthen structuralist assumptions. McCarthy (1979) showed that root-and- pattern morphology could be handled very nicely as a kind of affixation by adopting the then new theory of Autosegmental Phonology. Lieber (1980) built a theory of the lexicon in which affixes are almost exactly like fully-fledged lexical items, with a phonology, a meaning, a syntactic category and a subcategorization frame. At the same time, Selkirk (1982) and E. Williams (1981b) were arguing that word structure is very much like phrase structure, by applying X-bar syntax to words. This very influential approach is reviewed in Toman's chapter, WORD SYNTAX.

Central to the debate over the relationship between phonology and morphology is a long-standing question in structuralist linguistics, whether morphology is best thought of in terms of Item-and-Process or Item-and-Arrangement. In an IA approach, a word is made out of a string (or tree) of objects; that is, word formation is the concatenation of morphemes, conceived of as mini-lexemes. In an IP approach, forms of a word are the outputs of processes applied to a lexeme. This idea has been revivified in various ways. Categorial grammar has been co-opted to develop a formal way of describing the idea that affixation be viewed as a process (Hoeksema 1985). In a different vein, and working from a different tradition, McCarthy and Prince have studied the way in which non-concatenative effects are obtained by parsing out various phonologically defined subparts of words and stems before applying affixation (or other operations) to them, and this work is summarized in their chapter PROSODIC MORPHOLOGY.

However, the structuralist idea that words are just like phrases, and that the same set of principles applies to both domains, is very attractive, especially to non-morphologists, and it is a theme which runs through much of the research on the morphology—syntax interface over the past two decades. Its most obvious application is in compounding where almost everyone accepts that words have some kind of constituent structure. Somewhat more controversial is the view that derivational morphology is like phrase syntax, a thesis that is being explored in the domain of argument structure by Hale and Keyser (1993). This assumption was challenged by Aronoff (1976), and has more recently been attacked by Anderson (1992), for whom all non-compounding morphology is 'a-morphous'. Anderson's strong position is, perhaps, extreme (see Carstairs-McCarthy 1992 for a telling critique). However, the idea that morphemes are something other than just very short words which happen to be bound is particularly influential amongst morphologists. Many theorists view word formation not as the concatenation of two things to form a headed syntax-like structure, but as an operation on a lexeme. For such theorists, affixation tends to be thought of as just one type of morphophonological operation among several, and not a privileged syntactic process of concatenation. Word formation in Aronoff (1976) is accomplished by Word Formation Rules (WFRs), and this leads to a radically different conception of word structure. For one thing it opens the way to separating the phonological form of

an affix from the morphological function or meaning of which it is an exponent. This is the content of the Separation Hypothesis (Beard 1988). It is widely assumed in works on inflection, but Beard argues it for derivation too, and surveys a number of the arguments in his chapter, DERIVATION.

The domain where separationism has been most popular is inflection. Following Matthews's (1972) detailed critique of the structuralist notion of morpheme in inflection, Anderson (1977b) began a programme of research which took inflections to be the result of word formation rules much like those proposed by Aronoff (1976) for derivation, but with complex interactions. This work is summarized in Stump's chapter, INFLECTION.

In Principles and Parameters syntax the importance of functional categories, which include inflectional categories, was being stressed throughout the 1980s. At the same time, Baker's dissertation (written in 1985 and revised as Baker 1988a) developed an extremely influential view of valency alternations based on the idea of incorporation, coded as syntactic head-to-head movement. This meant that, for example, the causative form of a verb was treated as a syntactic compound of two verbs, one of them a causative. This led to the view that inflectional morphology could be handled in the same way, and that an inflectional piece, say, a third-person singular subject in the past tense, was syntactically a compound consisting of the verb, an Agreement head, Agr°, bearing the features [3sg] and a Tense head, T°, bearing the feature [+Past] (cf. Pollock 1989). Some general problems with this account are discussed in Borer's chapter, MORPHOLOGY AND SYNTAX, and a number of morphologists have pointed out problems with the full-blown version of the approach, mainly from allo- morphy (Carstairs-McCarthy 1992, Joseph and Smirniotopoulos 1993, Spencer 1992). However, more recently, Halle and Marantz (1993) have attempted to combine the separationist tradition in inflection with the functional head-movement approach, arguing that only in this way can we capture certain alleged homologies between morphological structure and syntactic structure. Their model is discussed in Stump's contribution. In addition, Rice shows how the complex and arbitrary-looking structure prefix of Slave (Athabaskan) none the less reflects syntactic structure to an interesting degree.

One of the traditional problems in morphology and lexicology has been defining what is meant by 'word'. There are various criteria based on form (which tend to be equivocal) and others based on behaviour and function (which tend to be even more equivocal). One symptom of this is the existence of elements which bear some of the hallmarks of words and also important features of affixes, namely, clitics. Ever since Zwicky's (1977) preliminary typology, there has been interest in this problem, and for many phonologists and syntacticians, as well as morphologists, it is an urgent practical matter, since both phonology and syntax appeal regularly to the distinction between 'proper' words and other elements. The issues are surveyed in Halpern's chapter, CLITICS.

One of the alleged criterial properties of words is 'integrity': words are 'islands' to syntactic and other processes, which are unable to 'see inside' words; in this way words contrast with phrases. There is a great deal of appeal to distinguishing words from phrases in this way (see Bresnan and Mchombo 1995 for a defence of lexical integrity and a catalogue of advantages), but lexical integrity has been denied by many linguists. The head-movement approach to word structure is a clear case in point, as is the approach of Hale and Keyser (1993) to argument structure. One traditional problem related to lexical integrity is the distinction between compounding (morphology) and phrase formation (syntax). In many (if not most) languages with compounding, the distinction is far from clear (half of the annual *Yearbook of morphology 1989* was given over to this: Booij and van Marie 1990). Compounding is surveyed in Fabb's chapter, COMPOUNDING.

The kinds of phenomena which tend to raise questions of integrity most keenly are serial verb constructions, light verb contructions, and, most notoriously, incorporation. The most studied type of incorporation is noun incorporation, in which a verb stem forms a morphological compound with a noun apparently functioning, say, as its direct object. Other sorts of incorporation are also found, as in Chukchee, where a noun may incorporate its modifiers (adjectives, determiner-like elements and so on; see Muravyova's sketch of the language and also Spencer 1995). Gerdts's contribution, INCORPORATION, discusses these issues, suggesting that there might be types of incorporation effectively midway between genuine phrase formation and *bona fide* compounding.

Cliticization and noun incorporation can both be thought of as instances of a kind of structural mismatch. Thus, in a sentence such as *John's here* the '*s* of *John's* is phonologically simply the last phoneme of the first word, but syntactically it corresponds to the main verb, which doesn't even form

a constituent with the first word, *John*. Likewise, in a language in which object incorporation is possible and we can say *John bear=killed*, meaning *John killed a bear*, we seem to have a single word, *bear=kill*, functioning as a transitive VP [$_{VP}$[$_{V}$*kill*] [$_{NP}$*bear*]]. In both cases we have a mismatch between form and function over what we expect in the 'canonical' case.

Such mismatches occur elsewhere, most famously in so-called bracketing paradoxes.[1] These are instances in which the apparent constituent structure of a word is at odds with some other aspect of its form or function. The mismatch in *John's* would be a case in point. In some cases, the paradoxes are in effect theory-internal. Thus, a frequently discussed case is that of *ungram- maticality*. Semantically, this is a nominalization of the adjective *ungrammatical*, entailing a constituent structure [[*un + grammatical*] *ity*]. However, in the theory of Level Ordering, *-ity* is a Class I suffix and *un-* is a Class II prefix. The order of affixation should therefore give rise to a constituent structure [*un* [*grammatical + ity*]]. Similarly, some theories of English synthetic compounds such as *truck driver* would have them derived by suffixing *-er* to a noun- incorporated form of the verb, [[*truck drive*] *er*], even though morphologically the compound is clearly made up of *truck* and *driver*.

However, there are structures which are anomalous under any reasonable description. English personal nouns provide numerous examples (see Beard 1990, Spencer 1988b, Stump 1991, Zwicky 1988, amongst many references). A transformational grammarian is not (necessarily) a grammarian who is transformational; the bracketing appears to be [[*transformational grammar*] *ian*]. More extreme examples are *moral philosopher* (derived from, or at least motivated by, *moral philosophy*) and, with apparent truncation of a suffix, *monumental mason (monumental masonry), electrical engineer (electrical engineering)* and *theoretical linguist (theoretical linguistics)*. The direction of motivation is clear from the semantics (the personal noun has to inherit all the semantic idiosyncrasies of the abstract noun) and from the fact that only established fixed terms can motivate such personal nouns (witness the absence of **abstract linguist* from the purely compositional, non-lexicalized phrase *abstract linguistics*, cf. Spencer 1988b). Clearly, conundrums such as these have to be handled in anybody's theory, but a number of linguists have paid particular attention to such questions. Sadock (1991), in particular, has developed an integrated theory of the mismatches caused by incorporation and cliticization processes. This and other approaches are summarized in Sproat's contribution, MORPHOLOGY AS COMPONENT OR MODULE.

The interface between morphology and syntax also surfaces in a number of ways. One area of great interest for both syntacticians and morphologists is that of agreement morphology, and it is an area where any specialist needs to have a careful eye on both subdisciplines. Corbett's chapter, MORPHOLOGY AND AGREEMENT, provides a clear, morphologist's view of the matter, informed by his extensive experience as a typologist. An area which stands at the crossroads between morphology, syntax and semantics concerns the way in which grammatical relations such as subject and object are realized and the types of alternations in valency that are found. This has led to an investigation of notions of argument structure. The semantic prerequisites are laid down in Levin and Rappaport Hovav's chapter, MORPHOLOGY AND LEXICAL SEMANTICS, which asks such questions as 'What semantico-syntactic relations can be packaged up inside a single lexeme?' Sadler and Spencer's contribution, MORPHOLOGY AND ARGUMENT STRUCTURE, then explores the idea raised by Levin and Rappaport Hovav that there might be a specific level of representation at which argument structure is encoded.

Levin and Rappaport Hovav's chapter can also be seen as an investigation of the relations between morphology and semantics. This is also explored, though from a different perspective, in Beard's chapter, DERIVATION. Recent research has been uncovering the ways in which semantic principles underly the organization of much of the lexicon, and this has an impact, of course, on the way that derivational morphology works. Finally, we must not forget that morphology can also serve as the exponent of pragmatic functions, and this is summarized in Kiefer's MORPHOLOGY AND PRAGMATICS.

So far in this introduction we have stressed the interface questions which are raised by morphology. These have not been the traditional concern of the discipline, of course, and to a certain extent the autonomy of morphology has been overshadowed by research at the interfaces (as well as being denied by a fair number of syntacticians and a smaller number of morphologists). However, as Aronoff (1994) has recently reminded us, there is a good deal to say about 'morphology by itself. One of Aronoff's most significant claims is that inflectional paradigms can be autonomous with regard to syntax, semantics or phonology, and thus motivate a separate component, module or some kind of

level of representation. This set of questions is summarized in Carstairs- McCarthy's INFLECTIONAL PARADIGMS AND MORPHOLOGICAL CLASSES. Aronoff (1994) also argues that the existence of stems provides evidence for the autonomy of morphology. He points out that in Latin a verb has three stems (which may be idiosyncratic or derived by regular and productive operations), but that it is not possible to say that a given stem has a meaning as such. It functions as part of a morphological system, but as a pure phonological form – a further instance of separationism. The stem as such has no meaning, but contributes non-compositionally to the meaning of the whole word form. An illustration of stem autonomy in Sanskrit (recently discussed by Stump) is given in Spencer's chapter MORPHOPHONOLOGICAL OPERATIONS. Finally, another aspect in which words are different is the fact that words, unlike (most) phrases, have to have some component which is listed. This leads to the tricky question of productivity, an issue at the border between linguistics proper and psycholinguistics. The chapter by Aronoff and Anshen surveys these matters.

Part IV of the Handbook is devoted to what we may call 'hyphenated linguistics'. Joseph, in DIACHRONIC MORPHOLOGY, summarizes recent advances in historical morphology, another Cinderella subject which is undergoing something of a rebirth. The rest of this part is devoted to various aspects of psycholinguistics in which particularly important advances have been made of late. Clark summarizes recent research into first-language acquisition of morphology. While the acquisition of morphology has not received quite the same attention as the acquisition of syntax from linguists in recent years, it has none the less assumed considerable importance. In part, this is because of provocative and extremely challenging claims from researchers working in the field of connectionism, to the effect that the facts of acquisition, especially of inflection, can be handled by associationist networks without the mediation of linguistic rules, or indeed, of conventional linguistic representations. Another interesting recent development has been in the study of selective language impairment (SLI). Pioneering work by Gopnik and her collaborators, as well as other groups, has provided controversial evidence in support of a biologically defined innate predisposition for language in the form of language impairments, principally to the morphological system, which appear to be inherited genetically.

Psycholinguistic research of the mental lexicon, and the way in which morphological structures are perceived and produced, has been pursued intensively since the beginning of modern psycholinguistics. One of the challenges here is to reconcile the kinds of models which seem necessary to interpret the psycholinguistic data with the most plausible linguistic models of word structure, and with the facts of word structure across the world's languages unearthed in morphological research. One important question is: How do we identify words in the speech stream? And in particular, how can we do this in such a way as to be able to incorporate words into a syntactic parsing? An important constraint on models of on-line processing is the fact that words have to be recognized and parsed as they are spoken (i.e. in a left-to-right fashion). McQueen and Cutler's chapter, MORPHOLOGY IN WORD RECOGNITION, presents an overview of recent findings in this field.

One of the most powerful tools for investigating the workings of an on-line mechanism is to examine the patterns of errors that mechanism produces. Word production studies, which often involve the careful analysis of large corpora of speech errors, have generated a number of sophisticated models, including connectionist-inspired ones. These are surveyed in Stemberger's chapter, which includes a convenient summary of the issues raised by con- nectionism for morphology. A further important source of informative errors has been provided by victims of language impairment due to brain injury or disease, giving rise to aphasias or, in the case of reading and writing, dyslexias. Study of these language disturbances has provided ample opportunity to investigate the way in which processes of word recognition and production 'fractionate' into their component subprocesses. This work is surveyed in Badecker and Caramazza's chapter, MORPHOLOGY AND APHASIA.

The Handbook closes with a collection of morphological sketches. These are written by linguists who have both a specialist interest in some aspect of morphology and a detailed knowledge of the language sketched, in some cases being native speakers. We have selected a group of languages which illustrate as many as possible of the phenomena we believe to be of interest to the widest circle of morphologists.

Among the phenomena surveyed which show interesting features in certain of the languages are the following (where a language appears in parentheses, the phenomenon is either restricted or only

identifiable under certain theoretical interpretations of the facts):

non-concatenative morphology	Qafar
vowel harmony	Chichewa, Chukchee, Wari'
consonant mutation	Celtic, (Malagasy), (Slave)
apophony	Archi, Hua, Qafar
stress marking gender	Qafar
tone marking inflection	Chichewa
reduplication	Chichewa, Chukchee, Malagasy, Warumungu
infixation	Archi, Hua, Malagasy, Qafar
compounding	Chukchee, Malagasy, Qafar, Slave, Wari'
genitive complement	Malagasy
incorporation	Chukchee, Malagasy
clitics	Archi, Malagasy, Qafar, Slave, Wari', Warumungu
phonologically conditioned allomorph selection	Wari', Qafar
preverbs	Slave, Wari', Warumungu
conjugation classes	Archi, Qafar
agreement	
by prepositions	Celtic
inverse	(Chukchee), Warumungu
possessive	Archi, Hua, Qafar, Slave, Wari'
switch reference	Hua
with objects	Archi, Chichewa, Chukchee, Hua, Qafar, Slave, Wari', (Warumungu)
gender	Archi, Chichewa, Qafar
singulative	Qafar
diminutive	Chichewa, Chukchee, Slave
augmentative	Chichewa, Chukchee, Slave
case	Archi, Celtic, Hua, Qafar, Warumungu
ergative	Chukchee, Hua, Warumungu
localization	Archi
marked nominative	Qafar
multiple case marking	Archi, Warumungu

valency alternations and grammatical roles	
antipassive	Archi, Chukchee
applicative	Chichewa, (Chukchee)
autobenefactive	Qafar
causative	Archi, Chichewa, Malagasy, Qafar, Slave, Warumungu
comitative	Chukchee, Malagasy
inchoative	Malagasy, Qafar, Warumungu
passive	Malagasy
reciprocal	Chichewa, Malagasy
reflexives	Chichewa, Malagasy, Warumungu
reversive	Chichewa
stative	Chichewa
light verbs	Archi, Hua, Qafar (‘compound conjugation’), (Chukchee)
predicate nominal	Chukchee, Hua, Qafar
proper names	Hua
aspect	Archi, Chukchee, Slave,
mood	
admirative	Archi
associated motion	Warumungu
commentative	Archi
continuality	Archi
evidential	Archi, Hua, Qafar, Slave
focus	Qafar
inconsequential	Hua
inferential	Archi
interrogative	Archi, Hua
negation	Archi, Chichewa, Chukchee, Qafar, Slave, Wari'
requestive	Qafar
topic (potential)	Hua
nominalization	Archi (masdar), Chichewa, Chukchee, Malagasy, Qafar, Slave, Wari', Warumungu
agentive	Chichewa, Chukchee, Malagasy, Warumungu
relativizer	Hua
gerund	Archi, Chukchee

1 To refer to such phenomena as ‘paradoxical’ is a misnomer, of course, though the term has tended to stick.

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1. Inflection

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1 The logic of inflection

The notion of inflection rests on the more basic notion of lexeme. A *lexeme* is a unit of linguistic analysis which belongs to a particular syntactic category, has a particular meaning or grammatical function, and ordinarily enters into syntactic combinations as a single word; in many instances, the identity of the word which realizes a particular lexeme varies systematically according to the syntactic context in which it is to be used. Thus, English has a verbal lexeme meaning 'cantāre' which enters into syntactic combinations as either *sing, sings, sang, sung*, or *singing*, depending on its syntactic context; this lexeme might be given the arbitrary label SING.[1] The words realizing a given lexeme can be conceived of both as units of form (i.e. as *phonological words*, such as /sæŋ/) and as units of grammatical analysis (i.e. as *grammatical words*, such as 'the past tense of SING'); the full set of words realizing a particular lexeme constitutes its *paradigm.*

The structure of paradigms in a given language is determined by the inventory of morphosyntactic properties available in that language. Given a lexeme L of category C, the structure of L's paradigm is determined by the set S of morphosyntactic properties appropriate to C and by the co-occurrence restrictions on these properties: for each maximal consistent subset of S, there is a corresponding *cell* in the paradigm of L. For instance, in a language in which the set S of morphosyntactic properties appropriate to category C is the set {PER:1, PER:2, PER:3, NUM;sg, NUM:pl, TNS:pres, TNS:past} and in which distinct specifications of the same feature are forbidden to co-occur, the maximal consistent subsets of S are those in (1). Accordingly, a lexeme L of category C has (in this language) a paradigm with twelve cells, one for each of the sets in (1); each of these cells is occupied by a particular word realizing L.

(1)

{PER:1, NUM:sg, TNS:pres}	{PER:1, NUM:sg, TNS:past}
{PER:2, NUM:sg, TNS:pres}	{PER:2, NUM:sg, TNS:past}
{PER:3, NUM:sg, TNS:pres}	{PER:3, NUM:sg, TNS:past}
{PER:1, NUM:pl, TNS:pres}	{PER:1, NUM:pl, TNS:past}
{PER:2, NUM:pl, TNS:pres}	{PER:2, NUM:pl, TNS:past}
{PER:3, NUM:pl, TNS:pres}	{PER:3, NUM:pl, TNS:past}

A lexeme's *root* is that unit of form from which its paradigm of phonological words is deduced (e.g.

the phonological words /sŋ/, /sŋz/, /sæŋ/, /sŋ/, and /sŋ/ are all deduced from the root /sŋ/ by principles of English morphology). Some lexemes have more than one root: French ALLER, for example, has the root *all-* in *allons* 'we go', but the root *i-* in *irons* 'we will go'. A root also qualifies as a *stem*, as does any form which is morphologically intermediate between a root and a full word (such as the perfect stem *dūk-s-* in Latin *dūk-s-ī* 'I led').

Once the existence of lexemes is assumed, two different uses of morphology can be distinguished. On the one hand, morphological devices can be used to deduce the words constituting a lexeme's paradigm from that lexeme's root(s); for instance, a very general rule of English morphology entails that the verbal lexeme SING (root /sŋ/) has a third-person singular present indicative form /sŋz/ in its paradigm. On the other hand, morphological devices can be used to deduce new lexemes from existing lexemes; thus, another rule of English morphology deduces an agentive nominal lexeme SINGER (root /siŋr/) from the verbal lexeme SING. Morphology put to the former, paradigm-deducing use is *inflection;* morphology put to the latter, lexeme-deducing use has traditionally carried the (potentially misleading) label of *word formation*, which encompasses both derivation and compounding (see Beard, DERIVATION; Fabb, COMPOUNDING).

2 Empirical criteria for distinguishing inflection from other things

However clear the logic of this distinction might be, it can be difficult, in practice, to distinguish inflection from word formation, particularly from derivation; by the same token, inflection – a morphological phenomenon – is not always easily distinguished from cliticization – a syntactic phenomenon. Various empirical criteria have been invoked in drawing these distinctions.

2.1 Inflection vs derivation

At least five criteria are commonly used to distinguish inflection from derivation. These criteria are, to a considerable extent, logically independent of one another; a priori, one wouldn't necessarily expect each of the five criteria to divide morphological phenomena into the same two groups. The boundaries which these criteria actually entail coincide to a remarkable degree, but not perfectly, as we shall see.

Consider first the criterion of *change in lexical meaning or part of speech*:

> (2) Two expressions related by principles of derivation may differ in their lexical meaning, their part-of-speech membership, or both; but two expressions belonging to the same inflectional paradigm will share both their lexical meaning and their part of speech – that is, any differences in their grammatical behavior will stem purely from the morphosyntactic properties that distinguish the cells of a paradigm.

By this criterion, the rule of agentive nominalization which produces *singer* from *sing* must be derivational, while the rule of pluralization which produces *singers* from *singer* need not be.

The diagnostic utility of criterion (2) obviously depends on the precision with which one can articulate the principles for determining an expression's part of speech (for which see e.g. Schachter 1985) and the principles for distinguishing lexicosemantic properties from morphosyntactic ones (see section 3). But even if such principles are clearly delineated, the usefulness of criterion (2) is inherently limited, for two reasons. First, a change in lexical meaning is not always accompanied by a change in part of speech – that is, some derivation is category-preserving, e.g. the derivation of REREAD from READ; thus, category change is not a necessary property of derivation, but is at most a sufficient property. Second, synonymous pairs such as *cyclic /cyclical* suggest that derivational morphology need not change lexical meaning; that is, change of lexical meaning is at most a sufficient property distinguishing derivational morphology from inflection.

To complicate matters even further, criterion (2) is not fully consistent with the other criteria, since there are morphological phenomena which are otherwise arguably inflectional but which involve a change in part of speech; for instance, a verbal lexeme's past participle is traditionally seen as an integral part of its paradigm, yet past participles are, in many languages, unmistakably adjectival in character.

Now consider the criterion of *syntactic determination*:

> (3) A lexeme's syntactic context may require that it be realized by a particular word in its paradigm, but never requires that the lexeme itself belong to a particular class of derivatives.

Thus, if the lexeme SING is to head the complement of the auxiliary verb HAVE, it must assume its past participial form: *They have *sing/*sings/*sang/sung /*singing several sea shanties.* By contrast, there is no syntactic context which requires agentive nominalizations such as SINGER and therefore excludes simplex (synchronically underived) lexemes such as FAN: *a singer/fan of sea shanties.* This criterion is the intended content of the slogan "inflectional morphology is what is relevant to the syntax" (Anderson 1982: 587), but of course not all inflectional morphology is directly relevant to syntax; for instance, inflectional expressions of conjugation- or declension-class membership (e.g. the distinct theme vowels of Latin *laud-ā-mus* 'we praise' and *mon-ā-mus* 'we remind') need not be – that is, they may be *morphemic* (Aronoff 1994). Nevertheless, the logic of inflection entails that distinct members of a lexeme's paradigm carry distinct sets of morphosyntactic properties; in the context of a fully articulated theory of syntax in which such properties are by definition syntactically relevant, it follows that inflectional morphology must itself be syntactically relevant in the indirect sense that it spells out a paradigm's syntactically contrasting word-forms. Here again, the diagnostic utility of the criterion depends on the precision of one's principles for distinguishing lexicosemantic properties from morphosyntactic ones (cf. section 3).

A third criterion is that of *productivity:*

- (4) Inflection is generally more productive than derivation.

In English, for instance, an arbitrarily chosen count noun virtually always allows an inflected plural form; by contrast, an arbitrarily chosen adjective may or may not give rise to a related causative verb (e.g. *harden, deafen*, but **colden, *braven*). Thus, inflectional paradigms tend to be complete, while derivational relations are often quite sporadic.

Criterion (4) is sometimes inconsistent with the others. On the one hand, there are highly productive morphological phenomena which (by the other criteria) are derivational; in English, for example, virtually every nonmodal verb has a gerund (a nominal derivative identical in form to the present participle). On the other hand, one occasionally encounters groups of forms which (by the other criteria) constitute inflectional paradigms, but which are *defective* in that some of their cells are left empty; for instance, the paradigm of the French verb *frire* 'to fry' lacks a number of expected forms, including those of the subjunctive, the imperfect, the simple past, the plural of the present indicative, and the present participle.

Not all defective paradigms need be seen as instances of unproductive inflection, however. Defective paradigms are often systematically complemented by sets of *periphrastic* forms; in classical Sanskrit, for example, many vowel-initial roots consisting of a metrically heavy syllable lack an inflected perfect, but a periphrastic perfect formation (comprising the accusative singular form of the verb's nominal derivative in -ā and a perfect form of the auxiliary verb KR 'make' or AS 'be') makes up for this (Whitney 1889: §1071). If the cells of an inflectional paradigm admit periphrastic formations as well as individual inflected words (as Börjars et al. 1997 argue), then defectiveness is not as widespread a phenomenon as it might first appear to be. Nevertheless, once periphrastic formations are admitted into inflectional paradigms, criteria must be established for distinguishing systematically complementary periphrasis from mere coincidence of meaning; for instance, should *more alert (cf. *alerter)* be assumed to figure in the paradigm of ALERT, given the coexistence of *more muddy* and *muddier?*

A fourth criterion is that of *semantic regularity:*

- (5) Inflection is semantically more regular than derivation.

Thus, the third-person singular present-tense suffix *-s* in *sings* has precisely the same semantic

effect from one verb to the next, while the precise semantic effect of the verb-forming suffix *-ize* is somewhat variable (*winterize* 'prepare (something) for winter', *hospitalize* 'put (someone) into a hospital', *vaporize* '(cause to) become vapor'). This difference might be attributed to a difference in lexical listing:

- (6) Assumption: The lexicon lists derivative lexemes, but not inflected words.

On this assumption, the fact that derived lexemes are listed in the lexicon frees their meanings to "drift" idiosyncratically, while the fact that regularly inflected forms are not listed requires their meanings to remain rule-regulated. The semantic "drift" typical of derivation need not be understood in dia-chronic terms: it is not clear, for example, that the meaning of *winterize* has, through time, been drifting away from an original, less idiosyncratic meaning. Rather, it seems that, in this case and many others, the meaning of a derived form is not fully determined by the grammar, but depends on the intentions and inferences of language users at the moment of its first use (the moment at which the form and meaning are first "stored"); that is, the semantic idiosyncrasy of many derived lexemes follows not from the fact that their meanings are lexically listed, but from the fact that their meanings are inevitably shaped by pragmatic inferences at the very outset of their existence (and are therefore in immediate need of lexical listing). The opposite is true in instances of inflection: given the meaning of a lexeme L, the meaning associated with each cell in L's paradigm is in general fully determinate. This is not to say, of course, that it is the *form* of an inflected word that determines its meaning. On the contrary, an inflected word's form frequently underdetermines its morpho-syntactic properties (i.e. its membership in a particular cell), hence its meaning; indeed, there are often blatant mismatches between an inflected word's morphology and its semantics (as e.g. in the case of Latin deponent verbs). An inflected word's meaning is instead generally a function of the lexeme which it realizes and the cell which it occupies in that lexeme's paradigm (Stump 1991).

Criterion (5) is occasionally inconsistent with the other criteria. On the one hand, there are (rare) instances of semantic idiosyncrasy involving forms which (by the other criteria) are inflectional (cf. the discussion of (8d) below); on the other hand, classes of derived lexemes are sometimes quite regular in meaning (e.g. English verbal derivatives in *re-*). Facts such as these suggest that, contrary to assumption (6), listedness is neither a necessary nor a sufficient correlate of the inflection/derivation distinction (a conclusion that is in any event necessitated by the existence of highly productive classes of derived forms and irregular or defective paradigms of inflected forms).

A final, widely assumed criterion for distinguishing inflection from derivation is that of *closure:*

- (7) Inflection closes words to further derivation, while derivation does not.

In English, for example, a privative adjective cannot be derived from a noun's inflected plural form (**socksless*), but can be derived from a noun's uninflected root, whether or not this is itself derived (*sockless, driverless*). A corollary of this criterion is that in words containing both inflectional and derivational affixes, the inflectional affixes will always be further from the root than the derivational affixes (except in cases of infixation). This criterion has been used to motivate a principle of grammatical organization known as the Split Morphology Hypothesis (Perlmutter 1988; cf. Anderson 1982; Thomas-Flinders (ed.) 1981), according to which all derivation takes place in the lexicon, prior to lexical insertion, while all regular inflection is postsyntactic.

Evidence from a variety of languages, however, suggests that neither criterion (7) nor the Split Morphology Hypothesis can be maintained. To begin with, it is actually quite common for category-preserving derivational morphology to appear "outside of" inflectional morphology: for instance, Russian *stučát'-sja* 'to knock purposefully' (a derivative of *stučát'* 'to knock') inflects internally (*stučím-sja* 'we knock purposefully', *stučát-sja* 'they knock purposefully', etc.); the plural of the Breton diminutive noun *bagig* 'little boat' is *bagoùigoù*, in which one plural suffix *-où* appears before the diminutive suffix *-ig* while the other appears after it; and so on. Moreover, it is even possible for category-changing derivation to appear "outside of" inflection: in Breton, for example, plural nouns can be converted to verbs from which a variety of derivatives are then possible (e.g. *pesk-ed* 'fish-PL' gives rise to *pesketa* 'to fish', whence the agentive nominalization *pesketer* 'fisherman'); they can give rise to privative adjectives (*ler-où* 'sock-PL', *dileroù* 'without socks'); and so on. For discussion of the

evidence against the Split Morphology Hypothesis, see Bochner 1984; Rice 1985; Booij 1993; and Stump 1990a, 1993a, 1995b.

2.2 Is the distinction between inflection and derivation illusory?

In its simplest form (unadorned by such supplementary assumptions as (6) or the Split Morphology Hypothesis), the logic of inflection does not entail that the five criteria discussed in section 2.1 should partition morphological phenomena along the same boundary; the extent to which the criteria do coincide therefore suggests that a number of independent morpholexical principles are sensitive to (if not categorically constrained by) the distinction between inflection and derivation. This conclusion has, however, been questioned: it has sometimes been asserted (Lieber 1980: 70; Di Sciullo and Williams 1987: 69ff; Bochner 1992: 12ff) that the distinction between inflection and derivation has no real empirical motivation, and therefore has no place in morphological theory. According to Bochner (1992: 14),

> The basic argument in any theory for treating inflection and derivation in a unified fashion is that they involve the same sorts of formal operations. Operations such as prefixation, suffixation, reduplication and infixation all have both inflectional and derivational uses in the world's languages.

But nothing in the logic of inflection excludes the possibility that inflection might involve the same sorts of formal operations as derivation; indeed, nothing excludes the possibility that the very same operation might serve a derivational function in some instances and an inflectional function in others. Breton furnishes an example of just this sort (Stump 1990b: 219ff): in Breton, the suffixation of *-enn* yields feminine nouns. In many cases, this operation serves a transparently derivational function: *bas* 'shallow (adj.)', *basenn* 'shoal'; *koant* 'pretty', *koantenn* 'pretty girl'; *lagad* 'eye', *lagadenn* 'eyelet', *c'hoant* 'want (n.)', *c'hoantenn* 'birthmark' (cf. French envie). But when *-enn* is suffixed to a collective noun, it yields the corresponding singulative: *buzug* 'worms', *buzugenn* 'worm'; *sivi* 'strawberries', *sivienn* 'strawberry'. Such singulative/collective pairs are syntactically indistinguishable from ordinary singular/plural pairs. Thus, *-enn* suffixation allows the root of one lexeme to be deduced from that of another, but it likewise fills the singular cell in a collective noun's inflectional paradigm; and this fact is in no way incompatible with the logic of inflection. As Aronoff (1994: 126) observes, "derivation and inflection are not kinds of morphology but rather uses of morphology: inflection is the morphological realization of syntax, while derivation is the morphological realization of lexeme formation." (See Beard 1995, where the implications of this fact are explored in detail.)

The theoretical appropriateness of the inflection/derivation distinction will be definitively established only through the comparison of carefully constructed formal analyses of ambitious scope for a typologically diverse range of grammatical systems. Only by this means can the fundamental question be addressed: Does a theory that incorporates this distinction furnish simpler (more learnable) grammars than one that doesn't? A theory must naturally provide some means of accommodating such exceptional morphological phenomena as category-changing inflection and defective paradigms, but it is the unexceptional phenomena – which are vastly more numerous – whose properties will likely weigh most heavily in the resolution of this issue.

2.3 Inflections vs clitics

Because of their syntactic relevance, inflectional affixes are sometimes difficult to distinguish from *clitics*, elements which exhibit an affix-like phonological dependency on a neighboring word but whose syntax is word-like. Zwicky and Pullum (1983a: 503f) propose the following six criteria for distinguishing affixes from clitics:

(8)
(a) "Clitics exhibit a low degree of selection with respect to their hosts while affixes exhibit a high degree of selection with respect to their stems."
(b) "Arbitrary gaps in the set of combinations are more characteristic of affixed words than of clitic groups."
(c) "Morphophonological idiosyncrasies are more characteristic of affixed words than of clitic

groups."
(d) "Semantic idiosyncrasies are more characteristic of affixed words than of clitic groups."
(e) "Syntactic rules can affect words, but cannot affect clitic groups."
(f) "Clitics can attach to material already containing clitics, but affixes cannot."

Consider, for example, the Breton preposition *da* 'to'. On the one hand, *da* may inflect for agreement with a pronominal object, as in (9); on the other hand, it may host the first-person singular clitic *-m* and the second-person singular clitic *-z*, as in (10).

(9)

din	'to me'
dit	'to thee'
dezañ	'to him'
dezi	'to her'
deom	'to us'
deoc'h	'to you'
dezo	'to them'

(10)

dam zad	'to my father'
dam gweloud	'to see me'
daz tad	'to thy father'
daz kweloud	'to see thee'

This difference in status between the person/number markers in (9) and (10) is revealed quite clearly by the criteria in (8). Although *-m* and *-z* impose a rather severe prosodic requirement on their host (it must be a codaless monosyllable), they are otherwise quite indifferent to its category (criterion (8a)): it may be a preposition (as in (10)), a preverbal particle (e.g. *ne-m selaouez ket* 'you (sg.) aren't listening to me'), a subordinating conjunction (*pa-m magit* 'because you feed me'), or a coordinating conjunction (*ma c'hoar ha-m breur* 'my sister and my brother'). By contrast, object-agreement paradigms comparable to (9) are found with only a subclass of prepositions in Breton (e.g. *araog* 'before' inflects, but *kent* 'before' does not); exactly which prepositions inflect is apparently a matter of arbitrary lexical stipulation.

The expected combinations of *-m* or *-z* with a (prosodically appropriate) host are uniformly possible (criterion (8b)), but some inflecting prepositions (including *da*) have defective paradigms lacking the so-called indefinite form; contrast *dirag* 'in front of, whose indefinite form is *dirazer* 'in front of one'.

The result of concatenating *-m* or *-z* with its host exhibits no morpho-phonological peculiarities (criterion (8c)); by contrast, inflecting prepositions are often quite idiosyncratic in form (e.g. the first singular and third singular feminine forms of *ouz* 'against' are *ouzin* and *outi*, while those of a 'of' are *ac'hanon and anezi*).

Whereas inflected prepositions can be "stranded" by principles of anaphoric ellipsis (criterion (8e)), clitic groups with *-m* or *-z* cannot: *Da biou eo al levr-se? Din.* To whom is this book? To me.' *Da beseurt mestr eo al levr-se? *Dam.* 'To which teacher is this book? To mine.'

The person/number inflections in (9) cannot attach to prepositions that are already marked with *-m*

or *-z* to express meanings such as that of *aux miens* 'to my ones'; nevertheless, criterion (8f) is not particularly revealing here, since Breton happens not to have any clitics which attach before or after the clitics *-m* and *-z* (but cf. English *I'd've*), Criterion (8d) is likewise relatively unhelpful, for although the clitics *-m* and *-z* are regularly interpreted (as possessive pronouns in prenominal contexts and as object pronouns in preverbal contexts), the inflected prepositions are also regular in their interpretation. Nevertheless, inflected forms occasionally have unexpected meanings. For instance, Breton nouns with suffixal plurals sometimes also allow "double plural" forms with two plural suffixes; but the exact nuance expressed by a double plural varies idiosyncratically from noun to noun: while the simple plural *preñv-ed* 'worm-s' and its double plural counterpart *preñv-ed-où* differ in that the former refers to an undifferentiated mass of worms and the latter to a number of individually distinguishable worms, the simple plural *merc'h-ed 'girl-s'* differs from its double plural *merc'h-ed-où* in that the latter conveys a sense of affectionate scorn (Trépos 1957: 264).

Notwithstanding the ease with which the criteria in (8) allow the inflections in (9) to be distinguished from the clitics in (10), there are many cases which are much less clear. A well-known example is that of bound pronouns in French: criteria (8a, e) imply that they are affixes (cf. Auger and Janda 1994), while criteria (8b—d) are compatible with the (traditional) assumption that they are clitics (see Halpern, CLITICS).

3 The functions of inflection

As was seen above (section 2.1), the distinction between inflection and derivation presupposes a well-delineated distinction between morphosyntactic properties (such as 'plural' and 'nonfinite' in English) and lexicosemantic properties (such as 'agentive' and 'stative' in English). Fundamentally, the latter distinction is one of function: morphosyntactic properties are phrase-level properties to which syntactic relations such as agreement and government (in the traditional sense) are sensitive; a word's lexicosemantic properties, by contrast, simply determine the manner in which it enters into the semantic composition of larger constituents. 'Plural' is a morphosyntactic property in English because (e.g.) the subject and the predicate of a finite clause in English agree with respect to this property; 'nonfinite' is a morphosyntactic property because verbs such as *condescend* require that their clausal complement assume a non-finite form. By contrast, English expressions are never required to agree with respect to agentivity, nor to assume a 'stative form' in a particular syntactic context. Thus, the distinction between inflection and derivation is first and foremost one of function: while derivation serves to encode lexicosemantic relations within the lexicon, the function of inflection is to encode phrase-level properties and relations. Typically, a phrase's morphosyntactic properties are inflectionally encoded on its head (but see section 5.2).

3.1 Agreement properties

Agreement is asymmetrical in the sense that one member of an agreement relation can be seen as depending on the other member for some or all of its morphosyntactic properties. This asymmetry is particularly clear in cases involving a property which is invariably associated with one member of the relation; in French, for instance, adjectives and nouns covary in number (*petit animal*, pi. *petits animaux*) but not in gender – rather, the adjective must be seen as conforming to the invariant gender of the noun it modifies. Even where there is covariation, there is evidence of asymmetry. Thus, even though French adjectives and nouns covary in number, the adjective is clearly the dependent member of the relation of number agreement: whereas adjectives exhibit number inflection purely as an effect of their participation in this sort of relation, nouns exhibit number inflection wherever they appear, whether or not there is an agreeing expression. A word's *agreement properties* are those morphosyntactic properties which it possesses by virtue of being the dependent member of an agreement relation.

Languages vary widely with respect to the range of syntactic relations they encode by means of agreement morphology. Some familiar relations include the agreement of a modifier or specifier with the head of the encompassing phrase (as the article and the adjective agree in number and gender with the nominal head in *la petite souris*, or as certain Maori adverbs agree in voice with the verb they modify (K. Hale 1973a: 417)); the agreement of a predicate with one or more of its arguments (as an English verb agrees in person and number with its subject, or as many Welsh prepositions agree with their object in person, number, and (in the third person) gender – *yno i* 'in me', *ynot ti* 'in thee',

ynddo fe 'in him', *ynddi hi* 'in her', etc.); the agreement of an anaphoric expression with its antecedent (as *kile* 'that one' agrees in noun class with its antecedent *kisu* 'knife' in the Swahili example in (11)); and the agreement of a complementizer with the subject of its complement (as West Flemish *dat* agrees in person and number with the subject of the finite clause which it introduces (Haegeman 1992: 47ff)).

(11) Wataka ki-su ki-pi? Nataka ki-le.
you.want NOUN.CL-knife NOUN.CL-which I.want NOUN.CL-*that.one*
'Which knife do you want? I want that one'.

Among languages that exhibit verb—argument agreement, a range of patterns is found. In an *accusative* agreement system, subjects are encoded differently from direct objects. In Swahili verbs, for instance, third-person singular personal subject agreement is encoded by a prefix a- (which precedes the tense prefix, as in *a-li-soma* 's/he read', *a-li-ni-ona* 's/he saw me'), while third-person singular personal object agreement is expressed by a prefix *m(w)-* (which follows the tense prefix, as in *ni-li-mw-ona* 'I saw her/him'). In an *ergative* agreement system, by contrast, subjects of transitive verbs are encoded differently from direct objects and subjects of intransitive verbs, which are themselves encoded alike. In vernacular Hindustani, for example, perfective/preterite verb forms are marked identically for agreement with direct objects and intransitive subjects, and are not overtly marked for agreement with transitive subjects:

(12)

(a) 'aurat chal-ī.	(b) mard chal-ā
woman went-FEM.SG	*man went-MASC.SG*
'The woman went.'	'The man went.'

(13)

(a) 'aurat-nē ghōrī	(b) 'aurat-nē ghōrī
woman-ERG mare	*woman-ERG horse*
mār-ī.	mār-ā.
struck-FEM.SG	*struck-FEM.SG*
'The woman struck the mare.'	'The woman struck the horse.'

These two sorts of system may appear side by side; in Hindustani, for example, verbs outside of the perfective/preterite exhibit an accusative pattern of agreement. In some languages, moreover, it is an intransitive verb's lexicosemantic properties that determine whether its subject is encoded in the same way as a direct object or a transitive subject. Thus, in an *active* agreement system, the subject of an active intransitive verb is encoded in the same way as the subject of a transitive verb, while the subject of a stative intransitive verb is encoded in the same way as the object of a transitive verb; the Choctaw verb forms in (14) and (15) (from Davies 1986) illustrate this.

(14)

(a) Hilha-li-tok.	(b) Sa-hohchafo-h.

dance-1SG-PAST	1*SG-hungry-PREDICATIVE*
'I danced.'	'I am hungry.'

(15)

(a) Chi-bashli-li-tok.	(b) Ano is-sa-hottopali-tok.
2SG-cut-1 SG-PAST	I 2SG-1SG- hurt-PAST
'I cut you.'	'You hurt me.'

Agreement relations vary widely with respect to the set of morphosyntactic properties that agreeing constituents are required to share. This is true of distinct agreement relations in the same language; in French, for instance, adjective-noun agreement is sensitive to number and gender, while subject-verb agreement is sensitive to number and person. It is likewise true of comparable agreement relations in distinct languages: in Swahili, for example, the relation of verb-object agreement is sensitive to properties of person, number, and gender (which receive simultaneous expression in the Swahili system of noun-class inflections); in Maithili, verbs agree with their objects in person and honorific grade but not number; in Lardil, nonimperative verbs and their objects agree in tense (K. Hale 1973a: 421ff); in Hungarian, verbs agree with their objects in definiteness; and so on. The diversity of agreement relations in natural language presents an imposing challenge for syntactic theory: besides providing a means of representing such relations, an adequate theory must furnish a principled delimitation of the range of possible agreement relations (see Corbett, MORPHOLOGY AND AGREEMENT).

3.2 Governed properties

Although an asymmetrical dependency exists between the members of an agreement relation, agreement is nevertheless symmetrical in the sense that the members of an agreement relation share the properties to which the relation is sensitive. It is this latter sort of symmetry that distinguishes agreement from government: in a relation of government, the governing member imposes specific restrictions on the morphosyntactic properties of the governed member, but does so without (necessarily) sharing any of its properties. A word's *governed properties* are those morphosyntactic properties which are constrained by a governing expression in this way.

A wide range of government relations can be found; typically, the governing member is the head of a phrase, and the governed member is its complement or specifier. A verb or preposition may govern the case of its nominal object (as German *helfen* 'to help' and *mit* 'with' govern the dative case, while *sehen* 'to see' and *ohne* 'without' govern the accusative); a verb or complementizer may govern the mood or finiteness of its clausal complement (as French *craindre* requires a subjunctive complement, or as English *that* requires a finite complement); a numeral may govern the case and number of the enumerated noun (as nominative and accusative forms of Russian *tri* 'three' require the enumerated noun to appear in the genitive singular); an auxiliary may determine the inflection of its associated verb (as the English progressive auxiliary be requires that its associated verb appear as a present participle); and so on.

Languages with case systems vary in their patterns of case government. In an *accusative* system of case marking, the subject of a finite verb has the same (nominative) case whether the verb is transitive or intransitive, and the object of a transitive verb has a distinct (accusative) case; in an *ergative* system, by contrast, the subject of an intransitive verb and the object of a transitive verb exhibit the same (absolutive) case, while the subject of a transitive verb exhibits a distinct (ergative) case.[2] Systems of the two sorts may serve complementary functions in a single language; in the Australian language Pitjantjatjara, for instance, nouns exhibit ergative case marking, while pronouns show the accusative pattern, as the examples in (16) (from Bowe 1990: 10f) show.

(16)

(a) Tjitji a-nu.	(b) Ngayu-lu a-nu.
child(ABS) go-PAST	*1SG-NOM go-PAST*
'The child went.'	'I went.'
(c) Tjitji-ngku ngayu-nya	(d) Ngayu-lu tjitji
child-ERG 1SG-ACC	*1SG-NOM child(ABS)*
nya-ngu.	nya-ngu.
see-PAST	*see-PAST*
'The child saw me.'	'I saw the child.'

Languages with case systems also show considerable variation in the number of cases they distinguish: English has only three, while Sanskrit has eight, Finnish fifteen, and so on.

A government relation and an agreement relation may be sensitive to the same morphosyntactic property. In German, for instance, the government relation between preposition and object and the agreement relation between determiner and noun are both sensitive to properties of case; thus, in the expression *gemäß den Vorschriften* 'according to the rules', the dative case is a governed property of the object noun phrase (hence also of its head *Vorschriften*) as well as an agreement property of the determiner *den.*

3.3 Inherent properties

Morphosyntactic properties which are neither agreement properties nor governed properties are said to be *inherent* (cf. Anderson 1985a: 172). From a morpholexical perspective, inherent properties are of two types. On the one hand, an inherent property may be associated with some but not all words in a lexeme's paradigm. In German, for example, plural number is associated with some words in a nominal lexeme's paradigm but not others; plural number might therefore be characterized as a *word property* in nominal paradigms. On the other hand, a property may be invariably associated with the words in a lexeme's paradigm; thus, feminine gender might be characterized as a *lexeme property* in the paradigms of feminine nouns in German.

The properties to which an agreement relation is sensitive are, in general, either governed properties or inherent properties of its controlling member. Inherent properties do not always figure in agreement relations, however. In Amharic, for example, definiteness is an inherent property of noun phrases.

The inflection is situated on the head of the first constituent of the noun phrase (Halpern 1992: 204ff):

(17)

(a) məSihaf-u	(b) tinnˇ-u məSihaf
book-DEF	*small-DEFbook*
'the book'	'the small book'

In Amharic, definiteness is irrelevant to the expression of agreement (a verb e, g, agrees with its subject in person, number, and sometimes gender, but not in definiteness) and is not imposed by a

governing head. Nevertheless, the exponence of case is sensitive to definiteness: as the examples in (18) show, definite objects carry the suffix *-(ı)n* while indefinite objects do not.

(18)

(a) and məSihaf yasayyu-ñ.	(b) məSihaf-u-n yasayyu-ñ.
one book show-me	*book-DEF-OBJ show-me*
'Show me one book.'	'Show me the book.'

The boundary between inherent properties and governed properties is in some instances rather cloudy, since the same property can sometimes seemingly be either inherent or governed according to its syntactic context. In French, for instance, the indicative mood is to all appearances an inherent property of verbs in main clauses; yet, it is a governed property of verbs in conditional clauses introduced by *si* 'if. Properties of mood (section 4.2) are particularly prone to exhibit this sort of variability.

4 Inflectional categories

A language's *inflectional categories* are the categories of morphosyntactic properties which are expressed in its inflectional system. Languages vary considerably in their inflectional categories. An exhaustive enumeration of the inflectional categories found in human language is beyond the scope of the present discussion; nevertheless, some widely recurring categories can be noted.[3]

4.1 Some inflectional categories of nouns

Many languages exhibit gender and number as inherent inflectional categories of nouns. *Gender* is a category of morphosyntactic properties which distinguish classes of nominal lexemes: for each such class of lexemes, there is a distinct set of inflectional markings for agreeing words. In many languages, a noun's gender is overtly expressed only through the inflection of agreeing words; in French, for example, the feminine head noun of *la petite souris* 'the little mouse' does not carry any overt inflection for feminine gender, but the agreeing article and adjective both do. Often, however, a noun's membership in a particular declension class implies that it belongs to a particular gender; in Sanskrit, for example, nouns in the ā declension (e.g. SENĀ 'army') are virtually always feminine. Moreover, in languages with noun-class systems, nouns ordinarily carry an overt inflectional marking simultaneously expressing gender and number; thus, in the Kikuyu noun phrase *mũ-ndũ mũ-kũrũ* 'old person' (pi. *a-ndũ a-kũrũ*), both the noun and its agreeing modifier carry an overt gender/number marker. Languages vary widely in the number of genders they encode: French, for example, has two genders (masculine and feminine), while Kikuyu has ten (A. R. Barlow 1960: 14A). Correlations may exist between the meanings of nouns and the genders to which they belong (thus, in French, nouns which refer exclusively to females are generally feminine); such correlations need not involve the sex of a noun's referent (in Plains Cree e.g. the genders instead correlate with an animate/inanimate distinction). Correlations of this sort are, however, virtually never perfect; that is, membership in a particular gender is most often a matter of arbitrary stipulation. In French, for instance, bête 'beast' is feminine, while *animal* 'animal' is masculine; Plains Cree *nitās* is animate with the meaning 'my pants', but inanimate with the meaning 'my gaiter' (Wolfart 1973: 22); and so on.

Number is a category of morphosyntactic properties used to distinguish the quantity to which a noun phrase refers. Many languages distinguish only two number properties (singular and plural); others additionally distinguish a dual and (rarely) a trial. In Sanskrit, for example, nouns have three distinct nominative forms, a singular, a dual, and a plural: *aśvas* 'horse', *aśvau* '(two) horses', *aśvās* '(more than two) horses'.

Another inherent inflectional category of nouns in many languages is that of *(in)definiteness* – a category of morphosyntactic properties distinguishing noun phrases according to whether their reference in a given context is presumed to be uniquely identifiable. In the Syrian Arabic noun phrase

l-madīne l-ᵊkbīre 'the large city', for example, the definite prefix l- on the head and its agreeing modifier implies that the city in question is uniquely identifiable – an implication absent from the indefinite noun phrase *madīne kbīre* 'a large city'.

Case is a category of morphosyntactic properties which distinguish the various relations that a noun phrase may bear to a governing head. Some such relations are fundamentally syntactic in nature – for example, the subject, direct object, indirect object, and genitive relations; cases used to encode relations of this sort (the so-called *direct* cases) include the nominative, the accusative, the ergative, the absolutive, the dative, and the genitive. Other cases – the *oblique* cases – encode relations which are instead fundamentally semantic; these include the instrumental case (e.g. Sanskrit *tena aśvena* 'by/with that horse'), the ablative (*tasmāt aśvāt* 'from that horse'), and the locative (*tasmin aśve* 'at that horse'), among many others.

A noun may also inflect as the dependent member of an agreement relation with a possessor noun phrase. In Uyghur, for example, a noun agrees in person (and number, in the nonthird persons) with a possessor noun phrase – *Nuriyi-niŋ yoldiš-i* 'Nuriya's husband' [Nuriyä-GEN husband-3RD. PERSON. POSSESSOR]; unsurprisingly, possessor agreement allows pronominal possessors to be omitted (*u-niŋ) yoldis-i ~ yoldiš-i* 'her husband').

It is sometimes claimed (e.g. by Anderson 1982: 586; 1985a: 177) that evaluative properties such as 'diminutive' and 'augmentative' constitute an inflectional category of nouns in some languages. Consider, for instance, the situation in Kikuyu. Every Kikuyu noun belongs to a particular gender. A noun's gender and number are cumulatively realized as a noun-class inflection, so a gender can be thought of as a pairing of a singular noun class with a plural noun class; for instance, *-raatũ* 'shoe' belongs to gender 7/8, exhibiting the class 7 prefix *kĩ-* in the singular and the class 8 prefix *i-* in the plural. Rather than inflect for its proper gender, a noun may exhibit the class 12 prefix *ka-* in the singular and the class 13 prefix *tũ-* in the plural; when it does, it takes on a diminutive meaning (*ka-raatũ* 'little shoe', pi. *tũ-raatũ*) and requires agreeing constituents to exhibit the appropriate class 12/class 13 concords. Should "diminutivity" be regarded as an inherent inflectional category on a par with number and gender in a system of this sort? It is not clear that it should. Morphosyntactically, the pairing of classes 12 and 13 behaves like an ordinary gender, not like a morphosyntactic property of some separate category; moreover, there are members of gender 12/13 that are not diminutives of nouns from other genders (e.g. *ka.-raa.gita* 'tractor', pi. *tũ-raagita*). One might just as well assume that the pairing 12/13 is simply a gender, and that the category of diminutives arises by means of a highly productive derivational rule whose effect is to shift nouns to this gender.

4.2 Some inflectional categories of verbs

Inherent inflectional categories of verbs include tense, aspect, polarity, voice, and (in some uses) mood.[4] *Tense* is a category of morphosyntactic properties distinguishing a finite verb's temporal reference. In Latin, for instance, verbs inflect for three tenses: past, present, and future (*laudābam* 'I praised', *laudā* 'I praise', *laudābō* 'I will praise'). Despite the conceptual naturalness of this three-way distinction, it is far from universal: inflectionally speaking, English has two tenses, past and nonpast (J. Lyons 1968: 306); Kikuyu has six (far past, yesterday past, today past, present, near future, far future – Bennett et al. 1985: 138f); and so on.

Aspect is a category of morphosyntactic properties distinguishing the various senses in which an event e can be situated at a particular time interval i. In Kikuyu, six such properties are distinguished in the present affirmative (Bennett et al. 1985: 139ff): the continuous aspect (e.g. *tũraagũra nyama* 'we are buying meat') indicates that e is in progress throughout i; the habitual aspect (*tũgũraga nyama* 'we buy meat') indicates that events of kind e are customary at i; the projected aspect (*tũkũgũra nyama* 'we are going to buy meat') indicates an intention at i for e to take place; the completive aspect (*twagũra nyama*, roughly 'we have bought meat') indicates that e has just come to completion at i; the initiative aspect (*tigũriite nyama*, also roughly 'we have bought meat') indicates that the state resulting from the completion of e holds true at i; and the experiential (*twanagũra nyama* 'we have (at some point) bought meat') identifies e as having happened at some indefinite (and potentially remote) time interval prior to i. Often, there is a kind of conceptual overlap between the categories of aspect and tense; for instance, an event which is described in aspectual terms as having come to completion by a particular time can likewise be described in temporal terms as a past event relative to that time. In view of such cases, the boundary between aspect and tense is sometimes

elusive.

Polarity is a category of morphosyntactic properties distinguishing affirmative sentences from negative sentences. In Kikuyu, for instance, a verb's affirmative form is unmarked for polarity, while a verb's negative form is marked by a prefix *ti-* (in subordinate clauses, *ta-*): *tũ-kaagwata* 'we will take hold', *tũ-ti-kaagwata* 'we will not take hold' (in subordinate clauses, *tũ-ta-kaagwata*). The expression of mood and polarity sometimes intersect; thus, Sanskrit verbs exhibit a special prohibitive (negative imperative) inflection (Whitney 1889: §T579).

Voice is a category of morphosyntactic properties distinguishing the various thematic relations that may exist between a verb and its subject. In Sanskrit, for instance, a verb appears in the active voice if its subject is the agent but not the beneficiary of the action it describes (*odanam āpnoti* 's/he obtains porridge (for someone else)'), in the middle voice if its subject is both agent and beneficiary (*odanam apnute* 's/he obtains porridge (for herself/himself)'), and in the passive voice if the subject is the theme rather the agent (*odana āpyate* 'porridge is obtained').

Mood is a category of morphosyntactic properties which, as inherent properties (section 3.3), distinguish the ways in which a proposition may relate to actuality (in the speaker's mind). In classical Sanskrit, for example, there are three principal moods: the indicative mood (e.g. *bhavāmi* 'I am') is used to assert a proposition as fact; the optative mood (*bhaveyam* 'would that I were') is used to express propositions whose reality is wished for; the imperative mood (*bhauāni* 'I will be!') is used to command that a proposition be realized. The boundaries between distinct moods can be quite fluid; for instance, the expression of a wish can have the illocutionary force of a command. Moreover, the boundary separating mood from tense and aspect is itself sometimes hazy; future tense, for example, is inherently nonactual. As noted earlier (section 3.3), properties of mood behave, in some uses, as governed rather than inherent properties; thus, certain English verbs (e.g. *require*) mandate that a finite complement be in the subjunctive mood.

Another category for which a verb may inflect under the influence of a governing head is that comprising the morphosyntactic properties 'finite' and 'nonfinite', which distinguish verbs according to whether they are inflected for tense; in French, for example, the verb *devoir* 'to have to' requires its clausal complement to be nonfinite, while *vouloir* 'to want to' allows either a finite or a nonfinite complement.[5] Similarly, verbs in many languages exhibit a special set of forms for use in subordinate clauses: in Plains Cree, for example, the set of verbal affixes used to mark agreement (in person, number, gender, and obviation) in main clauses is distinct from that used in dependent clauses (Wolfart, 1973, p. 41); in Swahili, relative verb forms (i.e. those bearing an affix encoding the relativized argument) exhibit a smaller range of tense inflections than ordinary indicative verb forms, and inflect differently for negation; and so on.

A syntactic relation in some ways akin to government is encoded by verbal inflections in systems of *switch reference*. Choctaw furnishes an example of this sort of system: in coordinate clauses, the verb in the first clause inflects to indicate whether its subject is identical in reference to that of the second clause (Davies 1986: 9); in (19a), for instance, the first verb carries the same-subject suffix *-cha* (glossed 'ss')/ while in (19b), the first verb carries the different-subject suffix *-na* (glossed 'DS').

(19) (a) Tobi apa-li-cha oka ishko-li-tok.
bean eat-1SG-ss water drink-1SG-PAST
'I ate beans and drank water.'
(b) Wa:k nipi ish-awashli-na oka ishko-li-tok.
cow flesh 2SG-fry-DS water drink-1SG-PAST
'You fried the beef, so I drank water.'

As the dependent member of an agreement relation, a verb may inflect for a number of categories; instances of verb agreement in person, number, gender, honorificity, and definiteness have been alluded to above. In many languages, verbs inflected for *person* exhibit special subsidiary distinctions (which likewise tend to be expressed in pronominal inflection). In Plains Cree, for example, verb forms marked for agreement with a nonthird-person plural argument show a three-way distinction (Wolfart 1973: 16): *exclusive* first-person agreement encodes an argument referring to a group which includes the speaker(s) but excludes the addressee(s); exclusive second-person agreement encodes an

argument referring to a group which excludes the speaker(s) but includes the addressee(s); and *inclusive* agreement encodes an argument referring to a group which includes both the speaker(s) and the addressee(s). Moreover, Plains Cree verb forms marked for agreement with a third-person argument show a distinction in obviation: *proximate* agreement encodes an argument whose referent is "the topic of discourse, the person nearest the speaker's point of view, or the person earlier spoken of and already known" (Bloomfield 1962: 38, cited by Wolfart 1973: 17), while *obviative* agreement encodes an argument whose referent lacks these characteristics. The inter-penetration of agreement categories in a language's system of verb inflection can be quite complex; for instance, a verb may exhibit more honorific grades in the second person than in the third (as in Maithili); a verb may inflect for gender in the second-person plural but not the second-person singular (as in Kabyle Berber); and so on.

4.3 Some inflectional categories of adjectives

Degree is an inherent inflectional category of adjectives; the morphosyntactic properties which it comprises serve to distinguish the extent to which a referent evinces some quality. The English adjective TALL, for instance, has three degrees. The positive degree *tall* specifies the quality of tallness without reference to the extent to which it is exhibited; the comparative degree *taller* specifies the extent of one referent's tallness relative to that of some other referent; and the superlative *tallest* specifies extreme tallness relative to some class of referents.

An adjective may exhibit distinct attributive and predicative forms, depending upon its syntactic relation to the controlling noun; in Russian, the feminine nominative singular of NOVYJ 'new' is *nóvaja* in attributive uses (*nóvaja kníga* 'new book') but *nová* in predicative uses (*kníga nová* 'the book is new').

As the dependent member of an agreement relation, an adjective may inflect for the properties possessed (either inherently or as an effect of government) by the controlling noun. In the Russian noun phrase *nóvaja kníga* 'new book', for instance, the dependent adjective is feminine, nominative, and singular, matching the controlling noun in gender, case, and number; contrast *nóvyj dom* 'new house' (where the gender is instead masculine), *nóvuju knígu* (where the case is instead accusative), and *nóvye knígi* (where the number is instead plural). Similarly, adjectives may agree in (in)definiteness (e.g. Syrian Arabic */-madm/īnel-madīne /-ᵊkbīre*, lit. 'the-town the-large', cited above), and so on.

5 The realization of inflection

Languages show extraordinary variation in the morphological realization of their inflectional categories; two dimensions of variation are particularly salient.

5.1 Inflectional exponence

An *exponent*[6] of a morphosyntactic property in a given word is a morphological marking expressing that property in that word; thus, the property 'plural' has -s as its exponent in *girls* and a vowel modification (of [u] to [i]) as its exponent in *women*. Very frequently, a single marking serves simultaneously as an exponent of two or more morphosyntactic properties; in Latin, for instance, the suffix *-ibus* in Latin *rēgibus* 'to kings' is simultaneously an exponent of dative case and plural number. In this particular example, the simultaneous exponence of case and number is a reflection of a more general fact: namely, that in Latin declensional morphology, the exponents of case and number always coincide; that is, the categories of case and number exhibit *cumulative exponence* in Latin declension. Not all simultaneous exponence is cumulative, however. For instance, voice and subject agreement are simultaneously realized in second-person plural verb forms (by *-tis in laudātis* 'you praise', by *-minī* in *laudāminī* 'you are praised') but not in third-person plural forms (e.g. *laudant* 'they praise', *laudantur* 'they are praised', where *-nt* expresses subject agreement while *-ur* expresses passive voice); thus, voice and subject agreement are merely said to exhibit *overlapping exponence* in Latin verb inflection. A morphosyntactic property may also exhibit *extended exponence*: that is, it may exhibit more than one exponent in a single word; thus, in Latin *lauāvī* 'I have praised', both -v and -ī are exponents of the perfect. (Because -ī additionally expresses first-person singular subject agreement and present tense, *laudāvī* is also another example of overlapping exponence.)

Inflectional systems employ a variety of different kinds of exponents. These include concatenative operations of suffixation (*girl*, pl. *girl-s*), prefixation (Kikuyu *mũ-rũthi* 'lion', pl. *mĩ-rũthi*), and infixation (Oaxaca Chontal *kwepo?* 'lizard', pl. *kwe-t-po?*), quasi-concatenative operations of partial or total reduplication (Papago *bana* 'coyote', *kuna* 'husband', pl. *baabana, kuukuna*; Indonesian *babi* 'pig'/ pl. *babibabi*), and an array of nonconcatenative operations, from vowel modifications (*woman*, pl. *women*) and consonant gradation (Fula *yiite* 'fire', pi. *giite*) to modifications of accent (Russian *oknó* 'window (nom. sg.)', nom. pi. *ókna*) and tone (Somali *èy* 'dog' (with falling tone), pi. *èy* (with high tone)). One can even find instances in which subtraction serves an inflectional function; in Huichol, for example, a verb's completive form arises from its stem through the loss of its final syllable (*pïtiuneika* 'he danced', completive *pïtiunei*). Naturally, these different sorts of exponence are often intricately interwoven within a single paradigm.

In many languages, stem choice may serve as an exponent of some morphosyntactic property. In Latin, for example, there is a special stem (Aronoff (1994: 59) calls it the *b stem*) which is formed by suffixing *-b* to the present stem (with concomitant lengthening of its final vowel). The *b* stem is used to form the imperfect of verbs in all conjugations, as well as the future of verbs in the first and second conjugations. In view of this fact, the *-b* suffix in *laudāb-* (the *b* stem of the first-conjugation verb *laudare* 'praise') cannot, in and of itself, be seen as an exponent of any morphosyntactic property; its (purely morphomic) status is simply that of a *b* stem-forming suffix. Nevertheless, the choice of *laudāb-* from among the range of available stems must count as one of the exponents of the imperfect in *laudabam* 'I praised' and as one of the exponents of the future in *laudāb-* 'I will praise'.

In the simplest cases, stems are inflected without regard to their internal morphological structure. Nevertheless, category-preserving derivation gives rise to stems which are *headed*, and some such stems inflect through the inflection of their head. In Russian, for example, the verb *stučát'-sja* 'to knock purposefully' is headed by the verb *stucdt'* 'to knock' and inflects on its head (*stučím-sja, stučát-sja*, etc., noted above); Sanskrit *ni-pat-* 'fly down' inflects on its head *pat-* 'fly' (*ni-patati* 's/he flies down', *ny-apatat* 's/he flew down', etc.); English *undergo* inflects on its head go (whose suppletive past-tense form is therefore faithfully preserved in *underwent*); and so on. The phenomenon of head marking has numerous implications for morphological theory (see Hoeksema 1985, Stump 1995b, for discussion).

Quite separate from the (morphological) fact that some headed stems inflect on their head is the (syntactic) fact that a phrase's morphosyntactic properties are ordinarily realized through the inflection of its head. In English, for example, the plural number of the noun phrase *her favorite books* is manifested only in the inflection of the head noun. In some cases, however, a phrase's morphosyntactic properties are realized by inflectional markings situated on a constituent other than the head of the phrase. In many such cases, the inflected constituent is at the periphery of the phrase. In English, for example, a possessive noun phrase has the inflectional suffix -s on its final constituent, whether or not this is the head of the phrase: *someone else's (hat), the King of England's (hat)*; the possessive suffix has therefore been characterized as an *edge inflection* (Zwicky 1987; cf. also Lapointe 1990, Miller 1992, Halpern 1992). But inflections which aren't realized on a phrase's head aren't necessarily realized at its periphery. In Bulgarian, for example, noun phrases are inflected for definiteness on the head of their first constituent: the inflected word need not be the head of the noun phrase itself; nor does it have to be at any phrasal periphery (Halpern 1992: 193ff).

5.2 Inflectional "templates"

Many languages exhibit what has come to be known as *template morphology*- systems in which inflectional affixes are apparently organized into a number of *position classes* such that the members of any given class are mutually exclusive but occupy the same sequential position, or *slot*, relative to members of other classes within a given word form. For instance, Swahili verb inflections are (pretheoretically) organized according to the following template:

(20) The Swahili verb "template" (cf. Schadeberg 1984: 14ff)
1 negative affix *ha-* (nonrelative, indicative forms; optionally in the conditional)
2 subject agreement prefixes; infinitive affix *ku-*; habitual affix *hu-*
3 negative affix *si-* (relative, subjunctive, and imperative forms; optionally in the conditional)
4 tense and mood prefixes; negative infinitive affix *to-*

5 relative agreement prefixes (tensed or negative forms)
6 metrically motivated empty affix *ku-* (Ashton 1947: 142f, Schadeberg 1984: 14)
7 object agreement prefixes
Stem (= verb root + theme vowel *-a*, *-i*, or *-e*)
affix *-ni* encoding a plural addressee; relative agreement suffixes (tenseless affirmative forms)

Systems of this sort raise an important question: how, if at all, does "template" morphology differ from ordinary inflection?

Simpson and Withgott (1986) propose the following criteria for distinguishing "template" morphology from what they call "layered" morphology:[7]

(i) The absence of any affix in a particular slot may, in a "templatic" system, contrast paradigmatically with the presence of any given affix in that slot; in Swahili, for example, the absence of any slot 2 prefix is what distinguishes the imperative form *si-pige* 'don't you (sg.) beat!' from the subjunctive form *u-si-pige* 'that you (sg.) may not beat'.

(ii) "Template" morphology yields a form whose morphosyntactic properties cannot all be attributed to a single one of its parts. For example, Swahili *tu-li-wa-ona* 'we saw you (pl.)' has the morphosyntactic properties 'first-person plural subject', 'past tense', and 'second-person plural object'; the first of these is associated with the prefix *tu-*, the second with li-, the third with *wa-*.

(iii) "Template" morphology presents cases in which the exponence of one property is sensitive to the presence of another property whose principal exponent is nonadjacent (in violation of the Adjacency Constraint – M. Allen 1978, Siegel 1978); thus, in Swahili verbs, the choice between the slot 3 negative prefix *si-* and the slot 1 negative prefix *ha-* is conditioned by the presence of the property 'subjunctive mood', whose principal exponent (the theme vowel *-e*) is not structurally adjacent to either slot.

(iv) "Template" morphology presents cases in which a property's exponence is sensitive to the presence of another property whose principal exponent is more peripheral (in violation of the so-called No Lookahead Constraint): in finite verb forms in Swahili, the principal exponents of negation are peripheral to those of tense, yet the exponence of past tense as *li-* or *ku-* is sensitive to negation (*tu-li- taka* 'we wanted', but *ha-tu-ku-taka* 'we didn't want').

(v) Finally, systems of "template" morphology typically allow a verb to agree with more than one of its arguments (as in the Swahili example in (ii)).

Simpson and Withgott (1986) assert that "layered" morphology possesses none of these characteristics. The clearest cases of "layered" morphology, however, are instances of category-changing derivation. The question therefore arises as to whether a distinction can be drawn between "templatic" inflection and "layered" inflection. Stump (1997) argues that such a distinction is unmotivated – that all inflection is in fact "templatic." Inflectional systems generally behave like "template" morphology with respect to criteria (i) and (ii), and although inflection does not behave uniformly with respect to criteria (iii)–(v), these are at most sufficient and not necessary properties of "template' morphology. Stump nevertheless rejects the notion (implicit in the unfortunate template metaphor) that "template" morphology is regulated by positive morphological output conditions (whose postulation is otherwise unmotivated), arguing instead that "templates" take the form of paradigm function schemata (section 6.3), whose existence is independently motivated by the phenomena of head marking (Stump, 1995b).

6 Theoretical approaches to inflection

Although there is considerable consensus on which phenomena are inflectional and which are not, there is considerable disagreement about the theoretical status of inflection. Here, I will briefly discuss four contrasting points of view.

6.1 The lexicalist approach to inflection

In one widely pursued approach to inflection (see e.g. Di Sciullo and Williams 1987, Lieber 1992,

Selkirk 1982) an affix is assumed to have much the same status as a word: it has a lexical listing which specifies its phonological form, its semantic content (if any), its subcategorization restriction, and its morpho- syntactic properties. On this view, the suffix -s in *sing-s* has a lexical entry something like (21):

(21)

(a)	Phonology:	/z/
(b)	Semantics:	∅
(c)	Subcategorization:	[$_v$V____]
(d)	Morphosyntactic properties:	PER:3
		NUM:sg
		TNS:pres
		MOOD:indic

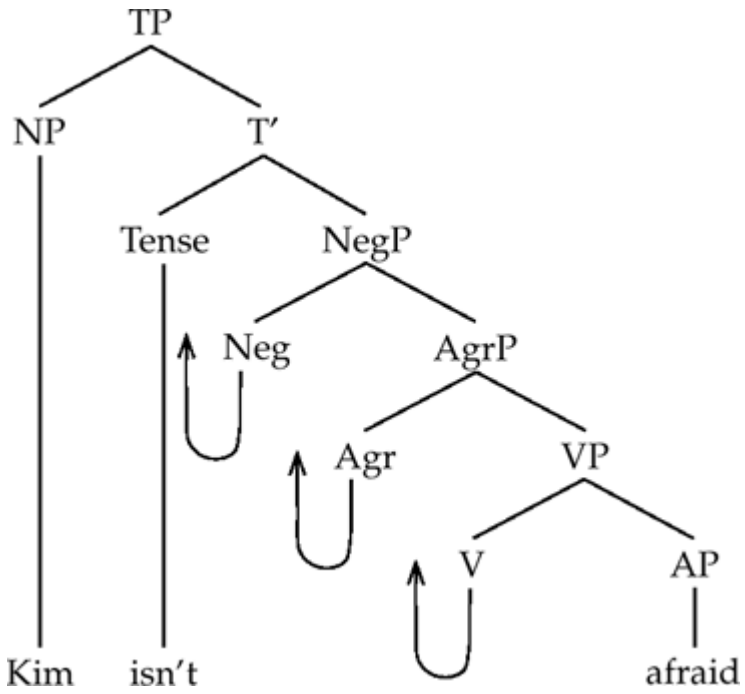
The subcategorization restriction (21c) allows -s to combine with the verbal stem *sing* to yield the third-person singular present indicative form *sing-s*; a mechanism of feature percolation guarantees that *sing-s* is (like *sing*) a verb and carries (like -s) the morphosyntactic properties in (21d).

Whatever intuitive appeal it may have, this lexicalist approach is subject to a wide range of criticisms. Because it accords affixes the special status of lexical items, it entails a fundamental grammatical difference between affixal exponence and nonconcatenative varieties of inflectional exponence; for instance, it entails that the manner in which *played* comes from *play* is, in theoretical terms, quite separate from the manner in which sang comes from *sing*. This distinction, however, is poorly motivated; there is no clear empirical obstacle to assuming that the process of affixation by which *play → played* is on a theoretical par with the process of substitution by which *sing → sang*.[8] The assumption that an. inflected word's morphosyntactic properties are assembled from those of its component morphemes by a percolation mechanism is highly dubious, since a word's morphosyntactic properties are often underdetermined by its form; as Stump (1993e: 488f) shows, this fact can only be reconciled with the lexicalist approach through the postulation of zero affixes, a device whose theoretical legitimacy has rightly been questioned (Matthews 1972: 56ff). Moreover, the phenomena of overlapping and extended exponence pose an enormous technical obstacle to the formulation of a structure-based percolation mechanism (Stump 1993d). The assumption that an affix's distribution is regulated by a subcategorization restriction is similarly problematic: as Stump (1992, 1993c) shows, subcategorization frames are inherently incapable of capturing certain kinds of generalizations about the distribution of inflectional affixes.

6.2 The functional head approach to inflection

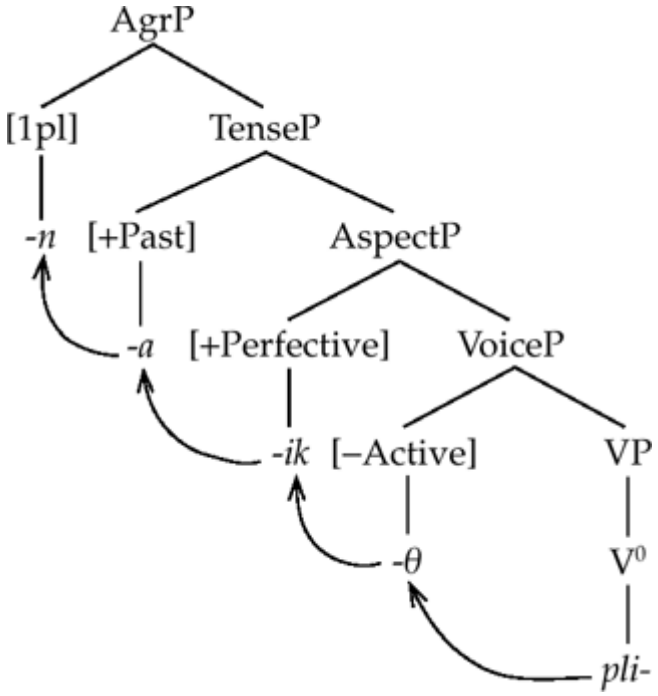
A second, more recent approach to inflectional morphology has its origins in the proposals of Pollock (1989). Assuming a version of the 'Principles and Parameters' approach to syntax, Pollock argues that INFL, the syntactic locus of tense, subject agreement, and negation in English and French, should be broken down into three distinct functional categories, each of which heads its own maximal projection. Pollock demonstrates that this idea affords a unified account of several subtle syntactic differences between French and English (relating, specifically, to the syntax of adverb placement, negation, verb fronting, quantifier floating, and quantification at a distance). At the core of Pollock's discussion is the assumption that verbs generally acquire their inflectional properties by moving from one head position to the next, as in the derivation of the sentence *Kim isn't afraid* in (22).

(22)



Developing this assumption, a number of researchers (e.g. Rivero 1990, Speas 1990, Mitchell 1991) have proposed that the order of inflectional formatives in a verb's morphology arises through a gradual accretion of affixes during a verb's movement from one functional head to the next; on this view, the order of inflectional markings follows the sequence in which functional categories are nested in syntactic structure. Thus, Rivero (1990: 137) proposes that the Modern Greek verb form *pli-θ-ik-a-n* 'they were washed/they washed themselves' arises by head movement, as in (23).

(23)



This approach to verb structure suggests that inflection is not a morphological phenomenon at all,

but rather a syntactic one; indeed, it calls into question the very claim that morphology exists as an autonomous grammatical component in natural language.

Compelling reasons for rejecting this approach to inflectional morphology are abundant. Joseph and Smirniotopoulos (1993) demonstrate that the segmentation of morphemes presumed by Rivero's analysis of Modern Greek verb inflection is fundamentally incompatible with the surface morphology of the language – that here and elsewhere, the frequent incidence of overlapping and extended exponence relations simply excludes the possibility of reducing inflectional morphology to head movement. Janda and Kathman (1992) observe, in addition, that the head-movement approach requires the ordered nesting of functional categories to be stipulated on a language-specific basis (note e.g. the contrasting affix orderings in Latin *amā-ba-m* 'love-iMPF-1sc' and Welsh Romany *kamá-v-as* 'love-1sc-IMPF'), and that it affords no credible account of nonconcatenative morphology, nor of affix orderings which are sensitive to nonsyntactic properties (such as the fact that in Qafar, a stem's initial sound determines whether subject agreement is realized suffixally, as in *bah-t-é* 'bring-she-PERFECT', or prefixally, as in *t-okm-é* 'she-eat-PERFECT').

Moreover, Bresnan and Mchombo (1995) discuss five tests of lexical integrity and demonstrate that in the Bantu languages words exhibiting noun-class inflections generally pass these tests; as they show, a head-movement approach to Bantu noun-class inflections affords no explanation for this fact. None of these considerations militate against the postulation of abstract functional heads whose existence is syntactically motivated;[9] it does, however, cast serious doubt on the assumption that functional heads are concrete pieces of morphology whose combination with a given stem is effected by head movement. That is, they favor the lexicalist view of Chomsky (1995b: 195), according to which words are already fully inflected at the time of their insertion into syntactic structures (cf. Borer, MORPHOLOGY AND SYNTAX).[10]

Both the lexicalist approach and the functional head approach to inflection are based on the assumption that in the inflection of a stem X, a morphosyntactic property P is associated with X only through the addition of an exponent of P to X. This is not a necessary assumption, however; in particular, one might instead assume that in the inflection of a stem X, an exponent of P is added to X only if X is, by prior assumption, associated with P. This latter hypothesis has been pursued by proponents of two (otherwise very different) approaches to inflection: the Word-and-Paradigm approach and Distributed Morphology.

6.3 The Word-and-Paradigm approach to inflection

Under the Word-and-Paradigm approach to inflection (Robins 1959; Matthews 1972; Anderson 1977b, 1992; Zwicky 1985), a word's inflectional markings are determined by a set of inflectional rules. The markings introduced by these rules may be affixal or nonconcatenative; a rule's applicability to a stem X is conditioned by the set of morphosyntactic properties associated with X, by X's phonological form, by X's membership in a particular morphological class, or by some combination of such factors. For example, the suffix -s in *sing-s* is introduced by a rule such as (24); where /X/ is any verb stem carrying specifications for third person, singular number, present tense, and indicative mood, (24) applies to /X/ to yield /X-z/.

(24)

$$\begin{bmatrix} \text{V} \\ \text{PER:3} \\ \text{NUM:sg} \\ \text{TNS:pres} \\ \text{MOOD:indic} \end{bmatrix} \quad /X/ \rightarrow /X\text{-}z/$$

In the Word-and-Paradigm approach, inflectional rules are assumed to be organized into blocks such that rules belonging to the same block are mutually exclusive in their application. A central question

concerns the factors which determine this mutual exclusivity: where one member of a rule block overrides another member, can this override relation always be predicted as the effect of universal principles, or are some such overrides a matter of sheer stipulation? Anderson (1992: 128ff) argues for the latter conclusion. A second question concerns the sequencing of rule blocks. Anderson (1992: 123ff) shows that this must be, at least in part, a matter of language-specific stipulation. But a language's rule blocks cannot be assumed to adhere to a fixed linear sequence, since the sequencing of rule blocks may vary according to the set of morphosyntactic properties being realized (Stump 1993c). This is one kind of evidence favoring the introduction of paradigm functions. Thus, suppose that a is a cell in the paradigms of lexemes belonging to some class C, and that the *paradigm function* for cell σ is that function f_σ such that for each L e C, f_σ applies to the root of L to yield the word form occupying a; one can then say that the sequence of rule blocks in a language may vary according to the definition of its individual paradigm functions.

The Word-and-Paradigm approach to inflection has a number of virtues: it doesn't presume an unmotivated theoretical boundary between affixal and non- concatenative exponence; it is fully compatible with the incidence of extended and overlapping exponence and with the fact that a word's form may underdetermine its morphosyntactic properties; and it does not entail nonoccurring interactions between morphology and syntax.

6.4 Distributed morphology

Halle and Marantz (1993) argue for an approach to inflection which they call Distributed Morphology. The salient properties of this theory are as follows:

> (i) At the superficial level of syntactic structure known as S-structure (SS), morphemes exist as terminal nodes associated with bundles of morphosyntactic feature specifications but lacking any association with phonological feature specifications.
>
> (ii) Intermediate between the levels of SS and Phonological Form (PF) is a level of Morphological Structure (MS) at which "vocabulary insertion" takes place; it is through the process of vocabulary insertion that the abstract morphemes supplied by the syntax acquire their phonological feature specifications.
>
> (iii) In the mapping from SS to MS, the abstract morphemes may undergo various kinds of modifications: the relation of linear ordering is, for instance, introduced as a part of this mapping, which may also involve the addition of new morphemes (e.g. the introduction of agreement morphemes), the adjunction of one morpheme to another (e.g. the attachment of tensed INFL to an adjacent V), the merging of two morphemes into one, the splitting of one morpheme into two, and so on.
>
> (iv) Vocabulary insertion is assumed to be constrained by the Elsewhere Condition, so that when two morphs are both insertable into a given morpheme, it is the more narrowly specified morph that wins.
>
> (v) Once vocabulary insertion has taken place, the inserted morphs are subject to a battery of readjustment rules.

Under this approach, the past-tense form *play-ed* arises as follows: in the mapping from SS to MS, tensed INFL gets adjoined to an adjacent V node, producing M-structures of the form $[_V$ V INFL]; on the assumption that INFL carries the specification [+Past], the process of vocabulary insertion then inserts the suffix *-ed* into INFL from its vocabulary entry (25).

> (25) *ed*, [+Past].

Numerous arguments against this approach to inflection have been raised (Pullum and Zwicky 1992, Spencer 1996). Consider, for instance, the following problem: why doesn't the suffix *-ed* in (25) appear in the past-tense form of SING? According to Halle and Marantz (1993), this is because there is a zero suffix whose vocabulary entry is as in (26):

$\varnothing_1$, [+Past]. Contextual restriction: Y + ____, where Y = *sing*, *drive*, etc.

By virtue of its contextual restriction, $-\varnothing_1$ is more narrowly specified than *-ed*, and is therefore chosen for insertion into INFL in those instances in which the preceding verb stem is *sing*. As for the change from [I] to [æ] in *sang*, this is effected by a readjustment rule:

vowel → /æ/ in the context 'X____Y + [+Past]', where X-vowel-Y = *sing*, *sit*, etc.

By the very same reasoning, the failure of the default plural suffix -s in (28a) to appear in the plural of TOOTH would be attributed to the existence of the more narrowly specified zero suffix in (28b), and the change from [u] to [i] in *teeth* would be attributed to the readjustment rule in (28c); likewise, the failure of the Breton default plural suffix *-où* in (29a) to appear in the plural of DANT 'tooth' would be attributed to the more narrowly specified zero suffix in (29b), and the change from [a] to [ɛ] in *dent* 'teeth' would be attributed to the readjustment rule in (29c); and so on. Both within and across languages, instances of this same general character appear again and again.

(a) *s*, [+Plural].
(b) $\varnothing_2$, [+Plural]. Contextual restriction: Y + ____, where Y = *tooth*, *man*, etc.
(c) vowel → /i/ in the context 'X____Y + [+Plural]', where X-vowel-Y = *tooth*, *foot*, etc.

(a) *où*, [+Plural].
(b) $\varnothing_3$, [+Plural]. Contextual restriction: Y + ____, where Y = *dant*, *maout* 'sheep', etc.
(c) vowel → /ɛ/ in the context 'X____Y + [+Plural]', where X-vowel-Y = *dant*, *sant* 'saint', ect.

These facts highlight some of the problems with Halle and Marantz's approach. First, their approach forces them to assume that in a very large class of cases, a default inflectional affix is prevented from appearing by a more narrowly specified affix whose own appearance is never prevented by anything narrower and whose form is zero; yet they portray this state of affairs as an accident of piecemeal stipulation in the vocabulary entries of language after language. Zero affixes are purportedly just like other, overt affixes in their theory, but it is clear that they actually serve a special, homogenizing function by allowing words which are different in structure to be assigned structural representations which are alike; for instance, they allow both *play-ed* and *sang* to be treated as stem + suffix structures. (This special status can be seen especially clearly by imagining an overt phonetic sequence such as [ba] in place of the zeroes entailed by Halle and Marantz's assumptions: *sangba, sungba, teethba, worseba*, Breton *dentba*, etc. An overt affix with that sort of distribution – within and across languages – would be an unprecedented find.) Moreover, their theory portrays the frequent pairing of zero affixes with readjustment rules (such as (27), (28c), and (29c)) as still another coincidence.

The Word-and-Paradigm approach affords a much more natural account of such cases: that of dispensing with zero affixes and assuming that the "reajustment" rules with which they are paired are in fact simply morphological rules whose narrower specification causes them to override default rules of affixation (so that the past tense of SING lacks *-ed* because the rule replacing [I] with [æ] belongs to the same rule block as the rule of *-ed* suffixation and overrides it, and so on).

A further problem with Distributed Morphology is that it unmotivatedly allows an inflectional affix to be associated with morphosyntactic properties in two different ways. Consider, for instance, the Kabyle Berber form *t-wala-d* 'you (sg.) have seen', in "which *t-* is an exponent of second-person agreement (cf. *t-wala-m* 'you (masc. pl.) have seen', *t-wala-m-t* 'you (fern, pl.) have seen') and *-d* is an exponent of second-person singular agreement. How should the M-structure of *t-wala-d* be represented, given the assumptions of Distributed Morphology? One might assume either the M-structure in (30a) (in which case the affixes *t-* and *-d* would have the vocabulary entries in (31a, b)) or that in (30b) (in which case *d-* would instead have the entry in (31c)).

(30) (a) [2nd person] V [2nd person, -Plural]
(b) [2nd person] V [-Plural]

(31) (a) *t*, [2nd person]. Contextual restriction: ———+ V.
(b)

d

, [2nd person, -Plural]. Contextual restriction: V+———.
(c)

d

, [-Plural]. Contextual restriction: [2nd person] V +———.

The choice between (30a) and (30b) is, in effect, a choice between treating the property [2nd person] as a part of *-d*'s feature content and treating it as part of *-d*'s contextual restriction. Considerations of pattern congruity are of no help for making this choice, since Berber person agreement is sometimes only marked prefixally (e.g. *i-wala* 'he has seen', *n-wala* 'we have seen') and sometimes only suffixally (*wala-γ* I have seen', *wala-n* 'they (masc.) have seen'). The choice here, however, is merely an artifact of Halle and Marantz's assumptions: in the Word-and-Paradigm approach to inflection, for instance, no such choice even arises, since the morphosyntactic properties associated with an affix (or rule of affixation) are not artificially partitioned into properties of content and properties of context.

As the foregoing discussion suggests, the theoretical status of inflectional morphology is hardly a matter of current consensus. Nevertheless, a unifying characteristic of much recent inflectional research has been its heightened attention to the properties of inflectional paradigms, including such properties as syncretism (Carstairs 1987: 87ff, Zwicky 1985, Stump 1993b, Noyer, in press, Spencer 1996), periphrasis (Börjars et al. 1997), defectiveness (Morin 1996), suppletion (Plank 1996), limits on the diversity of a language's paradigms (Carstairs-McCarthy 1994), the theoretical status of the notion of "principal parts" (Wiirzel 1989), and so on. It seems likely that work in this domain will turn up important new criteria for the comparative evaluation of theories of inflection (see Car stairs-McCarthy, INFLECTIONAL PARADIGMS AND MORPHOLOGICAL CLASSES).

1 Throughout, I follow Matthews's (1972: 11, n. 3) practice of representing lexemes in small caps.

2 In many instances, a language's systems of case marking and verb agreement coincide in the sense that they are either both ergative or both accusative; there are, however, languages in which an ergative system of case marking coexists with an accusative system of verb agreement (Anderson 1985a: 182).

3 For more extensive discussion, see J. Lyons 1968: 270ff, Anderson 1985a, Bybee 1985: 20ff, and Beard 1995: 97ff.

4 For detailed discussion of the categories of tense, aspect, and mood, see Chung and Timberlake 1985.

5 Note the fundamental difference that exists between finiteness and tense: although finiteness is a governed property, properties of tense are inherent (rather than governed) properties of finite verbs.

6 The terminology given in italics in this paragraph is that of Matthews (1972).

7 The Swahili illustrations in (i)–(v) are from Stump (1997).

8 Recent psycholinguistic findings (Bybee and Newman 1995) suggest that there is no significant difference in the ease with which the human brain processes affixal and nonconcatenative morphology.

9 But see Janda 1994 and E. Williams 1996 for syntactic arguments against "exploded INFL".

10 See Spencer 1992 for additional arguments against the functional head approach.

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2. Derivation

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1 Derivation versus inflection

Unlike inflectional morphology, which specifies the grammatical functions of words in phrases without altering their meaning, *derivational morphology* or *word formation* is so named because it usually results in the derivation of a new word with new meaning. This traditional definition, however, has failed to secure a distinction between the two types of morphology, and the reasons for this failure have become matters of considerable discussion. Before proceeding to the question of what is derivational morphology, therefore, it makes sense to first attempt to locate the inflection–derivation interface.

2 The derivation–inflection interface

Chomsky (1970) proposed a sharp modular distinction between lexical and syntactic processes, known widely under the rubric of *Lexicalism*.[1] According to the Lexicalist position, words are derived in the lexicon and emerge with an internal structure to which syntax has no access (*Lexical Integrity Hypothesis*, Postal 1969). Sentences like *I speak Russiain though I've never been there*, are thereby ruled out, since the pronoun *there* is syntactically coindexed with a lexeme-internal morpheme, *Russia*, which has no independent status in the syntax. Sentences, on the other hand, are generated by the principles of syntax, to which lexical operations have no access. This rules out phrasally based lexical items such as *over-the-counter* in *over-the-counter sales*, widely held to be extragrammatically generated.[2]

Lexicalism entails a set of diagnostics which distinguish derivation from inflection. First, if inflection is relevant only to syntax, the output of inflectional rules cannot be listed lexically. Derivation, on the other hand, is purely lexical, so the output of a derivation rule is a new word which is subject to lexical listing. Listing allows lexical but not inflectional derivates to semantically idio-matize or lexicalize. Even though *went* has been phonologically lexicalized for centuries, semantically it has remained no more than the past tense of go. *Terrific*, on the other hand, has lost all semantic contact with its derivational origins in *terror* and *terrify*, despite its residual phonological similarity.

Second, if lexical operations precede syntactic ones, and if derivational operations map isomorphically onto marking operations (see section 6 for alternatives), inflectional markers will always occur outside derivational markers, as in Russian *lët-ˇik-a fly-AGENT-GEN* 'the flyer's (pilot's)', where the derivational agentive marker -(š)čik precedes the inflectional case marker -*a*. Third, since inflection is purely syntactic, it cannot change the lexical category of a word; derivation can. The agentive suffix in this example changes the verbal base to a noun, but the case ending does not affect that nominal status.

Finally, since inflection specifies syntactic relations rather than names semantic categories, it should be fully productive. If an inflectional stem is susceptible to one function of a paradigm, it is

susceptible to them all. No verb, for example, should conjugate in the singular but not the plural, or in the present but not the past tense. The productivity of derivation, however, is determined by semantic categories, and we would expect derivation to be constrained by less predictable lexical conditions.

Unfortunately, each of the Lexicalist diagnostics is vexed by some aspect of the data. Derivation does change the meanings of words so as to allow the derivate to become a lexical entry in the lexicon. Case functions, however, also lexicalize. In Russian, for example, the Instrumental never marks punctual time with the odd exception of instances involving temporal nouns which form natural quadruplets – for example, *utr-om* 'in the morning', *dn-em* in the afternoon', *večer-om*' 'in the evening', and noč-ju 'at night'. There is simply no way to derive punctuality from the major or minor functions of the Instrumental: that is, manner, means, vialic, essive. Punctuality is productively marked by *v* 'in' + ACC in Russian, e.g. *v to vremya* 'at that time'. The instrumental time nouns apparently must be lexically marked, even though punctuality is a case function.

Under most current grammatical theories, lexical selection occurs prior to agreement operations and the amalgamation of functional categories under INFL. If derivation is a lexical process, inflectional operations must apply subsequent to lexical ones. Assuming again an isomorphic relation between form and function, it follows that inflectional markers will emerge in surface structure outside all derivational markers. However, inflectional markers occur widely inside derivational markers. For example, the derivation of verbs by *preverbs*, prefixes which often share the form of an adverb or adposition, is considered derivational, since these derivates often lexicalize semantically. In English these derivations are marked with *discontinuous morphemes*: for example, *bring* (someone) *around*. In Sanskrit, however, similar derivations prefix the base: for example, *pari=nayat*, literally 'around he.leads', the present active for 'he marries'. The imperfect is derived by inserting a marker between the idiomatized prefix and stem: that is, *pary=a-nayat*. Georgian exhibits a similar tendency: for example, *mo=g-klav-s* PREVERB=2OBJ-KILL-3SUB 'He will kill you'.

The third entailment of lexicalism, that derivation changes the category of a stem while inflection does not, also faces a variety of problems. The first is a practical one: a dearth of research on lexical and grammatical categories. Whether N, V, A, for example, are lexical or syntactic categories has never been resolved. It has been common to presume that they are both and to ignore the fact that this presumption violates the strict modularity of lexicalism. Assuming that these categories are lexical, they are not changed by derivations like *violin: violinist, cream: creamery, zip: unzip*. A diminutive does not alter the referential category of its base, even though it changes its sense, very much as does inflection. Thus Russian *dožd*' 'rain': *dožd-ik* 'a little rain': *dožd- ič-ek* 'a tiny little rain' – all refer to rain, even though they might express varying judgments and attitudes of the speaker towards a particular instance of rain.

There are also ostensible inflectional functions which belong to categories other than that of the base. Participles like English *talking* and *raked*, for instance, freely reflect the inflectional categories of aspect, tense, and voice, as in *John is talking* and *the leaves have been raked*. They also serve the relational adjectival function of attribution – for example, *the talking boy, the raked leaves* – and agree adjectivally in languages requiring agreement – for example, Russian *govorjašč-ij mal'čik* 'talking boy', but *govorjašč-aja devuška* 'talking girl'. The diagnostics of lexicalism, therefore, remain fragile until contradictions like these are resolved. Nonetheless, an intelligible picture of derivation emerges from the data underlying them.

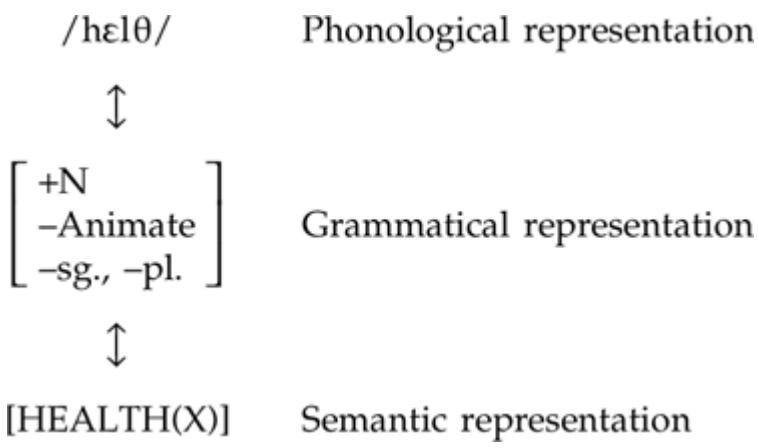
3 The nature of derivation

Three accounts of derivation have emerged in the recent literature.[3] The first considers derivation simply a matter of lexical selection, the selection of an affix and copying it into a word-level structure. Others see derivation as an operation or set of operations in the same sense that Matthews and Anderson see inflection. A derivational morpheme on this view is not an object selected, but the processes of inserting or reduplicating affixes, vocalic apophony, etc. Finally, Jackendoff and Bybee argue that derivation is a set of static paradigmatic lexical relations. In light of the lack of agreement on the subject, a brief examination of each of these three accounts would seem appropriate.

It is common to assume that the lexical entries (*lexemes*) upon which derivational rules operate

comprise at least three types of features: a phonological matrix, a grammatical subcategorization frame, and a semantic interpretation, all mutually implied. For future reference, let us illustrate these relations with the hypothetical entry for English *health* in (1).

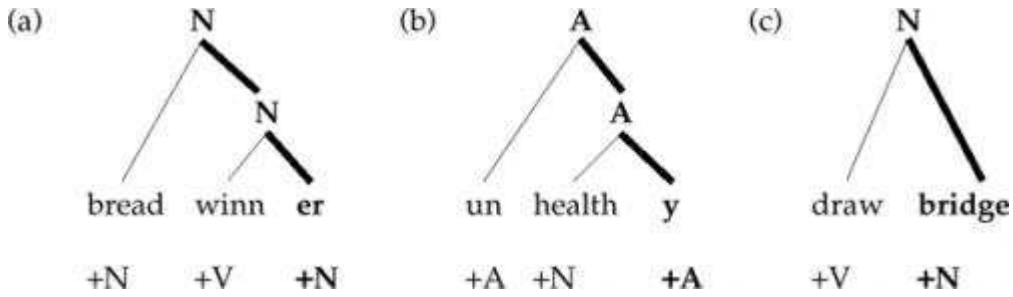
(1)



There is general agreement on these three constituents of a lexical representation, and that they mutually imply each other in the Saussurean sense; that is, no one such representation occurs without the other two, as indicated by the double-headed arrows in (1). Current disagreement centers on whether lexemes comprise only open open-class morphemes (N, A, V stems) or whether they include grammatical (functional) morphemes as well. We will return to this issue further on.

3.1 Derivation as lexical selection

Advocates of *Word Syntax*, including Selkirk (1982), Lieber (1981,1992), Scalise (1984), and Sproat (1985), reduce derivation to the selection of an affix from the lexicon (see Toman, WORD SYNTAX). This particular view of derivation is dependent upon the existence of word-internal hierarchical structure: that is, below the X0 level. Lieber (1992) claims that this structure in no way differs from syntactic structure, so that words contain specifiers, heads, and complements, just as do clauses. If words contain their own structure, and if affixes are regular lexical entries like stems, then derivation, compounding, and regular lexical selection may all be accomplished by a single process: lexical selection. (2) illustrates how compounds and derivations might share the same structure.



Derivational affixes are not distinguished from stems, but share the same classification, *morpheme*, defined as a classical linguistic sign. That is, derivational morphemes have the same mutually implied phonological, grammatical, and semantic representations as do lexemes. According to Lieber, the grammatical representation contains the category and subcategorization of the affix, plus any diacritics, such as its *Level Order*, the level at which an affix applies under Lexical Phonology (Kiparsky 1982b). The semantic representations of the stems and affixes in (2), for example, compose under the scope conditions provided by the structural hierarchy and the head-dominance principles. In (2), the rightmost lexical item dominates and assigns the grammatical and semantic categories to

the derivate or compound, as indicated by the boldface branches. The simplicity of the Word Syntax theory of derivation is achieved by the assumption that affixes are regular lexical items, and as such may serve as heads of derivates. However, morphology involves far more types of marking than simple affixation, and most of these types represent problems for Word Syntax.

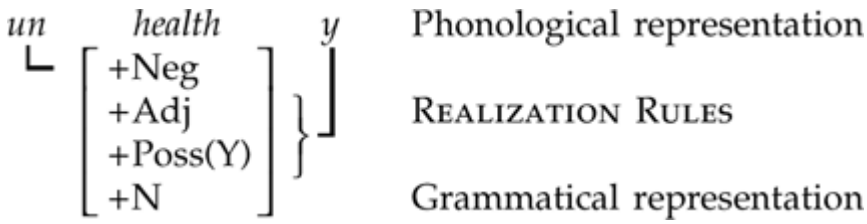
3.2 Derivation as morphological operations

Anderson (1992), Aronoff (1976, 1994), and Beard (1981) have extended the notion of grammatical morphemes as operations developed in Matthews's WORD-AND-PARADIGM (see Stump, INFLECTION) theory to derivation. Process morphology addresses first and foremost those types of morphology other than external affixation. For example, both inflectional and derivational morphology are characterized by *reduplication*. Reduplication is a process which copies all or part of the phonological representation of a stem as an affix: for example, the Dakota de-adjectival verbalization: *puza* 'dry': *puspuza* 'be dry', *c*^{h}*epa* 'fat': *c*^{h}*epc*^{h}*epa* 'be fat'. Notice that reduplication presupposes the prior existence of some lexeme, making it difficult to classify this process as a lexical item as Marantz (1982) proposes. Whatever reduplication is, it must take place subsequent to lexical selection, and hence cannot be accounted for by lexical selection itself, unless that process is enhanced in an ad hoc fashion.

In addition to external affixation, languages also widely exhibit *infixation*. The inchoative de-adjectival verb in Tagalog infixes the base; for example, *ganda* 'beautiful': *gumanda* 'become beautiful', *gising* 'awake': *gumising* 'awaken'. Processual morphology handles infixation with the same sort of rules employed in accounting for external affixation. Structures like (2) cannot adequately explain infixation without special phonological rules which determine the position of infixes but not prefixes and suffixes. The issue between Word Syntax and process morphology then reduces to the question of whether such special operations differ qualitatively from other phonological operations.

Whether affixes are copied from stems to which they are attached, or whether they are written external or internal to the lexical base, are matters of indifference if affixation is a process, rather than the selection of a lexeme. This interpretation of derivation distinguishes operations on the grammatical representation of the lexical base from phonological modifications of the base such as affixation. (3) illustrates how affixation is realized on the derived base for unhealthy on this hypothesis.

(3)



Affixation applies after morpholexical and morphosyntactic rules have provided the base with derivational features. Since no grammatical or semantic operations are involved, affixation becomes a set of purely phonological modifications of the phonological representation of the base conditioned by the grammatical features. The head of such derivations is the lexical base. The crucial factor determining the order of affixes is not structural relations, but the order in which they are attached. Scope relations are determined by autonomous semantic operations which follow the order of grammatical features in the base.

3.3 Derivation as lexical relations

Jackendoff (1975) and Bybee (1988) have argued that derivation is simply a static set of lexical relations. Jackendoff argued that all derivates must be listed in the lexicon since they are subject to lexicalization. Derivational rules are *redundancy rules*, rules which state the single redundant relation

"is lexically related." The nominalization rule for assigning *-ion* to Latinate verbs would then have the form (4):

(4)

$$\begin{bmatrix} /y+\ \text{ion}/ \\ +\text{N} \end{bmatrix} \leftrightarrow \begin{bmatrix} /y/ \\ +\text{V} \end{bmatrix}$$

Separate semantic rules are similar in that they express the same redundancy relation between the meanings of the base and the affix.

$$\begin{bmatrix} +\text{N} \\ +[\text{NP}_1\text{'s } ((\text{P})\text{NP}_2)] \\ \text{ABSTRACT RESULT OF} \\ \text{ACT OF NP}_1\text{'s Z -ING} \\ \text{NP}_2 \end{bmatrix} \leftrightarrow \begin{bmatrix} +\text{V} \\ +[\text{NP}_1 \_\_\_\_ ((\text{P})\text{NP}_2)] \\ \text{NP}_1\ \text{Z}\ \text{NP}_2 \end{bmatrix}$$

Jackendoff proposed that such rules as (4) and (5) could be applied generatively in speech to create neologisms; however, generation is not their purpose in the competence model. Jackendoff also left open the question of how such regularities arise in the lexicon in the first place if they are lexically superfluous. Bybee offers a psychological answer to that question.

Bybee argues for a connectionist theory of morphology, inflectional and derivational, based on the theory of parallel distributed processing by Rumelhart and McClelland (1986). In her view, lexical rules have no status "independent of the lexical items to which they are applicable. Rather, rules are highly reinforced representational patterns or schemas." Schemas are abstractions from memorized lexical items which share semantic or phonological properties. One such schema results from the association of verb pairs like *cling: clung, sling: slung, sting: stung*.[4] A derivation rule on Bybee's account is simply a relationship which is more strongly represented, where "strongly" refers to the number of representations a pattern has in long-term memory. In the instance just cited, the phonological relation /Iŋ/: /ʌŋ/ is more strongly represented than /kl/: /si/ or /sl/: /st/. The more recurrent phonological relation is therefore more likely to be associated with the past tense than the less frequent ones.

When speakers add the past tense innovatively, they simply search their memories for phonological relations associated with the past tense and choose one analogically. Following recent connectionist theories, the most highly reinforced relation is most likely to be selected for the neologism. The relation /Iŋ/: /ʌŋ/, for instance, will not be as strongly represented in the semantic schema for past tense as ô: /d/. Speakers are therefore more likely to add /d/ to a neologism than to replace a stem vowel /I/ with /ʌ/. If the neologism ends in /ŋ/, however, the probability that this method will be selected increases.

Bybee's suggestion has the advantage of conflating derivation and derivational acquisition. A derivational rule reduces to the arrangement of memorized items in mental storage. Without derivation rules, all morphology may be confined to the lexicon as in Word Syntax, and only one rule, lexical selection, is required to account for morphology in syntax. Moreover, morphological creativity reduces to the general cognitive process of analogy which is commonly used in categorization. So far, however, many of the processes vital to Bybee's model remain undefined, so it is not currently possible to determine this theory's efficacy in accounting for the derivational data.

4 Derivational heads

If affixes are regular lexical items which may be selected for word structures as fully derived words

are selected for phrase structures, they should be able to serve as heads, as do fully derived words. If affixes are the results of processes, however, they cannot be lexical heads, and the traditional assumption that stems represent morphological heads regains credibility. This issue has been a central concern of recent morphological research, so is next on the agenda.

4.1 Affixes as heads

If derived words are structured, the question naturally arises as to whether word structure is the same as syntactic structure. Lieber and Sproat claim that not only are the two types of structure identical, but the principles for composing words are precisely those of X-bar syntax. It follows that morphology may be dispensed with altogether, resulting in yet another major theoretical economy under Word Syntax. A major contention of modern X-bar theory is that the head of a phrase (X) determines the category of the whole phrase (XP). A sound test of Word Syntax, therefore, is whether the head of a derived word determines the category of the whole word. Since the outermost affix of a word is often associated with the category of the whole word, it might be possible to mount a case for affixes serving as the heads of derived words.

E. Williams (1981b) advanced the simplest account of affixes as heads of words: the head of a word is its rightmost element. Thus the head of *breadwinner* in (2a) would be *-er* which, under the premise that affixes are lexical items, is a noun in the same sense that *bridge* in *drawbridge* (2c) is a noun. Both *-er* and *bridge* are nouns which determine the category of *bread-winner* and *drawbridge*. The heads of *redraw and unhealthy* (2b), on the other hand, are the bases *draw* and *healthy*, since prefixes in IE languages tend not to change the category of the derivates to which they adhere.

Some features, however, must be raised from nonheads. Diminutives, for example, usually bear the features of the base rather than the affix. In Russian, for example, both *sobaka* 'dog' and its diminutive, *sobač-k-a*, are feminine; *jazyk* 'tongue' and its diminutive, *jazyč-ok*, are both masculine. This contrasts with German diminutives, which are all consistently neuter: for example, *der Brief: das Briefchen* 'letter', *die Lampe: das Lämpchen* 'lamp'. To redress this problem, Di Sciullo and Williams (1987) proposed that feature inheritance relativizes the head; that is, features of categories present in the stem but not in the affix determine the lexical categorization of the final derived word. This new variation presumes that affixes, like Russian diminutive suffixes, are unmarked for certain features such as gender; this allows gender features from the next highest node to be inherited by the derivate. The German suffix *-einen*, on the other hand, does bear an inheritable gender valuation, neuter, and so passes this feature on to the derivate.

Unfortunately, relativizing morphological heads renders them radically different from phrasal heads, which are always absolute and never relative. Derived words differ greatly from derived phrases, where *face* is just as good a noun phrase as *a strange face peering through the door*. *Ist is not just as good a noun as *violinist*. Relativizing morphological heads then defeats the original purpose of postulating affixal heads. This difference between word and phrase heads nonetheless must be characterized in an adequate model of grammar, even though it impedes the reduction of morphology to syntax.

4.2 Head operations

There is another clue to the question of morphological heads. The phonological structures of a wide range of derivations do not isomorphically parallel their semantic structures. English, for example, restricts the comparative suffix *-er* to monosyllabic adjectives or disyllabic stems ending on a weak vowel: for example, *quick: quicker, hateful: *hatefuller* but *happy: happier* (see Sproat, MORPHOLOGY AS COMPONENT OR MODULE, for further details). Trisyllabic stems are wholly excluded from the distribution of this suffix, with one exception: disyllabic stems prefixed with un-: *unhappier*. This exception is obviated on the assumption that *-er* attaches to *happy* before *un-*; however, the semantic reading of such terms is not 'not happier' but 'more unhappy'. The morphological and semantic structures of such forms are hence "mismatched."

To circumvent exceptional treatment of such MORPHOSEMANTIC MISMATCHES, Hoeksema (1985) proposed that every rule of derivation has a correlate that applies specifically to heads, but is in all other respects a context-free rewrite rule. Stump (1991) argues that this correlate is the default. English derived verbs exhibit the effect of a head operation in maintaining their conjugations even

when serving as a base in a derivate. The past tense of *understand is understood*, and that of *overdrive* is *overdrove*. This seems to indicate that although past tense has scope over the entire derivation (or compound) in these instances, morphology applies strictly to *stand* and *drive*, respectively; otherwise, we might expect the past tense to be the productive **understanded* and **overdrived*.

Morphosemantic mismatches like *unhappier* are susceptible to the same interpretation; the morphology of the negative adjective applies to the head of the derivate, *happy*, even though the scope of comparison extends to the entire word *unhappy*. Head operations may also be extended to instances of inflection occurring inside derivation, such as the Sanskrit perfect mentioned above, *pari=nayat* 'he marries': *pary=a-nayat* 'he married', and to diminutives like the Hebrew loan *xaxom-im-l-ex* 'smart little people' in Yiddish and Breton *bag-où -ig-où* 'little boats' (Stump 1991), assuming that diminutive suffixes are grammatically empty and that the stem is the head. On this account the Sanskrit perfect inflection is added to the head (stem) inside the preverb, because the preverb is a phrasal head clitic or semi-discontinuous morpheme. The Hebrew and Breton plural mark both their scope and the head of the derivation, for reasons undetermined.

Head operations remain exceptional so long as affixes may be heads, since semantic evidence indicates that affixes are never themselves affixed. No language exhibits scope ambiguities such that the plural of a locative nominalization like *bakeries* would refer either to an aggregate of places, only some of which are devoted to baking (head marking, the affix the head), or to an aggregate of baking places (scope marking). The scope of all derivational functions is the entire word to which it is added, derived or underived; the only variation is in the placement of affixes marking them. This situation, combined with the failure of theories of affixal heads, endorses the traditional assumption that the morphological head of a word is its root or stem. Morpholexical and morphosyntactic feature operations seem to apply concatenatively to the base lexeme; the distribution of affixes, on the other hand, seems to be determined by language-dependent rules of spellout.

5 Synthetic compounds and derivation

If affixes are not morphological heads, the question arises as to whether compounds and derivations are at all related as (2) implies. If they are, it is doubtful that their relation is structural. It is common to distinguish *analytic* from *synthetic compounds* by the presence of affixation. *Drawbridge, redhead, houseboat* are thereby analytic compounds, while *truck-driver*, *truck-driving, redheaded* are all synthetic. There is little evidence that most analytical compounds are related to derivation. Rather, other analytic compounding appears to be a simple process of combining lexemes. The head of those compounds composed of constituents belonging to different categories determines the category of the compound. The right constituent determines the category of English compounds, so that a *houseboat* is a boat while a *boathouse* is a house. However, this description excludes prepositions, since compounds with prepositional modifiers are often adjectives (*inland, between-class, outboard*), and those with prepositional heads may be anything but prepositions (*sit-in, hold-out, runaway*). Even most P + P compounds fail the head test: *without* does not imply *out*, and *in* and *on* would seem to be the heads of *into* and *onto*, respectively. The evidence from compounding hence suggests that adpositions are not lexemes in the sense that N, V, A stems are.

The distinction between analytic and synthetic compounds is nevertheless imperfect at best. Synthetic compounds do resemble simple derivations in several respects. For example, they share the same derivational categories often marked by the same affixes: *bearded: gray-bearded, driver: truck-driver, driving: truck-driving*. Analytic *Bahuvrihi* compounds, like *redhead, long-hair, hardhead*, for instance, share their derivational function with possessional adjectives like *red-headed, long-haired, hardheaded*. Indeed, the same possessional function ("having *N*") emerges in simple derivations like *headed* and *hairy*. Parallels like these suggest that synthetic compounding is derivation which allows an optional modifier. Affixation, however, is not a reliable indicator of the distinction between compounds and derivations, since the zero morphology, which is available to simple derivations, is also available to compounds. Indeed, Booij (1988) has shown that synthetic compounds, whose structure is presumed to be [*truck-driv]ing*, may be explained with equal cogency as analytic compounds with the structure [*truck][driving*], given a semantic level capable of resolving morphosemantic mismatches.

Until research better clarifies the subject, it is best to assume that analytic compounds represent an independent lexical means of derivation; however, it is doubtful that those bearing adpositions are compounds (see also Fabb, COMPOUNDING). Analytic compounds in this sense should not be confused with zero-marked Bahuvrihi compounds. Like synthetic compounds, bahuvrihis may be interpreted as derivations with optional modifiers. This area of research is very fluid, however, and Booij has shown how all compounds may be reduced to analytic concatenation.

Morphosemantic mismatches raise another important issue in morphology: the fact that derivational meaning and the affixation marking it are not always isomorphic. Karcevskij (1929) called this phenomenon *morphological asymmetry*. It is an attribute of morphology whose importance is only now being appreciated.

6 Morphological asymmetry

Karcevskij noted that while several endings mark the genitive in Russian – *-i, -a, -u* – each of these endings also has multiple functions. The ending *-a*, for example, also marks feminine nominative singular and neuter plural. The ending *-i* marks feminine and masculine nominative plural, as well as genitive, dative, and locative singular in declension III. In other words, it is common for grammatical morphemes to be *cofunctional* (*-i, -a, -u* above) and *multifunctional* (*-i*), to use the terms of Szymanek (1989). In addition to cofunctionality and multifunctionality, Matthews (1972) identified *extended* and *cumulative exponence* as morphological asymmetries. In the Latin word rēxistē [re:k-s-is-ti:] 'you (sg.) ruled', for example, the suffix *-ti*: cumulatively (simultaneously) marks second person, singular, and perfective. The remaining markers, -s and -is are empty extensions of *-ti*, redundantly marking the perfective, too. The same phenomena characterize derivation. In the adjective *dram-at-ic-al, -at* and *-al* are empty extensions of *-ic*; cf. *theatr-ic*. The German suffix *-er* in *Lehr-er* 'teacher' cumulatively marks [+subjective], [+masculine], and [declension I]. Finally, *zero* (null) *morphology* reflects morphological asymmetry. While most non- count modalic (instrumental) nominals require either the suffix *-er (conditioner, softener*) or *-ənt* (*stimulant, relaxant*), many require no suffix at all: for example, *a rinse, a wash, a spray*. Again, the relationship between the grammatical and phonological levels is nonisomorphic.

Bazell (1949,1952) argued that these phenomena collectively indicate a fault in structuralist morphology, which he dubbed the *Correspondence Fallacy*, the assumption that an analysis at one linguistic level will isomorphically map onto analyses at other levels. Bazell argued that the phonological analysis of a word need not correspond to its semantic analysis; however, it does not follow from this that no analysis is possible. It is quite conceivable that each level is defined in its own terms, and that mapping from one level to another involves more sophisticated relations than the isomorphic relation of the classical linguistic sign.

To obviate the correspondence fallacy, Beard (1966,1976), Kiefer (1970), and Leitner (1973) proposed what was subsequently called the *Separation Hypothesis*, the claim that the functional and spelling operations of derivation are discrete and autonomous. The Separation Hypothesis assumes that lexical items are restricted to N, V, and A stems, all of which are perfect signs comprising mutually implied phonological, grammatical, and semantic representations, as in (1). It then provides a set of abstract lexical operations on the grammatical representation of a lexical item discrete from operations on the phonological and semantic representations. Algorithms in an autonomous morphological spelling component like those proposed by Matthews (1972) then modify the phonological representation of grammatically and semantically derived stems. By the same token, compounding operations which combine words like *truck* and *driving* mentioned above need not establish the semantic scope of compound constituents. This can be accomplished by autonomous principles of composition based on the argument structure of the phrasal head, in this case, *drive*.

The separation of grammatical and phonological operations allows for a simple account of all morphological asymmetry. Cumulative exponence results from a single-stem modification conditioned by several grammatical features, while extended exponence is the collective marking by several stem modifications of a single feature. Cofunctionality and multifunctionality are explained similarly. Finally, zero morphology is simply derivation without affixation, while empty morphemes result from affixation without derivation.

Morphosemantic mismatches like those in *unhappier*, those in compounds like *truck-driving* on Booij's interpretation, and those in head operation constructions may be resolved by a similar separation of derivation and semantic composition. The asymmetry explored by Karcevskij and Matthews, on the other hand, is more a *morphophonological mismatch* between derivation and phonological realization. The ultimate implication of asymmetry, therefore, is that semantics, derivation, and affixation represent three distinct levels of morphological operations, which require two distinct mapping systems.

7 Types of derivation

We have surveyed the general attributes of derivation and the major accounts of them. We may now turn to the particular properties of derivation: the types of derivation and the types of affixation marking them. In its broadest sense, *derivation* refers to any process which results in the creation of a new word. However, the output of some morphological operations is far more principled than the output of others. The derivations in (6), for example, form a sort of lexical paradigm which holds for many other bases:

(6)

$$\textsc{Laser}\begin{cases}\text{re-laser, out-laser, over-laser, . . .}\\ \text{laser-er} \rightarrow \text{laser-er-s, laser-er-'s}\\ \text{laser-ing} \rightarrow \text{laser-ing-s, laser-ing-'s}\\ \text{(un)laser-able} \rightarrow \text{(un)laser-abil-ity}\end{cases}$$

Some types of derivation do not fit into derivational paradigms like (6). It is well known that words may be misanalyzed when a phonological sequence identical with that of an affix is misperceived as that affix. The result is that a previously nonexistent underlying base is extracted and added to the permanent lexical store via a process known as *back formation. Sculptor*, for example, was borrowed as an integral base into English. However, because the final phoneme cluster /*ər*/ is identical with an agentive marker in English, and since *sculptor* is an agentive noun, a verbal base, *to sculpt*, has been extracted and added to the stock of English verbs. Consequently, *sculptor* changes from a lexical base to a derivate.

Several facts obstruct the conclusion that back formation is a derivational process. First, in order to use back-formed words, we must be familiar with them. While some potentially back-formed words are used, far more may not be. It is not possible, for instance, to say that a butcher **butches* or that a barber **barbs*, even though these verbs are potential back derivates as legitimate as *sculpt*. There is no grammatically definable constraint preventing this; it simply is not acceptable to do so. Second, we do not find positions for back derivates in lexical paradigms like (6). Take the back derivate of *laser* itself: *to lase*, for example. It generates exactly the same paradigm as (6). Thus, in those dialects which use *lase*, one may say *relase, outlase, overlase, laser, lasing, (un)lasable, (un)lasability* – all with the same sense as the corresponding zero-derived verb in (6). In other words, rather than forming a derivational relationship with a lexical base, back-formed words create a new base, expanding the underived lexical stock in a way that regular derivations do not. This characterization partially fits several other types of word formation which need to be distinguished from regular, grammatically determined derivation.

7.1 Lexical stock expansion

Clipping (telephone: phone), blends (smoke + fog = smog), acronymization (aids), and *analogical formation (workaholic*) all conform to the description of back formation in significant ways. Back formation generates a base which the lexicon lacks. Clipping, on the other hand, produces a redundant base, but a new one all the same. With rare exceptions (e.g. *caravan: van*), the input and output of clipping rules are semantically identical, and both remain active in the lexicon. Both *telephone* and *phone* have the same range of grammatical derivations, all with the same meaning:

(*tele) phoner, (tele) phoning*, etc. Notice, too, the irregularity of clipping. It usually reduces a polysyllabic word to a monosyllabic one; however, this may be accomplished by removing the initial syllables (*phone*), the final syllables (*rep*), or the initial and final syllables (*flu*).

Blending, acronymization, and analogical formation also tend to be conscious operations, unlike grammatical derivation. Words like *smog, motel*, and *tangelo* are created intentionally by a logical rather than grammatical process: if the reference is part A and part B, then the word referring to it should comprise parts of the words for A and B. Acronyms like *laser, scuba, aids*, have been converted from phrases to the initial letters of the words in those phrases, which are not part of grammar, then the initials have been phonologically interpreted. *Acquired immune deficiency syndrome*, for example, provides *aids*, which is rendered pronounceable by applying English spelling rules in reverse. The process hence requires considerable conscious activity outside the bounds of grammar. As in the case of clipping, the phrase and the acronym are synonymous, and both remain in the language.

Analogical forms like *workaholic, chocoholic* and *cheeseburger, fishburger, chicken-burger* differ from regular derivations in that they require prosodie identity. Genuine suffixes like *-ing* may be added to stems of any length or prosodie structure. Pseudo-derivates like *chocoholic*, however, must additionally fit the prosodie template of their analog, in this case, *alcoholic*: the output must contain four syllables with penultimate accent. Thus *chocolaholic, shoppingaholic*, and *handiworkaholic* do not work as well as *chocaholic, shopaholic*, and *workaholic*. When we begin to find acceptable violations of this extragrammatical principle like *chickenburger*, we usually find that the remainder, in this case *burger*, has become an independent back-formed word capable of undergoing regular compounding.

This does not exhaust the catalogue of lexical stock expansion processes. That catalogue also contains *borrowing (troika, detente, thug), commonization (quisling, aspirin), semantic narrowing (percolator, escalator), loan translation* (German *Einfluß* 'influence', *Mitleid* 'compassion'), *folk etymology (craw[l]fish* from Old French *crevise*), and perhaps others. The point is that these processes tend to be conscious, extragrammatical, and hence grammatically irregular. Rather than filling a position in some lexical paradigm, they create new lexical bases which then generate their own paradigms. To better understand the difference, let us now examine the regular derivation types.

7.2 Lexical derivation

Four distinct types of regular grammatical derivation have been described in the literature; *featural derivation, functional derivation, transposition*, and *expressive derivation*. While all the details of the properties of these types of derivation and their interrelations have not been refined, their basic nature and functions may be broadly described.

7.2.1 Featural derivation

Featural derivation does not change the category of the underlying base, but operates on the values of inherent features. An obvious candidate for such a rule is natural gender, as described by Jakobson (1932, 1939) in connection with his concept *markedness*.[5] In most languages which support natural gender, the default or unmarked form is masculine. A convenient technical notation of the fact that unmarked masculine nouns may refer to males or females is [+Feminine, +Masculine]. This requires a Jakobsonian principle of markedness whereby in cases of conflict, the surface realization will default to that of the unmarked category, masculine. Thus the Russian noun *student* 'student' may refer to females or males, but all grammatical agreement will be the same as purely masculine nouns like *brat* 'brother', *otec* 'father', which cannot refer to females.

Default masculines like *student* differ from pure masculines in that they are susceptible to feminization. This requires some rule on the order of *student*(ø) → *student-k(a)* which converts the default masculine noun into a purely feminine one and marks this fact by transferring the base from declension I, marked in the nominative by -ø, to declension II, marked in the nominative by *-a*. All that is required grammatically and semantically of this rule is the toggling of the masculine feature from positive to negative: that is:

- (7) [+Feminine, +Masculine] → [+Feminine, -Masculine]

(7) converts the lexical description of the base from unmarked masculine to marked feminine like the purely feminine nouns *sestra* 'sister' and *mat'* 'mother', which may refer only to females and not to males. The addition of any feature [+Feminine] would be inappropriate since (7) applies only to nouns with natural gender: that is, those which inherently (lexically) possess lexical gender features.

7.2.2 Functional derivation

Kuryłowicz (1936) first distinguished rules which add features to the underlying base from those which merely change its category. Consider (8), for example:

(8) (a) recruit: recruit-er
(b) recruit: recruit-ee
(c) bake: bak-ery

Kuryłowicz referred to this type of derivation as "dérivation lexicale," because the derivate differed semantically from its base. In the middle of this century, several European linguists, among them Belić (1958: 140–1, 148–50), noted a similarity between the functions of these derivations and those of the case system. The traditional names of nominals like *recruiter and recruitee*, "agentive" and "patientive," suggest that the functions of this type of derivation are semantic. However, many "agentive" forms are not animate as the name implies (*breaker, floater, sparkler*), and many are not even active (*riser, marker, divider*). The same is true of patientives: alongside *employee, recruitee, draftee*, we find inanimate "patientives" of resultative verbs like *painting, carving, writing*. The suffixal distinction does not change the fact that a painting is an object painted in just the same sense that an employee is an object employed. It therefore seems more likely that this type of derivation is based on case functions: for example (nominative of) subject, (accusative of) object, (locative of) place (*bakery, fishery*), (genitive of) possession (*dirty, forested*) and material (*oaken, woolen*), (ablative of) origin (*American, Brazilian*), (dative of) purpose (*roofing, siding*), (instrumental of) means (*cutter, defoliant*).

Languages with rich morphologies have dozens of such derivations, including those just mentioned. Even in Serbian and Polish all these derivations are still quite productive, and all their functions serve as pure case functions expressed without adpositions in some language. Basque has a locative of locus, *mendi-an* = mountain-Loc 'on the mountain'; Serbian exhibits the possessional (qualitative) genitive: *čovek plav-ih oči-ju* 'a man of (with) blue eyes'; Turkish marks origin and material with the ablative, *Ankara-dan* = Ankara-ABL 'from Ankara', *taş-tan bir ev* = stone-ABL one house 'a house of stone'; and Latin has a dative of purpose: *castr-īs locum* = camp-DATSG place-ACCSG 'a place for a camp'. All languages express these functions with case endings, adpositions, or a combination of both. Few verbs and no nouns are subcategorized for these argument relations, yet they are widely available to functional lexical derivation in languages with rich morphological systems like Serbian, Inuit, and Chukchee.[6]

If the ultimate constraint on functional derivations is the set of case functions, the question becomes why some functions seem to be missing and why subject and object relations are more productive and diachronically stable than others. Some omissions are obvious: the (ablative) absolute relation is missing because it is purely a syntactic relation, that of sentential adverbs; the same applies to the (ablative of) distinction, used to mark comparatives in many languages: for example, Turkish *Halil'-den tembel* = Haul-ABL lazy 'lazier than Haul'. The reason why we find more subjective and objective nominalizations than others is, no doubt, high pragmatic demand. This is an area which has received little attention historically, and thus no definitive answers to these questions are available.[7] However, it is clear that functional derivations involve far more functions than the argument functions found in the base, yet few if any productive derivational functions fall outside those found in the inflectional system.

7.2.3 Transposition

Another type of derivation which reflects a simple change of category without any functional change is *transposition*, illustrated in (9):

(9) (a) walk: walk-ing (V → N)
(b) new: new-ness (A → N)

(c) budget: budget-ary (N → A)

Kuryłowicz called derivations like those of (9) "dérivation syntaxique," but Marchand (1967) used the more distinctive term, "transposition."

Transposition introduces no argument structure, but simply shifts a stem from one category to another, sometimes marking the fact affixally, sometimes not. The definition of *dryness* must coincide with that of *dry* in all essential respects, since, unlike *bake* and *baker*, its reference is identical to that of its base. The same is true of all the relations represented in (9). Whether transpositions are marked by real or zero affixation is a separate issue, bound up with the general issue of the nature of zero morphology.

7.2.4 Expressive derivation

Expressive derivation does not change the referential scope of its input; however, expressive derivation also does not change the lexical category of the base. As mentioned in section 2, the reference of the three grades of the Russian word for 'rain', *dožd', doždik*, and *dožd-iž-ek*, all refer to the same conceptual category. The formal variation reflects subjective perceptions of the speaker: whether he perceives the rain to be relatively light, beneficial, or pleasant. For this reason, expressive derivation may be recursive, applying to its own output as in the Russian example. In addition to diminutive and augmentative expressive derivation, pejorative and affectionate forms also occur: for example, Russian *kniga: knižonka* 'damned book' (cf. *knižka* 'little book') and *papa* 'daddy': *papo ˇka*.

There is no obvious means of relegating expressive derivation to any of the other three types. The categories involved are not found elsewhere in grammar as are functional categories, nor are they inherent lexical categories like gender. Since expressive derivation does not involve a category change, it cannot be a form of transposition. It therefore remains mysterious in many respects.

8 Realization and productivity

The types of phonological realization (stem modification) which express derivation are by and large the same as those which express inflection. The glaring exception seems to be that derivation is not expressed by *free morphemes*: those which are not modifications of stems, but which stand alone. This would follow from the assumption that only inflection is syntactic. Since free morphemes require a structural position, this type of realization would be ruled out for lexical derivation by the Lexicalist Hypothesis.

Evidence indicates, however, that the bound phonological realization of derivational and inflectional morphology is provided by a single component (see also the discussion of the Split Morphology Hypothesis in Stump, INFLECTION). The English suffix *-ing*, for example, may be attached to verb stems to generate inflectional forms like the progressive (*is painting*), the present participle (*painting machine*), as well as derivational forms like the objective nominalization (*a painting*). The same is true of *-ed*, which productively marks the past tense and participles (*John (has) annoyed Mary*), as well as derivations like the possessional adjective: for example, *two-headed, forested*. The important point is that derivation seems to be an abstract process independent of the various means of phonological realization and of the means of semantic interpretation.

Two specific types of marking, *subtraction* and *metathesis*, weakly represented in inflection, apparently do not mark derivation. Papago, for example, seems to derive perfective verbs from imperfective ones by deleting the final consonant if there is one, *him* 'walking': *hi*: 'walked (sg.)', *hihim* 'walking (pl.)': *hihi* 'walked (pl.)' (Anderson 1992). However, aspect is probably inflectional, though the matter remains unclear. Metathesis for the most part is an allomorphic change effected by affixation, as in the case of the Hebrew reflexive prefix, *hit-*, whose final segment metathesizes with initial voiceless strideents: for example, *xipes* 'seek': *hitxapes*, but *silek* 'remove' *histalek*.

8.1 Discontinuous morphemes

Evidence suggests that one type of verbal derivation is marked by *discontinuous morphemes*, morphemes which may be loosened or removed from their base. The English correlate of *preverbs*, a type of verbal prefix expressing a closed set of adverbal functions, is a particle which is written

separately and may appear either immediately following the verb or the VP. Consider the Russian examples and their English counterparts in (10) for example:

(10) (a) Ivan vy-vel sobaku *'John brought [out] his dog [out]'
(b) Ivan v-vel sobaku 'John brought [in] his dog [in]'
(c) Ivan so-stavil plan 'John put [together] a plan [together]'

Because verbs with preverbs form notoriously irregular patterns and are equally notorious for idiomatizing (e.g. *pri 'to' + pisat' 'write' = pripisat'* 'attribute'), they are considered lexical derivates. How, then, may their markers appear a phrase away from the stem which they mark?

Preverbs are in fact often loosely attached to their stem as the examples above from Sanskrit (*pari=a-nayat* = AROUND=IMP-lead 'he married') and Georgian (*mo=g-klav-s* PRVB=2OBJ-KILL-3SUB 'He will kill you') illustrate. These preverbs attach to the outside of the fully inflected verb, the head of the VP. One possible account of these morphemes is that they are clitics, defined in terms of attachment to either the phrasal head or periphery, depending on the morphological conditions of specific languages. The important point is that their position is morphologically predictable by Anderson's general theory of affixation (see *affixation* in section 8.2.1 below), and requires no syntactic projection as do lexemes and free morphemes. Hence it is possible to explain these derivations without violating the Lexicalist Hypothesis, given the Separation Hypothesis.

8.2 Other types of stem modification

8.2.1 Affixation

Affixation (prefixation, suffixation, and infixation) is the most productive means of marking derivation. Anderson (1992: ch. 8) points out that affixation may be defined in the same terms as cliticization, assuming that the peripheral element of a word is its initial or final segment or syllable and its head is the accented syllable. That is, affixes may attach only to the inside or outside of the initial or final phoneme or syllable, or to either side of the head, the accented syllable.[8] This purely morphological definition of affixation is far more accurate than structural descriptions, and does not require word structure or any sort of affix movement. *Circumfixation*, such as Indonesian *ke... -an as besar* 'big': *ke-besar-an* 'bigness, greatness', is merely extended exponence involving a prefix and a suffix simultaneously.

8.2.2 Apophony (stem mutation, revoweling)

This type of stem modification is well attested in Semitic languages. Lexical items in those languages comprise consonants only, and vowels are used to mark morphological functions. The (Algerian) Arabic stem for 'write' is **ktb-*, and the deriva te for 'book' is *ktaab*, while that for 'writer' is *kaatəb*. This type of morphological modification, like subtraction and metathesis, raises the question of the limits on modification of the phonological representation of the base: to what extent may the base be corrupted before it becomes unrecognizable? This is another open question in morphology.

8.2.3 Conversion

Transposing a lexeme from one category to another without affixation is sometimes called *conversion*. The evidence weighs against a separate operation of conversion, however, for we find precisely the same semantic relations between conversional pairs as between derivational pairs. Thus for every conversion *to dry, to wet, to empty* we find at least an equal number of affixed derivates with the same relation: *to shorten, to normalize, to domesticate*. Moreover, precisely those stems which affix are precluded from conversion (*to *short, *normal, *domestic*), and precisely those which convert are precluded from affixation: *to *endry, *wetten, *emptify*.[9] The simpler account of such forms is that those without affixation are null marked variants of the same derivation which is otherwise marked by a variety of affixes.

8.2.4 Paradigmatic derivation

A common means of marking lexical derivation is shifting the base from one nominal declension class to another, with or without a derivational marker. Thus, in Swahili, diminutives are formed by shifting nouns to noun class 3: for example, *m-lango* 'door' (class 2): *ki-lango* 'little door' (class 3), *m-lima*

'mountain': *ki-lima 'hill'*. Feminine agentives in Russian are usually derived from masculines of declension I (= noun class 1) by adding a declension II (= noun class 2) suffix: for example, *učitel'* 'teacher': *u ˇitel'-nic-a*, where the final *-a* indicates declension II. However, the processes of adding the suffix and changing the declensional paradigm must be independent, since the latter may apply without the former: *rob* (masc, declension I): *rab-a* (fern., declension II) 'slave', *suprug* (masc., declension I): *suprug-a* (fern., declension II) 'spouse'.

8.2.5 Prosodie modification

A derivational function may be marked by simply shifting the accent of a word or modifying the intonation, perhaps a variant of apophony. Thus, in English, it is common to indicate the objective (resultative) nominalization by shifting accent from the stem to the prefix: for example, *survéy: súrvey, suspéct: súspect*. The process is productive with verbs prefixed by *re-: rewríte: réwrite, remáke: rémake*. The morpheme here seems to be the process of shifting the accent from one syllable to another.

8.2.6 Reduplication

In addition to attaching phonologically specified affixes to a stem, derivation is often marked by the full or partial reduplication of a part of the stem attached to it. Indonesian forms adverbs from all categories by completely reduplicating them: *kira* 'guess': *kira-kira* 'approximately', *pagi* 'morning': *pagi-pagi* 'in the morning'. Reduplication may be combined with various types of affixation as in Indonesian *anak* 'child': *ke-anak-anak-an* 'childish'.

8.3 Productivity and allomorphic variation

Proponents of *Natural Morphology* (NM) have long noted that not all the modes of stem modification surveyed in the previous section are equally productive (Dressier et al. 1987); some means of morphological marking are more productive than others. Aronoff (1976) first noted that affixes such as the English suffixes *-ing* and *-ness* (e.g. *deriding, kindness*), which are *transparent*, in that they involve no allomorphy, tend to be more productive and more predictable than those which do induce allomorphy: for example, *-ion* and *-ity* (e.g. *deride*: *derision*, but *ride*: **rision; curious: curiosity, but spurious: *spuriosity*).

NM argues that the isomorphic linguistic sign is the linguistic ideal, and that the further a morpheme deviates from this ideal, the more difficult it is for languages to sustain it. If the subjective nominalization changes or adds semantic material to the underlying base, it should add phonological material to the stem iconically and transparently. English derivates like *bak-er, resid-ent, escap-ee* then are more natural, and thus more likely to be productive, than unmarkered derivates like *(a) cook, guide, bore*. Opaque affixes which cause or require phonological adjustments such as the Latinate suffixes mentioned above should be less productive inter- and intralinguistically. Zero and empty morphology should be rare, and subtractive morphology nonexistent for the same reasons.

NM offers a means of uniting Word Syntax and processual morphology. Notice that while NM offers the isomorphic morpheme as the ideal, it implicitly admits the sorts of asymmetrical variations that processual morphology is designed to explain. Processual morphology, however, holds that this ideal is restricted to lexemes in the lexicon. Moreover, it has no inherent account of why transparent, symmetrical markers seem to be more productive than asymmetrical ones. If the predictions of NM hold, they could make a major contribution toward unifying the two major approaches to derivational morphology discussed in this chapter.

9 Conclusion

Derivational morphology differs from inflectional morphology in that it provides new lexical names for objects, relations, and properties in the world. Lexical names may be combined in syntactic constructions to generate descriptions of the real world in speech, or may be used to label objects in the real world: for example, *bakery, careful, occupied, slippery, gentlemen*. The grammatical relations upon which derivation operates seem to be the same as those found in inflection; the difference is that these relations hold between the derivate and its base in derivation, rather than between two different phrases in syntax. Consider *the cookie-baker bakes cookies*, for instance. The noun *cookie-*

baker exhibits internal subject and object relations between the derivate and its constituent parts. The same relations hold in the sentence between the subject, *cookie-baker*, the object, *cookies*, and the verb. The semantic difference between the two uses is that *cookie-baker* is the name of a semantic category while the sentence is a description of a specific event. We would expect inflectional means of marking the subject and object relations in the sentence but derivational means of marking it in the derived compound.

Evidence supports the conclusion that morpholexical derivation and phonological realization are two discrete processes executed by autonomous components. Lexical rules apparently provide for derivation, and either the phonological component or a separate morphological component is responsible for phonological realization. The Split Morphology Hypothesis notwithstanding, it is possible that a single autonomous spellout component accounts for inflectional and derivational morphological realization. If the lexicon and syntax appropriately distinguish morpholexical features and morphosyntactic features, derivation and inflection may be distinguished despite the fact that both operate over the same morphological categories, realized phonologically by the same spellout component.

1 Bybee (1985) is one of several morphologists to take issue with the Lexicalist position itself. She argues that derivational and inflectional processes form a scale along which rules are more or less derivational and inflectional. A rule's position along this scale is determined by its *generality* and *relevance*. Tense, for example, is more general than the functions of prefixes like *trans-* and *re-* since it applies to all verbs. Tense, on the other hand, is more relevant to verbs than is person, since it directly modifies the meaning of the verb, while person simply denotes an argument of the verb. The less general and more relevant the meaning of a morphological operation, the more "derivational" it is; the more general and less relevant, the more "inflectional" it is. Tense by this measure is less derivational than verbal prefix functions, but more so than person. No strict division between the two may be made, however, according to Bybee.

2 Beard (1995: 286–9) offers a contemporary account of phrasal adjectives as an extragrammatical phenomenon.

3 Chomsky's Minimalist Program (Chomsky 1995b) as of the moment provides no theory of derivation, hence any comment would be premature. However, since words are copied from the lexicon "fully inflected," it would seem that Minimalism currently makes no distinction between either derivation and inflection or lexemes and grammatical morphemes. To the extent that this observation is accurate, Minimalism is susceptible to the problems with these assumptions discussed here.

4 Although Bybee exemplifies her hypothesis with inflectional categories, she makes it clear that she intends it to extend to derivation, which, in her view, is merely the other end of the same continuum (see n. 1).

5 Note that the following discussion does not apply to *grammatical gender*, which amounts to no more than *lexical class* (Halle 1989).

6 Only two accounts of the parallel between inflectional and derivational categories have been suggested. According to Botha's *Base Rule Theory* (Botha 1981, Beard 1981), both lexical and syntactic rules operate on deep structures, which must contain these functions. Borer (1988) argues for a single word formation component which operates at two levels, deep and surface structure. At present it is not clear whether these two approaches differ in any essentials.

7 Beard (1993) argues that higher productivity is also facilitated by "dual origin." Subjective and objective nominalization e.g. may be derived either by functional derivation or by transposition. The semantic interpretation is identical in either case; however, if the desired output is blocked for any reason via one derivational type, another means of derivation, which may not be blocked, is available in these cases.

8 Clitics may be attached at correlate points of a phrase, i.e. either side of the phrasal head or either side of a peripheral word or constituent (see Halpern, CLITICS).

9 A few sporadic examples of derivation-"conversion" pairs may be found, e.g. to *clear: clarify, winter: winterize*. However, such pairs are rare and semantically unpredictable, and may be explained as easily in terms of zero morphology.

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3. Compounding

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1 Overview

A compound is a word which consists of two or more words. For example, the Malay compound *mata-hari* 'sun' is a word which consists of two words: *mata* 'eye' and *hari* 'day'. Compounds are subject to phonological and morphological processes, which may be specific to compounds or may be shared with other structures, whether derived words or phrases; we explore some of these, and their implications, in this chapter. The words in a compound retain a meaning similar to their meaning as isolated words, but with certain restrictions; for example, a noun in a compound will have a generic rather than a referential function: as Downing (1977) puts it, not every man who takes out the garbage is a *garbage man*.

1.1 Structure and interpretation

The meaning of a compound is usually to some extent compositional, though it is often not predictable. For example, *popcorn* is a kind of corn which pops; once you know the meaning, it is possible to see how the parts contribute to the whole – but if you do not know the meaning of the whole, you are not certain to guess it by looking at the meaning of the parts. This lack of predictability arises mainly from two characteristics of compounds: (a) compounds are subject to processes of semantic drift, which can include metonymy, so that a *redhead* is a person who has red hair; (b) there are many possible semantic relations between the parts in a compound, as between the parts in a sentence, but unlike a sentence, in a compound, case, prepositions and structural position are not available to clarify the semantic relation.

1.1.1 Endocentric and exocentric compounds

Compounds which have a head are called 'endocentric compounds'. A head of a compound has similar characteristics to the head of a phrase: it represents the core meaning of the constituent, and it is of the same word class. For example, in *sneak-thief, thief* is the head (a sneak-thief is a kind of thief; *thief* and *sneak-thief* are both nouns). Compounds without a head are called 'exocentric compounds' or 'bahuvrihi compounds' (the Sanskrit name). The distinction between endocentric and exocentric compounds is sometimes a matter of interpretation, and is often of little relevance; for example, whether you think *greenhouse* is an endocentric or exocentric compound depends on whether you think it is a kind of house. The major interest in the head of a compound relates to the fact that where there is a clear head, its position seems to be constrained; endocentric compounds tend to have heads in a language systematically on either the right (e.g. English) or left (e.g. Vietnamese, French).

1.1.2 Co-ordinate compounds

There is a third kind of compound, where there is some reason to think of both words as equally sharing head-like characteristics, as in *student-prince* (both a student and a prince); these are called

'appositional' or 'co-ordinate' or 'dvandva' (the Sanskrit name) compounds. Co-ordinate compounds can be a combination of synonyms (example from Haitian):

toro-bèf (*bull-cow*) 'male cow'

a combination of antonyms (example from French):

aigre-doux (*sour-sweet*)

or a combination of parallel things (example from Malayalam):

acchanammamaaṟə (*father-mother-pl.*) 'parents'

Co-ordinate compounds can have special characteristics in a language. For example, in Mandarin, co-ordinate compounds behave differently in terms of theta-assignment from (endocentric) resultative verb compounds. And in Malayalam, co-ordinate compounds are not affected by gemination processes which other compounds undergo (see section 5.2).

1.1.3 The semantic relations between the parts

The semantic relations between the parts of a compound can often be understood in terms of modification; this is true even for some exocentric compounds like *redhead*. Modifiermodifiee relations are often found in compounds which resemble equivalent phrases; this is true, for example, of English AN%N[1] compounds and many Mandarin compounds (see Anderson 1985b). It is not always the case, though; the French compound *est-allemand* (East German) corresponds to a phrase *allemand de Vest* (German from the East). In addition, many compounds manifest relations which can be interpreted as predicator-argument relations, as in *sunrise* or *pull-chain*. Note that in *pull-chain, chain* can be interpreted as an argument of *pull*, and at the same time *pull* can be interpreted as a modifier of *chain*.

1.1.4 Transparency: interpretive and formal

The transparency and predictability of a compound are sometimes correlated with its structural transparency. For example, in languages with two distinct types of compound where one is more interpretively transparent than the other, the less interpretively transparent type will often be subject to greater phonological or morphological modification. A diachronic loss of transparency (both formal and interpretive) can be seen in the process whereby a part of a compound becomes an affix, as in the development of English *-like* as the second part of a compound to become the derivational suffix *-ly*.

1.2 Types of compound

Accounts of compounds have divided them into classes. Some of these – such as the exocentric, endocentric and appositional types, or the various interpretive types (modifier-modifiee, complement-predicator, etc.) – are widespread across languages. Then there are compound types which are language- or language-family-specific, such as the Japanese postsyntactic compounds (4.3), Hebrew construct state nominals (4.2), or Mandarin resultative verb compounds (4.1). Other types of compounds are found intermittently; these include synthetic compounds (section 1.2.1), incorporation compounds (section 1.2.2) and reduplication compounds (section 1.2.3).

1.2.1 Synthetic (verbal) compounds

The synthetic compound (also called Verbal compound') is characterized by a co-occurrence of particular formal characteristics with particular restrictions on interpretation. Not all languages have synthetic compounds (e.g. English does, but French does not). The formal characteristic is that a synthetic compound has as its head a derived word consisting of a verb plus one of a set of affixes (many writers on English restrict this to agentive *-er*, nominal and adjectival *-ing*, and the passive adjectival *-en*). Thus the following are formally characterized as synthetic compounds:

expert-test-ed

checker-play-ing (as an adjective: a checker-playing king)

window-clean-ing (as a noun)

meat-eat-er

(There is some disagreement about whether other affixes should also be included, so that *slum-clear-ance* for example would be a synthetic compound.) Compounds with this structure are subject to various restrictions (summarized by Roeper and Siegel 1978), most prominent of which is that the left-hand member must be interpreted as equivalent to a syntactic 'first sister' of the right-hand member. We discuss this in section 3.2. There have been many accounts of synthetic compounds, including Roeper and Siegel 1978, Selkirk 1982, Lieber 1983, Fabb 1984, Botha 1981 on Afrikaans, and Brousseau 1988 on Fon; see also section 2.1.2. Many of the relevant arguments are summarized in Spencer 1991.

1.2.2 Incorporation compounds

In some languages, incorporation words resemble compounds: for example, both a verb and an incorporated noun may exist as independent words. Bybee (1985) comments on this, but suggests that even where the two parts may be independently attested words, an incorporation word may differ from a compound in certain ways. This includes phonological or morphological differences between incorporated and free forms of a word. (In fact, as we have seen, this is true also of some compound processes; e.g. segment loss, which is found in Tiwi incorporation words, is found also in ASL compounds.) Another difference which Bybee suggests may distinguish incorporation from compounding processes is that the incorporation of a word may depend on its semantic class. For example, in Pawnee it is mainly body part words which are incorporated, while various kinds of name are not (such as personal names, kinship terms, names of particular species of tree, etc.). It is possible that compounding is not restricted in this way; as we will see, semantic restrictions on compounding tend to be in terms of the relation between the parts rather than in terms of the individual meanings of the parts.

1.2.3 Repetition compounds

Whole-word reduplication is sometimes described as a compounding process, because each part of the resulting word corresponds to an independently attested word. Steever (1988), for example, describes as compounds Tamil words which are generated through reduplication: *vantu* 'coming' is reduplicated as *vantu-vantu* 'coming time and again'. In another type of Tamil reduplicated compound, the second word is slightly modified: *viyā.param* 'business' becomes *viyāparam-kiyāparam* 'business and such'. English examples of this type of compound include words like *higgledy-piggledy*, *hotchpotch*, and so on.

1.3 Compounds which contain 'bound words'

In a prototypical compound, both parts are independently attested as words. However, it is possible to find words which can be parsed into an independently attested word plus another morpheme which is not an independently attested word but also does not appear to be an affix (see Aronoff 1976). Here are some examples from English (unattested part italicized):

church-goer *ironmonger tele*vision *cran* berry

The part which is not attested as an isolated word is sometimes found in other words as well; in some cases it may *become* an attested word: for example, *telly* (= television). These parts fail to resemble affixes morphologically (they are relatively unproductive compared to most affixes), and there is no good evidence on phonological grounds for considering them to be affixes. They are also unlike affixes semantically; judging by their contribution to the word's meaning, they have lexical rather than grammatical meanings. A similar example from standard Tamil (Steever 1988) is the form *nā* 'goodness', which is not independently attested, but can be found in compound nouns such as *nalla-nā* 'good-day'.

2 The structure of compounds

One thing that is reasonably clear about the structure of compounds is that they contain two words, and the distinctness of these two components is visible to various rules. Other aspects of structure are not so obvious, however: in the order of the parts regulated by rules 2.1, are their word classes

visible to any rules 2.2, and are three-word compounds hierarchically structured (2.3)?

2.1 Directionality

A compound can be 'directional' in two senses. One sense involves the position of the head: whether on the right or the left. The other sense involves the direction of the relation between the parts of the compound: the direction of modification in a noun-noun compound (e.g. in *log cabin* modification is rightwards) or the direction of complementation in a verb-based compound (e.g. in *push-bike* complementation is rightwards). Notice that the two senses of directionality can be independent, because a compound can have internal modification or complementation without having a head: *killjoy* has no head, but it does have a predicator-complement order. This is an important descriptive issue; some accounts assume that a modifier-modifee or predicator-argument relation inside a compound is itself evidence that part of the compound is a head. To the extent that there are any useful claims about directionality of the head to be made, it is probably best to focus on the narrowest definition of head (which involves a semantic link between head and whole); see Brousseau 1988 for arguments to this effect.

2.1.1 The location of the head

In English, the head of an endocentric word is on the right. In French, the head is on the left (as in *bal masqué*, 'masked ball'). It has been argued (e.g. by DiSciullo and Williams 1987) that all true endocentric compounds are right-headed, and that any left-headed compounds should be considered as exceptions – for example, as phrases which have been reanalysed as words. This is not a widely accepted account (it is based on the controversial Right-Hand Head rule of Williams 1981b).

2.1.2 An argument about directionality and synthetic compounds

Brousseau suggests that the direction of relations inside a compound is responsible for determining whether a language is able to have synthetic compounds. She suggests that in a synthetic compound, the non-head must modify the head, and be a complement of the head. This means that the direction of modification must be opposite to the direction of complementation:

—modifies→

meat-eater

← takes as complement—

Because in English, the directions of complement taking and modification are opposed, synthetic compounds are possible (the same is true of Fon). In French and Haitian (a Fon-French Creole), on the other hand, both modification and complementation are leftward, and so the particular conditions which allow a synthetic compound are absent – hence there are no synthetic compounds in these languages.

2.2 The word classes of the component words

Another question which must be asked about the structure of compounds is whether the class of the component words is relevant, or whether word class is lost when the words are formed into a compound. 'Relevant' would mean, for example, visibility of word class to a class-sensitive phonological or morphological rule. Little attention has been focused on this question; clearly some compound-internal affixation rules are class-sensitive (but this might be because they are added before the compound is formed).

Most of the attention to word class in a compound has focused on the attested word-class structures of compounds in a language. For example, in Punjabi (Akhtar 1992) there are large numbers of compounds involving a combination NN, AN, AA, NV and VV, but none with a structure VA, and very few with a structure VN. Selkirk (1982) suggests that these facts about a language are best expressed by compound-specific rewriting rules analogous to phrase-structure rules. This approach has been adopted by many people, and is useful as a descriptive device. However, there are some fundamental differences between structure-building rules for compounds and structure-building rules for phrases:

(a) There is no true equivalent of X-bar theory as a constraint on compound-building rules.

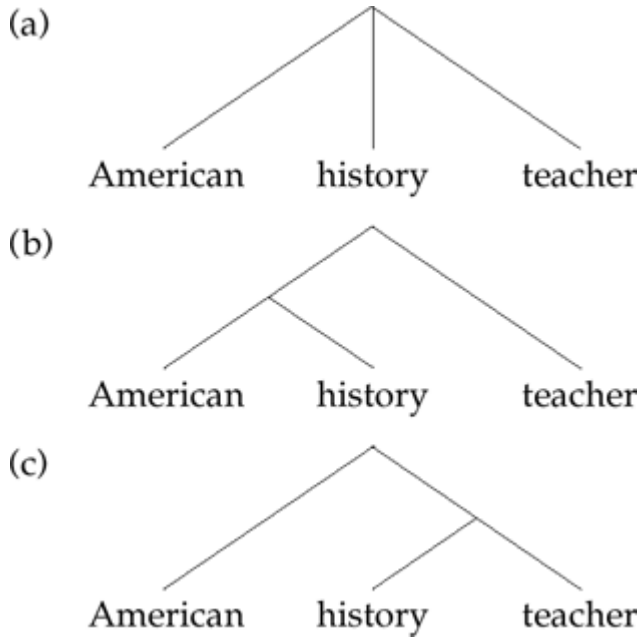
Most obviously, compounds need not have a head. More generally, it is hard to find structural generalizations across compound structures analogous to the generalizations expressed by X-bar theory for phrases.

(b) Compound-building rules would rarely be recursive. In English, for example, the only clearly recursive type is the NN%N combination.

(c) There is a problem about productivity. Phrase-structure rules are fully productive; each rule can underlie an infinite number of phrases (partly because of recursion). But some rules for building compounds are manifested by very few actual compounds. Selkirk recognizes this, and distinguishes rule-built compounds from non-rule-built compounds. Perhaps, though, there is an alternative way of explaining the prevalence of certain compound types along functional rather than formal lines. Thus, in English, the prevalence of NN%N and AN%N types might be because of a functional need for compound nouns before other word classes, and because these have a modifier-modifee structure which is easily interpreted. This is a complex problem which requires metatheoretical decisions about the place of functional considerations and the meaning of productivity.

2.3 Sub constituency in three (or more) word compounds

Where compounds consist of three or more words, the compound can sometimes be interpreted by breaking it down into subconstituents. This is true, for example, of *chicken-leg-dinner*, which is interpreted by taking *chicken-leg* as a subcompound within the larger compound. In some cases, ambiguity arises from the possibility of two alternative groupings of words, as in *American history teacher* (a history teacher who is American or a teacher of American history). This fact about interpretation raises the question of whether three-or-more-word compounds might perhaps have a subconstituent (hierarchical) structure like a phrase (i.e. (b) or (c) rather than the flat structure (a)).



It is not obvious that the interpretive facts alone demonstrate the presence of a complex structure. The interpretive rules might simply pick any pair of adjacent units and make them into a unit, taking a 'syntactic' structure like (a) and building a 'semantic' structure like (b) or (c). Compare hierarchical *phrase* structure, which pre-exists any interpretive strategy, as can be shown by the sensitivity of syntactic processes (such as binding theory) to constituent structure. But compounds are relatively inert compared to syntactic constituents (no movement, anaphoric coindexing, etc.), so it is harder to find supporting evidence for complex constituent structure.

As we will see (section 5.1.1), there is some evidence in English from the stressing of four-word compounds that the compound-specific stress rules are sensitive to a subconstituent structure, and

hence that such structure exists outside the interpretive component. Turkish also presents evidence for subconstituent structure in hierarchically interpreted compounds (Spencer 1991). The 'indefinite izafet compound' has the structure Noun + Noun-poss. when it consists of two words. The three-part compound has one of two types of structure, each corresponding to a different interpretation of its hierarchical structure (as bracketed):

[Noun + Noun-poss.] + Noun-poss.
Noun + [Noun + Noun-poss.]

Here the placement of the possessive affix is sensitive to hierarchical structure.

Most of the multiple-word compounds which are cited (particularly those cited as hierarchical compounds) tend to be combinations of nouns. This suggests that if there are structure-building rules for compounds, as discussed in the previous section, they are not generally recursive.

Note that sometimes a compound can be interpreted as having an internal subconstituency, without that subconstituent being an attested word. An example from Fon (Brousseau 1988) is:

gàn-gɔ̀-kɛ̀n NNN%N money-stomach-cord = money belt

This compound is presumably interpreted as N[NN], but the [NN] subconstituent does not exist as an independent word. This is not necessarily a strong argument against a hierarchical structure in this case, however, because there are also many examples of two-word compounds where one 'word' is not independently attested.

Note that some multiple-word compounds are not interpreted as having a hierarchical structure; this is true particularly of dvandva compounds such as the following from Tamil:

vīra-tīra-cakacaṅ-kaḷ (*courage-bravery-valour-pl.*) 'courage, bravery and valour'

An example of a compound which mixes non-hierarchical with hierarchical interpretation is the following, from Mandarin:

jī-yā-yú-ròu = 'animal foodstuffs' (i.e. chicken-duck-fish-meat) Interpretively the structure is [[chicken + duck + fish] meat].

2.3.1 Hierarchies which include non-word components

A three-member compound need not contain three words. For example, a morpheme may appear between two words in a compound or at one end of a compound. It has been argued by a number of writers that in (English) synthetic compounds, the suffix is a third constituent of the compound; synthetic compounds on this analysis have a hierarchical structure such as [[meat-eat]-er].

3 The interpretation of compounds: interpretive gaps

Extensive descriptive work has been undertaken on the semantic relations holding between the components of English compounds (see e.g. Levi 1978, Warren 1978). An interesting theme that arises from some of this work is the possibility that there are certain gaps: semantic relations between the parts of a word which are possible in principle, but are not attested in practice. In this section we look at two such gaps in English compounds.

3.1 The missing goal

One of the commonest kinds of compound in English is the NN%N type. Many different relations can be interpreted as holding between the two members of such a compound. The interesting question in these cases is whether any relationships are not attested; in surveys of NN%N compounds, both Downing (1977) and Warren (1978) found that while source (something moved away from) was attested, goal (something moved towards) was only marginally attested. Warren found only fourteen potential examples out of 3,994 compounds, and suggests that these may not even be true examples of 'goal' compounds. In her list of relations between the parts of nominal compounds, Levi (1978) has

'from' (e.g. *store-clothes*) but not 'to'.

The same gap can be seen in other compounds; for example, while we find VN%N compounds like *print-shop* (a shop where printing takes place), there are no compounds like *go-place* (meaning a place to which someone goes). This gap also appears in synthetic compounds: *heaven-sent* can be interpreted only as sent *from* heaven, not sent *to* heaven. Note that apparent goal compounds like *church-goer* actually mean 'someone who attends church' (not someone who moves towards church); similarly, *sea-going* means 'going on the sea' (not *to* the sea).

3.2 Synthetic compounds in English: the absence of 'subject'

In a synthetic compound, the crucial interpretive restriction is that the left-hand word (a noun, adverb or adjective) must be interpretable as a complement of the right-hand word (and must *not* be interpretable as an external argument or subject). In effect, synthetic compounds with *-ing* or *-er* are like reversed active verb phrases with equivalent components (play checkers > checker-playing), while synthetic compounds with passive *-en* are like reversed passive verb phrases (tested by experts > expert tested). Synthetic compounds thus differ from other compounds (sometimes called 'root compounds'); hence while **bird-singing* is excluded, there is a compound *bird-song* where the left-hand member is interpretable as the subject of the right-hand member.

Synthetic compounds are interesting because the rules for their interpretation seem to be related to rules for building the meaning of sentences (e.g. the assignment of thematic roles to particular positions in a sentence, depending on the active or passive nature of the verb).

3.3 Ways of explaining interpretive gaps

Interpretive gaps in compounds could in principle be explained in one of three ways:

(a) Constrain the compound-building rules to make them sensitive to interpretation-relevant aspects such as thematic relations. Levi (1978) takes this approach within a Generative Semantics framework, for compound nouns. This is also the approach taken by Roeper and Siegel (1978) in an Extended Standard Theory framework; they build synthetic compounds by a special (transformational) rule which takes a combination of a verb and a subcategorized complement as input. The gaps exist because there is no possibility of building synthetic compounds which have a verb combined with a non-subcategorized argument such as its subject. But Roeper and Siegel's approach (in particular) runs into a problem. Consider, for example, the compound *bird-singing*. This cannot be built by the synthetic-compound-building rule, because it combines the verb with a non-subcategorized argument (its subject). But nothing stops it being built by an alternative rule – the root-compound-building rule, which takes two nouns and combines them (*bird* + *singing*). This rule is not subject to thematic constraints, as can be seen in subject-predicate compounds like *sunrise*. So whatever rules out *bird-singing* as a root compound is clearly not associated with the compound-building rules.

(b) Instead, it may be that the subject is ruled out by some filter which looks at the compound, and if it has the structure of a synthetic compound, applies certain constraints on interpretation to it. This would differentiate root from synthetic compounds not in how they are built, but in their surface form.

(c) A third possible approach would be to explain interpretive gaps in compounds in terms of general constraints on the possible meanings of a word (see Carter 1976). Such an approach does not necessarily require that compound-internal thematic relations be specified, because these relations are not explicitly referred to. This approach might provide an explanation of the 'goal' gap. Note that this gap is found also in non-compound word formation: Hale and Keyser (1992) point out that while there is a verb *shelve*, meaning 'put on a shelf, there is no verb *church*, meaning 'go to church'. It may be that a meaning of 'movement towards' is incompatible with some aspect of possible word meaning. For example, Downing (1977) comments that 'unambiguously fortuitous or temporary relationships' are ruled out in favour of generic or habitual relationships. Perhaps 'movement towards' is ruled out in general because it is not usually a generic or habitual relationship: in this light, it is interesting to compare 'source' (movement from) with 'goal' (movement towards). The source of something remains a stable and permanent property of that thing; the goal of something is its goal only

while it is travelling towards it.

4 Compounds and syntax

In this section we look at some language (or language-family)-specific compound types which have an internal structure open to syntactic manipulation and visible to syntactic processes. Incorporation compounds are a clear example, and synthetic compounds have also been argued to have such a structure (e.g. by Fabb 1988). There are two complicating factors when considering the 'syntactic' aspects of compounds.

One is that compounds tend to have relatively fixed meanings, so that it is difficult, for example, to modify them; the question of syntax vs morphology may be irrelevant here. Thus, for example, the ASL compound 'blue-spot' (= bruise) cannot be morphologically modified to '*darkblue-spot' (?=bad bruise); and the French compound *garde-malade* (= nurse) cannot be syntactically modified to *garde-bien-malade* (?= good nurse).

The second problem relates to the possibility that some compounds are the result of lexicalization of phrases. Thus, while in English it is generally impossible to have *the* inside a compound, there is a word *middle of the road* which looks like a compound but may best be analysed as a lexicalized phrase; the same can be said for many French compounds such as *pomme-de-terre* (= potato) or *trompe-l'œil* (= illusion), both of which contain typically syntactic components, the preposition *de* or the article *l'*. Compounds containing *and*, such as *foot-and-mouth disease* may perhaps be dealt with by claiming lexicalization of a phrase; or it may simply be that co-ordination can involve parts of words with no syntactic implications (see Sproat 1985 and Bates 1988 for different positions on this).

4.1 Mandarin resultative verb compounds

Y-F. Li (1990) discusses resultative verb compounds in Mandarin, which have a VV%V structure:

Baoyu qu-lei-le ma

Baoyu ride-tired-asp horse

'Baoyu rode a horse (and as a result it/Baoyu got) tired'

The resultative verb compound here is *qu-lei*. The first verb describes an action 'ride'; the second verb characterizes the result of that action as a state, 'tired', of the compound verb's subject (Baoyu) or object (that horse). The compound verb thus inherits theta-role-assigning properties from the component verbs. This is one reason for thinking that the internal structure of the compound may be visible in the syntax. Another reason comes from the fact that the first verb can be duplicated and followed by the object, so that the above sentence has this as an alternative form:

Baoyu qu ma qu-lei-le

A third reason for assuming syntactic visibility is that it is possible to modify the compound by inserting *de* or *bu* between the two verbs; the particles add the meaning 'can' or 'cannot' respectively (see Anderson 1985b).

Li suggests that the identification of the first verb as the head of the resultative verb compound has important consequences. He compares the resultative verb compound with a co-ordinate VV%V compound type. In the resultative verb compound, only the first verb must assign its external argument to the subject of the sentence, because only the first verb is the head of the compound word; the second word is free to assign its external argument to the subject or the object in the sentence, resulting in the ambiguity illustrated above. In a coordinate compound, however, both verbs must assign their external argument to the subject of the sentence, because they are both heads of the compound word (hence the ambiguities found in the resultative verb compound are not available to co-ordinate compounds).

4.2 Hebrew construct state nominals

Borer (1988) distinguishes two kinds of multi-word words in Hebrew, construct state nominals:

ca9if ha-yaldá (*scarf the-girl*) 'the girl's scarf

and compounds:

beyt xolím (*house sicks*) 'hospital'

The two kinds of word can be seen as two kinds of compound. Both kinds of compound have word-like phonology (e.g. both have a single primary stress) and morphology (e.g. both are pluralized in the same way). Neither compound can be extracted from. The difference between them is that construct state nominals are more transparent interpretively and syntactically than other compounds; for example, definiteness and plurality on the components of a construct state nominal are taken into account by sentence-interpretation rules. Borer argues that the distinction should be achieved by having word-formation rules in the lexicon (to build ordinary compounds) or in the syntax (to build construct state nominals). A word built in the syntax will have its components visible to syntactic processes.

4.3 Japanese post-syntactic compounds

Shibatani and Kageyama (1988) argue that Japanese has lexical and postsyntactic compounds. A postsyntactic compound is 'postsyntactic' because it appears to consist of the turning of syntactic material into a compound: it consists of a noun phrase followed by a verbal noun which takes it as a complement (i.e. the compound is subject to a kind of first-sister constraint, and so cannot take a scrambled sentence as input). Here is an example of such a compound:

zikken-syuuryoo-go

experiment-finish-after = 'after the experiment was completed'

Postsyntactic compounds are interpretively transparent. They are also transparent to syntactic processes such as anaphoric co-reference, and they can contain demonstratives and honorifics. They do not have the tonal pattern associated with lexical words. Despite these syntactic characteristics, Shibatani and Kageyama argue that the constituents as a whole are words (i.e. compounds), because the case particle (following the NP) is omitted, there is no tense on the verbal element, and the compound cannot be interrupted by an adverb. Like Borer, they thus allow compounds to be built at different levels (in this case, lexicon and PF).

5 Phonological and morphological processes and compounds

Compounds resemble derived words in some ways, and resemble phrasal combinations in other ways. This is true also of the phonological and morphological processes which apply to compounds. For example, some phonological processes group compounds with derived words; others group compounds with phrases; and others isolate compounds as a distinct class. Most recent discussions of these groupings have been in a Lexical Morphology/Phonology framework, and have been used to argue for a level-ordering of morphological and phonological processes (see section 5.2 for an illustration).

5.1 Suprasegmental processes

5.1.1 Stress

One of the most commonly cited compound-specific phonological rules is stress assignment. Compounds may be subject to a rule which places heavier stress on one word. In English, for example, the compound *big-foot* (the name of a monster) is differentiated from the phrase *big foot* by the heavier stressing of *big* relative to *foot* in the compound. (In English and Danish, the first word is stressed; in Italian and Spanish, the second word.) Even where there is not a compound-specific stress rule, compounds can still show interesting stress properties. For example, Anderson (1985b) shows that in Mandarin, contrastive stress 'sees' a compound as a single word, so there is only one place in the compound where contrastive stress can be placed; by comparison, a two-word phrase can have contrastive stress on either word. The stress pattern of English compounds has been the source of extensive analysis. It is relevant primarily in three areas:

(a) The stress pattern of compounds may indicate the presence of hierarchical structure inside the compound. Since most versions of the compound stress rule apply to two-word compounds, it is interesting to see what happens to the stress in larger compounds. In these, there seems to be clear evidence that stress assignment recognizes internal subcomponents; for example, in a four-word compound like *student essay récord book*, the greatest stress is on *record* because a rule recognizes the presence of a subconstituent *record book* and places extra stress here. Note that a different hierarchical structure (corresponding to a different hierarchy of interpretation) involves a different stress pattern, as in *American history teacher association*. This is one of the few pieces of evidence that multi-word compounds in English have a complex internal formal structure.

(b) Compounds must be handled by some system of rules for stress assignment in English. Accounts vary in the extent to which they have rules specific to compounds. Chomsky and Halle (1968) have a separate Compound Rule. Breaking with this tradition, Liberman and Prince (1977) adapt the Lexical Category Prominence Rule so that it applies to derived words and compounds; similarly Halle and Vergnaud (1987) draw attention to the close similarity between rules for compounds and rules for derived words. The question of which rules apply to stress in compounds is relevant to questions of ordering in the lexicon (e.g. level-ordering). This extends beyond English: Shaw (1985) shows that the Dakota 'syntactic compounds' have two major stresses, while the 'lexical compounds' have one major stress; she explains this by having the compounds formed at different levels in a level-ordered lexicon, with stress rules also level-ordered.

(c) English compounds do not all have initial stress; examples of level-and final-stressed compounds are *knee-deep* and *apprentice-welder* respectively. This opens up the possibility that there are structural (or interpretive) characteristics of compounds, which stress rules are sensitive to. Bates (1988), for example, develops an analysis in which the English compound stress rules are sensitive to whether an initial adjective is predicative (initial stress) or not (final stress). Analyses along these lines provide potential evidence for internal structure in a compound (evidence which is otherwise sparse, see section 2.3). Note that the initial/final stress issue is in some cases a matter of dialectal difference; compare British English *ice-créam* and *hot dóg* with American English *íce-créam* and *hót dog*.

5.1.2 Other suprasegmental processes

While stress is the most commonly cited compound-specific suprasegmental process, other such processes may differentiate compounds from derived words or phrasal combinations. In many Mandarin Chinese compounds the second element loses stress because it first loses its tone (Anderson 1985b). In Fon, nasalization occurs in a suffix, but not in the second word in a compound (Brousseau 1988). And Klima and Bellugi (1979) argue that in American Sign Language, temporal rhythm is analogous to stress; a compound word and a simple word take more or less the same amount of time to produce, because in a compound word, the first word is made significantly more quickly. Hence there is a compound-specific temporal reduction rule (cited in Liddell and Johnson 1986).

5.2 Phonological processes between the two words

Segmental phonological processes will tend to happen between two morphemes – either a word and an affix, or two words. There are examples of such processes which distinguish compounds from other combinations. In English, some phonological rules apply within derived words but not within compounds; M. Allen (1978) shows this for *beauty-parlour* vs *beauti-ful*. In Dakota (Shaw 1985) a different alliance can be found, with compounds patterning with derived words rather than phrases: 'lexical compounds' are subject to an epenthesis rule adding a to the end of the first word, which then feeds a continuant voicing rule; this rule is found also in derived words, but not in 'syntactic compounds'.

Malayalam (Mohanan 1982) provides a particularly complex picture of the visibility of compound structures to different phonological processes. Stem-final nasal deletion and stem-final vowel lengthening apply just to compounds. Other rules apply to both compounds and derived words (but not to sequences of words in a phrase), such as a vowel sandhi rule where two adjacent vowels are

merged into one. A further complexity is that some rules apply only to a subset of the compounds: stem-final and stem-initial gemination of obstruents in Dravidian stems occurs in compounds with a modifier-modifiee structure ('subcompounds') but not in co-ordinate compounds. Mohanan uses these facts as evidence for a theory of level-ordered lexical phonology/morphology, along the following lines:

stratum	morphological processes	vowel sandhi	vowel lengthening	nasal deletion	gemination
1	derivation	yes			
2	subcompounding	yes	yes	yes	yes
3	co-compounding	yes	yes	yes	
4	inflection				

5.3 Segment loss

American Sign Language compounds tend to undergo more radical formal restructuring than most spoken language compounds, with loss of segments being a common feature of compound formation. For example, the compound translated as 'black-name' (meaning bad reputation) involves loss of one of the segments of the word for 'name' (which on its own consists of a sequence of two identical segments). Liddell and Johnson (1986) comment that in ASL 'the average compound has the same number of segments as the average simple sign'.

5.4 Morphemes and compounds

5.4.1 Compound-specific morphemes

In some languages, a morpheme (with no independent meaning) may be inserted between the two words. This morpheme may bear a historical relation to some affix, but is synchronically found only in compounds. In German, for example, *s* or *en* may be inserted:

Schwan-en-gesang 'swan song'

5.4.2 Inflectional morphology

There have been two lines of research focusing on whether an inflectional morpheme (e.g. marking plurality, case or tense) can be found on a component word inside a compound.

One approach (e.g. Kiparsky 1982b) focusing on the question of level-ordering of morphological processes, looks at the distinction between regular and irregular inflectional morphology, and asks whether irregular morphology is more likely to appear on a compound-internal word (because it precedes the compounding process) than regular morphology (which comes later than the compounding process). The evidence from English is not particularly clear. As predicted, regular inflection is lacking in some compounds like *footprints* (compare **foots-prints*), where irregular inflection is present in corresponding compounds like *teeth-marks*. But, *contra* predictions, sometimes regular inflection is present as in *arms race* where irregular inflection is missing as in *out-putted*. The second line of enquiry focuses on the implications of having any inflection on a part of a compound, and whether this means that the internal structure of compounds is visible to the syntax (the answer to this depends on one's theory of inflection). For further discussion, see Anderson 1992: ch. 11. Questions about the visibility of inflection relate also to questions about the visibility of theta-assigning properties of subparts (as e.g. in Mandarin resultative compounds) and what this implies about the visibility of compound structure in syntax.

5.4.3 Derivational processes and compounds

Compounds on the whole tend not to undergo derivational processes. However, there are some fairly clear examples such as English *bowler-hatted*, which can only be interpreted as *bowler-hat* + *ed*. It

may be that English synthetic compounds are the result either of a verb-final compound being affixed with *-ing*, *-er*, etc., or of a combination of derivation and affixation (as in Roeper and Siegel's (1978) compound formation rule). There has also been discussion of compounds such as *transformational grammarian*, which on interpretive grounds would seem to involve suffixation of *transformational grammar*; there are, however, other ways of dealing with these 'bracketing paradoxes' (see Spencer 1988b, e.g.). Liddell and Johnson (1986) show that in ASL a reduplication process adds the meaning of 'regularly' to a verb; this process reduplicates all of a compound verb (though this may be an inflectional process).

5.4.4 Clitics and compounds

Dakota postverbal clitics are attached in the lexicon (Shaw 1985). They attach to the first member of syntactic compounds, but not to the first member of lexical compounds.

6 Conclusion

Comparatively little theoretical work has been done on compounds. This is because compounds tend to be less phonologically or morphologically active than derived words, and less syntactically active than phrases: compounds are relatively inert. My view is that the three most interesting questions about compounds are as follows:

(a) If there are compound-building rules, what form do they take? Are they recursive (i.e. building hierarchical structure), and do they take word class into account? Are compound-building rules based on a universally available rule type (i.e. is 'compound' a universal?).

(b) How do compound-building rules interact with other rules – or, put slightly differently, what aspects of compound structure are visible to what other processes, whether syntactic, morphological or phonological? It is particularly important here to show that a certain structural fact about a compound is visible to two distinct rules (e.g. Bates (1988) argues that compound stress rules and interpretive rules both 'see' that a particular modifier in a compound is predicative rather than attributive). The question of the interaction of compound-building rules with other rules has been discussed particularly in the level-ordered systems of lexical phonology and morphology.

(c) Are there interpretive gaps? Are some sorts of meaning not creatable by putting compounds together – and if so, is this because of compound-specific rules, or because of more general principles of possible word meaning?

1 XY%Z is to be interpreted as: [XY] is a compound of word class Z.

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4. Incorporation

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1 Incorporation

Incorporation is the compounding of a word (typically a verb or preposition) with another element (typically a noun, pronoun, or adverb). The compound serves the combined syntactic function of both elements. This chapter focuses on noun incorporation, on which there exists a substantial literature. Much less is known about pronoun incorporation, due largely to the difficulty of distinguishing incorporation from agreement or cliticization. (See Halpern, CLITICS.) Other types of incorporation are rare. (See Muravyova, CHUKCHEE (PALEO-SIBERIAN) for various examples.)

Noun incorporation is the compounding of a noun stem and a verb (or adjective) to yield a complex form that serves as the predicate of a clause (Kroeber 1909, 1911; Sapir 1911; Mithun 1984). Compare sentences (la), (2a), and (3a), where the object nominals are free-standing noun phrases, with sentences (1b), (2b), and (3b), where they are incorporated into the verb stem.

(1) Nahuatl (Sapir 1911)

(a) ni-c-qua in nacatl	(b) ni-*naca* qua.
I-it-eat the flesh	*I-flesh-eat*
'I eat the lfesh.'	'I eat flesh.'

(2) Onondaga (H. Woodbury 1975)
(a) wa?hahninú? ne? oyɛ?kwa?.
tns-he:it-buy-asp. nm. prtc. it-tobacco-n.s.g.
'He bought the tobacco.'
(b) wa?hayɛ?Kwahn úl:nu?.
tns-he:it-tobacco-buy-asp.
'He bought (a kind of) tobacco.'

(3) Chukchee (Comrie 1992)

(a) kupre-n nantəvatg?an.	(b) *kopra*-ntəvatg?at.
net-ABS set	*net-set*
'They set the net.'	'They set the net.'

The incorporated noun in each of the (b) sentences is clearly part of the same word as the verb stem. In (1b) and (2b) the noun appears between the agreement prefixes and the verb. In (3b) the noun undergoes word-level vowel harmony (*kupre* > *kopra*). The above examples also demonstrate that a noun stem, not a word, is incorporated. In Nahuatl the absolute suffix *-tl* appears on free-standing nouns (la) but not incorporated nouns (1b). In Onondaga the nominal prefix *o-* and the final glottal stop appear only on free-standing nouns (2a). Furthermore, all of the above examples show that the incorporated noun does not take a determiner or case marker.

Pairs of examples like those above raise the question: when does a language use a free-standing noun and when does it use an incorporated noun? The noun + verb compound is used to express habitual or general activities or states. The noun is frequently generic and nonspecific in reference, although some languages, such as Southern Tiwa, allow specific nouns to be incorporated:

(4) Southern Tiwa (Allen et al. 1984)
ti-seuan-mũ-ban.
1sg.:A-man-see-past
'I saw the man.'

These nouns are nevertheless devoid of discourse focus. Thus, we see that incorporated nouns in most languages have a different discourse role from free-standing nouns. See Hopkins 1988, Merlan 1976, and Mithun 1984 for discussion of the discourse properties of noun incorporation.

Languages exhibiting noun incorporation place many restrictions on the nouns that can be, or must be, incorporated. H. Woodbury (1975) shows that only nouns that can be stripped down to a simple root can incorporate in Onondaga. Cross-linguistically we find that nouns that arise through nominalization or compounding do not incorporate. The constraints on object noun incorporation in Southern Tiwa (Allen et al. 1984) serve to illustrate the relevance of the semantic class of the nominal. Proper nouns do not incorporate in Southern Tiwa. Mardirussian (1975) posits this as a universal characteristic of noun incorporation. In contrast, inanimate nouns in Southern Tiwa must incorporate. Also, plural nonhuman animate nouns must incorporate. Singular nonhuman animate nouns and plural human nouns must incorporate if they are not modified. Singular human nouns obligatorily incorporate if there is a third-person subject. The above restrictions show that inanimate nouns incorporate more readily than animate nouns, and that nonhuman animate nouns incorporate more readily than human nouns. This hierarchy reflects the general cross-linguistic tendency for nouns that are higher in animacy to be more central to the discourse. The more salient a noun is, the less likely it is to be incorporated.

In some instances, the meaning of these noun + verb compounds may drift from a simple compositional one; that is, they are idiomatic:

(5) Mohawk (Hopkins 1988)
tehanuhwarawý:ye
du-MA-brain-stir-stat
'He's crazy.'

Such considerations lead to the conclusion that the noun + verb compound in a clause with incorporation is not a simple paraphrase of the same verb with a free-standing noun phrase.

We see, then, that it is not always possible to have two corresponding clauses, with and without noun incorporation. This is due to special discourse meaning assigned to incorporated nouns, restrictions on what cannot, can, or must incorporate, and the development of idiomatic meanings. Even when there are two corresponding clauses which seem to be propositionally equivalent, we see that they are not usually in free variation. In most languages, incorporation serves the function of making the nominal less salient in the discourse. In some languages, such as Southern Tiwa, it also seems to serve the function of reducing the number of free-standing nouns in a clause.

2 Syntactic conditions on incorporation

Kroeber (1909) and others have observed that the most common type of incorporation is where the incorporated noun serves as the notional object of the clause. The examples b in (1–3) above show this kind of incorporation. In addition, an incorporated noun can also serve as the notional subject of the clause in most languages:

(6) Onondaga (H. Woodbury 1975)
kahsahe?tahihwi.
it-bean(s)-spill-caus.-asp.
'Beans are spilled.'

(7) Southern Tiwa (Allen et al. 1984)
I-k'uru-k'euwe-m.
B-dipper-old-pres.
'The dipper is old.'

(8) Koryak (Bogoras 1917)
imtilı-ntatk-ın.
strap-break.off-pres.
The strap breaks off.'

In all of the above examples, the predicates hosting the incorporated noun are intransitive predicates that can be characterized as inactive: that is, process verbs, stative verbs, or adjectives. Active verbs generally do not allow incorporation of their subjects. (However, see Axelrod 1990 and Polinsky 1990.)

Sapir (1911) notes that some languages also allow the incorporation of obliques, such as instruments (9) or passive agents (10):

(9) Huahtla Nahuatl (Merlan 1976)
ya' ki-koScCillo-tete'ki panci.
3SG 3SG:it-knife-cut bread
'He cut the bread with it (the knife).'

(10) Southern Tiwa (Allen et al. 1984)
Khwienide Ø-kan-ẽdeure-ban.
dog A-horse-kick:pass-past
'The dog was kicked by the horse.'

In summary, incorporated nouns are typically related to objects or to subjects of inactive predicates, and rarely to locatives, instruments, or passive agents. They do not generally correspond to subjects of active intransitives or transitives, to indirect objects, or to benefactives. In this respect, noun incorporation appears to be like other cases of compounding. (See Fabb, COMPOUNDING.)

Since incorporation is prototypically limited to objects, and since most clauses contain only one object, examples with more than one incorporated noun are rare. One place where multiple incorporation is found is in morphological causatives:

(11) Alyutor (Koptjevskaja-Tamm and Muravyova 1993)
gəmmə t-akka-n-nalgə-n-kuww-at-avə-tk-ən.
I:ABS 1 SG.S-son-CAUS-skin-CAUS-dry-SUFF-SUFF-PRES-1 SG.S
'I am making a son dry a skin/skins.'

(12) Southern Tiwa (Allen et al. 1984)
Ti-seuan-p'akhu-kumwia-'am-ban wisi te-khaba-'i.
1sg.:A-man-bread-sell-cause-past two 1sg.:C-bake-subord.
'I made the man sell the two breads I baked.'

Here we see that two objects are incorporated: the object of the lexical verb and the object of the

causative (the causee).

3 The effect of incorporation on the clause

Incorporation, as defined above, is not a simple case of compounding. In standard cases of compounding, new words are produced, are assigned a category label in the lexicon, and, like simple words, are used in the syntax accordingly. In noun incorporation, however, the stem that results from the compounding of a noun stem and a verb serves a dual role in the clause: it is both the verb and one of the arguments of the verb.

This fact is seen most clearly in languages where clauses with and without incorporation have different valence. In such languages, when the incorporated noun corresponds to the object, the clause is syntactically intransitive. In Nahuatl, for example, the incorporated object does not determine object agreement (cf. (1b) above). In Chukchee, an ergative language, the subject of a clause with an incorporated object appears in the absolutive case, not the ergative:

(13) Chukchee (Polinsky 1990)
(a) ətləg-e qoraŋə təm-nen.
father-ERG reindeer (ABS) kill-AOR.3SG:3SG
The father killed a/the reindeer.'
(b) ətləg-ən qaa-nmə-g?e.
father-ABS reindeer (INC)-kill-AOR.3SG
'The father killed a reindeer.'

This led Mardirussian (1975) to suppose that detransitivization is a universal property of object incorporation.

However, we do not see this effect in all languages. For example, in Southern Tiwa the incorporated noun determines object agreement (for person, number, and class):

(14) Southern Tiwa (Allen et al. 1984)

(a) Ti-shut-pe-ban.	(b) Te-shut-pe-ban.
1sg.:A-shirt-make-past	*1sg.:C-shirt-make-past*
'I made the/a shirt.'	'I made (the) shirts.'

Also, in some ergative languages – for example, Rembarnga (McKay 1975), the subject of a clause with an incorporated object appears in the ergative case, the case used for subjects of transitive clauses:

(15) Rembarnga (McKay 1975)
...piri-rut-manin?-miŋ munana-yi?.
3sg.obj+3pl.trans.sub+Rel-road-build-past.punct. white.man-ERG
'... where the white men built the road'

Therefore, we find that in some languages the incorporation of the object nominal seems to have no effect on the clause valence.

Subject incorporation behaves similarly. In some languages – for example, Onondaga (6) and Southern Tiwa (7) – the incorporated subject determines agreement on the verb. In other languages, however, the incorporated noun does not determine agreement. Instead, there is no agreement, as in Koryak (8), or there is indefinite agreement:

(16) Huahtla Nahuatl (Merlan 1976)

tla-a-weci-Ø-Ø.
indef.-water-fall-pres.-SG
'It is raining.'

Facts like the above lead to the conclusion that it is necessary to distinguish at least two types of noun incorporation (Hopkins 1988, Mithun 1984, Rosen 1989b, H. Woodbury 1975). These will be referred to here as "compounding incorporation" and "classifying incorporation." In compounding incorporation the valence of the clause is decreased, but in classifying incorporation the valence of the clause is not affected. Many languages with incorporation consistently use only one type. However, as Hopkins (1988) and Mithun (1984) have shown, some languages have both types.

3.1 Modification and doubling

Classifying incorporation can be viewed as simply a presentational device: that is, a means for expressing a nominal within the predicate rather than as a free-standing noun, thereby shifting the burden of lexicalization from the noun phrase onto the predicate. In languages with classifying incorporation, it is also possible to have free-standing material in the object position when a noun is incorporated. For example, determiners (17), numerals (18), and other modifiers (19, 20) can appear in the object position of the clause. (A, B are class designations.)

(17) Southern Tiwa (Allen et al. 1984)
Yedi bi-musa-tuwi-ban.
those 1sg.:B-cat-buy-past
'I bought those cats.'

(18) Wisi bi-musa-tuwi-ban.
two 1sg.:B-cat-buy-past
'I bought two cats.'

(19) Wim'a-tin ti-musa-tuwi-ban.
one-only 1sg.:A-cat-buy-past
'I bought only one cat.'

(20) Mohawk (Mithun 1984)
Kanekwaninyu wa'-k-akya'tawi'tsher-ú:ni.
it.dotted.DIST PAST-1sg.-dress-make
'I made a polka-dotted dress.' ('I dress-made a polka-dotted one.')

Such data show that the incorporated nominal should not be regarded as a noun phrase, but rather as the head of a noun phrase.[1]

Furthermore, a full noun phrase can appear in the object position when there is an incorporated noun:

(21) Gunwinggu (Oates 1964)
... bene-red-naŋ redgereŋeni.
they.two-camp-saw camp.new
'... they saw a camp which was freshly made.' ('... they saw a new camp.')

(22) ...bene-dulg-naŋ mangaralalymayn.
they.two-tree-saw cashew.nut
'... they saw a cashew tree.'

(23) Mohawk (Mithun 1984)
Tohka niyohserá:ke tsi nahe' sha'té:ku nikú:ti rabahbót
several so.it.year.numbers so it.goes eight of.them bullhead
wahu-tsy-ahni:nu ki rake'níha.
he-fish-bought this my.father
'Several years ago, my father bought eight bullheads.'

In this case, the free-standing object must be semantically related to the incorporated noun. It is either a double of the incorporated noun, as in (21), or a more specific noun phrase referring to the

same element as the incorporated noun, which is often of a generic nature, as in (22) and (23).

Examples like these have led Di Sciullo and Williams (1987) to claim that it is unreasonable to propose that noun incorporation arises through a transformation that takes the head of the noun phrase and moves it into the predicate (Baker 1988a, Postal 1979, Mardirussian 1975). While it may be possible to account for examples like (21) by allowing the noun to leave a copy of itself *in situ*, such a proposal does not accommodate data like (22) and (23), where the external position is occupied by a more specific coreferential noun phrase. (See Spencer 1991: ch. 7, for an evaluation of this debate.)

3.2 Other nominals in clauses with incorporation

In many languages, nominals other than the patient can appear as the grammatical object – for example, benefactives, locatives, and possessors. We find that this is also the case in many languages with incorporation. In the following examples, the patient is incorporated, while the benefactive (24, 25) or locative (26) serves as the grammatical object:

(24) Classical Nahuatl (J. R. Andrews 1975)
ni-quin-xōchi-tēmo-lia.
1sg.-3pl.-flower-seek-for
'I seek flowers for them.'

(25) Chukchee (Polinsky 1990)
tumg-e ekək kayŋə-nmə-nen.
friend-ERG son (ABS) bear-kill-AOR.3SG:3SG
'The friend killed the bear for his son.'

(26) Chukchee (Polinskaja and Nedjalkov 1987)
ətləg-e kawkaw mətqə-rkele-nen
father-ERG bread (ABS) butter-spread on-AOR.3SG:3SG
'The father spread the butter on the bread.'

That a semantically oblique nominal is the grammatical object is evidenced by the fact that it determines object agreement (24) or appears in the absolutive case (25, 26).

More commonly, the incorporated noun corresponds to a possessed nominal: that is, the head of a possessive phrase. When a possessed body part is incorporated, the possessor assumes the function of object in the clause, and hence determines object agreement.

(27) Tupinambá (Rodrigues, n.d.)

(a) s-oßá a-yos-éy.	(b) a-s-oßá-éy.
his-face I-it-wash	*I-him-face-wash*
'I washed his face.'	'I face-washed him.'

(28) Blackfoot (Frantz 1971)
Nít-ssik-o'kakín-aw óma nínaawa.
I-break-back-him that man
'I broke the man's back.'

(29) Gunwinggu (Oates 1964)
namegbe biru-dur-aynbom.
that (man) he/him-heart-speared
'He speared that man in the heart.'

In many languages, constructions like the above are limited to cases of part_ whole possession. However, in some languages, alienably possessed nouns can also be incorporated, and, as above, the possessor assumes the object function.

(30) Southern Tiwa (Allen et al. 1984)
Ka-kuchi-thã-ban.
1sg.:2sg./ A-pig-find-past
'I found your pig.'

(31) Classical Nahuatl (J. R. Andrews 1975)
ni-mitz-cac-tohtoma.
Isg.-2sg.-shoe-undo
' I take off your shoes.'

Instances of possessors assuming the role of the possessive noun phrase are not limited to object function. As noted above, most languages allow the incorporation not only of a noun corresponding to the object of a transitive verb, but also of a noun corresponding to the sole argument of an inactive intransitive predicate. If this argument is a possessed body part, the body part is incorporated, and the possessor takes on the subject function in the clause, and hence determines subject agreement.

(32) Blackfoot (Frantz 1971)
Nit-á-istts-o'kakíni.
I-DUR-pain-back
'I have a backache.'

As in the case of possessed objects, some languages also allow alienably possessed subjects to be incorporated:

(33) Southern Tiwa (Allen et al. 1984)
In-shut-k'euwe-m.
1sg./A-shirt-old-pres.
'My shirt is old.'

(34) Alyutor (Koptjevskaja-Tamm and Muravyova 1993)
gəmmə tə-sejnik-av-Ø-ək.
I:ABS 1 SG.S-tea.pot-have.a.hole-AOR-I SG.S
'I have a hole in my tea-pot.' (Approx. 'I am tea-pot-broken.')

4 Incorporation compared to other similar phenomena

The properties of noun incorporation can be summarized as follows:

(i) An element that can otherwise exist as a noun stem and an element that can otherwise exist as a verb stem are compounded into a single word.

(ii) This word serves as the predicate of the clause, and the incorporated noun stem corresponds to one of the arguments of the verb.

(iii) Prototypically, the incorporated noun stem corresponds to the object of a transitive predicate or the subject of an inactive intransitive predicate. In many languages, an incorporated noun may also correspond to an oblique nominal, such as a locative, instrument, or passive agent.

(iv) Two types of incorporation exist across languages (and sometimes within a single language): compounding incorporation, which decreases the valence of the clause, and classifying incorporation, which does not decrease the valence of the clause.

(v) Languages with classifying incorporation allow the modification or doubling of the incorporated element.

(vi) In both types of incorporation, when the incorporated noun corresponds to the head of a possessive phrase, the possessor assumes a grammatical function – subject or object – in the clause.

If we look beyond the strict definition of incorporation in (i), we find that many languages exhibit phenomena that share many of the properties of noun incorporation. Several of these phenomena are discussed in the following sections.

4.1 Noun stripping

One phenomenon that closely resembles noun incorporation is noun stripping (Miner 1986, 1989), also known as composition by juxtaposition (Mithun 1984). As seen in (35b), a "stripped" noun does not have the usual case marking associated with its grammatical function.

(35) Tongan (Churchward 1953)
(a) Na'e inu 'a e kavá 'e Sione.
PAST drink ABS CONN kava ERG John
'John drank the kava.'
(b) Na'e inu kava 'a Sione.
PAST drink kava ABS John
'John kava-drank.'

Noun stripping differs from incorporation, however.[2] Incorporation is morphological: the two elements involved are part of the same word in surface structure. In noun stripping, the two elements remain as separate words according to phonological criteria such as stress placement. However, surface adjacency of the noun and verb is required. For example, in Kusaiean, adverbs can appear between a verb and an object (36a) but not between a verb and a stripped noun (36b).

(36) Kusaiean (K. Lee 1975)
(a) Sah el twem upac mitmit sac.
Sah he sharpen diligently knife the
'Sah is sharpening the knife diligently.'
(b) Sah el twetwe mitmit upac.
Sah he sharpen knife diligently
'Sah is diligently knife-sharpening.'

The motivation for noun stripping may be simple: languages prefer to represent generic and nonspecific nouns with as little morphological marking as possible. We can observe, however, that noun stripping does more than simply delete the case marking or determiners of the noun phrase; the valence of clauses with noun stripping is also decreased. For example, the subject in (35b) is in the absolutive case, indicating that it is the subject of an intransitive clause. In this respect, noun stripping is like compounding incorporation. As is the case in compounding incorporation, stripped nouns may not be modified:

(37) Kusaiean (ibid.)
*Nga twetwe mitmit sahfiht sac.
I sharpen knife dull the
'I am knife-sharpening the dull Ø.'

Miner (1986, 1989) points out other similarities between incorporation and noun stripping. Like incorporation, noun stripping is almost always limited to objects and to subjects of inactive verbs. Prototypical stripped nouns are indeterminate and inanimate, though animate nouns may be stripped in some languages. The stripping of possessed nouns is rare.[3]

Thus, noun stripping is very much like incorporation, particularly compounding incorporation. The sole difference is that in true incorporation the noun and verb form a single word. Noun stripping can thus be seen as a precursor of noun incorporation. If the language tolerates complex morphology, over time noun stripping can develop into incorporation.

4.2 Lexical suffixes

Salish languages, Wakashan languages, and other northwestern Native American languages are well

known for their lexical suffixes. These suffixes have substantival meaning, but bear little, if any, resemblance to free-standing nouns with the same or similar meaning. Compare some lexical suffixes in Halkomelem Salish with free-standing nouns of similar meaning: *-cəs* versus *céləš* 'hand', *-šən* versus *sx̌énʔə* 'foot', and *-ʔéx̌ən* versus *t'élu* 'arm, wing'.[4] Most Salish languages have around one hundred lexical suffixes denoting body parts ('hand', 'foot', 'heart', 'nose'), environmental concepts ('earth', 'fire', 'water', 'wind', 'tree', 'rock', 'berry'), cultural items ('canoe', 'net', 'house', 'clothing', 'language'), and human terms ('people', 'spouse', 'offspring'). Lexical suffixes are widely used in complex nominals:

(38) Halkomelem (Musqueam dialect, Wayne Suttles, p.c.)

Halkomelem (Musqueam dialect, Wayne Suttles, p.c.)	
qáʔ-liʔc	'water box' (water + container)
tə́x̣^{w}ac-əłp	'yew tree' (bow + plant)
xiləx̣-áwəł	'battleship' (make war + vessel)
t'íwəyəł-éwtx^{w}	'church' (worship + building)

They also appear on verbs, and in this case they have the same syntactic and semantic properties as incorporated nouns. First, the lexical suffixes correspond to the same range of relations typical of noun incorporation: objects (39a), subjects of inactive predicates (39b), and obliques such as locatives (39c) and instruments (39d), but not subjects of active verbs, goals, or benefactives.

Halkomelem (Musqueam dialect, ibid.)		
(a)	θék̓^{w}-əl'yən	'pull a net' (pull + net)
	məƛ'-é:l-zeʔ	'to return wealth' (return + hide)
	səẇq̓-iẇs	'search for a lost person' (seek + body)
	łəc̓-ə́l-qən	'shear wool' (cut + hair)
(b)	yəq^{w}-əlʔcəp	'fire burns' (burn + firewood)
(c)	q̓ət-á-θən	'walk along (a shore etc.)' (go along + mouth)
	p̓á:-l'-cəp	'blow on a fire' (blow + fire)
(d)	k̓^{w}c-áləs	'see with one's own eyes' (see + eye)
	q̓ə-xín-t	'accompany him' (accompany + foot + transitive)

Second, we see the same sort of transference of argument structure in cases of lexical suffixation that we saw with incorporation. When the lexical suffix is notionally equivalent to a possessed noun, the possessor assumes a clausal argument position:

(40) ni łic'-áq^{w}-t-əs łə słeni? k^{w}θə swiw?ləs.
aux. cut-head-tr.-3erg det. woman det. boy
'The woman cut the boy's hair.'

(41) ni can k'^{w}əs-cəs.
aux. 1sub. burn-hand
'I burned my hand.'

In general, Salish lexical suffixes parallel compounding incorporation. First, we can see that when the lexical suffix refers to the object, the clause is intransitive, since the subject determines absolutive rather than ergative agreement:

(42) ni yəq^{w}-əl?-cəp(*-əs).
aux. burn-cn.-firewood(-3erg)*
'He made a fire.'

Furthermore, external modification is usually not possible:

(43) ni lək^{w}-əl-wíl-t-əs (*(k^{w}θə) łíx̌^{w}) k^{w}θə John.
aux. break-cn-rib-tr.-3erg. det. three det. John
'He broke (*three of) John's ribs.'

Finally, the lexical suffix usually cannot be doubled with a free-standing noun of the same or more specific meaning:

q^{w}s-iy̓ən (*tə-n̓ swəltən)
go into water-net det.-your net
'set your net'

(45) ni tší-?q^{w}-t-əs (*k^{w}θə sx̌áləməs-s) łə stál?əs-s.
aux. comb-head-tr.-3erg. det. white hair-3pos. det. spouse-3pos.
'He combed his wife's (*white) hair.'

The above data show that lexical suffixation parallels compounding incorporation. We see that lexical suffixes, just like incorporated nouns, have the syntactic characteristics of a nominal in an argument or adjunct position in the clause. And while we have no direct evidence that the lexical suffix should be assigned the categorial status of a noun, we note that it does block a freestanding noun of the same or more specific meaning from occurring in the clause.

In addition, a small subset of lexical suffixes in each Salish language can serve as numeral classifiers. For example, there are thirteen classifiers in Halkomelem, including *-as* 'round or spherical objects', *-aq^{w}* 'head' (e.g. of cabbage, animals), *-ewtx^{w}* 'building', and *-x^{w}əɬ* 'canoe, conveyance'. This type of lexical suffixation parallels classifying incorporation. In the case of numerals, the classifier is usually doubled with an elaborating nominal:

(46) łix^{w}-əqən lisék
three-containers sack
'three sacks'

(47) te?cs-élé k^{w}θə nə me?mənə.
eight-people det. 1pos. children
'I have eight children.'

Also, in rare examples, classificatory suffixes attached to a lexical verb can double with a free-standing nominal:

Halkomelem (Musqueam dialect, Wayne Suttles, p.c.)
ż̓s-ələ́?c-t tə náwək^{w}a?
nail-container-tr. det. coffin
'nail up the coffin'

wə-náy kʷs žəx̌-wil-t ct tə lepát ʔi tə láʔθən.
only det. wash-vessel-tr. 1pl.sub. det. pot and det. dishes
'We only wash pots and plates.'

Data like the above are quite suggestive of noun incorporation. However, Sapir (1911: 251–2) says that the Salish lexical suffixes should not be considered to be noun incorporation. He claims that "it is clear that verbal affixes that refer to nouns… are not instances of noun incorporation if they are etymologically unrelated to the independent nouns or noun stems with which they seem logically connected." This point of view has been taken by Mithun (1984) and others (see e.g. Anderson 1985b, Hagège 1978) as rationale for excluding lexical suffixes from discussions of noun incorporation.[5] However, it has been claimed that lexical suffixes originated as nominals that commonly occurred as the second element in compounds (Carlson 1989). They were phonologically reduced, and eventually became bound forms. Once these shortened forms took on a generic meaning, new, longer, free-standing forms with more precise meaning were invented. From this viewpoint, lexical suffixes can be regarded as incorporated nouns that have lost their status as free-standing nominals.

4.3 Denominal verbs

In some languages we see a phenomenon that is the reverse of lexical suffixation. A noun stem that can be an independent word is compounded with a verbal affix that does not otherwise appear as a free-standing verb:

(50) Greenlandic (Sadock 1980)
Qimmeqarpoq.
dog-have-INDIC-3sg.
'He has a dog.'

Sadock (1980) estimates that there are roughly two hundred verbal affixes that can be attached to nouns in Greenlandic. These include *-qar-* 'to have', *-nngor-* 'to become', and *-lior-* 'make for'. Although such examples have been referred to as noun incorporation, a more appropriate label would be "denominal verbs." (See Mithun 1986 and Sadock 1986.)

Denominal verb constructions show interesting properties that at first glance may seem to parallel noun incorporation. First, like classifying incorporation, they allow external modification:

(51) Greenlandic (Sadock 1980)
Kusanartunik sapangarsivoq.
beautiful-NOM-PL-INST bead-get-INDIC-3sg.
'He bought beautiful beads.'

Second, the verbalized nominal can correspond to the head of a possessed noun phrase.

(52) Greenlandic (ibid.)
(a) Tuttup neqaanik nerivunga.
reindeer-REL meat-3sg.-INST eat-INDIC-1sg.
'I ate reindeer meat.'
(b) Tuttup neqitorpunga.
reindeer-REL meat-eat-INDIC-1sg.
'I ate reindeer meat.'

Note, however, that unlike the cases of noun incorporation discussed above, the possessor does not take on the object role in the clause when the head appears predicate-internally. Rather, it remains in its usual case, the relative/ ergative. The Greenlandic data also differ from noun incorporation with respect to the complexity of the nominals involved. In some examples, the noun to which the verbal

suffix is attached is not a bare noun stem, but rather bears case and other inflectional suffixes:

(53) Greenlandic (ibid.)
Palasip illuanukarpoq
priest-REL house-3sg.-ALL-go-INDIC-3sg.
'He went to the priest's house.'

Finally, the Greenlandic denominal verb construction differs from noun incorporation with respect to the grammatical relation of the participating noun. In noun incorporation, it is usually objects, subjects of inactive verbs, or obliques that incorporate. The Greenlandic data seem to involve objects (50) or obliques (53), but not subjects.[6] Sadock (1980) also gives examples involving predicative nominals:

(54) Palasinngorpoq.
priest-become-INDIC-3sg.
'He became a priest.'

The above examples show that what has been called noun incorporation in Greenlandic differs from core cases of noun incorporation in other languages. However, these data provide strong evidence that the predicate-internal nominal must be the head of the noun phrase in the syntax. Thus the derivational process of compounding the noun and the verb, whatever it is called, must occur in a postsyntactic level of structure (Sadock 1980).[7]

5 Conclusion

True noun incorporation, where a noun stem compounds with a verb, is a typologically rare phenomenon, though it appears in languages in many areas of the world. Noun incorporation is exhibited in some of the language families of the Americas (Algonquian, Athapaskan, Caddoan, Iroquoian, Muskogean, Siouan, Takelma, Tanoan, Tsimshian, Tupinambá, Uto-Aztecan, Yana), in Paleo-Siberian languages (Alyutor, Chukchee, Koryak), in Australian languages (Gunwinggu, Rembarnga), in a Munda language (Sora), in Oceanic languages, and in Turkish. (See Mardirussian 1975, Mithun 1984, and de Reuse 1992.)

In addition, several languages have constructions that might be analyzed as either noun stripping or noun incorporation: for example, Mayan, Zuni, and several Austronesian languages (Miner 1986). Noun stripping, where a noun (usually the object) is stripped of its case marking and positioned next to the verb, can be viewed as a precursor of incorporation or as the equivalent of incorporation in analytic languages. Lexical suffixes, which probably originated through incorporation, can be found in northwestern Native American languages, including the Salishan and Wakashan languages. What has been called "noun incorporation" in Greenlandic (Sadock 1980) is best regarded as a denominal verb (Mithun 1986).

However these various constructions are labeled, they all present an interesting challenge to theories of morphosyntax. In each case, a noun (or nominal affix) combines with a verb (or verbal affix) to form a complex predicate. In the case of noun incorporation, lexical suffixation, and denominal verbs, the complex predicate is a single word by morphological and phonological criteria. Thus, two syntactic constituents combine to form a single word that satisfies both the predicate function and some argument function (usually object) of the clause. This mixture of properties has led Mithun (1984) to call noun incorporation "the most nearly syntactic of all morphological processes."

1 Alternatively, the incorporated noun could be coreferential with a phonologically null head.

2 Miner (1986) argues that noun stripping and noun incorporation are distinct processes by showing that both exist in Zuni.

3 Japanese and Korean exhibit a phenomenon sometimes referred to as noun incorporation, but probably more accurately classified as noun stripping, where nouns preceding the verbs meaning 'do' are stripped of their case marking. Either nominative or accusative case can be stripped, depending on the valence of the clause. Modifiers, including possessors, which appear in the genitive case if the head noun is marked with

case, cannot appear in the genitive case if the noun is stripped. Rather, the modifier is marked nominative or accusative, depending on the valence of the clause.

4 Unless otherwise specified, the data in this section are from the Island dialect of Halkomelem Salish (Gerdts, field-notes).

5 Hagège's discussion hinges on the contrast between lexical suffixation and another construction that he calls noun incorporation. However, this latter construction is more appropriately classified as a denominal verb construction (see section 4.3).

6 As Sadock (1980) argues, the denominal verb construction is based on an intransitive construction. (See (52a) for example.) The notional object normally appears in the instrumental case. This accounts for the instrumental marking of modifiers, as in (51).

7 Alternatively, a theory of grammar such as Autolexical Syntax (Sadock 1985), in which morphological structure and syntactic structure exist independently but are cross- referenced with each other, could capture these facts.

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5. Clitics

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1 Introduction

While the distinction between independent words or phrases on the one hand and affixes on the other is often fairly clear, many languages have various formatives which are hard to classify as one or the other. Such formatives are often called clitics.[1] As we shall see, the various elements which are called *clitics* form a heterogeneous bunch, at least superficially, and exactly what is meant by "clitic" varies from study to study, though there are two predominant senses.

In some uses, "clitic" denotes any prosodically weak (unaccented) element which is not a canonical inflectional or derivational affix.[2] This is the sense in which the term is usually used in the discussion of phonological issues. Whether such a clitic lacks independent accent inherently or because of some reduction process, it must be incorporated into the accentual structure of an adjacent word or phrase, the clitic's *host*, since in order to be pronounced, a formative (word, affix, etc.) needs to be part of an accentual unit. This dependency leads to one of the common diagnostics used to distinguish clitics from independent words: they may not constitute an utterance on their own. Clitics which form a prosodic unit with a host on their left are *enclitics*, while those forming a unit to their right are *proclitics*.

Cliticization in this strictly phonological sense need not entail any syntactic consequences. An unstressed word which is otherwise unexceptional is known as a *simple clitic*, after Zwicky (1977); for example, a simple clitic which is a preposition will head a prepositional phrase and be followed by its complement; the resulting phrase will have the distribution of any other PP in the language. In contrast to this prosodic definition of the clitic, syntactic discussions usually use the term to refer to the sort of weak pronoun found in modern Romance languages which appears in a special position in the clause (generally immediately before the verb). However, the syntactic and morphological issues raised by such *special clitics* extend to elements with other functions and other distributions, as we shall see in later sections.

In the remainder of this chapter, I will focus primarily on the behavior of special clitics, but it will be instructive to examine simple clitics first, since some of the apparently distinctive properties of special clitics may result purely from their prosodic weakness rather than anything to do with syntax or morphology (section 2). In sections 3, 4, and 5, we will examine in some detail the behavior of various types of special clitic and the descriptive and theoretical issues they raise. In the final section, we will return to some proposals which aim to provide a general theory of the distribution of clitics.[3]

2 Simple clitics – accentless words

Reduced auxiliaries and pronouns in English are often cited as examples of simple clitics; they lack stress, and are pronounced as a single unit with the preceding word, while their distribution is essentially a subset of that which the corresponding unreduced forms occupy. Various function words

in most if not all languages may be reduced in this fashion, or perhaps be listed in the lexicon without an inherent accent (see Kaisse 1985 for discussion of these alternatives).

(1) She will have to find a new job soon. [šiwil]/[šil]/[šl]

Jonathan saw him. [sɔhɪm]/[sɔm̩]/[sɔm]

Simple clitics often do not have the full range of distribution of an independently accented word of the same category, but the restrictions seem to reflect a filtering of the structures permitted by the syntax, rather than some special syntactic status. For instance, fully reduced (i.e. vowel-less) forms of auxiliaries other than *is* and *has*, which are subject to looser constraints, are available only immediately after a subject pronoun, and not after a nonpronominal subject, a nonsubject, or even after a pronoun if the pronoun is part of a coordinate subject.

(3) He'll have to go now. [hl]

(4) Mary'll have to go now. [mæril]/*[mærl]

(5) Mary and he'll have to go now. [hil]/*[hl]

Perhaps more surprisingly, reduced auxiliaries are also sensitive to the following context, being ungrammatical before the site of various elisions, though they are phonologically enclitic.

(6) John's tired, and Mary is too/*Mary's – too.

(7) John's as tall as you are/*you're – wide.

These limits on the distribution of reduced auxiliaries have received a good bit of attention (Kaisse 1985, Selkirk 1984), with the nature of the elements to which the constraints must refer – syntactic or prosodic – being the primary theoretical question.[4] Regardless, we may say that the syntax per se, as opposed to postlexical/postsyntactic phonological rules or filters, does not need to give special treatment to reduced auxiliaries.[5]

Regarding the attachment of a clitic to its host, there is considerable debate as to its nature. It is commonly accepted that, for simple clitics, it is of a nonsyntactic nature. Zwicky and Pullum (1983a) consider syntactic irrelevance an important way of distinguishing cliticization from affixation, one of several which have become a standard set of diagnostics.[6] This can be made sharper by contrasting reduced auxiliaries with *n't*, the reduced form of *not*, which does behave like a part of the preceding auxiliary, as illustrated by the fact that it may accompany the auxiliary in subject-auxiliary inversion contexts.

(8) Isn't/*Is not Regina going to come to practice tonight?

(9) Is Regina not/*n't going to come to practice tonight?

Various authors have proposed that cliticization involves the formation of a morphological constituent, making it affix-like in this sense, though not syntactically (see esp. Sadock 1991). This is motivated by the fact that cliticization can lead to phonological interactions between a clitic and its host which are not seen between two independent words. However, the phonology and morphology of cliticization is generally not entirely that of an affix. For instance, like suffixes, enclitics in Latin affect the location of stress on their host; independent words, on the other hand, generally do not affect the stress of an adjacent word. Yet, the effect of an enclitic is not the same as the effect of a suffix (Nespor and Vogel 1986: 115–16; Steriade 1988). The addition of a suffix causes stress to shift so that it is located as follows: stress is on the penultimate syllable if that syllable is heavy, but on the antepenultimate syllable if the penult is light, as shown in (10a, b). The addition of a clitic, however, causes stress to appear on the penultimate syllable of the host + clitic sequence regardless of the weight of that syllable, as shown in (10c, d):

(a)	stomachŏ́sus	'irritated'
(b)	homúncŭlus	'little man'
(c)	rosā́=que	'and the rose (nom.)'
(d)	rosā́=que	'and the rose (abl.)'

Simple clitics are also notably lacking in irregularities in their combinations with their hosts; they are not involved in suppletion, and do not generally enter into morphologically conditioned alternations with their hosts. Several explanations of this phonologically and morphologically intermediate behavior have been advanced, including treating clitics as an outer layer of affixation within a level-ordered morphology (Klavans 1983, Kanerva 1987, Booij and Rubach 1987), treating clitic + host as a *clitic group* – a unique prosodic constituent between the phonological word and the phonological phrase (Hayes 1989a, b; Nespor and Vogel 1986), treating clitics as being adjoined to phonological words or other prosodic constituents (Inkelas 1990, Zee and Inkelas 1991, Lapointe 1991, A. Woodbury 1996).

To sum up, it is quite common for stressless function words to behave in a syntactically normal fashion while being prosodically bound to an adjacent word. Ways in which such a simple clitic differs from a nonclitic may be derived from the surface conditions or filters which the clitic imposes, plausibly reducing to requirements related to the incorporation of a clitic into its host.

3 Verbal clitics

In contrast to, say, weak pronouns in English, which occupy essentially the same position as stressed pronouns and nonpronominal NPs, weak pronouns in French do not behave like other noun phrases. Consider the following examples:[7]

(11) (a) Jean le vois. (Fr)
Jean it sees
'Jean sees it.'
(b) *Jean vois le.

(12) (a) Jean vois le livre.
Jean sees the book
'Jean sees the book.'
(b) *Jean le livre vois.

While nonclitic objects follow the tensed verb in a simple finite clause, clitics must precede it. Similar behavior for weak pronouns is observed in many languages, including nearly all of the modern Romance dialects and several Balkan languages (Greek, Macedonian, Albanian). Their special distribution and other ways in which they differ from independent words distinguish them from simple clitics. At least superficially, there are a variety of types of such special clitics, and I will refer to the type illustrated above as *verbal clitics*.

Kayne (1975) pointed out several respects in which verbal clitics are like inflectional affixes.[8] To begin with, they always appear adjacent to a verb and attach morphologically or phonologically to it.[9] They are also subject to various language-specific co-occurrence conditions which are similar to conditions on the co-occurrence of inflectional affixes; these conditions are often expressed in terms of a *template* which separates clitics into groups which are associated with an ordered set of slots.[10] A given slot will generally contain at most one clitic, drawn from the relevant group. The classes of clitics associated with a given slot are defined according to a variety of properties, grammatical function and grammatical person being common factors, but phonological shape may also play a role (Schachter 1973, Tegey 1978). Such templates are also known in systems of complex inflectional morphology, as in the Athabaskan languages. Consider the following examples (where '1', '2', '3' means '1st', '2nd', '3rd' person):

(13) Bulgarian: NEC < FUT < AUX < IO < DO < 3SG.AUX

(14) French: 1 /2.PRO < 3ACC.PRO < 3DAT.PRO < y < en

(15) Ngiyambaa: PRT* < 1PRO < 2PRO < 3NOM.PRO < 3GEN.PRO < 3ABS.PRO (Donaldson 1980)

(16) Tagalog: 1 σ.PRO < PRT* < 2σ.PRO*

Phonologically speaking, certain nonautomatic alternations are observed between two special clitics and, perhaps less commonly, between special clitics and their host. For instance, Simpson and Withgott (1986: 167) note the arbitrary insertion of [z] in dialectal French *donnez-moi-z-en* 'give me some'. See also Akmajian et al. (1979: 5ff). Morphologically, we also find portmanteau clitics, and clitics whose interpretation depends on the presence or absence of other clitics (Steele et al. 1981: 24ff, Perlmutter 1971, Simpson and Withgott 1986).

Based on such observations, it is generally accepted that verbal clitics are syntactically adjoined to the verb or to a functional head which incorporates the verb. Indeed, they are often assumed to be types of inflectional affixes themselves, perhaps simply agreement markers. This *base generation* approach is a relatively traditional view; within the generative literature, it has been defended within a variety of frameworks (Rivas 1978; Lapointe 1980; Borer 1984; Stump 1980; Jaeggli 1982, 1986b; Suñer 1988; Dobrovie-Sorin 1990; P. Miller 1992). However, despite these similarities between clitics and inflections, there are also several respects in which clitics are not like canonical agreement affixes.

Agreement is usually a local relationship between a head and one of its arguments, and applies obligatorily regardless of the nature of the argument. Inflectional affixes are generally fixed in position with respect to a stem; and object-agreement affixes are generally internal to (or, closer to the stem than) tense, aspect, and subject agreement (Bybee 1985). Finally, inflection often involves a high degree of irregularity, involving selection of particular allomorphs or stem forms, and may sometimes be expressed via a suppletive form. In contrast, a typical special clitic is either in complementary distribution with an overt nonclitic argument or may co-occur with a nonclitic only under restricted circumstances. The ungrammaticality of (17) illustrates that in French complementarity is obligatory; we will return to contexts where cooccurrence is possible below. Verbal clitics are observed to attach to verbs which are not the source of the theta role to which the clitic is associated, a phenomenon known as *clitic climbing*, and they have greater *mobility* with respect to the verb stem than canonical inflections, in the sense that they may be preverbal in one context but postverbal in another; these points are illustrated in (18)–(20).

(17) *Jean le voit le livre. (Fr.) (cf. (11) and (12))

(18) Je l'ai fait manger aux enfants.
I it-have made eat.INF to.the children
'I made the children eat it.'

(19) J'en ai bu deux verres.
I-of.it have drunk two glasses
'I have drunk two glasses of it.'

(20) (a) Luis trato de comer -las. (Sp.)
Luis tried DE to.eat -them
'Luis tried to eat them.'
(b) Luis las trato de comer.

As for morphological considerations, clitics are generally external to any (other) inflectional affixes.[11] Finally, while they are known to interact with their hosts in somewhat irregular fashions, this is clearly true to a lesser degree than with inflectional affixes: they seldom if ever select for particular stem forms; nor are they sensitive to the morphology of the host, and they are not involved in suppletion.[12]

These are not necessarily fatal blows to the view that clitics are inflectional affixes. We will discuss the complementarity between clitics and other arguments shortly. As for the long distance character of clitic climbing, there are also cases of agreement applying long-distance (Spencer 1991, P. Miller 1992). For both clitics and clear cases of agreement, this probably reflects some sort of *restructuring*,

the formation of a complex predicate in which the semantic arguments of one verb act like the syntactic arguments of another (Kayne 1975; Rizzi 1982; Borer 1984a; Jaeggli 1982, 1986b; P. Miller 1992; Manning 1992). Fulmer (1991) and Noyer (1994) have documented cases of mobility of affixes similar to that observed with verbal clitics. As for the peripheral position of clitics, it is clear, even in light of recent suggestions as to how to make syntax more accountable for the structure of words (Baker 1988a and much subsequent work), that syntax cannot completely account for affix ordering; if nothing else, clitic templates clearly involve purely morphological conditions. The limited degree of interaction between verbal clitics and their hosts is matched by that of various affixes, such as English *-ing*, which is fully regular.

These considerations suggest that the theory of inflectional morphology probably has to be powerful enough to accommodate the behavior of verbal clitics. However, there remains some question as to whether verbal clitics should be reduced to inflections, for there remains a difference, if not in absolute (non)attestedness, then in the markedness of the various characteristics: what is marked for a clitic is unmarked for an inflection, and vice versa.

These observations have led to an alternative view of verbal clitics according to which they are generated in a deep-structure argument position just like a nonclitic pronoun and are subsequently adjoined to the position occupied by the verb.[13] This is known as the *movement* approach to clitic placement.

Whereas clitic climbing, the complementarity between clitics and independent noun phases in, for example, French, and the exterior morphological position of clitics are all complications for a base-generation account, they are the sort of behavior one would expect from the movement approach. However, the ability to explain the complementarity in (17), which is one of the clearest successes of the movement approach, is also one of its greatest stumbling blocks. Unlike standard French, many languages allow clitics and nonclitics serving the same function to co-occur, as in the following Spanish examples. This is known as *clitic doubling*; the nonclitic phrase is sometimes referred to as the clitic's double.

(21) (Le) puso comida al canario/a un perro. (Sp.)
to-him put.3SG food to-the canary/to a dog
'S/he gave food to the canary/to a dog.'

(22) (%La) oían a Paca/a la niña.
her listened.3PL to Paca/to the girl
'They listened to Paca/to the girl.'

Clitic doubling presents the movement approach with a problem which has not really received adequate treatment. The most common tactic is to treat the double as an adjunct rather than an argument (Aoun 1985, Jaeggli 1982).[14] However, several arguments have been made against this view (Borer 1984a, Everett 1987, Jaeggli 1986b, Suñer 1988), and it seems unlikely to provide a universal account of doubling.[15] Nevertheless, most approaches to clitic doubling have made a related assumption: namely, that some clitics do have some argument-like property which prevents the expression of a separate nonclitic argument (and perhaps simultaneously satisfies the subcategorization or thetarole requirements of the verb so that no other argument is necessary). The relevant property is often assumed to be case absorption.[16] This was originally motivated by the *Kayne-Jaeggli generalization*: namely, that doubling is possible only if the double is accompanied by an independent case assigner. In Spanish, doubling is possible only if the double is an indirect object or an animate direct object, both of which are accompanied by the preposition *a*. Inanimate direct objects, which are not accompanied by *a*, may not be doubled:

(23) *Lo compró el libro. (Sp.)
it bought.3SG the book
'S/he bought the book.'

Similar facts are observed in connection with the genitive clitics in the Hebrew Construct State, in which doubles must be preceded by the preposition šel (Borer 1984a). Consequently, several early

works assumed that clitic pronouns always absorb case: for example, Jaeggli 1982, Borer 1984a. However, the presence of an overt case marker, or even overt case marking, is not universal in cases of doubling – see Berent 1980, Joseph 1988, and Everett 1987 for discussion of Macedonian, Modern Greek, and Pirahã respectively.[17] This has suggested that whether or not a clitic absorbs case is a parameter of variation (Jaeggli 1986b, Everett 1990): case-absorbing clitics do not permit doubling (or require doubles to be accompanied by an independent case assigner), while clitics which don't absorb case permit, and in fact require, doubling.

Doubling also turns out to be sensitive to properties of the double; for instance, while Spanish clitics are generally optional in the presence of a nonclitic object, they are obligatory with pronominal objects, as in (24). Another common factor is specificity, as shown in (25) and (26): nonspecific direct objects often can not be doubled. (Examples from Suñer 1988.) Similar specificity effects are observed in Romanian, Macedonian, and Greek (Steriade 1980, Berent 1980, Kazazis and Pentheroudakis 1976). Dobrovie-Sorin (1990) proposes an account of the specificity effect based on the assumption that clitics are base- generated case absorbers in combination with the idea that nonspecific phrases are subject to quantifier raising at LF; however, it is not clear that the account can deal with variation in obligatoriness of doubling such as that which distinguishes Macedonian from Romanian or Spanish.

(24) Ellos *(la) llamaron a ella. (Sp.)
they her called.3PL A her
'They called her.'

(25) Diariamente, (la) escuchaba a una mujer que cantaba tangos.
daily her listened.3SG to a woman who sang tangos
'S/he listened daily to a woman who sang tangos.'

(26) (*La) buscaban a alguien que los ayudara.
her searched.for.3PL A somebody who them could-help.SUBJ
'They were looking for somebody who could help them.'

To summarize, common to most approaches to verbal clitics is the view that they in some sense form a morphological or syntactic unit with a verb (or with an inflectional head). Whether they are attached in the lexicon or in the syntax, and if the latter, whether they are base-generated or moved (or copied) from some other position, remains in question. The peripheral position of clitics is probably the most convincing argument against treating them as inflectional affixes, though this is only an argument if one adheres to a strongly syntactic theory of affix ordering. On the other hand, the facts surrounding doubling suggest strongly that they are not generated in the position of a nonclitic argument.

4 Second-position clitics

While verbal clitics have dominated discussion in the syntactic literature, there is a growing appreciation of the fact that several other types exist. The other most commonly discussed type is the *second-position* (2P) clitic, also sometimes known as a *Wackernagel's Law* (WL) clitic, after Wackernagel (1892). As a first approximation, second-position clitics must appear second in the relevant domain.[18] Consequently, they are not attached to a host of any particular category, and do not (necessarily) form a syntactic or semantic constituent with their host. For example, the words in the Serbo-Croatian sentence in (27a) may be rearranged in any order, so long as the clitics (as a group) are second; placing them elsewhere is ungrammatical. In this way they contrast with corresponding full forms: compare the position of *mu* with that of *njemu* in (27b).

(27) (a) Marija=mu=je dala knjigu. (SCr.)
Maria.NOM to.him AUX gave book. ACC
'Maria gave him a book.'
(b) Njemu=je Marija dala knjigu.
to.him AUX Maria.NOM gave book. ACC
'Maria gave HIM a book.'

Note that the clitic *je* is an auxiliary. This illustrates another salient fact about 2P clitics: they may serve a variety of functions other than pronominal, including that of auxiliary, voice marker, discourse particle, and so on. Serbo- Croatian has 2P clitics which function as object pronouns, auxiliaries, and a Y/ N question particle. In the ancient Indo-European languages, various Australian languages, Tagalog, and so on, we find a large set of discourse "particles" – markers of voice and mood, discourse connectives, and adverbials – which occupy 2P. Indeed, Kaisse (1982, 1985) suggested that nonpronominal 2P clitics are a prerequisite to pronominal 2P clitics; in support of this, we find that in languages which have both, they are often inseparable. In Serbo-Croatian for instance, pronominal clitics, interrogative *li*, and weak auxiliaries all have to appear in a string and, like verbal clitics, in a fixed order:

(28) Kad li ćeš joj ih dati? (SCr.)
when Q FUT.2SG.AUX *to.her them give*INF?
'When will you give them to her?'

Li itself is plausibly treated as a complementizer, based on its function and its distribution. Furthermore, we find that in embedded clauses the other clitics must immediately follow a complementizer, just as they follow *li*.

(29) Mama odgovara da su one u ormaru. (SCr.)
mama answers that are they in armoire
'Mama answers that they are in the wardrobe.'

Due in part to such observations and in part to analogy to the treatment of verbal clitics, it has been suggested that these clitics occupy some head in the syntax, usually C° (Progovac 1996), with the pronominal and auxiliary clitics adjoining to this position. If we assume that the various particle clitics of other languages are also generated in C° and that pronominal and auxiliary clitics are adjoined to this position, then we have a partial reconstruction of Kaisse's claim. This analysis in connection with the view that verbal clitics adjoin to a lower head suggests that perhaps all special clitics occupy a head position, with the difference being the choice of the head. Additional intuitive support for this interpretation of the behavior of 2P clitics comes from the analogy to *verb second* (V2) constructions.[19]

However, this conclusion is less plausible in other languages. We find that in various languages (Sanskrit, Ancient Greek, Tagalog), both particle and pronominal clitics may appear in 2P together in most situations, as in (30), but they may or must be separate in certain contexts, as in (31).

(30) ou pō pote moi to krēguon eipas. (Gr.)
not yet ever to-me the good spoke
'You have never yet spoken a good thing to me.' (*Iliad*, 1.106)

(31) tôn d' állōn há moi ésti thoēi para nēi melainēi
*the.*GEN PRT *others which me are swift beside ship black*
'of the others which are with me beside the swift black ship' (*Iliad*, 1.300)

Given this, we clearly cannot assume that pronominal clitics and particle clitics always occupy the same position in these languages (Hale 1987, Garrett 1990, Taylor 1990). Freeze (1992) and Halpern and Fontana (1994) present other reasons for doubting that all clause-level 2P clitics are adjoined to C°. One argument in favor of this view is that no cases of clitics which are proclitic to a complementizer (or other element in C°) have been documented – compare (29); given that the preverbal position is the unmarked case for verbal clitics, this strongly suggests that 2P clitics are not adjoined to C°.

Another thing which (31) illustrates is that some 2P clitics follow the first (phonological) word of a clause, while, as we shall see, others follow the first syntactic daughter (Browne 1974, K. Hale 1973b). I refer to these options as 2 W (for "second word") and 2D (for "second daughter") respectively. In some languages, the choice between 2D and 2W is fixed, while in others there is either free or

conditioned variation. Particle clitics in Ancient Greek follow a single (phonological) word, as just illustrated. The following examples illustrate that Serbo-Croatian allows alternation between the two, while Czech clitics must appear in 2D.

(32) (a) [Taj čovek]$_{np}$ joj ga je poklonio. (2D) (SCr.)
that man her it AUX presented
'That man presented her with it.'
(b) Taj joj ga ge čovek poklonio. (2W)

(33) (a) Ten básník mi čte ze své knihy. (Cz.)
that poet to.me reads from his book
'That poet reads to me from his book.'
(b) *Ten mi básník čte ze své knihy.

It has been noted that many languages which allow 2W placement of clitics permit extensive discontinuous constituency (Klavans 1982, Nevis 1988, Kaisse 1985), suggesting that 2W may ultimately reduce to 2D. In support of this, several languages which allow for 2W placement in some circumstances require 2D placement in others, as illustrated in (34)–(36) for Serbo-Croatian. Crucially, those constructions which require 2D placement of clitics are also more resistant to discontinuous expression. See Kroeger 1993 for discussion of this with respect to Tagalog, and Progovac 1996 for Serbo-Croatian.

(34) (a) Prijatelji moje sestre su upravo stigli. (SCr.)
friends my.GEN sister.GEN AUX just arrived
'My sister's friends have just arrived.'
(b) *Prijatelji su moje sestre upravo stigli.

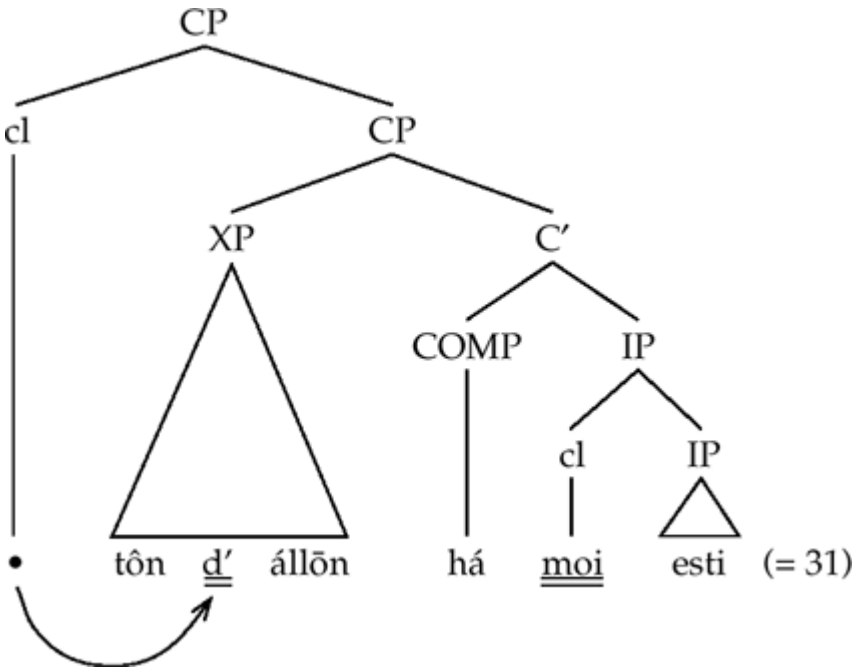
(35) (a) Studenti iz Beograda su upravo stigli.
students from Belgrade AUX just arrived
'Students from Belgrade have just arrived.'
(b) *Studenti su iz Beograda upravo stigli.

(36) (a) Lav Tolstoj je veliki ruski pisac.
Leo Tolstoj AUX great Russian writer
'Leo Tolstoj is a great Russian writer.'
(b) %*Lav je Tolstoj veliki ruski pisac.

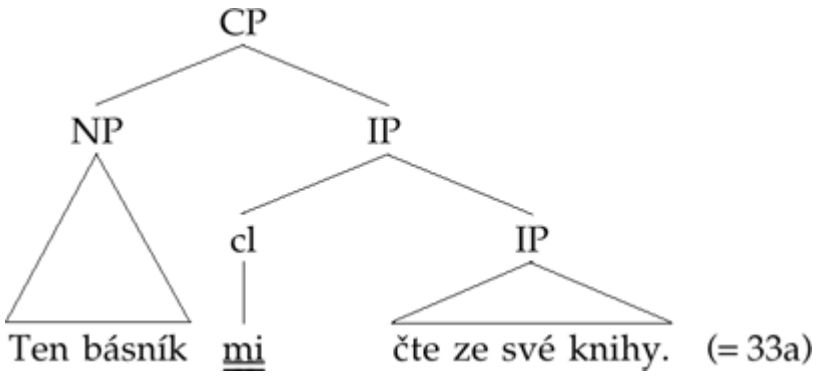
However, there are certain problems with this view as a general approach to 2W. For one thing, some speakers apparently accept (36b) without allowing for more extensive discontinuous constituency (Browne 1975:113–14). More generally, 2W is possible in languages or constructions where there is no other possibility for discontinuous constituency (Steele 1976: 610, Halpern 1995: 48–52). Another problem is that while considerable discontinuous constituency is possible in the ancient Indo-European languages, such an approach doesn't explain the fact that the relevant clitics never appear at the end of a multi-word constituent. Treating 2P clitics in these languages as following a full syntactic daughter of the clause would force us to claim that there is some special syntactic construction which allows only constituents comprised of a single (phonological) word to be fronted (Schäufele 1991, Taylor 1992). Indeed, similar arguments can be made with respect to Tagalog, where clitics must follow the first word of certain sorts of constituents. Thus, while some apparent cases of 2W placement may reduce to 2D with discontinuous constituency, there are other cases where clitics may truly be located with respect to a prosodic constituent (the first phonological word) rather than a syntactic one.

Another approach to 2W which has been pursued by several authors (Sadock 1985, 1991; Marantz 1988, 1989; Sproat 1988; M. Hale 1987, 1996; Taylor 1990, 1992, 1996; Halpern 1995) is to assume that, syntactically, 2W clitics are initial within their domain, perhaps adjoined to an entire phrasal constituent, but that their requirement for a preceding host triggers metathesis of the clitic and the syntactically following phonological word, an effect we might refer to as *prosodic inversion*. For instance, particle clitics in Ancient Greek could be treated as being left-adjoined to CP (or as heads which take CP as their complement), but surfacing after the first word of the CP because of their

enclitic status. Assuming that prosodic inversion takes place only if necessary to provide the clitic with a host, we may account for the placement of Sanskrit pronominal clitics by assuming that they are syntactically adjoined to IP, with inversion taking place when they are adjoined to a bare IP (to put them in 2W of a simple clause), but not when other material from the same clause precedes the IP, such as a complementizer or a wh-word.[20]



Similarly, 2D clitic placement would presumably result if the initial constituent is outside the domain of the clitic; for instance, we might propose that clitics in Czech are adjoined to IP, and that the initial constituent in a main clause occupies SpecCP.



One final point about 2P clitics is that in perhaps all languages with 2P clitics, certain sentence-initial constituents have to be ignored for the purpose of determining the second position, as illustrated in (39). Such *skipping* is generally assumed to indicate that the skipped constituents are in some sense invisible to the clitic, or outside the domain relevant for the calculation of second position. Studies differ as to the notion of domain which is relevant, whether it is syntactic (e.g. phrases outside CP don't count) or prosodic (e.g. phrases outside the intonational phrase containing the verb don't count). See, for instance, Fontana 1993 for the syntactic approach, and Radanovíc-Kocić 1988 and Hock 1992, 1996, for the prosodic approach.

(39) (a) Ove godine, taj pesnik mi je napisao knjigu (SCr.)
this year that poet me AUX *wrote book*
'This year that poet wrote me a book.'

(b) *Ove godine*, taj mi je napisao knjigu.

5 Other special clitics

In this section, I will briefly mention some additional types of special clitics. One interesting case to begin with is that of clitics in Old French, especially in the earliest texts (de Kok 1985, Cardinaletti and Roberts, to appear), and Bulgarian (Hauge 1976, Ewen 1979). Like verbal clitics, clitics in OFr. and Bg. are always adjacent to a verb; however, the choice of pre-or postverbal positioning is determined as follows: they are preverbal unless this would make them 'sentence-initial', in which case they are postverbal, regardless of the finiteness or mood of the clause. This is known, within the Romance tradition, as the *Tobler-Mussafia Law*.

(40) (a) Az mu go dávam. (Bg.)
I to.him it give.1SG
'I give it to him.'
(b) Dávam mu go.

(41) Včera v gradinata Daniela mu gi dade.
yesterday in the.garden Daniela to.him them gave
'Yesterday in the garden Daniela gave them to him.'

(42) Falt me li cuer. (OFr.)
lack to.me the heart
'I lack the courage.' (*Eneas*, 1274)

(43) [L]essiez le et me prennez.
leave him and me take
'Leave him and take me.' (*Mort Artu*, 41, 126)

This mobility of the clitics suggests that the connection between the verb and the clitic is not as direct as in the mainstream modern Romance languages.[21] The specific pattern suggests that the clitics require some constituent to precede them, much like 2P clitics.[22] Lema and Rivero (1989) suggest that this requirement can force the verb to raise exceptionally to a position above a clitic if nothing else precedes it; see also Cardinaletti and Roberts, to appear. Alternatively, Halpern (1995: 26–32) suggests that clitics are syntactically preverbal in these languages, but may undergo prosodic inversion to avoid being sentence- initial – see Rivero 1993 for additional evidence for something like prosodic inversion in Bulgarian. As with second-position clitics, we must refine the notion 'sentence-initial' to allow for certain fronted constituents to be skipped.

(44) Ivan, vidjah go včera. (Bg.)
Ivan, saw.1SG him yesterday.
'Ivan, I saw him yesterday.'

European Portuguese offers another interesting variation on the verbal clitic in that the choice of pre- and postverbal conditioning is sensitive to a wider range of factors than in the standard modern Romance paradigm. Here, clitics are preverbal in embedded clauses, but may appear before the verb in a main clause only if preceded by certain types of constituents: negation, a universally quantified subject, a wh-phrase, or a focused constituent.

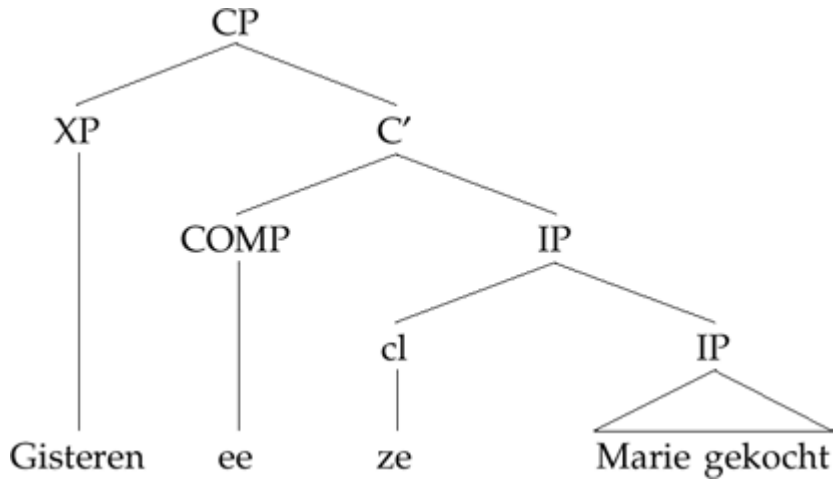
(45) (a) O Pedro encontrou -a. (EP)
the Peter met her
'Peter met her.'
(b) Dizem que o Pedro a encontrou.
say.3PL that the Peter her met
'They say that Peter met her.'
(c) Onde a encontrou o Pedro?
where her met the Peter
'Where did Peter meet her?'

(46) (a) Todos los rapazes me ajudaram.
all the boys me helped
'All the boys helped me.'
(b) Alguns rapazes ajudaram -me.
some boys helped me
'Some boys helped me.'

Spencer (1991) and Barbosa (1996) suggest that this pattern results from the same sort of skipping which is observed with 2P clitics in Old French and Bulgarian; the difference between Portuguese and Old French/Bulgarian would have to do with the syntactic conditions on the skipped constituents. See Manzini 1994 for an alternative based on differences in the order of movement of clitics and the inflected verb to their surface position.

Several recent studies (Pintzuk 1991; Cardinaletti 1992; Cardinaletti and Roberts, to appear; Zwart 1993,1996; Haegeman 1992; Fontana 1993; Halpern and Fontana 1994) have suggested that weak pronouns in various Germanic and Old Romance languages are closely related to the behavior of second- position clitics, despite substantial superficial divergence from this pattern. For instance, in West Flemish, clitics are third (postverbal) in V2 main clauses, but second (immediately after the complementizer) in embedded clauses and V1 main clauses, as illustrated in (47). Assuming that verb—second in West Flemish involves the verb occupying C° with a topic occupying SpecCP, the clitic pronouns may be assumed to occupy the same position as those of the ancient Indo-European languages (see above). One analysis is schematized in (48).

(47) (a) Gisteren ee ze Marie gekocht. (WF)
yesterday has them Mary bought
'Yesterday Mary bought them.'
(b) da et Marie gisteren gekocht eet
that it Mary yesterday bought has
'that Mary bought it yesterday'



Still other types of special clitics have been documented which are less well understood. Polish pronouns and past tense (preterite) markers have considerable distributional freedom, but show signs of being clitics (Sussex 1980, Booij and Rubach 1987, Spencer 1991). Other cases are interesting because they contrast different types of clitics within a single language; Pashto (Tegey 1978) and Bulgarian (Hauge 1976, Ewen 1979) distinguish a set of 2P clitics from a set of verbal clitics, as illustrated in the following examples, suggesting that verbal clitics and 2P clitics should not be reduced to a single source. On the other hand, various Ngumpin languages (McConvell 1978,1996) suggest precisely the opposite conclusion, as pronominal clitics in these languages may alternate between 2P and verbal placement.

(49) Nova-ta li riza ti podari Krasi? (Bg.)
new-DEF Q shirt to. you gave Krassi
'Did Krassi give you the new shirt?'

(50) Nen me dafter pe pak ke. (Pa.)
today I office with-him cleaned
'I made him clean the office today.'

Other distributions are known as well. Phrase-final locative clitics which apparently undergo climbing are discussed by Kaufman (1974); other phrase- final clitics are discussed in Zwicky 1977. Possible cases of second-to-last clitics (the mirror image of 2P clitics) in Nganhcara and Modern Greek are discussed by Klavans (1985: 104–5) and Sadock (1991: 171), but see Marantz (1988: 268) and Halpern (1995: 34–6) for critical assessments of these examples.

6 Prospects for a unified theory of clitics?

We have seen that there are various ways in which clitics may be distributed. Ultimately, evaluating approaches to clitics amounts as much to deciding which cases deserve a unified treatment as it does getting the facts of particular examples correct. So far, I have focused on the behavior of certain individual types of clitics, and on primarily syntactic accounts of their behavior. In the last fifteen years, several general theories of the behavior of clitics which seek to provide a unified (parametric) account of the different types have been proposed.

Klavans (1980,1985) was perhaps the first to suggest that the distribution of all clitics could be accounted for by a limited set of parameters. (Verbal clitics may not be part of this system – Klavans 1985: 100.) In addition to the specification that a given formative is a clitic and that it has a certain domain, she proposed that they be specified for the following three parameters:

(51) P1: Initial/Final
P2: After/Before
P3: Proclitic/Enclitic

The specification for P1 indicates whether a clitic should be positioned with respect to the first or last (syntactic) daughter of the domain; P2 specifies whether it should appear before or after this daughter; and P3 specifies whether it is enclitic or proclitic. This theory predicted that there should be eight basic types of clitics, corresponding to the eight ways of setting these parameters. For example, one type would involve an enclitic which appeared before the first constituent of its domain. A classic example of this are the Kwakwala case-marking determiners: syntactically part of the following noun phrase, they are phonologically part of the preceding word. This example also illustrates one of the points of Klavans's work which has gained the widest acceptance: namely, the independence of syntactic affiliation and phonological/ morphological attachment of clitics. The attachment is thus viewed as something which is syntactically irrelevant, the behavior of verbal clitics aside.

Subsequent work in the same general vein (Marantz 1988; Sadock 1985, 1991; Sproat 1988; Taylor 1990; Pintzuk 1991; Halpern 1995; Fontana 1993) has led to certain alternative proposals in both the distribution and the attachment. One common change is to assume that the work of P1 and P2 should be reduced to independent syntactic principles. Regarding P3, the attachment parameter, some recent work concurs with Klavans in assuming that cliticization is simply a matter of stray-adjoining clitics to adjacent material (Nespor and Vogel 1986, Anderson 1993), while other theories assume that the attachment may effect an adjustment in the surface position of the clitic, as per the discussion of prosodie inversion above; more dramatic versions of this (Marantz 1988, 1989; Sadock 1991) allow a clitic which is associated to an entire phrase in the syntax to incorporate into the head of that phrase in the morphology/ phonology.

Of these latter approaches, Sadock's proposal is the most thoroughly worked out. It is based on the central idea of Autolexical Theory that there are several levels of grammatical representation which must be put in correspondence with one another according to certain constraints. For clitics and certain other phenomena (e.g. noun incorporation), it is the morphological and syntactic

representations which are relevant. Both the syntactic and the morphological representation encode linear order, but the orders involved may diverge when necessary to satisfy the requirements of each level. The divergence, however, must satisfy the following conditions (Sadock 1991: 103; cf. also Sproat MORPHOLOGY AS COMPONENT OR MODULE):

(52) Linearity constraints
(a) Strong: The associated elements of morphological and syntactic representations must occur in the same linear order.
(b) Weak: The associated elements of morphological and syntactic representations must occur in as close to the same linear order as the morphological requirements of the lexemes allow.
Constructional integrity constraints
(a) Strong: If a lexeme combines with a phrase P in the syntax and with a host in the morphology, then the morphological host must be associated with the head of the syntactic phrase P.
(b) Weak: If a lexeme combines with a phrase P in the syntax and with a host in the morphology, then the morphological host must be associated with some element of the syntactic phrase P.

A given association between morphology and syntax must either satisfy the strong version of one of the constraints or satisfy at least the weak version of both constraints (Sadock 1991: 104). See Lapointe (1991: 149–50) and A. Woodbury (1996) for proposed revisions within the basic autolexical framework, especially the question of whether the behavior of clitics involves morphological or prosodie conditions.

Anderson (1992, 1993) argues for a conceptually very distinct approach to special clitics, according to which they are the result of an entirely different mechanism: namely, the application of morphological spellout rules applied to a phrase. (Simple clitics, in contrast, are syntactic words which are phonologically stray-adjoined to adjacent material.) The range of possible spellouts for a clitic, given in (53), is entirely parallel to that of word-level spellouts except for the nature of the input (the phrase as opposed to the word).

(53) The distribution of special clitics (quoted from Anderson 1992):
(a) The clitic is located in the scope of some syntactic constituent (S, VP, NP, etc.: probably only X^{max} but perhaps e.g. V as well) which constitutes its domain.
(b) The clitic is located by reference to the {FIRST VS LAST VS HEAD element} of the constituent in which it appears.
(c) The clitic {PRECEDES VS FOLLOWS} this reference point.

In favor of this treatment, which is essentially the extension to the phrasal domain of his treatment of (inflectional) morphology, Anderson points out that there is a strong parallel between the properties of clitics on the one hand and affixes on the other. Similar generalizations can be drawn about their distributions – abstracting away from the difference in their domains (i.e. affixes being related to wards, and clitics being related to phrases).

All such general theories of clitics run the risk of over-generalizing. For instance, several authors have questioned whether indeed all eight types predicted by Klavans are attested. Specifically, proclitics appearing after the first constituent of their domain, proclitics appearing after the last constituent of their domain, proclitics before the last constituent of their domain, and enclitics before the last constituent of their domain are all at best questionably attested (Marantz 1988, Sadock 1991, Halpern 1995). The lack of so many types of proclitics suggests that perhaps independent factors conspire against procliticiza- tion, much as suffixation is more common than prefixation. However, at least at its simplest articulation, there is a problem with this: there are certainly plenty of simple clitics which attach to the beginning of their domain (proclitic determiners, prepositions, complementizers, etc.), and procliticization is in fact the norm rather than the exception with verbal clitics. In contrast, sentence- initial special clitics (pronominal or particle) are virtually unknown – though see Pintzuk 1991: ch. 4 for a discussion of Old English clitic pronouns, which could appear sentence-initially. This is a fact which remains unexplained in any framework to my knowledge.

Another sort of approach to clitics which we have discussed indirectly throughout the chapter would treat all clitics as being syntactically incorporated into a head. Everett (1996) argues for a particularly strong version of this view, according to which all clitics and inflectional affixes are syntactically the same type of element, differing only in their requirements for morphological or phonological support. We have seen ways in which simple versions of the view that clitics are adjoined to a head are problematic (e.g. 2P clitics need not adjoin to an overt head at all; the split between 2P clitics and verbal clitics mentioned above for Pashto and Bulgarian indicates that these must be differently represented in the syntax). It is likely that the problems may be overcome by appeal to a sufficiently rich theory of functional heads. Whether such a theory of heads can be independently motivated remains to be seen.

In this chapter, we have reviewed various characteristic properties of clitics. We have also seen that there is significant variation from clitic to clitic which resists reduction to a single invariant characterization, though parametric approaches are highly promising for certain subsets of clitics. Determining the nature of these parameters ultimately depends not only on the behavior of individual cases, but also on deciding which phenomena deserve a unified treatment. We must ask whether there is a significant split between simple and special clitics, between verbal clitics and other (special) clitics, between clitics and affixes, or between clitics and independent words. It is my sense that answers to these questions go hand in hand with a theory of the distinction between independent words and affixes. Consequently, the behavior of clitics is a problem which any theory of grammar must face; but we also expect that our theory of grammar will help us understand the behavior of clitics, as indeed many of the works reviewed above have done.

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1 I use the term “formative” here rather than “morpheme” or the like because various clitics seem to be at least partially segmentable into meaningful parts. The question of whether clitics may be morphologically complex has received a certain amount of attention. See Inkelas, 1990: 302 for the view that clitics – like function words – must be simplex, but see also Klavans 1985: 115 for an example which is arguably complex.

2 While clitics may in some cases come to bear stress, they do so only by forming a unit with an adjacent element.

3 Due to the scope of this chapter, many interesting topics pertaining to clitics will have to be given cursory treatment. In addition to the original sources cited throughout the chapter, the reader is urged to consult Nevis et al. 1994.

4 The conditions on auxiliary reduction, and on the distribution of other simple clitics, are very similar to those which affect the application of postlexical phonological (external sandhi) rules, and raise similar issues regarding the correct formulation of syntactic conditions on phonological or prosodie processes.

5 But see Kaisse 1985: 43, for some respects in which reduced auxiliaries are syntactically exceptional as well.

6 Other tests include selectivity with respect to the host, morphological conditioning on the interaction between bound form and host, idiosyncrasies in interpretation, peripherally of attachment.

7 I will use a double underscore to identify special clitics throughout. This is a variation on the usual use of ‘=’ between a clitic and its host. In various cases, it is unclear from the literature whether a given clitic is an enclitic or a proclitic, or the language allows some variation – see e.g. de Kok 1985: 152ff on the attachment of clitics in Old French. Moreover, cases have been reported of words which have the distribution of a special clitic but do not seem to be phonologically dependent on an adjacent host – for instance, Warlpiri clitic sequences involving a disyllabic base (K. Hale 1973b: 312), various adverbials in Finnish (Nevis 1988).

8 Ironically, some of Kayne's more influential arguments may have more to do with clitics' prosodic dependency than any particular syntactic status: he noted that verbal clitics in French, like affixes, cannot be modified, conjoined, used in isolation, or emphasized; but this turns out to be true of reduced auxiliaries and pronouns in English as well, which are much less plausibly affixes, making these points rather weak arguments for affixal status.

9 There are limited, unproductive exceptions to this claim, of the sort in *en bien parler*, which I ignore here.

10 See Perlmutter 1971, Schachter 1973, Bonet 1991, Stump 1993c, Inkelas 1993, Halpern 1995, for various approaches to formalizing the notion of the template.

11 Various exceptions arise; e.g. in both Greek and Portuguese, clitics may come between the verb stem and certain tenses (see Joseph 1988, Spencer 1991). At least in the Portuguese case, this seems to reflect the fact that the morphemes expressing these tenses became verbal affixes more recently, if indeed one can claim them to be fully affixal at this point.

12 See Poser 1985, Nevis 1988, Zwicky 1987, Lapointe 1991, P. Miller 1992, and Halpern 1995, for discussion of some problems with this generalization which either require clitics to interact in nonautomatic fashions with their hosts, or require a more flexible theory of the distribution of inflectional affixes than is generally assumed.

13 Kayne (1975) suggested that verbal clitics were generated as pronouns and were subsequently adjoined to a verb to yield the structure [$_{V}$ cl V]. More recent formulations have proposed adjoining clitics not to the verb but to some higher functional head (Kayne 1990, 1991).

14 There are a couple of variants of the movement approach worth mentioning, though they fare little better in accounting for the full complexity of doubling. One is to assume that clitics are not pronouns but, rather, some functional head generated inside the noun phrase but subsequently incorporated into the verb. The other would be to decompose movement into two operations: copying and deletion, with doubling resulting from the application of the former only. Regarding the first of these, it is not clear what position the clitic could be assumed to originate in. There seems to be no language in which verbal clitics are in complementary distribution with some noun-phrase-internal function words; furthermore, this makes it all the more surprising that clitics are obligatory with pronominal objects in Spanish, where pronouns are cross-linguistically not usually accompanied by other nominal heads (determiners, etc.). Regarding the second option, two problems arise. First, the conditions on deletion which would effect the variability of doubling would be completely ad hoc. Second, in many cases it is unclear what could be being copied, aside from a set of features; the common similarity between the shape of definite articles and pronominal clitics suggests that the article itself is being copied, and that such clitics are generally a type of definite article, but examples such as (25) where an indefinite noun phrase is doubled then become problematic.

15 See Bresnan and Mchombo 1987 for some cases which do seem best analyzed by treating the double as an adjunct.

16 See ibid, for an alternative view.

17 Indeed, Suñer (1988: 399ff) discusses dialects in which this constraint does not hold.

18 We will only consider clitics which are in second position with respect to the clause here; however, there are also examples of clitics in second position within other domains, such as possessive pronouns or determiners in 2P of the noun phrase, prepositions in 2P of the prepositional phrase, etc.

19 This analogy between 2P and V2 has also been noted in connection with very different proposals, as in Anderson 1993, but also as far back as Wackernagel 1892.

20 The view that 2P clitics are adjoined to phrases treats them like adverbs distributionally, a connection also noted by Nevis (1988).

21 In other old Romance languages, clitics are still less connected to the verb, and may indeed be separated from it (Ramsden 1963, Wanner 1987). In the literature on Old Romance, the separation of clitics from the verb has been viewed as the marked case and is known as *interpolation*.

22 Interestingly, it appears that this is true even when the clitics are attached to a following host – see de Kok (1985: 152ff), Ewen (1979: 5). This suggests that clitics may impose constraints independent from their

host requirement, a hypothesis which is reinforced by the behavior of reduced auxiliaries discussed in connection with (6) and (7).

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6. Morphophonological Operations

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1 Introduction

This chapter describes the manipulations of the morphophonological shape of roots, stems and words which are found in morphological systems. It will be first and foremost a typological survey, but I will also argue for a particular view of the place of allomorphy in the grammar. I shall adopt the perspective that morphophonological operations of various sorts can be the exponents, or at least the partial exponents, of morphological properties.

Chomsky's work in generative morphosyntax, despite undergoing radical changes of emphasis and philosophy, has retained two key related assumptions throughout its history, both of them derived from its structuralist antecedents. The first is that morphemes are listed lexical items, and the second is that they subtend syntax-like structural relationships within word forms (see Halle and Marantz 1993 for a recent defence of this). In other words, much work in generative grammar presupposes a concatenative, 'Item-and-Arrangement (IA)' approach (cf. Hockett 1958). On this conception, a morpheme is a thing, and morphology is simply the concatenation of these things, so is viewed as formally agglutinative. The plural *cat-s* of *cat* is then viewed as a kind of compound, but one in which there are highly restricted privileges of occurrence of the second 'lexeme', the plural morpheme -s. Cases of non-concatenativity, such as the alternation between singular *man* and plural *men*, are not treated as special types of deviation from this scheme, but are accommodated by appeal to greater abstraction in the forms of morphemes, and to morphological triggering of phonological operations. This position was inherited in generative phonology (*SPE*, Chomsky and Halle 1968). In more recent frameworks, we might, for instance, say that the plural morpheme was a floating palatal feature, which docked on to the /a/ of /man/ to give /men/ (see Wiese 1996 for a detailed analysis of the much more systematic case of German umlaut in these terms).

However, a distinct tradition, associated with Sapir (1921) in American linguistics, holds that morphology should be regarded as a set of processes acting on stems or words to produce new stems, words or word forms. In this 'Item-and-Process (IP)' framework (Hockett 1958), *men* is derived from *man* by a vowel-changing process, while *cats* is derived from *cat* by a process of attaching a formative or phoneme (sequence) -s. On this conception only the stems or words can be thought of as pairings of form and meaning. The morphological property of plural for the lexeme *man* is then realized as the difference in the two vowels. In effect, the property of plural is a paradigmatic relationship between forms, not a thing listed in the lexicon. Clearly, both perspectives have little difficulty in providing an adequate description of *cats*. The differences revolve around the extent to which we regard examples like *men* as indicative of an important type of morphological operation or just a more abstract instance of concatenation.

One consequence of an IP view is that we do not have to picture affixes as lexical entries, because they do not have to be listed form-meaning correspondences. Rather, affixation can be thought of as the result of an operation, such as Aronoff's (1976) Word Formation Rules for derivation or

Hoeksema's (1985) head operations (see Beard, DERIVATION). A radical version of this view is Beard's Separation Hypothesis (ibid.), some form of which is widely assumed in inflectional morphology (see Stump, INFLECTION). However, this does not, of course, prevent us from assuming that the concrete formatives themselves (such as the -s affix of *cats*) can have their own phonological properties. The question that is raised by the IP perspective is simply this: are there operations over phonological form, or equivalently, alternations in phonological form, which can be regarded as the exponent, or at least the partial exponent, of a morphological property? In a strict Item-and-Arrangement model the answer would be 'no', and all phonological variation would be ascribed to perhaps rather abstract underlying phonological properties of the affixes and stems. On an IP perspective we can answer the question positively, thus giving substance to the notion of 'morphologized phonology'.

In many instances, no doubt, a good case might be made for treating a superficially processual phenomenon as underlyingly the result of concatenation of things in tandem with the application of purely (or perhaps 'essentially') phonological processes and phonologically defined constraints. Infixation in languages such as Tagalog is arguably of this type (see section 2.2). Indeed, Stonham (1994) argues in detail that all of the most processual phenomena discussed in the literature are susceptible to such analyses. He, in common with many phonologists, views this as an advantage, in that it means that there is only one morphological operation, that of concatenation. This is then supposed to lead to a more constrained theory (of morphology, presumably), on the assumption that all the phonological operations are independently motivated phenomena of Universal Grammar.

To see what is at stake, consider a case of morphologically triggered allo-morphy in English, the famous case of Velar Softening. In *SPE* a rule system was proposed for capturing the lexical relatedness of pairs such as *critic* □ *criticize, analog* □ *analogy*. The /k □ s/ and /g □ d/ alternations were the result of a palatalization rule triggered by a high front vowel. This meant that the suffix *-ize* had to be furnished with an underlying vowel /I/ (a tense /i/) which later underwent a battery of changes, the Great Vowel Shift, to become /aI/. The palatalization process itself had to be split into several subprocesses, because /s/ is not what one would expect phonetically from adding a palatal element to /k/. The upshot is that the relatedness can be expressed in the vocabulary of phonology, and all the roots and affixes can be given a single underlying form. In an IP model it is open to us to argue that the consonant alternations are triggered purely by the morphological affixation process, and serve to partially identify that process. This can be coded as a process which replaces /k/ with /s/ in tandem with affixation, or as a set of relations between listed stem allomorphs, with the affix marked to select the 'softened' allomorph. The crucial point is that there is an explicit recognition that Velar Softening is a *part of* the affixation process, and not just an accidental byproduct of it.

Now, the *SPE* analysis of Velar Softening is a modified recapitulation, of course, of a set of historical changes (in English and Norman-French). As is typical in such analyses, the cost is a battery of rules, extrinsically ordered, operating over underlying forms which are often strikingly distant from the surface forms. Even with the more recent technology of autosegmental multi-tiered representations and phonological operations triggered by constraints, a detailed analysis of a single language within this framework of assumptions retains essentially all the properties of the original *SPE* model. A good example of this is Rubach's (1993) meticulous description of Slovak (though unfortunately, the point is not so obvious, because detailed studies such as Rubach's, while indispensable for testing phonological models, are rather rare).

Among many morphologists and a good many phonologists, the assumption remains that a common underlier must be assumed for all alternants and that phonological determinants must be factored out at all costs. However, for present purposes, there are several reasons for retaining a perspective closer to IP. In subsequent discussion I shall refer to the phonological alternations which realize morphology as 'operations'. However, it is not crucial to the thesis that the alternations in phonological form be coded in the grammar as explicit operations, as opposed to, say, redundancy rules relating allomorph types. The crucial point is that there should be cases in which morphology is not realized affixally, where the phonological form of stem is the principal exponent of some morphological property. Under this conception the use of a particular prosodic template as the exponent of a given category would count as a non-affixal realization (see Aronoff 1994: ch. 5 for a detailed discussion of such cases). There are several reasons for adopting such a perspective here.

First, it will be convenient to view morphological exponence in terms of the operations 'visible' at the surface for purely expositional reasons, in order to bring out the rich variety of formal relationships which morphology can commandeer for its semiotic and grammatical purposes. This can be of practical value to the descriptive linguist working on little-known languages, for whom highly abstract investigation might be premature.

Second, the phonologically driven approach treats as a surface accident any correspondence between allomorph selection and morphological function. This means that allomorphy can never be viewed as a (partial) exponent of a morphological property. Typologically, then, we would be saying that languages are permitted to list floating features as morphemes (which may, of course, be true), but we would not be allowed to say that languages are permitted to signal a difference in morphological property by means of a paradigmatic relationship between singular and plural allomorphs. Now, it is quite possible that nothing of interest will come of the IP research programme which asks such questions, so it is feasible that the 'phonology first' strategy will ultimately prove correct. However, suppose that the IP view is, after all, correct. By ruling out that possibility from the outset, we will never discover the error of our ways. The IP programme would not, however, impinge on phonological research, to the extent that the devices which phonologists appeal to are really phonological, so there could be no corresponding methodological catastrophe awaiting phonology. Thus, from a purely methodological standpoint, it is better to make the richer set of assumptions embodied in the IP view.

In a related vein, there is a strong methodological reason for rejecting the phonology-first approach and adopting an IP perspective, based on considerations of learnability. Item-and-Arrangement theorists (often tacitly) assume that restricting all morphological operations to simple concatenation makes grammatical theory more constrained. This is then supposed to have beneficial consequences for the child acquiring language. Actually, as far as I can tell, such talk is almost invariably empty. This is because learnability considerations have to be computed over the whole of the relevant portions of the grammatical system. In order for considerations of 'restrictiveness' to have any meaning at all, what has to be shown is one of two things: either that the formal class of languages permitted under one conception leads to learnability problems, and that these are absent under the other conception, or that the best available theory of language learning is compatible with one conception and not the other.

Needless to say, no one has even attempted to make a case of either sort. Worse than this, no one has ever demonstrated that learnability considerations based on 'restrictiveness' are even relevant to morphology. The point here is that in syntax a case can be made for the existence of highly abstract universals on the basis of the 'poverty of the stimulus' argument (cf. Chomsky 1980). This argument gains much of its strength from the observation that syntax is an unbounded system, and, at a more practical level, that language users show evidence of linguistic knowledge which is underdetermined by the primary data. Now, although morphological systems can be very large and can occasionally show recursion, it is far from clear that they pose any 'poverty of the stimulus' problems. On the contrary, a characteristic of morphological systems is that they are subject to idiosyncratic restrictions, indicating that storage, rather than generation, is the key device. But this would suggest that there are no learnability-theoretic reasons for wishing to impose some notion of restrict-iveness. On the other hand, at a more practical level, learnability considerations are, indeed, relevant where analyses require highly abstract underlying forms and complex interactions. This is because in many cases the 'correct' analysis can be obtained only from a fairly detailed survey of the entire system, with some crucial examples appearing only in vocabulary which is normally learnt fairly late in acquisition. Now, when the language learner has yet to be exposed to all the relevant data, s/he will presumably have to construct a grammar which is ultimately inadequate and will have to be overhauled. The simplest strategy is memorization of allomorphic variants, and given that we are dealing with lexemes or finite lists of affixes, this strategy will presumably be successful. Moreover, for the language use system (perception and production) storage of small sets of alternations is not likely to be disadvantageous compared to on-line production. Thus, it is difficult to see why any language learner should bother to project the more abstract, phonologically driven analyses.

An objection to this strategy is to say that it leaves unconstrained the space of possible operations that can be posited. This may be true, but then it is unclear why we should need to constrain that space. Children can learn language games which involve reversing the order of phonemes or syllables

of a word. However, no natural language described hitherto has been shown to employ this strategy for grammatical purposes. But this does not mean that such a possibility is excluded by Universal Grammar; rather, it means that the chances of a language developing such a strategy, given the way that language change occurs, are minutely small (though theoretically possible, say, as a development from an adolescent language game). It may also mean that the learning strategies adopted by small children would deter them from positing such a rule. Finally, within the perspective of Optimality Theory, Universal Grammar must countenance a completely arbitrary set of operations over strings (the Gen function of McCarthy and Prince 1993a: 86). The effects of these operations are filtered out by ranked constraints, but in principle the theory permits a very wide spectrum of operation types to surface.

The rest of the chapter surveys the most common processual phenomena that can be seen as helping to realize a morphological property.

2 Concatenation

As we have seen, even the concatenation of concrete forms is often associated with morphophonological operations which serve as partial morphological exponents. This is true both of compounding and of affixation.

2.1 Compounding

Compounding is canonically characterized as the concatenation of two words to form another word. This is arguably the simplest type of morphology, and one from which many types of affixation derive historically. In practice, it can be extremely difficult to distinguish this from syntactic phrase formation. However, when compounded types become fossilized, the head of the compound may turn into an affix. At intermediate stages it might be very difficult to decide which type it falls into. This is also a problem in languages in which (bound) roots are compounded, for we are not then dealing with the formation of a word from other words. Neoclassical compounding in English poses such problems: is the *hypo-* of *hyponym* a prefix or a bound root compounded with another bound root (notice the stress shift in *hyponymy*, something more characteristic of affixes than compounded elements in English)? The type of compounding seen in incorporating languages (e.g. Chukchee; see Muravyova, CHUKCHEE (PALEO-SIBERIAN)) is also frequently a type of root compounding, in which a new stem, rather than a new word, is formed.

On the periphery of genuine word formation and word creation are so-called stub compounds in Russian and a number of other languages. Here, we concatenate some phonological subpart of each compounded element (in Russian this is generally a bimoraic syllable, which effectively means a closed syllable). Some examples are shown in (1) (I have separated the elements by = for ease of reading):

(1) (a) arabotnaja plata zar=plata
'earned payment' 'salary'
(b) kollektivnoe xozjajstvo kol=xoz
'collective farm' 'collective farm'
(c) Gos=sort=sem=fond
Gossudarstvennyj Fond Sortovyx Semjon
state collection specialist.GEN.PL seed.GEN.PL
'State Specialist Seeds Collection'

(d)NIIN=Avto=sel^{j}xoz=maʃ
Nautʃno-Issledovatel^{j}skij Institut Informacii po Avtotraktornomu
scientific-research institute of-information on tractor

i Sel^{j}skoxozjajstvennomu Maʃinostroeniju
and farming machine-construction
'Research and Information Institute for Tractor and Farm Machinery Construction'

In (Id) we see an abbreviation incorporated into the compound, which allies the construction with

non-morphological (non-linguistic?) means of word creation such as acronyms. In addition, the component *sel'xoz* is constructed from the compound adjective *sel'-sk-o-xozjaj-stv-ennyj, village-ADJ-o-husbandry-NOM-ADJ* (where -o- is a meaningless intermorph) by taking the CVC initial of the two lexical elements, *sel'skij* 'pertaining to the village' and *xozjajstvennyj* 'pertaining to husbandry'. Note, too, that this compound is effectively headless, because the element that would correspond to a head, *institut* 'institute', is incorporated into the abbreviated first component *NIIN-*. In (1c), on the other hand, we observe that the element order of the compound is different from that of the full name, in that it seems that the compound is headed by its semantic head, *fond* 'collection', and its modifiers precede it. This is interesting, because genuine pre-head modification in root compounds is very rare in Russian (indeed, genuine root compounding is limited).

2.2 Affixation

The most important affixal operations are prefixation and suffixation.[1] These operations may be combined to conjointly realize a single process by means of a circumfix. Prefixation and suffixation do not invariably entail that the prefix/suffix appears on the far left/right of the word or stem, however. Prosodic considerations may demand that the affix appears inside the stem to which it is attached, in which case we have an infix. This is discussed in detail by McCarthy and Prince, PROSODIC MORPHOLOGY.

An intriguing puzzle is presented by circumfixation, in which a given morphological property is signalled by a simultaneous prefixation and suffixation process. In most cases both prefix and suffix are independently attested, usually with rather different meanings or functions. This is true of the two types of Comitative case in Chukchee (Muravyova, CHUKCHEE (PALEO-SIBERIAN)). However, the negative form of the verb in Chukchee is formed by a circumfix *e-…-ke*, neither part of which occurs elsewhere except in the privative circumfix added to nouns *e-…-ki*. The latter is almost identical to the negative circumfix, and is presumably closely related to it.

The term 'infixation' is properly applied to the insertion of an affix within some other morpheme (and not, for instance, simply between two other morphemes). Thus, we might wish to say that the plural form *mothers-in-law* is derived from the singular *mother-in-law* by inserting the plural formative -s between *mother* and *in*, but this would not count as infixation (for discussion of such cases see Stump 1995b). Genuine examples are provided by the Tagalog examples (taken from McCarthy and Prince 1993a: 101, in which an affix *um-*creates verb forms). When the verb stem is vowel-initial, *um-* appears as a prefix. When the stem begins with a consonant (or consonants), *um-* shifts to the right of the onset of the first syllable:

(2)

aral	um-aral	'teach'	
sulat	s-um-ulat	'write'	*um-sulat
gradwet	gr-um-adwet	'graduate'	*um-gradwet

In other words, the prefix is aligned as far to the left as possible, provided it doesn't create a coda.

Particularly interesting cases from Ulwa are shown in (3) (McCarthy and Prince 1993a: 109–10; *idem*, PROSODIC MORPHOLOGY):

(3)

hás	'hair'	bás-ka	'his hair'
asna	'clothes'	as-ka-na	'his clothes'
arakbus	'gun'	arak-ka-bus	'his gun'

Here the suffix *-ka* is placed immediately after the stressed syllable; that is, it is aligned to the right of the stress foot of the stem. The interaction between morphological positioning of the affix and phonological constraints has been extensively explored with Optimality Theory, and the reader is referred to McCarthy and Prince 1993a, 1995b and PROSODIC MORPHOLOGY).

Reduplication is a morphological operation which, since Marantz 1982 has been fruitfully analysed as a species of affixation of a prosodic template to a stem, followed by copying of that stem and association to the template. More recent conceptions are discussed in McCarthy and Prince (1995b and PROSODIC MORPHOLOGY). The simplest type is simple copying of an entire root, as in the Japanese examples (4) and (5) (from Tsujimura 1996: 152, 107). In (4) we see examples of mimetics (similar to onomatopoeic words):

(4)

pota-pota	'dripping'
hena-hena	'weak'
pitya-pitya	'splashing'

In (5) we see cases of Renyookei reduplication, which creates a particular verb stem in conjugation:

(5)

nak-	'cry'	nakinaki
tabe-	'eat'	tabetabe
yorokob-	'rejoice'	yorokobiyorokobi

In more complex cases reduplication is only partial. Tagalog, for instance, has (in addition to whole form reduplications) reduplications of the sort shown in (6):

(6)

(a)	sulat	'writing'	su-sulat	'will write'
	trabaho	'working'	ta-trabaho	'will work'
(b)	magpa-sulat	causative	magpa-pa-sulat	'will cause to write'
(c)	basa	'reading'		
	mambasa	infinitive	mam-ba-basa	nominalization

Notice that the reduplication can affect a root which has already been prefixed (6b), and may even appear to affect part of the prefix itself (6c).

In other cases, part of the reduplicated affix is pre-specified. This was true in Ancient Greek, for instance, where the first consonant is reduplicated in the prefect prefix, but the vowel is always /e/ (cf. Spencer 1991: 150):

(7)

ly:o:	'I release'	le-lyka	'I have released'
grapho:	'I write'	ge-grapha	'I have written'

Finally, we sometimes find that the reduplicated portion is introduced within the morpheme (i.e. as an infix). A simple example is Samoan, in which certain verb forms are the result of reduplicating the first syllable of the main stress foot of the word (which effectively means reduplicating the penultimate, stressed syllable; cf. ibid. 151):

(8) alofa 'love (sg.)' a-lo-lofa (pi.)

Cliticized elements may be reanalysed over time as affixes, and this is probably the commonest source of inflectional affixes. Zwicky and Pullum (1983a) have argued that this has happened to the English negation formative *-n't* (as in *hasn't*), and that this is now an inflection. The transition can be seen in midstream in the reflexive clitic/affixes of some Scandinavian languages and of Russian. In (9) we see examples of the Russian reflexive formative *-sja/s*^{j} with various verb forms:

(9)

myt^{j}	'to wash'	myt^{j}-sja	'to wash oneself
moju	'I wash'	moju-s^{j}	'I wash myself
mojem	'we wash'	mojem-sja	'we wash ourselves'
myl	'(he) washed'	myl-sja	'he washed himself
myla	'(she) washed'	myla-s^{j}	'she washed herself
mojuftfij	'(one who is) washing'	mojuftfiesja	'(ones who are) washing themselves'

The reflexive formative *-sja/s*^{j} is always the rightmost element. In general, we find the *-sja* allomorph after consonants and *-s*^{j} after vowels; but this is not true of the present participles, where we find *-sja* even after a vowel (*mojuftfiesja*). Such phonologically unmotivated deviation is typical of an affix. In addition, the reflexive formative is regularly used to form a passive voice form from imperfective verbs. This suggests that we are dealing with an inflectional suffix (though it is typologically unusual for passive morphology to be outside agreement morphology).

On the other hand, the *-sja* formative is often simply a part of the lexeme without any identifiable meaning of its own, and certainly without any inflectional function, as in *utfit*^{j}*-sja* 'to learn' (cf. *utfit*^{j} 'to teach') or *loit*^{j}*-sja* 'to lie down' (imperfective) (cf. *leit*^{j}, which is the perfective form of the same lexeme, without any 'reflexive' morphology). In *loit*^{j}*sja* the tense and agreement markers occur inside the *-sja* formative, just as in the case of a genuine reflexive:

(10)

lo-u-s^{j}	lo-l-a-s^{j}
lie-1sg.PRES-SJA	*lie-PAST-FEM.SG-SJA*

‘I lie down’	'she lay down’

The problem here is that we must say we have a case of ‘internal’ inflection if we regard the *-sja* as part of the lexeme itself. Moreover, this internal inflection is identical to the external inflection we get from an ordinary verb. The situation is readily understandable if we think of the *-sja* formative as a clitic. It is noteworthy that in most other Slav languages the cognate formative is still very clearly a clitic. Thus, by some criteria *-sja* is a suffix, and by others a clitic.[2]

3 Morphophonemic processes (often accompanying affixation)

3.1 Apophony

The most well known cases of apophony (ablaut) serving as a morphological exponent come from the Semitic languages, though it is also found in other Afroasiatic languages, including Cushitic (cf. Hayward, QAFAR (EAST CUSHITIC)). Haiman (HUA (PAPUAN)) describes a particularly interesting case in the Papuan language Hua. Thus, the basic (default) shape of a perfective active verb stem in Modern Standard Arabic is CaCaC – for example, *katab-a* ‘he wrote’. Verbs of this class form their passive by replacing the vocalism with *u-i*: *kutib-a* ‘it was written’. Many nouns in Arabic, including recent borrowings, have a ‘broken plural’, in which both the vocalism and the disposition of vowels with respect to consonants may be altered. Thus, one class of nouns behaves like the word film ‘film’, which has the plural *aflaam* (see McCarthy and Prince 1990a for detailed discussion). These systems have been discussed in great detail in the wake of the work of McCarthy (1979), who provided an IA analysis within an autosegmental framework. Within the framework of Prosodic Morphology a more processually oriented account has been proposed by McCarthy and Prince (e.g. PROSODIC MORPHOLOGY).

Semitic provides abundant cases in which the consonantism of a stem is manipulated for morphological purposes, though this is widespread in certain Penutian languages of California (e.g. Yokuts, Miwok; cf. Archangeli 1983, N. Smith 1985). Though not traditionally referred to as apophony, this is a comparable type of operation. See below on consonant gemination in Amharic. McCarthy and Prince (PROSODIC MORPHOLOGY) provide more extensive discussion.

A relatively common type of apophony involves a nasal prosody. In (11) we see examples from Terena (Spencer 1991: 157), in which the nasalization is the exponence of 1sg:

(11)

(a) emo?u	‘his word’	emoō?u	‘my word’
(b) owoku	‘his house’	õwõ^{ŋ}gu	
(c) piho	‘he went’	^{m}biho	‘I went’

In (11a) the nasalization affects all the sonorants in the word (skipping the glottal stop). In (11b, c) we see that the nasalization moves from left to right until the first plosive, giving a prenasalized stop.

3.2 C-mutation

It is very frequently the case that affixes induce phonological changes in the final consonant (or consonants) of their bases and that these alternations then become morphologized. At this stage we can say that the alternations cease to be part of the productive phonological system, but remain as signals of the affixation operation and hence as partial exponents of the morphological process.

When consonantal alternations take place word-initially, we speak of (initial) consonant mutation, which we could also call left-edge mutation. This is described fully for the Celtic languages in Fife and King (CELTIC (INDO-EUROPEAN)), and is also well known from the West African language Fula and its

relatives, and from the Siberian language isolate Nivkh. Such mutation often arises historically from the effects of prefixes which induce phonological alternations but which are then lost. Initial consonant mutation has been analysed in terms of the effects of a floating autosegment (cf. Lieber 1987), mirroring diachronic change to some extent, though the alternations are sometimes such as to require phonetically unmotivated derivations. Keenan and Polinsky (MALAGASY (AUSTRONESIAN)) discuss a similar kind of left mutation which is triggered by certain types of compounding process in Malagasy, somewhat reminiscent of the mutation found in certain types of Welsh compound. In these cases there is no synchronic purely phonological source for the consonant alternations.

Typologically speaking, we could easily use the term 'mutation' to refer to non-automatic consonant alternations occurring when the affix is still overtly present. Similarly, (and more commonly) we could speak of right-edge mutation when a suffix induces a morphologized change. Slavic palatalizing suffixes provide a rich source of examples of such right-edge mutations (cf. Rubach 1984 on Polish, Rubach 1993 on Slovak). Note that many phonologists within structuralist as well as generative paradigms propose quasi-phonological treatments of such phenomena, which generally require rather abstract derivational analyses appealing to various types of rule-ordering convention.

A rather intriguing case of right-edge mutation without synchronic suffixation is found in the West Nilotic Kenyan language DhoLuo. Nouns form their singular construct forms (used for expressing possession) by mutation, which in some cases has the effects of a feature-switching operation, in that a basic voiced sound may become voiceless, while a basic voiceless sound may be voiced (Stafford 1967) (these examples also show Advanced Tongue Root vowel alternations):

Singular	Singular construct	Meaning
gɔt	god	'hill'
lʊθ	luð	'stick'
kɪdo	kit	'appearance'
lwɛdo	luet	'hand'
puoðo	puoθ	'garden'
ʧogo	ʧok	'bone'
buk	bug	'book'
kɪtabu	kɪtap	'book'
gowi	gop	'debt'
barua	barup	'letter'
sɪgana	sɪgand	'story'
bul	bund	'drum'
lwɛɲ	lueɲʤ	'war'
ʧɔŋ	ʧoŋg	'knee'
ʧiemo	ʧiemb	'food'
ndara	ndaʧ	'road'
taya	taʧ	'lamp'
wɪʧ	wi	'head'
agulu	aguʧ	'pot'

A similar alternation is found with accompanying suffixation in the plural and plural construct forms. This feature switching is sometimes cited as an instance of an exchange rule, and has been cited as the kind of phenomenon which poses difficulties for purely concatenative morphology (e.g. Anderson 1992: 43). Stonham (1994) points out that several cases (including DhoLuo) involve singular/plural alternations, and suggests that in some words it is the plural stem which is basic. However, this

doesn't explain other cases; nor does it help to explain why in DhoLuo the (singular) construct form also participates in the alternation.

Consonants between vowels often undergo lenition (or less commonly, fortition) processes, depending on prosodic, especially syllabic, structure. Since syllable structure is often affected by affixation, such alternations can easily become morphologized. Such word-medial alternations are generally referred to as (consonant) gradation. A well-known instance of this occurs in Finnish (Karlsson 1987: 30f), where long consonants in open syllables alternate with short consonants in closed syllables (length is shown as a doubling of the letter in the orthography; I have used a hyphen in these examples to separate a suffix from its stem):

(13)

(a) kaappi	'cupboard'	kaapi-ssa	'in the cupboard'
(b) matto	'mat'	mato-lla	'on the mat'
(c) kukka	'flower'	kuka-n	'of the flower'

This is morphologized, as shown by three facts. The alternation is not entirely regular phonologically. First, the alternants of original short vowels undergo gradation which cannot be captured as a natural phonological process:

(14)

(a) tupa	'hut'	tuva-ssa	'in the hut'
(b) katu	'street'	kadu-lla	'on the street'
(c) jalka	'foot'	jala-n	'of the foot'
(d) kenka	'shoe'	kengä-n	'of the shoe' [=keŋŋän]
(e) polke-	'trample'	polje-n	'I trample'
(f) särke-	'break'	särje-n	'I break'
(g) puku	'dress'	puvu-n	'of the dress'

Secondly, the phonological context of being in a closed syllable is not sufficient to determine when gradation will take place. Some suffixes do not trigger the process. Thus possessive suffixes, even if they close the syllable, never trigger gradation:

(15)

katto	'roof'	kato-lle	'on to the roof'
		katto-mme	'my roof' [*kato-mme]

Thirdly, gradation does not take place before a long vowel:

(16) renkaa- 'ring' renkaa-n 'of a ring' [*rengaa-n]

However, it does generally take place before a diphthong: for instance, one formed by the plural

suffix *-i*:

(17) kato-lle 'on to the roof' kato-i-lle 'on to the roofs'

But if the stem ends in a long vowel underlyingly, as in the case of *renkaa-* in (16), then gradation is still blocked, even though vowel length in diphthongs is neutralized:

(18) renkaa- 'ring' renka-i-lta 'from the rings' [*renga-i-lta]

3.3 Tone

Innumerable languages make use of tonal alternations as exponents of grammatical categories. A straightforward example is again provided by DhoLuo. In (19) we see the imperfective and perfective forms of the phrase 'taste soup':

(19)

	Imperfective	Perfective
1sg.	á ! bíló àdò	á bìló kàdò
2sg.	í ! bíló kàdò	ì bílò kàdò
3sg.	ó ! bíló kàdò	ò bílò kàdò
1pl.	wá ! bíló kàdò	wá bílò kádó
2pl.	ú ! bíló kàdò	ù bílò kàdò
3pl.	gí ! bíló kàdò	gì bílò kàdò

(The raised exclamation mark (!) indicates downstep, an acute accent means high tone, and a grave accent means low tone.)

3.4 Stress

Although stress, like tone, is an extremely common phonological feature used for distinguishing lexemes, it is not, perhaps, used morphologically as much as tone is. However, it isn't difficult to find examples of languages in which derivational or inflectional forms are distinguished solely by stress, and stress is regularly an important concomitant of affixation and compounding. An often cited case of stress apparently being used for derivation is that of English *contrast* (verb) versus *contrast* (noun), and there are a fair number of similar examples. However, it is probably better to relate this to a general difference between the stress patterns of nouns and verbs: nouns exhibit what is often called Noun Extrametricality, under which the final syllable is ignored for stress purposes. Verbs do not show this property. Hence, given some principle placing stress on the final syllable of verbs with Latinate prefixes such as contrast, we would in any case expect the stress to shift back by one syllable after the verb had undergone conversion to a noun. Interestingly, no such stress alternation is shown when a verb arises by conversion from a noun. Thus, the verb (and adjective) *abstráct* has end stress, and the noun *ábstract* has initial stress; but the verb derived from the noun *abstract* meaning 'to write an abstract of an article' (i.e. produce an abstract of) has the same stress as the noun: *abstract* (cf. Kiparsky 1982a).

Stress is often used to mark membership of particular cells of inflectional paradigms, and many authors speak about 'paradigmatic stress' in this context. Thus, in Spanish the first- and third-person singular forms of the preterite of verbs are given end stress, in violation of the usual pattern for vowel-final words, which is to have penultimate stress. This can give rise to minimal pairs as in *háblo*

'I speak' (1sg. pres.) versus *habló* 'he spoke' (3sg. preterite).

Phonologists regularly analyse such cases in terms of stress assignment rules or principles triggered by various morphosyntactic features. However, some alternations are not necessarily easy to analyse in such a quasi-phonological fashion. One such example comes from Russian. The overwhelming majority of monosyllabic, neuter noun stems in *-o/-e* exhibit a curious stress exchange in the singular and plural paradigms. In one class the singular is ending-stressed throughout and the plural stem-stressed, while in the other class it is the plural that is ending-stressed and the singular which has stress on the stem. In (20) we see two such nouns, *okno* 'window' and *mesto* 'place', inflected for all their cases:

(20)

Case	Singular	Plural	Singular	Plural
nominative	oknó	ókna	mésto	mestá
accusative	oknó	ókna	mésto	mestá
genitive	okná okné	ókon óknam	mésta méste	mest
dative	oknó	óknam	méste	mestám
instrumental	oknó	óknami	méstom	mestámi
locative	okné	óknax	méste	mestáx

This could be taken as another instance of an 'exchange rule' (cf. discussion of DhoLuo mutation above).[3]

3.5 Vowel length

In Slovak the genitive plural of (mainly feminine) nouns in the *-a* class and the (neuter) -o class has no suffix, but usually has a lengthened final syllable (depending on details of phonological form). This applies to the syllabic liquids /l, r/ as well as vowels, and often manifests itself as a diphthongal vowel: for example, e □ ie, o □ ô (=˙/ᵘo/):

(21)

kladivo	'hammer'	kladiv
mesto	'town'	miest
srdce	'heart'	sŕdc
stopa	'trace'	stôp
vlna	'wave'	vĺn

Despite the apparently processual nature of this alternation, Rubach (1993) argues for an analysis in which it is triggered phonologically, by an affix consisting of an 'abstract' lax vowel with no associated skeletal slot (a 'yer'). When final, such yers regularly trigger lengthening of the vowel of the previous syllable. All word-final yers are then deleted. This gives rise to what phonologists call an 'opaque' derivation, in that there can never be a surface form in which the triggering suffix (the yer) ever materializes. There is thus some pressure on proponents of such analyses to demonstrate that the system is learnable, compared to more surface-oriented alternatives.

Just as it is possible to see paradigmatic stress alternations, so vowel length may shift systematically

across a paradigm. In (22) we see noun paradigms of certain nouns, *vrána* 'crow' and *jáma* 'pit', in Czech (this is not a regular phenomenon, only a feature of certain limited lexical classes; regular nouns do not exhibit any length alternations):

(22)

Case	Singular	Plural	Singular	Plural
nominative	vrána	vrány	jáma	jámy
genitive	vrány	vran	jámy	jam
dative	vráně	vranám	jámě	jámám
accusative	vránu	vrány	jámu	jámy
locative	vráně	vranách	jámě	jámách
instrumental	vránou	vranami	jámou	jámami

(NB: an accent here indicates a long vowel, not stress!)

3.6 Consonant length

Length alternations can affect consonants, too. A particularly interesting use of gemination is found in the verb system of Amharic, a Semitic language of Ethiopia.[4] As in other Semitic languages, the lexeme is built on a consonantal root (usually three in number, giving a 'triliteral root'). In many verbs we find gemination of the penultimate of these consonants: that is, the second for a triliteral root, the third for a quadriliteral (four-consonant) root. This is found throughout the inflectional and derivational system, including the formation of the stems for the perfect, imperfect, imperative, jussive, infinitive, instrumental, gerund and agentive (Type B). In other verbs, Type A, gemination is only found in the perfect (regarded as the basic stem form for Amharic verbs). Other verbs have gemination in the perfect and imperfect, Type C. Finally, a few verbs lack gemination. Examples of Type A (mäakkärä 'advise') and Type B (*fällägä* 'want') are given in (23):

(23)

	mäkkärä	fällägä
perfect	mäkkärä	fällägä
imperfect	yəmäkral	yəfälləgal
gerund	mäkro	fälləgo
imperative	məkär	fälləg
jussive	yəmkär	yəfälləg
infinitive	mæmkær	mæfællæg
agentive	mäkari	fällagi
instrumental	mämkärya	mäfällägya

3.7 Metathesis

Metathesis is the reordering of phonemes, as when in child speech or certain dialects the verb *ask* is pronounced /aks/. Metathesis often accompanies affixation (when it is frequently little more than a phonological repair of an illicit phonotactic combination resulting from the affixation), but on

occasion it gives the impression of being the sole exponent of a morphological property. Clearly, if it could be demonstrated that metathesis was a morphological exponent, this would demonstrate that a purely concatenative, affixal theory of morphology was inadequate.

A case that has been the subject of some discussion is that of the derivation of the 'actual' (essentially an imperfective) form of a verb from its 'non-actual' (perfective) form in certain Salishan languages, notably Saanich. The data in (24) are taken from Stonham 1994: 172:

(24)

	Non-actual	Actual	
(a)	se	se-?	'send'
	wéqəs	wé-?-qəs	'yawn'
(b)	t'sə	t'əs	'break something'
	q'k'^{w}ə	q'ək'^{w}	'straighten something'
	sc'ə	səc'	'whip something'

In the (a) examples the actual form is derived from the non-actual by infixation of -? after the first nucleus of the stem. In the (b) forms we have metathesis of the second consonant and the vowel. Stonham points out that this CV metathesis occurs only with roots beginning with a cluster. He argues that the actual is formed by adding a mora to the first syllable. In the (a) cases this is achieved by closing the syllable with -?. In the (b) cases a 'simpler' solution is to assume that consonants and vowels are segregated (cf. McCarthy 1989); in effect, that the linear ordering of vowels with respect to consonants is not fully determined. The non-actual forms are monomoraic, which means that the vowel must be syllable-final. However, the actual forms are bimoraic. This means that, instead of closing the syllable with -?, the root can simply assign its second consonant to the second mora (note that there are no long vowels in the language).

This is an ingenious solution which skilfully appeals to phonological constraints apparent elsewhere in the language. However, even if this type of solution allows us to dispense with metathesis as a primitive operation, it does not dent the thesis that non-segmental phonological shape can be used as the exponence of a morphological property. First, suppose we grant that the Saanich lexicon contains a prefix consisting of just a single mora serving as the exponent of the 'actual' category. (How exactly you 'list' a mora in the lexicon is a question that needs investigating, but we will pass this by for the present.) We must then ensure that the grammar selects the metathesis solution for (24b) over glottal stop insertion. In Optimality Theory there are various plausible possibilities. For example, we could say that the constraints against epenthetic consonants and against onset clusters outrank the constraint against codas. However, Stonham points out that minimal words in Saanich are bimoraic (as is frequently the case cross-linguistically). Therefore, given the claim that vowels and consonants are segregated, and that their relative ordering is determined by syllable phonotactics, there must be a constraint in the morphology stating that non-actual roots lacking vowels must not be bimoraic. But this is itself an instance of a morphological property being realized by purely phonological exponence – there is no way to characterize this in terms of addition of an affix.

3.8 Subtractive morphology

Another phenomenon which is very hard to analyse in terms of the addition of affixes is subtractive morphology, under which a form is derived from another form by deleting material. Dressier (1987) has discussed a number of such cases. A simple example is provided by agentive nouns in Russian derived from Latinate names of sciences or profession: *biologija* 'biology' *biolog* 'biologist', *agronomija* 'agronomy' *agronom* 'agronomist'. Here, a portion of the stem is deleted, *-ija*. Dressier points out that there is no justification for assuming the opposite direction of derivation.

3.9 Truncation

Related to subtractive morphology is the sort of shortening which is very widespread in evaluative morphology, as in the formation of diminutives of personal names: *Michael – Mike, Patricia – Trish*. This can regularly be analysed as the fitting of the original phoneme string of the word to a prosodically defined template. In this respect it is reminiscent of many forms of reduplication, in which it is the reduplicant which is often analysed as fitting over a template. Opinion is divided as to whether such evaluative formations reflect genuine morphological phenomena and processes (see Zwicky and Pullum 1987 for a dissenting view). Of potential relevance is the fact that such formations often reflect spelling pronunciations, as in *spec* (from *specification*) or *Ameslan* (from American Sign Language).

3.10 Replacive morphology

In structuralist morphemics the alternation between singular *man* and plural *men* would often be handled in terms of the replacement of part of a morpheme by another phoneme string, in this case /a/ by /e/. However, there are a good many ways in which such apophonic alternations might be handled. More interesting are cases in which there appears to be a paradigmatic relationship between affixes. Consider the case of *–ist* and *–ism* suffixation. We could take the forms *Marxist* and *Marxism* to be derived by adding either *–ist* or *–ism* to *Marx*. However, this would miss the point that a Marxist is not just someone with some arbitrary relationship to Marx, but rather one who practises Marxism. Thus, semantically at least, we can say that *Marxist* is motivated by *Marxism*, not by *Marx*. But this would mean saying that *Marxist* is derived by replacing *–ist* with *–ism*.

4 Stem indexing

A final aspect of the morphological use of phonology is the way in which different stem forms of a word are used to signal morphological relations. Though not strictly speaking an instance of a morphological property realized as a morphophonological operation, it represents essentially the same kind of relationship. Lieber (1980) argued that it was possible to do without purely morphological diacritical markings on Latin verb stems, and that conjugation class membership could be established purely on the basis of the phonology of the main stem allomorph (listed in the lexical entry). She then concluded that morphological diacritics of this sort were universally unnecessary. This position was criticized by Spencer (1988a), and a much more detailed demonstration of the need for purely morphological indexing of stems has been made by Stump (1995a) from Sanskrit.

Many Sanskrit stems occur in three forms, depending on the nature of the vowel of the final syllable of the stem (an instance of ablaut). These are known traditionally as the vrddhi grade, guna grade and zero grade. The precise phonological shape assumed in these grades depends on a complex phenomenon involving vowel coalescence, sonorant vocalization and so on, but the basis is that the vrddhi grade has a long *–a:*, the guna grade has a short *–a*, and the zero grade has no *–a* vocalism. An example using the verb lexeme *pat* 'fall' is given in (25), and one involving a nasal alternation from the masculine declension of the possessive adjective *bhagavant* 'fortunate, blessed' is shown in (26) (ignoring accent):

(25)

pa:t	pa–pa:t–a	3sg. perf. act.	'has fallen'	vrddhi
pat	pat–ati	3sg. pres. indie. act.	'falls'	guna
pt	apa–pt–at	3sg. aor. act.	'fell'	zero

(26)

bhagavant–	bhagavant–as	nom. pl.	guna

	bhagavant-a:u	nom./acc. du.
bhagavat-	bhagavat-as	abl./gen. sg. or ace. pl. zero
	bhagavat-os	gen./loc./ du.

At the same time, various morphological properties or categories make appeal to different types of stem. In nominals, for instance, declensional forms are regularly built on two stems, referred to as Strong and Middle. Thus, in the possessive adjective *bhagavant*, the Strong stem is found in the nominative forms and in accusative singular and dual (but not plural) forms, with the Middle stem occurring elsewhere. Notice that this cannot be defined purely in terms of the phonology of the case/number/gender suffixes, since formally identical suffixes may select different stems, as is seen with *-as* 'nom. pl.' (Strong) and *-as* 'abl./gen. sg. or ace. pl.' (Middle).

In (26), the Strong stem is the guna form, and the Middle stem is the zero form. However, this correspondence between morphologically defined stem type and ablaut type (vrdhhi, guna, zero) doesn't always hold. The Strong stem of the neuter noun *na:man* 'name', for instance, is in the vrddhi grade, not the guna, as seen in (27):

(27)

na:ma:n-i	'nom. /ace. pl.'	na:ma:n-	vrddhi
na:mn-a:	'instr. sg.'	na:mn-	zero

Some nominals have a third stem form, called 'Weakest'. In some adjectives the Weakest stem is suppletive, while in others it is the zero grade. In the noun *ahan* 'day', however, the Weakest stem is zero grade, the Strong stem is vrddhi, and the Middle stem is suppletive. In present and future active participles, the Strong stem is in the guna grade, while both Middle and Weakest are in zero grade (with differences in accent).

These kinds of data illustrate that it is not in general possible to predict the stem type from the morphophonology. Stump concludes that stems in general need to be indexed for the morphological function they fulfil. Where there is a regular relationship between morphophonological form and function, this can be stated as part of the stem-indexing rule, but in general such rules have to be kept separate from the morphophonological stem-formation rules. Such indexing rules may take the form shown approximately in (28) (where 'Class (V)' is an arbitrary feature I have created for labelling nominals such as *na:man* or *ahan*):

(28)

For lexeme L:	
where L is in Class (V), $Stem_{Strong}$	= vrddhi(L)
$Stem_{Strong}$	= guna(L)
$Stem_{Middle}$	= zero(L)
$Stem_{Weakest}$	= zero(L)

The point here is that purely morphological properties within the organization of the inflectional

system such as Strong, Middle and Weakest stem are realized by a complex interaction between phonological shape and purely morphological indexing in a fashion that cannot be handled in terms of affixation. Given that languages clearly have to appeal to such non-affixal relationships between stems, it should not come as any great surprise to find that stem allomorphy can be extended to include inflectional or derivational forms, giving rise to situations in which morphological properties which are normally expressed affixationally are realized as systematic morphophonological relationship, without the intermediary of affixation.

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I am grateful to Greg Stump for helpful comments on an earlier draft.

1 Throughout I shall use examples predominantly from inflection. For examples in derivational morphology of some of the operations discussed here see Beard, DERIVATION.

2 Interestingly, there seem to be no cases of infixation of true clitics (endoclitics; see Nevis 1984).

3 Brown et al. 1996, provides a defence of the paradigmatic approach to Russian stress, though it does not treat the alternations seen in (20) as a unitary phenomenon. It thus remains to be seen whether the behaviour of monosyllabic neuter (for Brown et al., 'Class IV) roots is systematic or accidental.

4 The data, though not the terminology, are based on Titov 1971: 99f. I am grateful to Dick Hayward for discussion of the examples and for explaining the standard terminology to me.

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7. Phonological Constraints on Morphological Rules

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Pieces of morphological material, when strung together or combined, can affect each other phonologically, as Spencer (MORPHOPHONOLOGICAL OPERATIONS) makes clear. But phonology can have a more radical influence on morphology than that, in that it can determine whether some pieces of morphological material are combinable at all. This is because some morphological processes (of affixation, reduplication or whatever) are restricted to bases with certain phonological characteristics, and cannot apply to bases without those characteristics, even if they are appropriate on other grounds (syntactic, morphological and semantic).

Phonological constraints of this sort can be found in both derivation and inflection. Here are some derivational examples:

(1) The English suffix -al which forms abstract nouns from verbs, as in *arrival, committal, referral, refusal*, is restricted to bases with main stress on the final syllable. Evidence for this is the non-existence of nouns such as **abolishal*, **benefital*, *developal, **examinal* (Marchand 1969: 236–7; Siegel 1979). (One apparent exception is the noun burial.) The restriction does not apply to the adjective-forming suffix -al, as is shown by the acceptability of *occasional, procedural, fanatical*, etc. This shows that such restrictions need not reflect any general phonological characteristic of the language in question, unlike many of the morphophonological operations described by Spencer.

(2) The English suffix -en which forms verbs from adjectives, as in *blacken, dampen, redden, loosen, stiffen*, is restricted to bases ending in obstruents. Evidence for this is the non-existence of verbs such as *coolen, *greyen, *thinnen, *puren (Marchand 1969: 271–3; Siegel 1979). Again, this restriction does not reflect any general phonological characteristic of English, because it does not apply to the adjective-forming suffix -en (as in woollen), or to the past participle, or passive, suffix -en (as in *swollen*).

(3) The Turkana suffixes for forming abstract nouns from intransitive verbs of state are distributed mainly on the basis of stem shape; for example, the suffix -(i)si (and its vowel-harmonic variants) seems to be productively attachable only to verbs with the stem shape CVC (Dimmendaal 1983: 270).

Here now are some inflectional examples:

(4) The English comparative and superlative suffixes *-er* and *-est*, as in *redder, calmer, happiest*, are restricted to short bases. Among two-syllable adjectives, individual speakers differ over precisely which examples are acceptable, but nearly all adjectives of three or more syllables consistently lack these forms: for example, **curiouser*, **sen-sitivest*, **motherlier*.

(5) The Hungarian second-person singular present indicative indefinite suffix -(a)sz [-DS], as

in ir-sz 'you write', *mond-asz* 'you speak', cannot be attached to bases (verb stems) ending in [s, z, J] (coronal strident segments). Hence a form such as *olvas-asz [olvfs] 'you read' is unacceptable (Banhidi et al. 1965: 87).

(6) In Classical Attic Greek, perfect stems of verbs were regularly formed from a base identical with the present stem, by reduplicating the first consonant and inserting -e-. Examples are *pe-paideu- from paideu-*'train' and te-*ti:me*:- from *ti:ma*:- 'honour'. Reduplication could not, however, apply to bases beginning with a vowel or certain consonants including r and h, and was avoided with stems beginning with consonant clusters, especially sC- clusters. Forms such as *se-spa-from spa- 'draw (sword)' and *he-haire- from haire- 'take' were therefore unacceptable (Smyth 1956: 147; Schwyzer 1939: 649–50).

(7) In Classical Attic Greek, the third-person plural perfect indicative passive suffix *-ntai*, as in *pe-paideu-ntai* 'they have been trained', was not added to consonant-final bases. From a perfect stem such as te-tag- 'have (been) drawn up' we find forms such as first-person singular *te-tag-mai*, third-person singular *te-tak-tai*, etc., but we do not find a form such as third-person plural *te-tag-ntai 'they have been drawn up' (Smyth 1956: 132).

These phonological restrictions leave morphological 'gaps' which may or may not be filled in other ways. We can distinguish three situations:

(a) The gap is usually filled morphologically, but in unsystematic fashion.

(b) The gap is filled morphologically in systematic fashion.

(c) The gap is filled in systematic fashion by a syntactic periphrasis.

In (1)–(7) we find all three of these situations exemplified: (a) by (1) and (2), (b) by (3), (5) and (6), and (c) by (4) and (7).

Examples of situation (a) (where gap filling is not systematic) are:

(1′) Most English verbs whose phonology prevents the attachment of noun-forming -al have corresponding abstract nouns formed in other ways: for example, *abolition, benefit, development, examination*. As these examples show, however, there is no single alternative for -al; nor is there a set of alternatives with a clearly systematic distribution. But that is not surprising, given that corresponding to any one English verb there may be several abstract nouns, formed in different ways and differing more or less subtly in meaning. For example, corresponding to *commit* we find not only *committal* (formed with the suffix in question) but also *commission* and *commitment*.
The lack of any overall system in English deverbal abstract noun formation is confirmed by the existence of arbitrary gaps. That is, for some verbs there is no corresponding abstract noun at all with the expected meaning 'act of Ving' or 'state of being Ved' (apart from a 'gerundive nominal' in -ing, which is available for every English verb). This is true both of some verbs which appear to meet the phonological condition for the -al suffix, such as ignore, and of some which do not, such as *edit*. (The nouns *ignorance* and *edition* do exist, but they do not have the expected meanings 'act of ignoring' and 'act of editing'.)

(2′) Many of the adjectives which do not meet the conditions for the suffixation of -en can be used as verbs without any morphological change, thus illustrating 'zero-derivation' or 'conversion'. Examples are *cool, grey, thin*. Some use another verb-forming suffix: for example, purify. Alongside three adjectives which reject -en (viz. *long, strong, high*) there is a verb in -en formed from a corresponding noun which happens to end in an obstruent and therefore meets the phonological condition for -en suffixation: *lengthen, strengthen, heighten*. Nevertheless, some adjectives, whether or not they could appropriately take -en, arbitrarily lack any corresponding verb: for example, *cold, limp* 'not stiff, *tall, wild*; and some which could take -en have corresponding verbs formed by other means: for example, *wet* (verb wet, not *wetten) and hot (verb heat, not *hotten).

Examples of situation (b) (where gap filling is systematic and morphological) are:

(3′) In Turkana, every intransitive verb of state (including many items which would be glossed in English as adjectives) has a corresponding abstract noun (Dimmendaal 1983: 270–4). These nouns are formed through a variety of processes, distributed largely on the basis of the phonology of the verb stem, as follows (Dimmendaal 1987: 206):

Stem shape	Suffix	Example
-CVC	-isi *or* -ISI	a-rɛŋ-ISI 'goodness'
$-CV_iCV_iC_i$	$-V_iC_i$	a-sɔlɔb-ɔb 'disorder'
$-C_iV_iC_iV_iC$	-u	a-lilim-u 'coldness'

Thus, for any verb which is polysyllabic and is therefore phono-logically inappropriate for the -isi suffix, some other suffix will be available, and its choice is likely to be phonologically determined.

(5′) All Hungarian verbs whose stem ends in a coronal strident fricative and which therefore cannot take -(a)sz in the second-person singular present indicative indefinite take the suffix -ol instead: for example, *olvas-ol* 'you read'. The suffix -ol is therefore in systematic complementary distribution with -(a)sz. Historically, -ol belonged to a minority inflection class of verbs which, in modern colloquial Hungarian, is merging with the majority class in all forms except the third-person singular. So the distribution of -(a)sz and -ol, which was once based at least partly on inflection class, irrespective of stem phonology, has now acquired a purely phonological rationale (Sauvageot 1951: 70–2).

(6′) Attic Greek verbs whose phonology prevents the formation of a perfect stem by means of reduplication regularly form perfect stems by two other means. If there is an initial vowel or *hV*– sequence, the vowel is lengthened, with or without a change in quality, as in *e:ukse*:– 'have (been) increased' and *heiire*:– 'have (been) taken' from auks(–an)– and haire– respectively. If there is an initial r–, sC– cluster or z– (probably pronounced [zd–]), then e– is prefixed, as in e–spa–'have (been) drawn' from *spa–, e–zeug*– 'have (been) yoked together' from *zeug*–. This is sometimes found, instead of reduplication, with other consonant clusters too.
It is clear from comparison with other Indo-European languages that reduplication for perfect stem formation was an old feature, and that it was not originally restricted from applying to sC– clusters; thus, we find the Latin perfect stem *spo–pond*– corresponding to non-perfect *spond(–e)*– 'pledge', and Gothic *(ga–)stai–stald*– corresponding to *(ga–)stald*– 'possess'. It is also clear that e-prefixation (traditionally called the 'syllabic augment') was originally characteristic of other, non-perfect verb forms, where it is also still found in Attic Greek. What has happened in Attic, therefore, is that a stem-formation process from elsewhere in the verb system (the augment) has had its domain extended to fill the gap left by a new phonological constraint on perfect-stem reduplication which is peculiar to Greek (Smyth 1956: 145–9; Schwyzer 1939: 649–50). (Steriade 1990 offers an explanation for the Attic reduplication 'gaps' in terms of sonority and syllabification.)

Examples of situation (c) (where gap filling is systematic but not morphological) are:

(4′) For those English adjectives which reject the comparative and superlative suffixes -er and -est, there is always available a periphrasis with *more and most, as in more curious, most sensitive, more motherly*.

(7′) In the earlier stages of Ancient Greek, a third-person plural suffix -atai appeared on those consonant-final perfect passive stems which rejected -*ntai*, as in *te–takh–atai* 'they have been drawn up'. Etymo-logically these two suffixes are related, and synchronically too one might well regard them as alternants of the same suffix, related morphophonologically. But in Classical Attic Greek the -atai form came to be replaced by a periphrasis involving the perfect passive participle in -men- and the third-person plural present indicative form (*eisi*) of the

copula *einai* 'be', as in *te-tag-men-oi eisi* 'they have been drawn up' (Smyth 1956: 132, 183; Schwyzer 1939: 812).

It is notable that for the gaps resulting from all the examples which we have classified as inflectional, (4)–(7), there exists a systematic filler, whether purely morphological or not. On the other hand, of the gaps classified as derivational, (l)–(3), only one is systematically filled. This reflects the importance of the paradigmatic dimension in inflection (see Stump, INFLECTION; Carstairs-McCarthy, INFLECTIONAL PARADIGMS AND MORPHOLOGICAL CLASSES).

Inflected forms fill 'cells' in a paradigm of related word forms appropriate to different grammatical contexts; consequently, if some morphological process is debarred phonologically from applying to some lexeme in some cell, there will be pressure to fill that cell in some other way, so as to avoid the risk that there may be some grammatical contexts from which the lexeme in question is excluded, just for want of an appropriate word form. This pressure to fill 'cells' is not felt in most areas of derivational morphology, though there is evidence that it is felt in some (Carstairs 1988); the Turkana example in (3) above may be one such instance, unless it is classified as inflectional.

Facts of the kind discussed here have recently become more prominent in theoretical debate within the framework of Optimality Theory (e.g. McCarthy and Prince (1993a; idem, PROSODIC MORPHOLOGY).

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8. Morphology and Syntax

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Introduction

The interaction between syntax and word formation has always been a battleground, on which many important linguistic wars have been fought. In the late 1960s and early 1970s, disagreements involving the nature of the Word Formation (WF) component and the Lexicon provided the background for the emergence of two radically different trends within generative grammar: that of Generative Semantics, on the one hand, and Lexicalism, on the other hand. At stake at the time was the appropriate constraining of the grammar, and whether an independent, list—like lexicon is more or less costly than an xtremely powerful syntax, in which transformations could derive varying syntactic and morphological structures from unique semantic representations.

To a large extent this issue, which has been inert within the Extended Standard Theory during the late 1970s and early 1980s, has reemerged in the mid 1980s, albeit in a slightly different guise. Work done on the lexicon during that decade has resulted in important structural insights into the nature of word formation, thus strengthening the claim that morphology is an autonomous module, on a par with the phonological and the syntactic modules, and that it should be understood in these terms. On the other hand, work done in syntax during that same decade resulted in the emergence of syntactic systems capable of handling word-formation operations in a more restricted way, thereby avoiding many of the pitfalls encountered by earlier, less constrained such work.

It is within this enhanced understanding of both syntax and word formation that the same question is now raised again: is word formation an independent module, subject to restrictions all its own, or should it be subsumed under syntax, obeying syntactic restrictions which are independently motivated? For those who believe in the existence of an independent word-formation component, another question must be resolved: how is the interaction between such an independent word-formation component and the syntax to be characterized?

The resolution of these questions is an empirical issue. Proponents of an independent word-formation component must show that such a component includes operations and constraints which cannot be reduced to independently motivated syntactic conditions. They must further show that an independent word-formation component with its accompanying restrictions allows for a range of phenomena that cannot otherwise be accounted for. Proponents of an exclusively syntactic word formation, on the other hand, must do the opposite: they must provide a way of accounting for the richness of WF phenomena, without appealing to any syntactic processes which are not otherwise motivated. An illustrative example: if in order to allow word formation in the syntax one has to introduce constituent structures which are only attested in word formation, never induced for non-word-formation syntactic operations, this would not represent any simplification of the grammar. It would simply allow a modified specialized syntax for generating words, differing in crucial, principled

ways from that needed for generating syntactic phrases.

Below, I will review very briefly some of the answers that have been given to these two questions in recent studies, pointing out the strengths as well as the weaknesses of those positions. Section 1 reviews a lexicalist, pre-syntactic approach to WF. In section 2, I review approaches attempting to reduce WF to syntax. In section 3 I turn to a formal comparison of morphological and syntactic structures, while section 4 reviews briefly issues concerning morphology and argument structure. Section 5 focuses on the existence, or nonexistence, of isomorphism between morphosyntactic and morphophonological representations. Finally, section 6 is devoted to a review of some "mixed systems," those which cannot be easily described as syntactic or lexicalist in nature.

1 Linear models

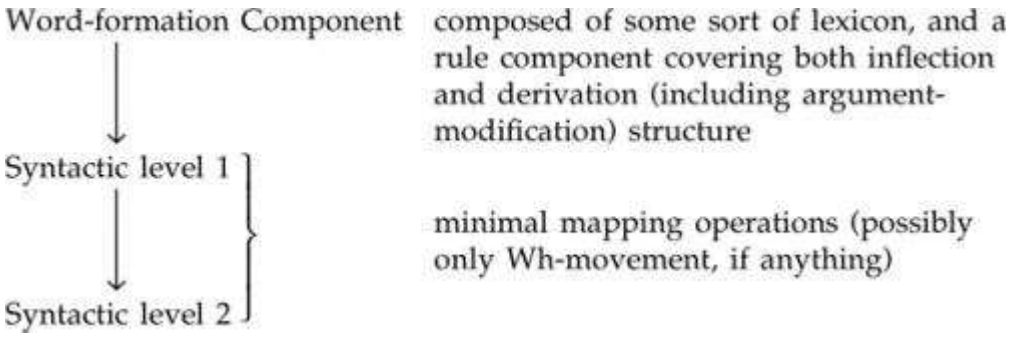
Much of the work on word formation in the 1970s and the early 1980s has been informed by the assumption that not only is there an independent word-formation component, but its interaction with the syntax is severely limited by some version of Lapointe's (1980) Lexical Integrity Hypothesis (LIH). Di Sciullo and Williams (1987) formulate this principle as the Atomicity Thesis in (1):

> (1) The Atomicity Thesis: Words are 'atomic' at the level of phrasal syntax and phrasal semantics. The words have 'features,' or properties, but these features have no structure, and the relation of these features to the internal composition of the word cannot be relevant in syntax.

The way in which LIH is enforced in many of these models is by assuming that the WF component, as a block of rules, is ordered with respect to the syntax. The WF component and the syntax thus interact only in one fixed point. Such ordering entails that the output of one system is the input to the other. This notion of the autonomy of the syntax and the WF component, and the restricted interaction between them, thus mimics the notion of autonomy developed for the interaction between the syntax and the phonology, where it is the output of the former which interacts with the latter. I will refer to this class of models as linear models.

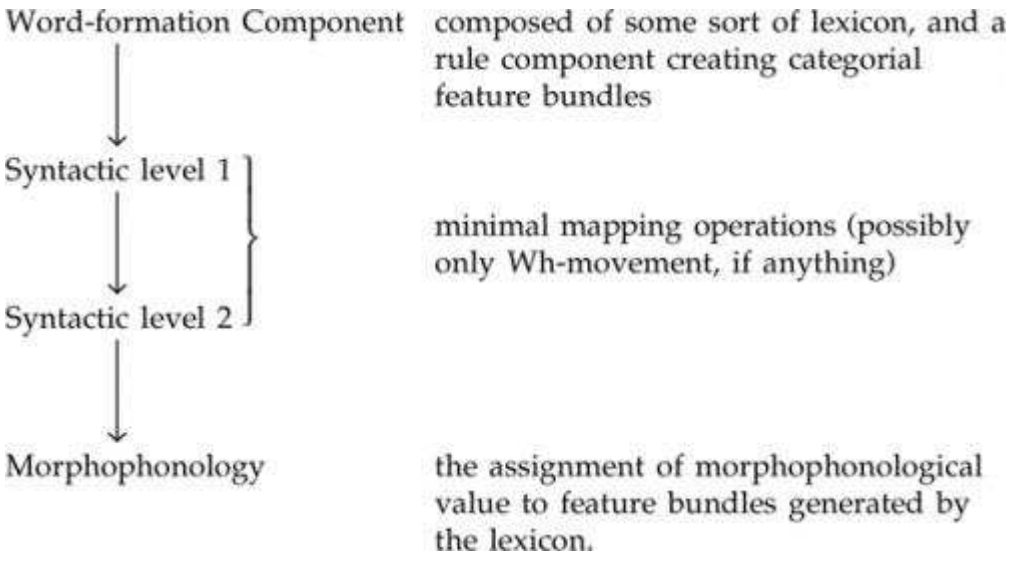
One possible ordering for the WF component is prior to D-structure: that is, prior to the availability of any syntactic operations. Such ordering entails that the output of the WF component is the input to the syntax. Oversimplifying, this model may be schematized as in (2):

(2)



Another possible ordering would entail a separation between the lexical and word-formation components which precedes the syntax, and some morphophonological component which follows it. Within such approaches, lexical insertion and WF involve the combination of categories and features (e.g. V+NOM), and it is the morphophonological component which is responsible for assigning actual phonological value to these combinations. Such an approach is depicted in (3):

(3)



As an illustration of the distinction between (2) and (3), consider a case of suppletion, as in, for example, the *sing—sang* pair. In type (2) models, the phonological string /*sang*/ is generated by the lexicon and inserted at D-structure. It is lexically specified as [+past], a feature that percolates to the root of the word, thereby becoming syntactically visible. On the other hand, in type (3) models the past tense of *sing* is generated by the WF component exactly on a par with the past tense of *walk*: both consist of [V+past] feature bundles. It is only at a later stage, when the morphophonological component is reached, that [SING+past] is given the phonological representation /*sang*/, while [WALK+past] is given the phonological representation /*walked*/.

Note that while the Atomicity Thesis may hold for (3), only the model in (2) actually *requires* it to be correct. If, indeed, the phonological string /*sang*/ is inserted as such under V, the fact that it is past tense must be associated with the entire word, rather than with any internal segment of it, for the word as a whole is clearly morphologically opaque. In other words, for supporters of model (2), there could not be a discrete [past] morpheme associated with /*sang*/ which is syntactically visible. On the other hand, this is not the case for (3). Here, a discrete morpheme [past] is associated in an identical fashion with both [SING+past] and [WALK+past], regardless of their phonological spellout, making it possible, at least in principle, for the syntax to refer to such a morpheme. I will return in section 5 below to some further ramifications of this distinction.

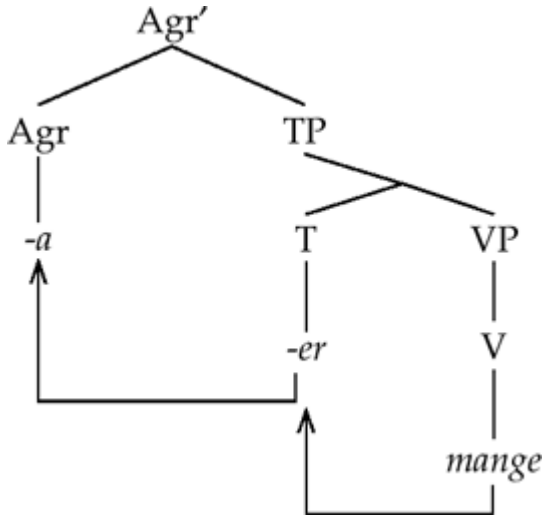
Proponents of an independent word formation, LIH, and the D-structure insertion of word-formation output typically support a strongly lexicalist approach to syntax, where much of the syntactic tree is base-generated as is, and the power of syntactic movement operations to modify the tree is greatly reduced. This correlation, while not logically necessary, is nevertheless not accidental. Within such models, it is assumed that there is a pre-syntactic independent word-formation component, with a set of well-defined properties and formal operations associated with it. Among the properties we find typically lexical ones such as subregularities, accidental gaps, suppletion, semantic drift, and blocking. Among the formal operations we find, depending on particular models, rewrite schemata, subcategorization frames for affixes, heads-of-words and percolation, level ordering, etc.[1] Crucially, now, these properties and operations characterize both derivational morphology and inflectional morphology. Halle (1973) has already pointed out that inflectional morphology shares its formal properties with derivational morphology: both exhibit accidental gaps, semantic drift, and blocking, and both can be characterized by the same formal mechanisms. In the work of Kiparsky (1982c) it is further shown that, morphologically speaking, regular inflectional morphology and irregular inflectional morphology do not form a natural morphological class, thus casting serious doubt on the validity of any formal morphological distinction between derivation and inflection.[2]

Proponents of linear models thus assume the existence of an independent WF component which encompasses both inflection and derivation, and whose internal structure, in accordance with (1) or a similar principle, is syntactically opaque. It thus follows that inflectional morphological structures,

although they typically interact with syntactic structures, may not be derived by a post-lexical syntax but, rather, must be derived lexically and pre-syntactically, forcing the introduction into the lexicon of richly annotated lexical entries where syntactic information is abundant. Now, having given so much formal power to the WF component, and having incorporated so much syntactic information into it already in order to allow the derivation of inflectional forms, it is only natural to attempt to bank on the resulting formal richness, and to try to restrict the syntax so as to leave in it only those mapping operations which cannot be encoded lexically at all.

Consider a concrete example. In much work done in the early 1990s, and much inspired by Pollock's (1989) adaptation of Emonds (1978), it is assumed that V moves from its original position to the functional heads Tns and Agr, thereby becoming inflected for tense and agreement. A scheme of such a movement is illustrated in (4) for the French form *mangera* 'eat-fut.-3-sg.' (irrelevant details omitted):

(4)



If, however, /*mangera*/ is base-generated already as is, specified as future and third person, the *morphological* motivation for the movement in (4) disappears. It can no longer be derived from the need for a host for the affixes heading TP and AgrP respectively, as has been argued by Baker (1988a) and Ouhalla (1991), among others.[3]

This rationale, note, carries over to supporters of type (3) models as well. Here, the verb would be inserted at D-structure as [STEM+Future+Agreement], and although phonological representation is delayed, head-to-head movement is not necessary for the stem to accumulate the necessary inflectional affixes.

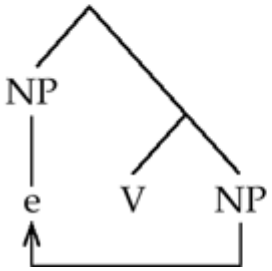
Even more important, support for a strong lexicalist model, of type (2) or (3), comes from a massive redundancy present in models which assume the existence of syntactic movement alongside operations which modify argument structures lexically. Consider, for instance, the classical GB account of verbal and adjectival passives (cf. Freidin 1978, Chomsky 1981, Marantz 1984a). In these accounts, the burden of explaining verbal passives is divided between the lexicon and the syntax. First, in the lexicon, some sort of de-thematization of the external argument takes place. The resulting participle is then inserted into D-structure having, essentially, the structure of an unaccusative verb. Subsequent NP movement then moves the internal argument to its surface subject position to receive Case. This highly modularized account of passive is schematized in (5) (where the underlined theta role is the external argument):

(5)

Passive:

(a) WF operation: [*wash*] ⇒ [*washed*]
<,$\underline{\theta_1}\theta_2$> <$\theta_2$,(,$\theta_1$),>

(b) D-structure insertion and NP movement:

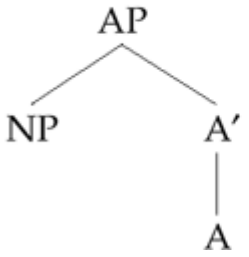


Yet within the same approach, adjectival passives are derived without NP movement, by a WF operation which takes the participle derived in (5a) as its input, and further lexically externalizes the internal argument, and (possibly) eliminates the original external argument altogether, as is schematized by (6a) (cf. Levin and Rappaport 1986). The resulting D-structure is (in essence) as in (6b), where the structure of adjectival passives (in predicative contexts) is in essence like that of unergative verbs:[4]

(6b)

(a) WF operation: [$_V$ *washed*] ⇒ [$_A$[$_V$ *washed*]]
<,$\underline{\theta_1}$,θ_2> <$\underline{\theta_2}$>

(b)



While empirical data lend some support to the representation of verbal passives as unaccusatives and adjectival passives as unergatives, from a conceptual point of view the following question arises: if lexical operations are allowed to modify argument structure, to eliminate external arguments, and to externalize internal arguments, as in adjectival passives, what, in principle, prevents a lexical operation that will externalize an internal argument in passive participles, thereby giving rise to a "lexical" verbal passive? Without an appropriate constraining of the WF component, such an operation cannot be ruled out in principle. In eliminating NP movement and restricting argument-structure modification to the WF component, proponents of strong lexicalist models, such as Lexical Functional Grammar (see Bresnan 1982a, Bresnan and Kanerva 1989), thus carry to its logical conclusion the research program launched by Chomsky (1970).

2 Syntactic models

In contrast with so-called linear models, much research from the mid-1980s onwards (notably inspired by Baker 1985, 1988a) can be characterized as an attempt to deny (much of) WF its status as an independent module. The thrust of the argumentation in these works is to show that WF

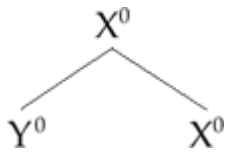
phenomena adhere to syntactic constraints and interact with syntactic rules, and hence are best char acterized as syntactic phenomena, not WF-specific phenomena. Most recently, this research program has been explicitly articulated in Lieber 1992:

> The conceptually simplest possible theory would…be one in which all morphology is done as a part of a theory of syntax… A truly simple theory of morphology would be one in which nothing at all needed to be added to the theory of syntax in order to account for the construction of words,
>
> (p. 21)

As Lieber (1992) herself points out, "no one has yet succeeded in deriving the properties of words and the properties of sentences from the same basic principles of grammar" (and I return to Lieber's own attempt shortly), but the desirability of this result continues to inform much current morphosyntactic research. Most of this research, however, continues to concentrate on a rather narrow range of phenomena, and the expansion of its results to a general explanatory model of syntactic WF is not clearly tenable.[5] In fact, with the recent exception of Lieber (1992), most researchers who have attempted to construct a model explicitly reducing (at least some of) WF to syntax have concluded that the task is impossible and quite possibly an undesirable one.[6]

Syntactically speaking, much of the work done by Baker (1988a) and subsequent work utilizes the notion of head-to-head movement, first proposed by Travis (1984). Head-to-head movement is the possibility of moving a Y° projection by Move-α and adjoining it to a governing X°, thereby creating the adjunction structure in (7):[7]

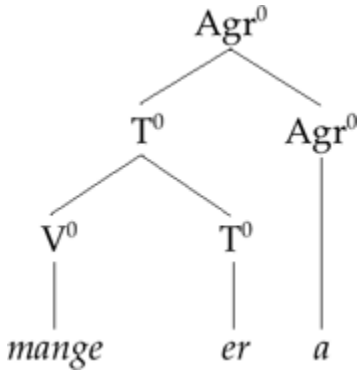
(7)



The availability of a syntactic operation which creates X° projections under well-defined conditions sets the stage for forming words syntactically. The case for syntactic WF is a formal one: if syntactic operations may form words, then the formal necessity for an autonomous WF component is weakened considerably. The reader should note, however, that the availability of syntactically derived X° projections does not entail that words as such are derived in the syntax, unless it is actually assumed that, *by definition*, all adjunction-created X° projections are *words* in the morphological sense: that is, if it is already assumed that morphological structures and syntactic structures are identical. It is in fact entirely compatible with existing syntactic assumptions to claim that the structures generated by head-to-head movement are *not* words in the morphological sense, but rather, nonmaximal phrases with some well-defined range of syntactic (rather than morphological) properties.

In general, work attempting to reduce morphological representations and operations to the syntactic configuration in (7) is divided into two groups, roughly corresponding to the traditional distinction between inflectional and derivational morphology. The first centers on the derivation of complex inflected forms from movement of lexical items through a succession of functional heads occupied by inflectional affixes. A typical example is shown in (4) above. It is an explicit assumption of most of these studies (see Belletti 1990 and subsequent work) that the representation in (4) is not just a syntactic one, in "which nodes such as Tns and Agr are bundles of functional and possibly syntactic features, but that, specifically, these nodes dominate actual morpho-phonological strings, and that the head-to-head movement depicted in (4) has the effect of affixing to a verb specific morphemes, resulting in a structure which is a morphophonological word, as depicted in (8):

(8)



Furthermore, the formation of a complex inflected word adheres to Baker's (1985) Mirror Principle:

> (9) The Mirror Principle: Morphological derivations must directly reflect syntactic derivations (and vice versa). (Baker 1985: 375)

Given the Head Movement Constraint, the order of morphemes in a derived form must reflect the syntactic structure. Thus, if the morpheme /*er*/ corresponding to FUTURE appears closer to the stem than the morpheme /*a*/ representing third person, it follows that the syntactic node which dominates tense markers is lower in the tree than the syntactic node which dominates agreement markers.

A historical note is of some interest here. Pollock (1989), in arguing for the existence of two functional projections above the VP (but below CP), uses exclusively syntactic argumentation. Given the placement of negation, adverbials, tensed verbs, and infinitives in French, he argues for the existence of two possible X° landing sites for the verb outside the VP, and hence for the existence of two maximal projections above the VP. The labeling of these nodes as Tense' and 'Agreement', with the former dominating the latter, is not directly argued for by Pollock; nor is this labeling a crucial part of his argumentation. The claim that these projections are morphological in nature was first put forth by Belletti (1990), who linked the syntactic structure proposed by Pollock with the Mirror Principle, suggesting that since agreement morphemes in Italian occur outside tense morphemes, the Mirror Principle requires postulating AgrP over TP. It is worthwhile noting here that Baker's (1985) Mirror Principle was a claim specifically about the syntactic representation of argument-structure-changing morphology, not about the order of inflectional morphemes, and extending the Mirror Principle to structures such as those in (4) is by no means a logical necessity.

On the other hand, the possibility of deriving morphophonological strings by syntactic movement, coupled with a research program seeking to reduce WF to syntactic operations, resulted immediately in the emergence of what Laka (1990) refers to as the "Inflectional Big Bang." If, indeed, syntactic head-|to-head movement is the only device for forming (8), the projection, as a full syntactic phrase, of every inflectional piece of morphophonology is inevitable. Further, as languages do not always display the same order of affixes with respect to the stem (i.e. some have tense markings outside agreement markings), the model requires the parameterization of the order of functional projections in a syntactic tree, allowing it to differ from one language to the next.[8] The system further necessitates postulating language-specific, and sometimes affix-specific, direction of adjunction. For a review of the problematicity of these results and attempts to constrain the system, see, in particular, Laka 1990 and Speas 1991a.

Before considering further implications of syntactic versus nonsyntactic WF, let us turn briefly to a comparison of the formal structures proposed for WF with syntactic structures.

3 Morphological vs syntactic structures

From the late 1970s onwards, work on WF typically utilizes notions such as head, projection, and subcategorization, all terms used in current syntactic theories. But are morphological structures one

and the same as syntactic ones? Let us briefly consider some of these alleged parallelisms.

3.1 Headedness and hierarchical structures in morphology

A review of the rewrite schemata and hierarchical structures proposed for morphology reveals immediately that they are systematically incompatible with notions of phrase structure and tree structure proposed for syntax.[9] Considering, specifically, proposals made by Selkirk (1982), note that her rewrite schemata cannot be reduced to a categorial projection from the lexicon, as is customarily assumed for syntax (nor was it intended to achieve this goal). Second, there is no way to reduce it to X′-theory. Selkirk proposes rules such as WORD □ STEM; STEM □ ROOT, etc., where notions such as WORD, STEM, and ROOT are morphological primitives with a host of morphological and phonological properties, in order to represent cyclical domains for the application of morphological and phonological rules. An attempt to translate this terminology into syntactic phrase structure would require postulating that X^{max} be formally distinct from X′, each representing a syntactically distinct primitive undergoing fundamentally distinct syntactic operations, a perspective implicitly and explicitly rejected in syntax (for an explicit argument against this perspective see esp. Speas 1990, as well as Kayne 1994, Chomsky 1995a).[10] Clearly, there is no sense in which Selkirk's rewrite schemata give rise to maximal or nonmaximal projections in the X′-theoretic sense.

Heads and maximal projections of sorts are explicitly proposed for morphological structures by E. Williams (1981). Specifically, it is proposed that the rightmost element in a morphological string determines the categorial type of the projection dominating it (the Right-hand Head Rule). As such, the notion of head proposed for morphological structures is similar to that proposed for syntax: it is proposed that in branching hierarchical structures, branches may differ in their relations to the root node, and that some constituents may be more prominent or more closely related to the root than others. Note, however, that this generalization is true not only of syntax and morphology, but also of phonology, specifically in representations of syllable structure, where the vowel is more prominent than either the onset or the coda. This, then, may represent an inherent property of grammatical hierarchical structures across the board, and does not argue for reducing the morphology to the syntax any more than it argues for the reduction of the phonology to the syntax, or vice versa. Rather, "what needs to be explored is whether the sense in which some subconstituent in a hierarchical structure is more prominent than others is identical in morphological representations and syntactic ones.

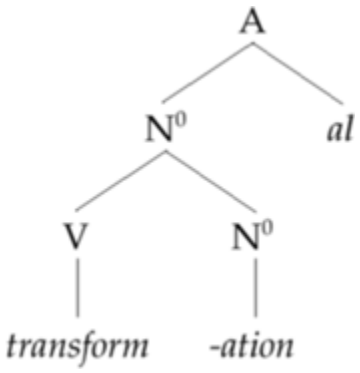
As a case at hand, consider the Right-hand Head Rule. Putting aside the question of its empirical adequacy, note that this is a very different type of relation from the one proposed for syntactic projections: it is relativized to a linear order. The head, rather than being a terminal projection of the same type as its dominating category, as it is in syntax, is identified by its position. Considering, for instance, a strict SOV language, it is unlikely that the presence of a Y constituent to the right of the verb in such a language would result in interpreting that Y constituent as a head. Rather, a movement would be assumed to derive that configuration, and the head would continue to be the X° terminal which projects the X°. As a particularly striking illustration, consider a recent proposal of Kayne's (1994), according to which UG only provides for [Specifier[Head Complement]] word orders at D-structure. At first sight, the mandated left-headedness of such a proposal appears similar to the Right-hand Head Rule, postulating a strict correlation between linearity and hierarchical order. Upon closer scrutiny, however, the similarity disappears. Thus, when confronted with a typical SOV language in the Kayne model, the null syntactic hypothesis would still be that the noncanonical position of the verb (or more accurately, the position of the object to the left of it) is the result of some movement operation, and that a closer investigation would, in fact, reveal the effects of such movement. It is rather unlikely that because of its location to the left of the final constituent, the structure would designate the object as the head and the verb following it as the complement. Yet, this is precisely the proposal made by E. Williams (1981) for all morphological structures, and by Lieber (1980) for the structure of English compounds, assuming that the determination of headedness of morphological structures is computed strictly from linearity.[11] Note, interestingly, that while the head of a word is assumed to be the rightmost constituent, heads of phrases according to Kayne (1994) are always generated in the leftmost periphery of X', rendering the unification of these two notions of head *prima facie* implausible.[12]

Lieber (1980), rather than defining heads and projections as such, defines a set of percolation

relations in morphological binary-branching structures. At times these are relations between affixes and the binary structure which dominates them. The term 'affix' in her system is a derivative, rather than a primitive notion: it is the element that has a subcategorization frame. For compounds, on the other hand, percolation is directionally determined.

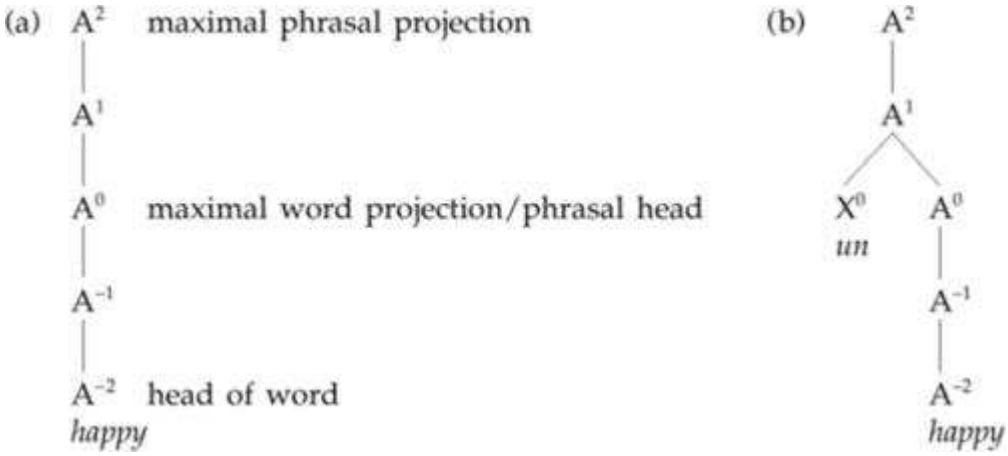
While Lieber's (1980) notions of affix, binary structure construction, and percolation come closest to the notions of projection from the lexicon used in syntax, they still show a range of properties which are clearly distinct from those attested for syntactic heads. First, head affixes may be on the right periphery (*-ation, -ment*, etc.) or the left periphery (*en-, be-*). Second, headedness for compounds remains strictly directional. Third, while syntactic structures give rise to trees in which heads are dominated by projections with an increased number of bars, morphological representations are typically recursive, and a morpho logical head X is typically dominated by a formally identical X. Thus, in a representation such as (10) an identical bar-level projection, N°, is associated with the verb *transform* and with the adjectival affix *-al*:

(10)



As Lieber (1992) points out, a simple solution in terms of introducing a subzero projection is problematic, in that it would require *happy* to be dominated by A° when occurring independently, but by A^{-1}, when occurring affixed, as in *unhappy*. In turn, however, Ackema (1995) suggests that the problem is only apparent, if it is assumed that *happy* is ambiguous between being a phrasal head and a morphological head. As a phrasal head, it is A°. However, as a morphological head, it is A^{-2}. The structure of *happy* is thus as in (lla), while the structure of *unhappy* is as in (l1b):

(11b)



While the solution proposed by Ackema is certainly attractive formally, note that it crucially requires

the assumption of projection levels dedicated to subword structures and the postulation, within a single maximal projection, of two distinct heads and two distinct maximal projections, phrasal and word respectively. Further, syntactic heads and phrasal maximal projections are subject to distinct formal conditions from heads of words and maximal projections of words. On the other hand, Ackema (1995), quite explicitly, does not try to reduce WF to syntax. Rather, he claims that there is a distinct morphological component which is governed by principles which are identical to those of the syntax, but which is nevertheless distinct from the syntax.[13]

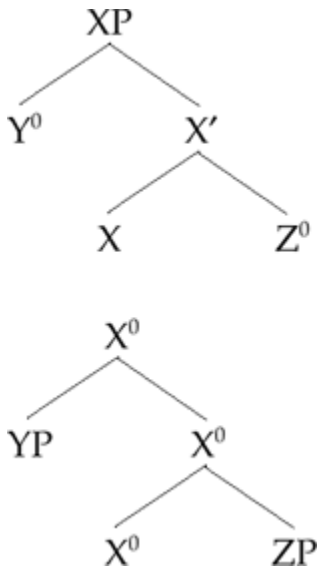
Interestingly, Lieber's (1980) notion of projections is not too different from that put forth in Chomsky's (1995a) Bare Phrase Structure. Here, as well, notions such as X° and X' are no longer basic; nor is a typical node composed of the sequence X"–X'–X°. Rather, a phrase is conceived as a succession of identical nodes dominating each other, as in $[_{cat}\ [_{cat}\ [_{cat}$ cat]]], where the lowest, the terminal, is interpreted as X^{min} and the highest as X^{max}. To draw a parallelism with a morphological structure, in a string such as $[_{A}$ *un* $[_{A}$ *happy*]], *happy* would be A^{min}, while *unhappy* would be A^{max}.

In her own attempt to unite the hierarchical representation of words and phrases, and being fully aware of the syntactic incompatibility of previous accounts, Lieber (1992) proposes a modification of the (syntactic) X' schema, adapting it to both morphological and syntactic needs. Such an attempt can only be successful, however, if in doing so, Lieber does not merely create a set of hierarchical structures and conditions on them which apply exclusively to word formation. Examining her proposed modification, it appears that she does precisely that. Specifically, she argues for the following modifications to the X'–schema:

(12) (a) Specifiers must be allowed to appear within the X' level.
(b) Recursion is allowed within the X° level.
(c) Nonheads need not be maximal projections.

It is not clear that the modifications proposed in (12) have any independent syntactic justification. Concerning (12a), Lieber relies on a comment by Stowell (1981), proposing that in Japanese and German specifiers are generated under X'. Research since then has seriously challenged this claim. Nor does Lieber provide any evidence for the independent necessity of (12b) in syntactic (i.e. nonmorphological) representations. Finally, proposals quoted by Lieber as evidence for (12c) are extremely limited in scope, and center on a very narrow range of properties. Specifically, even if structures such as (13) are, according to some phrase-structural approaches, attested syntactically,[14] the question is why structures such as (14), which Lieber predicts to exist freely, are rare for morphological units, and not attested at all for syntactic ones:[15]

(13)



However, the most serious problem for Lieber's (1992) attempt to reduce morphological formalism to a syntactic one concerns her use of specifiers and complement, a point to "which I return shortly.

3.2 Subcategorization

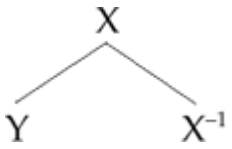
Lieber (1980) and others have proposed that morphological selection can be captured by means of a morphological subcategorization frame, or selection. Again, it is tempting to try and subsume this notion of subcategorization, or selection, under the notion of selection familiar from the syntax. Yet, an investigation of the properties of morphological selection reveals that it must be kept entirely distinct from syntactic selection. In order to illustrate this, consider a proposal by Rizzi and Roberts (1989) to encode morphological subcategorization syntactically. They propose that morphological subcategorizations are projected syntactically as adjunction structures with an empty slot into which substitution movement can move heads. Head-to-head movement is further possible without such base-generated structures, creating adjunctions, rather than substituting into base-generated ones. This latter operation does not result in a word. The two structures have distinct properties. Thus excorporation (in the sense of Roberts 1991) is possible from the latter, but not from the former.

Consider some of the consequences of this proposal. First, note that it allows head-to-head movement, and hence the formation of an X° projection, which is not a word, when no morphological subcategorization is projected. Thereby, the definition of word is lifted out of the syntax, becoming a purely morphological matter, which is entirely independent of the existence of an X° projection. This is especially striking, as, syntactically, the outputs of substitution into a base-generated adjunction structure and adjunction-creating movement are identical. The syntax is thus in principle incapable of distinguishing between these two outputs, and an (independent) morphology must be appealed to, to determine which syntactic configurations correspond to words and which do not.

Second, since the outputs of substitution and adjunction are identical, a configuration is introduced here which is otherwise unattested in syntax, and seems needed only for the purposes of incorporating word formation into the syntax. (Note that this issue is independent of whether or not adjunction structures can be base-generated, as it addresses specifically the possibility of substitution into such structures, if, indeed, they may be base-generated.)

Attempting to address some of these problems, Roberts (1991) proposes that in substitution cases (but not in adjunction cases) a sub-X° structure is basegenerated, with a null sister, having the structure in (15):

(15)



In this structure, substitution is to the empty Y slot. In this way, the structural identity between the outputs of adjunction and substitution is avoided. However, other problems arise. Some issues concerning sub-X° projections were reviewed in section 3.1. Note, in addition, that identity of output between adjunction and substitution is avoided here at the cost of introducing a sub-X° structure for the manifest purpose of allowing words to have syntactic structures. None but morphological structures would ever have sub-X° structure; nor would morphological selection ever be realized anywhere else. Thus the syntactic difficulty here is solved by reinforcing the gap between syntactic selection and morphological selection, not eliminating it.

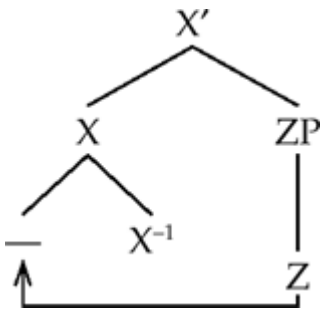
Second, note that under the standard assumptions that substitution movement is only possible to a specifier position, never to a complement position, we must assume that Y in (15) is a specifier. Under equally accepted assumptions, however, selection may only be realized by complements. We are thus faced with a contradictory situation where Y is selected by X^{-1}, and hence is its complement, but movement to it is possible, thus suggesting that it is a specifier. The problem is compounded by

approaches (cf. Speas 1990, Kayne 1994) which obliterate the distinction between specifiers and adjuncts altogether, making the distinction which Rizzi and Roberts (1989) try to draw impossible to state.

This criticism is equally applicable to proposals made by Lieber (1992). In her attempt to reduce morphological representations to syntactic ones, Lieber is clearly faced with the need to explain the persistent right-headedness of English words such as [[*happy*$_A$] *ness*$_M$]] [[*monster*$_N$] *ous*$_A$]] [[*glory*$_N$] *ify*$_V$]]. As *-ness, -ous, -ify* are clearly heads here, and as the stems to which they are attached appear to their left, Lieber concludes that *happy, monster*, and *glory* are specifiers (or possibly modifiers), and not complements of their respective heads. In addition, however, Lieber would still like to maintain that in a meaningful way, *-ness, -ous, -ify* categorially, and possibly semantically, select *happy, monster*, and *glory*. Again, selection according to standard syntactic assumptions may only be realized by complements, leading to a contradiction, or to a system of complements, specifiers, and selection which behaves differently for morphology and for syntax. (The nonstandard aspect of specifiers as sisters of an X° projection in Lieber's system was pointed out above.)

Returning to (15) (or, for that matter, to the original structure proposed by Rizzi and Roberts (1989)), and given the D-structure syntactic projection of morphological subcategorization frames, one may ask what actually prevents the base-generation of morphological structures such as (15) with all morphemes in place, preempting movement altogether. The answer is that such base-generation is often not possible as the incorporated element is itself a complement of X which must satisfy a distinct syntactic subcategorization frame at D-structure in order to meet the Projection Principle. The schema of such a structure is given in (16):

(16)



It thus seems that morphological subcategorization frames need not, and indeed, at times may not, be satisfied at D-structure. In fact, it is precisely the conflict between the syntactic subcategorization, which must be satisfied at D-structure, and the morphological subcategorization, which need not be thus satisfied, which gives rise to the movement. It is thus obvious that syntactic subcategorization and morphological subcategorization are distinct, and should be kept as such, to ensure that one must be satisfied at D-structure, while the other need not be.[16]

In conclusion, extending the syntax to cover morphological structures requires a radical modification of our notion of hierarchical structures and selection as they emerge from the X' schema. Notions such as head and selection, when used morphologically, are sufficiently distinct to seriously shake any attempt to reduce them to well-known syntactic mechanisms.

3.3 Incorporation and government

In view of the fundamental problems associated with the formal reduction of morphological structures to syntactic ones, what further support is there for the claim that, for example, noun incorporation as a morphological process is syntactically derived? Baker (1988a) brings forth many empirical arguments for his assumption that noun incorporation must be syntactically derived. However, subsequent work by Di Sciullo and Williams (1987) has shown clearly that none of his empirical arguments actually excludes a lexical derivation. Rather, Baker's argumentation by and large shows noun incorporation to be consistent with a syntactic analysis, rather than incompatible with a lexical

one.

A major conceptual argument brought forth by Baker in support of a syntactic derivation for noun incorporation is based on simplicity: some central properties of words can be shown to follow directly from independently motivated syntactic principles if we assume that they are formed by head-to-head movement. The major independently motivated constraint is the Head Movement Constraint (of Travis 1984) and its (possible) reduction to the Empty Category Principle (see Chomsky 1986). Specifically, the **HMC/ECP** accounts elegantly for subject-object asymmetries observed in noun incorporation, and groups them together with a wide range of syntactic subject-object asymmetries independently reducible to ECP effects.

This line of argumentation, however, is actually less than conclusive. More than anything else, it is indicative of the prevalence of the notion of government in syntactic models put forth in the 1980s. As is well established, word-formation operations which interact with argument structure are sensitive to selection properties. In particular, internal arguments, the classical "subcategorized" elements, enter word formation with the stem in a way which is not (typically) attested with external arguments. This was observed at least as early as Lees (1960), and has been incorporated in some fashion into WF accounts, be they syntactic (as in Roeper and Siegel 1978) or lexical (as in Lieber 1983).

Under standard assumptions, complements are projected in some minimal domain of the head, while noncomplements, either adjuncts or specifiers, are projected outside that same domain. If we refer to this minimal domain as "government," as is commonly done, it is clear that a statement concerning the incorporability of selected complements and a statement concerning the incorporability of elements governed by V are almost identical.[17]

Configurations of government and configurations of selection do, however, vary. Within phrase structures proposed in the mid-1980s, one area of difference involves Exceptionally Case Marked embedded subjects. Another involves specifiers of complements. As is well known, clitics do incorporate in the former contexts, as the following example from French illustrates. However, there are no documented cases of noun incorporation from such contexts:

(17) Je le$_2$ considère [$_{AP}$ t$_2$ malade]
'I him consider sick'

Baker (1988a) discusses, however, a case in Chichewa where it is clearly not a selected complement which incorporates into the verb, but rather its possessor, which is governed by the verb but is not selected by it:

(18) (a) Fisi a- na-dy-a nsomba za kalulu
hyena sp-PAST-eat-ASP fish of hare
'The hyena ate the hare's fish'
(b) Fisi a- na-dy-er-a kalulu$_1$ nsomba (t$_1$)
hyena sp-PAST-eat-APPL-ASP hare fish

Note that in (18a), the possessor appears as a post-nominal PP, while in (18b) an applicative affix is attached to the verb, and the possessor appears adjacent to it.

Interestingly, on recent assumptions concerning phrase structure, the government asymmetry between complements and subjects disappears. Specifically, if subjects are base-generated as the specifiers of the head selecting them, and that head moves to a higher head, resulting in the configuration in (19), noun incorporation of subjects into the V can no longer be excluded by the HMC:

(19) [$_{FB}$...[$_F$V + F[$_{VP}$ Subj t$_V$(Obj)]]]

Borer (1995) argues that, indeed, the incorporation of specifiers in structures such as (19) is licit, also in construct state nominal configurations such as (20a), exemplified in (20b), where *'axilat-Dan*

'eating Dan' is argued to be an incorporated form (irrelevant details omitted):

(20) (a) $[_{DP1}\ N_1 \ldots [_{NP}\ N_2\ t_1\ [_{XP} \ldots]]]$
(b) 'axilat Dan 'et ha-tapuax
eating Dan ace. the-apple
'Dan's eating of the apple'

In view of this, one wonders why it is that cliticization and Hebrew construct state allow a type of head-to-head movement which is excluded for noun incorporation.

4 WF and argument structure

Word formation by syntactic means receives its strongest, overwhelming support from the existence of a very powerful pretheoretical approach to the interaction between lexical semantics and syntax. According to this view, closely resembling the Generative Semantics tradition, there should be a direct mapping between thematic roles and syntactic structures, and if such a direct mapping could be established, it would per force favor those formal representations which are compatible with it and exclude others. For proponents of such an approach it thus suffices that syntactic word formation be shown to be empirically adequate. It is not necessary to show that the rival approach, the lexical one, is empirically flawed, since everything else being equal, it is to be dismissed on general, pretheoretical grounds.

In the work of Baker (1988a), this perspective on the interaction of syntax and lexical semantics is formulated as the Uniformity of Theta Assignment Hypothesis given in (21):

> (21) The Uniformity of Theta Assignment Hypothesis: Identical thematic relationships between items are represented by identical structural relationships between these items at the level of D-structure.

UTAH, as utilized by Baker, argues that, for example, active and passive verbs must have the same D-structure; that causative verbs must appear in structure in which the arguments of the source, a noncausative verb, are fully represented, etc. Intuitively, **UTAH** suggests that for every lexical item there is a unique D-structure, and any further manipulation of argument structure or affixation must be syntactic, the output of movement. In its strongest possible interpretation, a principle such as **UTAH** not only enables words which interact with argument structure to be formed syntactically, but actually forces them to be formed syntactically.[18]

An illustration of the way in which a principle such as **UTAH** motivates a derivation is the comparison of the derivation of verbal passive in Chomsky 1981 with the analysis of verbal passive put forth in Baker et al. (1989). Recall (see section 1 for a brief discussion) that in the system of Chomsky (1981), deriving verbal passive is a modular process, having a 'lexical' WF component and a syntactic one. Specifically, for a verb such as *derive*, the WF operation forms the participle *derived* from the source V and suppresses/internalizes the external argument. The internal argument, however, remains intact, and projects as the complement of the participle at D-structure. Syntactic considerations (i.e. the need for Case) now result in that internal argument moving to receive nominative Case.

This derivation, note, is only partially compatible with **UTAH**. Although the projection of the internal argument remains identical for the lexical entry of derive both in its verbal and in its participial form, the projection of the external argument is altered. While for *derive* the external argument is projected as a sister of V (or, alternatively, as a sister of VP), for the participle *derived* the external argument is not projected at all, or, alternatively, it is internalized, in violation of **UTAH**. Similarly, proposals put forth by Jaeggli (1986a) are not fully compatible "with **UTAH**. This suggests that the affix *-en* is assigned the external argument. However, that affix is placed internal to the V constituent, thereby allowing the external argument to be realized in different positions, although its thematic relationship with *derive(d)* is constant.

Baker et al. (1989) address this issue directly. Adopting Jaeggli's (1986a) assumption that the external argument is assigned to the morpheme *-en*, they project that morpheme *external* to the VP, and as its

sister. Assuming that the notion "identical structural relations" means for external arguments sisterhood with a maximal projection, the assignment of an external thematic role to a head external to the VP satisfies **UTAH**. Relevant aspects of the structure proposed by Baker et al. (1989) are given in (22):

(22)

$$[_{IP}\ \underset{\theta_{ex.}}{\textit{-en}_1}[_{VP}\ \textit{derive}\ \underset{\theta_{int.}}{\text{NP}}]]$$

The ramifications of **UTAH** for the **WF** component and its interaction with argument structure are far-reaching and interesting. As has been pointed out often, however, for some argument-structure-changing morphology, a full syntactic representation might turn out to be problematic. A particular problem is presented by the existence of complex morphological forms which are derived from verbs, but which do not preserve the argument of the source verb. This is the case for (some) agentive nominals derived from transitive verbs, which appear to lose their internal arguments (e.g. *killer*); for adjectives derived from verbs, either as adjectival passives (e.g. *the derived structure*) or as *-able* adjectives (e.g. *a derivable structure*), which appear to lose their external arguments; or for derived de-verbal nominals, which, on their result reading, lose both external and internal arguments of the source verb (e.g. *the excavation was successful*). I return, specifically, to the issue of derived nominals in section 6 below.

The necessity of introducing into the syntax all argument-structure-changing morphology follows from a particular set of assumptions concerning the relationship between argument structure and syntax, one which entails, in essence, that D-structure is the canonical level of argument-structure realization, and that the lexical entry is the locus of argument-structure specification. Recent approaches to argument structure, however, have cast doubt on the existence of D-structure as GF-θ, or, more generally, as a level of representation encoding argument structure altogether. Further, currently, the pivotal role played by lexical entries is in question, and models giving more weight in the determination of argument structure to predicates and to functional (rather than lexical) structures are widely entertained (for some current research along these line see e.g. van Hout 1992,1996; Kratzer 1994; Borer 1994, in press; Ghomeshi and Massam 1994; Davis and Demirdash 1995). In view of this, the epistemological advantage of placing in the syntax all argument-structure-changing morphology, as follows from the **UTAH** research program, is no longer self-evident, leaving the merits and de-merits of syntactic WF to be determined independently of issues concerning argument structure and its projection.

5 Morphophonological/morphosyntactic isomorphism?

5.1 Projecting phonological strings?

Interestingly, the so-called Inflectional Big Bang approach shares an important property with type (2) linear models, but not necessarily with type (3) linear models. In both, the syntactic properties of words and the phonological properties of words are assumed to go hand in hand. Proponents of (2), assume that what is inserted at D-structure is the actual phonological string, rather than categorial feature bundles. Likewise, proponents of the derivation in (4) assume that the relevant inflectional heads dominate actual phonological material, and that the structure in (8) is responsible for the formation of an accurate phonological string. Clearly, this is the rationale which drives the positioning of AgrP higher than **TP**, as discussed in section 2: it is based exclusively on the order of the morphophonological material in forms like */mangera/*. Likewise, the assumption that grammars may project functional heads in different hierarchical orders is an attempt to derive a morphophonological string by syntactic movement.

Consider, however, the model in (3). Here, what are inserted at D-structure are categorial feature bundles, which are in turn given phonological representation later on. If this is the case, there is no longer any reason to assume that a feature bundle such as [**STEM+AFF**$_{\textbf{infl1}}$**+AFF**$_{\textbf{infl2}}$] actually

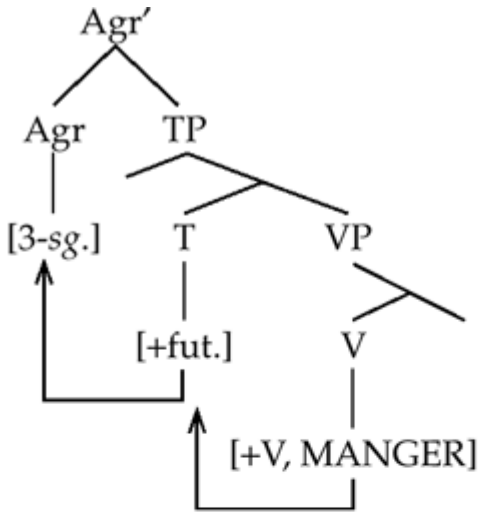
corresponds to any particular morphophonological sequence. And indeed, this point has been made by Marantz (1988), who suggests that there is no necessary isomorphism between feature bundles, lexically or syntactically derived, and the morphophonological representations assigned to them. In other words, it may be that while in Grammar 1 morphophonological considerations would lead to AFF-1 being realized closer to the stem, in Grammar 2 different morphophonological considerations would realize the same syntactic featurebundle differently.

What is at stake here is the following question: are syntactic representations or word structure isomorphic with phonological representations of word structure? Specifically, is there a unified notion of a morpheme, such that it is the true mediator between sound and (syntactic) function? Or, put differently, are morphological operations to be captured through the existenceof lexical-like elements, which compose to give rise to the correct combinations, very much as|is assumed for syntactic representations? For proponents of type (2) models, as well as for proponents of the Inflectional Big Bang approach, the answer is "Yes." For "lexicalists," thisisomorphism is reflected by a lexically derived WF structure, encoding, as a derived unit, allthe syntactic information associated with its components. For "movers," on the other hand, it is the syntactic movement which creates, through adjunction, the string which is directly mapped onto phonological representations.

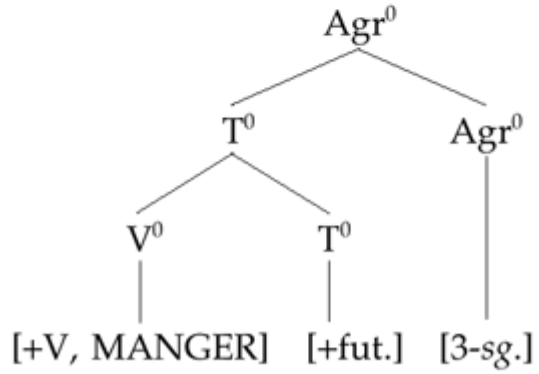
Just as the assumption of morphophonological/morphosyntactic isomorphism has its lexical and syntactic variants, so the assumption of no isomorphism has a lexical and a syntactic variant. Its lexical variant is the model in (3), Consider now its syntactic variant. Returning to the original Pollock (1989) argumentation, one may argue syntactically for the existence of a complex functional structure above the VP, or support the existence of such functional structure on semantic grounds (e.g. the existence of a T head as necessary for the formation of a proposition, and the existence of a D head as necessary for the assignment of reference). Such functional structure may itself dominate a feature bundle to which a stem will be adjoined by syntactic movement. However, the specific ordering of such projections, or their existence, would now be motivated exclusively on syntactic or semantic grounds. As an illustration, consider the following structure, assuming there to be compelling UG reasons to place Agr above T:

(23)

(a)



(b) syntactic output:



(c) morphological output:
[+V, MANGER][+fut.][3-*sg*.] ⇒ /*mangera*/

For *mangera*, the order of syntactic projections following head-to-head movement and the order of phonological material are the same, thereby leading to an appearance of syntax/phonology isomorphism. Consider, however, the case of agreement and tense morphology in Hebrew, as illustrated in (24). While in the past tense, agreement and tense marking are stem-final, as in (24a), in the future tense, the agreement morpheme is split between a post-stem and a prestem position:[19]

(24)

(a) qibbsl	*-u*	(a′) *ye-*	qabbəl *-u*
receive+past	-3pl.	3+fut.-	receive -pl.
(b) qibbal	*-ti*	(b′) *'a-*	qabbel
receive+past	-1sg.	1+sg.+fut.-	receive
(c) qibbal	*-nu*	(c′) *ne-*	qabbel
receive+past	-1pl.	1+pl.+fut.-	receive

Even if one were to grant, as Ouhalla (1991) suggests, that in some languages TP is above AgrP, such

an order would not give rise to the correct order of morphemes in Hebrew. First, the division of the agreement morphology in some cases, but not in others, into pre- and post-stem positions is hard to reconcile with a morphophonological/morphosyntactic isomorphism. The fact that in (24a') a future plural form receives its number specification post-stem, but its person specification pre-stem, while in (24c') a future plural form receives both its number and its person specification pre-stem could only be reconciled within an isomorphic model by fragmenting the functional representation so as to give a separate, and hierarchically distinct, representation to first person, third person, plural, singular, etc. A theory which does not assume isomorphism faces no such difficulties.

Isomorphic models, be it noted, need not elaborate on the structure of the morphophonological component. That structure is one and the same as the morphosyntactic component. However, proponents of nonisomorphic models must address another issue. Assuming the syntactic aspect of WF to be essentially as in (23b), where (23b) is derived either lexically or through movement, and its hierarchical structure is either syntactic or morphological in nature, what is the nature of the morphophonological component? In other words, what is the model that would give the structure in (23b) the correct phonological representation?

On this issue, we find considerable variation. On the one hand, we find models which assume that the morphophonological component is hierarchical in nature, and that morphemes are coherent phonological units. Typically, in these models the hierarchical structure of (23b), derived lexically or syntactically, is matched with a distinct hierarchical structure which is morphophonological in nature, but which still embodies within it a coherent notion of a morpheme. Such a model is explicitly put forward by Zubizarreta (1985), who proposes that Italian causatives, exhibiting both bi-clausal and mono-clausal properties, do so because their morphosyntactic structure is bi-clausal, but their morphophonological structure is mono-clausal. A similar idea is put forward in Sadock's (1985, 1991) autolexical model, where the output of syntactic trees projects independently as a morphological structure, with cooccurrence conditions restricting the relationship between the two structures and preventing reordering of elements. Most recently, a morpheme-based nonisomorphic model has been proposed by Halle and Marantz (1993) (see also Marantz 1988 on cliticization). This model, Distributed Morphology, derives syntactic structures akin to (23b) through syntactic movement, subsequently assigning to them morphophonological representations. Crucially, in this model it is possible to assign an identical syntactic structure to amalgams in which the order of agreement and tense differs and cannot be derived from the syntactic structure, as is the case in (24), leaving the derivation of the correct (distinct) morphophonological structure to a postsyntactic component. Further, it is capable of assigning the correct phonological string to syntactically regular, but morphophonologically irregular forms, such as */sang/*. Crucially, within the model there is still a coherent phonological notion of a morpheme, and hence some hierarchical structure associated with complex phonological words.

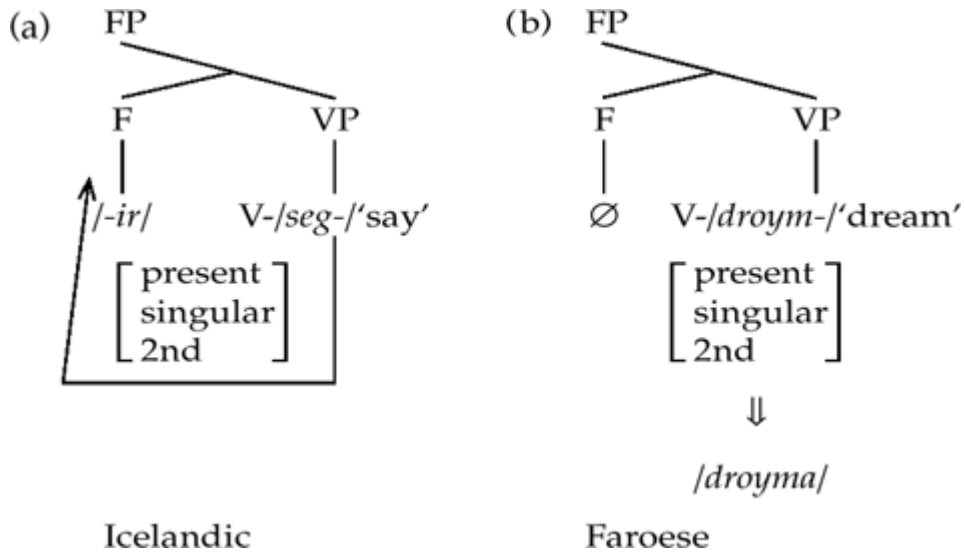
At the other end of the spectrum, we see the coupling of hierarchical syntactically relevant representations with a phonological component that is explicitly based not on discrete morphemes, but rather, on phonological representations of particular operations. The strongest thesis along these lines, labeled appropriately as the "Separation Hypothesis", was proposed by Beard(1976,1988,1995). In such a model, the derivation of, for example, */walked/* from */walk/* is not phonologically or morphologically distinct from the derivation of */sang/* from */sing/*: both involve the mapping of syntactic amalgams to phonology on the basis of paradigmatic representations. A similar model is proposed for inflectional morphology (but not for derivational morphology) by Anderson's (1992) A-morphous Morphology (or, alternatively, the Extended Word-and-Paradigm model), where it is argued that inflectional processes are exclusively phonological in nature, consisting in giving a phonological representation to an abstract entry, comprising, among other factors, syntactic information. Again, there is no necessity in this approach to assume that the hierarchical nature of morphosyntactic representations translates into a morphophonological hierarchical structure or, for that matter, that morphemes are discrete phonological terminals of any sort.

Summarizing, nonisomorphic approaches assume that the hierarchical grammatical properties of words are segregated completely from their phonological realization, and that the term "morpheme," as such, implying, indeed, some phonological-functional isomorphism, is an ill-defined one.[20]

Morphophonological considerations, especially those concerning the representations of suppletive

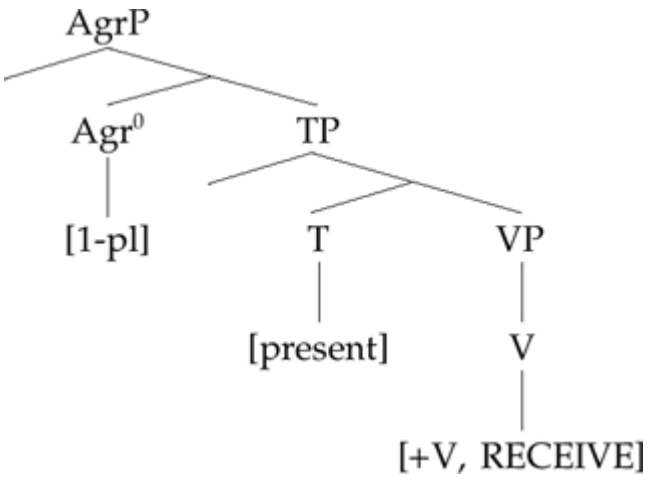
forms, mixed-order forms, and autosegmental forms strongly favor a nonisomorphic approach, be it lexical or syntactic. However, some recent syntactic analyses which depend crucially on the actual projection of morphophonological material in the syntactic tree cannot be captured naturally in a **DM**-type system. As an illustration, consider recent proposals to account for the restrictions on verb movement by appealing to the "richness" of morphophonological representations. Thus it has been proposed that the existence of V movement in Icelandic, versus its absence in the mainland Scandinavian languages or English, is due to the presence of a "rich," in some sense, inflectional paradigm in the former, and its absence in the latter (see Platzack and Holmberg 1989, Roberts 1985, Rohrbacher 1994). Thus Rohrbacher (1994) proposes that the "rich" inflectional paradigm comprises a full person/ number paradigm in at least one tense. In this system, "rich" paradigms are lexical entries which project as independent heads, thereby requiring the verb to move and attach to them. By contrast, "nonrich" paradigms are not lexical entries; nor are they discrete morphemes at all. Rather, they are the result of phonological stem change of the type advocated in Anderson's (1992) A-morphous Morphology. Syntactically speaking, they do not project, and therefore no (overt) V movement is required. A movement configuration is given in (25a), a nonmovement one in (25b):[21]

(25)



Crucially, the notion of richness is based on the properties of actual morphophonological strings. From the perspective of a Distributed Morphology model, such a distinction cannot be made. Considering, within a DM model or any other model based on feature bundles, the syntactic structure of English versus that of Icelandic form such as, for example, *receive* in the context of *we receive*, both would have the structure shown in (26), making the statementof any dependence between verb movement and the nature of the inflectional paradigm unstatable (see Rohrbacher 1994, where this point is made explicitly):

(18)



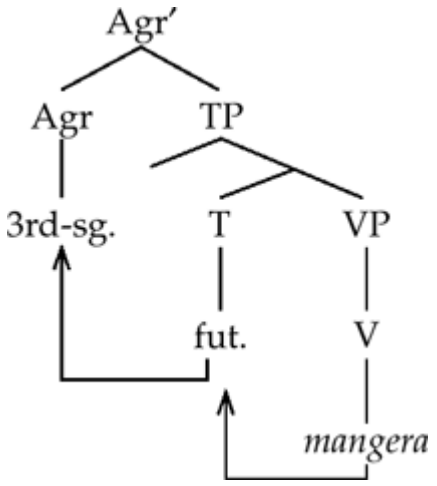
In turn, the result obtained in (25) could be achieved within a DM model by stipulating that in English, but not in Icelandic, Agr is weak, in the sense of Chomsky (1993), thereby making (overt) movement unnecessary. However, within the DM model the weak–strong feature must be formally dissociated from the properties of the morphophonological paradigm, as these are strictly nonpresent in the syntactic structure. The correlation, if such indeed exists, between the "weak–strong" property and morphophonological "richness" thus becomes entirely stipulative in nature.

Similar issues arise concerning accounts of null pronominal subjects which are based on the richness of inflection. Thus, Speas (1994) suggests that English bars null pronominal subjects because Agr must be phonologically licensed, through the presence of phonological material either in its head (a condition met by the classical null-subject languages such as Italian and Spanish) or in its specifier. As Agr does not dominate (sufficiently rich) phonological material in English, the specifier must be filled.[22] Again, it is hard to see how such a notion of phonological licensing can be translated into a DM-type system which utilizes syntactic feature matrices rather than actual phonological material.

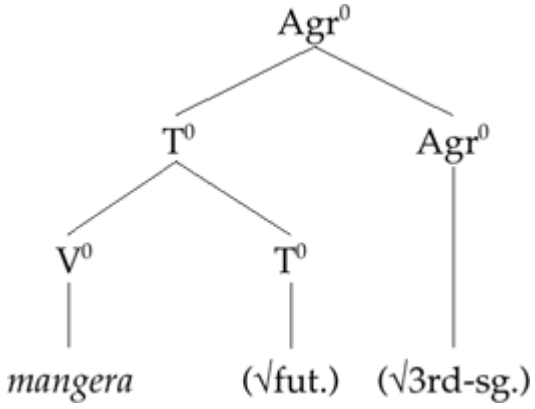
5.2 Checking Theory

In what is possibly the strongest departure from the assumption of isomorphism, Chomsky (1993, 1995b) assumes that while (inflectionally-derived) words are well formed only if syntactic head-to-head movement has occurred, syntactic movement and the resulting adjunction are entirely divorced from any morphological properties of such words, be they phonological or syntactic. Thus, for the formation of words, Chomsky adopts, in essence, a linear model of WF, assuming that the output of some WF component consists of fully formed words with a set of properties which may be syntactically relevant, but with an opaque internal structure, thereby, in essence, adopting the atomicity thesis.[23] However, in departure from the spirit, if not the letter, of the atomicity thesis, these outputs of the WF component must move through the syntactic tree, checking their inflectional features through a succession of functional projections marked inflectionally. The input of such movement may be a syntactic structure similar to (4) (cf. (27)), in which head-to-head movement applies, but (27) is specifically not the input to WF, and the output of head-to-head movement, as in (28), is specifically *not* morphological in nature, nor do the heads in it dominate actual phonological material, or even bundles of features to be associated with the moved stem, in the sense of Distributed Morphology. Rather, the heads dominate abstract semantic features, such as tense, number, etc., to be matched with the properties of the word as a whole. The movement is thereby entirely divorced from morphological considerations, and the syntax, while equipped with a device for checking the *syntactic* appropriateness of words, is deprived of any role in the building of morphological units, be they phonological, as in isomorphic approaches, or syntactic, as in nonisomorphic ones.

(27)



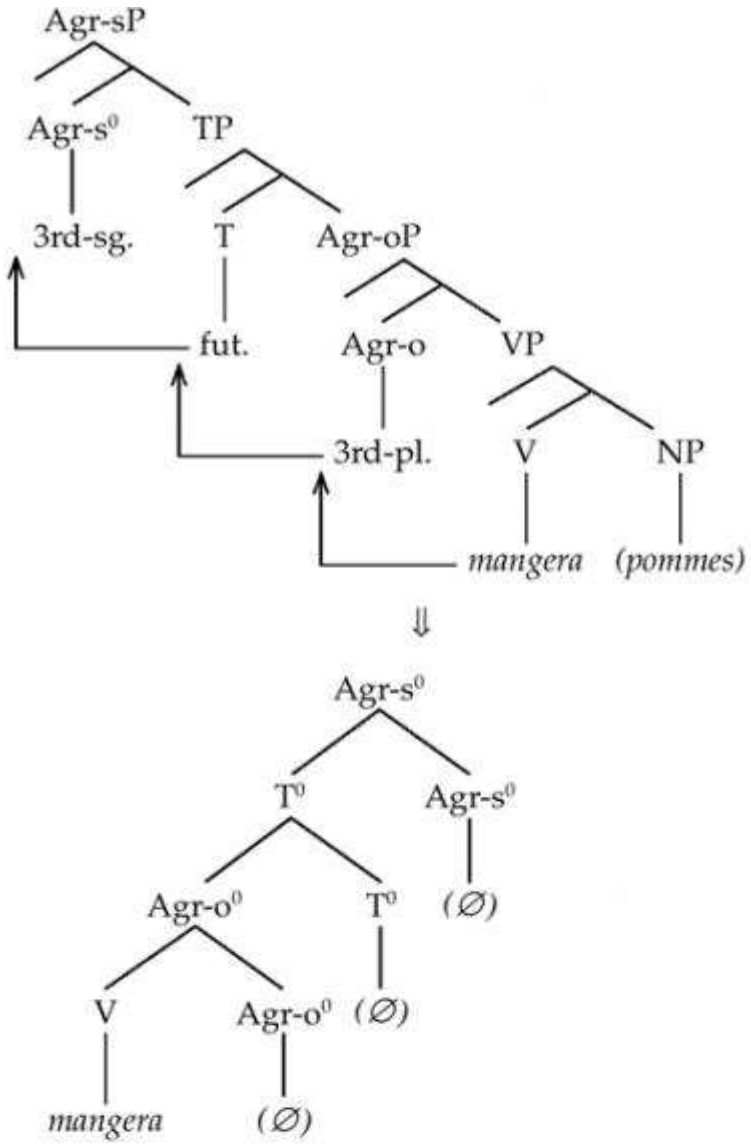
(28)



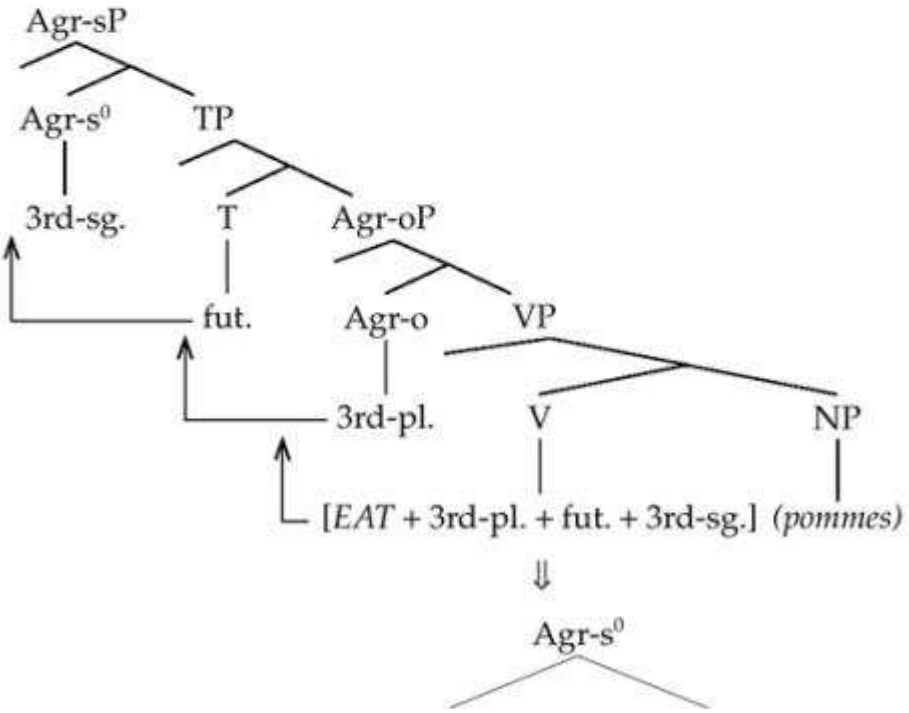
As within Checking Theory, the specific nature of the WF component is not fully explicit; it is not clear whether it entails the insertion of morpho-phonological forms as in (29a) (in essence a type (2) model) or bundles of features as in (29b) (in essence a type (3) model):

(18)

(a)


Agr-sP
Agr-s⁰
TP
3rd-sg.
T
Agr-oP
fut.
Agr-o
VP
3rd-pl.
V
NP
mangera
(pommes)
⇓
Agr-s⁰
T⁰
Agr-s⁰
Agr-o⁰
T⁰
(∅)
V
Agr-o⁰
(∅)
mangera
(∅)

(b)


Agr-sP
Agr-s⁰
TP
3rd-sg.
T
Agr-oP
fut.
Agr-o
VP
3rd-pl.
V
NP
[EAT + 3rd-pl. + fut. + 3rd-sg.]
(pommes)
⇓
Agr-s⁰

Nor is it entirely clear how properties of derivational morphemes are to be checked. As an illustration of the problems involved, consider the structure of (bi-clausal) synthetic causatives, using as an example Chichewa, as discussed by Baker (1988a). As is well established, (30b) is bi-clausal, on a par with (30a), leading Baker to give it the D-structure in (30c) and the S-structure in (30d) (irrelevant details omitted):

(30) (a) Mtsikana ana-chit-its-a kuti mtsuko u-gw-e
girl AGR-do-make-ASP that waterpot AGR-fall-ASP
(b) Mtsikana anau-gw-ets-a mtsuko
girl AGR-fall-made-ASP waterpot
(c)... [$_{vp1}$ its... [$_{vp2}$ waterpot gw]
(d)... [$_{vp1}$ [$_{v1}$ [$_{v2}$ gw] [$_{v2}$ its]]... [$_{vp2}$ waterpot t_{v2}]

In (30), the D-structure configuration, the level at which argument structure is determined, V_2 gw, 'fall' assigns its thematic roles and projects a well-formed VP. At S-structure, it has incorporated into the matrix a causative verb, forming a morphological unit with it. Consider, however, a potential Checking Theory account of (30b). If all morphological structures are inserted as such at D-structure, to preserve the bi-clausality of (30b), the incorporated causative form gw-ets 'make-fall' would have to head the embedded VP at D-structure, as in (31a). In turn, V_2 in (31) would rise to check its causative component. Addressing this issue briefly, and proposing that checking can only be accomplished in functional (non-lexical) heads, Chomsky (1995b) suggests that checking in such structures would be in a superordinate functional V projection. Suppose, then, that the structure is as in (31b), where V: adjoins to F dominating VP_1, thereby checking off its its-*CAUSE* properties (again, irrelevant details omitted):

(30) (a) Mtsikana ana-chit-**its**-a kuti mtsuko u-**gw**-e
girl AGR-do-make-ASP that waterpot AGR-fall-ASP

(b) Mtsikana anau-**gw-ets**-a mtsuko
girl AGR-**fall-made**-ASP waterpot

(c) ... [$_{vp1}$ **its** ... [$_{vp2}$ waterpot **gw**]

(d) ... [$_{vp1}$ [$_{v1}$ [$_{v2}$ **gw**] [$_{v1}$ **its**]] ... [$_{vp2}$ waterpot t_{v2}]

The structures in (31) give rise to a host of yet to be resolved issues. What is the argument structure associated with **gw-ets** when it heads VP_2 prior to head-to-head movement? At least morphologically, the causative verb its is the head of such structures. How, then, is the argument structure of the embedded verb **gw** 'fall' realized in the embedded VP? Further, in order to be checked, **gw-ets** must move and adjoin to F. Does this movement pass through V_1? If yes, how is this movement motivated, given that no features are checked at V_1. If not, how can the movement skip V_1 without violating HMC? Further, does V_1 dominate an abstract *CAUSE* marker? If yes, is this marker an abstract lexical entry, of the sort typically associated with the derivation of causative *break* ([ø [$_V$ *break*]])? But if V_1 does dominate a lexical entry distinct from its, "what is the nature of the fully morphologically derived **gw-ets** form? On the other hand, if the abstract *CAUSE* marker generated under V_1 is not an abstract lexical entry, but rather, a semantic feature, on a par with, say, *TENSE*, is VP_1 a regular VP, or rather, is it a functional projection of sorts (e.g. CAUSEP)? Similar questions clearly arise with respect to noun incorporation and synthetic compounding, both morphological structures that have been argued to correspond to syntactically articulated structures.[24]

Leaving the possible resolution of these issues to future research, let us turn now to a more detailed comparison of morphological structures and syntactic structures, asking whether they are the same. Specifically, let us ask whether the notion of head and, consequently, selection (or subcategorization) are unified notions; or, put differently, whether morphological hierarchical structures are identical to syntactic hierarchical structures.

6 "Mixed" models

In sections 1 and 2 of this chapter two types of models were reviewed: LIH models, which assume an independent WF component which does not interact with the syntax, and syntactic models, which attempt to derive internal word structure syntactically. Indeed, it has often been assumed that an independent WF component entails the absence of syntactic interaction with word-internal structure, while syntactic interaction with word-internal structure entails the absence of an independent WF component. For convenience of presentation, this entailment is given as (32):

(32) Independent WF component □ no syntactic interaction with word internal structure

However, the discussion in section 5 has already indicated the possible existence of models in which the entailment in (32) does not hold. Consider again nonisomorphic models, such as those of Beard (1988,1995), Sadock (1985,1991), Anderson (1992), or Halle and Marantz (1993). From the perspective of these proposals, it is not clear that the entailment in (32) can even be stated coherently. In these models (abstracting away from differences between them), the formation of amalgams of functional heads is a nonmorphological task, and its output, in turn, feeds into an independent morphophonological component that is syntactically irrelevant. Recall again that lexicalist versus movement accounts are neutral with respect to this factor. Thus in lexicalist isomorphic models, an output of the WF component, a word, is associated with all the syntactic features, allowing it to interact with the syntax. These features, in turn, are associated with it as a result of the internal structure of the word, as determined by the WF component (see Di Sciullo and Williams 1987). On the other hand, in nonisomorphic models, regardless of the existence or nonexistence of movement, word structure as formed by syntactic or morphological rules is explicitly distinct from morphophonological considerations, and the output of the morphophonological component, in turn, does not have, meaningfully, any syntactic properties. Consider, as an example, the representations given by Zubizarreta (1985) or by Sadock (1985,1991): the syntactic representation is fully syntactically interactive, while the morphophonological representation is fully syntactically opaque, rendering the entailment in (32) meaningless. Rather, in nonisomorphic systems the relationship between the (independent) morphophonological component and the syntax is either linear, as in (33a), or parallel, as in (33b):

(33) (a) Phrasal syntactic structure → morphophonological spellout

(a) Phrasal syntactic structure → morphophonological spellout

(b) $\begin{bmatrix} \text{Phrasal syntactic structure} \\ \text{Morphophonological structure} \end{bmatrix}$

Yet another type of system in which the entailment in (32) does not hold in a straightforward way is that proposed by Laka (1990) and by Rohrbacher (1994) (see section 5 for some discussion), as well as the system proposed by Emonds (1985). Here, WF is partitioned into syntactically active versus syntactically inert components, or in essence, into the two logical possibilities provided by (32). Thus, syntactically active WF is reduced to syntax, while syntactically inert WF is syntactically opaque:

(34) WF 1: no independent morphological component □ syntactic derivation of word-internal structure
WF 2: independent morphological component □ no syntactic interaction with word-internal structure

Crucially for Rohrbacher (1994) as well as for Laka (1990), there is no principled functional distinction between those operations which fall under WF1 and those which fall under WF2. For Laka (1990), some typically inflectional markings are generated pre-syntactically, while others are projected as heads. For Rohrbacher (1994), it is crucial that while some agreement markers in some languages be

projected as independent heads, having their own lexical entries – for example, agreement in Icelandic – the same function in other languages would not constitute an independent lexical entry and would be part of an abstract morphophonological spellout rule – for example, agreement in Danish.[25]

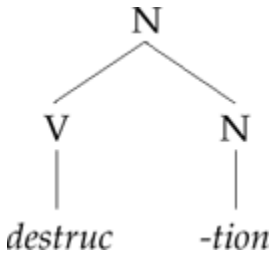
It is in this latter respect that Laka (1990) and Rohrbacher (1994) differ from Emonds (1985). On Emonds's account, WF is partitioned according to the function of the morphology involved. While some morphology remains, in essence, pre-syntactic in accordance with type (2) linear models, other morphological processes, defined specifically as those which are transformationally introduced, are the amalgamation of abstract features through syntactic means, to be spelled out in a post-lexical phonology, in essence along the lines suggested by Anderson's Extended Word-and-Paradigm system. The former, lexical morphology encompasses, in essence, those traditional WF processes classified as derivational (but excluding some argument-structure-changing operations). The latter encompasses, in essence, those WF processes traditionally classified as inflectional. Thus, for Emonds, unlike Rohrbacher (1994), the introduction of agreement morphology at times through direct projections and at other times through a post-syntactic spellout rule, as in the picture in (25), is an impossibility.

While Laka (1990), Rohrbacher (1994), and Emonds (1985) are interested primarily in WF processes which are sensitive to syntactic contexts, systems embodying the duality in (34) have been proposed extensively for derivational processes. Specifically, consider the model proposed by Shibatani and Kageyama (1988) and that proposed by Borer (1984b, 1988, 1991). Like that of Rohrbacher (1994), these models assume that the output of morphological processes may be inserted at D-structure or later on. In accordance with the entailments in (34), these systems further propose that, depending on the level at which the relevant morphological output becomes available, it does, or does not, interact with syntactic representations.[26] In Shibatani and Kageyama 1988 and in Borer 1988 this analysis is articulated with respect to compounds in Japanese and Hebrew respectively. While lexical compounds display idiosyncratic, drifted properties, compounds that are inserted later preserve argument structure (Japanese, Hebrew), allow their nonhead members to be modified (Hebrew), and exhibit word-internal effects of post-syntactic phonology (Japanese), all absent from lexical compounds.[27]

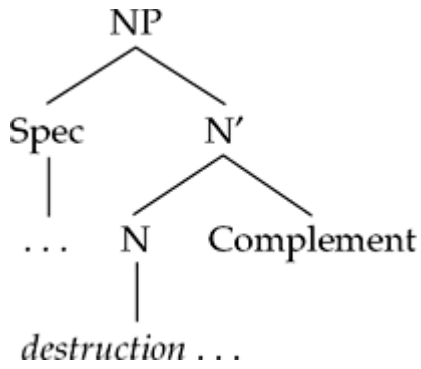
The existence of parallel processes of WF applying pre-syntactically as well as at a later stage, be it the syntax or post-lexical phonology, presents an interesting problem for co-representational models of the type put forth by Zubizarreta (1985) and Sadock (1985,1991). In these theories, a form could, in principle, have two representations, one syntactic and one morphological, where morphological well-formedness conditions are met on the morphological representations, while syntactic well-formedness is met by the syntactic one. Thus, for Zubizarreta (1985), the morphological representation of causatives is, in essence, flat, while the syntactic one is bi-clausal. What, within such a system, is the fate of forms which are morphologically identical, but syntactically distinct?

As a possible answer to this question, consider Parallel Morphology as proposed by Borer (1991). Here, there is an independent WF component, and its output is, in accordance with the LIH or similar principles, syntactically inert. However, in violation of the spirit, if not the letter, of LIH and the Atomicity Thesis, there is a clear interaction between morphological and syntactic struc tures. This interaction is dependent on whether morphological structures have a corresponding syntactic one or not. In turn, the presence versus absence of a coexisting syntactic structure depends exclusively on whether the output of WF is inserted at D-structure or at a later level, where it corresponds to the output of syntactic movement. In this model, as in (34), there is no morpho logical difference between forms derived prior to D-structure and those derived later on. Further, the morphological properties of the output are identical. There are, however, syntactic differences between the derivations, dependent exclusively on the accompanying syntactic structure. As an illustration (with irrelevant details omitted) consider de-verbal derived nominals. Morpholo gically, a form such as destruction has the structure in (35):

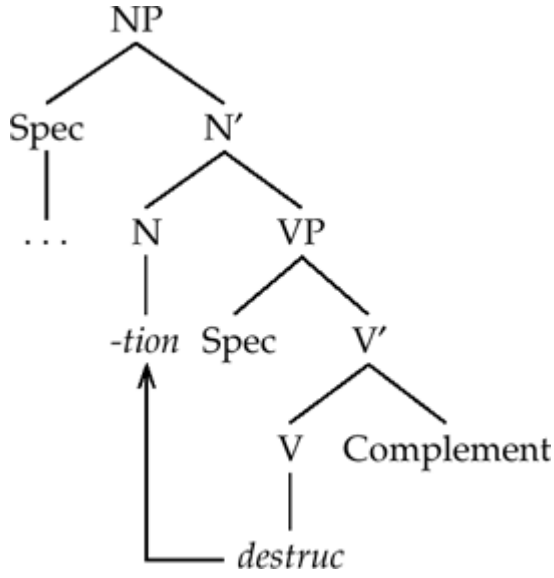
(35)



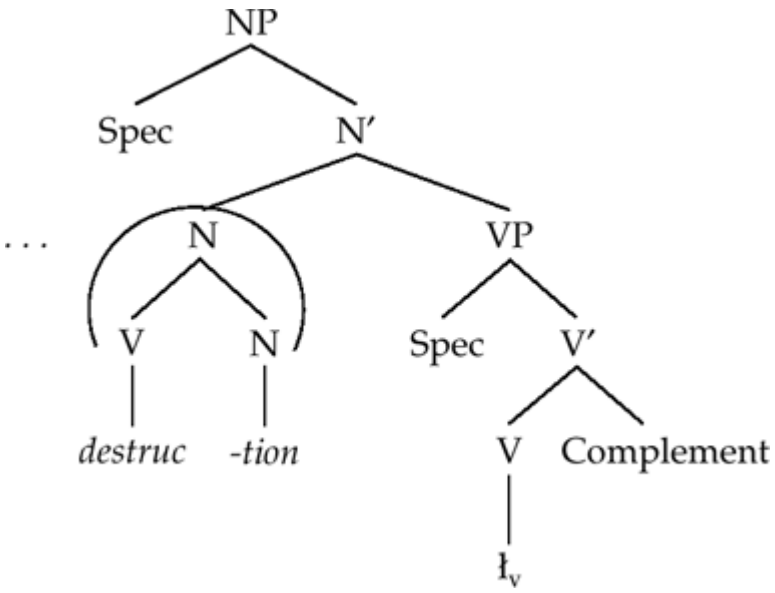
(35) may be inserted as such at D-structure, under N, resulting in the following syntactic structure, where the syntactic properties of *destruction* are not different from those of an underived word such as, for example, *event*:



Crucially, however, both *-tion* and *destruc (= destroy)* are independent lexical entries, and, as such, may either enter into WF or be projected as heading their own phrases. In the latter case, D-structure is as in (37) (functional structure omitted):



In (37), head-to-head movement adjoins V to N, thereby giving rise to the syntactic structure in (38). In turn, the circled tree segment in (38) could enter WF, resulting in the formation of *destruction*:



Note that, syntactically, head-to-head movement in (37) is optional, and without it, (37) is still well formed. However, we may assume that (37) is not morphologically well formed, due to the presence of a morphologically free affix, *-tion*. While, morphologically, *destruction* always has the structure in (35), note that the syntactic structures in (36) and (37) are very distinct: (37) contains a VP, while the existence of a V node word-internally in (36) is syntactically irrelevant. It is this syntactic difference, I argue, which results in the so-called process reading associated with (38), versus the result reading associated with (36) (see Grimshaw 1990 for extensive discussion of process versus result nominals).

Interestingly, Hebrew provides some reason to prefer the insertion of concrete phonological material under the heads in (37), rather than bundles of abstract features such as V and NOM. Specifically, it turns out that morphologically complex forms where an actual source V exists allow a process reading, in this account corresponding to a structure with a projected VP, as in (37), alongside a result reading, with the syntactic structure in (36). On the other hand, synonymous forms with no such source V – for example, borrowed words – may only have a result interpretation. A minimal pair is given in (39) and (40):

(39) (a) ha-transformacia Sel ha-'ir
the-transformation of the-city
(b) ha-Sinui Sel ha-'ir (source verb: *Sina*, 'change')
the-transformation of the-city

(40) (a) *ha-transformacia Sel ha-Sita 'al yedey ha-memSala
the-transformation of the-system by the-government
(b) ha-Sinui Sel ha-Sita 'al yedey ha-memSala
the-transformation of the-system by the-government

However, as pointed out by Hazout (1990, 1995), the direct projection of mor-phophonological segments in structures such as (37) faces the typical problems associated with direct phonological projections, already discussed in section 5 above. Thus derived nominals in Hebrew are often morphophonologically deviant, presenting the same problem as is presented by English forms such as /*sang*/ or /*children*/.[28] It is to be hoped that future research will shed additional light on these matters, as well as on other matters concerning the morpho-phonological /morphosyntactic isomorphism already discussed in section 5.

7 Conclusion

I have surveyed here a number of important issues that have emerged in the attempt to model the relationship between WF and syntax. We have looked at exclusively syntactic models, as well as

exclusively lexicalist models, surveying a number of issues that emerge in each. We saw that the lexical/syntactic distinction interacts with another, equally important one: the issue of isomorphism, which cuts across the lexical/syntactic distinction. Finally, we have looked at mixed systems, where solutions to the interaction between morphology and syntax are given in terms of partitioning the morphological component, allowing it to accomplish its task in slightly different ways, depending on the way in which it interacts with the syntax. As is clear from the range of models and possibilities, issues concerning the interaction between WF and syntax are not resolved, and they remain sensitive to theoretical contributions to syntactic theory on the one hand and to WF theory and phonology on the other hand.

1 I am referring here, in no particular order, to the work of Halle (1973), Aronoff (1976), Jackendoff (1975), Lieber (1980), Selkirk (1982), E. Williams (1981b), and Kiparsky (1982c), as well as others.

2 Some important work on word formation (notably Jackendoff 1975; Aronoff 1976; M. Allen 1978; Anderson 1982, 1992; and Emonds 1985) does subscribe to the view that inflectional morphology is formally distinct from derivational morphology. In much of this work, however, a model of the interaction of inflectional morphology with the syntax is not proposed in any detail. Excepted from this generalization are the models proposed by Anderson and by Emonds. Emonds (1985) puts forth an explicit theory which distinguishes inflectional morphology and derivational morphology formally. In the theory, inflectional morphology is that morphology which is introduced through syntactic transformations. On the other hand, derivational morphology remains pre-syntactic in the sense discussed in section 1. I return briefly to Emonds 1985 in section 6. For discussion of Anderson 1992, see primarily section 5.

3 The so-called stray affix filter, often attributed to H. Lasnik. Note that regardless of the need for an affix to find a host, there may still remain a *syntactic motivation* for such movement, as e.g. in Chomsky's Checking Theory. See discussion in section 5.2.

4 I am abstracting away here from a number of irrelevant details such as the D-structure position of verbal subjects and the correct representation for modifying (as opposed to predicative) adjectives.

5 As an example, consider Ouhalla 1991, in which a theory of functional heads and inflectional affixation is spelled out in great detail, and where there is an implicit assumption that the reduction of WF representation to syntactic structures is a desirable one. While the workings of inflectional affixation are spelled out in detail, a full, comprehensive model of the reduction of morphology to syntax is not attempted; nor is it clear what is the fate of affixes which do not have a syntactic representation in the Ouhalla system. Much other research which tries to derive morphological representations and syntactic representations from similar principles, such as Toman 1985 and Walinska de Hackbeil 1986 is, in general, either too vague or utilizes syntactic principles specific to WF. See Lieber 1992 for a recent review.

6 Thus, in a departure from his earlier position stating that "all Grammatical Function changing rules such as passive, causative, and applicative can be eliminated from the grammar [and] their effects can be derived entirely from… the result of standard movement rules applying to words rather than to entire phrases" (1985: 10), Baker (1988) has himself moved away from the attempt to reduce all grammatical function-changing rules to syntax, allowing at least some of them (notably, adjectival passive) to be derived lexically. See section 6 for some additional discussion. Other illustrative examples are the system proposed in Rohrbacher 1994 (see section 5.1 below for a brief discussion) and that proposed in Laka 1990, where the inflectional system is divided between the syntax and the morphology, some inflectional markings are added through head-to-head movement, while others are base-generated on the stem. Yet a third type of affix is generated as a syntactic specifier. I return in section 6 to "mixed" systems, which divide the morphological task between different components.

7 In (7), movement is restricted to a governing head so that the resulting structure obeys the Head Movement Constraint (see Travis 1984), possibly reducible to the Empty Category Principle (see Chomsky 1986).

8 Thus Ouhalla (1991) argues that in Arabic TP dominates Agr-SP, unlike French and English, which display the opposite order.

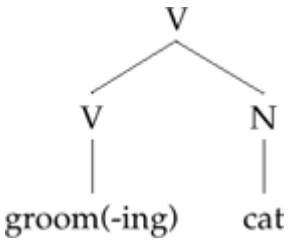
9 For an excellent recent review of the differences between morphological hierarchical structures and syntactic hierarchical structures, which goes beyond the review given here, see Lieber 1992. The discussion

in the text incorporates many of her points, as well as independent ones.

10 See directly below for more comments on the implications of Chomsky 1995a for the attempt to integrate morphology into the X'-system.

11 The same observations are applicable to revisions of the Right- hand Head Rule proposed by Selkirk (1982) and Di Sciullo and Williams (1987). See Lieber 1992 for review. One may argue that the Kayne model is, in fact, identical to the RHR model for morphology, with the added proviso that movement is not available for morphological structures, and hence surface order reflects the base-generated order. However, if, indeed, the morphology is to be reduced to the syntax, which is the purpose of postulating this identity of structure to begin with, the prohibition of movement, rather than accounting for the distinction, just adds to the mystery. Why should it be impossible for the head of a compound, say, to move and adjoin to the left of its complement, creating a left-headed S-structure, although the D-structure was right-headed?

12 For an interesting attempt to apply Kayne's system to morphology, with the assumption that all morphologically right-headed structures are derived by adjunction, see Keyser and Roeper 1994. Roeper argues that if Kayne is correct, and e.g. synthetic compounds are generated syntactically as in (i), in a left-headed structure, the surface right-headed structure is derived by head-to-head movement of the complement:



As is clear already from the representation in (i), this proposal, although intriguing, and possibly promising, would need to further elaborate on the derivation of *-ing* forms and the way in which *-ing* comes to be positioned between the V and its complement. Syntactically, *cat* is the complement of *groom*, not *grooming*. On the other hand, *-ing*, if a syntactic functional head, would need to be a sister to the entire [*groom cat*] constituent, thereby predicting the erroneous [[cat groom$_V$]-ing$_N$

13 That WF and syntax do remain in essence segregated systems in Ackema's (1995) model is further clear when one considers the representation in (i), which, for Ackema, consists of a single projection containing a maximal phrase, a maximal word, a head of phrase, and a head of word, all projected in accordance with the same X'-theoretic principles: (i) [$_{n2}$[$_{n1}$[$_{n0}$[$_{n-1}$[$_{n-2}$ *John*]]]]] Formally, however, it is not at all clear in what sense, other than a definitional one, there is a single phrasal maximal projection N^2, which in turn dominates the maximal head projection N°, in a string such as (i), rather than a maximal phrasal projection with a syntactic head which is distinct from a maximal word projection with a morpheme head as in (ii), given that the well-formedness conditions on N_2 as a maximal projection and N° as a maximal projection are distinct anyway: Phrasal maximal projection:

[$_{n2}$[$_{n1}$[$_{n0}$ *John*]]]

Word maximal projection:

[$_{n0}$[$_{n-1}$[$_{n-2}$ *John*]]]

14 Note in this context that here Lieber's (1992) proposal is quite different from that put forth by Chomsky (1995a), where a Y° specifier would be both maximal and minimal. Kayne (1994) and Chomsky (1995a) allow (13) as a possible syntactic structure (albeit for Chomsky without the X' specification for the intermediate projection), but would specifically exclude the structure in (10). The possibility of generating structures such as (13) syntactically derives directly from the relative definition of maximal and minimal projections, which would render a bare head an X° and an X^{max} at the same time. Precisely for that very reason, the [$_X$[$_X$ [X]] structure in (14) is a syntactic impossibility, rendering the most deeply embedded X° by definition X^{min}, and the topmost one, by definition, X^{max}.

15 Lieber (1992) specifically argues that they do exist as morphological units, as in*an ate too much headache* and *the Charles and Di syndrome*.

16 Ouhalla (1991) makes this distinction between morphology and syntax explicit, arguing that the

(Generalized) Projection Principle applies differently to affixes and to syntactic elements, forcing selection by the latter, but not the former, to be satisfied at D-structure. Clearly, such a proposal flies in the face of reducing morphological selection to a syntactic one.

17 Chomsky (1995b) defines the domain of complementation without using government. For the purposes of this work, however, his approach is equivalent, as the relevant domain would cover both selection and subject-object asymmetries.

18 A somewhat similar principle of lexical projection sometimes utilized is the Universal Alignment Hypothesis, due to Perlmutter and Postal (1984): (i) The Universal Alignment Hypothesis: Principles of UG predict the initial relation borne by each argument in a given clause from the meaning of the clause. While the claims made by UTAH and UAH appear similar in nature, they are actually distinct. Unlike UTAH, UAH predicts the role played by arguments from the meaning of the entire clause rather than from the properties of particular lexical entries. Thus UAH is entirely consistent with an approach whereby argument structure is computed on the basis of a predicate, rather than the lexical semantics of individual entries. As the dominant approaches to morpho-syntax within the GB model clearly center on lexical entries, only UTAH will be discussed here. See Pesetsky 1995 for a lexical-entry-based formulation of UAH.

19 An additional complication for the morphophonology/morphosyntax isomorphism approach is the fact that in Semitic languages some of the tense morphology is affixal and some is autosegmental. Note in this context that autosegmental morphological systems, such as Semitic morphology, present a particular problem here, as the order of morphemes is sometimes an incoherent notion when a particular vocalic melody serves to give information about a binyan (typically derivational information), person, and tense, all in one. In fact, the existence of such portmanteau marking supports the approach of Anderson (1992), who argues that viewing WF as the hierarchical projection of discrete morphemes attached to a stem (rather than viewing morphology as an operation which transforms a stem) is empirically problematic. See text below for a brief discussion.

20 The determination of the formal nature of the morphop ho no logical component is dependent, to a large extent, on the determination of the formal property of the phonological operations involved. This issue, not touched upon here, is reviewed in detail in Halle and Marantz 1993, as well as in Anderson 1992.

21 Alternatively, Rohrbacher (1994) suggests that nonrich markers may fail to project, but are nevertheless available for pre-syntactic affixation processes, resulting in the base-generation of a fully inflected form, thereby preempting movement.

22 Neither the particular notion of richness used by Speas (1994) nor the overall workings of her system are crucial to the discussion here. What is of significance is that any system accounting for null subjects by appealing to properties of inflection cannot be naturally captured in DM terms.

23 In a tentative weakening of this claim, Chomsky (1995b) suggests, following Lasnik (1994), that it may turn out that some inflectional affixation is syntactically derived. See n. 25 below for a brief discussion of Lasnik 1994.

24 It could be argued that causatives are light verbs of sorts, and hence functional in nature, thereby avoiding at least some of the problems presented by (31) (although note that licensing the argument structure for both VP_2 and VP_1 remains an issue). However, a similar problem exists for noun incorporation, where a V+N form must be inserted under N. Even if the appropriateness of the form is checked in some functional projection dominating V, it is difficult to see, in this case, how a lexical VP intervening between the inserted form under N and the functional head where it is checked can be avoided.

25 For a similar system, see Lasnik 1994, where it is assumed that the base-generation of inflected forms as well as the projection of inflectional morphemes under functional heads coexists in UG as well as being internal to the grammar of specific languages. Thus in English, auxiliaries are base-generated as inflected forms, as are, perhaps, irregular verbs; but regular past tense /*-ed*/ may still be projected as an independent functional head under TENSE. Note that in Checking Theory, as assumed by Lasnik (1994), this difference in the formation of, say, /*were*/ and /*walked*/ cannot be syntactically relevant, due to the extreme nonisomorphic nature of Checking Theory, as discussed in section 5.2 above.

26 The possibility of identical affixing existing lexically as well as a result of syntactic movement is also put forth in Baker (1988a), but is not executed in detail.

27 An additional issue concerns the existence of morphological processes at a post-lexical, but pre-phonological stage, i.e. in a direct interaction with syntactic structures. In Borer 1988 it is suggested that these, indeed, exist. Thus *syntactically* formed compounds allow modification of the nonhead member, as well as its binding, as in (ia, b); but a nonhead quantifier embedded in a compound may not take wide scope, plausibly because of the impossibility of LF movement from within a word (compare (iia, b): (i) (a) **beyt mora** xadaSa
house teacher new
'the house of the new teacher' (b) Ran, hibit**be-tmunat**
Ran looked at-picture-
'acrno$_2$,
himself
'Ran looked at a picture of himself (ii) (a) tmuna Sel SloSa anaSim
picture of three people
'one picture showing three
people'
'three pictures, each of a
single person' (b) **tmunat SloSa 'anaSim**
picture three people
'one picture showing
three people'
*'three pictures of a single
person each' If this is indeed the correct interpretation of the data in (i) and (ii), it suggests that the word *tmunat SloSa 'anaSim* has been formed at a level which affects the possibility of further syntactic movement, most plausibly, at S-structure (or spellout).

28 Another problem pointed out by Hazout (1990) in advocating an abstract NOM representation is relevant to attempts to derive de-verbal derived nominals exclusively syntactically. Thus Hazout (1990) points out that in Hebrew the particular (nonexceptional) de-verbal nominalizing affix is determined on the morpho-phonological properties of the stem V, In a system which gives V+N a syntactic representation exclusively, it is not clear how the correct affix would be selected. However, in the parallel system sketched above, V+N has a morphological structure as well. Assuming free (overgenerating) lexical insertion, it may be assumed that morphologically inappropriate (although syntactically well-formed) V+N forms simply fail to result in the formation of a word, thereby violating the morphological well-formedness conditions on the affix.

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9. Morphology and Agreement

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1 Definitions

There have been several attempts to define agreement: for instance, Keenan 1978: 167; Lehmann 1982: 203; and Lapointe 1988; but as Anderson (1992: 103) says, 'this is a quite intuitive notion which is nonetheless surprisingly difficult to delimit with precision'. Steele (1978: 610) talks of 'systematic covariance between a semantic or formal property of one element and a formal property of another'. The essential notion is the covariance or matching of feature specifications between two separate elements, such as subject noun phrase and verb. There is then the question as to whether the determination of the form of anaphoric pronouns is a part of agreement. In fact, most mainstream work on agreement uses the term in this wider sense, to include pronouns. Barlow (1988: 134–52; 1991) reviews the literature and concludes that there are no good grounds for distinguishing between agreement and antecedent—anaphora relations. It is generally accepted that, diachronically, pronouns provide a major source of agreement morphology, progressing from full pronouns to clitics to inflections (see Givón 1976; Bynon 1990, 1992; Corbett 1995).[1]

In order to be able to generalize about different types of agreement, we need a set of terms. We call the element which determines the agreement (say the subject noun phrase) the 'controller'. The element whose form is determined by agreement is the 'target'. The syntactic environment in which agreement occurs is the 'domain' of agreement. And when we indicate in what respect there is agreement (agreement in number, e.g.), we are referring to 'agreement features'.[2] As these terms suggest, there is a clear intuition that agreement is directional. In *Mary laughs*, most accept that *laughs* is singular because *Mary* is singular. Some accounts of agreement capture this intuition directly by copying feature specifications from the controller to the target. There are several problems with this approach: the controller may be absent (as in pro-drop languages); or it may be present but underspecified; or the feature specifications on the controller and the target may simply not match.

More recent approaches, particularly that of Generalized Phrase Structure Grammar and its descendants, allow free instantiation of features on controllers and targets. To be grammatical, those structures must meet certain constraints, typically constraints requiring identity of particular feature specifications. The work is done by unification, which provides a matching of feature specifications without copying, but also without directionality of agreement. In Generalized Phrase Structure Grammar the intuitively important notion of directionality is reintroduced by the Control Agreement Principle, which specifies possible controllers and targets, and gives them different statuses (see Gazdar et al. 1985). Since, however, there is no movement of features in such models, it is more accurate to talk of 'asymmetry' of agreement rather than 'directionality'. In Head-Driven Phrase Structure Grammar the asymmetry is captured through 'anchoring'; gender, number and person features are anchored to real-world entities through noun-phrase indices, even though they may be expressed morphologically other than on the noun phrase (see Pollard and Sag 1994: 60–99; cf. Kathol, forthcoming). Unification does not require that feature sets should be fully specified; controllers may be absent or underspecified. Thus agreement can be seen as a matter of cumulating

partial information from the controller and the target (see Barlow 1988, Pollard and Sag 1988, Wunderlich 1994).[3]

Traditional accounts treat agreement as a matter of syntax. However, there are well-known cases where the information available to the syntax is inadequate to allow a full account. For instance, plural agreement with *committee*-type nouns in some varieties of English suggests that semantic information is relevant. As a result, and particularly if one starts from English data, there is a temptation to suggest that agreement is instead all a matter of semantics. However, there are serious problems here too: *I'm parked on the hill* is acceptable for *My car is parked on the hill*, but semantic agreement is impossible here: **I is parked* (H. Clarke, cited in Barlow 1988: 227). An adequate theory requires reference both to syntactic and to semantic/pragmatic information (Pullum 1984, Corbett 1994).

What then is the role of morphology? Obviously to mark the agreement information (whether of syntactic or semantic/pragmatic origin) on targets. Given the asymmetric nature of agreement just discussed, this means that agreement morphology will mark on targets information which relates primarily to controllers. Note especially that the morphological part of agreement need not mirror syntax: dependants may agree with their heads, mirroring the syntactic dependency; but, conversely, the syntactic head may bear agreement morphology controlled by its syntactic dependent (Nichols 1985; Zwicky 1993: 298, 303–10). In other words, the agreement controller may be the syntactic dependent.

In the next section we consider the agreement features. Then we look at the forms used to express them (section 3). In section 4 we consider the effect that the target has on agreement in terms of the forms available, while in section 5 we examine its effect on the form to be selected.

2 Agreement features

There are three indisputable agreement features, gender, number and person, which we shall examine in turn.

2.1 Gender

Agreement in gender is widespread; for instance, adjectives may agree with their head noun in gender, as in these Russian examples:

(1) nov-yj avtomobil'
new-SG.MASC car
'a new car'

(2) nov-aja mašina
new-SG.FEM car
'a new car'

(3) nov-oe taksi
new-SG.NEUT taxi
'a new taxi'

The adjective selects its form according to (= it agrees with) the noun: in (1) it takes *-yj* because the noun *avtomobil'* 'car' is of masculine gender (we would find a similar agreement form with nouns denoting males); in (2) it takes *-aja* because the alternative word for 'car', *mašina*, is feminine; and (3) shows the neuter ending. Such three-gender patterns are quite common, as are two-gender systems; but languages with four or five genders are not unusual, and larger numbers are found (as in Fula, which has around twenty genders, depending on the dialect). Gender systems may have sex as a component, as in languages with masculine and feminine genders; but equally, sex may be irrelevant – the distinction may be between animate and inanimate, for example (see Corbett 1991 for illustrations).

2.2 Number

The Russian examples above also show agreement in number; in each, the adjective is singular, to

agree with the singular noun. If we change the noun in (1) to a plural, the form of the adjective must change to match:

(4) nov-ye avtomobil-i
new-PL car-PL
'new cars'

The contrast here is just between singular and plural. Many languages have a third member of the number system, the dual, for two items. More complex systems may also be found: for example, with special forms for three items (the 'trial', as in Larike; see Laidig and Laidig 1990) or for a small but unspecified number of items (the 'paucal', as in Bayso; see Hayward 1979). We return to the question of the interaction between the categories in section 3 below.

2.3 Person

The third agreement feature is person. Systems with three persons, like Russian *ja beru* 'I take', *ty bereš'* 'you take' and *on/ona beret* 'he/she takes', are common. Larger inventories occur in languages which subdivide one or more of these three persons in some way. For example, languages like Quechua subdivide the first-person plural into the first-person inclusive (including the hearer) and exclusive (excluding the hearer). Another type of extended system occurs when the third person is divided into proximate and obviative (for less central participants in the situation), as in Algonquian languages like Cree (Wolfart and Caroll 1981: 25–39). For illustration of person systems see Forchheimer 1953 and Ingram 1978, and for further exemplification of all three features see Moravcsik (1978a: 336–62).

The three features which we called indisputable agreement features are somewhat different in nature. Gender is an inherent feature of the noun. It is found on the target, say the adjective, as a consequence of its presence in the noun (overt or covert). In example (1), the masculine ending on *novyj* has nothing to do with the lexical meaning of the adjective, but results from the fact that the adjective is modifying a masculine noun. A somewhat similar situation obtains for person; in Russian *ja beru* 'I take', person is an inherent feature of the pronoun, but not of the verb. Number is more difficult. It is an inherent feature of some nouns: those which are only singular (like English *watchfulness*) or only plural (like *trousers*) impose this feature value on their modifiers. Typically, however, a considerable proportion of the nouns of a given language can be associated with both (or all) numbers. In straightforward examples involving such nouns, like (4), the number feature appears to relate primarily to the noun; the property denoted by the adjective is not affected by the change in number. The three agreement features are all nominal; they are what Zwicky (1992: 378) calls the 'direct features' of nouns and noun phrases. As Nichols (1992: 160–2) shows, they have an interesting hierarchical relationship: gender is the one which is most prone to be marked only by agreement; number is quite likely to be marked only in this way, but this never occurs with person. Further discussion of the relations between the three features can be found in Bybee 1985: 22–4, 28–33, and Wunderlich 1993.

2.4 Other possible features

Traditional accounts of languages like Russian also discuss agreement in case: all the examples given so far are in the nominative case, as would be appropriate for subject position. If instead we take one in a prepositional phrase, then noun and modifier both take a different form:

(5) v nov-om avtomobil-e
in new-SG.LOC.MASC car-SG.LOC
'in a new car'

The preposition *v* 'in' governs the locative case, and the adjective, like the noun, stands in this case. While both do indeed stand in the same form, this covariance differs from that found with gender, number or person. Case is not a feature of the noun: it is imposed on the noun phrase by government by some other syntactic element (the preposition in (5)). Thus the noun and adjective in (5) are in the same case because it is imposed equally on both. This is not agreement, if we take seriously the

question of asymmetry. On that view, we should not recognize case as an agreement feature, though we should recognize that it interacts strongly with agreement features. Besides the straightforward instances of case being shared within the noun phrase, there are more complex instances of covariance in case between predicate complements and their controllers (for which see Timberlake 1988; Anderson 1992: 115–18; and references in both to earlier work; for other complex patterns of case see Plank (ed.) 1995).

Finally, some consider definiteness to be an agreement feature, since there are languages like Arabic in which definiteness is marked more than once within the noun phrase. But this too is an instance where there is no asymmetry within the noun phrase. Rather, a feature value is imposed on the noun phrase as a whole, and may be indicated at more than one point in the phrase.

3 Forms

In this section we look at the exponents of agreement (section 3.1) and the constraints on the expression of agreement features (section 3.2).

3.1 The exponents of agreement

The examples of agreement so far have involved inflectional affixes; these occur after the stem in our Russian examples, but before the stem in many other languages – in various Bantu languages, for instance. While some languages treat all agreement in the same way, this is not necessary. Thus in Babanki (a language of the Ring group, part of the Western Grassfields division of Bantu, spoken in north-west Cameroon) agreement may occur as a prefix or as both a prefix and a suffix, depending on the target involved (Hyman 1980: 237).[4]

Agreement may even be found stem-internally. Marind (which belongs to the family of the same name and has about 7,000 speakers in southern Irian Jaya) uses this device; the data, originally from Drabbe 1955, are presented in Foley 1986: 82–3. There are four genders (indicated with Roman numerals):

(6) e-pe anem e-pe akek ka
*I-the man I-the light.**I** is*
'the man is light'

(7) u-pe anum u-pe akuk ka
*II-the woman II-the light.**II** is*
'the woman is light'

(8) e-pe de e-pe akak ka
*III-the wood III-the light.**III** is*
'the wood is light'

(9) i-pe behaw i-pe akik ka
*IV-the pole IV-the light.**IV** is*
'the pole is light'

The forms of the adjective *ak-k* 'light' mark gender by the infixed vowel: -e-/-u-/-a-/-i-. Infixed agreement is also found in various Pamir languages (Iranian languages of Tadzhikistan and Afghanistan), such as Roshani, but it is restricted to certain adjectives and past-tense intransitive verbs (Payne 1989: 429, 436–8). It appears that all the means of inflectional morphology are available for agreement. And there are difficult boundary cases, when it is not clear whether inflections or clitics are involved (see the references in section 1 above).

It is important to note the possibility of multiple formants (mentioned above in relation to Babanki). Thus in Archi, a Daghestanian (North-east Caucasian) language, we find forms like this (Kibrik 1977a: 127–30, 320):

(10) **d**-aš-a-**r**-ej-**r**-u-ƫu-**r** x̌anna
***II**-of.me-SELF-**II**-SUFFIX-**II**-SUFFIX-ADJ-**II** wife*
'my own (emphatic) wife'

The initial *d-* signals gender II singular agreement. Next is a pronominal stem. Then, following Kibrik's analysis, there are two complex suffixes for forming reflexives, each with an internal agreement slot: *a-GN-u* and *ej-GN-u* (*GN*=gender/number marker). Both suffixes are used here, with the first *u* dropped before the second suffix. The final suffix *ɬu* derives an adjective, and brings with it an agreement slot (naturally). Thus we have a prefixed gender/number marker (the *d-*), a suffixed form (the final *-r*) and two internal forms (the other occurrences of *r*). The four markers are all the same, in the sense that they mark the same person/number combination for agreement with the same controller. Agreements of this type may be problematic for analyses based on the notion of functional heads, as Spencer (1992: 323–9) shows. We take up the question of multiple formants again in section 4.

3.2 Constraints on the co-occurrence of agreement features

If we return to the Russian examples (l)–(3), which show agreement in gender, we find that the plural for each would be identical: the plural adjective is *novye* 'new'. Thus gender is constrained by number in Russian: gender distinctions are found only in the singular number. This conforms to Greenberg's universal number 37: 'A language never has more gender categories in nonsingular numbers than in the singular' (Greenberg 1966: 112). There are further universal constraints of this type (for which see Greenberg 1966) and some language-specific constraints; both may involve just the agreement features, or they may refer to other features too. For instance, Russian verbs show agreement in gender only when in the past tense.

A rather different type of interaction between the features is found if we look at the formal expression of combinations of features. In the Russian examples, the expression of different features was fusional: in example (2), the inflection *-aja* marks feminine gender and singular number (and nominative case). One such marker may represent different possible combinations of feature values (i.e. it may be an instance of syncretism); the most spectacular examples of this type are provided by polarity. This phenomenon can be found in the Cushitic language Somali (data from Serzisko 1982:184–6; see also Bell 1953:12–13 and Saeed 1987: 114–16):

(11) ìnan-kii baa y-imid
boy-the.SG.MASC FOCUS.MARKER SG.MASC-came
'the boy (!) came'

(12) inán-tii baa t-imid
girl-the.SG.FEM FOCUS.MARKER SG.FEM-came
'the girl (!) came'

(13) inammá-dii baa y-imid
boys-the.PLMASC FOCUS.MARKER PL-came
'the boys (!) came'

(14) iná ma-hii baa y-imid
girls-the.PL.FEM FOCUS.MARKER PL-came
'the girls (!) came'

Table 9.1 The definite article in Somali (basic forms)

gender	*singular*	*plural*
masculine	kii	tii
feminine	tii	kii

The postposed definite article has various morphophonologically determined variants: after any vowel except *i, kii* becomes *hii*, and after any vowel *tii* becomes *dii*. Given this, in the examples above the article used for the masculine plural might be considered the same as that for the feminine singular,

while that for the feminine plural is the same as that for the masculine singular. The basic forms are as in table 9.1.

The two markers are exponents of two features (gender and number), and when the value of one feature is changed, the marker changes, but if both values are changed, the form stays the same.[5] The polar opposites are identical, hence the term 'polarity'.

Not surprisingly, we never find complete polarity. For Somali, this is shown by two facts. First, it has polarity only in noun-phrase internal agreement. Examples (11)–(14) show that the verbal agreement forms are different: there the plural for both genders is the same as the masculine singular, which is another type of syncretism. The second restriction in Somali is that not all nouns fall into the pattern shown in (11)–(14). Some masculine nouns form their plural by reduplication, and take the same article in the singular and the plural: for example, *nin-kii* 'the man', *niman-kii* 'the men'. Thus not all targets show polarity; nor are all nouns included in the polarity system. (Conversely, a small number of nouns are exceptional in taking polarity-type agreements for predicate agreement too: see Hetzron 1972; Zwicky and Pullum 1983b.)

4 Effect of the target – the forms available

A simple but not unreasonable view of agreement would have the syntax establish the domains of agreement, the agreement features and their values, and leave the morphology with the apparently simple task of 'spelling out' those feature values. Things are somewhat more complicated, however, since the agreement forms available depend on the agreement target and on its type. In part, the availability of agreement may be syntactically determined: thus, in German, adjectives in pre-nominal attributive position show agreement, while others, particularly those in predicative position, do not. But the restriction frequently depends just on the word class of the target; often we find that, say, adjectives agree in number in a given language, irrespective of their syntactic role.[6]

The question then arises as to the outcome when the demands of the syntax in terms of agreement cannot be met by the morphology. The issue was raised by Huddleston (1975) with respect to verbal agreement in English. Assume that on the basis of present-tense verbs we set up a syntactic rule of agreement. How then do we ensure that the verb *be* will agree when in the past tense, but no other verb will? The usual move is to configure the morphology to match distinct forms (when available) to feature specifications, and to allow for a default form when no distinct forms are available. But this is not the only possible outcome. It is possible for the lack of appropriate agreement morphology to render a syntactic construction ungrammatical; for instance, Addis (1993: 446–52), in a discussion of Basque, claims that ditransitive sentences which would require verbal agreement with a first – or second-person direct object and with an indirect object are ungrammatical and must be reformulated, since the agreement morphology is not available (she indicates similar problems in Georgian (for which see Anderson 1992: 128–32), Southern Tiwa and Spanish). Thus the relation to syntax is more complex than a simple spelling out of feature specifications. We shall therefore consider briefly the inventory of agreeing items, the agreement slots they have available, the agreement features involved, and finally in this section variation within word classes.

The word class of the target has a major effect on agreement. Of course, verbs regularly show agreement, as do adjectives. We also find articles, demonstratives, numerals, possessives (including associative morphemes) and various types of pronoun showing agreement (for examples see Lehmann 1982: 207–15; Corbett 1991: 106–12). We might expect that to be the complete list, but in fact there are several other items which can show agreement. Thus, in West Flemish, and elsewhere in West Germanic, we find agreement of the complementizer (Bennis and Haegeman 1984: 41; cf. Hoeksema 1986 and Zwart 1993a for other examples); adpositions may agree with their noun phrase, as in the North-west Caucasian language Abkhaz (B. G. Hewitt 1979: 113–14, 125–37) and in most of the modern Indie languages (Payne 1995); various languages have agreeing adverbs: for instance, Lak (Daghestanian), Kala Lagaw Ya (the language of the western Torres Straits Islands), Italian to a limited degree (for sources see Corbett 1991: 113) and Gujarati (Hook and Joshi 1991). And in Somali the focus marker can show agreement (Gebert 1988). Several of the Daghestanian languages allow a case-marked noun to take an agreement marker (Kibrik, p.c.). Thus in Lak, the allative marker, which is added to the lative marker, brings with it an agreement slot: *q̄at-lu-wu-n-m-aj (house- OBLIQUE-IN-LATIVE-III-ALLATIVE)* 'into the house'. In this example, the *-m-* is a gender III singular marker for

agreement (for the possible controllers see Kibrik 1979a: 76). In Dargwa (Lak's closest relative), the essive similarly adds an agreement slot, but has no distinct marker itself; thus the presence of the agreement signals essive case: *bidra-li-če-b (bucket-OBLIQUE-SUPER-III)*; 'on the bucket'; the *-b* (gender III singular marker in this instance) signals the essive case. Pronouns too may behave in a comparable way. Consider these Archi examples (Kibrik 1972: 124):

(15) d-ez buwa ǩ′anši d-i
II-me.DAT mother like II-is
'I like mother'

(16) b-ez dogi ǩ′anši b-i
III-me donkey like III-is
'I like the donkey'

Since Archi is an ergative language, the part of the verb which shows agreement agrees with the object of a transitive verb; the different forms in (15) and (16) correspond to two of the four genders of Archi. With verbs of emotion and perception, the subject stands in the dative case; in (15) and (16) the subject is a personal pronoun with an agreement slot, and this also agrees with the object. Evidently, then, languages have different inventories of agreeing items, and the possible distributions have yet to be fully investigated.

Given that we have an item which can show agreement, we may then ask how many times it can mark agreement and with how many controllers. The Russian adjectives we analysed earlier are simple, in that they agree just once (there is a suffixal position for agreement which is always with a single type of controller). As we shall see, targets vary both in the number of times they can mark agreement and in the type of their controller(s). A single target may have more than one agreement position: in the Archi example (10) we saw four agreement slots. In this instance they were all for agreement with the *same controller*, in respect of the *same features*. Four appears to be the maximum number of same-controller agreement slots. As a variant of the same-controller type, the different slots of the target may show agreement with the same controller, but with different morphological patterning (different syncretisms); this is found in the Daghestanian language Khinalug (Corbett 1991: 119–23). Then we may find targets with more than one agreement slot, which agree with a single controller in respect of *different features*. Thus Maltese verbs when imperfective agree with their subject prefixally in terms of person (and to a limited extent in gender) and suffixally in terms of number (Fabri 1993: 94). We also find targets with more than one agreement slot, for agreement with *different controllers*. A common example is verbs which agree with both subject and object; for discussion of the handling of such cases by the use of 'layered features' see Anderson 1992: 93–100; an alternative, 'tagged features', is presented by Zwicky (1986a). Just as the maximum number of slots for same-controller agreement is four, so, it seems, the same may hold for different-controller agreement; Anderson (1985a: 196) claims that verbs in the Penutian language Chinook and North-west Caucasian languages like Adyge can agree with up to four different noun phrases.[7]

While different slots may correspond one-to-one to different controllers, this need not be the case. A given slot may take agreement with different controllers under different conditions; for instance, in Dargwa (Chirag dialect), the verb has a suffixal person marker for the subject if first or second person and for the object if third person (see Kibrik 1979b: 28–9).[8] Note that while targets may offer more than one slot for one and the same controller (as in Archi) or for more than one controller in different syntactic positions (as in Georgian), we never find slots for two or more controllers in the same syntactic position.[9] We never find, for instance, a verb with slots available to agree with conjoined subject noun phrases individually, such that if the noun phrases were, say, feminine singular and neuter singular, the verb would have feminine singular and neuter singular agreement. In such circumstances agreement is with just one controller, or with all conjuncts, but the agreement feature values are determined by a resolution rule (Corbett 1991: 261–9).

Table 9.2 Agreement of Latin adjectives (nominative singular)

masculine	*feminine*	*neuter*	*gloss*

acer	acris	acre	sharp
facilis	facilis	facile	easy
felix	felix	felix	happy

When we turn to agreement features, we find that these cannot be stated just at the level of the language. We cannot simply say that a particular language has gender agreement. There is likely to be variation among the elements identified as agreement targets, as this example from the West Slavonic language Upper Sorbian shows:

(17) wón je pisał
he is.3SG written.SG.MASC
'he wrote'

Here the finite verb agrees in number and person, while the participle agrees in number and gender.[10]

While observing differences *between* word classes in respect of the agreements they may show, we have nevertheless treated word classes as internally uniform in respect of their agreement potential. This too is an oversimplification, since there are instances of systematic differences *within* word classes. Thus, as mentioned previously, Russian verbs agree with their subject in person and number, except in the past tense (formerly a participle), which agrees in gender and number. This generalization holds for all verbs. But there are also instances of idiosyncratically different agreement possibilities within word classes. Latin adjectives show this clearly (see table 9.2).

In the nominative singular, *acer* 'sharp' and similar adjectives distinguish three genders; those like *facilis* 'easy' mark neuter as opposed to masculine and feminine; while *felix* 'happy' and adjectives like it do not distinguish gender for this case/number combination.

5 Effect of the target – the form selected

In the last section we saw that, even if we assume a reasonable morphosyntactic representation with the relevant agreement information, the task remaining for the morphology may be quite complex. Nevertheless, these problems could in principle be handled for each agreement target separately, given a full array of morphosyntactic and lexical information. We now turn to examples which appear to pose problems for such a view, since the agreement form selected appears to depend on more complex interactions – typically interactions between agreement targets. In each case, determining the appropriate form to mark agreement requires more information than a 'common sense' view of agreement would lead us to expect.

The first type of example involves agreement of one target requiring information about another. For instance, in the Semitic language Tigre, three types of noun phrase (direct objects, indirect objects and causees) can trigger object agreement. Furthermore, a definite direct object can optionally give rise to an agreeing object clitic. But this is possible, according to Jake (1980: 75–8), only provided another noun phrase triggers object agreement; thus one type of agreement depends on the occurrence of the other. A second example can be found in Somali. Here the focus marker agrees with or does not agree with the subject, according to a set of factors which need not detain us. The relevant point is that when the focus marker does agree, the verb has a reduced agreement paradigm; that is, it makes fewer distinctions (Gebert 1988: 599–600; cf. Saeed 1987: 62–4; 1993: 86–7). In other words, the form of agreement of the verb depends on whether or not the focus marker shows agreement. A third, more familiar example concerns adjectival agreement in German. Adjectives within the noun phrase show agreement in gender and number, but the form of this agreement depends on the agreement information supplied by various types of determiners within the same noun phrase (see Zwicky 1986c for analysis).

The last type of problem involves syncretism. It is common to find different morphosyntactic representations which have a single realization: we saw examples in section 3.2. Occasionally the

existence of syncretism, which would appear to be a matter of morphology (the morphology of targets in the cases which interest us here), makes possible a type of agreement which would otherwise be unacceptable. To illustrate this we will consider briefly the problem of gender resolution in the Bantu language Chichewa (for details see Corbett and Mtenje 1987 and Corbett 1991: 276–8). Chichewa has ten genders, which we refer to by the agreements they take in the singular and plural. Thus 7/8 is a gender which includes a wide variety of inanimate nouns. When noun phrases which do not refer to humans are conjoined, the general rule requires that the agreeing verbal predicate will be in the plural of gender 7/8, shown by the prefixed marker *zi-* (irrespective of whether the head nouns belong to that gender or not). However, there is an interesting class of apparent exceptions:

(18) ma-lalanje ndi ma-samba a-kubvunda
6-orange and 6-leaf 6-be.rotting
'the oranges and leaves are rotting'

Here we find noun phrases headed by nouns of the same gender, both plural, and the verb takes the same plural form. This was found fully acceptable, though it is not the form which would be predicted by the rule given. Now consider phrases headed by non-human plural nouns which are of different genders, but whose subject agreement forms happen to coincide.

(19) a-mphaka ndi ma-lalanje a-li uko
2-cat and 6-orange GN-be there
'the cats and the oranges are there'

The gender/number marker (GN) on the verb (*a-*) is that corresponding to the plural both of gender 1/2 and of gender 5/6 (the form *zi-*, which would be predicted by the usual rules, may be an alternative). The regularity here is that if noun phrases headed by plural nouns which would take the same target gender form are conjoined, then that target gender form will be the preferred form. There are different ways in which these examples might be analysed. The crucial point, however, is that the agreement form is determined, at least in part, by the fact that particular markers are syncretic. If the forms did not happen to be syncretic, then the regular rule would apply. For further discussion of syncretism in agreement morphology see Zwicky 1991; Gvozdanović 1991; and Carstairs-McCarthy 1992: 202–6.

6 Conclusion

It used to be considered that agreement was primarily a matter of syntax. But several investigations have show that semantics and pragmatics also have a large role. It now seems that morphology too has a more substantial role in the working of agreement than has generally been assigned to it. Indeed, the morphology of agreement is one of the most interesting parts of inflectional morphology.[11] We should be looking to predict which types of language will have agreement, the conditions under which particular agreement features will be expressed, the types of formal expression which will be employed, and the ways in which the target itself may help to determine the form of agreement.

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1 For the synchronic connection see C. Lyons 1990. It is also important, though sometimes quite difficult, to distinguish pronominal affixes from straightforward verbal agreement. Pronominal affixes are obligatory arguments of the verb; a verb with its pronominal affixes constitutes a full sentence, and additional noun phrases are optional (as e.g. in Barbareño Chumash; see Mithun 1991: 85–6). If pronominal affixes are the primary arguments, then they may be said to agree only in the sense that anaphoric pronouns agree, provided that one accepts that broader definition of agreement (see also Siewierska and Bakker 1996: 116–

19 for discussion of the difficulties).

2 We shall treat, say, number as a 'feature' and singular, dual, plural as 'values' of that feature. The features and their values carried by a controller or target are its 'feature specification'. An alternative terminology has number as a 'category7 and singular as a 'property' or 'feature' (Matthews 1991: 39–40).

3 For a different approach to the compatibility of feature specifications in agreement see Steele (1990: 90–3). For a critique of the treatment of agreement in unification-based grammars and an account of an approach using Lambek Categorial Grammar see Bayer and Johnson 1995.

4 Several languages of the East Cushitic group have some verbs which mark subject agreement by prefixation, while the majority of verbs use suffixation (Hayward and Orwin 1991).

5 Of course, the case would be more convincing if these basic forms were not subject to variation.

6 A closer tie between syntax and morphology is postulated by Baker (1985), and agreement data form a crucial part of his argument. There are problems, however, for which see Grimshaw 1986 and Anderson 1992: 127–8.

7 Davies (1986: 1) states that 'a Choctaw predicate can agree with up to five arguments in a single clause', but he seems to be referring to potential controllers; it is not clear how many agreement markers can occur on a single target.

8 A complex example is found in verb agreement in Tabassaran, described by Kibrik and Seleznev (1982); see also A. C. Harris 1994; another is Georgian (A. C. Harris 1978; Anderson 1992: 141–56).

9 Foley (1986: 185–6) reports data (originally from Scott 1978) on the Gorokan language Fore. Dependent verbs whose subject differs from that of the independent verb take separate markers showing the person and number of their own subject and the person and number of the subject of the independent verb. Thus a verb can be said to agree with two subjects; but note that they are not in the same syntactic position: one is the subject of a dependent verb, the other is the subject of a different (independent) verb.

10 The target type also influences the form of agreement when there is an agreement option (as e.g. in British English, where *committee* may take a singular or a plural predicate). The distribution of these options is constrained by the Agreement Hierarchy (Corbett 1979, 1991: 225–60; Barlow 1991) and the Predicate Hierarchy (Comrie 1975; Corbett 1983: 42–59, 87–8). Typically, these constraints operate at the level of the corpus – the target type makes one agreement form more or less likely. But these constraints may also operate as a sentence-level constraint (Corbett 1983: 60–9), in which case the choice of form of one target is determined in part by the choice of form for another. Similar considerations apply to stacked constructions (Corbett 1983: 69–74).

11 It is also proving of considerable interest to psycholinguists; see e.g. Kehayia et al. 1990, Bock and Miller 1991, Clahsen and Hansen 1993, Vigliocco et al. 1995.

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10. Morphology and Argument Structure

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1 Introduction

In English we can say (la) or (1b):

(1) (a) The peasants loaded hay onto the wagon.
(b) The peasants loaded the wagon with hay.

However, although we can say (2a), we can't say (2b):

(2) (a) The peasants poured water into the tank.
(b) *The peasants poured the tank with water.

And while we can say (3b), we can't say (3a):

(3) (a) *The peasants filled water into the tank.
(b) The peasants filled the tank with water.

Further, we can say (4a) or (4b):

(4) (a) Ira broke the vase.
(b) The vase broke.

Yet, although we can say (5a), we can't say (5b):

(5) (a) Ira cut the bread.
(b) *The bread cut.
In addition to the contrasts in examples (4) and (5), we have those exhibited by examples such as (6) and (7):

(6) (a) Children easily break such vases.
(b) Such vases are easily broken (by children).
(c) Such vases break easily (*by children).

(7) (a) An ordinary knife will easily cut such bread.
(b) Such bread is cut easily (with an ordinary knife).
(c) Such bread cuts easily (with an ordinary knife).

Examples such as these raise the question of how participants which are entailed by the lexical meaning of predicates are made explicit in the morpho- syntactic representation, and whether and under what conditions they may remain implicit: that is, issues of valency. In addition, they raise the question of alternations: that is, where two morphologically related (or even identical) predicates differ in their lexical semantics and in the way participants are realized in the morphosyntax and, in particular, in morphology. This facet of the morphology–syntax interface has come to be referred to as 'argument structure'. This term means different things to different authors, and one of our aims will be to make explicit a number of distinctions between some of the different types of realization and different types of alternation that have fallen under this term.

We begin our discussion with a distinction between two sorts of operation which affect valency. Section 3 goes on to examine the question of linking, the way that grammars describe the associations between semantic and/or argu ment structure representations and surface grammatical relations. We describe how this is accomplished in two major frameworks: Lexical Functional Gram mar and Principles and Parameters Theory. We also discuss the vexed question of unaccusativity and its representation, and conclude the section with brief mention of other frameworks. In the fourth section we provide three case- studies illustrating the architecture we propose: passives/middles in English, reflexives/reciprocals in Bantu, and causatives in Japanese, then close with a brief discussion of noun incorporation and synthetic compounding.

There are several important topics we cannot address for reasons of space. First, we are restricting our attention to verbs, and ignoring the argument structure properties of adjectives, nouns and prepositions. More specifically, we will side-step a number of difficult but important questions about par ticiples and nominalizations, especially the inheritance of argument structure in deverbal nominalizations (cf. Grimshaw 1990: chs 3, 4). We are also unable to delve into the question of light verb constructions (and the related problem of serial verbs). Finally, there are interesting questions surrounding argu ment structure and derivational morphology (e.g. the argument structure of deverbal adjectives such as *readable* from *read*) which we leave untouched. However, we hope to have provided sufficient foundation in this chapter for the interested reader to investigate the primary literature in those areas with some confidence.

2 Two types of operations

Between them, lexical semantics and morphosyntactic theory must enable us to relate, at some level, the two uses of *load* in (1) and *break* in (4), and the passive voice to the active. There is by now a broad consensus that lexical semantics plays a large role in determining such morphosyntactic realizations, but disagreement as to whether it can all be reduced to semantics. For those who believe that semantics is insufficient on its own, it is necessary to stipu late some other level of representation to account for these phenomena. In addition, we would wish to see evidence that such extra structure is empiric ally or conceptually necessary.

Any verb will have some number of (optional or obligatory) syntactic dependents, and the lexicon and grammar of a language must therefore include information about these valency requirements. This information may be expressed in a variety of ways, appealing directly to grammatical functions such as subject and object, as in Lexical Functional Grammar (Bresnan 1996) or Relational Grammar (see Blake 1990), or to syntactic configurations, as in Principles and Parameters Theory (Chomsky 1981), or to some combination of grammatical functions and category labels, as in Head-Driven Phrase Struc ture Grammar (HPSG, Pollard and Sag 1994). In addition, there must be some representation of the linguistic aspects of word meaning: that is, a semantic level of representation characterizing the necessary properties of the semantic arguments of predicates. A number of different proposals have been put for ward in the literature concerning the nature, structure and vocabulary of the level of lexico-semantic representation, summarized by Levin and Rappaport Hovav, MORPHOLOGY AND LEXICAL SEMANTICS.

Given this background, two fundamentally important, and clearly related, issues arise:

> (i) To what extent is syntactic valency idiosyncratic, and to what extent can it be said to be predictable from the lexico-semantic representa tions associated with individual predicates?

(ii) How can the relationships between different 'uses' of the same word form and between related word forms be captured/predicted in a non-redundant manner?

Our first response to these questions will be to follow a number of authors in drawing a distinction between two sorts of operation 'in' the lexico-semantic/ syntax interface (cf. Levin and Rappaport Hovav, MORPHOLOGY AND LEXICAL SEMANTICS, for a succinct summary of this claimed distinction). The first, 'meaning-changing' operation alters the semantic content of predicates, and we refer to such operations as 'morpholexical operations'. The second, 'meaning- preserving' operation alters the syntactic manifestation of a given semantic rep resentation, particularly the way that it is mapped on to grammatical relations.

We will refer to these as 'morphosyntactic operations'.[1] In a sense, this division corresponds to the traditional distinction between derivation (lexeme-creating) and inflection (creation of distinct forms of a given lexeme), though it may not always be helpful to push this analogy. The distinction is reminiscent of that found in morphophonology, in which phrasal phonology becomes morpho-logized by giving rise to morphophonological alternations and ultimately suppletive allomorphy.

2.1 Morpholexical operations

To makes things more concrete, consider (8):

(8) Resultative construction
(a) The blacksmith hammered the metal.
(b) The blacksmith hammered the metal flat.

This example illustrates an operation which is appropriate for verbs in cer tain semantic classes (roughly, the meaning of the verb must be compatible with an eventual change of state), and adds a semantic argument to a predic ate. This argument expresses the resultant state, flatness, of the object, metal. Evidently, the resultative construction increases the syntactic valency of the predicate – in (8b), *hammer* in the resultative complex *hammer flat* has a sur face syntactic valency of three. The claim that result predication is a semantic or morpholexical operation is based on the assumption that the syntactically bivalent predicate illustrated in (8a) expresses a relation between just two semantic arguments, without entailing an end result. That is, (8b) crucially means that the blacksmith flattened the metal by means of hammering activ ity. Example (9) is a particularly clear case in which the main verb is atelic:

(9) They drank the teapot dry.

Since one cannot drink a teapot, (9) must be interpreted as 'they rendered the teapot dry by drinking (from it)'.

2.2 Morphosyntactic operations

Two constructions in English, dative shift and passive, are often taken to be examples of morphosyntactic operations. These are illustrated in (10) and (11):

(10) Dative shift
(a) Tom gave a bone to his dog.
(b) Tom gave his dog a bone.

(11) Passive
(a) Tom broke the vase.
(b) The vase was broken (by Tom).

Each operation brings about an alteration in the morphosyntactic manifesta tion of the semantic dependents of a predicate, but they do not alter the basic semantics of the predicate itself (though see section 3.3 for discussion of dis senting views).

The first of these alternations, dative shift, appears to involve a simple altern ation between two

different syntactic manifestations of the same semantic roles. In (10a) the direct object realizes the Theme role, and in (10b) it realizes the Recipient. Now, other things being equal, we might expect morphosyntactic operations to be unconstrained by the semantics of the predicate. This is largely true of the passive in English, for instance. On the other hand, dative shift is restricted in applicability to verbs of transfer respecting rather subtle semantic constraints (see Pinker 1989 for detailed discussion and for examination of some the consequences of this for learnability).

Turning now to the second alternation, it is common to treat passivization as a morphosyntactic operation involving the suppression of the external argu ment, or most prominent argument. If passive is a morphosyntactic operation, we would expect that the semantics of the predicate would remain constant across the voice alternation. A consequence of this in English and many other languages is that the Agent is available semantically, and enjoys a certain pres ence syntactically without necessarily being syntactically expressed. In many languages, this suppressed argument may be expressed as an oblique or an adjunct of some sort, as in the English optional by phrase illustrated in (lib). If the passivization process is simply one of syntactic suppression (as opposed to downright deletion), we would expect the first argument to be available for processes which are semantically rather than syntactically governed, and indeed this seems to be the case. This is discussed in more detail in section 4.1.

A distinction something like that between our morpholexical and morpho syntactic operations is widely assumed, and it is very often taken to motivate a further (third) notion of dependent and a third level of information. This con ceptual level is often known as ‘argument structure’ or ‘predicate-argument structure’ (PAS), and it occupies the interface between the two sorts of opera tions. The morpholexical operations alter (add, delete, identify) semantic com ponents of predicates and create new semantic representations, LCSS. Each of these is associated with its own argument structure, PAS. The morphosyn tactic operations intervene between PAS and syntactic structures, resulting in a multiplicity of syntactic realizations for one and the same argument structure.

Argument structure is essentially a syntactic representation: in fact, it is the syntactic reflex of certain semantic properties. These properties determine the arity (adicity) of the predicate and the relative prominence of the dependence. Both these properties will determine the way the arguments project into the syntax. In a two-place predicate, if no morphosyntactic operations intervene, the most prominent argument (the more ‘agent-like’) will map to the subject position, and the less prominent (the more ‘theme-like’) will map to the object position. In many accounts, the parallel between PAS and constituent syntactic structure proper is increased by distinguishing a special argument position, that of external argument (E. Williams 1980) or most prominent argument (Grimshaw 1990), which always surfaces as the subject. This is the argument of which the entire VP is predicated (hence, it is in a sense external to the verb as such). In a two-place predicate, the remaining argument is often called an internal argument, while a three-place predicate may distinguish a direct internal argument, generally associated with the direct object, and an indirect internal argument, associated with an indirect object. For many purposes it is convenient to assume a further PAS position, denoting events (cf. Higginbotham 1985). This is a position which can be bound by tense operators in the syntax, and to which certain sorts of adverbial may have access.

We give a simplified sketch of this architecture in an essentially theory- neutral fashion. We take examples (11) for illustration, ignoring various com plexities such as the precise surface representation of tense elements, participles and so on:

(a) Active form: *Tom broke the vase.*

[[*x* ACT] CAUSE [BECOME [BROKEN(*y*)]]]			LCS
break: <x <y>>			PAS
Tom SUBJECT	broke	the vase. OBJECT	syntax

(b) Passive form: *The vase was broken by Tom.*

[[*x* ACT] CAUSE [BECOME [BROKEN(*y*)]]]			LCS
broken: <(x) <y>>			PAS
The vase SUBJECT	was broken	(by Tom). OBLIQUE	syntax

In the PAS representations, the external argument is leftmost, the direct internal argument is written in its own set of angle brackets,... <y>.... In the passive representation, the suppression of the external argument is notated by means of parentheses <(x) ...>. The reader must expect to see a number of notational variants on this theme. If we wish to include an event position, we would write the PASS as *break* <e <x <y>> and *broken* <e <(x) <y>>> (assuming passive participles are 'eventive' in the appropriate sense).

In this section, we have motivated and illustrated Levin and Rappaport's (MORPHOLOGY AND LEXICAL SEMANTICS) distinction between two conceptu ally different sorts of relations between lexemes or word forms. The morpho- syntactic operations are meaning-preserving, but alter the syntactic realization of the predicate. The morpholexical operations are meaning-altering, and add, delete or identify certain components of meaning. They therefore create slightly different lexemes with syntactic realizations different from those of the base predicate. Either type of operation may be, but is not necessarily, morphologically mediated. Morphosyntactic operations regularly arise when fully fledged syntactic processes become morphologized (as when a verb becomes an affix). Not infrequently a morphosyntactic operation becomes a morpholexical operation in historical change (lexicalization). As a result of this, one and the same piece of morphology may realize a morphosyntactic operation in one language/dialect and a morpholexical operation in a closely related language/dialect.

In most of the rest of this paper, we will be turning our attention to morphologically mediated operations of these two sorts. Before doing so, however, we will turn in the next section to the question of how the surface syntactic form (possibly through the mediation of PAS) is related to the LCS representation.

3 Linking

3.1 Standard cases in LFG and PPT/GB

In this section we provide a brief sketch of linking theories, within two frame works, Lexical Mapping Theory (LMT), within Lexical Functional Grammar (LFG) (Bresnan and Kanerva 1989, Bresnan and Moshi 1990), and the Principles and Parameters Theory (PPT, also called Government Binding Theory, GB) of Chomsky 1981.

The lexical semantic representation in LMT uses a set of thematic roles, including Agent, Patient, Theme, Experiencer, Beneficiary, Goal, Instrument, Location.[2] For break, this lexical representation, known as the argument struc ture in LFG, would then be as in (13):

(13) break: <Agent, Patient>

The roles are ordered by the hierarchy given in (14) (Bresnan and Kanerva 1989):

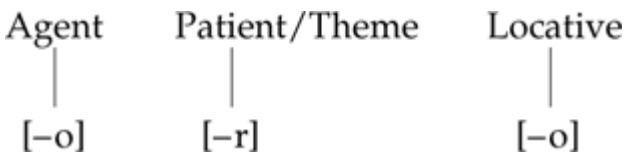
(14) Agent < Benefactive < Goal/Experiencer < Instrumental < Patient/ Theme < Locative…

The argument structure given in (13) is then mapped to a set of sub- categorized grammatical functions, which are syntactic primitives in LFG (SUBJ, OBJ, etc.). These are decomposed into binary distinctive features as shown in (15):

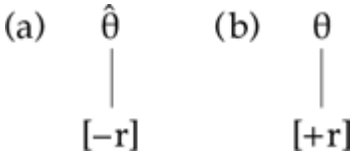
(15) SUBJ [−r, −o]
OBJ [−r,+o]
OBJ2 [+r, +o]
OBL [+r, −o]

Subjects and ordinary objects can express any thematic role, so they are unrestricted, [−r]. Secondary objects and obliques are associated with some specific thematic role, and are hence restricted [+r].[3] Genuine objects are able to complement transitive verbs, but not, say, nouns or adjectives, and these are marked [+o]. Subjects and obliques lack this property. This leads to the classification given in (15).

Mapping is achieved as follows: first, a set of Intrinsic Classification (IC) principles associate thematic roles with particularly syntactic feature values, as exemplified in (16):



The association of Patient/Theme with [−r] in (16) reflects the fact that Patients or Themes alternate between subject and object functions. Next, a set of Default Rules (DR) apply, filling in redundant values in accordance with (17):[4]

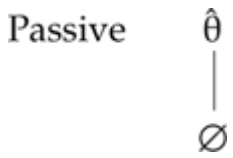


The symbol 0 stands for the highest thematic role. The effects of these can be seen in (18):

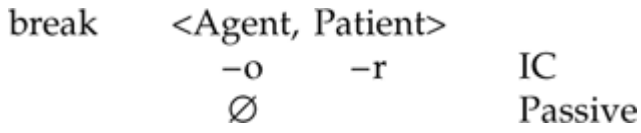
break	<Agent, Patient>		
	−o	−r	IC
	−r		DR

Notice that the system is monotonic, so it would be impossible for DR (17b) to override the intrinsic specification [−r] on the Patient role. Thus far, (18) guarantees that the Agent is mapped to the SUBJ position. To complete the derivation, we appeal to a principle of Function-Argument Biuniqueness which states that every lexical argument position must be uniquely associated with a grammatical function (and vice versa). This limits the specification for [o] which may be given to the Patient in (18). It cannot be [−o], as that would mean that the clause would have two subjects, thus violating bi-uniqueness. Hence, the Patient must be marked [+o], and therefore maps to OBJ.

Of course, we may find that the lexical form in (18) is altered by a valency- affecting (for us, morphosyntactic) operation such as Passive. In LFG passive is an operation which suppresses the highest thematic role:



The morphosyntactic operations apply before the Default Rules, a consequence of the Elsewhere Condition, under which the more specific of two rules in com petition applies in preference to the more general (see Stump, INFLECTION, for general discussion of the Elsewhere Condition). The derivation for the passive of break (as in *The vase was broken*) would therefore be (20):



The Default Rule cannot apply (even vacuously). We now appeal to a further well-formedness condition which states that every clause must have exactly one subject. Thus, the Patient is mapped to the SUBJ function, as required.

These represent very simple cases, of course (the minimal requirement on a successful linking theory). Rather complex problems emerge when we look at more tricky types of predicate, especially those with double objects in some languages (cf. Alsina and Mchombo 1993, Bresnan and Moshi 1990) and, per haps most notoriously, psychological predicates. The problem with the latter is that there are languages (such as English) which have two types of predicate with roughly the same meaning, as illustrated in (21):

(21) (a) Tom fears enclosed spaces.
(b) Enclosed spaces frighten Tom.

Suppose we say that these are exactly synonymous, so that the thematic rela tions borne by *Tom and enclosed* spaces are identical in each case: how do we then construct a linking theory which will obtain both mappings? This conun drum has been the subject of much recent debate (see e.g. Belletti and Rizzi 1988, Dowty 1991, Grimshaw 1990, Pesetsky 1995).

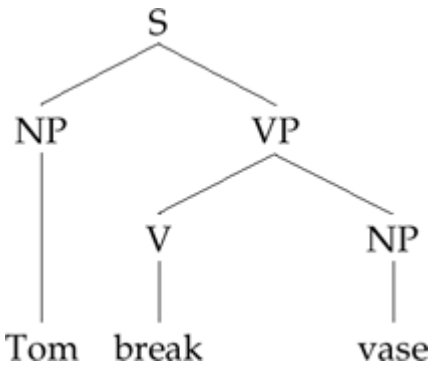
We now turn briefly to the second model, in which grammatical relations are not primitive labels or feature bundles, but are positions in a constituent structure. The PAS representation for *break* will be that of (22):

(22) break: <x <y>>

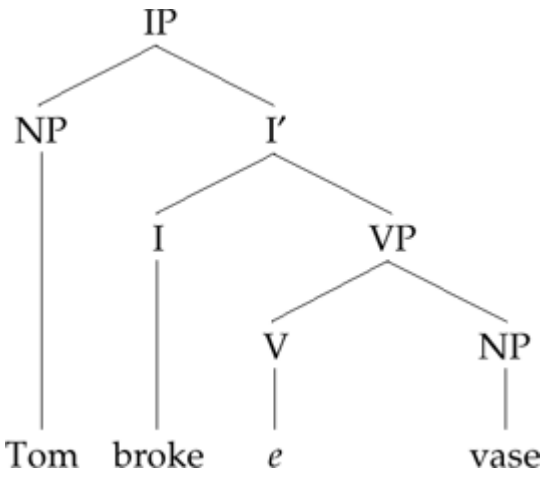
This representation conveys information about arity, just as representation (13) did, but it also contains limited information about prominence. In addition to indicating that there are two syntactically realizable arguments, (22) also specifies the x argument as the external argument and y as the internal argument. This is obtained by means of rules mapping the LCS to the PAS. The semantic argument of an ACT (or CAUSE) predicate is more prominent than, say, the semantic argument of a stative predicate such as BROKEN (or BECOME [BROKEN]). (This is another way of saying that Agents are more prominent, or higher on a hierarchy, than Themes.) Most of what has been said about the use of a thematic hierarchy can be automatically translated into this framework (including the problems with psychological predicates!), so we will not rehearse this (see Jackendoff 1990 for

detailed discussion).

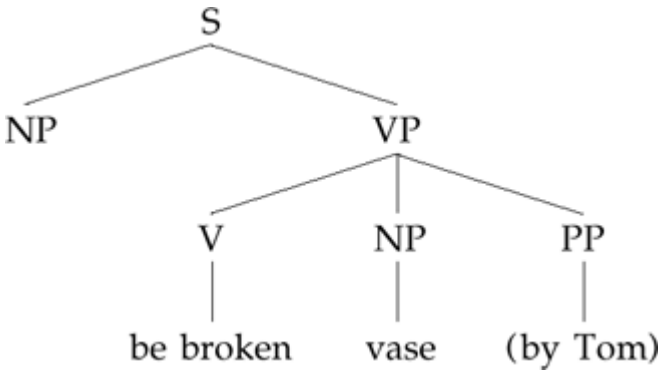
The next question is how (22) is related to a syntactic representation. In the standard Principles and Parameters Theory of Chomsky (1981) there is a D- structure representation, which reflects argument structure very directly, and this is mapped into S-structure by the general rule of Move-α (constrained in various ways). We therefore map the PAS (22) for sentence (11a) into the D-structure shown in (23):



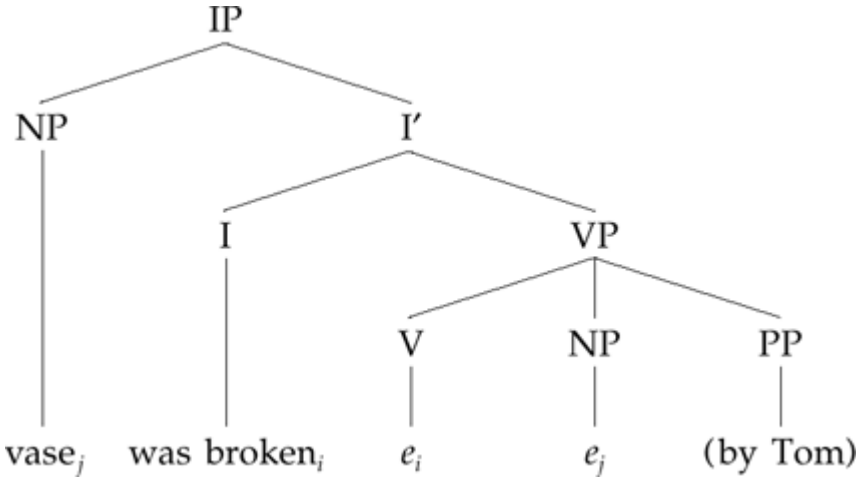
Representation (23) corresponds very closely to the S-structure representation. In PPT, nominals have to be licensed in syntactic form by receiving abstract Case. The subject position receives Nominative Case from I, the position asso ciated with tense marking and subject agreement, while the direct object gets Accusative Case from the verb. These conditions are satisfied in (26), the S- structure derived from (23):



The passive operation is viewed as suppression of the external argument/ notated by putting it in parentheses. As in all other theories, there is then a rider permitting this argument to be expressed as an oblique of some kind in many languages. The passivized verb form, which in English is a periphrastic construction involving a participle and auxiliary verb *be* or *get*, is inserted into the D-structure and the internal argument, *vase*, is linked to the object posi tion (technically, the nominal complement governed by the V head of the VP). However, the external argument has been suppressed, and cannot therefore be linked to the subject position. The best it can hope for is to be realized as an optional PP adjunct, as in (25):



There is a general principle known as Burzio's Generalization, which states that a predicate lacking an external argument cannot assign Accusative Case. This means that passive participles cannot assign Accusative Case and hence cannot license their own objects. This means that vase in (25) cannot remain where it is. It is therefore moved to the only landing site where it will receive a legitimate Case: namely, the (currently unoccupied) subject position. Hence, we obtain (26):



PPT, like LMT, is governed by ancillary assumptions: in particular, that all clauses must have a subject (the Extended Projection Principle) and all lexical argument positions must map on to a structurally defined argument position in the syntax, and vice versa (the Theta Criterion).

It will be seen that although the details of the architecture differ, and a num ber of theoretical positions contrast starkly (e.g. whether grammatical relations are primitive or not), the two models manipulate very much the same ideas, especially with respect to argument-structure representations.

3.2 The mapping of intransitive verbs

As is well known, many languages distinguish morphosyntactically between two types of intransitive verb. In the first type, the unergative, the subject fulfils an active semantic role (such as the traditional Agent), while in the second, the unaccusative, the subject is more passive semantically, and corres ponds to a Theme or Patient. The important point here is that there are some times morphosyntactic processes which treat the subject of an unaccusative and the direct object of a transitive verb as a single class, distinct from the subject of an unergative verb.[6] An example of this is found in the English resultative construction (seen in (8) and (9) above). We can say *They hammered the metal flat*, and also *The river froze solid*, but we can't say *She ran tired* with a resultative meaning 'she tired herself by running'. This corresponds to the fact that *freeze* has a Theme subject and is thus unaccusative, while *run* has an Agent subject and is thus unergative. In other languages the distinction is said to manifest itself in terms of the auxiliaries selected for certain tense/aspect forms (Italian, French, Dutch, Danish), whether an impersonal passive is permitted (Dutch, German and many

other languages), whether a genitive subject is possible under negation (Russian), which argument certain quanti- fications or aspectual prefixes apply to (Slavic generally), or whether the argument can undergo noun incorporation (Mohawk, Chukchee and many other languages).

In LMT this distinction is coded in terms of the specification of grammatical function features. The Intrinsic Classification presented in (16) above will give us the representations (27) for the unergative and unaccusative verbs *run, freeze*:

(a) *run*<Agent>
−o

SUBJ

(b) *arrive*<Theme>
−r

SUBJ

We can now make those processes diagnostic of unaccusatives sensitive to the presence of a [−r] argument.

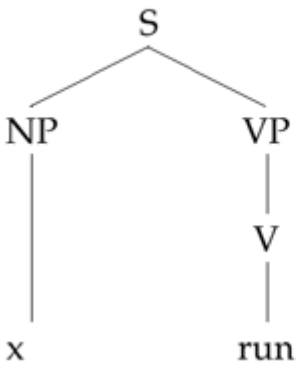
In the PPT/GB framework an unaccusative predicate can be characterized in two ways. First, we could say that it is a one-place predicate with no external argument; second, we could say that it is a one-place predicate whose argument occupies a D-structure object position. In principle, one might even expect to find different processes sensitive to these different characterizations, though such evidence is hard to come by.

The PAS representations for *run* and *freeze* are shown in (28), and the corresponding D-structures are given in (29):

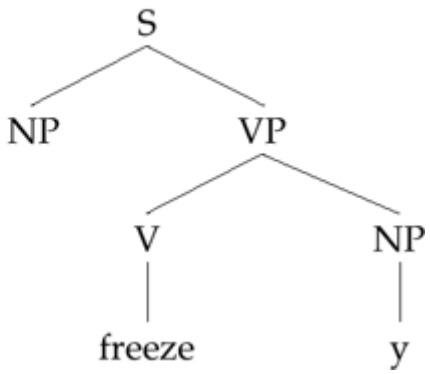
(28) (a) *run* <x>
(b) *freeze*<<□x>>

Here we follow Grimshaw (1990) in representing the internal argument in double angled brackets.

(a) *run* – unergative



(b) *freeze* – unaccusative



By Burzio's Generalization, the unaccusative predicate cannot assign Accusative Case (because it has no external argument), so the 'y' argument has to move to subject position to receive Nominative Case.

3.3 Alternative approaches to argument structure

This chapter is investigating the idea that argument structure is an independently definable level of representation, and for that reason we have not delved into those approaches under which alternations are the result of head movement in the syntax (Baker 1988a, D. G. Miller 1993, Ackema 1995; for review see Carstairs-McCarthy 1992, Spencer 1991). It is not clear how this relates to PAS/

LCS representations, especially in a theory such as Baker's which countenances an autonomous morphology module. It is worth mentioning, though, that most approaches to morphological causatives treat them at some level as a kind of complex predicate (see section 4.3), which is reminiscent of Baker's view that they have the morphosyntax of V–V compounds.

An interesting offshoot of Baker's work which links it to the notion of LCS is that of Hale and Keyser (1992, 1993). They propose that argument structure be described in terms of lexical argument structures or lexical relational struc tures (LRS), essentially a sparse form of LCS built up out of binary-branching syntactic structures and obeying syntactic principles from PPT such as the Empty Category Principle. The idea is that the argument positions are repres ented by NP or PP complements, and the differences in argument structure associated with various verb types are coded as occurrences of (generally empty) V, A or sometimes P slots in the LRS. Thus, a causative verb is one which has a lexical VP structure headed by a V slot (corresponding roughly to a causative predicate in other frameworks).

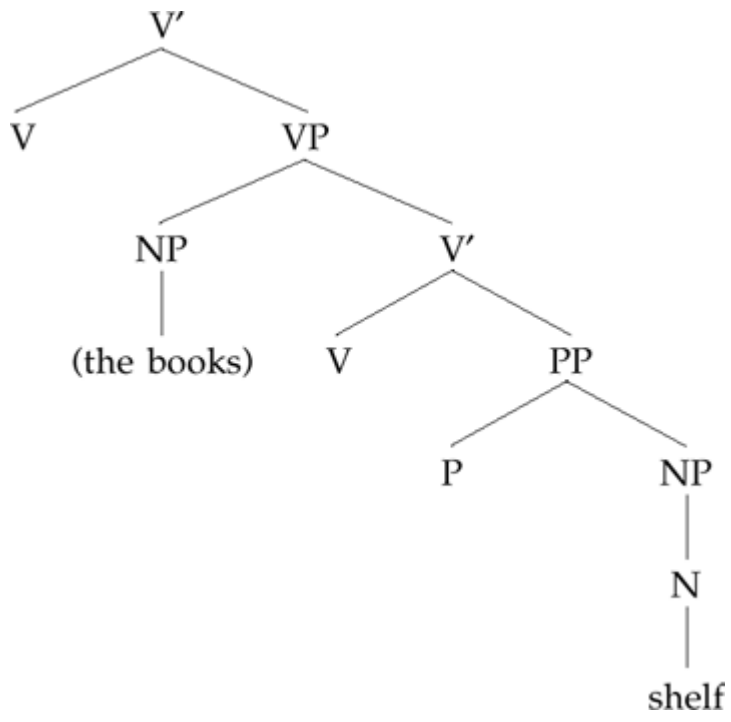
Hale and Keyser consider location verbs such as *shelve*, in which the incorp orated noun corresponds to a locative prepositional phrase:

(30) She shelved the books.

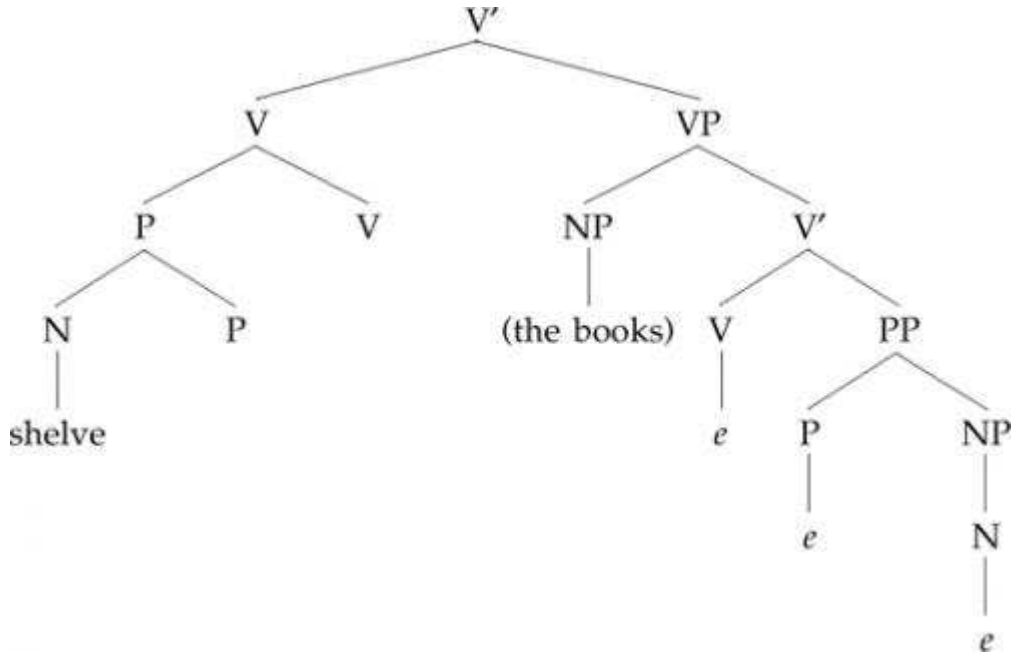
Cf.

(31) She put the books on the shelf.

They argue that the LRS for *shelve* is (32), akin to the syntactic structure cor responding to (31):



The final verb form is derived by multiple application of head movement of *shelf*, successively through P, V and V:



Hale and Keyser argue that similar derivations account for cases such as saddle (*Harriet saddled the horse; cf. Harriet provided the horse with a saddle*). They claim that syntactic principles explain why this is not possible when the con verted noun corresponds to an indirect object. Thus, although we can say *Harriet donated a fortune to the church*, we can't say **Harriet churched a fortune*. They also analyse causative/inchoative pairs in terms of movement of nouns or adjectives through empty V positions (*The gravy thinned, The cook thinned the gravy*). In this theory there appears to be no room for a distinction between morpholexical and morphosyntactic operations. Most of the alternations Hale and Keyser discuss are lexically restricted, and are clearly morpholexical (e.g. conversion from *shelf to shelve*).

One very interesting alternative to the two-level architecture presented here is the theory of argument-structure alternations developed by Goldberg (1995) within the framework of Construction Grammar. For Goldberg, an alternation such as dative shift or the locative alternation is the result of fusing the lexical structure of an individual lexical item with a more general frame, the dative shift construction. A construction modulates the original verb entry, and is even capable of adding extra arguments or underlying predicates such as CAUSE. The framework is a particularly attractive way of handling alternations in which a semantic component is added, such as causatives and resultatives. It is less obvious how it handles cases of argument identification (e.g. reflexivization) or suppression (passives, antipassives). There is little scope in such a frame work for the LCS/PAS distinction, because all alternations are regarded as on a par.

4 Morpholexical and morphosyntactic operations

Having discussed background notions and general theoretical approaches to argument structure, we will now illustrate our overall typology of operations with specific examples. We will discuss three sets of alternations which are each similar except that one can be regarded as a morpholexical relationship while the other can be viewed as a morphosyntactic operation. In the first morphosyntactic operation, passive, an argument position is suppressed. A similar morpholexical operation (which is not expressed morphologically) is English middle formation. In Chichewa reflexivization we see a process in which one argument position is linked with another referentially. The mor phological reciprocal turns out to be morpholexical, however. In productive causatives an argument position is added. This has a drastic effect on the LCS, but in regular cases this is a predictable side-effect of the morphosyntactic change brought about by fusing the argument structure of the base verb with that of the causative. Finally, we look briefly at noun incorporation and at some of the theoretical responses to this phenomenon.

4.1 Passives and middles

In both the passive and the middle alternations in English an argument is lost and fails to be projected in the syntax. Consider (34, 35) (cf. Ackema and Schoorlemmer 1995: 175):

(34) (a) Tom painted the walls.
(b) The walls were painted (by Tom). (Passive)

(35) These kinds of walls paint easily. (Middle)

The suppressed external argument of the passive is still syntactically 'active' to some extent. It can appear as a by phrase more or less irrespective of the semantics of the verb (34b), and it can license agent-oriented adverbials (36), and can control the null subject of purposive clauses (37):

(35) The walls were painted on purpose.

(37) The walls were painted to protect them against the rain.

As is well known, the middle construction imposes semantic constraints: the resulting sentence is interpreted as a stative, and stylistically is preferred, there fore, with a generic subject. In addition, the construction is generally difficult or impossible without adverbial support (in the form of adjuncts referring to ease or difficulty).

An important contrast between passives and middles is that the lost subject is not syntactically available, even where the above felicity conditions are met:

(38) (a) *These kinds of walls paint easily by professional painters.
(b) *These kinds of walls paint easily on purpose.
(c) *These kinds of walls paint easily to protect them against the rain.

English passives are possible with a great variety of verb construction types, including raising verbs (39), double object constructions (40) and with idiom chunks, as in (41):

(39) (a) The coach expected Tom to win.
(b) Tom was expected to win (by the coach).

(40) (a) Tom gave Dick a book.
(b) Dick was given a book (by Tom).

(41) (a) The used-car salesman took advantage of Tom.
(b) Tom was taken advantage of by the used-car salesman.
(c) Advantage was taken of Tom by the used-car salesman.

Middles fail in such cases:

(42) Such committed athletes readily expect to win.

(This is ungrammatical on a reading synonymous with *are readily expected to win*.)

(43) (a) *Such well-educated children give books easily.

(Also **Such books give easily to young children*.)

(44) (a) *Tom takes advantage of easily.
(b) *Advantage takes easily of Tom.

We will follow Ackema and Schoorlemmer (1995) in assuming that middles are formed by a 'pre-syntactic' – for us a morpholexical – process, whereas passives are formed by a morphosyntactic

process. The middle, then, has a single syntactically projectable argument (an external argument, according to Ackema and Schoorlemmer, hence the middle is an unergative form) and no syntactically available implicit argument. This lone argument corresponds to a patient argument in semantic structure (and, of course, corresponds to the patient argument which is associated with the direct internal argument of the ordinary active form of the verb). The passive, however, has an internal argument which is linked to subject position in the syntax, and a suppressed, but implicit, argument corresponding to the external argument of the active form. The existence of such an implicit argument is, for us, a sufficient con dition for a morphosyntactic valency-reducing operation.[7]

Given the logic of the overall architecture of grammar which we have taken as our descriptive starting-point, the active and passive alternants of a verb are forms of one and the same lexeme, while the middle form is effectively a closely related lexeme, with slightly different semantics. The difference in syntactic projection in the middle follows from the difference. The fact that there are fairly strict lexical and semantic restrictions on the formation of middles should come as no surprise. However, this is not to say that all verb forms in a given language which behave like the English middle with respect to argument structure necessarily exhibit such restrictions.

In Bantu languages – for instance, Swahili – verbs accept a wide range of suffixes to form new voices or new lexemes. Swahili has a form which is generally referred to as a passive, formed by a suffix -w-. Hence, from *pika* 'cook' we have *pikwa* 'be cooked', *funga* 'close', *fungwa* 'be closed'. The Swahili passive permits expression of the suppressed external argument, as in (45):

(45) Chakul kili-pik-wa na mwanamke yule.
food PAST-cook-PASS by woman that
The food was cooked by that woman.'

In addition, we find a class of derivates known as 'stative verbs', formed regularly by suffixation of *-k*. Thus, we have verb stems such as the following (Wilson 1985: 63; Ashton 1944: 226–8):

(46)

(a)	vunja	'break'	vunjika	'be broken'
(b)	pasua	'crack'	pasuka	'be cracked'
(c)	funga	'close'	fungika	'be closed'
(d)	fungua	'open'	funguka	'be opened'

Stative verbs refer to a resultant state without any indication of an agent. Thus, we have examples such as (47) and (48) (Ashton 1944: 229, 361):

(47) Sikuvunja kikombe hiki, kimevunj-ika tu
NEG.I.broke cup this broke-STAT just
'I didn't break this cup; it merely broke.'

(48) Sikufunga mlango, umefungika tu.
NEG.I.open door open-STAT just
'I didn't shut the door, it shut of itself.'

The difference between *mlango ulifungwa* The door was closed (*passive*)' and *mlango umefungika* The door is shut' is essentially the same as in the English translations: the passive refers to an event, the stative to a state (cf. Mchombo's discussion of similar facts, in CHICHEWA (BANTU).

Very intriguingly, the stative form is associated with a potential meaning in addition to the simple intransitive meaning illustrated so far. Thus, the stems *fungika* and *funguka* can also mean 'be closeable/openable' respectively. This is reminiscent of the meaning of the English middle (*This book*

reads easily □ It is easy to read this book).

Wilson (1985: 65) claims that 'any verb, provided its meaning allows it, can be made into a stative form', by which we take it that the verb's lexical semantics must be such as to imply the possibility of a resultant state. Thus, stative formation is very productive, and arguably part of the paradigm of the verb. However, from the brief descriptions provided here, it would seem to have the same argument structure as the English middle. Here, then, is a case in which we have something akin to English passive and middle constructions, but both are realized by regular and productive suffixation. The difference is that the passive merely suppresses the external argument, leaving it syntactic ally available, while the stative disposes of that argument altogether.[8]

4.2 Reflexives and reciprocals

Many languages have within their inventory of morphological operations a class of processes which may be viewed as deriving reflexive or reciprocal verb forms from transitive verb forms (see e.g. the brief discussion and exemplifica tion in Levin and Rappaport Hovav, MORPHOLOGY AND LEXICAL SEMANTICS). Syntactically, these operations are valency-reducing, resulting in predicates which do not permit a direct function to be assigned to an NP corresponding to the reflexive or reciprocal affix or clitic, as in the French examples (49):

(49) (a) Jean voit 1'homme dans le miroir.
Jean sees the.man in the mirror.
'Jean sees the man in the mirror.'
(b) Jean se voit dans le miroir (*l'homme).
Jean REFL sees in the mirror (the.man).
'Jean sees himself in the mirror.

Levin and Rappaport Hovav (MORPHOLOGY AND LEXICAL SEMANTICS) suggest that such processes result in a predicate with the same semantic representation as the input predicate, and on this basis we might be tempted to classify all such processes as morphosyntactic. There are a number of issues here. First, although intuitively speaking it is clear that the basic verb and its reflexive or reciprocal form have the same semantics, these operations clearly have a semantic effect: namely, that of identifying the semantics of the fillers of two role slots (and, in the case of reciprocal, placing a constraint on plurality). The question is whether this identification is brought about syntactically (by syn tactic binding) or whether it falls purely within the lexical domain. Second, we have argued that the prototypically morphosyntactic processes are simply relation-changing alternations. These operations, of which the best examples are voice alternations, may be viewed as doing nothing more than providing different sets of syntactic prominence arrays for sets of roles, or as mapping between alternative syntactic realizations for the arguments of predicates. In this context, then, we may ask whether reflexivization and reciprocalization are morphosyntactic in the appropriate sense, specifically:

(i) Do they provide different grammatical function arrays/surf ace real izations for arguments?
(ii) Does the reflexive or reciprocal 'role' remain accessible in the syn tax (in the way that the suppressed argument of a passive remains accessible)?

Both these questions are addressed in Mchombo's (1993a) discussion of reflex ives and reciprocals in the Bantu language Chichewa. In Chichewa the object marker (OM) is optional, and Mchombo treats it as an agreement marker (unlike the subject marker, SM, which is ambiguous in status between an agreement marker and an incorporated argument/function). Reflexives are realized by a prefix -dzi- occupying the OM slot (FV= 'final vowel'):

(50) Mkângo u-na-dzí-súpul-a
3-*lion 3SM-past-REFL-bruise-FV*
'The lion bruised itself.'

Mchombo offers a most interesting argument for the syntactic 'presence' of the reflexive marker on

the basis of ambiguities in comparative clauses. In (51) the reflexive gives rise to strict as well as sloppy identity readings, and also to a comparative object (rather than subject) reading:

(51) Alenje á-ma-dzi-nyóz-á kupósOaA asodzi
2-hunters 2SM-hab.-reflex.-despise-FV exceeding 2-fishermen
(i) The hunters$_i$ despise themselves$_i$ more than the fishermen$_i$ (despise themselves$_i$) – sloppy identity reading.
(ii) The hunters$_i$ despise themselveS more than the fishermen (despise them;) – strict identity reading.
(iii) The hunters despise themselves more than (the hunters despise) the fishermen – comparative object reading.

The existence of strict identity and comparative object deletion readings points to the presence of a syntactic argument (for Mchombo, in fact, an object) corresponding to the reflexive in the two clauses.

Given Mchombo's reasoning, it follows that at least at PAS, reflexivized pre dicates have two arguments, so they remain bivalent even if they are not transitive in surface syntax. This indicates that reflexivization in Chichewa is a morphosyntactic operation. If, furthermore, Mchombo is correct that the reflexive really *is* an object, then we have no difference in surface grammatical function, although we do have a difference in surface expression (as an affix rather than an independent NP).

Mchombo presents further data to support this position. In (52) we see that under gapping, thereflexive verb patterns in a way parallel to a normal transitive verb:

(52) Alenje á-ma-dzi-nyóz-á kupósá asodzi alimi.
2-hunters 2SM-hab.-reflex.-despise-FV exceeding 2-fishermen 2-farmers
'The hunters despise themselves more than the fishermen the farmers.'

The essence of Mchombós claim concerning the Chichewa (and by extension, the Bantu) reflexive is that it is present in the syntax, as an anaphoric syntactic element, subject to syntactic binding. Since the domain of binding is syntax, and this domain is separate from that of the morpholexical rules, reflexivization cannot be a morpholexical rule.

The behaviour of the reflexive morpheme contrasts sharply with that of the reciprocal. The reciprocal marker is a suffix to the verb root, hence part of the verb stem. This means that in contrast to the reflexive marker, the reciprocal participates in the process of vowel harmony, reduplication, nominalization and imperative formation. This puts the reciprocal in the same position as exponents of morphosyntactic operations such as passive, applicative and causative; but this does not mean that it is a morphosyntactic operation itself. To see this, note its behaviour in comparative clauses. As seen in (53), the reciprocal gives rise only to the sloppy identity reading:

(53) Alenje á-ma-nyoz-án-á kupósá asodzi
2-hunters 2SM-hab.-despise-redp.-FV exceeding 2-fishermen
'The hunters$_i$ despise themselves$_i$ more than the fishermen$_j$ (despise themselves$_j$).'

This strongly suggests that the process involved identifies the fillers of the two semantic role slots lexically and not syntactically; that is, we have a (productive) semantic derivation providing a predicate with a slightly altered semantic representation. In parallel fashion, the counterpart of (52) is impossible with reciprocal verbs.[9]

4.3 Causatives

In a causative construction a bare verb, V, an adjective, A, or sometimes a noun stem, N, alternates with a verb meaning 'cause/allow/persuade/help|... to V' or 'cause/allow/persuade/help... to become A/N'. In many genetically and typologically varied languages this is realized morphologically in a completely regular fashion. The causative alternation has been the subject of considerable research, to which we can hardly do justice here. At first blush this would seem to be an instance of the

creation of an entirely new lexeme, as in English *They darkened the room* (from adjective *dark*) or *They enslaved the populace* (from noun *slave*). This is because there is an additional semantic component of causation. Moreover, this component often receives subtly different interpretations (as indicated in our glosses above), such as persuasion, instruction ('tell someone to do something') or permission ('allow someone to do something'). However, many researchers regard the morphological causative as an instance of an argument-structure alternation, rather than lexemic derivation proper. This is particularly attractive when the causative is completely productive and lacking in lexical idiosyncrasies.

Japanese has an interesting and well-studied causative morphology. For convenience we will follow the discussion in Tsujimura's (1996) overview of Japanese grammar (cf. also Shibatani 1976). The examples in (54) are adapted from Tsujimura (1996: 247):

(54) (a) Hanako-ga arui-ta.
Hanako-NOM walk-PAST
'Hanako walked.'
(b) Taroo-ga Hanako-o aruk-ase-ta.
Taroo-NOM Hanako-ACC walk-CAUSE-PAST
'Taroo made Hanako walk.'
(c) Taroo-ga Hanako-ni aruk-ase-ta.
Taroo-NOM Hanako-DAT walk-CAUSE-PAST
'Taroo had Hanako walk.'

The causative morpheme is a suffix taking the form -(s)ase (-sase occurs after vowel-final stems). As is typical cross-linguistically, the subject of the basic verb *walk* in (54a), *Hanako*, is expressed as a direct object marked by -o in the causative version in (54b). This sentence means something like 'Taroo forced Hanako to walk'. In (54c), however, *Hanako* is marked with a dative case marker -*ni*, and the interpretation is closer to 'Taroo persuaded Hanako to walk'.

When a transitive verb is causativized, the embedded subject is always marked with dative case, as in (55):

(55) (a) Taroo-ga hon-o yon-da.
Taroo-NOM book-ACC read-PAST
'Taroo read a book.'
(b) Hahaoya-ga Taroo-ni hon-o yom-ase-ta.
mother-NOM Taroo-DAT book-ACC read-CAUSE-PAST
'His mother made/had Taroo read a book.'

This has been linked to a general prohibition in Japanese against two nominals marked with -*o* in one clause. In other languages it is quite common for the embedded subject of a transitive verb to be marked as an (optional) oblique rather than as a direct object, but Japaneseis only accidentally similar to this type.

Morphological causatives in Japanese are very productive, and are relatively free of lexical restrictions or idiosyncrasies. Moreover, there is good evidence (cf. Shibatani (ed.) 1976) that at some level a causativized transitive sentence such as (56) behaves like two clauses, much like the bi-clausal English translation (again, adapted from Tsujimura 1996: 255):

(56) Taroo-ga Ziroo-o/ni zibun-no heya-de benkyoo-sase-ta.
Taroo$_i$-NOM Ziroo$_j$-ACC REFL$_{i/j}$-GEN room-in study-CAUSE-PAST
Taroo made Ziroo study in his own room.'

Reflexivization in Japanese is subject-oriented, so (56) suggests that both *Taroo* and *Ziroo* correspond to subjects at some level. We can say that, in a certain sense, *Ziroo* is the subject of *study*, while Taroo is the subject of CAUSE. Evidence from ambiguities with temporal and subject-oriented adverbs points the same way. We can call a causative construction of this sort 'bi-clausal'.

In what sense is a productive morphological causative a morphosyntactic operation? One viewpoint, which in some ways incorporates the insights of Baker (1988a), is to say that the causative operation comprises the fusion or union of two argument structures. Thus, suppose we take the argument structure of predicates such as *walk* or *hit* as something like (57):

(57) (a) walk: <arg. 1>
(b) hit: <arg. 1, arg. 2>

Then we can say that the causative will be (58):

(58) (a) cause-walk: <arg. 0 <arg. 1>>
(b) cause-hit: <arg. 0 <arg. 1, arg. 2>>

To some extent it is immaterial for our typology whether structures such as (58a, b) are the result of an operation 'in the lexicon' or the result of V- movement 'in the syntax'. The point is that it makes sense to say that the operation is defined over an essentially unrestricted set of predicates and results in an argument structure representation along the lines of (58), such that all three of the arguments are syntactically visible in some sense. The operation thus qualifies as morphosyntactic in our sense.[10]

Languages differ in how these three arguments are realized (see Baker 1988a for a detailed study of this). Cross-linguistically, *arg*. 1 in (58a) is uniformly realized as a canonicaldirect object. However, the (58b) structure (where it exists) will sometimes realize *arg*. 1 as a direct object, and sometimes *arg*. 2 retains the direct object status, depending on the language. When *arg*. 1 becomes the derived directobject, *arg*. 2 is generally marked as a second object, though this will often be inert to object-oriented processes like passive. Thus, despite the fact that *Taroo-ni* in (55b) is an obliquely marked phrase, it is in fact the direct object of the causative. This is clear when we try to passivize a causative. Consider the data in (59) (cf. Tsujimura 1996: 259):

(59) (a) Ziroo-ga Mitiko-ni kodomo-o home-sase-ta.
Ziroo-NOM Mitiko-DAT child-ACC praise-CAUSE-PAST
'Ziroo made Mitiko praise the child.'
(b) Mitiko-ga Ziroo-ni kodomo-o home-sase-rare-ta.
Mitiko-NOM Ziroo-DAT child-ACC praise-CAUSE-PASS-PAST
'Mitiko was made to praise the child by Ziroo.'

Here, *Mitiko-ni* in (59a) has been promoted to subject when (59a) is passivized, while *kodomo-o* 'child-ACC' remains marked as an accusative. However, if we try to passivize on the accusative marked object in (59a), *kodomo-o*, we get an ungrammatical sentence:

(60) *Kodomo-ga Ziroo-ni Mitiko-ni home-sase-rare-ta
child-NOM Ziroo-DAT Mitiko-DAT praise-CAUSE-PASS-PAST
'The child was made praised by Mitiko by Ziroo.'

Thus, *kodomo-o* behaves like an inert, or frozen, second object. Such 'freezing' of the second object is typical, though in some languages both objects retain full object properties, including passivization, object agreement marking and so on (see Baker 1988a and Bresnan and Moshi 1990 for discussion of variation in Bantu in this respect).

In other languages *arg*. 2 in (58b) is treated as the object of the causative, with *arg*. 1 becoming an oblique marked adjunct, generally optional. This is how causatives work in Turkish, for instance. Consider (61) (Comrie 1976: 268):

(61) Dişç, i mektub-u müdür-e imzala-t-ti.
dentist letter-ACC director-DAT sign-CAUSE-PAST
'The dentist made the director sign the letter.'

Here the object of the basic verb, *letter*, remains the object of the derived causative verb, while the subject of the basic verb, *director*, appears as a Dative marked oblique.

In general, when *arg*. 2 is treated as the derived (as well as basic) object, the causative construction behaves syntactically like a single clause. Thus, if the object is a reflexive pronoun, it can only refer back to the surface subject, *arg*. 0, and not to *arg*. 1. In other words, *arg*. 1 cannot be treated as a kind of subject for the purposes of reflexivization, and we have a monoclausal causative construction. This is in contrast to the biclausal causative of Japanese.[11]

The semantic effects of the causative operation will differ somewhat from language to language, and, importantly, from construction to construction, so Japanese causatives with -o marked objects have the coercive or the adversity reading, while those with the *-ni* object have the permissive reading. However, the basic semantic relationships are the same cross-linguistically.

Japanese also has verb pairs which we can interpret as lexical causatives, often related by non-productive ablaut. Some examples are given in (62) (Tsujimura 1996: 260):

(62)

(62)causative	intransitive	
tomeru	to mar u	'stop'
ageru	agaru	'rise/ raise'
sageru	sagaru	'lower'
okosu	okiru	'wake up'
nekasu	neru	'sleep'

Despite the meanings of these pairs, the causative member does not behave like a morphologicalcausative derived with *-(s)ase*. Thus, with reflexives we get a monoclausal patterning. Compare (63) with (56):

(63) Taroo-ga Ziroo-o zibun-no heya-no mae-de tome-ta.
Taroo$_i$-NOM Ziroo$_j$-ACC REFL$_{i/*j}$ room-GEN front-at stop-PAST
'Taroo stopped Ziroo in front of his room.'

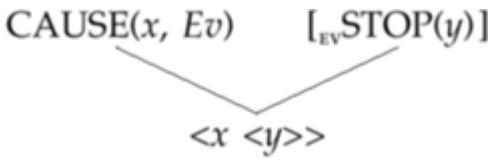
In (63) Ziroo is a 'pure' object, and hence cannot be the antecedent to the reflexive. Contrast this with (64), in which the intransitive *toma-* is causativized morphologically, not lexically:

(64) Taroo-ga Ziroo-o zibun heya-no mae-de tomar-ase-ta.
Taroo$_i$-NOM Ziroo$_j$ACC REFL$_{i/j}$ room-GEN front-AT stop-CAUSE-PAST
'Taroo made Ziroo stop in front of his room.'

Here, *his room* can refer to Taroo or to Ziroo.

Clearly, we want to relate the intransitives to their lexical causatives by means of a morpholexical operation, while we will argue that the morphological causatives (at least in Japanese) are the result of morphosyntactic operations. A further piece of semantic evidence in favour of this is that the lexical causatives signify direct causation, in which the agent must come into direct contact with the patient. Morphological causatives, however, denote indirect causation. Thus, (64) could refer to a situation in which Ziroo is brought to a stop outside Taroo's room by a large obstacle which Taroo has left there. Taroo could be hundreds of miles away when Ziroo is thus halted. Sentence (63) cannot have such an interpretation.

Discussion of how exactly the linking to grammatical functions is achieved would require a separate chapter in itself, and would require a detailed analysis of the morphosyntax of various subject- and object-oriented processes in the languages which have such causatives. However, we must address one question which arises with a morphosyntactic analysis of causatives. Since there is a sharp shift in meaning (the addition of a CAUSE predicate), in what sense can any causative be morphosyntactic: that is, an operation over argument structures? We assume that what is actually happening here is that the causative operation involves addition of an argument structure, consisting minimally of an external argument position and a further argument position corresponding to the embedded proposition. This then 'fuses' or 'merges' with the argument structure of the basic predicate. Language-particular principles dictate exactly what happens to the elements of the embedded PAS. We thus obtain a representation such as (65):



This is a complex predicate, whose overall argument structure is a function of two independent argument structures. However, the fusion takes place at the level of PAS, not LCS. The LCS portion of (65) is what we would see in a syntactic causative, so the causative predicate and clausal semantic argument can behave, to some extent, independently.

In the lexical causatives we simply have a causative LCS which includes the embedded predicate:

This does not differ significantly from the representation for any (mono-morphemic) transitive verb with a causative component.

4.4 Noun incorporation

Levin and Rappaport (MORPHOLOGY AND LEXICAL SEMANTICS) illustrate English verbs derived by conversion from nouns, such as *butter* in to *butter toast (with margarine*). Here the converted noun corresponds to an object in a syntactic construction such as to *spread butter on the toast*. In some languages the conversion is signalled morphologically, by affixation: for example, Dutch *ver-botter-en* from the noun *botter*, Hungarian *meg-vaj-az* from the noun *vaj*. In other languages, we can create a lexical unit akin to the **VP** *to spread butter* by means of noun incorporation. An example from Chukchee is cited by Gerdts (INCORPORATION), from Polinskaja and Nedjalkov 1987: 240:

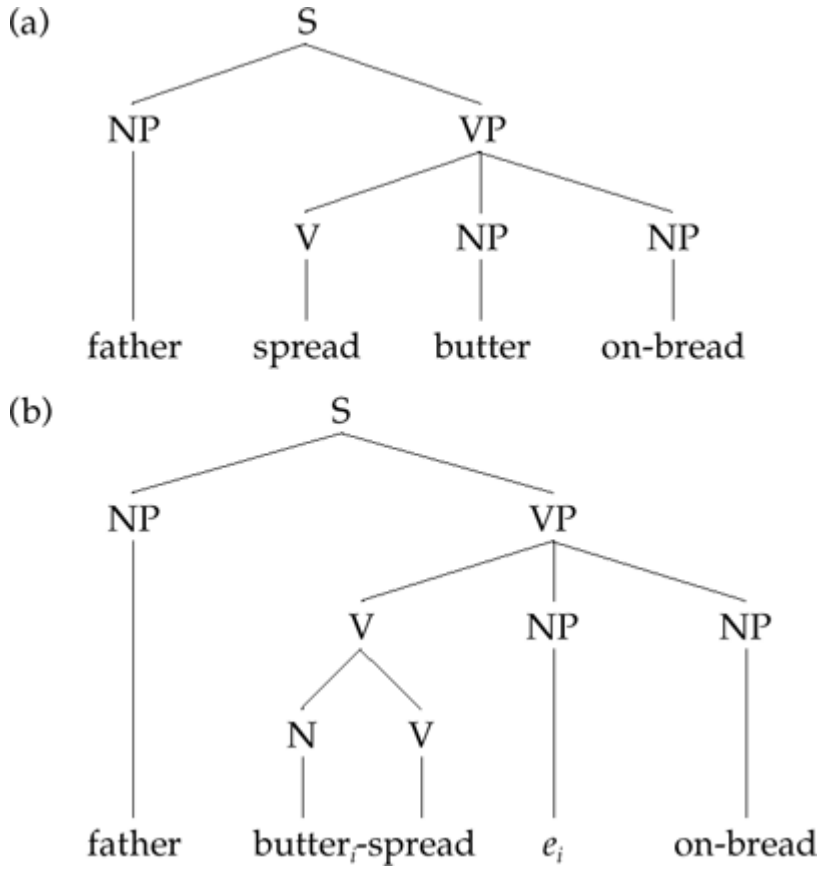
(67) ətləg-e kawkaw mətqə=rkele-nin.
father-ERG bread.ABS butter=spread.on=AOR.3SG:3SG
'Father spread the bread with butter.'

This corresponds to (68) without incorporation:

(68) ətləg-e kawkaw-ək mətqəmət kele-nin.
father-ERG bread-LOC butter.ABS spread.on=AOR.3SG:3SG
'Father spread the butter on the bread.'

In the model proposed by Baker (1988a) such an alternation would be the result of movement

applying to the head noun of the object **NP** *butter*, forming a compound verb as in (69):



The movement of butter leaves a trace, e_i, which has to be properly governed by the verbal complex. Given this analysis, Baker is able to account for a number of important features of NI, such as the stranding of modifiers in some languages. In this type of approach, the fact that the noun *butter* is interpreted as the direct object of the verb is a consequence of the fact that it is, indeed, the verb's object in the syntactic representation. Further discussion of some of the implications of this type of approach is given in Borer (MORPHOLOGY AND SYNTAX).

A similar kind of analysis is available in principle for an English synthetic compound such as *butter-spreader* (e.g. Roeper 1988, Lieber 1992), though here there are important questions surrounding the fact that the verb is nominalized and cannot occur in finite forms, as witnessed by the ungrammaticality of **Tom butter-spreads his toast every morning (with margarine*). An alternative analysis, which is also open to noun incorporation proper, would say that the incorporated element discharges an argument position, but not in the same way as a syntactic direct object. Sproat (1985) and DiSciullo and Williams (1987) propose rather different solutions, which, however, are alike in not appealing to syntactic movement. This is especially attractive for synthetic compounding, in which compounding renders the verb syntactically intransitive: there is no stranding of modifiers, and no 'doubling' is possible: **butter-spreader of bread with rancid* e_i, **butter-spreader of bread with margarine.*

What is the argument-structure status of *butter-spreader*? Here, again, we have a combination of lexemes, which produces what is morphologically more akin to a single word than to a genuine phrase. We can then say that the argument structure of the noun *butter* is somehow 'fused' with that of the verb stem *spread* in such a way that *butter* is interpreted as the direct internal argument of *spread*. If this is a direct operation over the verb argument structure, then presumably we have to say that the nominalizing suffix *-er* is attached after the internal argument is discharged. This means we must assume that the grammar creates an otherwise non-existent verb stem [*butter-spread*] which then triggers discharge of the internal role. Only then does suffixation take place to give *[[butter-spread]er]* (cf. Sproat 1985). On the other hand, we might argue that the argument structure of the

verb is in some way inherited by the nominalization. Thus, *[[spread]er]* retains at least the direct internal argument of the verb stem. This argument can then be projected either as an of phrase (*a spreader of butter (on bread)*), or as part of the compound to give *[bread [spread-er]]* (cf. DiSciullo and Williams 1987).

Approaches to synthetic compounding which appeal to operations over argument structures leave a number of questions unresolved, of course (see Carstairs-McCarthy 1992 for discussion). One of these is the status of the notion of 'inheritance' of argument structure (see Lieber 1992 for discussion of this). Another concerns the generality of the approach. As stressed by Roeper and Siegel (1978) in an early generative treatment of synthetic compounds, English permits compounds in which an adverbial modifier is incorporated, as in *quick drying (paint), sun-dried (tomatoes), home-made (cakes)* and many others. Recent discussion has tended to ignore these cases. An approach which appeals solely to the discharge of argument-structure positions has little to say about them.

The situation is rendered more interesting by the fact that incorporation of adverbials is observed in some noun-incorporating languages. Thus, in Chukchee it is possible to say things like *Tom quick-ran or The mother tent-sewed the shirt* (i.e. the mother sewed the shirt in the tent) (cf. MURAVYOVA, CHUKCHEE (PALEO-SIBERIAN). The incorporation of adverbials is a distinct embarrassment to the framework of Baker (1988a), which is so constructed as to explicitly exclude such constructions (for extensive discussion of this point see Spencer 1995). It seems to us that there is merit in exploring the idea that incorporative structures of this sort can, in part at least, involve something akin to the complex predicate formation we proposed for morphological causatives. Thus, the Chukchee example in (67) might involve a representation along the lines of (70), in which the verb and its object have distinct LCS representations but at PAS that of the object *butter* is indexed with the verb's internal-argument position, thereby saturating it and preventing it from being realized syntactically:

This can be thought of as the PAS equivalent of syntactic incorporation in such theories as those of Baker (1988a) or Sadock (1991) (for the latter, cf. Sproat, MORPHOLOGY AS COMPONENT OR MODULE). In the relatively rare cases like Chukchee where adverbials can be incorporated, we can adopt a similar analysis, in which the adverbial's argument structure is fused with an event position at PAS.

Noun incorporation in many languages is lexically restricted, non-productive and idiosyncratic, much like noun-to-verb conversion of the type *butter the toast* in English (see Mithun 1984 for extensive discussion of this). For such languages, we would argue that the incorporation takes place at the LCS level, despite being realized morphologically by compounding, giving a representation such as (71):

(71) [[x ACT] CAUSE [*BUTTER* BECOME-ON z [$_{BY}$ x SPREAD *BUTTER*]]

This could then correspond to any of the PAS representations in (72), depending on the language, corresponding to syntactic structures (73):

(72) (a) spread <x <P_{loc} z<<
(b) spread <x <z<<
(c) spread <x <y, P_{loc} z>>
(73) (a) butter=spread on to the toast
(b) butter=spread the toast
(c) butter=spread margarine on to the toast

5 Summary

We have argued that valency alternations can be of two distinct types: morpholexical operations at a semantic level and morphosyntactic operations at a level of argument structure. The morpholexical operations are likely to be semantically or lexically restricted, and to bring withthem semantic changes which cannot always be predicted from the valency shift as such. Morphosyntactic operations are moreoften semantically unrestricted, and are thus often defined solely in terms of input/output conditions on argument-structure representations, independently of the semantic representation. They generally do not give rise to additional semantic affects (modulo other aspects of the construction). The result of a morpholexical operation tends to behave syntactically in the same way as a corresponding monomorphemic predicate, whereas syntactic processes may have access to the individual parts of the result of a morphosyntactic operation (cf. the difference between morphological and lexical causatives). We illustrated these distinctions by contrasting passives/middles in English (and Bantu), reflexives/reciprocals in Bantu, and morphological/lexical causatives in Japanese. We finally discussed noun incorporation and synthetic compounding as possible instances of complex predicate formation, in which PAS positions (rather than LCS positions) are saturated morphologically.

1 The terminology, with essentially this interpretation, is due to Ackerman (1992). We acknowledge that the nomenclature is potentially rather misleading, particularly given that 'morpholexical', which already has a number of unrelated uses in linguistics, is used to refer to both our morpholexical operations and our morphosyntactic operations in the LFG literature.

2 In practice, thematic role labels are used for convenience, not out of theoretical commitment to these labels. It is generally understood that they stand for more complex LCS representations, perhaps of the kind argued for by Jackendoff 1990. Alternatively, some theorists take Dowty's (1991) Proto-roles as their starting-point (cf. Ackerman 1992).

3 Though this is a rather complex matter: see Ackerman 1992, Alsina and Mchombo 1993, Bresnanand Moshi 1990, for discussion.

4 There are various formulations of these operations in the literature.

5 There are languages in which this restriction does not hold: e.g. Turkish, in which unaccusative predicates, including passivized verbs, can be passivized. See Spencer 1991 for brief discussion.

6 This explains in part the alternative term used for unaccusative predicates, 'ergative'. However, this is a rather misleading term, since ergative patterning would lead one to expect objects to pattern with all intransitive subjects. The more appropriate alternative to 'ergative' would therefore be 'inactive', though as far as we know, no one has ever made this terminological proposal.

7 The reader should bear in mind that this conclusion is meant to follow for English passives and English middles. Constructions which are called 'passive' or especially 'middle' in other languages, e.g. French (Levin and Rappaport Hovav, MORPHOLOGY AND LEXICAL SEMANTICS), may well have different properties from the ones described here (French middles can be eventive, for instance). In addition, many factors govern whether a semantic argument is accessible to syntactic processes, so absence of an implicit argument cannot be taken as criterial for a morpholexical valency-reducing operation.

8 We haven't investigated the full set of properties of the Bantu passive and stative constructions. Given the level of disagreement over the status of Germanic middles in the recent syntactic literature, a detailed cross-linguistic study of that sort on Bantu might be rather timely.

9 A terminological warning: Mchombo uses the term 'morpholexical', but does not explicitly make our terminological distinction between 'morpholexical' and 'morphosyntactic'.

10 Alsina (1992), to whom the approach here offers a certain debt, provides a detailed analysis of causatives in Chichewa along similar lines, except that for him the arg. 1 position is an argument of the causative itself. It is a matter of considerable debate whether the 'real' argument of causation is a patient ('causee') and an event, or just an event, or whether these represent direct and indirect causation respectively. The matter is tangential to our main concerns here.

11 In some languages of the Japanese type, it is *only* arg. 1 which can be the antecedent of a reflexive in a causative. Japanese allows arg. 0 to serve as antecedent, because its reflexive allows 'long-distance'

binding, by the subject of a higher clause.

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11. Morphology and the Lexicon: Lexicalization and Productivity

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1 Morphology and the lexicon

According to one widely accepted view (Aronoff 1976, 1982), the morphology of a language, because it is part of grammar and trades in structural matters, deals primarily with the internal structure of the potential complex words of a language. These words may not all exist, but they all conform to the morphological structure of the language.[1] By contrast, the lexicon of a language is a list of existing items in the language, those that a speaker has to know because they are arbitrary signs: unpredictable in some way. Most of the items on this list are words, though the lexicon also contains larger units like idioms, and maybe also smaller units like affixes. On this view, in which the regular morphology and the irregular lexicon are separate entities, one might imagine the two having very little to do with one another, since the morphology deals only with potential words and the lexicon only with existing words. In fact, the two systems do have a great deal to do with one another, for two simple reasons. The first is that they serve the same role in a language: both provide words. This overlap has even led some linguists to say that morphology is "in the lexicon" (Jensen and Stong-Jensen 1984), although in doing so, these linguists are using the term *lexicon* in a much broader and different sense, to mean the source of all words, actual and potential, rather than in the narrow sense of a list of unpredictable items that we have inherited from traditional grammar and from Bloomfield (Bloomfield 1933, Zwicky 1989, Aronoff 1994). The second reason is that morphology and the lexicon are interdependent. Most centrally, the morphology, which forms words from words, finds the words that it operates on (its bases) in the lexicon. We will explore each of these interrelations in a separate section.

1.1 Morphology versus the lexicon

As with any two entities that share a task, morphology and the lexicon do not always do so happily; they are rivals. This rivalry is not empty, but plays a central role in the larger system of the language. In order to understand its nature, we must consider a single speaker/hearer. When we speak of the lexicon from this perspective, we speak of the individual's mental lexicon, the list of irregular items that the speaker/hearer carries around in his or her head. We may then define the difference between existing words and potential words in terms of this mental lexicon. We will say that any word that is stored in a single speaker/hearer's mental lexicon or list of irregular items is an existing word, and that nothing else is. In particular, a word that meets all the criteria for being a word of the language but that is not in an individual's mental lexicon does not exist for that person, though it may exist for another speaker/ hearer. The unlisted word is a potential word, and we will say that morphologically well-formed complex potential words are provided by the morphology, not by the lexicon. Thus, the conventional idea that the existing words of a language – English, for example – comprise all the words in the *Oxford English Dictionary* or some other comprehensive dictionary does not apply in this model of the lexicon and the morphology. The difference between which words exist and which are

potential is defined solely in terms of the individual's lexicon and morphology.

Most importantly for our purposes, even if our ideal speaker/hearer has spoken or heard (or read) a particular word before, if that word has not been stored in that person's mental lexicon for some reason, then the word is still a potential word rather than an existing word as far as the mental lexicon is concerned. Which words are stored? In the simplest case, a word will be stored because it contain only one morpheme. Take the word *bamboozle*.[2] It has no morphological structure, so nothing to predict its meaning. Someone who hears this word, even in a context in which its sense is clear, must enter it into memory in order to use it again, so it will enter the hearer's mental lexicon. Similarly, a morphologically complex word must be placed in the lexicon if a piece of it is unknown to the hearer. An example of this type is *hornswoggle*, which is almost synonymous with *bamboozle*. One of its components, *horn*, is recognizable, but the other one, *swoggle*, is not, so that, again, we must memorize the word in its entirety if we wish to reuse it in the same sense, even if we can deduce its sense from the context in which we hear it. Yet again, all the components of a word may be familiar, but its sense may not be deducible from them. Here too we must put the word in our lexicon. An example of this phenomenon is yet a third synonym, *hoodwink*. Both *hood* and *wink* are familiar words, but the sense of the entire word *hoodwink* has little to do with the sense of its parts, so even here our ideal speaker/hearer must resort to lexical storage in order to have a hope of reusing the word. So if a word is unpredictable, it must be stored in the lexicon. By contrast, consider the word *rigidification*, encountered in a journal article recently. The parts of this word are readily apparent: *rigid, ify* (which forms verbs from adjectives and nouns), and *ation* (which forms abstract nouns from verbs), with *ific* being a contextual variant of *ify* that appears regularly before *ation*. Also transparent is its meaning, which can be paraphrased roughly as 'the act or fact or state of making or becoming rigid'. The paraphrase is ambiguous, but which of these senses is meant in a particular instance will generally be clear from the context. Since the actual sense of the word does not diverge from its predicted sense, based on its parts and its morphological structure, there is no need for this word to be listed in the speaker/hearer's lexicon, for the morphological component of the speaker/hearer's grammar is able to process it entirely. The word will therefore be spoken, heard, and most likely discarded by all parties, perhaps to be created and discarded again, but not stored, unless it is used in some special sense that is not predictable from the morphology.[3]

So far, the morphology and the lexicon do not interact. The first creates regular words, and the second stores irregular words. To see how they do interact, we must look at a case where both the lexicon and the morphology are in principle capable of being invoked. We will begin with a simple case, that of the plural of a noun in English. Some plurals come from the lexicon, and some from the morphology. The plural will come from the lexicon in case it is irregular and stored there on account of its irregularity, like *women* or *people*, and it will come from the morphology in case it is regular, like *dogs*. But now a question arises. If a word has an irregular plural stored in the lexicon, why does it not also have a regular plural, which comes from the morphology? In the case at hand, how does a speaker know not to say *womans* instead of or as well as *women*? Or why doesn't the speaker sometimes say one and sometimes the other? Something must be preventing the morphology from producing a regular plural just in case an irregular plural for the same word exists in the lexicon. The same is true of irregular past tenses of verbs. A person who knows that the past tense of *go* is *went* (a fact that must be stored in the lexicon) will not say *goed*, although a young child or someone in the early stages of learning English as a second language might say *goed*, because the child or learner hasn't yet learned the form *went*. The lexicon and the morphology seem to interact in assuring that only one form will be used, but how? Does the speaker/hearer somehow check the lexicon to see if a word is there, and only resort to the morphology if there is none?

A clue to the right answer to this question has been known for centuries: languages tend to avoid synonyms (though not always, as *bamboozle, hornswoggle*, and *hoodwink* reveal). In most cases, the speaker will use a word from his or her lexicon (*women, went*) rather than resort to the morphology to produce a new word with the same meaning. This phenomenon, "the nonoccurrence of one form due to the simple existence of another" (Aronoff 1976: 43), is called *blocking*, and its effects can be seen not only in inflection, but also in derivation, where a word like **furiosity* (formed from *furious*) will be blocked by *fury*, which already exists in a speaker's lexicon. We can tell that blocking is at work in rendering **furiosity* unacceptable, because other words of the same pattern are perfectly acceptable, when there is no already existing word to block them. Thus, *curiosity*, which is structurally analogous

to **furiosity*, is perfectly acceptable|, because there is no word **cury* to block it. The effects of blocking are also felt in syntax, where an existing word will sometimes block an entire synonymous phrase, as Hoffman (1982) first noted. We do not, for example, find *this night* used in standard English in a sense parallel to *this morning* or *this evening*, because of the existence of synonymous *tonight*. As the example shows, exact synonymy is crucial, for the expression *this night* can in fact be used, so long as it is not synonymous with *tonight* (e.g. in the question "Why is this night different from all other nights?")– There will also be no blocking without synonymy, so we may find a pair like *brethren* and *brothers*, precisely because the former refers not to actual brothers but rather to fellow members of an organized group of some sort. The most cogent account of why blocking occurs is Horn's (1984, 1993), based on general principles of economy of expression, to which we will return in section 2.3.

Because blocking is a psychological phenomenon, it is subject to the vagaries of the mind: if a person has temporarily forgotten the word *fame*, then that person may in fact use the word **famousness*, which *fame* would otherwise block. This seeming failure of blocking is especially common in children, who coin new words quite freely, because their vocabulary is not as entrenched as that of adults. An articulate child might use words like *famousness* and *liquidize* in conversation without hesitating.

Blocking is also subject to another psychological factor: familiarity or its more easily measurable counterpart, frequency. In general, the more frequently used an irregular form is, both in absolute terms and compared to its base, the more likely it is to block the corresponding regular form (Anshen and Aronoff 1988, Rainer 1988). This effect of frequency can be detected not only experimentally (Pinker and Prince 1991), but also in children's "overregularizations," as Bybee and Slobin (1982) have shown for irregular verbs in English. The effect of frequency can also be seen in morphological regularization over time: in general, the more frequently an irregular form is used, the more resistant it will be to being replaced by a regular form, which is to say, the more likely it is to block the corresponding regular form (Anshen and Aronoff 1988). The most widely accepted models of blocking take frequency into account by translating it into processing speed. According to these models (MacWhinney 1975, Anshen and Aronoff 1988, Pinker and Prince 1991), the search for the proper word can be viewed as a race between the mental lexicon and the morphology. Both operate simultaneously, and the faster one wins. If it is true that the speed of lexical access for individual stored irregular words is proportional to the logarithm of their frequency, then the more frequent an irregular word is compared to its base, the more likely it will be to block the morphology. Note that this general model does not involve any direct interaction between the mental lexicon and the morphology. The two components of the language mechanism can thus be insulated from each other, as far as this one phenomenon is concerned. They interact more closely in the actual operation of the morphology, which we will now explore.

Table 11.1 All words of the form *Xidify* and *Xidification* in a very large word list

Xidify	*Xidification*
acidify	acidification
deacidify	deacidification
reacidify	reacidification
disacidify	*
rancidify	rancidification
*	lucidification
rigidify	*
*	validification
solidify	solidification
resolidify	resolidification

humidify	humidification
dehumidify	dehumidification
nidify	nidification
renidify	renidification
lapidify	lapidification
fluidify	fluidification

1.2 Morphology based on the lexicon

Morphological patterns are abstract. Returning to the word *rigidification*, we may view it simply as an instantiation of the abstract pattern $[[[X]_A$ ify$]_V$ ation$]_N$. But if we look more closely at attested words that fit this pattern, we see the effect of the lexicon. Let us narrow our gaze from the general pattern just mentioned to a slightly more particular one, in which the adjective is of the form *Xid* (e.g. *acid, livid, candid*). If the pattern were completely independent of the lexicon, then we might expect to find that any adjective of the form *Xid* could serve as the base of an attested word of the form *Xidification*. We have access to a very large English word list, compiled from eighteen general and technical dictionaries, containing about 400,000 entries. Among these are approximately 1,000 words of the form *Xid*. But there are only 14 words of the form *Xidify*, which indicates that this particular rule is not very productive. Thus, we do not find the following words in the list, though all of them have easily constructible senses: **rabidify*, **lividify*, **acridify*, **stolidify*. There are simlarly only 14 words of the form *Xidification*. Remarkably, as table 11.1 shows, in all but two cases in each column, the words of the two forms share a base. We cannot, of course, extrapolate directly from a large dictionary to the mental lexicon, but dictionary data of this type, which can be repeated for many patterns in which one suffix is added to another, suggest that the actual production of morphologically complex words is done largely by applying morphological rules (adding affixes) to actually occurring base words that are stored in a speaker's mental lexicon.

Another indication that morphological rules operate on words in the lexicon is the inheritance of irregularity. The most common type of inherited irregularity is semantic. Complex words often have conventional senses that differ slightly from their predicted sense (see section 2.2). Consider the word *immeasurable*. Judging by its parts, it should mean 'that cannot be measured'. In actual use, it almost always means Very large'. The adverb formed from it, *immeasurably*, therefore means 'greatly', as in expressions like "I have benefited immeasurably from your assistance." Another example is *naturalize*, which should mean 'to make natural', but which has a number of specialized senses, including 'to confer the rights of citizenship upon (an alien)' and 'to adapt (a plant or animal) to a new environment'. The noun *naturalization* that is derived from this verb has the nominal derivatives of these two as senses, because it is formed on the actual verb in the lexicon with all of its specialized senses. Furthermore, because the most familiar sense of the verb for most people is 'to confer the rights of citizenship upon (an alien)', the most salient sense of the noun for most people is based on this sense of the verb. So, for example, a search of our university library's computerized catalogue under the key word *naturalization* reveals a large number of books having to do with immigration to various countries and no other books (though we might expect a different outcome at a school of horticulture).

The inheritance of the phonological irregularities of words in the lexicon is a little harder to detect, largely because we tend to be less aware of them, but one example that springs to mind is the word *comfortable*, which for many people is pronounced [kəmftə(r)bl]. The adverb is similarly pronounced [kəamftə(r)bli], inheriting the phonological irregularity of the adjective base. By contrast, although *probably* is often pronounced [prabli], *probable* is not pronounced *[prabl], showing that a derived word (*probably*) may deviate phonologically from its base (*probable*) and acquire its own lexical entry.

In conclusion, we have seen that morphology is distinct from the lexicon (at least if by the word *lexicon* we mean a speaker/hearer's mental lexicon of unpredictable forms), and that the morphology and the lexicon are rival sources of words. The morphology depends on the lexicon, however,

inasmuch as the bases of morphologically complex words are normally lexical entries.

2 Morphological productivity

2.1 Quantitative and qualitative productivity

Morphological productivity may be defined informally as the extent to which a particular affix is likely to be used in the production of new words in the language. On this view, productivity is a probabilistic continuum that predicts the use of potential words. At one end of the continuum are the dead or completely unproductive affixes, which are not likely to be used at all in coining new words. One example of this from English is the nominal suffix *-th* (as in *truth* or *growth*), which has not been used successfully to form a new word for 400 years, despite valiant attempts at terms like *coolth* (which is attested sporadically, but which just never seems to be able to survive long). At the other end in English are the productive inflectional suffixes *-ed*, *-ing*, and *-s*, which are added whenever syntactic conditions are appropriate and there is no irregular form already in existence to block them, and highly productive derivational suffixes like *-ness* and *-ation*. In the middle, we find the less productive derivational suffixes like *-ity*. Some linguists treat morphological productivity as an absolute notion – a pattern is either productive or unproductive – but there is a good deal of evidence for the existence and utility of intermediate cases, which we will review below, so we will assume in this chapter that affixes may differ continuously in productivity, rather than falling only into the polar categories of completely productive and completely unproductive|, to which some linguists have restricted the discussion.

Table 11.2 Morphologically restricted de-adjectival nominal suffixes

conditioned suffix	*example*	*conditioning suffix*	*base word*
-(c)e	tolerance	-ant	tolerant
″	putrescence	-ent	putrescent
-(c)y	buoyancy	-ant	buoyant
″	latency	-ent	latent
-ity	separability	-able/-ible	separable
″	legibility	″	legible
″	legality	-al/-ar	legal
″	popularity	″	popular
″	toxicity	-ic	toxic
″	stupidity	-id	stupid
″	agility	-ile	agile
″	ferocity	-ous	ferocious

Aside from quantitative considerations, there are qualitative morphological factors that are relevant to productivity. This can best be seen by examining rival affixes, affixes that are very similar in their semantic and syntactic conditions. Consider the several suffixes that form nouns from adjectives in English. Most of them are productive only within a morphologically restricted domain, as shown in table 11.2, which classifies the suffixes according to the preceding suffixes that they generally occur with. The suffix *-ness* is different from those exemplified in table 11.2. It occurs with a wide variety of base adjectives patterns, including monomorphemic words and those of the morphological types included in table 11.2: *dryness, redness, wetness, fetidness, prolificness, venerableness, trivialness, obliviousness, recentness, pleasantness*. Being unrestricted, -ness operates as the default affix for

forming de-adjectival nouns, the affix that is normally used when no additional morphological conditions on the base adjective hold. Linguists have found that one of the members of any similar set of rival affixes or operations will usually be the default, qualitatively unrestricted. This qualitative difference is usually mirrored quantitatively as well: the qualitatively least restricted operation among a set of rivals will most often also be the quantitatively most productive, though cases of the default not being the most productive have been found. Clahsen et al. (1992), for example, have shown that the default plural suffix in German is not the most productive or most common. It is also not always true that the least restricted member of a set of rivals will be totally unrestricted in its distribution. For example, we have shown in earlier work (Anshen and Aronoff 1981, 1988) that *-ness* does not attach at all to words of the form *Xible*, despite being the default for de-adjectival nouns in English.

How can quantitative productivity be measured? Baayen (1992) has developed a number of measures that take advantage of modern computational analysis of large corpora in English and other languages. First of all, productivity is related to growth (the rate at which new words in general are being added to a language). The growth rate of the vocabulary of any language is estimated from a large corpus as the ratio of those words occurring only once in the corpus (*hapax legomena*, henceforth *hapaxes*) to the total number of word tokens in the corpus. For rival operations, a similar measure (the ratio of hapaxes formed by that operation to the total number of tokens of the same morphological type in the corpus) can be used to compute relative growth rates. The English suffixes *-ity* and *-ness*, for example, show growth rates of 0.0007 and 0.0044 in Baayen's calculation (based on a corpus of 18,000,000 words), meaning that *-ness* is six times as productive as *-ity*, regardless of any difference in the qualitative morphological restrictions on the two. Another statistical measure is what Baayen calls global productivity, which depends not only on the likelihood of encountering new words of a given morphological type, but also on the number of words of that type that a speaker already knows. By this measure, *-ness* is not quite three times more productive than *-ity*.

The ratio of hapaxes to tokens in a corpus is clearly associated with a lesser average frequency of types; the lower average frequency of *-ness* formations compared to *-ity* formations has long been noted (Aronoff 1982). Baayen's measures assume that the larger ratio of hapaxes is the cause of the lower average frequency, rather than vice versa. We can thread our way out of this trap if we go back to the original concept of productivity mentioned above, the extent to which a given affix is used in the production of new words in the language. The data presented in table 11.3 show that there are close to twice as many *-ness* words as *-ity* words in the language, but it also shows that the productivity of *-ity* as opposed to *-ness* has shown a steady increase over time (with one exception in the fifteenth century) until the *OED* shows more *-ity* words than *-ness* words coined in the twentieth century. Given the more restrictive environments for *-ity* versus *-ness*, the table shows that *-ity* is in fact synchronically more productive in English than *-ness*, at least judging from the dictionary data. The dictionary method and the corpus-based method do not agree. A word of caution is in order, though: dictionaries are not always dependable indicators of actual usage, since the entries in a dictionary are selective rather than inclusive, and since hapaxes are less likely to be seen as meriting dictionary entries. Counts based on actual large corpora of the sort that Baayen employs are generally more reliable, since they measure actual use, rather than being filtered editorially. Thus, it may be that the *-ity* words, though in fact less productively formed, are more likely to be listed in the dictionary, because they are more memorable than the *-ness* words, a point that we will return to in section 2.3.

Table 11.3 The growth in productivity of *-ity* over the centuries, based on entries in the *OED*

century	*-ness*	*-ity*	*percent -ness*
8th	4	0	100.00
9th	38	0	100.00
10th	67	0	100.00
11th	6	0	100.00
12th	21	0	100.00

13th	63	14	81.82
14th	225	72	75.76
15th	145	91	61.44
16th	610	193	75.97
17th	913	447	67.13
18th	308	196	61.11
19th	506	480	51.32
20th	152	166	47.80
total	3058	1659	64.83

2.2 Frequency and productivity

Word frequency, which we discussed above in relation to blocking, is also related to productivity: the less productive a morphological pattern is, the more frequent on average its individual members will be. But frequency is also important in the selection of bases: a less productive affix is generally found attached to higher-frequency base words than is a more productive affix (Aronoff 1982). This makes sense in terms of what we know about the connection between frequency and lexical recognition: words with high-frequency bases are more readily recognized than words with similar frequency but low-frequency bases (Laudanna and Burani 1985). If less productive affixes are at a disadvantage to begin with, then they seem to benefit from the boost provided by a more frequent base, although the exact psycholinguistic mechanism behind this pattern is not yet clear.

2.3 Pragmatics and productivity

Some scholars have insisted that the study of morphological productivity should confine itself to the study of words that are produced unintentionally (Schultink 1961). This rules out entirely the study of unproductive morphology, which resembles more marginal forms of word creation like the formation of blends (e.g. *smog* as a blend of *smoke* and *fog*) or acronyms (e.g. *laser* formed from the initial letters of the phrase *Light Amplification by Stimulated Emission of Radar*), in being more likely to be intentional or noticed. However, less than fully productive morphological patterns are pervasive in language, and they seem to serve a function that arises from their very unproductivity. When we compare the set of words formed by means of a less productive affix to the set formed by a rival affix in the same morphological environment, we generally find that the meanings of the less productively formed set are less predictable, making the entire set less *coherent* semantically. This difference in coherence carries over to newly coined words: the meaning of a new word formed by means of a less productive affix will be less predictable semantically. For that reason, less productive affixes may easily be used to coin special or narrowly technical terms (Aronoff 1982). For example, the word *specialism* has come into use quite recently in British English in the very restricted sense of 'what a (usually medical) specialist practises'. Similarly, we linguists (and participants in other technical fields like economics) use the technical term *productivity* instead of the more productively formed *productiveness*, because the very unproductiveness of the affix allows it to be used in more specialized senses. Horn (1984, 1993) explains this use of less productive affixes in terms of the interaction of two Gricean pragmatic principles. The principle of relation (say no more than you must) leads the speaker not to use the less productive form in most instances, because the more productive form is more readily available; but the principle of quantity (say as much as you can) will interact with that of relation, and lead the speaker to use the less productive affix in order to make a special point or to call attention to some aspect of the word. What the speaker is usually calling attention to is a special sense, which the less productive affix is more likely to allow. Thus we find that morphology and pragmatics act together to enrich language's expressive potential. In Horn's own words: "there is always (given the Division of Labor) a sufficient reason, but it is not always the same reason." Horn's account also helps us to understand why the productivity of inflectional affixes is generally more polarized: they are likely to be either completely productive or completely unproductive, and there are

very few in-between cases resembling *-ity*. In the case of inflection, whose role is the realization of morphosyntactic information, which is always compositional, there is nothing for the speaker to call attention to, and hence less productive morphology has no role. Only productive morphology or lexicalized forms will surface.

1 For reasons of simplicity, we will couch our discussion of morphology in terms of affixes throughout this paper. In fact, none of the issues that we discuss here bears heavily on the issue of whether the morphology is organized in terms of affixes or in terms of operations.

2 We will use examples from English for the most part, for ease of exposition, and also because most of the work done on the topics covered here has dealt with English data.

3 There is evidence, though, that some regular words can gain entry into the lexicon simply on grounds of familiarity or frequency (Stemberger and MacWhinney 1986b, 1988).

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12. Morphology and Lexical Semantics

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The relation between lexical semantics and morphology has not been the subject of much study. This may seem surprising, since a morpheme is often viewed as a minimal Saussurean sign relating form and meaning: it is a concept with a phonologically composed name. On this view, morphology has both a semantic side and a structural side, the latter sometimes called "morphological realization" (Aronoff 1994, Zwicky 1986b). Since morphology is the study of the structure and derivation of complex signs, attention could be focused on the semantic side (the composition of complex concepts) and the structural side (the composition of the complex names for the concepts) and the relation between them.

In fact, recent work in morphology has been concerned almost exclusively with the composition of complex names for concepts – that is, with the structural side of morphology. This dissociation of "form" from "meaning" was foreshadowed by Aronoff's (1976) demonstration that morphemes are not necessarily associated with a constant meaning – or any meaning at all – and that their nature is basically structural. Although in early generative treatments of word formation, semantic operations accompanied formal morphological operations (as in Aronoff's Word Formation Rules), many subsequent generative theories of morphology, following Lieber (1980), explicitly dissociate the lexical semantic operations of composition from the formal structural operations of composition, focusing entirely on the latter. Carstairs-McCarthy (1992), following Corbin (1987), calls such theories "dissociative" theories of morphology, while Beard (1990) calls them "separationist." Although attention is often paid to 'theta-role" operations, such as the addition, suppression, binding, or merger of "theta-roles," which accompany morphological operations (Baker 1985, 1988a; Bresnan 1982c; Bresnan and Kanerva 1989; Bresnan and Moshi 1990; Grimshaw and Mester 1988; Lieber 1983; Marantz 1984a; S. T. Rosen 1989; E. Williams 1981a; among others), many of these operations are syntactic, rather than semantic, in nature, as we argue in section 3.2.

The lack of attention paid to the relation between lexical semantics and morphology stems in part from the absence of a comprehensive theory of lexical semantic representation that can provide a context in which to study such a relation. Yet, such a study could shed light on lexical semantics as well as morphology (Carstairs-McCarthy 1992). In fact, there have recently been advances in the area of lexical semantics that make it possible to pose initial questions concerning the relation between it and morphology, and to venture initial answers to some.[1]

In section 1, we outline the basic elements of the lexical representation of verbs. We distinguish between the lexical syntactic representation, often called "argument structure," and the lexical semantic representation which, following Hale and Keyser (1986, 1987), has come to be known as the "lexical conceptual structure" (LCS); we then focus on the latter. (See Sadler and Spencer, MORPHOLOGY AND ARGUMENT STRUCTURE, for an overview of the former.) We concentrate solely on the lexical semantic representation of verbs, since verbs have been the focus of most of the lexical semantic research in

the generative tradition. (See Pustejovsky 1991a for discussion of the lexical semantic representation of nouns.) In this overview, we stress those aspects of verb meaning that are most likely to be relevant to morphology.

In section 2, we suggest that the relation between lexical semantics and morphology can best be investigated by asking how names are attached to the lexical semantic representations that are made available by a theory of lexical semantics. We show that languages differ systematically in terms of which representations can be associated with names, and also in the morphological composition of such names.

In section 3, we pose some questions that arise in the context of the discussion in sections 1 and 2. Given the nature of the lexical representations described in section 1, it is possible to define different types of relations between the representations of pairs of verbs. We show that certain kinds of relations are systematically instantiated in language. We then ask whether verbs with related lexical representations have morphologically related names, and if so, whether there are any generalizations involved in the assignment of such names. We hypothesize that languages in general distinguish morphemes that signal the relation between verbs with the same LCS but different argument structures from those that signal the relation between distinct, though related, LCSS. We illustrate both types of morphological relations, although we concentrate on the second type, since operations on argument structure are the topic of another chapter (Sadler and Spencer, MORPHOLOGY AND ARGUMENT STRUCTURE). Finally, we speculate that certain types of systematically related meanings are never morphologically encoded.

1 The nature of the lexical semantic representation of verbs

In dealing with the lexical representation of verbs and other argument-taking lexical items, it is important to distinguish between the lexical semantic representation proper, often called a lexical conceptual structure (LCS), and another lexical representation, often called a predicate-argument structure (PAS), or simply an argument structure. There are different conceptions of argument structure, but most share the assumptions that argument structure is syntactic in nature and encodes the "adicity" or "valence" of a predicator – the number of arguments it requires – together with an indication of the hierarchcial organization of these arguments. The example below, which is taken from Rappaport and Levin 1988: 15, illustrates one view of argument structure. This particular representation specifies that the verb *put* takes three arguments, and that one is an external argument, one is a direct internal argument, and one is an argument governed by a locative preposition.

$$x <\underline{y}, \mathrm{P}_{\mathrm{loc}}\ z>$$

An argument structure does not contain any explicit lexical semantic information about the verb or its arguments (Grimshaw 1990, Rappaport and Levin 1988, Zubizarreta 1987), although it is projected via general principles from the LCS (Carrier and Randall 1992, Grimshaw 1990, Jackendoff 1990, Levin and Rappaport Hovav 1995).[2]

The distinction between LCS and argument structure is an important one, not recognized in all theories of lexical representation. We argue that this distinction finds empirical support in the morphologies of the languages of the world, which in general distinguish between morphemes that signal the relation between words with distinct but related LCSS and morphemes that signal the relation between words with common LCSS but distinct argument structures. This morphological division of labor is all the more striking since, as is well known, affixes tend to be associated with more than one function. Therefore, if the multiple functions associated with a given affix are consistently either of the type that derive new LCSS or of the type that derive new argument structures, this dissociation strongly supports the positing of these two distinct lexical representations. In this section we sketch the elements of LCS in order to explore these issues further.

Much research in lexical semantics has been aimed at elucidating the lexical semantics-syntax interface, and advances in this area have been made possible by exploiting the realization that some

aspects of meaning are relevant to the grammar and others are not (Grimshaw 1993; Jackendoff 1990; Levin and Rappaport Hovav 1992, 1995; Pesetsky 1995; Pinker 1989). Research aimed at isolating the grammatically relevant meaning components has focused on those aspects of the syntactic behavior of verbs that seem to be determined by their semantic properties, most prominently, the possible syntactic expressions of arguments.

Many lexical semantic studies have illustrated how the syntactic expression of the arguments of a verb is to a large degree determined by its membership in semantically coherent verb classes (Fillmore 1970, Guerssel et al. 1985, B. Levin 1993, Pinker 1989, among others). However, the verb classes cross- classify in intricate ways with respect to the syntactic behavior of their members. This extensive cross-classification suggests that the verb classes themselves are not primitive; rather, they arise because their members share certain basic components of meaning. Thus, generalizations that involve semantically coherent classes of verbs are probably best formulated in terms of these meaning components, just as phonological rules are stated in terms of the basic building blocks of distinctive features.

Explicit representations of verb meaning have generally been of two types: semantic role lists and predicate decompositions (B. Levin 1994). In a semantic role list approach, the meaning of a verb is reduced to a list of the semantic roles that its arguments bear. For example, the causative change-of-state verb *dry of Kim dried the clothes* might receive the representation in (2).

(2) *dry*: <Agent, Patient>

In a predicate decomposition approach, a verb's meaning is represented using members of a fixed set of primitive predicates together with constants – typically chosen from a limited set of semantic types. The constants either fill argument positions associated with these predicates or act as modifiers to the predicates. A verb's arguments are represented by the open argument positions associated with these predicates. Thus, the causative change-of-state verb *dry* might be given the predicate decomposition in (3); in this decomposition *DRY* is a constant representing the state associated with the verb *dry*, and x and y represent the verb's arguments.[3]

(3) *dry*: [[x ACT] CAUSE [y BECOME *DRY*]]

The information contained in a semantic role list can be extracted from a predicate decomposition; the semantic roles of a verb's arguments can be identified with particular argument positions associated with the predicates in a decomposition (see Jackendoff 1972, 1987). For example, the Agent could be identified as the argument of ACT and the Patient as the first argument of BECOME (see (3)). It appears, however, that the grammatically relevant components of meaning can be better represented using the predicate decomposition approach than the semantic role list approach; see Gropen et al. 1991, Jackendoff 1987, Pinker 1989, Rappaport and Levin 1988, among others, for discussion.

Typically, predicate decompositions are selected so that verbs belonging to the same semantic class have decompositions with common substructures, including common constant positions filled by constants of a particular semantic type. Such recurring substructures are what Pinker (1989) calls "thematic cores"; we refer to them as "lexical semantic templates." Pinker identifies about a dozen of these templates; they include analogues of certain repeatedly cited combinations of predicates. As an example, causative change-of-state verbs would have the lexical semantic template in (4), where "$[]_{STATE}$" represents the constant that will distinguish one change-of-state verb from another (cf. (3)).

(4) [[x ACT] CAUSE [y BECOME $[]_{STATE}$]]

Most theories of the lexical semantics-syntax interface include a set of rules that effect the mapping from the LCS to argument structure; following Carter (1976, 1988b), these rules are often called "Linking Rules." The LCSS of verbs are chosen to facilitate the perspicuous formulation of the Linking Rules. Therefore, it is appropriate to describe the lexical semantic templates as determining the syntactic properties of the members of the verb classes. The templates that are most widely cited as

defining grammatically relevant semantic classes bear a striking resemblance to the predicate decompositions suggested by Dowty (1979) for representing the lexical aspectual classes of verbs. In fact, Foley and Van Valin (1984), in adopting aspectually motivated decompositions, implicitly claim that these are the grammatically relevant lexical semantic representations of verbs. Tenny (1987, 1992, 1994) goes further, proposing the Aspectual Interface Hypothesis: only aspectual information is relevant to the mapping between lexical semantics and syntax.[4]

Following Vendler (1957), four major lexical aspectual classes of verbs are identified: activities, accomplishments, achievements, and states. Various decom- positional representations have been suggested for these four classes (Dowty 1979; Foley and Van Valin 1984; Pustejovsky 1991b, 1995; among others). All take as their starting point Kenny's (1963) insight that achievements embed a state, and that accomplishments are complex events including an activity and an achievement. The representations used by Foley and Van Valin (1984) and more recently by Van Valin (1990, 1993), which are adopted with slight modifications from Dowty (1979), are presented in (5). In these representations **predicate'** represents a state, except in (5c), where it represents an atomic activity (Van Valin 1990: 224; 1993: 35–6).[5]

(5) (a) STATE: **predicate'** (x) or (x, y)
(b) ACHIEVEMENT: BECOME **predicate'** (x) or (x, y)
(c) ACTIVITY (+/−Agentive): (DO (x)) [**predicate'** (x) or (x, y)]
(d) ACCOMPLISHMENT: ϕ CAUSE ψ, where ϕ is normally an activity predicate and ψ an achievement predicate
(Van Valin 1990: 224, table 2)

Each of these decompositions specifies the lexical semantic template associated with the members of a particular lexical aspectual class.

Of course, there are more than four grammatically relevant semantic classes of verbs, as a cursory glance at the classes of verbs listed in B. Levin 1993 reveals. It is likely that primitive predicates other than those employed in (5) will have to be introduced, and indeed Jackendoff (1990), in what is perhaps the most fully articulated system of lexical semantic representation today, includes additional predicates. But it is primarily through the use of constants that lexical semantic templates such as those in (5) are further differentiated, and the various grammatically relevant verb classes are defined by constraints on the type of constant that can fill particular argument positions in the decompositions. A few examples will illustrate this point.

Although all accomplishments have the decomposition in (5d), particular subtypes can be derived by choosing constants to fill particular argument positions. For example, denominal verbs such as *pocket* and *butter* have the basic decompositional structure of accomplishment verbs, but differ both in the type of constant and in the positions of the constant within the decomposition, as shown in (6) (Carter 1976; Jackendoff 1983, 1990).[6]

(6) (a) *butter*: [[x ACT] CAUSE [[*BUTTER*]$_{\text{THING}}$ BECOME P_{loc} z]]
(b) *pocket*: [[x ACT] $_{\text{CAUSE}}$ [y BECOME P_{loc} [*POCKET*]$_{\text{PLACE}}$]]

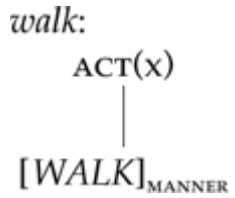
As the examples in (6) show, the placement of a constant in a particular position derives individual verbs.[7] Classes of such verbs can be defined by more general restrictions on the ontological type of what can fill that position. Thus, the lexical semantic template in (7a) is associated with the class of verbs which includes *butter*, and the one in (7b) with verbs like *pocket*. In these decompositions "[]$_{\text{THING}}$" and "[]$_{\text{PLACE}}$" indicate the position that is filled by a constant, and specify the ontological type of that constant.

(7) (a) [[x ACT] CAUSE [[]$_{\text{THING}}$ BECOME P_{loc} z]]
(b) [[x ACT] CAUSE [y BECOME P_{loc} []$_{\text{PLACE}}$]]

The *butter* and *pocket* verb classes both belong to the more general class called "verbs of putting" by Carter (1976), whose members share the representation in (8):

(8) [[x ACT] CAUSE [y BECOME P_{loc} Z]]

In addition to filling argument positions in LCSS, as in the examples so far, constants may modify predicates, as in the LCS for the verb *walk* in (9):



In this LCS, the constant *WALK* represents the essence of walking; the vertical line connecting this constant to a predicate indicates that the constant modifies the predicate, and the subscript on the square brackets around the constant specifies the constant's ontological type: it is a manner constant. There is a large class of manner constants that serve to modify an activity predicate in a LCS. The LCSS of *walk* and other verbs of manner of motion such as *jog*, *run*, and *trot* contain such a constant. They all share the same lexical semantic template, which includes a manner constant; but the particular constant differs for each, since it represents what is distinct about each form of motion. Thus, classes of verbs can be defined according to whether or not particular predicates in their LCSS are modified by constants, just as such classes can be defined according to whether or not particular argument positions in their LCSS are filled by constants. Furthermore, constants of the second type are most likely to be elements representing entities in the world, as in (6); constants of the first type might be what Jackendoff (1990) refers to as "action patterns." See Pinker 1989 and Jackendoff 1983, 1990, 1996, for further discussion of the types of constants found in LCSS.

As pointed out by Carter (1976), the use of constants provides the decom- positional approach to lexical semantic representations with much of its power.[8] By allowing constants to fill selected positions in a LCS, it is possible to give a finite characterization of the possible verb meanings in a language, while allowing for the coining of new verbs. A language will have a fixed set of lexical semantic templates, but new verbs can be created through the use of new constants in these templates.

As already mentioned, the hypothesis implicit in work on lexical semantic representation is that the predicates used in decompositions represent the principal grammatically relevant aspects of meaning. What is less often appreciated is that the presence or absence of a certain kind of constant in a decomposition may be relevant to a verb's classification, although the content of the constant itself is not. The content of the constant is, by hypothesis, opaque to the grammar (Grimshaw 1990, Jackendoff 1990, Pinker 1989). For example, the existence of a manner modifier – one type of constant discussed here – in a verb's LCS may affect its syntactic behavior, but its syntactic behavior will not be sensitive to the particular instantiation of the modifier. Thus, there are rules which distinguish verbs of manner of motion from verbs of motion whose meaning does not include a manner specification, such as *arrive*, *come*, and *go*. For example, only verbs of manner of motion can undergo causativization in English (Levin and Rappaport Hovav 1995); compare *The general marched the soldiers across the field* to **The driver arrived the car in front of the house*. By contrast, we know of no rule that is, say, like the English passive rule, but that applies only to verbs of fast motion. Similar observations about the grammatical "inertness" of the components of verb meaning associated with constants are made by Grimshaw (1993), Jackendoff (1990), and Pesetsky (1995).

With this background, we now turn to the central focus of this chapter: the relationship between lexical semantics and morphology.

2 The pairing of names with meanings

A fully articulated theory of lexical semantic representation should be a generative theory that allows for the characterization of all possible word meanings in a language (Carter 1976; Pustejovsky,

1991a, 1995). Many of the possible meanings are meanings of actual words. Those meanings that are realized need to be associated with a name. In order to study the relation between lexical semantics and morphology, we can ask how names are associated with the available meanings. We continue to restrict our attention to verbs, though comparable questions about possible meanings have been asked and answered with respect to the noun lexicon, and to a lesser extent the adjective lexicon, primarily by psychologists interested in concept formation and word learning (Carey 1994; Landau 1994; Markman 1989, 1994; Waxman 1994; and references cited therein).

Setting sound symbolism aside, the pairing of a morphologically simple phonological form with a particular verb meaning is arbitrary (Saussure 1959); for example, there seems to be no reason why the phonological form of the verb *lend* could not have been paired with the meaning associated with the verb *borrow*, and vice versa. However, one aspect of this pairing does not seem arbitrary: the fact that certain LCSS can be associated with monomorphemic names, while others cannot. There appear to be some absolute constraints on the complexity of the LCSS that can be associated with such names (Carter 1976). For instance, Carter points out that there are no verbs meaning "change from *STATE1* to *STATE2*," unless *STATE1* can be characterized as "not *STATE2*." That is, there is no English verb meaning "change from pink to white," although there is a verb *whiten*, meaning "change from not white to white." Furthermore, as we illustrate below, not all languages allow monomorphemic names to be associated with the same LCSS. The question of which LCSS can receive mono- morphemic names may be considered by some not to fall under the purview of morphology, but rather to be part of the study of the lexicon. (See Aronoff 1994 and Carstairs-McCarthy 1992 for an articulation of such a view.) Nevertheless, in order to understand the relationship between lexical semantics and morphology, we need to consider this question.

Let us clarify this question with an example. It has often been noted in the literature on lexical aspect (e.g. Declerck 1979; Dowty 1979; Vendler 1957; Verkuyl 1972, 1993) and unaccusativity (e.g. Hoekstra 1984; Levin and Rappaport Hovav 1992, 1995; L. Levin 1986; Van Valin 1990; Zaenen 1993) that English verbs of manner of motion have a dual aspectual classification. For example, the verb *walk* can be used as an activity verb, as in *Sandy walked (for an hour)*; or, in the presence of a goal phrase, it can be used as an accomplishment verb, as in *Sandy walked to the store*. There is reason to assume that the meaning of the activity use is more basic than the meaning of the accomplishment use. We can, therefore, take *walk* to have a basic classification as an activity verb and a derived classification as an accomplishment verb in the presence of a goal phrase. This dual aspectual classification is open to all English verbs of manner of motion; *amble*, *jog*, *limp*, *swim*, and *trudge* also have both classifications. Thus, there are two relevant facts about the English verb lexicon: (i) for a given manner of motion both activity and accomplishment meanings are available (the exact nature of the relation between these two meanings still needs to be established), and (ii) the same monomorphemic name can be associated with the LCSS associated with both meanings.

There are languages that differ from English in both these respects. As discussed by Carter (1988a), Levin and Rapoport (1988), Schlyter (1978, 1981), Talmy (1975, 1985), Wienold (1995), and others, French does not allow a manner of motion verb to appear with a goal phrase, and hence to receive an accomplishment interpretation. Although (10a) is ambiguous in English, allowing either an activity or an accomplishment interpretation, its French translation (10b) has only the activity interpretation.

(10) (a) The mouse is running under the table.
(b) La souris court sous la table.

As (10b) shows, French does have verbs of manner of motion, but these only have a meaning comparable to the activity sense of English verbs of manner of motion. In French, the sense conveyed by the English accomplishment uses of verbs of manner of motion cannot be expressed by the addition of a goal phrase to a verb of manner of motion. Instead, such meanings must be expressed periphrastically: in (11) and (12) the English (a) sentence could receive the French translation in (b).

(11) (a) Blériot flew across the Channel.
(b) Blériot traversa la Manche en avion.
'Blériot crossed the Channel by plane.'
(Vinay and Darbelnet 1958: 105)

(12) (a) An old woman hobbled in from the back.
(b) Une vieille femme arriva en boitant de l'arrière-boutique.
'An old woman arrived in limping from the back-store.'
(ibid.)

As these examples illustrate, in French the manner of motion is typically expressed in a subordinate clause or adverbial phrase, and the goal of motion is expressed through the use of the appropriate verb of directed motion as the main verb (Vinay and Darbelnet 1958). The generalization that emerges is that English manner of motion constants can be associated with both activity and accomplishment lexical semantic templates, while French allows such constants to be associated only with activity lexical semantic templates.

Russian differs from both French and English. Although Russian makes both activity and accomplishment meanings available to verbs of manner of motion, the two meanings are not always associated with the same name, although the names are always morphologically related. In Russian, as in French and English, morphologically simple verbs of manner of motion have the activity sense, as in (13).

(13) (a) On begal po komnate.
he (NOM) ran over room-DAT
'He ran around the room.'
(b) On plaval v ozere.
he (NOM) swam in lake-PREP
'He swam in the lake.'

Unlike French, Russian also allows an accomplishment sense for verbs of manner of motion; however, unlike English, it uses the morphologically simple verb name only for the activity sense. In the accomplishment sense, the verb's name is morphologically complex, including one of a range of directional prefixes indicating the goal of motion, as in (14) (Talmy 1975, 1985). Many of the prefixes are homophonous with prepositions. For example, in (14a) the prefix *v-* is homophonous with the preposition *v* 'in'; in this example, the goal is further specified in the prepositional phrase.

(14) (a) On v-bežal v komnatu.
he (NOM) in-ran in room-ACC
'He ran into the room.'
(b) On pere-plyl čerez reku.
he (NOM) across-swam across river-ACC
'He swam across the river.'

It appears, then, that in Russian, lexical semantic templates of a certain complexity cannot be associated with a monomorphemic name. The complexity of the template is reflected in the morphological makeup of the name.

Having set the context by introducing our conception of LCSs and having briefly explored the attachment of names to meanings, we return now to the relationship between lexical semantics and morphology.

3 The morphological expression of lexical relatedness

Several types of relations can be defined over the elements of the lexical representations introduced in section 1. In this section we identify these relations and ask whether they are morphologically signaled, and if so, how. First, we examine the morphological relation between verbs with distinct but related LCSs; then we consider the morphological relation between verbs with a single LCS but distinct argument structures.[9]

3.1 Verbs with distinct but related LCSs

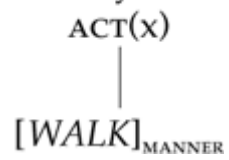
In section 2 we identified two major components of LCSS: the predicates and the constants. Given these elements, there are several possible relations between LCSS. LCSS can be related by virtue of containing a shared constant, though the constant itself is found in different lexical semantic templates. Alternatively, LCSS can be related by a shared lexical semantic template, while differing in the identity of the constant filling a particular position in this template.[10] We consider each possibility in turn, examining whether these relations are reflected in the names associated with the LCSS.

3.1.1 Verbs with a shared constant We begin with LCSS that involve different lexical semantic templates with a shared constant. A survey of such pairs in languages of the world reveals that there are two dominant patterns concerning the morphological relation between the members of such pairs. Either the two members bear the identical name with no morphological derivational relation between them, or the members have different names which share a common base, where the affixes used to signal the morphological relation between the members are drawn from the class of affixes employed for signaling lexical aspect. We begin with a discussion of the first pattern using English for illustration.

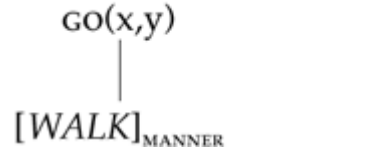
In English the name of a verb often derives from the name associated with the constant in its LCS, as can be seen from the *pocket* and *butter* examples in (6). Given this, when two English verbs have LCSS related by a shared constant, it is most natural for them to share the same name – a name that simply reflects the identity of the constant. In fact, many English verbs follow this pattern. The verb *shovel*, for example, though basically an activity verb (*She shoveled all afternoon*), can be used as a verb of either putting (*shovel the gravel onto the road*) or removing (*shovel the snow off the walk*), showing the properties of an accomplishment in both cases. The names associated with the activity, putting, and removing meanings (or LCSS) are identical, and there is no overt derivational morphological relation between them.

English is notoriously poor in morphology, and the absence of an overt derivational morphological relation between the various senses of *shovel* may reflect nothing more than this property. However, there are other languages with richer systems of verbal derivational morphology than English, where the relations between verbs with different lexical semantic templates and shared constants are not necessarily signaled morphologically. We exemplify this with verbs of manner of motion. As the discussion in section 2 implies, the LCSS for the activity and accomplishment uses of a verb of manner of motion such as *walk* involve different lexical semantic templates with a shared constant. Possible LCSS are presented below.[11]

Activity *walk*:



Accomplishment *walk*:



The constant *WALK*, then, can be associated with more than one lexical semantic template in English. This multiple association is not a property of the verb *walk*; rather, it is a property of the English lexicon that all verbs of manner of motion permit activity and accomplishment uses.[12]

Hebrew, which has a richer system of verbal derivational morphology than English, has the same two meanings available to verbs of manner of motion, and allows the association of a single name with both. That is, in Hebrew, as in English, the relationship between these two meanings is not signaled

morphologically, as shown by the examples in (17) and (18).

(17) (a) Hu rakad ba-xeder.
he danced in.the-room
'He danced in the room.'
(b) Ha-saxyan saxa ba-nahar.
the-swimmer swam in.the-river
'The swimmer swam in the river."

(18) (a) Hu rakad el mixuts la-xeder.
he danced to outside to.the-room
'He danced out of the room.'
(b) Ha-saxyan saxa la-gada ha-šniya šel ha-nahar.
the-swimmer swam to.the-side the-second of the-river
'The swimmer swam to the other side of the river.'

In the languages in which the relation between the names associated with such pairs of LCSS is morphologically encoded, there seems to be a generalization concerning the morphological device used to signal the relationship. As mentioned in section 1, certain combinations of predicates and constants found in LCSS define lexical aspectual classes of verbs, and most languages have pairs of verbs with different lexical semantic templates but shared constants that belong to distinct aspectual classes, as in the verb of manner of motion examples discussed here. This aspectual relation is reflected in the names associated with the members of these pairs: the members tend to have names with a common base, and one, if not both, members of such pairs have morphologically complex names that involve the morphological devices employed to signal classification with respect to lexical aspect. In fact, the existence of morphemes in some languages that indicate the lexical aspectual classification of verbs can be taken as support for lexical semantic representations such as those in (5). For example, in Russian, an atelic verb is typically morphologically simple, while a telic verb is morphologically complex, consisting of a base (which is often a morphologically simple activity verb with a related meaning) and one of a set of prefixes (Brecht 1985).[13] Thus, compare Russian *pit'* drink' with *vypit'* 'drink up'. This suggests that, as a general pattern in Russian, morphological complexity is a reflection of template complexity.

The naming of manner of motion events in Russian also illustrates this point. Manner of motion events that qualify as activities are named by morphologically simple verbs (see (13)), while manner of motion events that qualify as accomplishments have morphologically complex names consisting of the same morphologically simple base as the related activity verb together with a directional prefix, chosen from a set of prefixes which are also used to signal aspectual classification (see (14)). Russian is not the only language to show this pattern; as reported by Harrison (1976) (see also Chung and Timberlake 1985), the Micronesian language Mokilese also distinguishes the accomplishment sense of verbs of manner of motion from the activity sense through the use of a set of suffixes that also serve as aspectual markers. For manner of motion verbs, the generalization seems to be that some languages do not allow a single verb name to be associated with lexical semantic templates differing in lexical aspectual classification. The names of such templates are distinguished morphologically in Russian and Mokilese, while one of the templates simply seems to be lacking in French. It is a matter for further research to see whether this generalization may hold more generally in these and other languages.[14]

Another phenomenon that can be characterized as involving different lexical semantic templates with a shared constant is the locative alternation. This term refers to the two expressions of arguments characteristic of verbs such as *spray, load, cram*, and *spread*.[15]

(19) (a) The farmer loaded hay on the truck, (locative variant)
(b) The farmer loaded the truck with hay. (*with* variant)

(20) (a) I spread butter on my toast.
(b) I spread my toast with butter.

The pairs of sentences that typify the locative alternation were originally thought to be derived by

syntactic transformations from a common deep structure (Hall 1965). This analysis was abandoned because the alternation does not bear what Wasow (1977) identifies as the hallmarks of syntactic operations (see e.g. Baker, in press). Subsequent accounts took as their starting point the subtle differences in meaning between the variants, as we refer to the alternate expressions of arguments associated with locative alternation verbs. For example, (19b), the *with* variant, implies that the truck is full, while (19a), the locative variant, need not. (See Anderson 1977a, Jeffries and Willis 1984, Schwartz-Norman 1976, among others, for a discussion of this effect.) Pinker (1989) and Rappaport and Levin (1988) note that the verbs in the two variants can be assigned to two independently established semantic classes. Once the two variants are given the appropriate LCSS, the expression of arguments characteristic of each follows from general principles governing argument expression. Possible representations for the two variants of the verb *LOAD* are given in (21):[16]

(21) (a) [[X ACT] CAUSE [Y BECOME PLOC Z] $[LOAD]_{MANNER}$]
(b)[[X ACT] CAUSE [Z BECOME $[]_{STATE}$ WITH-RESPECT-TO Y] $[LOAD]_{MANNER}$]

On this approach, the locative alternation involves two distinct LCSS related by a shared constant. As in the *walk* example, these LCSS are associated with the same name in English; and again, English is not unique in having the locative alternation or in associating the same name with the verb in both variants, as the following examples show:

(22) French:
(a) On a chargé beaucoup de colis sur le cargo.
'One loaded many packages on the cargo ship.'
(b) On a charge le cargo avec des colis.
'One loaded the cargo ship with packages.'
(Postal 1982: 381, ex. 74a-b)

(23) Japanese:
(a) kabe ni penki o nuru
wall on paint ACC smear
'smear paint on the wall'
(b) kabe o penki de nuru
wall ACC paint with smear
'smear the wall with paint'
(Fukui et al. 1985: 7, ex. 7a-b)

(24) Kannada:
(a) ra:ju trakkannu pustakagalinda tumbisida.
Raju (NOM) truck-ACC books-INST filled
'Raju filled the truck with books.'
(b) ra:ju pustakagalannu trakkinalli tumbisida.
Raju (NOM) books-ACC truck-LOC filled
'Raju filled the books in the truck.'
(Bhat 1977: 368, ex. 5a-b)

(25) Hebrew:
(a) Hu he'emis xatzir al ha-agala.
he loaded hay on the-wagon
'He loaded hay on the wagon.'
(b) Hu he'emis et ha-agala be-xatzir.
he loaded ACC the-wagon with-hay
'He loaded the wagon with hay.'

These examples further support the proposal that the relation between LCSS with distinct lexical

semantic templates but a shared constant is often not reflected in the morphological shape of the names associated with these LCSS.

It is perhaps less obvious that the two variants of the locative alternation, although both classified as accomplishments,[17] can nevertheless be distinguished aspectually, as shown by Dowty (1991). The variants differ with respect to the argument said to be the "incremental theme," a term Dowty employs to refer to the argument of a telic verb which determines the aspectual properties of the sentence that verb is found in. Thus, as suggested above, each such verb is associated with two lexical semantic templates. It is not surprising, then, that in many languages, for a particular choice of constant the pair of lexical semantic representations associated with the locative alternation is associated not with the same name, but rather with morphologically related names, where the affixes used to establish this morphological relation are chosen from those signaling aspectual classification, as suggested above. In fact, there are languages in which the locative alternation involves morphologically related verbs, and in each of the languages illustrated, the morphemes involved have an aspectual function.

(26) German:
(a) Adam schmierte Farbe an die Wand.
Adam (NOM) smeared paint-ACC at the wall-ACC
'Adam smeared paint on the wall.'
(b) Adam be-schmierte die Wand mit Farbe.
Adam (NOM) be-smeared the wall-ACC with paint-DAT
'Adam smeared the wall with paint.'
(Pusch 1972: 130, ex. 27a, c)

(27) Russian:
(a) Krest'jany na-gruzili seno na telegu.
peasants (NOM) na-loaded hay (ACC) on cart-ACC
'The peasants loaded hay on the cart.'
(b) Krest'jany za-gruzili telegu senom.
peasants (NOM) za-loaded cart-ACC hay-INST
'The peasants loaded the cart with hay.'

(28) Hungarian:
(a) János rá-mázolta a festéket a falra.
John onto-smeared.he.it the paint-ACC the wall-onto
'John smeared paint on the wall.'
(b) Janos be-mázolta a falat festékkel.
John in-smeared.he.it the wall-ACC paint-with
'John smeared the wall with paint.'
(Moravcsik 1978b: 257)

Let us consider the locative alternation in each of these languages in turn. The prefixes in the Russian examples are found on the perfective forms of the locative alternation verbs; the imperfective forms are typically unprefixed.[18] More generally, the same prefixes are used to signal felicity elsewhere in Russian; they also overlap with the prefixes signaling the accomplishment sense of verbs of manner of motion. In German, *be-* is often used to signal the affected- ness of the object of the verb to which it is attached (Pusch 1972); thus, as a prefix tied to the determination of telicity, it can be viewed as an aspectual morpheme. In fact, Becker (1971) presents other uses of this prefix that support this view. Furthermore, Dutch, like German, uses the prefix *be-* in the locative alternation, and Hoekstra and Mulder (1990) propose that the Dutch morpheme signals total affectedness. De Groot, in a discussion of the Hungarian locative alternation, points out that although the prefixes found in this alternation are sometimes used in Hungarian to contribute independent meaning in the way that the directional prefixes of Russian can, they also function "as indicators of perfectivity and termination of an action" (De Groot 1984: 138).

3.1.2 Verbs with shared lexical semantic templates Although LCSS that involve different lexical semantic templates but share the same constant can have the same name, we are not aware of any instances in which a single name is associated with multiple instantiations of a certain combination of predicates that differ simply in which constant fills a particular position.

Interestingly, it is verbs that share a lexical semantic template but differ in the associated constant that form classes whose members show the same expression of arguments. For example, all verbs of manner of motion in their activity sense share the same lexical semantic template and expression of arguments. Specifically, such verbs are unergative (Hoekstra 1984, Levin and Rappaport Hovav 1995, Zaenen 1993, L. Levin 1986, C. Rosen 1984). By contrast, when a single verb name is associated with several LCSS that are based on different combinations of predicates but share the same constant, each pairing of the name with a LCS is associated with a distinct argument expression. For instance, *walk* is unergative when it is an activity verb, but unaccusative when it is an accomplishment verb (Hoekstra 1984, Levin and Rappaport Hovav 1995, L. Levin 1986, Zaenen 1993, among others).

In this context it is appropriate to mention one additional relationship between verb meanings that, to our knowledge, is never morphologically signaled. Morphology is not involved in the cross-field generalizations discussed by Jackendoff (1972, 1978, 1983), building on the work of Gruber (1965). Jackendoff points out that certain parallels are found across apparently unrelated semantic fields, such as the fields of location and possession. For instance, the verb *keep* can be used in a variety of semantic fields, as in (29).

(29) (a) Tracy kept the bicycle in the shed.
(b) Tracy kept the bicycle.
(c) Tracy kept the dog quiet.

This verb is used to describe physical location in (a), possession in (b), and a state in (c), being used in what Jackendoff terms the positional, possessional, and identification fields, respectively. According to Jackendoff, these uses arise because motion and location organize a variety of semantic fields, as articulated in his Thematic Relations Hypothesis (1983:188). Thus, possession can be conceived of as location or motion within an abstract possessional field, with possessors playing the role of locations in this field, and possessed objects playing the part of physical objects. Similarly, states can be conceived of as locations within an abstract identificational field. When a verb is used in more than one semantic field, Jackendoff associates the same LCS with that verb independent of the field. We know of no language in which the morphological shape of a verb reflects the semantic field it is being used in. More generally, we know of no morphological indication that verbs – or words from other lexical categories for that matter – are being used figuratively or metaphorically.

3.2 Verbs with a shared LCS but distinct argument structures

Having looked at the morphological expression of the relation between verbs with distinct but related LCSS, we turn to the morphological expression of the relation between verbs that have the same LCS but differ in their argument structures. Our contention is that the morphological devices which languages use to signal this kind of relationship are different from those mentioned in the previous section. First, across languages, relationships between argument structures are almost always given morphological expression (in this respect, English is rather unusual). Second, the morphemes used to signal these relationships are not the same as those that signal the relationship between words with distinct, but related, LCSS. We begin by sketching the relations we have in mind.

As mentioned in section 1, the LCS contains variables corresponding to the participants in the event described by the verb. The LCS is not projected directly onto the syntax, however; rather, this mapping is mediated by the argument structure. The argument structure is a lexical representation of the syntactic expression of a verb's arguments. This representation, in effect, specifies which participants will be syntactically expressed and how. In the (morphologically) unmarked case, each variable in the LCS corresponds to a grammatically interpreted variable in argument structure. However, there are operations on argument structure that usually result in a change in the number of grammatically interpreted arguments or in the position of an argument in the hierarchical organization of argument structure.

Two examples of operations which result in a change – specifically, a decrease – in the number of arguments are reflexivization and middle formation, which may be called "valence-reducing operations." Reflexivization essentially identifies two of the variables in a verb's argument structure, indicating that they have the same referent (Grimshaw 1982), thus reducing by one the number of

syntactic arguments of a verb. We illustrate reflexivization using French. The (a) sentences in (30) and (31) show nonreflexive uses of the verbs *voir* 'see' and *purler* 'speak'; the (b) sentences show reflexives uses, which are signaled by the reflexive clitic *se*.

(30) (a) Jean voit l'homme.
Jean sees the man
'John sees the man.'
(b) Jean se voit.
Jean REFL sees
'John sees himself.'

(31) (a) Il parle à 1'homme.
he talks to the man
'He is talking to the man.'
(b) Il se parle.
he REFL talks
'He is talking to himself.'

Although in terms of meaning reflexive verbs take two arguments, from the perspective of the syntax they are monadic. The examples in (30) and (31) suggest that reflexivization is not sensitive to the semantic roles of a verb's arguments, since the verbs *voir* 'see' and *purler* 'talk' do not take arguments bearing the same semantic roles. This insensitivity would be expected of an operation on argument structure (Grimshaw 1990, Rappapport and Levin 1988, Zubizarreta 1987).

Middle formation also relates a transitive verb to an intransitive one, as illustrated once again using French data:

(32) (a) Il a nettoyé Aces lunettes.
he has cleaned those glasses
'He cleaned those glasses.'
(b) Ces lunettes se nettoient facilement.
those glasses REFL clean easily
'Those glasses clean easily.'
(Ruwet 1972: 95, ex. 35a)

The exact nature of this operation is a matter of debate (see Condoravdi 1989; Pagan 1988, 1992; Hoekstra and Roberts 1993; Keyser and Roeper 1984; among others), but it is clear that the external argument of the unmarked transitive verb cannot be expressed in the middle form, as discussed with respect to French by Ruwet (1972).

(33) *Cela se dit par le peuple.
that REFL says by the people
(Ruwet 1972: 110, ex. 100)

Thus, middle formation is also valence-reducing. In fact, in French this process is accompanied by the same reflexive clitic that signals reflexivization.

Valence-reducing operations operate on argument structure.[19] They do not create new LCSS, nor do they relate two different Less.[20] It is striking that languages which do not mark the locative alternation and, if they have them, manner of motion pairs morphologically may nevertheless mark operations on argument structure morphologically (e.g. Italian, French, Hebrew). Moreover, as far as we know, none of these languages uses aspectual morphology for this purpose. For example, Russian does not use aspectual prefixes to mark changes in valence. It is also striking that a number of languages use a single morpheme for many, if not all, of the valence-reducing operations (Comrie 1985, Langacker 1976, Langacker and Munro 1975, Marantz 1984a, Nedjalkov and Silnitsky 1973, Shibatani 1985, among others). Thus, as already mentioned, the same morpheme is associated with reflexivization and middle formation in French. Furthermore, the morpheme used in valence-reducing operations may be synchronically or diachronically related to a reflexive pronoun, as in the Romance

and Slavic languages.

Additional support for the differentiation of argument-structure-related morphology from Lcs-related morphology is provided by Haspelmath (1990), who investigates the multiple functions of the passive morpheme – another valence- reducing morpheme – cross-linguistically, and finds that there is a range of uses for this morpheme that are repeatedly attested across languages. Again, these uses resemble passivization in involving valence-reducing operations; they do not signal relations between Less.[21] Moving beyond valence-reducing operations, which have been the focus of this section, there are other morphological operations that are good candidates for being considered operations on argument structure. These include the formation of light verb constructions (Grimshaw and Mester 1988) and causative constructions (Marantz 1984a, S. T. Rosen 1989a, among others).[22]

4 Conclusion

Recent work in lexical semantics provides a framework for investigating the relationship between lexical semantics and morphology, which is clearly a rich, though underexplored, area of study. The morphology of languages provides further support for the existence of two levels of lexical representation, LCS and argument structure, as independently argued in studies of the lexicon. Specifically, the morphemes that signal the relation between verbs with related LCSs are different from those that signal the relation between verbs with common LCSs but distinct argument structures. This morphological division of labor is particularly noteworthy, since in the case-studies we have presented, it is maintained even by affixes with multiple functions. Thus, a particular affix consistently derives either new LCSs or new argument structures. Furthermore, when verbs with different LCSs but the same constant are morphologically related, the morphological devices used to signal such relations are associated with grammatically relevant components of meaning, such as aspectual classification. We hope that the ideas sketched here will serve as a starting point for continued exploration of the relationship between lexical semantics and morphology.

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1 One researcher who has paid attention to the relation between lexical semantics and morphology is Joan Bybee, who asks questions that are similar in spirit to those we address here. In her work, Bybee (1985) attempts to predict the kinds of meanings that are likely to find expression as inflectional morphemes and the degree of fusion between two morphemes based on the meaning relation that obtains between them. A second researcher who has investigated the relation between lexical semantics and morphology is Robert Beard, whose recent book (1995) came to our attention after this was completed.

2 The idea that the argument structure is projected from the LCS reflects the assumption that the syntactic expression of arguments of verbs is predictable from their meaning. This idea is incorporated in varying ways in the work of Bresnan and Kanerva (1989), Dowty (1991), Foley and Van Valin (1984), Hale and Keyser (1993, 1997), among others.

3 The LCSs that we give throughout this paper are chosen to illustrate particular points, and are not intended to present a unified system of lexical semantic representation.

4 See Croft 1991 for an alternative approach to the mapping between lexical semantics and syntax that makes reference to the causal structure of events, as elaborated in the work of Talmy (1976, 1988).

5 In this respect, Foley and Van Valin (1984) and Van Valin (1990, 1993) depart from Dowty (1979), who builds the decompositions of all four lexical aspectual classes on state predicates. See also McClure (1994) for a further elaboration of Dowty's idea that all classes are derived from basic state predicates.

6 We use ACT as the predicate, indicating an unspecified activity; some other work uses the predicate DO. The predicate ACT (or DO) is often used as the activity predicate in the LCS of an accomplishment verb, since

accomplishment verbs have a complex LCS that consists of an activity and an achievement (Dowty 1979, Grimshaw and Vikner 1993, Levin and Rappaport Hovav 1995; Pustejovsky 1991b, 1995; among others), but many accomplishments are vague as to the nature of the activity. Thus, the meaning of causative *dry* includes a specification of a particular result22 state, but is vague as to which of a number of activities brings this state about.

7 For a different lexical semantic analysis of verbs like *butter* that preserves the distinction between the primitive predicates and constants see Hale and Keyser (1993, 1997) and Kiparsky (1997).

8 A word of clarification is in order concerning the use of the term "constant" to refer to an element that fills a certain argument or modifier position in a verb's lexical semantic template and thus is lexically associated with that position. This term is chosen to contrast with the term "variable," used to refer to those argument positions that are not filled in the LCS, but whose interpretation is determined in the syntax via the association of these positions with overt XPs in the syntax. However, the use of the term "constant" may not be altogether felicitous: there is some variability in the meaning of certain verbs that might be said to involve the same constant within the same lexical semantic template. We suspect that this variability arises because the constant itself may actually be a prototype or a cluster concept. The precise representation of constants is an important question for further study. Jackendoff (1990: 33–4), e.g., proposes that all constants take the form of the "3-D model structures" of Marr and Vaina (1982); these structures provide an interface between visual and linguistic representations. Since this issue is outside the scope of this chapter, we simply adopt the convention of representing a constant by the name of the associated verb in capital italics.

9 We distinguish between the "name" of a verb, which is just a phonological stretch of sound, and two uses of the word *verb*. The first corresponds to Aronoff's notion "lexeme": i.e. all forms of a verb associated with a single LCS; thus, *walk, walks, walking, walked* are all instances of the lexeme *walk*. The second corresponds to what Aronoff (1994) calls the "grammatical word": i.e. a verb with a particular set of morphosyntactic features (e.g. the third-person singular present *walks*). It should be clear in any given context which use of *verb* is intended.

10 There is one other possibility, which is not often observed and which is most easily introduced with an example. Consider the verb *string*. This verb can be used as in to *string beans* (to remove the strings from beans), where the constant is a thing, or as in to *string beads* (to put beads on a string), where the constant is a place. *STRING* is one of a handful of constants that qualify for membership in more than one ontological category, and hence can fill more than one constant position in a combination of predicates; see Kiparsky (1997) for additional examples.

11 The predicate GO in (16) is not meant to be equivalent to the predicate BECOME found in the decomposition of achievements in (5b); specifically, unlike BECOME, it is not meant merely to indicate a transition from one state to another. We introduce this predicate to account for sentences such as *The ball rolled out of the room* and *The car rumbled into the driveway*. It seems inappropriate to use BECOME for these sentences, since there is then no appropriate predicate for the manner constant to modify. Current analyses give a causative representation to all accomplishments, and analyze sentences such as *Tracy walked out of the room* as having a representation along the lines of "Tracy did something that caused Tracy to become at a place out of the room." Whether or not these examples should receive a causative analysis, it seems fairly clear that the just- cited *roll* and *rumble* examples should not. If there are noncausative accomplishments, then the accomplishment use of a verb like walk cannot simply be derived by adding a goal to the representation of the verb in its activity use, as is assumed for example in Pustejovsky (1991b). See Jackendoff 1990: 93–5 for a similar suggestion that a predicate like GO is needed.

12 Due to the unavailability of the accomplishment sense of verbs of manner of motion in some languages and to the existence of morphologically complex names for this sense in others, we suggest that manner of motion constants are basically associated with the activity lexical semantic template. We take the association of the constant with the accomplishment lexical semantic template to be effected by rule. We do not formulate such a rule here, but see Levin and Rappaport Hovav 1995 for further discussion.

13 Due to space considerations we cannot provide a fuller discussion of the Russian aspectual system; for further discussion see Brecht 1985, Chung and Timberlake 1985; C. S. Smith 1991, as well as the papers in Flier and Timberlake (eds) 1985.

14 There is reason to believe that this generalization holds more generally in Russian (see e.g. Brecht 1985), but it remains to be seen to what extent it holds true of French. As we go on to discuss, French does allow the locative alternation, although the two variants differ aspectually, but it is perhaps significant that both variants still describe accomplishments. Further investigation is needed to determine whether other lexical aspectual shifts which are attested in English are attested in French as well, and if so, whether these shifts are accompanied by any changes in the form of the verb.

15 See Anderson 1971, Dowty 1991, Hoekstra and Mulder 1990, Jackendoff 1990, Pinker 1989, Rappaport and Levin 1988, among others, for discussions of the locative alternation, and B. Levin 1993 and Pinker 1989 for a list of English locative alternation verbs. The locative alternation should be distinguished from what might be called "locative advancement," a process by which a locative adjunct or oblique argument becomes a syntactic object of a verb. Such processes, which are found in some Bantu languages, typically involve a different type of morphology than the locative alternation. See also n. 22.

16 In these representations we have not associated the constant with a specific predicate, because it has proved difficult to determine the exact representation for locative alternation verbs. (See Pinker 1989 and Rappaport and Levin 1988 for two suggestions.) It is likely that what is special about these verbs is that the constant restricts facets of the causing activity, the result state, and the theme argument (i.e. *hay* in (19)).

17 We are simplifying somewhat here. As pointed out by Dowty (1991: 591), some of these verbs do permit an activity interpretation.

18 Due to the complexity of aspectual morphology, a full discussion of these examples cannot be offered here.

19 English does have apparent analogues to the two valence- reducing rules discussed in this section – reflexivization and middle formation – as illustrated by *I dressed quickly this morning* and *The can opened easily*, but again there is no morphology associated with such examples. What is interesting is that these processes are much more restricted in English than they are, say, in French. Reflexivization is found only with verbs of grooming and bodily care (see B. Levin 1993 for a list), while middle formation is subject to a much- discussed affectedness condition (Jaeggli 1986a, Roberts 1987, among others). We suspect that the lack of morphology is responsible for these semantic constraints, although we do not understand precisely why this should be.

20 A word of caution is needed here. A sentence with a middle verb does not report an event in the same way that the corresponding sentence with the nonmiddle form does. In this respect, the semantic representations of the two sentences differ significantly. The middle operator is most likely a sentential operator with modal force (Condoravdi 1989; Doron and Rappaport Hovav 1991), and thus embeds the LCS of the corresponding nonderived verb unchanged. However, see Ackema and Schoorlemmer 1994 for an account of middles that uses an operation on LCS and Sadler and Spencer, MORPHOLOGY AND ARGUMENT STRUCTURE, for some discussion of the issue of whether middle formation involves an operation on argument structure or LCS.

21 The fact that the passive morpheme is homophonous with the perfect morpheme in some languages does not present a problem for our discussion, as the perfect morpheme is different from the perfective morpheme. It is the perfective morpheme which has the lexical aspectual function, and, as far as we know, languages do not tend to use this morpheme to mark the passive.

22 Applied affixes may be additional candidates, though their status requires further investigation. We believe that they are likely to be associated with operations on argument structure, and that, unlike the Russian directional prefixes found with verbs of manner of motion, they are not indicators of an LCS that shares a constant with another LCS.

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13. Morphology and Pragmatics

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1 The notion of morphopragmatics

Pragmatics relates linguistic structure to contextual phenomena. In other words, pragmatics can be defined as the functional perspective on language. '[P]ragmatics … [can] be conceived as the study of the mechanisms and motivations behind any of the choices made when using language (at the level of phonology, morphology, syntax, semantics, whether they are variety-internal options or whether they involve regionally, socially, or functionally distributed types of variation)' (Verschueren 1987: 36). The relevant contextual phenomena include (i) time, location, social setting and participants' roles, on the one hand, and (ii) the interlocutors' strategies, plans, goals and intentions, on the other. (i) may be referred to as aspects of the 'speech situation' and (ii) as elements of the 'speech event' (Dressier and Merlini-Barbaresi 1993: 3–4).

Morphopragmatics is the study of the interrelationship between morphology and pragmatics. Morphology is relevant pragmatically in so far as word structure (affixes, clitics) can be taken as an indication of the speech situation and/or of the speech event. Morphopragmatics has to be distinguished from lexical pragmatics, on the one hand, and syntactic pragmatics, on the other. Morphologically complex forms which are lexicalized (e.g. German *hierher* 'over here', *dorthinein* 'in there', also a large number of compounds) and which carry pragmatic information come under the heading of lexical pragmatics. Syntactically relevant morphological categories contribute to pragmatics via the syntactic structure in which they appear (e.g. case and plural marking), and belong thus to syntactic pragmatics.

Morphology falls into two parts. 'Grammatical morphology' is rule-governed, and is thus part of grammar. 'Extragrammatical morphology', on the other hand, does not conform to the rules of grammar. The latter is related to 'expressive morphology' (Zwicky and Pullum 1987; Dressier and Merlini-Barbaresi 1993: 23–6). Both types of morphology may be pragmatically relevant, but in the case of extragrammatical morphology it is difficult, if not impossible, to provide general pragmatic accounts of the phenomena involved.

The situation is different with grammatical morphology, where the essential question to be asked is whether a morphological rule has pragmatic effects, and if so, which ones. In general, pragmatic aspects come into play whenever we have to do with competing realizations of morphological rules, or with morphological rules which do not affect denotative meaning or whose semantic contribution is minimal, or which are not prototypical of the respective domain (e.g. diminutives, augmentatives, comparatives in the case of derivational morphology, suffix-like clitics in the case of inflectional morphology).

Most work on morphopragmatics was carried out in the framework of natural morphology (Dressier and Merlini-Barbaresi 1993 and the references quote therein). A number of works treat

morphopragmatics under the heading of semantics (e.g. Wierzbicka 1983, 1984). Mey (1989) pleads for the study of the relationship between morphology and pragmatics, and by way of illustration provides a brief survey of some morphological means for expressing power and solidarity. A description of emotive attitudes expressed by diminutives can be found in Volek (1987). However, Dressier and Merlini-Barbaresi 1993 is the only systematic work on morphopragmatics to date.

2 Pragmatics and inflection

Inflection has primarily a syntactic function: it makes the word conform to whatever is required by syntax. In a number of cases, however, there is a choice available between inflectional categories or between affixes expressing the same inflectional category or categories, which may be determined by pragmatic factors.

2.1 Case marking in Polish

A case in point is case marking in Polish (Wierzbicka 1983). In Polish the nominative plural has several allomorphs conditioned by a number of different factors. For example, human masculine nouns with a hard stem can take one of the following endings: *-i*, *-y* and *-owie*. The first ending is neutral; it has no pragmatic implications. The ending *-y*, however, implies contempt, and the ending *-owie* importance or dignity. Some masculine nouns have a choice between two or sometimes even three of these endings. Thus, for example, an inherently respectful word such as *profesor* or *astronom*, which normally takes the *-y* suffix, can be lowered to a neutral form such as *profesorzy* or *astronomy* (with an underlying *-i* suffix which surfaces as *-y* in certain well-defined phonological contexts), and jokingly even a contemptuous word such as *lobuz* 'rascal' can be raised to a marked neutral form such as *lobuzi*, but not to a respectful form such as **lobuzowie*. Consequently, in addition to phonological and semantic factors, the choice of the nominative plural depends on pragmatic factors, on the intentions and goals of the speaker.

2.2 Inflectional suffixes in Hungarian and stylistic layer

The choice of inflectional suffixes may have stylistic consequences. The stylistic meaning of suffixes may range from 'substandard' to 'formal'. For example, the first-person plural conditional has two variants for the definite conjugation: *-nánk*/*-nénk* and *-nók*/*-nők*. The first variant is neutral; the second one belongs to the 'elevated style', and can be used in an appropriate speech situation only. The same holds true for the two variants of the first- and third-person singular present tense conditional suffixes for the indefinite conjugation (*-nék* and *-nám*/ *-ném*, *-na*/*-ne* and *-nék*, respectively). In both cases, the older forms belong to the elevated style, whereas the more recent forms are stylistically neutral. Upcoming forms, on the other hand, are often 'substandard'. For example, in careless colloquial speech the present tense indicative endings are sometimes replaced by the corresponding suffixes of the imperative: thus forms such as *takarít-suk* 'we are tidying up' and *vált-sa* 'he is changing' are used instead of *takarít-juk* and *vált-ja*. This variation is partly conditioned phonologically: it is possible only after stem-final or suffix-final *-t*. The use of the imperative instead of the indicative is typical of certain social settings and age-groups.

2.3 Inflectional suffixes as indicators of the speech event

It also happens that the choice of one inflectional variant rather than the other indicates the strength of illocutionary force. For example, in Hungarian some imperatives appear in two forms: for example, *ad-d* 'give' and *ad-jad*, *mond-d* 'say' and *mond-jad*, both second-person singular imperative. Typically, the shorter forms are used to issue a stronger order, and the longer forms are preferred when the speaker wants to issue an attenuated order.

2.4 Inflectional suffixes and honorifics

In Japanese, which seems to have one of the most complex systems of honorifics, some variants are due to morphology rather than to syntax. For example, from among the three ways of expressing the sentence 'Here is a book': (i) *Koko ni hon ga aru*, (ii) *Koko ni hon ga ari-masu* and (iii) *Koko ni hon ga gozai-masu*, (i) is the most neutral, (ii) the polite and (iii) the super-polite variant (Harada 1976: 553-4). *-masu* is an inflectional suffix, and *gozai* is a suppletive form of the existential verb *aru*. The relevant speech situation may be analysed in terms of the speaker, the hearer, other participants,

place, time and topic (Dressler and Merlini-Barbaresi 1993: 48–51). It has been observed, for example, that female speakers use polite *-masu* forms more often than male speakers. As far as the hearer is concerned, the polite *-masu* forms are always used with members of an out-group. Also television and radio speakers and oral announcements in train and subway stations use these forms, because the addressees are considered to be members of an out-group. Furthermore, if the hearer has authority over the speaker (in terms of relative social status, power, age), the *-masu* form must be used. If a bystander is present who is a member of an out-group or whose rank is higher than that of the speaker, again the polite form must be used. The place and the time of the interaction influence the formality of the speech situation, and constitute an overriding factor. For example, funerals, weddings and opening ceremonies demand the use of *-masu*. Also a change of topic may prompt the use of *-masu*: for example, businessmen use *-masu* when their topic switches from personal items to business. Additional factors come into play when the super-polite form is used.

3 Derivational morphology and pragmatics

Derivational processes which affect syntactic structure do not seem to have any direct relevance to pragmatics. Thus, causatives and passives derived from a base verb or deverbal nouns can attain pragmatic relevance only via the syntactic structure into which they enter. Typically, morphopragmatics becomes pertinent with derivational affixes which do not affect syntax. Another area where pragmatic effects may be expected are instances of non-prototypical derivation.

3.1 The Japanese beautificational prefix

Japanese has a derivational beautificational prefix *o-*, which is used to make speech softer and more polite (Harada 1976: 504). For example, by using this prefix, an offer becomes more polite. Compare *Biiru ikaga*? 'How about a beer?' with *O-biiru ikaga*? 'Would you like some beer?'

3.2 Australian depreciatives

A 'depreciative' form constitutes an abbreviation of the standard form combined with a pseudo-diminutive suffix (Wierzbicka 1984: 128–9). Thus, the 'depreciative' form of *present* is *prezzie*, of *mushrooms* is *mushies*, of *barbecue* is *barbie*. Though the pseudo-diminutive suffix *-ie* does not mean smallness, it is not void of semantic meaning. It carries the connotation that the thing denoted by the noun should not be considered a big thing. Pragmatically, depreciatives express informality (hence they cannot be used in formal settings) and solidarity (hence they are inappropriate in speech situations in which solidarity is excluded).

3.3 Italian diminutives

Italian has a considerable number of diminutive suffixes. The productive suffixes are *-ino*, *-etto*, *-ello*, *-(u)olo*, *-uccio*/*-uzzo*, *-otto* and *-onzolo*. For example, *film* - *film-ino*, *verme* 'worm' - *verm-etto*, *mano* 'hand' - *man-uccia*. Pragmatically, diminutives express an evaluation or judgement which depends on the speaker's intentions, perspective and standards of evaluation. The most general pragmatic meaning of diminutives seems to be non-seriousness. That is, by using the diminutive suffix, the speaker evaluates his speech act as being non-serious. Furthermore, in order to minimize the risk of disapproval on the part of the hearer, the prepositional content of the speech act is shifted into an imaginary world. For example, *Eh, sono dei bei sold-ini/dollar-ini!* 'Well, they are of the nice moneys-/dollars' – diminutive: 'Well, that's a pretty penny', where the diminutive is used to downgrade the precision of the statement concerning the bigness of the amount. The use of the diminutive can be analysed adequately in terms of (i) speech situations, (ii) speech acts and (iii) regulative factors such as playfulness, emotion, intimacy, understatement, modesty, euphemism, etc. Typical speech situations in which diminutives are used are child-centered, pet-centered and lover-centered speech situations. As to speech acts, the main contribution of diminutives is the modification of the relative strength of a speech act (Dressier and Merlini-Barbaresi 1993: 54–275).

3.4 Italian intensification (augmentatives)

Intensification in Italian can be expressed by means of the suffix *-one* as in *porta* 'door' - *port-one*, *mano* 'hand' - *man-one*, *tazza* 'cup' - *tazz-ona*. Like diminutives, augmentatives indicate the fictiveness of the situation at hand. The speaker suspends the norms of the real world and makes the

norms of his evaluation glide upwards' (ibid.: 291). But, in contrast to the diminutive, where in most cases the semantic meaning of smallness is lost, the augmentative preserves the semantic feature of bigness. Compare the augmentative in (i) with the diminutive in (ii): (i) *Come vorrei essere nel mio lett-one!* 'How I'd like to be in my bed' – augmentative: 'How I'd love to be in my big bed!'; (ii) *Come vorrei essere nel mio lett-ino!* 'How I'd love to be in my snug little bed!' In (ii) the bed is not taken to be small, while in (i) the bed is certainly big in the speaker's imaginary world. The importance of the feature of bigness is responsible, among other things, for the frequent use of augmentatives in overstatements and in exaggerations (ibid.: 275–326).

3.5 The excessive in Hungarian and Viennese German

In Hungarian, the excessive is formed by repeating the superlative prefix *leg-*: *leg-es-leg-*, where *es* stands for the conjunction *es* 'and'; or even *leg-es-leg- es-leg*, which is added to the comparative form: *nagy* 'big' – *nagy-obb* 'bigger' – *leg-nagy-obb* 'biggest' – *legesleg-nagy-obb* 'the very biggest'. The corresponding German prefix is *aller-*, preposed to a superlative: *aller-neu-est* 'the most recent of all'. The excessive expresses the absolutely highest possible degree of a property, and it is compared only with items which have this property to a high degree; it is used for emphasis and for impressing the hearer (Dressier and Kiefer 1990: 69–72). The excessive can also be used as a corrective device in discourse: *Das ist sehr schlimm* 'That is very bad' – *Aber das allerschlimmste ist, dass...* 'But the very worst of all is that...'. Furthermore, it may express the last word on the matter in question. At the end of a TV discussion, the moderator may ask the question *Gibt's nodi eine allerletzte Frage?* 'Is there a truly last question?', with the excessive *allerletzte* 'very last' signalling that an extra question is still possible, but that this opportunity must be taken immediately, and that any other question will be totally excluded (Dressier and Merlini-Barbaresi 1993: 373).

4 Compounds

Much less is known about the pragmatics of compounds. Morphopragmatics is concerned with the pragmatic effects of *ad hoc* compounds; lexical compounds with lexicalized meaning fall outside its scope. Compounds have been investigated mainly with respect to their discourse function (Dressier 1982, Brekle 1986). For example, compounds have a special discourse referential function; they are used when a pronoun would not suffice to establish referential identity between two expressions: for example, die *Wahlkampfmannschaft von Strauss – die Strauss-Mannschaft* 'Strauss' election-campaign team' (Brekle 1986: 46). *Apple-juice seat* is an English example for a compound used as a deictic device (Downing 1977: 823). Also, newly coined compounds, in virtue of their innovative nature, have a foregrounding function. This function can be observed particularly well in poetic language, in advertising and in journalism (in headlines). Furthermore, most *ad hoc* compounds are many-ways ambiguous|. The inherent ambiguity of compounds is often exploited in poetry, in political discourse and in jokes.

5 Clitic particles

The study of the pragmatic effects of clitic particles may be subsumed under the heading of morphopragmatics, since they behave in many respects exactly like affixes: they are unable to bear stress; they have a fixed position in word structure; and quite often they cannot be attached to just any type of word.

5.1 Evidential clitics

Evidential particles are often expressed by suffixes, and are thus part of word structure. In Wintu, an American Indian language spoken in Northern California, direct evidence is unmarked and assumed to be visual, whereas non-visual sensory evidence and inference from intuition are marked by the suffix *-nthEr*. Both second- and third-hand hearsay evidence is marked by *-kee*, inference from observed results by *-ree*, and inference from previous experience by *-?el* (Willett 1988: 64–5). Evidential markers are pragmatically relevant in so far as they modify or determine the speech act performed. The speaker may assert a statement or a supposition, but he or she may also express emphasis and surprise. The latter seem to arise when the claimed fact is directly observable by both the speaker and the hearer. In Turkish, for example, the evidential suffix *-miş* is used to convey inference and hearsay. But an utterance such as *Ahmet gel-miş* 'Ahmet came' could also be an expression of

surprise, even if the speaker has had full, sensory information of Ahmet's arrival. For example, this utterance could be used in a situation in which the speaker hears someone approach from outside and open the door, and sees Ahmet, provided that Ahmet is a totally unexpected visitor. The same particle can also be used to express scorn, irony and compliments (Aksu-Koc. and Slobin 1986: 162-3). Moreover, evidentials may influence the strength of assertion. Between the source of information and the strength of assertion the following correlation seems to hold: The source of a speaker's information can skew the relation between his/her conception of the truth and the strength of his/her assertion about that situation' (Willett 1988: 86). Thus, emphatic assertion can be based only on attested evidence, doubtful truth only on inference.

Evidential suffixes may even determine the illocutionary force of the utterance. Kashaya, for example, has a pair of performative suffixes, -*wela* and -*mela*, which signify that the speaker knows of what he speaks because he is performing the act himself or has just performed it. These suffixes are often used to introduce a conversation. As a conversational interchange develops from the opening remarks, the performative suffixes are replaced by the factual-visual suffixes -*wa* and -*ya* (Oswalt 1986: 34-6).

5.2 Other clitics

Clitics may also function as illocutionary act indicators. Some clitics in Ngiyambaa (South Australian), for example, are used to express the speaker's beliefs about what he or she is saying, giving performative equivalents like 'I assert that…', 'I counter-assert that…', 'I guess that…' (Donaldson 1980: 253-8). The speaker may also make explicit the source of his or her evidence by means of an evidential suffix. In that case evidential suffixes always follow 'belief clitics. In Ngiyambaa the suffixes -*ba:*, -*bara* and -*baga*: mark assertions, and -*gila* marks a hypothesis. Plain assertion is expressed by -*ba:*, categorical assertion by -*bara*, counter-assertion by -*baga:*, hypothetical assertion by -*gila*. For example, *guyan-baga:-dhu gara*, shy counter-assert I am, 'But I am shy' used to invalidate a previous pragmatic presupposition ('People are not reticent'). The suffix -*gila* also occurs in boasts, 'whose essence is that they assert the subjective, and not necessarily confirmed, value of what is being boasted about'.

In a Central Australian language, Mparntwe Arrernte (Aranda), clitics are used to indicate the illocutionary force of criticism and/or complaint. These pragmatic effects are functions of the meaning of these clitics, of culture-specific pragmatic factors and speech situation. The relevant particle clitics are -*itanye*, -*iknge*, -*me*, -*kathene* and *kwele* (Wilkins 1986: 577). Of these, only the last one does not exhibit suffix-like behaviour. Criticism or complaint is expressed by -*iknge*: for example, *R-iknge angke-me*, which, depending on the speech situation, may mean either 'He's always speaking?' (When do I get my chance?), '(Poor thing.) He's always having to speak', or 'He never stops speaking' (The big-mouth). The clitic -*kathene* invokes special socio-cultural norms determined by the relationship between the participants in the speech situation. The use of this suffix presupposes the 'full command of the sociocultural knowledge of what obligations various relations entail and what constitutes a breach of those obligations'. The clitic -*me* alludes to unfair expectations of what the speaker should do, and forces the addressee to realize what he or she should normally expect of the speaker, and so how he or she should behave. Finally, -*itanye* is the contrary of the expectation clitic, and expresses surprise (Wilkins 1986: 575-96).

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14. Prosodic Morphology

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1 Introduction

Prosodie Morphology is a theory of how morphological and phonological determinants of linguistic form interact with one another in grammatical systems. A core area of investigation is the way in which prosodie structure impinges on templatic and circumscriptional morphology, such as reduplication and infixation. In McCarthy and Prince 1986 and 1990a, three essential claims are advanced about Prosodie Morphology:

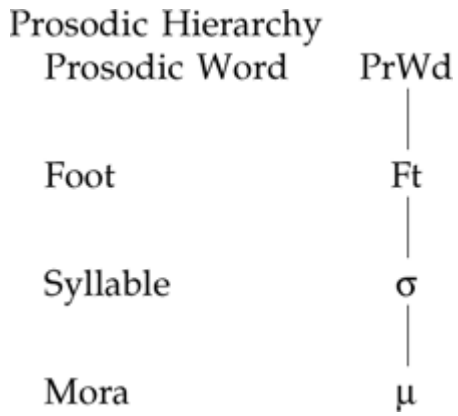
(1) Principles of Prosodie Morphology
(a) Prosodie Morphology Hypothesis
Templates are defined in terms of the authentic units of prosody:
mora (μ), syllable (σ), foot (Ft), prosodic word (PrWd).
(b) Template Satisfaction Condition
Satisfaction of templatic constraints is obligatory and is determined by the principles of prosody, both universal and language-specific.
(c) Prosodie Circumscription
The domain to which morphological operations apply may be circumscribed by prosodie criteria as well as by the more familiar morphological ones.

In short, this approach to Prosodie Morphology hypothesizes that templates and circumscription must be formulated in terms of the vocabulary of prosody, and must respect the well-formedness requirements of prosody.[1] The commitment to prosody is based neither on simple inductive empirical observations, nor on some kind of hegemonic impulse to extend a favored subdiscipline at the expense of others. Rather, it answers to a fundamental explanatory goal: to reduce or eliminate the descriptive apparatus that is specific to particular empirical domains like reduplication, and instead derive the properties of those domains from general and independently motivated principles. Claims (1a), (1b), and (1c) assert that prosodie theory is where these independent principles are to be found; but the pursuit of more embracing explanations has led researchers to modify and generalize these initial hypotheses in ways we will discuss.

On the morphological side, the assumptions made within Prosodie Morphology are relatively uncomplicated. The morphological constituents Root, Stem, and Affix form a labeled bracketing, essentially along the lines of Selkirk 1982. Most work in Prosodie Morphology adopts a view of morphology that is morpheme-based, under the broad rubric of item-and-arrangement models, though the (morpheme-based) model of prosodie circumscription in McCarthy and Prince (1990a) is a processual one.

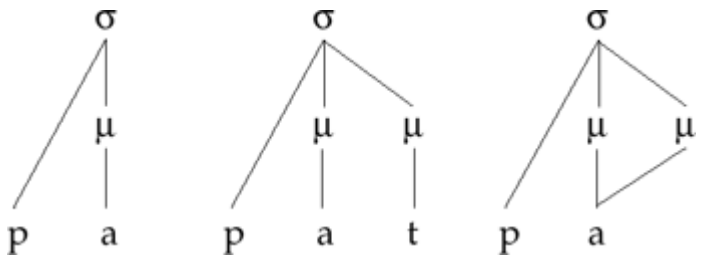
On the phonological side, Prosodie Morphology is based on the Prosodie Hierarchy in (2), evolved

from that of Selkirk (1980a, b):



The mora is the unit of syllable weight (Prince 1980, van der Hülst 1984, Hyman 1985, McCarthy and Prince 1986, Zee 1988, Hayes 1989a, Itô 1989, etc.). The most common syllable weight typology is given in (3), where short open syllables like *pa* are light, and long-voweled or closed syllables like *paa* or *pat* are heavy.

(3) Syllables in Moraic Theory — Modal Weight Typology
Light (L) Heavy (H)



Syllables and syllable weight are fundamental to defining metrical feet. Feet are constrained both syllabically and moraically. The foot inventory laid out in (4) below is proposed in McCarthy and Prince 1986 and Hayes 1987 to account for Hayes's (1985) typological findings. We write L for light syllable, H for heavy syllable:

(4)

Foot types	Iambic	Trochaic	Syllabic
	LH LL, H	H, LL	σσ

Conspicuously absent from the typology are degenerate feet, consisting of just a single light syllable, though they may play a marked role in stress assignment (Kager 1989, Hayes 1995; but see Kiparsky 1992). The following general condition on foot form is responsible for the nonexistence (or markedness) of degenerate feet (Prince 1980; McCarthy and Prince 1986, 1991b, 1993b: ch. 4; Hayes 1995):

(5) Foot Binarity: Feet are binary under syllabic or moraic analysis.

The Prosodie Hierarchy and Foot Binarity, taken together, derive the key notion "Minimal Word" (Prince 1980; Broselow 1982; McCarthy and Prince 1986, 1990a, 1991a, b). According to the Prosodie Hierarchy, any instance of the category prosodie word must contain at least one foot. By Foot Binarity, every foot must be bimoraic or disyllabic. By transitivity, then, a prosodie word must contain at least two moras (or syllables, if all syllables are monomoraic). As we shall see, the Minimal Word is of singular importance in characterizing certain Prosodic-Morphological phenomena, and its role is a matter of continuing study.

2 Exemplification

Reduplicative and root-and-pattern morphology are typical cases where the principles of Prosodie Morphology emerge with full vigor.2 In reduplicative and root-and-pattern morphology, grammatical distinctions are expressed by imposing a fixed prosodie requirement on varying segmental material. In reduplication, the prosodically fixed material stands as a kind of affix, copying segments of the base to which it is adjoined. In root-and-pattern morphology, broadly construed, the prosodically fixed material is a free-standing stem, to which segments of a root or related word are mapped.

The Ilokano reduplicative plural exemplified in (6) specifies a prefix whose canonical shape is constant – a heavy syllable – but whose segmental content is a (partial) copy of the base to which it is attached:

(6) Ilokano plural reduplication (McCarthy and Prince 1986, 1991a, 1993b; Hayes and Abad 1989)

kaldíŋ	'goat'	kal-kaldíŋ	'goats'
púsa	'cat'	*pus*-púsa	'cats'
kláse	'class'	*klas*-kláse	'classes'
jyánitor	'janitor'	jyan-jyánitor	'janitors'
nó?ot	'litter'	*ro:*-ró?ot	'litter (pl.)'
trák	'truck'	*tra:*-trák	'trucks'

We follow the practice of highlighting the copy, called the *reduplicant* (after Spring 1990). The template of the Ilokano plural is a heavy syllable, $\sigma_{\mu\mu}$ Given the independently motivated prosody of the language, a heavy syllable can consist of a diverse set of segmental strings, with simple or complex initial clusters (*kal* vs *klas*) and with a closing consonant or a long vowel (*pus* vs *ro: klas* vs *tra:*). The heavy-syllable template $\sigma_{\mu\mu}$ is the invariant that unites the various forms of the plural in Ilokano. The Prosodie Morphology Hypothesis demands that templates be characterized in just such abstract, prosodie terms; in this way they partake, as the Ilokano template does, of the independently motivated conditions on prosody generally and in the particular language under study.

The Ilokano case also illustrates another significant finding: the fact that the reduplicative template is itself an affix (McCarthy 1979, 1981; Marantz 1982). On the face of it, the idea that reduplication involves affixing a template may seem surprising, since a natural, naive expectation is that reduplication involves an operation like "copy the first syllable," as illustrated in (7):

(7) "Copy first syllable," hypothetically

ta.ka	→ *ta*-ta.ka
tra.pa	→ *tra*-tra.pa
tak.pa	→ *tak*-tak.pa

Moravcsik (1978c) and Marantz (1982) observe that syllable copying, in this sense, does not occur.

Rather, reduplication always specifies a *templatic target* which is affixed to the base, and is satisfied by copying elements of the base.[3] The Prosodie Morphology Hypothesis, together with the Prosodie Hierarchy, predicts the existence of a range of possible types of reduplicative templates. The heavy syllable $\sigma_{\mu\mu}$ of the Ilokano plural is one of these. Another is the light-syllable template σ_{μ}, which is also used in Ilokano, in other morphological constructions:

(8) Ilokano *si* + σ_{μ} 'covered/filled with'

buneŋ	'buneng'	si-bu-buneŋ	'carrying a buneng'
jyaket	'jacket'	si-*jya*-jyaket	'wearing a jacket'
pandiliŋ	'skirt'	si-*pa*-pandilŋ	'wearing a skirt'

Both of these reduplicative patterns are common cross-linguistically. Equally common too is the minimal word (MinWd) template, which consists of a single binary foot, often matching the smallest word-size in the host language. A typical example of this is found in the Australian language Diyari:

(9) Diyari Reduplication (Austin 1981; Poser 1982,1989; McCarthy and Prince 1986, 1991 a, b, 1994a)

wi[l]a	*wi[l]a*-wi[l]a	'woman'
kanku	*kanku*-kanku	'boy'
kulkuŋa	*kulku*-kulkuŋa	'to jump'
tʲilparku	*tʲilpa*-tʲilparku	'bird species'
ŋankan[ti]	*ŋanka*-ŋankan[ti]	'catfish'

Reduplicated words of Diyari have various meanings. The formal regularity that unites them is the presence of a prefixed MinWd template. The realization of this template, and of the smallest words in the language as a whole, is a disyllabic trochaic foot, since Diyari does not make distinctions of syllable weight. In fact, the reduplicative prefix of Diyari is a free-standing prosodie word, as shown by the facts that it is vowel-final (like all prosodie words of Diyari) and that both prefix and base bear their own primary word stresses: *kánku-kánku, tʲípa-tʲíparku*. In effect, then, the prefix + base collocation in Diyari is a compound of a MinWd with a complete PrWd. We will revisit Diyari below, in section 3, with the goal of a better understanding of the relation of MinWd phenomena to general constraints on prosody and morphology.

In root-and-pattern morphology, the prosodie template determines the shape of the whole stem, rather than just an affix. Full-blown systems are found in several widely scattered language families, touched on below. But a particular type of quasi-grammatical root-and-pattern morphology is quite broadly attested: the process of forming a nickname or hypocoristic by mapping a name onto a minimal word template MinWd. This type of prosodie morphology "was identified by McCarthy and Prince (1986, 1990a), and is comprehensively surveyed by Weeda (1992). The formation of "proximal vocatives" in Central Alaskan Yup'ik Eskimo is a typical example.

(10) Proximal vocatives in Central Alaskan Yup'ik Eskimo (A. Woodbury 1985; McCarthy and Prince 1986, 1990a)

Name	Proximal vocative
Aŋukaɣnaq	Aŋ ~ Aŋuk
Nupiɣak	Nup ~ Nupix/Nupik
Aŋivɣan	Aŋif
Kalixtuq	Kał ~ Kalik

qətunɣaq	'son'	Qət ~ Qətun
Maɣ^{w}luq		Maχ^{w}
Aɣnaɣayaq		Aɣən
Nəŋqŋχalɣia		Nəŋŋq
Qakfalɣia		Qak ~ Qakəf ~ Qakfał
Akiuɣalɣia		Akiuk

As is usual in such cases, personal preferences may influence the result. But there is a clear invariant structure amid the alternatives: the shape of a licit vocative is exactly an iambic foot, a single heavy syllable or a light–heavy sequence. This is the minimal prosodie word in a language like Yup'ik, with its pervasive iambic prosody.[4] Hence, the vocative template is MinWd.

Closer to home, the force of this same template can be observed with a certain species of nicknames in English:

(11) English nicknames (McCarthy and Prince 1986)

Name	**Nickname**
Mortimer	Mort, Mortie
Cynthia	Cynth, Cindy
Marjorie	Marge, Margie
Angela	Ange [æñdʒ], Angie,
Francis	Fran, Frank, Frannie, Frankie
Cyrus	Cy
Barbara	Bar, Barb, Barbie
Alfred	Al, Alf, Alfie
Edward	Ed, Eddie, *Edwie
Abraham	Abe, Abie, *Abrie
Jacqueline	Jackie, *Jacquie (=[dʒækwi:])
Douglas	Doug, Dougie, *Douglie
Agnes	Ag, Aggie, *Agnie

Again, personal preference is a factor in fixing choices, but the overall scheme is clear: the shape invariant in English nicknames is a bimoraic (heavy) syllable, the minimal word of the language.5 As in Yupik, the minimal word is the prosodie word that contains a single foot; English is subject to the further restriction that not only the prosodie word but also the foot itself must be minimal, and therefore monosyllabic (McCarthy and Prince 1986, 1991b). By Foot Binarity (5), any single syllable that exhausts a foot must be heavy.

The templatic base of the nickname may be augmented by addition of the external or "Level II" suffix [*i*], spelled *-y* or *-ie*. That this suffix is prosodically independent of the template is shown by the impossibility of **Edwie* and the other asterisked examples. These all involve a cluster that cannot be mapped to the monosyllabic template, under independently motivated English syllable canons. Because there are no monosyllables **Edw*, **Dougl*, **Abr*, **Agn*, there are no nicknames **Edwie*, **Douglie*, **Abrie*, **Agnie*, and so on, even though such forms are syllabically perfect. The monosyllable base criterion thus limits the segmentism of suffixed hypocoristics in a principled way.[6]

Perhaps the most extensively studied example of this type is found in Japanese:

(12) Hypocoristics in Japanese (Poser 1984, 1990)

Name	**Hypocoristic**

ti	tii-čan	
šuusuke	šuu-čan	*šuusu-čan
yoosuke	yoo-čl;an	*yoosu-čan
taizoo	tai-čan	*taizo-čan
kinsuke	kin-čan	*kinsu-čan
midori	mii-čan	*mi-čan
	mit-čan	
	mido-čan	
wasaburoo	waa-čan	*wa-čan
	wasa-čan	
	sabu-čan	
	wasaburo-čan	*wasabu-čan

As usual, personal preferences are a factor; but with complete consistency, any modified hypocoristic stem consists of an even number of moras, usually two.[7] Though prominential stress is not found in Japanese, there is abundant evidence that it has a system of two-mora (probably trochaic) feet (Poser 1990) and that the minimal word is, as expected, bimoraic (Itô 1991). Thus, the template for the hypocoristic can be characterized in prosodie fashion as Ft^{+} (one or more feet) or $MinWd^{+}$, the latter perhaps to be analyzed as a kind of MinWd compound.

Variations on the same theme are played out in a number of other morphological patterns (Itô 1991, Mester 1990, Itô and Mester, 1997; cf. Tateishi 1989, Perlmutter 1992). Strikingly, standard Japanese (the Tokyo dialect) has a full complement of monomoraic words in the lexicon (cf. e.g. Itô 1991). But no morphological process that demands minimality is ever satisfied by a monomoraic structure. This shows that the notion of MinWd relevant to prosodie morphology is not a simple inductive one, based on the size of attested lexical words in a given language. Rather, the active notion is "minimal *prosodie* word," a unit whose structure is determined by the universal principles of the Prosodie Hierarchy (2) and of Foot Binarity (5).

The Japanese case is particularly notable in the diversity of ways that a bimoraic foot, and therefore a hypocoristic word/ can be realized. Long-voweled *tii*, diphthongal *tai*, closed *kin*, and disyllabic *mido* are all licit hypocoristics, and they represent all the canonical types of bimoraic feet to be found in Japanese as a whole. Such diversity defeats any effort to construct a respectable theory that comprehends the template in purely segmental terms, as a sequence of C and V positions. Any such segmentalist effort must painfully recapitulate the vocabulary of foot types within the parochial hypocoristic template. Obviously, any theory with the descriptive richness to do this – say, by basing itself on a Kleene-type regular language notation – will have little or no predictive force. By contrast, the templatic restriction *MinWd* inherits from Universal Grammar a cascade of information about foot and syllable structure. The hypocoristic pattern of many languages is simply *MinWd;* and further independent specification of the foot, syllable, and mora structure in the language determines the details.

Though truncation is usually rather limited in scope, root-and-pattern morphology is an utterly pervasive feature of some morphological systems, particularly in the Afro-Asiatic family, but also in various Penutian languages such as Miwok, Yokuts, and Takelma.[8] These systems are all rather complex and difficult to summarize briefly, but it is possible to get a general feel for the mode of analysis by a brief glance at one of them.

The shapes of canonical nouns in Standard Arabic, analyzed in McCarthy and Prince 1990b, Prince 1991, and McCarthy 1993, illustrate some basic prin ciples.[9] The data are given in (13), based on all the canonical noun stems occurring in the first half of a large dictionary (N ∽ 2400), and classified by syllable-weight pattern (H, L) with a single example of each type:

(13) The canonical noun patterns in Standard Arabic

(a) H	(b) LL	(c) LH	(d) HL
baħr	*badal*	*waziir*	*kaatib*
33%	7%	21%	12%
(e) HH	(f) HL	(g) HH	
jaamuus	*xanjar*	*jumhuur*	
2%	14%	11%	

These are glosses for the representative examples; 'sea', 'substitute', 'minister', 'writer', 'buffalo', 'dagger', 'multitude'. All patterns are well represented except for (e), which is probably a historical innovation in Arabic.

The classification of nouns in (13) according to the syllable-weight patterns assumes final consonant extraprosodicity, which is independently motivated in Arabic. Modulo this, we observe that the shapes of canonical nouns range from a lower bound at the bimoraic MinWd (H or LL) to an upper bound at the maximal disyllabic HH. These observations can be expressed in terms of prosodie conditions on canonical noun stems ($Stem_N$):

(14) Prosodie conditions on canonicity of $Stem_N$

(a) Minimally bimoraic	(b) Maximally disyllabic
$Stem_N$ = PrWd	$Stem_N$ [] σσ

Because the morphological category $Stem_N$ is equated with the prosodie category PrWd, a $Stem_N$ must contain a foot, under the Prosodie Hierarchy, and so it is minimally bimoraic, as required by Foot Binarity. The maximality condition is a natural one under general considerations of locality, which impose an upper limit of two on rules that count (McCarthy and Prince 1986); but it can perhaps be given an even more direct prosodie interpretation in terms of conditions on branching (Itô and Mester, 1997) or through an additional foot type, the generalized trochee of Prince (1980), Hayes (1995), and Kager (1992). Details of formulation aside, the minimality and maximality conditions define a family of templates in Arabic, with each member of that family available for particular morphological functions in the nominal system. This shows that the fundamental structural properties of root-and-pattern morphological systems can and should be characterized in prosodie terms.

In the varieties of Prosodie Morphology reviewed so far, the structural constraint falls entirely on the output, characterizing its shape without dependence on any phonological properties of the input. For example, a morphological category can be specified as "MinWd" regardless of whether an input base is itself minimal, supraminimal, or subminimal. There is, however, an important class of cases in which aspects of base shape also play a role in determining output form. These have been analyzed as involving the notion of *prosodie circumscription*.

Typically, affixation is defined on purely *grammatical* entities, adjoining an affix node to morphological categories such as root, stem, or (morphological) word, without regard to their phonological content. The result is ordinary prefixation or suffixation. Under prosodie circumscription, though, affixation or other morphology applies to a phonologically defined prosodie base situated within the grammatical base. The result is often some sort of infix, though there are many applications of prosodie circumscription extending beyond infixation.

Ulwa, a language of the Atlantic coast of Nicaragua, presents a remarkably clear case of infixation by prosodie circumscription (Hale and Lacayo Blanco 1989; Bromberger and Halle 1988; McCarthy and Prince 1990a, 1993a, b). The stress system of Ulwa is iambic, with the main stress falling on the leftmost foot. Remarkably, the possessive morphology of Ulwa is marked by a set of infixes located immediately after the main-stress foot:

(15) Ulwa possessive

(a) Forms of possessive

sú:lu	'dog'	sú:kinalu	'our (excl.) dog'
sú:kilu	'my dog'	sú:nilu	'our (incl.) dog'
sú:malu	'thy dog'	sú:manalu	'your dog'
sú:kalu	'his/her dog'	sú:kanalu	'their dog'

(b) Location of infixes (noun + 'his')

(i) After heavy initial syllable	
bás-ka	'hair'
kí:ka	'stone
sú:-ka-lu	'dog'
ás-ka-na	'clothes'
(ii) After peninitial syllable	
saná-ka	'deer'
amák-ka	'bee'
sapá:-ka	'forehead'
siwá-ka-nak	'root'
kulú-ka-luk	'woodpecker'
aná:-ka-la:ka	'chin'
arák-ka-bus	'gun'
karás-ka-mak	'knee'

The fundamental idea of prosodie circumscription is that infixes like Ulwa *-ka*, *-ki*, *-ma*,... are actually suffixes, but suffixes on the *prosodically circumscribed* initial foot within the Ulwa noun stem. The theory of prosodie circumscription aims to make precise and extend this basic idea. The analysis of Ulwa and the (quasi-) formal construction of circumscription theory on which it is based are presented in McCarthy and Prince 1990a; certain aspects of the approach recall earlier proposals in Broselow and McCarthy 1983 and McCarthy and Prince 1986.

Central to the formal development is a parsing function Φ(C, E, B) which returns the designated prosodie constituent C that sits at the edge E of the base B. The constituent C is thereby circumscribed; the initial foot of Ulwa is an example of exactly such a C. For notational convenience, we will write Φ(C, E, B) – the result of applying Φ – as B:Φ <C, E>, emphasizing that this is the portion of base B that falls under the description <C, E>. (In line with this usage, we will refer to the parsing function as Φ <C, E>, mentioning only its settable parameters.) In the case of Ulwa *karasmak*, for example, the circumscribed initial foot *karas* would be described as *karasmak*: Φ <Ft, L>.

The function Φ induces a factoring on the base B, dividing it into two parts: one is the kernel B:Φ, satisfying the constraint <C, E>; the other is the *residue* B/Φ, the complement of the kernel within B.[10] Assuming an operator "*" that gives the relation holding between the two factors (often left- or right-concatenation), the following identity holds:

(16) Factoring of B by Φ
B = B:Φ * B/Φ

Concretely, using Ulwa *karasmak*, we have the following analysis:

(17) Factoring of the Ulwa noun
karasmak = *karasmak*:Φ * *karasmak*/Φ

= *karas* * *mak*

The word is factored *initial foot* + *anything else*; that is, kernel + residue, in that order.

In *positive prosodie circumscription*, the specified prosodie constituent B:Φ serves as the base for the morphological operation. Let O be a morphological or phonological operation, so that O[X] is that operation applied to a base X. We can now define 'O:Φ' – the very same operation, but conditioned by positive circumscription of <C, E> – in the following way:

(18) Operation applying under positive prosodie circumscription
$O{:}\Phi\ [B] =_{df} O[B{:}\Phi] * B/\Phi$

To apply O to B under positive prosodie circumscription, is, by this definition, to apply O to B:Φ. The result stands concatenated with B/Φ in the same way ('*') that the kernel B:Φ concatenates with the residue B/Φ in the base B. In this way, the operation O:Φ inherits everything that linguistic theory tells us about O, except its domain of application.

The Ulwa possessive makes use of a parsing function that picks out the first foot of the base: Φ <Ft, Left>.[11] The morphological operations at issue are those that accomplish suffixation of the possessive markers. Suppose we write SUFFKA for the operation suffixing /ka/ 'possessed by 3psg.'. Appropriately circumscribed, the operation becomes SUFFKA:Φ <Ft, Left> Suffixation of the possessive now unfolds as follows:

(19) Possessive suffixation under prosodie circumscription

SUFFKA:Φ [*karasmak*]	= SUFFKA [*karasmak*:Φ]	* *karasmak*/Φ
	= SUFFKA [*karas*]	* *mak*
	= *karas-ka*	* *mak*
	= *karaskamak*	

The initial iambic foot, rather than the whole noun, functions as the base for suffixation of the possessive morpheme, leading to surface infixation. In the limiting case of words consisting of a single iambic foot, like bas or *ki*:, the infixes are actual suffixes, since B and B:Φ are identical.

In *negative prosodie circumscription*, the morphological operation is applied to the residue of circumscription, the B/Φ portion, which is what remains when the mentioned constituent C is disregarded. Symmetrically with positive circumscription, we can define an operation circumscribed to apply to the residue:

(20) Operation applying under negative prosodie circumscription
$O/\Phi\ [B] =_{df} B{:}\Phi * O\ [B/\Phi]$

This formalizes extrametricality. To apply operation O to base B *under extrametricality* is just to apply O to the residue of circumscription, B/Φ. For example, in the prototypical final-syllable extrametricality case of stress rules, a stress rule O applies to B/Φ <σ, R> – the base disregarding the final syllable. Exactly paralleling positive circumscription, the result of applying O to B/Φ stands concatenated with B:Φ in the same way as B/Φ concatenates with the kernel B:Φ in the original base B.

A common type of infixing reduplication requires negative circumscription of an *initial onsetless syllable*, one that starts with a vowel, rather than a consonant. An example of this comes from the Austronesian language Timugon Murut:

(21) Timugon Murut reduplication (Prentice 1971; McCarthy and Prince 1991a, 1993a, 1993b: ch. 7)

bulud	*bu*–bulud	'hill/ ridge'
limo	*li*–limo	'five/ about five'
ulampoy	u–*la*–lampoy	no gloss
abalan	a–*ba*–balan	'bathes/often bathes'
ompodon	om–*pa*–podon	'flatter/always flatter'

The reduplicative template in Timugon Murut is a light syllable, σ_{μ} It copies material of the base, minus an initial onsetless syllable, if any. We might therefore characterize it as PREFRED/Φ<σ^{v}, Left>, where σ_{v} is a temporary expedient for "onsetless syllable" and PREFRED stands for the operation of prefixing the reduplicative morpheme. Applied to the final example in (21), this schema yields the following result:

(22) Negative prosodie circumscription in Timugon Murut

PREFRED/Φ [*ompodon*]	= *ompodon*:Φ	* PREFRED [*ompodon*/Φ]
	= *om*	* PREFRED [*podon*]
	= *om*	* σ_{μ}–*podon*
	= *om*	* *po*–*podon*
	= *ompopodon*	

The morphological base *ompodon*, minus its initial syllable *om*, functions as the prosodically circumscribed base to which the operation of prefixing a σ_{μ} template applies. Crucially, it is the residue of circumscription, rather than the kernel, that is the target of the morphological operation. When the initial syllable has an onset, as in *bulud*, the kernel of circumscription is empty, and the entire base *bulud* is the residue to which the reduplicative template is prefixed.

Prosodie circumscription succeeds in unifying a wide range of phenomena that are sensitive to phonological subdomains, embracing under one theory operations that target a constituent, as in Ulwa, and those that exclude a constituent ("extrametricality"), as in Timugon Murut. The theory situates Prosodie Morphology within broader principles holding for all kinds of phonology and morphology, thereby addressing the fundamental explanatory goal of the enterprise. But Timugon Murut represents a kind of limiting case for prosodie circumscription theory (and, more generally, for its congener, extrametricality). Indeed, the limit appears to have been exceeded, for two reasons. First, the onsetless syllable, though granted the ad hoc symbolization σ_{w}, is not a legitimate prosodie constituent – on the contrary, it is a *defective* prosodie constituent. So its role in Timugon Murut circumscription contravenes principle (1c), which entails that recognized constituents be employed in circumscription criteria. Second, infixes with the same locus of placement as Timugon Murut are *always reduplicative*, to the best of our knowledge. Reduplicative infixes that go after an initial onsetless syllable are common and widespread, being found also in the Sanskrit aorist and desiderative (Kiparsky 1986, McCarthy and Prince 1986, Janda and Joseph 1986: 89), the Philippine Austronesian language Pangasinân (Benton 1971: 99, 117), and the non-Austronesian languages of Papua New Guinea Yareba (Weimer and Weimer 1970,1975: 685), Orokaiva (Healey et al. 1969: 35–6), and Flamingo Bay Asmat (Voorhoeve 1965: 51). Ordinary, nonredu-plicative infixes never show this distribution. There is an evident interaction: positioning an affix after an initial onsetless syllable is dependent upon the affix's being templatic and reduplicative rather than segmentally specified. Circumscription theory cannot explain this, because it formally divorces the placement of an affix from the structural nature of the affix. We now turn to "work which aims to derive this kind of connection.

3 Recent developments

Much current work in Prosodie Morphology is set within Prince and Smolensky's (1993) Optimality

Theory. Optimality Theory asserts that grammars consist of hierarchies of universal constraints that select among candidate output forms; constraint interaction is via this language-particular hierarchy, in "which lower-ranking constraints are violated when violation leads to satisfaction of a higher-ranking constraint. Since the constraints are universal (up to the fixing of parameters inherent in the formulation of some constraints), the grammar of a particular language consists of a ranking of the universal constraint set.

The application of Optimality Theory to Prosodie Morphology can be illustrated with a small part of the reduplication system of Axininca Campa (Arawakan, Peru), drawn from the complete treatment in McCarthy and Prince (1993b: ch. 5). (For important earlier work on this system, see Payne 1981, Spring 1990, Black 1991.) The normal pattern in Axininca Campa is total root reduplication (23a), but, under particular phonological circumstances, more or less than the whole root may be reduplicated. In particular, when the root is vowel-initial and long (23b), its first syllable is not reduplicated.

(23) Reduplication of long unprefixed roots in Axininca Campa (Payne 1981, Spring 1990, McCarthy and Prince 1993b)
(a) Consonant-initial long roots

/*kawosi*/	*kawosi-kawosi*	'bathe'
/koma/	koma-*koma*	'paddle'
/t^{h}aaŋki/	t^{h}aaŋki-*t^{h}aaŋki*	'hurry'

(b) Vowel-initial long roots

/osampi/	osampi-*sampi*	'ask'	*osampi-*osampi*
/osaŋkina/	osaŋkina-*saŋkina*	'write'	*osaŋkina-*osaŋkina*

The constraint responsible for total reduplication of consonant-initial long roots like those cited in (23a) is MAX (McCarthy and Prince 1993b, 1994a, b):

(24) MAX
Reduplicant = Base.

In total reduplication, there is no templatic requirement to be met (McCarthy and Prince 1986, 1988), so MAX is the sole determining factor. For a form like *kawosi*, MAX imposes a ranking on candidate reduplicants in which the exact copy *kawosi* itself stands at the top, ahead of all partial copies, such as *wosi* or *si*. The optimal candidate reduplicant is therefore *kawosi*. Undominated (and therefore unviolated), MAX will always yield total reduplication – maximal identity between base and reduplicant.

But MAX is crucially dominated in Axininca Campa, as shown by the incomplete reduplication of vowel-initial *osampi* or *osaqkina* (23b). The reason for the failure of perfect copying in these forms lies with the constraint ONSET, which prohibits onsetless syllables:

(25) ONSET (formulation from Itô 1989: 223)
*[$^{\sigma}$V

Any candidate reduplicant that exactly copied a base shaped /V … V/ would have hiatus at the base-reduplicant boundary, violating ONSET, as in **osampi.osampi*. Therefore, the grammar of Axininca Campa must contain the ranking provision ONSET » MAX, compelling less-than-full copying, but satisfying ONSET. The following tableau shows this:[12]

[æñdʒ]

Other logical possibilities, such as epenthesis at the base–reduplicant juncture, are barred by additional constraints that are known independently to dominate MAX (see McCarthy and Prince 1993b: ch. 5). The point here is that the reduplicant need not violate ONSET, and in fact it doesn't, at the price of a MAX violation. Since MAX is lower ranking, failure on MAX – that is, partial reduplication – is irrelevant to deciding the outcome.

The same ONSET constraint can also be applied to the problem of Timugon Murut, signaled above in section 2, by recruiting an idea in Prince and Smolensky 1991, 1993. They propose that the prefixal or suffixal positioning of a morpheme can be conceived of as a violable constraint; and one possible way of violating such a constraint is infixation. For a case like Timugon Murut, where the infix is fundamentally a prefix, the constraint responsible is ALIGN RED–L:

(27) ALIGN–RED–L
Align (RED, Left, Stem, Left)
"The left edge of the reduplicative morpheme RED aligns with the left edge of the Stem."
i.e. "The reduplicant stands initially, is a prefix."

The formalization comes from McCarthy and Prince (1993a), though details are not relevant here. The point is that obedience to ALIGN–RED–L ensures the absolute prefixal status of RED. However, disobedience can be compelled by higher-ranking constraints. Under general principles of Optimality Theory, any violation of ALIGN–RED–L must be minimal, so that RED will lie *as near as possible* to the initial word edge, given that it maximally satisfies any higher- ranking constraints.

The Timugon Murut reduplicative affix is prefixed to C-initial bases (*bubulud*) but infixed in V-initial bases (*om–po–podon*). Simple prefixation runs into problems with ONSET that infixation (i.e. violation of ALIGN–RED–L) successfully avoids. Reduplicating *ompodon* as **o.ompodon* is syllabically less harmonic than reduplicating it as *om.po.podon* because **o.ompodon* duplicates an ONSET violation.

Formally, this means that ONSET forces violation of ALIGN–RED–L; in terms of ranking, ONSET dominates ALIGN–RED–L in the grammar of Timugon Murut:

[dʒækwi:]

Ill-alignment (= infixation) spares an ONSET violation. With the ranking ONSET » ALIGN–RED–L, the unaligned *om–po–podon* is optimal. By contrast, in C-initial forms like *bu–bulud*, ONSET is obeyed by even the properly aligned candidate, so infixation is unnecessary – and therefore impossible, since it would involve gratuitous violation of ALIGN–RED–L.[13]

Recall that this infixal locus is observed only with *reduplicative* affixes, and never with segmentally specified (i.e. nonreduplicative) affixes. The proposal here explains why: reduplicating the initial onsetless syllable of *ompodon* would copy the ONSET violation. With segmentally specified affixes, regardless of their shape, the circumstances are different, since they cannot duplicate a violation of ONSET. (For formal analysis, see McCarthy and Prince 1993b: ch. 7.)

This result answers the two objections against a circumscriptional treatment of Timugon Murut raised at the end of section 2. There is no problem here of referring to the onsetless syllable as a type of (defective) prosodic constituent. Rather, the distribution of the infix is determined by the high rank of the constraint ONSET, an uncontroversial part of the universal theory of the syllable. Equally significantly, the fact that only reduplicative infixes are observed with this distribution is no longer mysterious, but rather follows from the constraint interaction responsible for this type of infixation.

We have just suggested how Prosodic Morphology within Optimality Theory can provide the first steps toward a real theory of infixability, predicting both what kind of morpheme shapes can be infixed at all and where they can lodge in their hosts. It also sheds further light on the theory of templates, sharpening and extending the predictions made by the Prosodic Morphology Hypothesis (Ia). We will

focus on the MinWd template, improving on the analysis of Diyari sketched in section 2.

The question raised by Diyari and similar cases is *why* the minimal word should be a possible reduplicative template. Linguistic theory ought to provide more than a heterogeneous list of the reduplicative templates that happen to be observed in various languages. The goal here is to explain why the Diyari reduplicant is identical to the minimal word of the language, without invoking the notion of minimality, or perhaps the notion of *template*. If the argument is successful, the minimality property will be shown to follow from the interaction of the universal constraints on prosodic form, whose status is quite independent of any phenomena of prosodic morphology.

To accomplish this goal, we require some background about a particular aspect of prosodic theory as developed within Optimality Theory (Kirchner 1993, McCarthy and Prince 1993a). The stress pattern of Diyari, illustrated in (29), pairs up syllables into feet from left to right:[14]

(29) Diyari stress (Poser 1982, 1989)

(kàŋa)	'man'
(pína)du	'old man'
(ŋànda)(wàlka)	'to close'

The following constraints are responsible for this stress pattern:

(30) ALL-FT-LEFT
Align (Ft, L, PrWd, L)
"The left edge of every foot aligns with the left edge of some PrWd." = "Every foot is initial in the PrWd."
= "Every foot is initial in the PrWd."

(31) PARSE-SYLL
Every syllable belongs to a foot.

With the ranking PARSE-SYLL » ALL-FT-LEFT, the pattern of directional footing observed in Diyari is obtained. According to ALL-FT-LEFT, all feet should be *exactly at* the left edge. This constraint is satisfied when there is just one foot in the entire word. In partial contradiction, the constraint PARSE-SYLL requires that every form be fully footed, demanding multiple feet in longer words.[15] Thus, ALL-FT-LEFT will never be completely satisfied in words longer than three syllables, which will have more than one foot. But under minimal violation of ALL-FT-LEFT, a multifoot form must have its feet *as close to* the beginning of the word as possible. This is the foot-placement effect attributed to left-right directionality.[16]

In a quinquesyllabic form (σσ)(σσ)σ, both PARSE-SYLL and ALL-FT-LEFT are violated. PARSE-SYLL is violated because there is always an unparsed syllable in odd-parity words, because Foot Binarity is undominated. ALL-FT-LEFT is violated because the non-initial foot is misaligned. (See McCarthy and Prince 1993a, elaborating on the proposal of Kirchner 1993, for further development.)

Observe that these constraints are often violated, but are nevertheless consequential even when violated. Both constraints can, however, be obeyed fully. In that case,

Every syllable is footed (PARSE-SYLL is obeyed)

and

Every foot is initial (ALL-FT-LEFT is obeyed).

Only one configuration meets both of these requirements, the minimal word, since it has a single foot that parses all syllables and is itself properly left- aligned:

$[Ft]_{PrWd}$ i.e. $[(\sigma\sigma)_{Ft]]Prwd}$ *or* [(μμ)Ft]Prwd

Thus, the minimal word is the most harmonic prosodic word possible, with respect to PARSE-SYLL and ALL-FT-LEFT – indeed, with respect to every form of Ft/PrWd alignment. Of course, the single foot contained within the minimal word is optimally binary, because of FT-BIN. Hence, the most harmonic prosodic word, with respect to these metrical constraints, is a disyllabic in any language that does not make syllable-weight distinctions.

Diyari is such a language. Recall that the reduplicant is a free-standing PrWd, as evidenced by its stress behavior and vowel-final status. This is, in fact, *all* that needs to be said about the Diyari reduplicant:

(32) Templatic constraint
R = PRWD
"The reduplicant is a prosodic word."

There is no mention of the "minimal word" in this *or in any other* templatic requirement. Rather, minimalization follows from the ranking of PARSE-SYLL and ALL-FT-LEFT, in particular from their domination of MAX, the reduplicative constraint that demands total copy. If the base of reduplication is greater than a minimal word, the reduplicant will contain a less-than-complete copy, violating MAX but obeying high-ranking PARSE-SYLL and ALL-FT.

Consider, first, MAX violation under domination by PARSE-SYLL:

Hypocoristics in Japanese (Poser 1984, 1990)

Name	Hypocoristic	
ti	tii-čan	
šuusuke	šuu-čan	*šuusu-čan
yoosuke	yoo-čan	*yoosu-čan
taizoo	tai-čan	*taizo-čan
kinsuke	kin-čan	*kinsu-čan
midori	mii-čan	*mi-čan
	mit-čan	
	mido-čan	

Form (b) is a perfect copy, as indicated by its success on MAX. But success on MAX is purchased at the intolerable cost of a gratuitous PARSE-SYLL violation. Less-than-full copying is available that avoids this unparsed syllable, and given the dominance of PARSE-SYLL, this is more harmonic, as (a) shows.

The "minimalization" of the reduplicant follows from this ranking. Other seemingly plausible candidates fare no better against (a). Consider these, for example, which violate undominated constraints:

ONSET ≫ MAX, from /osaŋkina + redup./

	Candidates	ONSET	MAX
(a)	o.saŋkina-*.o.saŋkina*	** !	
(b) ☞	o.saŋkina- *saŋkina*	*	*

The failure of these candidates ensures the validity of the ranking argument just given.

A parallel ranking argument can be constructed for ALL-FT-LEFT and MAX, using a quadrisyllable root as input. (Unfortunately, no reduplicated quadrisyllables are cited by Austin, so this example is hypothetical.)

ONSET ≫ ALIGN-RED-L, from /redup. +ompodon/

	Candidates	ONSET	ALIGN-RED-L
(a)	|*o*.om.po.don	** !	
(b)	|*om*.om.po.don	** !	
(c) ☞	|om.*po*.po.don	*	*
(d)	|om.po.*do*.don	*	** !

In (b), the reduplicant fatally violates ALL-FT-LEFT, since it contains an unaligned foot, while (a) avoids that violation by less-than-full copying. Another failed candidate, *(*ŋanda*)*wa*-(*ŋanda*)(*walka*), incurs a fatal violation of PARSE-SYLL, which also dominates MAX, as was just demonstrated.

Both ALL-FT-LEFT and PARSE-SYLL are fully obeyed by the reduplicant, and this explains why it is minimal-word-sized. There is no need for a minimal- word template; rather, the templatic requirement is simply the prosodic word, with "minimalization" obtained from constraint interaction, via the ranking PARSE-SYLL, ALL-FT-LEFT » MAX.

The success of the accounts of both the Timugon Murut and Diyari examples is inextricably linked with the Optimality-Theoretic principles of constraint ranking and violation. In Timugon Murut, low-ranking ALIGN-RED-L is violated under the compulsion of ONSET. Nonetheless, violation is minimal, as usual in Optimality Theory. More remarkably, even ONSET itself is violated in this language, not only word-initially (*ulampoy, ompodon*) but also medially:

(35) ONSET violation in Timugon Murut

ambilú.o	'soul'	"two distinct phonetic syllables" (Prentice 1971: 24)
nansú.i	'slanting'	"both vowels are syllabic" (ibid.: 25).
lógo.i	'the price'	"two phonetic syllables" (ibid.)

ONSETis violated when obeying it would run afoul not of RED/Stem alignment, but of *faithfulness* to the underlying segmentism. That is, satisfaction of ONSET cannot be bought at the price of deleting or inserting segments, because faithfulness constraints dominate ONSET. (For various approaches to formaliz ing these faithfulness constraints, see Prince and Smolensky 1993 and McCarthy and Prince 1994a, b.)

Faithfulness likewise plays a role in Diyari. In contrast to the reduplicant, ordinary stems of Diyari (including the base of reduplication), may violate PARSE-SYLL and/or ALL-FTLEFT. The reason for this is that ordinary stems must honor the commitment to their underlying segmentism: that is, faithfulness constraints, which require that all input segments be realized in the output, crucially dominate the responsible metrical constraints PARSE-SYLL and ALL-FTLEFT.

In Optimality Theory, a form is marked with respect to some constraint if it violates it; hence, the universal constraints embody a theory of markedness (Prince and Smolensky 1993, Smolensky 1993). In particular, the constraints ONSET, PARSE-SYLL, and ALL-FTLEFT constitute part of a theory of prosodic markedness. In both Timugon Murut and Diyari, these constraints stand in the middle of a hierarchy

Faithfulness « "Prosodic Markedness" « X. They are crucially dominated by Faithfulness, as shown by the fact that they are freely violated when respecting the input is at stake. Yet they themselves dominate X, a constraint of *morphological* markedness, like ALIGN-RED-L or MAX, that demands a particular structure under morphological conditions. Given this ranking, X must be violated whenever it is possible to achieve a phonologically less marked structure, even though that less marked structure is not consistently observed in the language as a whole. This result, dubbed "emergence of the unmarked" by McCarthy and Prince (1994a), is fundamental to Optimality Theory, since it derives from the theory's intrinsic conception of constraint ranking and its role in linguistic typology.

4 Prospects

As research in Prosodic Morphology proceeds to explore connections between its phenomena and the general principles of phonology and morphology, we expect to find a continuing diminution of dependence on parochial assumptions, and correspondingly greater reliance on independent principles of form, perhaps within the context of Optimality Theory. We will highlight two prospects here.

Under Optimality Theory, where grammars are rankings of interacting constraints, ranking must also be the proper way to characterize phenomena like those studied in Prosodic Morphology. The hypothesis is that all of Prosodic Morphology should be understood in terms of a general ranking schema: "P dominates M" (P « M), where P stands for some prosodic constraint, and M stands for some morphological one (McCarthy and Prince 1993b). To paraphrase, in the analysis of prosodic-morphological phenomena, some phonological constraint must dominate some morphological constraint, forcing it to be violated minimally.

The ranking required in Axininca Campa and Timugon Murut conforms to this P ' M schema: the P-constraint ONSET dominates the M-constraints MAX and ALIGN-RED-L (respectively), which pertain to the exactness of reduplicative copying and the positioning of the affix with respect to the Stem. Likewise in Diyari, the P-constraints PARSE-SYLL and ALL-FT-LEFT crucially dominate the M-constraint MAX. Interesting questions arise about the full range of P- and M-constraints that may be subsumed under this schema.

Another matter rendered ripe for rethinking is the status of templates in Prosodic Morphology. A striking feature of the analysis of Diyari in section 3 is the relatively minor role played by the template. Instead of stipulating that the template is a foot or minimal word, it is sufficient to say that the reduplicant is a prosodic word; other properties of the Diyari reduplicant follow from appropriate ranking of the (quite independent) metrical constraints that specify the character of the most harmonic prosodic word.

It is possible to go still further in reducing the role of templates in Diyari and similar cases (McCarthy and Prince 1994b). The morphological category Stem has a characteristic congeries of phonological properties; in particular, the most harmonic Stem is one that is analyzed as a prosodic word, and appropriate rankable constraints demand this.17 We can therefore say that the Diyari reduplicant is a Stem, so the reduplicative formation is a Stem-Stem compound. This is sufficient, with no loss of descriptive accuracy, since the reduplicant's status as a prosodic word – and a minimal prosodic word to boot – will follow from appropriate ranking of the constraints that define the harmony of Stems and prosodic words.

There is, then, no template at all in Diyari or, by extension, in any other case of a minimal-word reduplicant. Rather, the only stipulation in the grammar is that the reduplicative morpheme *is a Stem*. Such a declaration must be present in the lexicon at any rate, regardless of Prosodic Morphology, since it is necessary, on most theories of morphology, to specify the morphological status or level of each morpheme.

Pressing the hypothesis to its logical conclusion, we might say that smaller reduplicative morphemes, like the Ilokano examples in (6) and (8), are of the morphological category Affix, looking to independent prosodic properties of Affixes to account for their phonology. If this is successful, then all that is left of the reduplicative "template" is an irreducible minimum of morphological specification – no more than would be required for any morpheme – with the apparatus that is specific to

reduplication or Prosodic Morphology essentially eliminated.

1 Earlier proposals for including prosody in templatic morphology in various ways include Archangeli 1983, 1984; Broselow and McCarthy 1983; J. Levin 1983; Lowenstamm and Kaye 1986; Marantz 1982; McCarthy 1979, 1981, 1984a, b; Nash 1986: 139; and Yip 1982, 1983. Prosodic Morphology extends this approach to the claim that *only* prosody may play this role, and that the role includes circumscription as well.

2 Treatments of reduplication within Prosodic Morphology include Aronoff et al. 1987; Bagemihl 1991; Bates and Carlson 1992; Black 1993; Chiang 1992; Cole 1991; Crowhurst 1991a, b; Finer 1985; Goodman 1994; Hewitt and Prince 1989; Hill and Zepeda 1992; Kroeger 1989a, b; C. Levelt 1990; McNally 1990; Mutaka and Hyman 1990; Nivens 1992; Noske 1991; Schlindwein 1988, 1991; Shaw 1987, 1992; Spring 1990; Steriade 1988b; Stonham 1990; Weeda 1987; J. Williams 1991; Yin 1989; Yip 1991, 1992.

3 Satisfaction of the $\sigma_{\mu\mu}$ template in Ilokano principally involves MAX and related constraints discussed below in section 3. Particular cases in which the copying is less complete than it could be show the intervention of Ilokano-specific requirements. Words like *ro?ot* reduplicate as *ro:-ro?ot*, rather than **ro?-ro?ot*, because Ilokano bans syllable-final glottal stop. By a further peculiarity of Ilokano, word-final consonants cannot be copied, so forms like *trak* or *nars* 'nurse' also reduplicate with a long vowel.

4 The complexities of the system are extensively explored in Kager 1993; Hayes 1995; Hewitt 1992, 1994; Leer 1985a, b; Rice 1988; A. Woodbury 1987; and others.

5 The bimoraic minimum is clearly evidenced in English by the impossibility of light monosyllables, like [tə] or [ə], except as prosodically dependent function words. The monosyllable minimum is also seen in the system of irregular verbs, all uniformly monosyllabic modulo prefixes (or pseudo-prefixes, as in *believe*). If, indeed, monosyllabicity is an output constraint on the past-tense forms of irregulars, then the lack of *-əd* endings is explained (both *-d* and *-t* are used: *told, lost*). See Pinker and Prince 1988 for recent discussion. Spring 1990, McCarthy and Prince 1991a, b, Black 1993, and Hewitt 1994 deal with some of the issues surrounding subtypes of prosodic minimality.

6 The unsuffixed forms are themselves also subject to additional limitations on their final clusters: **And* < *Andrew*, **Christ* < Christine, **Naft* < *Naftali*, **Alb* < *Albert*, **Ald* < *Aldo*. Contrast *Mart*, *Walt, Barb*, etc. Evidently, certain consonant sequences are banned, by a restriction that must be imposed after suffixation, since *Andy*, etc., are acceptable. (The markedness of the illicit sequences is evidenced by their inclination to simplify, in English and elsewhere.) Interestingly, certain clusters can appear before *-ie* that are generally banned in the language: *Pengie* < *Penguin* [attested], *Ambie* < *Ambrose* [constructed]. The clusters *ŋg* and *mb* must be admitted by the monosyllable restriction, which therefore refers to general sonority considerations, but they are then disallowed by other constraints of the language, which apply to e.g. [æamb] but not [æmbi]. In short, the monosyllable restriction is a necessary condition on both suffixed and unsuffixed forms, completely eliminating all postvocalic clusters of rising sonority; additional restrictions eliminate other 'marked' clusters of falling sonority from syllable-final position on the surface (Borowsky 1986). For further discussion of this interesting nexus of facts, see McCarthy and Prince 1991a.

7 It is also always possible to attach the hypocoristic suffix *-çan* to the entire original name: hence, *midorican*, with three moras in the base; *wasaburoo-çan*, with five. In this case, no prosodic template is at work, and no restriction falls on the base. All short forms invoke the template: contrast licit *wasaburo-* < *wasaburoo* with illicit **taizo-* < *taizoo*.

8 References include, for the Afro- Asiatic family: McCarthy 1979, 1981, McCarthy and Prince 1990b, Bat-El 1989, Dell and Elmedlaoui 1992, Hayward 1988, Lowenstamm and Kaye 1986; for Miwok: Freeland 1951, Broadbent 1964, Crowhurst 1991b, Lamontagne 1989, Sloan 1991, N. Smith 1985, 1986, Smith and Hermans 1982; for Yokuts: Newman 1944, Archangel! 1983, 1984, 1991; for Takelma: Sapir 1922, Goodman 1988, B. Lee 1991.

9 *Canonical* nouns are those that are truly integrated into the morphological system, based on their ability to form broken plurals and other criteria. The vast majority of nouns in Arabic are canonical, but many (such as recent loans like *tilifuun* 'telephone') are not.

10 Some aspects of this approach to formalizing the theory of prosodic specification are influenced by Hoeksema's (1985) notion of a "head operation." Compare also the developments in Aronoff 1988.

11 Alternatively, we might see the target of circumscription in Ulwa as the *head* foot, rather than the

leftmost one, allowing the parsing function Φ to refer to the hierarchical notion *head* rather than, or in addition to, left and right edges. This idea is pursued, within an Optimality-Theoretic account, in McCarthy and Prince 1993b: ch. 7).

12 This table observes certain notational conventions: constraints are written (left to right) in their domination order, violations are marked by "*", and crucial violations are also called out by "!." Shading emphasizes the *irrelevance* of the constraint to the fate of the candidate. A loser's cells are shaded after a crucial violation, the winner's when there are no more competitors.

13 Notice that deeper infixation, as in **ompo-do-don*, fares no better on ONSET and even "worse on ALIGN-RED-L, so it cannot be optimal. A complete account of the system requires consideration of various other candidates, in which the problem with ONSET is resolved by other means: e.g. deletion or epenthesis. A particularly interesting candidate is the purely prefixal *o.m-om.po.don, where the reduplicant straddles a syllable boundary. Here the templatic requirement on the reduplicant – that it constitute a syllable – is not met, indicating the dominance of the templatic constraint. For discussion, see McCarthy and Prince 1993b: ch. 7.

14 Complications arise in polymorphemic words – see Poser 1989.

15 In Diyari, as in many languages, PARSE-SYLL is subject to Foot Binarity (5), which forbids the construction of degenerate feet. FxBiN therefore dominates PARSE- SYLL in Diyari, preventing the complete footing of odd-syllabled words. Indeed, FxBiN is unviolated in the language (except for ya 'and'), and therefore undominated.

16 In right-to-left footing, ALL-FT- RIGHT, the symmetric counterpart of ALL-FT-LEFT, is the active constraint.

17 A nearby case is the phonology of Stems with "Level II" affixes in English.

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15. Word Syntax

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Introduction

Leafing through older literature on generative grammar, one soon notes that the 1970s mark a beginning of an intensive discussion of word structure in that framework. This was, by and large, for the following reasons. First, Chomsky (1970) argued in the influential "Remarks on nominalization" that word-formation facts cannot be accounted for by means of transformational rules as had until then been assumed. Instead, he suggested, a lexical approach was appropriate, where the term *lexical* essentially means that complex words (such as those formed with derivational affixes) are accounted for in the so- called lexical component of the grammar ("Lexicalism") – in any case not in the syntax. Second, a fundamental theoretical reorientation was beginning to exert its effect in the 1970s, amounting to what can be described briefly as a move from rules to principles. This philosophy of research, in many ways shaping up as early as the 1960s (cf. Ross's 1967 thesis), began to regard gram matical constructions (e.g. passive) as resulting from the interaction of simple elementary principles, rather than as a product of construction-specific rules (e.g. a passive transformation). This approach has guided the development of generative theories to the present day.

Both of these trends, Lexicalism and the abandonment of a construction- oriented transformational grammar, had a perceptible influence on a number of studies, mostly from the early 1980s, that aimed at explaining properties of words by recourse to general grammatical principles rather than word- formation rules. Among them a distinct group of investigations emerged, including Lieber 1980, 1983; Moortgat et al. 1981; Selkirk 1982; Toman 1983; E. Williams 1981a, b; and others. It seems fair to say that Elisabeth Selkirk's (1982) monograph *The Syntax of Words* and a series of articles by Edwin Williams (including his 1981 a, b) became the most representative examples of this approach. The interest in this defined perspective continued well into the 1980s and beyond, as witnessed, among others, by On the definition of word, a monograph by Anna Maria Di Sciullo and Edwin Williams (1987), and *Deconstructing morphology* by Rochelle Lieber (1992). Alternative approaches to morphology also emerged, mainly in the work of Mark Baker (1988a); despite differences, however, Baker continues the word-syntactic tradition by relying on headed tree structures and employing percolation conventions (see below). In the present chapter, I will review the main tenets of the theory of word syntax that was emerging in the period described. For reasons of space the survey must remain highly selective. I will turn to basic issues only, but will, at a few places, include critical discussion. Inconclusive as this discussion often may be, it should draw the reader's attention to the strategies and pos sibilities that inhere in the framework presented here. Borer, MORPHOLOGY AND SYNTAX, also discusses some of these trends, from a slightly different viewpoint.

1 Word syntax as a theory of word competence

As pointed out, Chomsky (1970) prompted an increased interest in questions of morphology in

generative grammar, and a number of competing concepts of the lexicon emerged as a result. Two basic variants can be noted: one regards the lexicon as nothing more than a list – be it a list of morphemes, or of all nonderived words, or even of all actually occurring words of the given language. Alternatively, the lexicon can be seen as a component which hosts not only lists, but also rules that actually produce words; in this concep tion the lexicon emerges as an "active" component of the grammar. Most of these approaches claim the label "Lexicalism" for themselves, and, indeed, since Chomsky (1970), a popular opinion, bordering on value-judgement, has emerged, that sees Lexicalism as superior to any other theory that does not explicitly consider the existence of the lexicon (or a lexical component) in the grammar.

In some sense, however, the focus on the lexicon leads away from the clas sical question of generative theories. In generative syntax, for instance, the declared aim has been a principled representation of the (human) linguistic faculty rather than the study of lists. In view of this, it seems appropriate to recall that some researchers have argued that the lexicon itself is not the primary focus of morphological, or word-formation, theories, especially if understood as a real-time object. Of course, the "real-time" lexicon (Di Sciullo and Williams's (1987) "psychological lexicon") remains a legitimate object of inquiry, as witnessed by numerous psycholinguistic studies; but one cannot presume that list-based mechanisms of storage and retrieval are the basic mechanisms of the human "word-faculty." Discussing this issue, Di Sciullo and Williams have suggested:

> Morphology is more like syntax than heretofore thought. Both of course have lists – the list of primes, which are the words in syntax and the morphemes in morphology. In syntax there is of course no further list of "actual" versus "potential" phrases; the whole theory is about potential objects, though some are in fact actual (*How are you, kick the bucket*). In our view *morphology is a the ory of potential objects in exactly the same sense*.
>
> (Di Sciullo and Williams 1987: 21; emphasis added)

Rephrasing this point of view, one can say that a generative theory of word structure is in the first place a theory of the human word-forming capacity. Obviously, this approach frees up the investigator to study principles that govern "the ability to create and understand new words" (Toman 1983: 6) rather than stick to superficial differences in the material nature of the data investigated.

2 The internal syntax of words

2.1 Phrase structure morphology

The insight that words can be broken down into subconstituents is probably as old as the study of words itself. For instance, in the descriptive practice of American structuralists of the 1940s and 1950s, immediate constituent analysis proceeded unimpeded right into words. A major step in the understanding of word structure in early word-syntactic theories has been the apparently triv ial idea that word structure can be represented by means of phrase-structure rules. This "phrase structure morphology," to use D. G. Miller's (1993) term, stands in contrast to a number of studies characteristic of the classical Lexicalist period which attempted to make the so-called lexical rules radically dissimilar from those of syntax. Jackendoff (1975), for instance, developed so-called lex ical redundancy rules that were supposed to work in a dual way to actively create new words and passively assess the cost of irregular formations in the lexicon. These rules were only minimally concerned with the internal struc ture of derived words. But Jackendoff himself nearly abandoned this approach as he was introducing it. In the conclusions to his 1975 article, in which he was arguing for lexical redundancy rules *sui generis*, he suggested that phrase struc ture rules are a perfectly viable alternative to morphological redundancy rules (Jackendoff 1975: 668).

A data domain in which this "tree"-oriented approach has been applied with notable success is compounding in languages such as English, German, and the like. Thus Selkirk discusses at length how context-free rewriting rules should be modified in order to generate English compounds. Following is one of the variants of her rules for English compounds (Selkirk 1982: 16):

N	→	{N, A, V, P}	N	mill wheel smallpox rattle snake overdose
A	→	{N, A, P}	A	nationwide icy cold underripe
V	→	P	V	overdo

Leaving questions of detail aside, we note that this is a simple list of language-particular rules. Among other things, the list is so designed as not to generate structures such as [PP] or [VV]: that is, compound prepositions and compound verbs. This is accomplished by simply stipulating that the requisite rules are not included in the list. While this approach appears to be descriptively correct, a move to a principled analysis is not yet visible – the question of why the English compounding system shows the gaps it shows is not addressed.

Speculating about alternatives, we note that the flavor of arbitrariness inherent in such lists as (1) can be removed by allowing overgeneration and explaining the nonoccurring products by recourse to independent principles. In other words, rather than stating particular rules, we may generalize the above list of rules to a schema such as:

(2) $X \rightarrow YZ$

where X, Y, and Z stand for category variables, and try to explain the non-occurrence of overgenerated forms by recourse to independently motivated principles. Some of such explanations will presumably be universal; some, however, will remain language-particular. We note, for instance, that in Slavic languages compounding is generally not very popular, yet certain subtypes are surprisingly productive. In other words, if a schema such as (2) is assumed for Slavic languages, the burden of explanation actually consists in explaining away the nonexistence of most of its outputs. Although this strategy is in principle straightforward, work of this type has in general been rare, and there is still little understanding even of such basic questions as why certain language types have very productive compounding systems, while others do not.

While word syntax may have benefited initially from thinking about word structure in terms of phrase-structure rules, major progress has consisted in an assimilation of phrase-structure rules for words to the general theory of phrasal architectonics generally known as X-bar theory. (The above suggestion to generalize a list of phrase-structure rules to a structural schema such as (2) is in fact a rudimentary attempt to apply X-bar theory to the structure of words.) A crucial element of X-bar theory is the principle according to which phrases are either uniquely headed, or, perhaps in a special case (such as word-internal coordination – see below), have a level structure. An early version of the prin ciple of headedness for English words (then labeled as a rule) is Williams's:

(3) Right-hand Head Rule (RHR)
In morphology we define the head of a morphologically complex word to be the right-hand member of that word. (E. Williams 1981b: 248)

The principle remains domain-specific, though, in that it holds only in morphological structures. One may argue, however, that the problem is just a matter of a historical coincidence, in that the Right-hand Head Rule merely reflects the state of research in syntax prevalent at the point it was proposed. Recall, among other things, that early variants of X-bar theory accepted tern ary and higher branching. However, with an X-bar theory in place that permits binary branching only, one can in fact

use the left-right distinction – that is, a positional definition of head – in both syntax and word syntax. Naturally, important questions remain: among others, whether binary branching is a prim itive or a property to be explained. In the domain of maximal projections – that is, syntax proper – Kayne has suggested that binarity falls out from a principle that is independently needed to determine antecedent-anaphor rela tions uniquely (Unambiguous Path Principle, Kayne 1984). In word syntax, we may speculate, binarity might also be a consequence of higher-order principles which perhaps do not even have to be typologically comparable to principles like the Unambiguous Path Principle. Note, for instance, that a great number of derivational suffixes can be viewed as operators (functors) that operate on a single domain to form a (derived) single domain upon which another functor can operate. Thus the distinction operator/operans seems to imply binarity to start with.

Other definitions of headedness have been suggested in the word-syntax literature:

This, too, is a domain-specific definition proposed largely under the "pressure of facts," mainly the existence of particle verbs in English. Assuming *put up* to be a single unit, (3) identifies *up* as the head, implying that the whole unit is a particle. By contrast, (4) prevents this incorrect conclusion. But again, Selkirk's modification can be evaluated only vis-a-vis a particular analysis of particle verbs, not against unanalyzed facts. That *put up* is a simple word structure is far from clear; for instance, if we accept the analysis of verb- particle combinations in terms of small clauses, the apparently simple verb- particle concatenation will receive a more complex analysis, and it is not clear whether a modification such as (4) will retain its force on an alternative ana lysis. At any rate, the modified version does not comply with the binarity principle, and seems to hard generalize beyond word syntax.

2.1.1 Uniquely headed Structures Proceeding to other cases, we recall that Germanic compounding has proved to be particularly successful in demon strating the headedness of words. Thus German *Winternacht* 'winter night', a compound based on Winter 'winter' and *Nacht* 'night', is right-headed. This is demonstrated by the fact that the head subconstituent determines the gender of the entire compound (see below for additional discussion). Accordingly, NP-internal concord shows feminine morphology, since it takes Nacht (femi nine), not Winter (masculine), as a point of reference:

(5)

(a)	eine	stürmische	Winternacht
	'a	stormy	winter night'
(b)	* ein	stürmischer	Winternacht

Moreover, there is a semantic intuition that associates the head with a certain kind of reference. Under the set/subset perspective, a winter night is a kind of night rather than a kind of winter. This semantic intuition may not always be reliable, though, and thus cannot be the exclusive basis of a formal defini tion. For instance, the intuition as to whether the German derogative com pound *Kommunistenschwein* 'Commie pig' denotes a subset of pigs is hazy – I would suggest, rather, the possibility that *Schwein* 'pig' is an epithet of sorts, and that the compound actually denotes a subset of Communists. But what ever semantic subtleties might be involved, morphological data reveal more. Taking NP-internal concord into consideration again, we observe that the adjective agrees in gender with the neuter noun Schwein, not with the mascu line Kommunist in the following constructed examples:

(6)

(a) ein	häßliches	Kommunistenschwein
an (neuter)	ugly (neuter)	Commie-pig (neuter)
(b) *ein	haäßlicher	Kommunistenschwein
an (masc.)	ugly (masc.)	Commie-pig (neuter)

This is expected under the standard assumptions about headedness of German compounds.

Given the relative success of word syntax in the domain of compounding, it is not altogether surprising that among the strategies pursued in word syn tax has been an assimilation of suffixal derivation to compounding. In general, word-syntactic analyses regard what have traditionally been termed "deriva tional affixes" as bound tokens of parts of speech they in turn derive. Thus -er in German *Les-er* 'reader', *-ness* in English *empti-ness*, etc., are essentially interpreted as bound nouns occupying the head position of a complex noun. The reasoning is that it is these elements which provide the relevant mor phological properties (Lieber's (1992) categorial signature – see below) of the complex words they appear in. Thus in *Les-er*, the base is a verbal root, but the entire structure is a masculine noun; it is thus reasonable to conclude that the suffix apparently has the relevant nominal features – that is, that it acts as a noun.

While not differing from other, perhaps more prototypical, nouns in having the categorial label "noun", derivational suffixes differ in other respects, though. For instance, their lexical entries include specific subcategorization frames:

er, [V^0 ____]N
ness, [A^0 ____]N

Suffixes may in addition carry morphophonemic information: for example, about ablaut, accentuation, and other similar properties.

Early work in word syntax, such as Selkirk 1982, was hesitant about analyzing inflectional suffixes as heads. To be sure, the semantic intuitions about headed- ness discussed above in connection with compounds like *Winternacht* break down when forms such as *hous-es* or (*they*) *work-ed* are tested. Clearly, the absence of a natural intuition along set/subset lines in these cases is an inter esting cognitive fact in and of itself. However, more recent generative studies of the role and structure of so-called functional categories have removed some of the barriers to regarding inflectional suffixes as heads. Staying with verbal forms, we note that they are derived by incorporating the verbal root into the functional head carrying inflectional features by so-called head-to-head move ment. In this system (inspired by Pollock 1989) inflected words are thus created in syntax by movement. Outside generative grammar, however, the idea that inflectional formatives are heads remains controversial.

2.1.2 Level Structures (coordination) It is interesting to note that besides the X-bar schema for uniquely headed structures (cf. (2)) the X-bar schema for coordinate structures is also instantiated in word-syntactic structures, although with severe restrictions (cf. Toman 1985). Turning to German again, we observe the following grammaticality judgments:

(8) schwarz-weßer Hintergrund
'black-white background'

The meaning is that the background is black and white. Among the points to be explained is why only and readings are acceptable in such structures; coordinate compounds comparable to disjunctive or negated phrasal coordina tions like *black or white, neither black nor white*, do not seem to exist.

Other questions arise also. Observing compounds such as:

(9) Kind-Mutter-Beziehung

'child-mother relationship'

note that the "coordinate subcompound" *Kind-Mutter* is distributable only in the nonhead position of the compound. In other words, the following form cannot appear as a freely distributable compound:

(10) *Mutter-Kind
'mother-child' (on the attempted reading "mother and child")

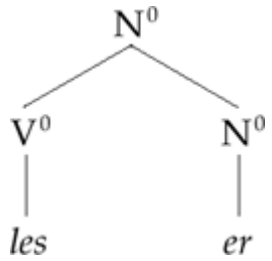
By contrast, such compounds are quite acceptable in languages such as Sanskrit and a number of contemporary languages of the Indian subcontinent (cf. Fabb, COMPOUNDING). It is not clear why languages show such restrictions.

3 Operations on base-generated word structure

Once we accept the idea that word structure can be related in a principled manner to the structure of phrases in general, it is natural to ask whether other principles of grammar apply to word structure, or whether word struc ture remains in some sense autonomous. Below, I will discuss three subtheories that shed some light on this issue. First, I will review word-syntactic literat ure on percolation, a mechanism claimed to be specific to word syntax. I will speculate on whether percolation could be understood as a general, domain- independent mechanism. Subsequently, I will discuss two subtheories of gen erative grammar, Case theory and Theta theory, both of which were designed independently of word syntax. I will be mostly interested in whether they also apply to word structure. The reader is referred to other sources for comple mentary information (D. G. Miller 1993, in particular, contains a discussion structured along similar lines to mine; Lieber 1992 discusses the validity of the theory of Binding in word syntax; and Spencer 1991 discusses questions of argument structure in complex words extensively).

3.1 Percolation

Continuing the discussion of examples such as Leser 'reader' from a slightly different angle, we recall that in German the suffix -er, traditionally under stood as a derivational affix, derives, among other things, agent nouns from deverbal bases (Les_{V}-*er*, Lehr_{V}-*er*). The products of this process are invariably masculine nouns belonging to the so-called strong declension. Positing the tree representation in (11):



and assuming the approach to suffixes discussed above, it is evident that the properties "masculine" and "strong declension" do not materialize on the mother node in an arbitrary manner. If agent noun spellout proceeded with out reference to the suffix, there would be no principled reason why Leser could not be a feminine noun, for instance.

As gender and declension features are clearly associated with a particular suffix, one might account for their accessibility either by making them visible in situ (where corresponding rules of case affixation and agreement would check them) or by devising a mechanism that copies them on the mother node. The latter analysis implies that the whole word has morphological properties, including gender, while the former implies that this is technically not the case. In general, the traditional position that the entire complex word has morpho logical properties has been accepted in word syntax, and so-called percolation (or "inheritance") mechanisms have been postulated that make the features of the head visible on the mother node. Lieber's (1983) percolation conven tions (first

articulated in Lieber 1980) were an early attempt in this direction; Selkirk's (1982) definition seems simpler, however:

(12) Percolation
(a) If a head has a feature specification [αF_i], a $\neq$ u, its mother node must be specified [αF_iI, and vice versa.
(b) If a nonhead has a feature specification [βF_jI, and the head has the feature specification [uF_jI, then the mother node must have the feature specification [βF_j].
(Here, *u* stands for unspecified feature value.) (Selkirk 1982: 76)

More recent discussions of percolation revolve, among other things, around the question of what properties can percolate in the first place. The problem has been explicitly addressed by Lieber (1992), who argues that not any fea ture can percolate. Lieber's definition of percolation principles is based on Selkirk 1982, but introduces some subtle distinctions:

(13) (a) Head percolation
Morphosyntactic features are passed from a head morpheme to the node dominating the head. Head percolation propagates the categor- ial signature.
(b) Backup percolation
If the node dominating the head remains unmarked for a given feature after head percolation, then a value for that feature is percol ated from an immediately dominated nonhead branch marked for that feature. Backup percolation propagates only values for unmarked features and is strictly local. (Lieber 1992: 92)

Among the distinctions Lieber is introducing is the notion of "categorial sig nature": that is, the set of morphosyntactic features that are allowed to percol ate. Such feature sets are category- and language-specific:

(14) English nouns: [N, ± plural, ±I, ±II]
(where I and II are person features)

(15) German nouns: [N, ±plural, ±$case_i$, ±$case_j$, fem., ±masc., ±I, ±II]
(where the proper setting of $case_i$ and $case_j$ yields the four cases of the German case system)
(based on Lieber 1992: 90)

Lieber argues that diacritic features such as [±L], for "learned" (in French), or [±strong] (as applying to German verbs), are not eligible for percolation; she argues that all German verbs take the same set of past-tense endings, so the desinence is not selected according to whether the verb is weak or strong.

Evaluating percolation conventions and speculating about their status as principles, one may of course wonder whether head percolation mechanisms could not be dropped from word syntax as redundant, on the grounds that they restate a well-formedness condition needed independently in X-bar theory: the head-projection line is categorially uniform in both minimal and nonminimal projections – that is, in both word syntax and phrasal syntax.

Assuming that (12a), or its variant (13a), is dropped from word syntax, percolation from the nonhead branch will attract remaining attention, because no comparable phenomenon is known independently from X-bar theory. In fact, percolation from the nonhead branch is rare in word syntax as well: the best cases are certain types of denominal diminutives that seem to preserve properties such as gender and number of the base noun. This is so in certain cases in Russian (also discussed in Lieber 1992):

(16)

(a)	travá 'grass' (fem.)	diminutive: tráv-ušk-a (fern.)
	pal'tó 'coat' (neut.)	pal't-íšk-o (neut.)

	krýlo 'wing' (neut.)	krýl-yšk-o (neut.)
(b)	štanš 'pants' (pl.)	štan-išk-i (pl.)

These words display a diminutive morpheme whose surface forms are -ušk, -isk, and -ysk. On the face of it, the diminutive morpheme seems to be an "interfix" that does not alter gender (16a) or inherent number (16b) of the noun from which the diminutive is formed; if this base noun is feminine, the product is also feminine; if it is neuter, the product is neuter.

One might thus take the position that we are dealing with diminutive suffixes which are "underspecified" for gender (and, in one example, number), and that these features must thus percolate under clause (12b). Although there is some degree of plausibility to such an approach, the scarcity of such instances is striking. Moreover, with clause (12a) eliminated, one might think about getting rid of clause (12b) also, thus simplifying word syntax considerably. Two lines of approach emerge: we either argue that percolation from the nonhead branch is only apparently unique to word syntax, or we reanalyze the cases under discussion so that eventually they do not require percolation from the left branch. Given the available data, it seems plausible to pursue the second approach and assume that the desinence itself is marked for gender. By this token, there is no necessity to supply the head with gender information.

3.2 Case assignment

The question of whether case morphology can appear word-internally, or, in generative terms, whether complex words are a proper domain of Case theory, is difficult both on the descriptive and the theoretical levels. In descriptive terms we observe that *bona fide* straightforward data are relatively scarce; and theoretical discussion has to come to grips with the fact that classical Case theory, outlined by Chomsky (1981), is constantly changing.

Word-internal case morphology is well attested in some languages. Sanskrit compounding is often cited:

(17)

(a) ACC	áśva-m_{ACC}-isti-	'horse-desiring'
(b) INST	bhas-$á_{INST}$-ketu-	'bright with light'
(c) DAT	asm-$é_{DAT}$-hita-	'errand to us'
(d) GEN	ray-$ás_{GEN}$-k´ma-	'desirous of wealth'

(Examples from Miller 1993: 79)

Contemporary languages, both non-Indo-European, such as Finnish (Andrew Spencer, p.c), and Indo-European, such as Czech, can be quoted also. Turning to Czech, we observe deverbal adjectives that incorporate a case-inflected noun in examples of the following kind:

(18)

(a) DAT	ohn-i_{DAT}-vzdorný	$fire_{DAT}$-resistant
(b) DAT	pravd-$ě_{DAT}$-podobný	lit. $truth_{DAT}$-similar, i.e. probable
(c) GEN	duch-a_{GEN}-plný	lit. $spirit_{GEN}$-full, i.e. witty
(d) GEN	boj-e_{GEN}-schopný	$fight_{GEN}$-able, deployable

Finally, we also note German examples such as *Ich-Roman*, literally 'I-novel': that is, a novel written in the first person; *Wir-Gefühl*, literally 'we-feeling': that is, a sense of togetherness. In these cases, the intriguing part is the full form of the personal pronoun that appears fully inflected.

As regards these examples, the main difficulty is to assess clearly whether we are dealing with curiosities or with major patterns. The answer is to some extent easy in the German cases, which are perhaps best analyzed as instances of an incorporated citation form. As far as Sanskrit is concerned, it is my understanding that word-internally inflected forms represent a minor pattern. In other words, Sanskrit compounds typically do not have a case morpheme on the left-hand member (Miller 1993: 79). The Czech examples are similar in this respect, in that they do not represent a major pattern, and often have a literary ring. Assuming, then, that we are really dealing with nonproductive patterns, perhaps historical residues, the question arises as to whether word syntax as a theory of word competence is the appropriate theory to explain these data. I tend to believe it is not.

Recent generative theory rules out the case of word-internal structure as a matter of principle. Under the newer understanding of case, so-called struc tural cases are assigned under Specifier-Head Agreement by functional cat egories AgrS and AgrO. These in turn must be licensed by other functional elements such as tense or finiteness. In general, then, the question of word- internal case marking reduces to the question of the distribution of functional categories within words. Put another way, asking why compounds typically do not have word-internal case equals asking why there is no inflection in compounds with a verbal element in the nonhead position. Consider German again:

(19)

(a) Mietv-wagen 'rent-car',	Schrumpf$_v$-leber 'shrink-liver'
(b) *Miet-et-wagen,	*Schrumpf-t-leber

These are VN compounds – that is, compounds with a verbal root in the nonhead position – and the -el, -I affixes in (19b) are attempts to add third- person singular inflections.

Again, assuming that the distribution of finite verbal desinence (cf. -t, -et) is normally licensed by functional nodes, we see that no such licenser is avail able word-internally. In other words, in order to be grammatical, the com pounds under discussion would contain whole clauses. But this seems generally impossible, primarily on the ground that clauses are semantic objects whose denotation (the truth-value) cannot be incorporated word-internally.

3.3 Operations on argument structure

There is an intuition going back to the ancient Indian grammarians that what we call thematic roles can be assigned inside compounds. Although there is no general consensus about the nature and actual importance of such entities as theta-roles in a generative model that is primarily based on tree geometry, this old intuition has by and large carried over into word syntax. All major studies of word syntax assume Theta theory, a set of component-independent principles, and apply it to words by showing that, and how, subconstituents of words saturate theta-grids (or, alternatively, argument structure) of theta- assigners – that is, mostly of verbs and adjectives. Virtually all principles of theta-role satisfaction maintain that there is a distinction between Theta-roles as regards their saturability in compounds. Much of the pertinent discussion is actually embedded in the discussion of argumenthood. For Selkirk the divid ing line falls between the SUBJECT/non-SUBJECT function:

> (20) All non-SUBJ arguments of a lexical category Xt must be satisfied within the first order projection of X_i. (Selkirk 1982: 37)

where first-order projection means 'within the compound' for the purposes of word syntax. This then accounts for such differences as:

(21) (a) trash removal by specialists
(b) *specialist-removal of trash
(c) *Girl-swimming is common.

Spencer (1991: 328) is correct, though, in glossing (20) as the use of "brute force." In view of this, E.

Williams's system represents a more principled account, in that it argues that the external argument must not be realized within a com pound, since it can be licensed only through predication, a relation that is not available word-internally.

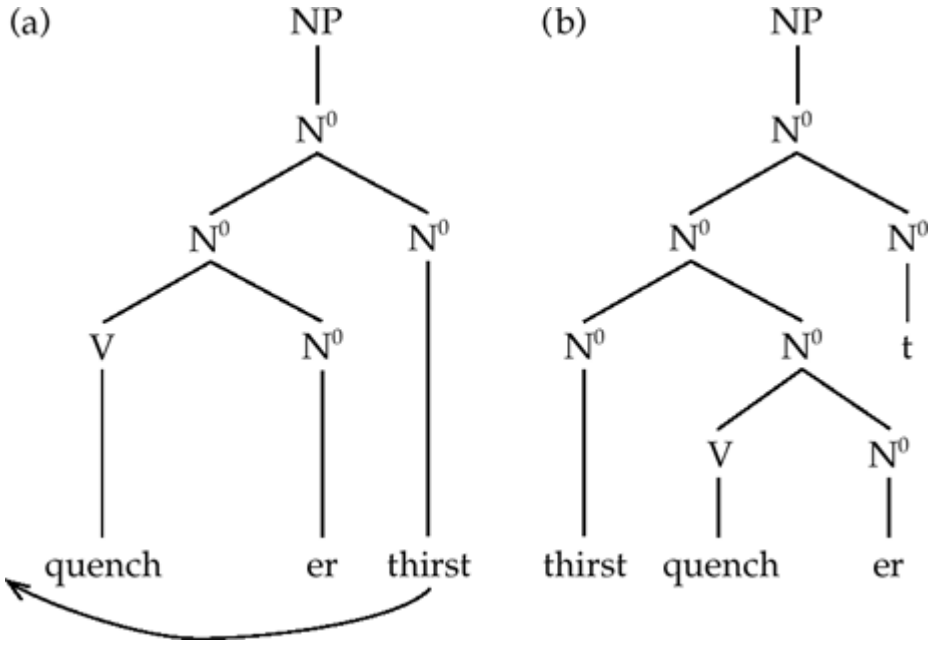
German VN compounds merit some attention in this connection. Note that this rather productive pattern seems to involve theta-roles assigned from the nonhead position to the right, whereby recipients seem to be both internal (22a) and external arguments (22b):

(22)

(a) Mietwagen	*rent-car*, i.e. 'rented car'
Rührei	*stir-egg*, i.e. 'scrambled eggs'
Hackfleisch	*chop-meat*, i.e. 'minced meat'
(b) Sprechvogel	*speak-bird*, i.e. 'talking bird'
Schrumpfleber	*shrink-liver*, i.e. 'shrinking liver'
Kriechtier	*creep-animal*, i.e. 'reptile'

Clearly, a number of problems remain. (22b) seems to point to the occurrence of external arguments compound-internally. A possible explanation would con sist in analyzing the supposedly external arguments as unaccusative – that is, internal arguments. Unfortunately, *Sprechvogel* defies this analysis (cf. Boase- Beier and Toman 1986 for further discussion).

Continuing the discussion of theta-satisfaction, we note that nontrans-formational analyses in this domain have been the rule. Some researchers, however, resort to movement in certain cases. For instance, Lieber (1992) derives verbal compounds such as *thirst-quencher* by movement:



(23a) is the input structure, (23b) the derived structure (adapted from Lieber 1992: 60).

Among the reasons for this analysis is the fact that in verbal compounds of this type the "logical" object precedes the verb, whereas it follows the verb in clausal syntax: that is, (something) quenches thirst. The reason for the clausal distribution of direct objects is assumed to be directionality of case assignment (to the right) and directionality of theta-role assignment (likewise to the right). Clearly, theta-assignment to the right cannot proceed in English compounds under these premises, because the receiving nominal is to the left of the verb (but it would actually be possible in corresponding German forms). Thus the underlying structure (23a) is posited in which the theta-role can be assigned

to the right, and the eventual linear order is established by movement (incorporation) – cf. (23b).

The justification for this account does not seem strong, though, mainly because the validity of the premise that theta-role assignment is directional has never been demonstrated. Moreover, the movement is an instance of lowering, a somewhat problematic analysis in view of the fact that traces of lowered material are not c-commanded properly. If we conceive of theta-role assignment as nondirectional, both NV and V NP structures follow naturally: in the former case N receives its theta-role *in situ*, since nothing prevents the theta-assigner from seeking a left-hand recipient; in the latter case, the non-directionality of theta-role assignment makes it possible to assign the role both to the right and to the left, yielding something like (24):

(24) (a) (something) quenches thirst
(b) *(something) thirst quenches

But directionality of case assignment, or an equivalent syntactic principle, is sufficient to take care of this: case can be assigned in (24a), but not in (24b).

4 Concluding remarks

As stated at the outset, this survey has been geared towards a discussion, rather than a monolithic statement about a particular doctrine. Given the close dependence of development in word syntax on developments and often rad ical changes in its "mother theory" – the theory of generative grammar – we can not expect to be able to provide the last word on the subject. Nonetheless, the range of questions and strategies within word syntax, and a certain consensus about them, do exist. Among questions agreed upon is that it is meaningful and theoretically legitimate to discuss the question of whether general prin ciples of grammar hold in word structures. One of the superficial effects of this approach to morphology is that morphology now looks very much like syn tax. In some ways this is hardly surprising, since the word-syntactic approach focuses precisely on those aspects of word structure that are not concerned with sound shape. Morphophonemic rules (such as k/š alternation in English *logic/logician*) are not assumed to be part of word syntax. On closer inspection, however, we are not obliged to regard morphology as being completely assim ilated into syntax. Note that the application of the principles of X-bar theory, theta theory (or a comparable theory of argument saturation), and other sub- theories of generative grammar to the domain of complex words means simply that we have created a single domain in which those particular principles hold. It does not necessarily imply that only syntactic principles apply in the domain of morphology.

Clearly, a number of conceptual and empirical problems remain. To con clude, consider so-called atomicity (Di Sciullo and Williams 1987), a property meant to characterize X° structures – that is, words. Words enter syntax as sealed-off "atoms" in the sense that some of their properties, such as their internal structure, are invisible, and hence inaccessible in syntax. Thus Di Sciullo and Williams argue that compounds, although superficially "more phrasal" than words formed by affixation are just as wordlike as affixed forms – for instance, both are islands with respect to Wh-movement, an uncontroversially syntactic phenomenon, as seen in (25) (Di Sciullo and Williams 1987: 52):

(25) (a) *[How complete-ness] do you admire?
(b) The who-killer did the police catch?

The unanalyzability of words in syntax has often been stressed in the liter ature, yet there are counterexamples which come to mind as well. Consider, for instance, the kind of coordination illustrated in the German examples (26) (Toman 1986: 424):

(26) (a) Luft- und Wasserverschmutzung
'air- and water-pollution'
(b) Wiederaufnahme der Inlands- und des größten Teils der Auslandsflüge 'resumption of domestic, and of the larger part of international, flights'
(c) rote Seide- und blaue Wollstoffe
'red silk and blue cotton fabrics'

While we might argue that cases such as (26a) are base-generated coordina tions, which could thus be accounted for by an extension of the coordination schema to the X° domain, examples such as (26b) point to the transparency of words – there must be some process that "sees" the internal structure of compounds.

Di Sciullo and Williams (1987) stress that the atomicity of words is a prop erty to be explained – an *explicandum* rather than an *explicans*. But if atomicity is not a primitive property of words, ample space remains for rethinking the property, and thus the relationship between phrase syntax and word syntax. This, again, illustrates the challenges a word-syntactician must live with. But the benefits of this challenge clearly outweigh its day-to-day frustrations.

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16. Paradigmatic Structure: Inflectional Paradigms and Morphological Classes

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1 Introduction

For a language to have inflectional morphology, there must be some words (more precisely, some lexemes) which occur in a variety of forms (or word forms), with the choice between these forms being determined by the syntactic context. Each word form can be thought of as expressing the lexical content of the lexeme plus some morphosyntactic property or combination of morpho-syntactic properties. For example, English *gave* can be thought of as expressing the lexeme GIVE plus the property Past, while *gives* expresses GIVE plus the properties Third Person, Singular and Non-Past.

There are widely differing views of how what we here call 'morphosyntactic properties' should be handled in syntax. Some linguists treat them on a par with lexical stems as occupants of terminal positions in syntactic structures (with or without a phonological shape); others treat them as features of lexical stems which are 'spelled out' outside the syntactic component. The linguists who have devoted most attention to paradigms and inflection classes in recent years have generally preferred the latter approach. In principle, however, the issues discussed here arise independently of the way in which inflection is handled syntactically, and the use of the term 'morphosyntactic property' in this article should not be taken as necessarily implying that entities such as 'Past', Third Person' or 'Plural' (or their phonological realizations) can never be syntactic constituents.

Each of the actually or potentially distinct word forms belonging to a lexeme is associated, then, with some morphosyntactic property or combination of properties. (The significance of 'actually or potentially' will be discussed in section 2.) The entire set of these properties or property combinations constitutes the 'paradigm' for that lexeme, and each individual property or property combination within this set can be called a 'cell'. For example, the paradigm for the English lexeme GIVE consists of five cells. Possible labels for these cells, in terms of morphosyntactic properties, are given here alongside the corresponding word forms:

(1)

Past	*gave*
Third-Person Singular Non-Past	*gives*
Perfective *or* Passive	*given*
Progressive	*giving*
Basic (used in all other syntactic contexts)	*give*

In the form labelled 'Perfective *or* Passive', comparison with the corresponding forms in other lexemes

such as *spoken, taken, eaten* allows us to distinguish a suffix *-en* which is added to the lexical stem. But not all English verbs take *-en* in the form corresponding to this cell; for example, the verb SING, as illustrated here, does not:

(2)

Past	*sang*
Third-Person Singular Non-Past	*sings*
Perfective *or* Passive	*sung*
Progressive	*singing*
Basic (used in all other syntactic contexts)	*sing*

This difference between GIVE and SING can be expressed by saying that they conform to the same paradigm, but belong to different morphological classes or 'inflection classes'. An inflection class is a set of lexemes which share a paradigm and whose word forms are alike in respect of the realization of the morphosyntactic properties in every cell.

Before we go further, some comments on terminology are needed. The sense of 'inflection class', as defined here, is well established. It applies to words of any word class; older writers, however, used the term 'declension' (class) for an inflection class of nouns or adjectives and 'conjugation' (class) for an inflection class of verbs. The sense of 'paradigm', as defined here, is also well established, although one also encounters it used in the sense of 'set of inflectional realizations appropriate to a given inflection class' (Carstairs 1987, Matthews 1991). In that sense, GIVE, SING and BAKE will have distinct 'paradigms'. The term 'cell', as defined here, is not yet well established, but there is a clear need for some term with this denotation.

Many questions arise from these introductory definitions and illustrations:

(1) Must all lexemes in a given word class share the same paradigm?

(2) What morphosyntactic properties typically distinguish the cells in paradigms, and how do these properties interact? For example, do some properties presuppose or exclude others? And do properties of one morphosyntactic category (e.g. Case or Tense) tend to be realized consistently in the same position relative both to the stem and to properties of other categories, whether in individual languages or cross- linguistically?

(3) For any given lexeme, how is the form for any one cell affected by forms for other cells? Do some forms act as the bases from which others are formed? And are there any generalizations to be made about patterns of homonymy or syncretism between forms?

(4) How much inflection class proliferation is possible within a language, and how is inflection class membership represented lexically?

These questions will be addressed in sections 2–5 respectively.

2 Paradigm consistency

It is conceivable that some members of a word class might be inflected for one set of morphosyntactic properties while other members of that word class in the same language are inflected for quite a different set of properties. In such a language, there would be two quite distinct paradigms applicable to lexemes of the same word class. But this kind of paradigm inconsistency never, or almost never, arises (Carstairs 1987:10–11). Instead, all, or nearly all, members of the same word class in a given language are inflected for the same properties. Deviations from this pattern, when they occur, may be of two kinds: a lexeme may unexpectedly lack some forms, or it may possess unexpected 'extra' forms. As regards the first kind of deviation, gaps in the set of word forms associated with certain lexemes nearly always turn out not to be unexpected after all, in that they are attributable to clear-cut semantic or syntactic factors; for example, mass nouns may lack Plural forms, or intransitive verbs

may lack Passive forms. In the few lexemes which lack expected word forms without any such motivation, what we find is that the same morphosyntactic properties apply as in the usual paradigm, but that some cells are simply left idiosyn- cratically unrealized. These are 'defective paradigms' (which in our terminology would more aptly be called 'defective inflection classes'). An example is the archaic English verb QUOTH 'say', used to indicate direct quotations, which has a form only for the Past cell (*quoth*). The second kind of deviation, involving 'extra' forms, will be discussed in section 4.2.

The strong tendency towards paradigm consistency is understandable from a syntactic point of view. If word classes were paradigmatically inconsistent, then there would be a risk that the syntax would need to make available different constructions with the same syntactic function for use with different lexemes. Paradigm consistency also makes it reasonable to allow the same word form to be associated with more than one cell. For example, most English verbs, unlike GIVE and SING, have only four, not five, forms (e.g. *bake, baked*, *bakes, baking* for the lexeme BAKE), yet we typically ascribe to all English verbs the same paradigm, thus:

(3)

Past	*baked*
Third-Person Singular Non-Past	*bakes*
Perfective *or* Passive	*baked*
Progressive	*baking*
Basic (used in all other syntactic contexts)	*bake*

The Past and Perfective cells are treated as morphosyntactically distinct for all verbs, because the associated word forms, though usually identical, are actually distinct in the small but frequently occurring class of irregular verbs such as GIVE and SING (see (1) and (2)).

The label 'Perfective *or* Passive' illustrates the fact that one word form may realize a disjunction rather than a combination of morphosyntactic properties. The term 'morpheme' has been proposed for such disjunctions of properties with consistently shared realizations (Aronoff 1994). It appears that the morphological system of a language may treat certain morphosyntactic properties alike, even if they have no special relationship in the syntax.

3 Morphosyntactic categories and the internal structure of paradigms

In Indo-European languages with relatively elaborate inflectional morphology, nouns typically inflect for the morphosyntactic categories Number and Case, adjectives for Number, Case and Gender, and verbs for Person, Number, Tense, Mood (e.g. Indicative, Imperative, Subjunctive), sometimes Voice and sometimes Aspect (e.g. Imperfective versus Perfective). But how typical are Indo-European languages in this respect? What cross-linguistic generalizations, if any, can be made about the morphosyntactic categories which are relevant to particular word classes? Bybee (1985) studied categories expressed inflec- tionally in verbs in a sample of fifty languages from different language families and different cultural and geographic areas. She found there to be nine such categories: Valence (relating to the number and role of arguments of the verb), Voice, Aspect, Tense, Mood, Number, Person of subject, Person of object and Gender. Of these, the most frequent is Mood (expressed inflectionally in 68 per cent of the fifty languages), followed by Person (56 per cent), Number (54 per cent), Aspect (52 per cent) and Tense (48 per cent); least frequent are Gender (16 per cent) and Valence (6 per cent). She seeks to explain these figures in terms of the two notions of 'relevance' and 'generality'. The commonest inflectional categories are those which are both highly relevant, in that their semantic content 'directly affects or modifies' the semantic content of the stem (Bybee 1985: 13), and highly general, in that their semantic content is applicable to all or almost all verbs. Gender and Valence are relatively rare as inflectional categories, because they fail this criterion, but in opposite ways. Gender is said to be highly general but low in relevance; Valence is said to be high in relevance but low in generality, because valence-changing operations such as causative formation often alter the meanings of stems so unpredictably that the new form becomes lexicalized,

and therefore no longer belongs to the same lexeme as its base.

A similar cross-linguistic survey has yet to be done for nominal and adjectival categories. There are in any case often difficulties in deciding objectively which of two categories, such as Tense and Aspect, has a greater effect on the semantic content of stems. But, independently of these semantic issues, Bybee points out generalizations concerning the order in which the nine categories are realized in relation to each other and to the verb stem. For example, when a language in Bybee's sample has both Aspect and Tense as inflectional categories and their order of realization can be determined (i.e. they are not realized cumulatively), Aspect is realized closer to the stem than Tense; similarly, Tense is nearly always realized closer to the stem than the less 'relevant' property Person (of subject). A related observation concerns stem allomorphy. It is not uncommon for languages to have special stem allomorphs or suppletive stem forms distributed according to Aspect or Tense, but it is very rare for stem allomorphy to be distributed according to Person (Rudes 1980). This tends to support the view that the property contrasts which partition a paradigm are not all equally important; rather, the distinction between cells which differ in Tense or Aspect is more fundamental, in some sense, than the distinction between cells which differ in Person – a less 'relevant' category in Bybee's hierarchy.

If, in general, all the morphosyntactic categories which are manifested in a paradigm were equally fundamental, one might expect to find a cell for every possible combination of the properties belonging to them. The English data in (l)–(3) show this to be wrong, however. There is a non-Past Third-Person Singular cell but no Past Third-Person Singular, and the Tense and Person distinctions do not apply to the Perfective or the Progressive forms. In other languages too it is common for a certain category to be excluded (or for property contrasts within it to be neutralized) when a particular property belonging to some other category is present. For example, adjectives in German and Russian inflect for Number, Case and Gender; however, there are no cells for distinct Gender forms in the Plural. It seems likely that the excluded category will generally be either low in 'relevance' (in Bybee's terms) or realized relatively far from the stem, while the property which imposes the exclusion will be high in relevance or realized relatively close to the stem, or both; but this has not yet been systematically investigated.

Bybee's observations also provoke the question as to whether all the properties of one category are always realized in the same position, or 'slot', relative to the stem. The answer is no; for example, in the Present Tense of Georgian verbs the Person and Number of the subject are sometimes cumulated as a prefix, sometimes cumulated as a suffix, sometimes realized separately, with Number as a suffix *-t*, and sometimes not realized overtly at all:

(4)

	Singular	Plural
Person:	1 v-xedav	v-xedav-t
	'I see (him/her/it/them)'	
	2 xedav	xedav-t
	3 xedav-s	xedav-en

Even so, it is more usual for all properties in a category to occupy a consistent position in all or most of the relevant word forms, as in the following Swahili example, where the prefixal positions labelled I, II and III are occupied by object markers, Tense markers and subject markers respectively:

(5)

III	II	I	Stem	
a-	ta-	ni-	penda	'he will like me'
a-	ta-	ku-	penda	'he will like you (sg.)'
a-	li-	ni-	penda	'he liked me'
a-	li-	ku-	penda	'he liked you (sg.)'

wa-	ta-	ni-	penda	'they will like me'
wa-	ta-	ku-	penda	'they will like you (sg.)'
wa-	li-	ni-	penda	'they liked me'
wa-	li-	ku-	penda	'they liked you (sg.)'

Detailed consideration of phenomena of this kind has led Stump (1992,1993c) to re-emphasize the importance in morphological theory of 'position classes', meaning classes of affixes which are mutually exclusive and occupy the same position (or positions) relative to the stem (cf. also Stump, INFLECTION). (Zwicky 1990 mentions the related principle of 'slot competition'.)

In the example at (5), each of the positions is occupied by affixes realizing properties belonging to only one category (subject Person, object Person, or Tense). This is not always so, however; for example, in Georgian the prefix position immediately before the verb stem in the Present tense (see (4)) may be occupied by an object Person marker such as *g-* 'you (sg.)' as well as by the subject marker v- 'I' When the two are in competition for this slot, it is *g-* which wins: *g-xedav* 'I see you (sg.)'. It remains to be seen how tightly the roles of slot competition and position classes can be constrained within morphological theory.

4 Word forms, syncretism and the internal structure of paradigms

Alongside the mutual relationship of the morphosyntactic properties which define the cells of a paradigm, one can consider the mutual relationship of the corresponding word forms. These word forms may simply be distinct, implying no special mutual relationship. On the other hand, one word form may appear to be built on another, or one word form may be identical with another. These situations will be illustrated and discussed in sections 4.1 and 4.2.

One constraint on nominal paradigms has been proposed which relates simply to the number of phonologically distinct exponents (affixes, etc.) available for the properties to be expressed. Plank (1986: 46) suggests that 'the number of exponents potentially available for nominal inflexion in any language is limited to about 30'. It follows that in a language with cumulative exponence of Case and Number (as in Latin), with two Numbers (Singular and Plural) and with two inflection classes for nouns, there can be no more than about seven Cases; on the other hand, a language with agglutinative exponence of Case and Number (as in Hungarian or Turkish) can have twenty or more Cases. Observationally this appears correct, but it is not clear why the crucial limit should be around thirty rather than (say) ten or sixty.

4.1 Word forms as bases for other word forms

Word forms which appear to be built on other word forms are common in the nominal inflection of Daghestanian languages such as Archi (Kibrik 1991a and ARCHI(CAUCASIAN-DAGHESTANIAN)). In these languages, each noun typically has an 'oblique' stem, which is used in some but not all Case forms, and which differs between Singular and Plural. The oblique stem may be identical to a particular Case form, such as the Ergative, as in Lezgian (Haspelmath 1993), so that the question arises of whether or not we should analyse this actual Case form as the base on which others are built. Mel'cuk (1986), in contrast to Kibrik (1991), favours this approach, distinguishing 'secondary' Cases whose forms are built on other Case forms from 'primary' Cases whose forms are independent. It is not clear how far the primary-secondary dichotomy, so defined, correlates with any other partitions of the paradigm discussed in this section and section 3. A better-known example of the same kind involves the Future Active Participle forms of Latin verbs, which are sometimes said to be built on the Past Passive Participle forms, as illustrated in (6):

(6)

Present stem	Past Passive Participle stem	Future Active Participle stem
am- 'love'	ama:t-	am-a:t-u:r-

po:n- 'put'	posit-	posit-u:r-
fer- 'carry'	la:t-	la:t-u:r-
rump- 'break'	rupt-	rupt-u:r-

Matthews (1972) describes the formation of the Future Active Participle as 'parasitic' on the Past Passive Participle; on the other hand, Aronoff (1994) argues that both participles have equal status as derivatives from one stem which is itself a purely morphological entity, expressing no morphosyntactic properties.

Bybee (1985) approaches this issue from the point of view of markedness relations between properties within a category. She emphasizes the historical tendency for forms which realize relatively unmarked properties within a category to function as the base for new forms realizing relatively more marked properties. An illustration is the development of Preterite inflection in the modern Charente dialect of Provencal, as shown in (8), from the Old Provençal pattern in (7):

(7) Old Provencal:

	Singular	Plural
Person:	1 améi 'I loved'	amém
	2 amést	amétz
	3 amét	améren

(8) Charente dialect:

	Singular	Plural
Person:	1 cantí 'I sang'	cantétem
	2 cantétei	cantétei
	3 cantét	cantéten

Bybee attributes this to the reanalysis of the Third-Person Singular form. Having been originally a combination of a stem *cant-* and a Tense-Person-Number suffix *-et*, it was reanalysed as Preterite Tense form *cant-ét* with no overt realization of the morphosyntactically unmarked Person-Number combination Third-Person Singular. As such, it came to function as the base for the derivation of a new set of Preterite forms in the Charente dialect (except in the First- Person Singular). In Mel'çuk's terms, one could say that all but the First-Person Singular are secondary forms derived from the primary Third-Person Singular form. Morphosyntactic unmarkedness is one of the factors which, according to Bybee, contribute to the autonomy of certain forms of a lexeme – that is, to the likelihood that they have separate lexical representations. Kuryłowicz (1945- 9) discusses similar phenomena, but with different terminology.

4.2 Syncretism

In principle, there could be both factors encouraging and factors inhibiting inflectional homonymy, or syncretism, both at the level of morphosyntactic content and at the level of morphological realization. This yields four possible types of factors. In practice, there is evidence that factors of all four types exist, though there are considerable differences between them as regards strength and theoretical status.

Universal homonymy, for all lexemes, in the realization of two cells in a paradigm is by definition impossible, for in any such purported situation there would be no ground for recognizing those two cells as distinct. Even near-universal homonymy is grounds for suspicion. For example, one might recognize two distinct Locative Singular cells in Russian on the grounds of the distinct forms lesu and lese of LES 'forest' in v lesu 'in the forest' and o lese 'concerning the forest', and likewise in a few

other nouns, even though for the majority of nouns the corresponding forms are identical. But synchronic descriptions of Russian have tended to say, rather, that for the majority of nouns there is only one Locative Case, thus implicitly attributing to Russian a departure from strict paradigm consistency on the part of the LES class (see section 2).

There are, however, clear-cut instances of inflectional homonymy which cannot be ascribed to paradigm inconsistency, and which are not attributable to phonological factors either. A standard illustration is the Dative-Ablative Plural syncretism in all Latin nouns, adjectives and determiners. Its universality in Latin confirms that it is a systematic feature of the morphological system, and the fact that two phonologically quite distinct affixes, -i:s and -ibus, realize Dative-Ablative Plural in different lexical contexts shows that this homonymy cannot just be a phonological accident. A second illustration is the Past and Perfective syncretism in regular English verbs, shown in (3). How should morphological theory accommodate such phenomena?

From a naive common-sense point of view, all inflectional homonymy should impair communicative efficiency by increasing the chance of misunderstanding through ambiguity. In practice, the pragmatic, semantic and lexical context of any utterance nearly always prevents misunderstanding due to homonymy, whether lexical or inflectional. Even so, it has been suggested that there are some inflectional homonymies which are avoided because of the morpho-syntactic ambiguity which they create. Plank (1979,1980) argues that the development in Vulgar Latin of Genitive and Nominative Singular homonymy in certain nouns was inhibited for prototypical possessors (humans) and for certain typical possessees (body parts, etc.) because of the need to maintain an overt distinction between possessor and possessee in constructions with a head noun as possessee and a dependent noun in the Genitive as possessor. The same need is held to explain certain otherwise puzzling patterns of acceptability in German; for example, Benachteiligungen andersgläubiger Frauen 'acts of discrimination against heterodox women' is acceptable because the suffix -er on andersgläubiger 'heterodox' unequivocally marks the phrase andersgläubiger Frauen as dependent; on the other hand, *Benachteiligungen Frauen 'acts of discrimination against women' is not acceptable because there is no overt indication of the roles of the two nouns.

Jakobson (1936: 85-8) proposed for Russian nouns a variety of implicational statements relating to syncretism possibilities, with the conditions expressed in terms of morphosyntactic content; for example, if a noun has distinct forms for the Accusative and the Nominative, then either the Accusative and Genitive or the Dative and Locative must be homonymous. Such conditions can hardly be generalized to other languages, however. Bierwisch (1967) described certain German syncretisms in terms of the sharing of syntactic features between cells. E. Williams (1981b, 1994a) also uses syntactic features to organize hierarchically the paradigm cells for any lexeme class into a branching tree structure, such that forms which are systematically homonymous for any lexeme are all and only those cells dominated by some node on the tree. One may question, however, whether this hierarchical organization is independent of the syncretisms which it is designed to explain; and in any case there are both syncretisms which might occur but do not, and (it has been suggested) some syncretisms which do occur despite the fact that the cells concerned do not form a 'constituent' within the tree structure (Joseph and Wallace 1984). So the search for morphosyntactic-feature configurations which strongly favour syncretism has had only modest success so far.

A characteristic of many syncretisms is that one can distinguish a morpho- syntactic property (or properties) which provides the context in which the syncretism occurs. This does not apply to the Past-Perfective syncretism in regular English verbs, for which the conditioning factor is purely lexical (a matter of belonging to the regular inflection class). On the other hand, it does apply to the Latin Dative-Ablative Plural syncretism, where the conditioning factor is morphosyntactic (a matter of being Plural rather than Singular). For such syncretisms, one can investigate the possibility of generalizations concerning the realization of the contextual property in the word forms concerned. Is it, for example, always realized cumulatively with the properties whose expression is rendered homonymous by the syncretism? Carstairs (1987) suggests that the answer to this question is generally yes, and that there is, moreover, a quasi-functional motivation for it. For a lexeme with cumulative inflection, a syncretism reduces the amount of morphological material (affixes, etc.) to be distributed among the cells of the paradigm. On the other hand, for a lexeme with agglutinative inflection, a syncretism does not reduce the amount of this material, and may even increase it; and, in any case, the syncretism will complicate the distribution of this material among the cells, by

comparison with a similar pattern without syncretism. Carstairs and Stemberger (1988) show also that syncretism with cumulation is easy to model in a connectionist framework, while syncretism without cumulation is difficult. There remains, however, the problem of the minority of morphosyntactically conditioned syncretisms where the contextual property is not cumulated with the homonymously realized properties. Carstairs (1987) suggests that they are subject to a generalization involving the mutual ranking of the properties in Bybee's relevance hierarchy; but even if this generalization is correct, the reason for it is not clear.

5 Inflection class organization

Two main questions have been asked about inflection class organization in recent years: (a) How is the assignment of a lexeme to its inflection class to be represented grammatically? (b) Are there any constraints on the number of inflection classes which words of a given class in a given language can have? These questions, though seemingly independent, have turned out to have answers (at least provisional ones) which impinge on one another.

Many pedagogical grammars and dictionaries of languages such as Latin and Russian indicate inflection class membership by means of essentially arbitrary labels, such as 'Class I' or 'second declension'. These labels are a shorthand for full sets of inflected forms illustrated by one or more exemplary lexemes for each class. Labels of this kind have been criticized as arbitrary by both generative and non-generative grammatical theorists. In the generative tradition, Lieber (1981) suggested that the full inflectional behaviour of any lexeme might be predictable from its pattern of morpholexical alternation (essentially, its set of stem allomorphs). However, this strong claim cannot be sustained, and another generative linguist, James Harris (1991), reverts to traditional numerical labels to encode lexically the inflectional behaviour of Spanish substantives.

An alternative tradition has been to cite certain word forms, or 'principal parts', for each lexeme, from which its whole inflectional behaviour can be determined by reference to rules. This approach is adopted and refined theoretically by Wurzel (1984,1987). Wurzel points out that simply to label distinct inflection classes as 'Class 1' etc. obscures three facts: (a) that inflection classes are typically not entirely distinct in their realizations for all cells, but rather resemble each other in some or most cells; (b) that inflection class membership is frequently influenced by extramorphological factors such as Gender, meaning (e.g. animateness) and phonological shape; (c) that within a set of inflection classes whose membership is not influenced by such extramorphological factors and which are therefore in a sense competing for the same pool of lexemes ('complementary classes', in Wurzel's terminology), there is typically one class which is unmarked in the sense that it is the class to which new words are assigned, the class to which words of the other classes are 'wrongly' assigned by infant learners, and the class into which members of the other classes drift in the course of language change. Wurzel seeks to account for these facts by a model of inflection class membership which incorporates 'paradigm structure conditions' (PSCs) and 'reference forms'.

A PSC is a statement to the effect that if a lexeme has characteristic X, then it must have realizations R_1,..., R_n for cells C_1,..., C_n. Such conditions are conceived as structuring the implicit knowledge that native speakers of inflectionally complex languages acquire. 'Characteristic X' may be more or less elaborate, and 'cells C_1,..., C_n' may cover greater or lesser portions of the paradigm. In the simplest case, characteristic X is membership of a given word class (e.g. verb), and cells C_1,..., C_n extend to the whole paradigm. A PSC of this kind is appropriate for a word class with no inflection class distinctions. But what if there are two or more complementary inflection classes within a word class (or an extramorphologically defined subset of a word class)? Here Wurzel invokes 'reference forms', which are akin to traditional 'principal parts'. Lexemes within the unmarked class have no lexical specification, and obey the dominant PSC for the set of complementary classes – one which specifies realizations for all cells in the paradigm. On the other hand, lexemes within a marked class contain in their lexical specification a reference form for at least one cell in the paradigm, which overrides the dominant PSC in respect of that cell. This reference form may also function as part of 'characteristic X' in a more specific PSC, which, so far as it extends, overrides the dominant condition; for cells not covered by the more specific PSC, however, these lexemes conform to the dominant PSC, which thus constitutes the default PSC for the whole set of complementary classes. The possibility of PSCs being wholly or partly shared by different inflection classes is what accounts for inflection class

resemblances in Wurzel's framework, and the drift in membership to unmarked classes is seen as lexical simplification through the loss of reference forms, whereby the lexemes in question become wholly subject to the dominant PSC.

The illustration in (9) shows a hypothetical set of complementary classes for nouns, with Class A assumed to be unmarked and a–h representing distinct inflectional realizations.

(9)

	Class A	Class B	Class C	Class D
Cell 1	a	a	f	f
Cell 2	b	e	e	e
Cell 3	c	c	h	h
Cell 4	d	d	d	g

In (10) we see how this pattern of classes would be represented in Wurzel's framework:

(10)

PSCs: (a) Noun→{a/1, b/2, c/3, d/4)
(b) g/4→h/3→{f/1, e/2}

Reference forms included in lexical specification:

Class A: none
Class B: e/2
Class C: h/3
Class D: g/4

The fact that PSC (a) is dominant follows from the fact that it is more general than PSC (b), being framed so as to apply to all nouns, not just those with a particular reference form; and the fact that Class A is unmarked is represented by the fact that it has no reference form in its lexical specification. PSC (b) incorporates two implications, and so serves for both Class C and Class D. For Class C words, however, only the second implication (h/3 → {f/1, e/2}) has effect, and the form for cell 4 (viz. d) is supplied by PSC (a). Wurzel has applied this sort of analysis to inflection class systems in a variety of mainly Indo-European languages, particularly German, Icelandic and Latin.

Carstairs (1987) asks a different question from Wurzel: What is the largest number of inflection classes which a given array of inflectional resources can be organized into? Looking at (10), one can see that the smallest conceivable number of inflection classes, given the number of distinct realizations available for each cell, is two; on the other hand, the largest conceivable number of inflection classes, given that each of the five cells has two realizations, is 2^5 or 32. Carstairs (1987) proposes a Paradigm Economy Principle to the effect that, subject to certain qualifications, the actual restriction on the number of distinct inflection classes for any word class in any language is very tight: it must be no more than the conceivable minimum. An actual language which had precisely two inflections available for each cell could therefore have no more than two inflection classes, not four, as posited in (9).

It is clear that Carstairs and Wurzel disagree, in that Wurzel's framework can handle without difficulty a pattern, such as (9), which Carstairs claims cannot occur. Carstairs-McCarthy (1991) has suggested that the sort of behaviour allowed by Wurzel's multi-stage PSCs, such as (b) in (10), can be found only in non-affixal inflection (such as stem allomorphy and stress alternation), not in affixal inflection. If

correct, this suggests that the two types of inflection are subject to different constraints.

More recently, Carstairs-McCarthy (1994) has suggested that inflection classes are constrained by a principle related to the Principle of Contrast proposed by Clark (1987) for lexical acquisition: every two forms contrast in meaning. As Carstairs-McCarthy applies this to affixal inflection, it has the effect of requiring that each word form should either identify unambiguously the inflection class to which its lexeme belongs or else supply no positive information about inflection class membership at all, exhibiting the sole default, or multi-class, realization for that cell. If correct, this claim would rule out the inflection class organization in (9), but for a different reason from the Paradigm Economy Principle; for cells 1 and 3 each have two realizations neither of which either unambiguously identifies its inflection class or constitutes the sole default realization for that cell.

The outcome of the comparison of Wurzel's and Carstairs-McCarthy's approaches will depend on further detailed study of actual inflection class systems; it seems clear already, however, that inflection class organization is by no means a language-particular free-for-all without interest for the morphological theorist.

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17. Morphology as Component or Module: Mapping Principle Approaches

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1 Introduction

It is common to speak of one or another theory of grammar as being modular. What is meant by a modular theory, of course, is one in which the well- or ill-formedness of an expression is determined not by a single monolithic set of rules, but rather by a set of modules (or components), each formally independent of the other, and each with its own set of rules or principles that must be satisfied. The best-known example of this view of grammar is the so-called Principles and Parameters approach to syntax, which has its origin in the modular Government Binding (GB) theory of Chomsky (1981).

To take a familiar example of how a modular system of grammar is supposed to work, consider a sentence such as (1a), which has a structure roughly like that shown in (1b), on a traditional GB view:

(1) (a) Mary seems to be intelligent.
(b) [Mary, seems [t, to be intelligent]]
(c) *It seems Mary to be intelligent.

Example (1a) is well formed because it meets the requirements of a number of different modules. For example, it satisfies the Case theory in that the NP *Mary* appears as the subject of an inflected verb (*seems*) and is therefore in a Case-marked position, as is required of overt NPs: non-Case-marked overt NPs are not Visible', and are ruled ill-formed by a visibility requirement. We see from the structure in (1b) that *Mary* does not appear on the surface in its D-structure position; rather, it has been moved from the position of the subject of the lower clause into the matrix subject position. This movement is licit since (among other things) the relationship between *Mary* and its trace satisfies the Binding theory: in classical GB a trace is an anaphor (functioning like a reflexive such as *herself*, and not like a pronoun like *her*), which must be locally bound by an antecedent in an argument position; the relationship between *Mary* and the trace happens to satisfy this constraint. Finally, *Mary*, being an NP, must be assigned a theta-role by a V or VP. The verb seem does not assign a theta-role to its subject (its notional subject is really semantically empty), so *Mary* cannot get one from there. However, since *Mary* is the antecedent of the trace *t*, which is in the subject position of the subject-theta-assigning VP *be intelligent, Mary* is able to inherit a theta-role from its trace, and thus the construction satisfies theta-theory. Thus, the construction is ruled in, because it satisfies a set of independent criteria for well-formedness.

Contrariwise, a construction is ill-formed when principles of one or more of the modules are violated. Take the case of (1c), for example. In this case, theta-theory is satisfied since *Mary* appears as the subject of the VP *be intelligent*. Binding theory is simply irrelevant here, since there are no anaphoric relations – at least under simpler versions of GB or Principles and Parameters theories. What is

violated relates to Case theory: the overt NP *Mary* is the subject of an infinitival VP, which in English is a non-Case-marked position.

Examples such as those in (1) are typical of the interactions of purely *syntactic* modules in the determination of the well-formedness of a sentence. However, utterances can obviously be unacceptable for reasons that are not syntactic. For example, one of the words in the sentence might be simply morphologically ill-formed, as in (2a) (cf. 2b):

(2) (a) *John edwant to go.
(b) John wanted to go.

The source of the ill-formedness in (2a) is, obviously, that the English past-tense affix *-ed* is a suffix rather than a prefix, and as such must attach at the end of its base, not the beginning. This restriction is morphological – or at least morphophonological (see section 3).

Now, obviously, anybody's theory of morphology must provide some account of why one cannot say **edwant* in English, and there is therefore a sense in which any morphological theory could be said to function as a module of the grammar, much as the syntactic modules that we have just discussed. However, in many morphological theories, the interaction between morphological principles or rules and the types of syntactic modules described above is not particularly direct. In a typical Lexical Morphology approach, for example, (2a) would be ruled out by simply not allowing the morphology to generate words like **edwant*. So, the sentence in (2a) would not be generated, simply because **edwant* would never be inserted into the sentence. There are, by contrast, views of morphology where morphological principles interact with other principles of grammar in a much more explicit and direct way: broadly speaking, these are theories in which morphology, syntax, and other modules of the grammar have an 'interlocking independence', as Baker (1988b) puts it.

In this chapter, I discuss morphological theories, such as those proposed by Marantz (1984a), Sadock (1985,1991), and Baker (1985,1988a, b), in which morphology functions as a module on a par with other modules of the grammar. I will concentrate in particular on the Autolexical Syntax theory as developed by Sadock. Some aspects of this theory will be outlined in section 2. As we shall see, on Sadock's theory, a sentence's morphological structure always differs from, and may actually be nonisomorphic to, the structure assigned by the syntax. There must, therefore, be a mapping between the two levels of structure, and this mapping must obey certain principles. Thus the relationship between the morphological component and the syntactic component(s) is rather like the relationship between the S-structure and the Logical Form components in GB theory, which (often) assign nonisomorphic analyses to a given sentence, these analyses to be related by the rule of Quantifier Raising.

So principles of morphology may be viewed as comprising a separate module, and this module, along with assumptions about mapping between modules, is consulted as part of the determination of a sentence's well-formedness. This view can be turned around, however: instead of having separate morphological principles that help determine the well-formedness of sentences, might one not instead assume that the well-formedness of *words* is derivable from principles of *syntax* and other components of the grammar? This opposite view has been argued for by Sproat (1985,1988), and subsequently by Lieber (1992), and I will outline a few aspects of such approaches in section 3. As we shall see there, despite the oppositeness of such theories in certain respects to that of Sadock, there are also some striking similarities.

2 Sadock's Autolexical Syntax

2.1 Cliticization in Autolexical Syntax

To begin with, let us consider a simple case of cliticization in English, involving *'d*, the reduced form of the auxiliary *would* (cf. Sadock 1991: 52ff). From a purely syntactic point of view, *'d* is a separate word, on a parallel with the full form *would*. This consideration would lead us to posit a structure roughly like (3a) for the sentence *He'd have done it*. From a purely morphological point of view, however, *'d* would appear to be attached to the preceding word, namely he. This would motivate (3b) as the structure of the sequence *he'd* from a purely morphological point of view, where the subscript

w indicates that the sequence counts as a single morphological word:

(3) (a) [He [$_{vp}$ 'd [$_{vp}$ have [$_{vp}$ done it]]]]
(b) [$_{w}$he'd]

The situation with *'d* is typical of clitics (cf. Halpern, CLITICS). As Sadock notes, clitics are associated with an array of properties, including being morphologically *bound* morphemes at the same time as being syntactically independent. (Indeed, these two characteristics might be taken as the defining property of clitics.)

In Sadock's approach, *'d* is represented as a lexical entry with two components as follows:

(4) (a) morphology = [$_{w[-21]}$ X[-]]——]
(b) syntax = [$_{VP[FIN]——}$VP[BSE]]

The morphological entry in (4a) states that the clitic attaches to a full word (bar level —1 in Sadock's model), and forms a "somewhat larger" than full-word constituent (cf. the "clitic group" of other theories, such as Nespor and Vogel 1986) – bar level -2 in Sadock's model. The syntactic entry simply states that the clitic subcategorizes syntactically for a VP headed by a bare verb.

So morphological structure may be nonisomorphic with syntactic structure. But just how different may the two structures be? Put another way, given a lexical entry such as that for *'d* in (4), and the requirement that a sentence in which such a morpheme occurs must satisfy both the morphological and the syntactic specifications, what is to stop the morphological and syntactic structures from being arbitrarily nonisomorphic with each other? For example, what is to rule out the sentence **John'd would prefer mole poblano and I prefer it too*, where both the syntactic and morphological requirements of *'d* are satisfied, as indicated by the following structures?

(5) (a) Syntactic:
John would prefer mole poblano, and [I ['d [prefer it too]]]
(b) Morphological:
[John 'd]

One principle that Sadock makes use of is the Cliticization Principle, which is stated as follows (Sadock 1991: 105):

(6) Cliticization Principle
If a lexeme combines with an inflected word in the morphology and with a phrase in the syntax, its morphosyntactic association will conform to at least the Weak Linearity Constraint.

The Strong and Weak Linearity Constraints are given as follows:

(7) (a) Strong: The associated elements of morphological and syntactic representations must occur in the same linear order.
(b) Weak: The associated elements of morphological and syntactic representations must occur in as close to the same linear order as the morphological requirements of the lexemes allow.

(Sadock's Cliticization Principle is similar in spirit and in predictive power to the Mapping Principle of Sproat 1985, 1988, which I describe later on.) Given this, it is clear why (3) is acceptable whereas (5) is not: in (3) *'d* obeys the Cliticization Principle since, although the word to which *'d* attaches (*he*) is not part of the phrase for which *'d* syntactically subcategorizes, it is immediately adjacent to *'d*, to its left. In this case, the mapping satisfies the Strong Linearity Constraint. Obviously, the same situation does not hold of the intended pairing of (5a) and (5b); not even the Weak Linearity Constraint would be satisfied here, since the phrasal position of *'d* and its morphological position can hardly be said to be 'in as close to the same linear order as the morphological requirements of the lexemes allow'.

2.2 Incorporation in Autolexical Syntax

In Sadock's theory, Cliticization is merely one instance of morphology/syntax mismatch – *morphosyntactic mismatch*, as Sadock terms it – which comes about as a result of morphology and syntax being separate modules, with their own principles. Another instance is incorporation. Sadock presents several arguments that noun incorporation in some languages must be viewed as involving nouns which are syntactically separate words, but which are morphologically part of a verb word; thus Sadock's treatment of incorporation is similar in this regard to the approach of Baker (1988a), and differs from that of Mithun (1984) or Di Sciullo and Williams (1987).

Like Cliticization, incorporation is governed by three sets of considerations. First, the incorporated element must occur syntactically in a position wherein its syntactic requirements can be met. Secondly, its morphological requirements and the morphological requirements of the other morphemes in the construction into which it is incorporated must be met. Thirdly, the mapping between the syntactic and morphological representations must be licit; in particular, it must obey the Incorporation Principle, as given below (Sadock 1991: 105):

> (8) If a lexeme combines with a stem in the morphology and with a phrase in the syntax, its morphosyntactic association will conform to the strong Constructional Integrity Constraint.

The Strong Constructional Integrity Constraint is stated as follows:

> (9) If a lexeme combines with a phrase P in the syntax and with a host in the morphology, then the morphological host must be associated with the head of the syntactic phrase P.

Consider, as a simple example, the Greenlandic sentence given in (10a) (Sadock 1991: 94). Following Sadock, in addition to the surface form of the morphologically complex words, I also give the underlying morphological analysis and a morpheme-by-morpheme gloss:

> (10) (a) Marlunnik ammassattorpunga.
> marluk-nik ammassak-tor-punga. *two-instrumental/pl. sardine-eat-indic./3sg.* 'I ate two sardines.'
> (b) Ammassannik marlunnik nerivunga. ammassak-nik marluk-nik neri-vunga. *sardine-instrumental/pl. two-instrumental/pl. eat-indic./3sg.* 'I ate two sardines.'

In (10a) the noun *ammassak* 'sardine' is morphologically incorporated into the verb. At the same time, it functions as the head of the object noun phrase meaning 'two sardines'. The *syntactic* structure of (10a) is thus effectively identical to the syntactic structure of (10b), where incorporation of *ammassak* 'sardine' has not taken place, and where the noun functions as a separate word both syntactically and (modulo case/number affixes) morphologically. The syntactic requirements of *ammassak* are thus satisfied in (10a), in that it is functioning as a head of an NP in the syntactic representation, a perfectly legal thing for a noun to be doing. At the same time, the complex verb *ammassattorpunga* is morphologically well formed: in particular, the morpheme glossed as 'eat' in this example, *-tor*, while it functions syntactically as a verb, is morphologically an affix that is marked to attach to nouns. Since *ammassak* is a noun, the morphological construction is licit as far as the morphological requirements on those two morphemes are concerned. Finally, we have to consider the mapping between the two levels of representation, which must satisfy the Incorporation Principle. Clearly the Strong Constructional Integrity Constraint, and thus the Incorporation Principle, is satisfied in this instance, since syntactically *ammassak* functions as the head of an NP, which is itself part of a VP of which *-tor*, the morphological host of *ammassak*, is the head.

The cliticization and noun incorporation examples that we have seen illustrate how, in Sadock's theory, morphology functions as a separate module of the grammar in determining grammatical well-formedness. The syntactic representation of grammatical constructions must satisfy various syntactic principles, and the – possibly nonisomorphic – morphological representations must satisfy morphological principles; and whatever nonisomorphism there may be between the syntactic and morphological representations must obey certain mapping constraints, as we have discussed.

It is important to note that Sadock's model is essentially tripartite, in that in addition to autonomous sets of syntactic and morphological principles and levels of represention, an important role is also played by an autonomous semantic module. Thus, Sadock also argues that one finds mismatches between semantic representations and the other levels of representation; this conclusion is perhaps a little surprising, at least on a compositional semantic theory such as the classic model-theoretic approach presented by Dowty et al. (1981). One instance of a morphology/semantics mismatch is what Sadock terms *morphosemantic incorporation* (Sadock 1991:170–8). Sadock presents arguments that a Greenlandic example like (11), where the morpheme meaning 'appear, seem' is *morphologically* attached to the morpheme meaning 'love', but where *semantically* 'seem' has scope over the entire phrase headed by 'love', should be considered to be a case of morphosemantic mismatch:

(11) Kaali-p Amaalia asa-gunar-paa.
Karl-erg. Amaalia(abs.) love-appear-indic/3sg.
'Karl seems to love Amaalia.'

(Sadock argues against the alternative analysis that this example should be analyzed as a form of verb incorporation (Baker 1988a), and thus should be counted as *morphosyntactic* mismatch, with the semantics reading directly off the syntactic structure. The reader is referred to Sadock's discussion for details.)

2.3 SumMary

To reiterate: Sadock provides a model in which morphology constitutes a separate module of the grammar, where morphological structure may be nonisomorphic with syntactic (or semantic) structure, and where the degree of nonisomorphism is governed by a set of what may be termed *Mapping Principles*.

One assumption that, at least on the face of it, Sadock would appear to subscribe to is that words have but one structure, from a purely morphology- internal point of view. In the next section, I describe relevant aspects of the approach to morphology espoused in Sproat (1985, 1988), where the assumption is made that the representation of words is distributed over different components of the grammar, and thus that the words have more than one structure. Multiple structures for words suggest the possibility of nonisomorphism between those structures, and such nonisomorphism is argued, in fact, to exist. As with Sadock's theory, nonisomorphism is constrained by a Mapping Principle. As we shall see, although the theory to be described starts with a rather different set of data and assumptions than does Sadock, both approaches end up giving a somewhat similar treatment of clitics. On the other hand, the conclusion that words have multiple structures spread across various components of the grammar led Sproat (1985) to argue that there is in fact no specifically *morphological* component, in direct opposition to Sadock's view.

3 Bracketing paradoxes and the mapping principle

3.1 Bracketing paradoxes

Let us start with what is in some ways possibly the simplest (but at the same time probably the most controversial) kind of structural mismatch that has been argued to support multiple structures for words: namely, the kind of *bracketing paradox* exemplified by the words *uneasier* or *unwiser*. As Pesetsky (1979, 1985) first observed, such words are paradoxical in the following way. The English comparative affix *-er*, as well as the superlative affix *-est*, has a phonological restriction on its distribution. Thus, while it may affix to adjectives that are monosyllabic such as those in (12a), or to trochaic disyllabic adjectives such as those in (12b), it does not generally attach to adjectives that do not fit into these categories (12c):

(12) (a) redder, sadder, wiser, kitscher
(b) easier, happier, manlier
(c) *ecstaticker, *contenter, *speciouser

At first glance, given the above considerations, adjectives like *uneasier* or *unwiser* would appear to be

unproblematic: although the adjectives *uneasy* and *unwise* do not have the right phonological properties to allow for the attachment of the comparative suffix, their bases easy and wise clearly do. This would lead us to propose the following structures for these two cases:

(13) [un [easy er]]
[un [wise er]]

But there is a problem here: with these structures the adjectives could not possibly receive the correct interpretation, at least under the most straight-forward assumptions (but see e.g. Stump 1991 for a theory under which such structures are not a problem). Pesetsky (1985) noted that structures like those in (13) ought to have the interpretations in (14):

(14) [NOT [MORE EASY]]
[NOT [MORE EASY]]

Now, the argument is actually a little trickier than that originally presented by Pesetsky. As Sproat (1992) points out, following Horn (1988), *un-*, when attached to scalar adjectives, does not have the contradictory interpretation implied by NOT, but rather the contrary reading OPPOSITE OF. With the examples in (13), however, the difference is of little consequence for the general form of the argument: with Sproat's (1992) considerations taken into account, *uneasier* should mean roughly the same as *harder*, and *unwiser* should mean roughly the same as *more foolish*. Yet the adjectives patently do not have these interpretations. Rather, they are interpreted as the comparative forms of the (idiomatically interpreted) base adjectives *uneasy* and *unwise*. This, in turn, suggests that the structures for these words must actually be as in (15):

(15) [[UN EASY] ER]
[[UN WISE] ER]

Thus we appear to require two opposing structures for these words. Pesetsky (1985) was the first to suggest that such cases could be viewed as a mismatch between the structural representation of the words at two different levels of the grammar. In his model the two levels were S-structure and Logical Form. As Pesetsky observed, the considerations that force the structures in (13) are basically phonological in nature, since they relate to prosodie restrictions on the affixation of the comparative suffix. Since the so-called Phonetic (or Phonological) Form component in GB syntax was supposed to "read off S- structure, Pesetsky proposed that the structures in (13) were the S-structure representations of these words. On the other hand, the considerations motivating the structures in (15) – leaving to one side for the moment the question of what *forces* these structures – would clearly appear to be semantic. Since semantic interpretation is computed from LF, Pesetsky proposed that these were the LF representations of the words. The mapping between these two structures was accomplished by Quantifier Raising, applying to the affix *-er*, to raise it out of its internal position in (13) to the position it occupies in (15). There are a number of problems, however, in interpreting the mapping between the two structures as involving QR; there is no space to go into the details here, but the reader is referred to Sproat (1985) and Hoeksema (1987).

Sproat (1985) took a slightly different tack from Pesetsky. Following some earlier suggestions of Marantz (1984b), Sproat proposed that the structures in (15) were actually the (*word-*) *syntactic* (say, S-structure) representation of the words, whereas those in (13) were the (*word-*) *phonological* (say, PF) representations of the words. Each of the two structures was licensed by principles applying at the relevant level in the grammar, much as under Pesetsky's proposal, and the two representations were further constrained to be related by what Sproat termed the *Mapping Principle*.

First let us consider the licensing conditions. We have already seen one of these: namely, the prosodie condition that "forces" the structures in (13). This would simply be stated as a prosodie condition on the comparative affix *-er* (and *-est*), and it would be determined in the PF component that the structures in (13) satisfied these conditions. But what principle of (word) syntax might force the (word-)syntactic structures in (15)? Note that these structures were *motivated* on the basis of their meaning. However, a moment's reflection will confirm that there is nothing theoretically wrong with

the alternative meanings that we discussed above, which these words happen, in fact, not to have.

Therefore, while one may believe on semantic grounds that the structures in (15) are correct, those structures do not appear to follow from semantic principles. One common suggestion for why these structures are forced is that while *un-* is a derivational affix, *-er* is apparently inflectional. On the assumption that those affixes that are termed inflectional are affixes that are "relevant to the syntax" in a way that derivational affixes are not, various researchers (e.g. Anderson 1982, Perlmutter 1988) have derived the principle that inflectional morphology must occur outside derivation. In Anderson's (1982, 1992) approach, this is encoded by having inflection take place in a later post-syntax part of the grammar than derivation, which feeds into syntax. Alternatively, one might take an approach such as that proposed by Fabb (1984), inter alia, and assume that *-er* is actually attached in the syntax. However this is handled, it seems as if one might be able to derive the semantically desirable structures in (15) on the basis of properties of the affixes involved and their interaction with syntax. So we have the following:

(16) (a) The structures in (13) are motivated on (word-) phonological grounds.
(b) The structures in (15) are motivated on (word-) syntactic grounds.

In Sproat's (1985) model, morphemes such as *un-*, easy, or *-er* were considered to be pairs of phonological and syntactic entities, much as, in Sadock's theory, morphemes have both morphological and syntactic (as well as semantic) frames in their morpholexical entries. Thus, *un-*, for example, was actually a pair of elements $<un\text{-}, UN_{<A, A>}>$, where the phonological half *un-* was assumed to be labeled as a prefix – in Sproat's model, notions implying linear ordering such as "prefix," "suffix," or "infix" were considered to be relevant only at the *phonological level* of representation – whereas the syntactic half *UN* was marked with various morphosyntactic features, including subcategorization features that mark it as an affix (crucially not a *prefix*) that attaches to adjectives and forms adjectives. The two sets of constraints summarized in (16a) and (16b) apply to representations over, respectively, the phonological halves and the syntactic halves of morphemes.

But, one presumes, there must be some constraints on the relationships between such structures: apparently uneasier has two nonisomorphic structures, but surely the nonisomorphism between a word's phonological and syntactic structures cannot be arbitrarily great. This is where the Mapping Principle, stated in (17), comes into play:

(17) If A and B are *sisters* in (word-) syntactic structure, and if B is an affix, then the phonological representation of B, denoted as Φ(*B*), *attaches* to the phonological representation of A, Φ(*A*).

Phonological attachment is denoted by the *commutative* "phonological attachment" operator *: thus Φ(*A*)*Φ(*B*) means simply that the phonological representation of B – for example, the entry *un-* in the pair $<un\text{-}, UN_{<A, A>}>$ – is attached to the phonological representation of A. For a case like *uneasier*, it was assumed that the (linearly unordered) (word-) syntactic structure was as in (18a) (cf. (15)). The phonological mapping of that structure is as given in (18b):

(18) (a) [ER[EASY UN]]
(b) (-er * (easy * un-))

The phonological structure in (18b) is clearly isomorphic to the (word-) syntactic structure; so how is the nonisomorphic phonologically motivated structure derived? As noted above, in Sproat's 1985 theory it is assumed that properties such as "prefix" or "suffix," which specify relative linear ordering between an affix and its base are purely phonological properties, and it is at the phonological level of representation that considerations of linear ordering become relevant. This is formally encoded by converting the operator * into the *associative* "linear ordering" operator ⌢ whenever the phonological characteristics of particular morphemes dictate a particular ordering. So, from (18b) can be derived (19a), since *un-* is a prefix; similarly, one can then derive (19b), since *-er* is a suffix. Finally, since ⌢ is an associative operator, the structure in (19c) is equivalent to that in (19b): hence this is a licit phonological representation of the word, and since, furthermore, this is the structure that is required

by the prosodie restrictions on *-er*, this is the *only* licit structure.

(a) (-er * (un- ⌢ easy))
(b) ((un- ⌢ easy) ⌢ -er)
(c) (un- ⌢ (easy ⌢ -er))

It is important to note that while the Mapping Principle, along with the behavior of the operator ⌢, allows mappings like that exemplified by *uneasier*, not all conceivable mappings are licit. For example, there is no way to derive (20b) from (20a):

(a) [RE [MIS ANALYZE]]
(b) (mis- ⌢ (re- ⌢ analyze))

Similar views of bracketing paradoxes have been presented by subsequent authors. For example, Cohn (1989) argues that certain bracketing paradoxes in Indonesian are best viewed as a consequence of the assumption that words have separate but parallel word-syntactic and prosodie (metrical) structures. So as not to present a completely biased view of the picture, however, it is important to bear in mind that not all scholars have been convinced that examples such as *uneasier* necessitate dual structures for words. Beard (1991, 1995) has argued against this view, and Stump (1991) has presented a particularly comprehensive model of morphology and semantics in which the relevant properties of cases such as uneasier can be derived by recourse to only one structure.

3.2 Consequences beyond bracketing paradoxes: parallels between words and phrases

If words have both a (word-) syntactic structure and a (word-) phonological structure (which may furthermore be nonisomorphic), then they are rather like phrases. Work on phrasal phonology – for example, Selkirk 1984, Chen 1987, Pierrehumbert and Beckman 1988, among many others – has largely tended towards the view that prosodie phrasing, while being derivable from syntactic phrasing, is often not isomorphic to it, and that the prosodie representation of a sentence must be considered to be a separate level of representation from its syntactic representation. So just as sentences should be viewed as having representations that are spread over several components of the grammar, including S-structure and PF (where the prosodie representation is presumably relevant), so may words. This particular parallel between words and phrases was implicit in Sproat 1985, and was subsequently made wholly explicit in Inkelas 1990. In that work, Inkelas, like Sproat, argued that words have a (word-) syntactic structure, which is separate from what she termed the "prosodie structure." In her theory, there are different levels in the word- internal prosodie hierarchy (just as there are usually presumed to be different levels in the phrasal prosodie hierarchy, cf. Pierrehumbert and Beckman 1988), and these levels correspond to the strata of the theory of Lexical Phonology (Kiparsky 1982b; Mohanan 1982, 1986). A word such as *nongrammaticality*, which is formed at two different strata – stratum I for *-ity* suffixation, and stratum II for *non-* prefixation – is represented in Inkelas's theory as consisting of two prosodie domains, the inner one spanning just *grammaticality*, the outer one spanning the whole word. Thus, in Inkelas's view, or in the earlier view of Sproat (1985), there are clear parallels between words and phrases.

3.3 Morphology across several components

So let us assume that morphological structure is correctly thought of as being distributed over several components such that there is a syntax-like – "word-syntactic" – representation as well as a prosodic-phrase-like – "word- phonological" – representation. One is then tempted to ask the question as to whether there is any reason to assume that word syntax is really handled in a separate component of the grammar from phrasal syntax? Similarly, is there any reason to assume that word phonology obeys different principles, and must therefore be separated, from phrasal phonology? Simply put, could word syntax be just (a part of) syntax? And is there any reason to make a categorical split between lexical and postlexical phonology?

The major thesis of Sproat (1985), and subsequently of Lieber (1992) (see also e.g. Walinska de

Hackbeil 1986), was that the syntax of words is properly a part of syntax, and that there is no reason to draw a categorical distinction between lexical and postlexical phonology. (Note that Fabb 1984 had previously made the somewhat more modest claim that *some* affixation, including derivational affixes such as -ness, were added in the syntax, but he stopped short of claiming that all morphology could be subsumed under other components of the grammar.) Sproat attempted to show, for example, that the properties of process nominals such as *destruction or categorization*, which had previously been considered to be wholly lexical constructions (cf. Chomsky 1970), could be derived from more general principles of syntax and semantics, given certain assumptions about the properties of the affixes involved. It is fair to say that Sproat's (1985) and Lieber's (1992) views have not gained wide acceptance, though it is equally fair to say that the reasons for insisting that morphology is a separate component from the rest of the grammar have not always been well considered; see my review of Lieber (1992) in Sproat (1993) for some discussion.

(Of course, it needs to be noted that there is a rather basic assumption that must be made before one can even begin to consider a thesis such as that of Sproat (1985): namely, that words can be broken down into morphemes in a more or less item-and-arrangement fashion. Obviously, in a theory such as Anderson's (1992) "A-morphous" morphology, where words are nearly always viewed as being constructed by the application of morphological rules, and where atomic segmentable morphemes have no status, one cannot even begin to make the assumption that word syntax should be considered to be merely a particular type of syntax. The same conclusion follows from Beard's (1995) Lexeme-Morpheme Base Morphology: in this model, only content morphemes have separate lexical entries. Function morphemes, including all affixes, lack separate lexical entries, being introduced rather by word-formation rules, much as in previous theories such as Matthews 1972 and Aronoff 1976. By contrast, Sproat's (1985) theory is based solidly upon the assumption that all morphemes, including affixes, have lexical entries, as proposed by Lieber (1980).

3.4 Other consequences: clitics

The treatment of clitics in the framework of Sproat (1985, 1988) and Marantz (1988) is quite analogous to their treatment in Autolexical Syntax. Let us consider again the English clitic *'d*. In the theory of Sproat (1985, 1988), this clitic would have a representation such as that in (21), where the left-hand portion of the entry says that phonologically *'d* is a suffix, and the right-hand portion claims that syntactically it is a verb:

(21) 'D = <-*d*, 'D$_V$>

The same Mapping Principle account as was given for bracketing paradoxes such as unwiser also extends to examples such as (3a). The syntactic structure would be essentially the same as that assumed in Sadock's theory, given previously in (3a), and repeated here for convenience in (22a). The Mapping Principle, plus the associative property of the linear ordering operator ⌢ allows the desired phonological representation in (22b). Furthermore, since *'d* is phono-logically specified as a suffix, and therefore must attach to something to its left in phonological representation, the structure in (3b) is actually forced.

(22) (a) [He [$_{vp}$ 'd [$_{vp}$ have [$_{vp}$ done it]]]]
(b) [he⌢-d]…

So, as we can see, the account given for morphological bracketing paradoxes also extends to clitics. Put slightly differently, simple clitics can be viewed as an instance of the same kind of syntax-phonology mismatch as bracketing paradoxes such as *unwiser*.

4 SumMary

In this chapter we have considered two approaches to morphology that are at once rather similar, yet quite different. The similarities lie in the fact that both consider interactions between modules of the grammar, and in particular, the mapping between those modules, as crucial for understanding the place of morphology in the grammar. However, on one view the morphology stands as a fully-fledged module with its own set of principles, whereas on the alternate view the morphology is split across

other components of the grammar, and is more or less absorbed into them.

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The various chapters of this Handbook have painted a fairly complete picture of what morphology is, what constructs are needed in the morphological component of a grammar, and how these constructs interact with one another and with other parts of the grammar. For the most part, the perspective taken on these questions has been purely synchronie; yet, as with all aspects of language (and indeed of human institutions in general), a diachronic perspective is possible as well, focusing on what happens to morphology through time. Thus in this chapter, several questions are addressed which are diachronic in their focus:

- What can change in the morphological component?
- What aspects of the morphology are stable?
- Where does morphology come from?
- What triggers change in the morphology?
- Is a general theory of morphological change possible?

Moreover, through the answers given to these questions, especially the first two, several examples of various types of morphological change are presented.

1 What can change? What is stable?

The easy answer here is that just about everything discussed in the previous chapters as constituting morphology is subject to change, especially so once one realizes that regular sound change can alter the shape of morphs without concern for the effect of such a change in pronunciation on the morphological system.[1] Thus, for example, once-distinct case endings can fall together by regular sound change (as a type of "syncretism"), as happened with the nominative plural, accusative plural, and genitive singular of (most) consonant-stem nouns in Sanskrit.[2] Still, morphological change goes beyond change induced merely by sound change, affecting not just the actual realizations of morphemes but also the categories for which these forms are exponents and the processes and operations by which these forms are realized. Thus it is possible to find change in the form taken by the various types of inflectional morphology, such as markings for person, number, gender, agreement, case, and the like, as well as the addition or loss or other alteration of such categories and the forms that express them; in the derivational processes by which stems are created and modified, and in the degree of productivity shown by these processes; in the morphological status (compound member, clitic, affix, etc.) of particular elements; in the overt or covert relationships among morphological elements, and, more generally, in the number and nature of the entries for morphemes and words in the lexicon, etc. Some examples are provided below.[3]

For instance, the category of person in the verbal system of Greek has seen several changes in the

form assumed by specific person (and number) endings. Ancient Greek allomorphy between *-sai* and *-ai* for the 2SG.MEDIOPASSIVE.PRESENT ending (generally[4] distributed as *-sai* after consonants, e.g. perfect indicative *tétrip-sai* 'you have (been) rubbed ((for) yourself)', from *tríb-ō* 'rub', and *-ai* after vowels, e.g. present indicative *timāi* 'you honor (for) yourself, contracted from / *timae-ai*/, or *lúēi* 'you are unloosing for yourself, contracted from / *lúe-ai*/) has been resolved (and ultimately, therefore, reduced) through the continuation of a process begun in Ancient Greek (note vowel-stem middle forms like *deíknu-sai* 'you are showing (for) yourself already in Classical Greek) that resulted, via the extension of one allomorph into the domain of the other, in the generalization of the postconsonantal form into all positions in Modern Greek, giving, for example, *timáse* 'you honor yourself (as if from earlier *tima-sai). Similarly, in some Modern Greek dialects, the ending for 3PL.MEDIOPASSIVE.IMPERFECTIVE.PAST has innovated a form *-ondustan* from the *-ondusan* found elsewhere; the involvement (via a type of change often referred to as contamination or blending[5]) of the 1PL/2PL endings *-mastan* / *-sastan* is most likely responsible for the innovative form, inasmuch as the innovative form shows the introduction of an otherwise unexpected *-t-* at exactly the same point as in the 1PL/2PL endings. As a final example, from verbal endings but a different language group, there is the case of the West Germanic 2SG.ACTIVE ending; the inherited ending from proto-Germanic was *-iz (as in Gothic *-is*), yet it underwent the accretion of a marker *-t*, giving forms such as Old English *-est*, Old High German *-ist*, which is widely held to be a reflex of an enclitic form of the second-person pronoun *þu*[6] bound onto the end of a verbal form (thus probably the result of cliticization, on which see below).

A change in the realization of number marking alone can be seen in the familiar case of the nominal plural marker /*-s*/ in English, for it has been spreading at the expense of other plural markers for centuries. For instance, the earlier English form *shoo-n*, as a plural of 'shoe', with the plural ending *-n* still found in *oxen*, has given way to *shoe-s*, with the most frequent, and indeed default, plural ending *-s*; in this case, the marker has not passed from the language altogether, as *oxen* shows, but the domain of a particular marker has come to be more and more restricted, and that of another has expanded. The "battleground" here in the competition between morphemes is constituted by particular lexical items and the markings they select for.[7]

Somewhat parallel to such changes in the form of endings themselves are changes in effects associated with the addition of such endings. The affixation of the plural marker /*-s*/ in English occasions voicing of a stem-final fricative with a relatively small set of nouns, all inherited from Old English: for example, *loaf* ([lowf]) / *loaves* ([lowv-z], *house* ([haws]) / *houses* ([hawz-əz]), *oath* ([owθ) / *oaths* ([owð-z]), though the default case now is to have no such voicing, as indicated by the fact that nouns that have entered the language since the Old English period do not participate in this morphophonemic voicing: for example, *class, gaff, gas, gauss, gross, gulf, mass, oaf, puff, safe, skiff*. Many nouns that do show this voicing are now fluctuating in the plural between pronunciations with and without the voicing, so that [owθs] for *oaths*, [(h)worfs] for *wharves*, and [hawsəz] for *houses* can be heard quite frequently.[8] It is likely that the innovative pronunciations will eventually "win out," thereby extending the domain of the default plural marking and essentially assimilating this class of nouns to the now-regular class.[9]

The creation of new markers also represents a change. Thus, when the early Germanic nominal suffix *-es-, which originally was nothing more than a stemforming element – that is, an extension onto a root to form certain neuter noun stems, as indicated in the standard reconstruction NOM.SG *lamb-iz 'lamb' versus NOM.PL *lamb-iz-ā[10] – was reinterpreted, after sound changes eliminated the final syllable of the singular and plural forms, as a marker of the plural, a change in the marking of (certain) plural nouns in Germanic came about.[11] The ultimate form of this marker, *-(e)r* with the triggering of umlaut in the root (e.g. OHG nominative singular *lamb* / nominative plural *lembir*, NHG *Wort* / Wört-er 'word/words'), reflects the effects of other sound changes and reinterpretations involving umlaut in the root triggered by suffixation.[12]

With regard to case markings, one can note that evidence from unproductive "relic" forms embedded in fixed phrases points to an archaic proto-Indo-European inflectional marker *-s for the genitive singular of at least some root nouns, which was then replaced in various languages for the same nouns as *-es or *-os, affixes which existed as allomorphic variants marking genitive singular already in proto-Indo-European, in use with different classes of nouns. For example, the Hittite form *nekuz*

'of evening' (phonetically [nek^{w}t-s]) in the fixed phrase *nekuz me h ur* 'time of evening', with its *-s ending, can be compared with Greek *nukt-ós*, Latin *noct-is*, with the innovative endings *-os/-es.[13] Similarly, the genitive ending *-os (as above, with a variant *-es), which can be inferred for *n*-stem nouns such as *óno-ma* 'name' (with *-ma* from *-mn)[14] in pre-Greek based on the evidence of Sanskrit *nāmn-as* and Latin *nomin-is* 'of a name',[15] underwent a cycle of changes in historical Greek. It was first altered through the accretion of a *-t-*, giving *-tos* (e.g. *onóma-tos*); although the exact source of this *-t-* is disputed, and although it is found ultimately in other cases, it seems to have arisen earliest with the genitive,[16] and so its appearance perhaps shows some influence from an ablatival adverbial suffix *-tos found in forms such as Sanskrit *ta-tas* 'then, from there' or Latin *caeli-tus* 'from heaven'. Whatever its source, it at first created a new genitive singular allomorph *-tos*; but later, when this *-t-* was extended throughout the paradigm, giving forms such as the dative singular *onóma-t-i* (for expected **ónomn-i*; cf. Sanskrit locative *nāmn-i*), the *-t-* became a virtual stem extension. At that point, one could analyze *ónoma* as having been "relexicalized" with a different base form /onomat-/, thereby reconstituting the genitive ending again as *-os* for this noun class.

Another relatively common type of change in the realization of case endings involves the accretion of what was originally a postposition onto a case suffix, creating a virtual new case form. This process seems to have been the source of various "secondary local" cases in (Old) Lithuanian (Stang 1966: 175–6, 228–32), such as the illative – for example, *galvôn* 'onto the head', formed from the accusative plus the postposition *nā (with variant form *na) 'in' (probably connected with Slavic *na* 'on') – and the allative – for example, *galvôspi* 'to(ward) the head', formed from the genitive plus the postposition *pie (an enclitic form of *priê* 'at') – where influence from neighboring (or substrate) Balto-Finnic languages is often suspected as providing at least a structural model.[17] Similar developments seem to underlie the creation of an innovative locative form in Oscan and Umbrian – for example, Oscan *húrtín* 'in the garden' (so Buck 1928: 114), where a postposition *en* is responsible for the form of the ending,[18] and may be viewed in progress in the alternation between a full comitative postposition *ile* 'with' in modern Turkish (e.g. *Ahmet lie* 'with Ahmet', *Fatma ile* 'with Fatma') and a bound suffix-like element *-(y)le* (with harmonic variant *-(y)la*), e.g. *Ahmetle, Fatmayla*). It should be noted, however, that though common, the development which these combinations apparently show, from noun-plus-free-postposition to noun-plus-case-suffix, is not unidirectional; Nevis (1986), for instance, has demonstrated that in most dialects of Saame (also known as Lappish) an inherited sequence of affixes *-pta-k-ek/n marking abessive has become a clitic word (*taga*, with variant *haga*), and more specifically a stressless postposition, while in the Enontekiö dialect, it has progressed further to become a nonclitic adverb *taga*.[19]

As the Turkish example suggests, in Lithuanian and Oscan, there most likely was a period of synchronie variation between alternates before the ultimate generalization of a new case form.[20] There can also be variation of a crosslinguistic sort here, in the sense that what is ostensibly the same development, with a postposition becoming a bound element on a nominal, might not lead to a new case form, if the overall "cut" of the language does not permit the analysis of the new form as a case-marked nominal. For instance, the special first- and second-person singular pronominal forms in Spanish, respectively *migo* and *tigo*, that occur with the preposition *con* 'with' and which derive from Latin combinations of a pronoun with an enclitic postposition – for example, *mē-cum* 'me-with' – could be analyzed as oblique case-marked pronouns. However, they are probably not to be analyzed in that way, since there is no other evidence for such case marking in the language, either with pronouns other than these or with nouns; one could just as easily, for instance, treat the element *-go* as part of a(n admittedly restricted) bipartitite discontinuous "circumposition" *con…-go*.[21]

As examples involving the creation of new case forms show, inflectional categories – for example, Allative in Old Lithuanian – can be added to a language. Indeed, a typical change involving categories is the addition of a whole new category and the exponents of that category, though sometimes the addition is actually more a renewal or reinforcement of a previously or already existing category, as with the Locative in Oscan. Loss of categories, though, also occurs. For instance, historical documentation reveals clearly that the dual was present as an inflectional category in the verbal, nominal, and pronominal systems of early Greek (cf. the Ancient Greek ending *-methon* noted above), yet there are no traces of the dual in any system in Modern Greek; similarly, a dual category is assumed for the proto-Germanic verb based on its occurrence in Gothic, and is attested for the personal pronouns of earlier stages of the Germanic languages (e.g. Old English *ic* 'I' /*wē* 'we/PL' /

wit 'we/DU'), yet such pronominal forms are not found in any of the modern Germanic languages, and verbal dual forms occur nowhere else among the older, or indeed the more recent, Germanic languages. Thus, as an inflectional category, one for which paradigmatic forms exist or might be expected to exist, dual number is no longer present in Greek or Germanic. Similarly, there was a loss of a synthetic perfect tense between Ancient Greek and late Koine Greek, so that Ancient forms such as *léluka* 'I have untied' became obsolete relatively early on in the post-Classical period; compare the merging of perfect and simple past tense for some speakers of Modern English, for whom *Did you eat yet*? is as acceptable as *Have you eaten yet*? Actually, though, the reconstitution (and thus addition) of the category "perfect" occurred in the medieval Greek period through the development of a periphrastic (analytic) perfect tense with 'have' as an auxiliary verb out of an earlier 'have' future / conditional tense.[22]

In the case of the Greek perfect, the medieval innovation led to what was a new category, for there had been a period of several centuries in post-Classical times when there was no distinct perfect tense. In some instances, though, it is not so much the creation of a new category as the renewal of the category through new morphological expression. The future in Greek provides a good example, for throughout its history, Greek has had a distinct future tense, contrasting formally and functionally with a present tense and a past tense, but the expression of the future has been quite different at different stages: the synthetic, suffixal, monolectic future in Ancient Greek (e.g. *grápsō* 'I will write') gave way in post-Classical times to a variety of periphrastic futures with infinitives plus auxiliary verbs, first with 'have', later with 'want' (e.g. *thélō grápsein*, lit. 'I-want to-write'), in which the parts maintained some independence (e.g. they could be separated by adverbs or inverted), but which in turn have ultimately yielded a new synthetic, monolectic future formed with a bound inseparable prefixed marker (in Standard Modern Greek, *θa*, as in *θa yrápso* 'I will write').[23]

There can be change as well in the content of a category, which, while in a sense a semantic shift, nonetheless can have morphological consequences, in that the category comes to be realized on elements not originally in its domain. For instance, the Slavic languages have developed a subcategory of "animacy" within the set of nominal gender distinctions, marked formally by the use of genitive forms where accusatives occur for inanimates; in early stages of Slavic (as represented e.g. by the earliest layer of Old Church Slavonic), only certain types of male humans (e.g. adults or freemen, as opposed to children or slaves) participated in such "animacy" marking; while later on, a wider range of nouns came to belong to this subcategory (e.g. in Russian, nouns for females show the animate declensional characteristic in the plural, and in Serbo-Croatian, an animal noun such as *lava* 'lion' follows the animate pattern).[24]

Similar to change in the content of a category is the possibility of change in the function / value of a morpheme: morphology involves the pairing of form with meaning, so it is appropriate to note here as well instances in which there is change in the function of a morpheme, even though that might be better treated under the rubric of semantic change. For instance, the development of the German plural marker *-er* discussed above clearly involves a reassignment of the function of the suffix *-iz- (→ *-er*) from being a derivational suffix serving to create a particular stem class of nouns to being an inflectional marker of plural number. So also, the polarization of *was*/*were* allomorphy in some dialects of English to correlate with a positive / negative distinction, so that *were* is more likely to occur with *-n't* than is *was* (Trudgill 1990, Schilling-Estes and Wolfram 1994), shows a reinterpretation of allomorphy that once signaled singular versus plural (or indicative versus subjunctive).

The changes illustrated so far have been fairly concrete, in that they concern the phonological realization of morphological categories or the categories themselves (which need some realization). There can also be change of a more abstract type, and a particularly fruitful area to examine is the matter of lexical relations. The components of grammar concerned with morphology, whether a separate morphological component or the lexicon, reflect the relationships that exist among forms of a language, whether through lexical "linking" rules, lexical redundancy rules, or common underlying forms. Significant changes can occur in the salience of certain relations, to the point where forms that were clearly related at an earlier stage of the language are just as clearly perceived by speakers at a later stage not to be related. Etymological dictionaries[25] provide dozens of examples involving separate lexical items that have lost any trace of a connection except for those speakers who have secondarily acquired knowledge of the relationship: for example, *two* and *twine*, originally a 'double

thread' (both from the earlier root for 'two'), or *yellow* and *gall* (both originally from a root for 'shine', but with different original vocalism and different suffixal formations),[26] to name just a few such sets from English. This situation frequently arises with words that are transparent compounds at one stage but lose their obvious composition. For instance, the modern English word *sheriff* derives from an Old English compound *scīrgerēfa*, literally the 'reeve' (*gerēfa*) of the 'shire' (*scīr*), but is not obviously connected in any way with Modern English *shire* or *reeve*; nor is *lord* plausibly connected synchronically with *loaf* or *ward*, the modern continuations of its Old English components (*hlāford*, literally 'bread-guardian', from *hlāf* 'bread' plus *weard* 'guardian'). In these cases, both sound changes, which can obscure the once obvious relationship, as with *l*(-*ord*) and *loaf*, and semantic changes, as with (*l*-)*ord* and *ward* (the latter no longer meaning 'guardian'), can play a role in separating lexical items once related synchronically.[27] And borderline cases provide some difficulties for analysis; for instance, are the semantically still compatible words *two* and *twelve* to be synchronically related in Modern English, and if so, does *two* derive from a form with an underlying cluster /tw-/? To a certain degree, the answers to such questions will depend on meta-theoretical concerns, such as a decision on the degree of abstractness to be allowed in morphophonological analyses (on which, see below).

In the face of such examples of change, it is equally important to reflect on what does not or cannot change in the morphology. To the extent that there are well-established principles and constructs that are taken to be part of the basic theoretical framework for morphology – for example, Lexical Integrity, Morphology-free Syntax, disjunctive ordering for competing morphological rules, and the like – presumably these will not change; they are the theoretical building blocks of any account of the morphological component, and thus cannot change diachronically (though they can of course be altered by linguists in their descriptions/accounts if synchronie or diachronic facts make it clear, for instance, that syntax is not morphology-free, or the like).

Among these theoretical building blocks are some that have a significant impact on diachronic accounts of morphology, in particular those that allow for the determination of the borderlines between components of grammar. That is, it is widely recognized that there is interaction at least between morphology and phonology (witness the term *morphophonology* and the possibility of phonological constraints on morphological rules) and between morphology and syntax (witness the term *morphosyntax*). Thus it becomes appropriate to ask how we can tell when some phenomenon crosses the border from "pure" phonology into morphology, or vice versa, or from "pure" syntax into morphology. Although there is a purely synchronie question here of how to characterize a given phenomenon in a given language for a given period of time, the matter of crossing component boundaries is also a diachronic issue. If a once-phonological phenomenon comes to be conditioned completely morphologically, and is considered to be part of the morphological component and not the phonological component, then there has been a change in the grammar of the language with regard to that phenomenon; the surface realization of the forms may not change, but the grammatical apparatus underlying and producing or licensing those surface forms has changed. Thus, when the vowel fronting induced by a following high vowel (so-called umlaut) in early German came in later stages of the language, when the phonetic motivation for the fronting was obscured or absent on the surface, to be an effect associated with the addition of certain suffixes (e.g. the diminutive *-chen*, the noun plural *-e*, etc.) or with the expression of certain categories (e.g. plurals of certain nouns which take no overt suffix, such as *Bruder* 'brother', with plural *Brüder*), one interpretation is that the umlauting process is no longer phonological in nature, but rather is a morphological process invoked by certain morphological categories.[28] Similarly, at a stage when the expression of locatives in (pre-) Oscan was accomplished by a noun plus a postposition, syntactic rules that license postpositional phrases were responsible for the surface forms; when the noun fused with the postpositional element to such an extent that a virtual new case-marker was created, the responsibility for the ultimate expression of the locative effectively moved out of the realm of syntax and into the morphological component.

These examples and the relevance of theoretical decisions separating components of grammar point to the need to recognize the impact that the theory of grammar one adopts has on diachronic analyses. For example, permitting a degree of abstractness in phonological analyses can often allow for a description that is purely phonological rather than morphological in nature. Umlaut in German, for instance, could still be considered to be purely phonological if each suffix or category now

associated with umlaut of a stem were represented underlyingly with a high front vowel to act as the triggering segment; deleting that segment before it could surface would have to be considered to be allowable abstraction. Similarly, the palatalizations of stem-final velars in various Slavic languages that accompany the attachment of certain suffixes (e.g. Russian adjectival *-nyj*, as in *vostoč-nyj* 'eastern' from the noun *vostok* '(the) east') were once triggered by a suffix-initial short high front vowel (the "front yer") that was ultimately lost in most positions in all the languages; thus a synchronie, purely phonological analysis could be constructed simply by positing an abstract front yer that triggers the palatalization and is then deleted.[29]

2 Where does morphology come from?

The examples in section 1 show that the primary source of morphology is material that is already present in the language, through the mediation of processes of resegmentation and reinterpretation applied in a variety of ways, as well as by other processes of change – for example, sound changes – that lead to grammaticalization. In addition, morphology may enter a language through various forms of language contact.

Thus, examples of blending or contamination involve preexisting material, as in the case of Greek 1DUAL.MEDIOPASSIVE ending (see n. 5), where a "crossing" of the 1PL.MEDIOPASSIVE ending *-metha* with the 2DUAL.MEDIOPASSIVE ending *-sthon* yielded *-methon*. In a parallel fashion, when a sequence of elements is resegmented – that is, given a different "parsing" by speakers from what it previously or originally had – material already in the language is given a new life. The English *-ness* suffix, for instance, derives from a resegmentation of a Germanic abstract noun suffix *-assu- attached to *n*-stem adjectives, with subsequent spread to different stem types; thus *ebn-assu- 'equality' (stem: *ebn- 'even, equal') was treated as if it were *eb-nassu-, and from there *-nassu- could spread, as in Old English *ehtness* 'persecution' (from the verb *eht-an* 'to pursue') or *gōdness* 'goodness' (from the adjective *gōd*). The extreme productivity of this new suffix in Modern English, capable of being added to virtually any new adjective (e.g. *gauche-ness, uptight-ness*) shows how far beyond its original locus a form can go, and also how the productivity of a morpheme can change, since *-ness* originally had a more limited use.

Other types of reanalysis similarly draw on material present at one stage of a language in one form and transform it at a later stage. In many cases of desyntacticization, for instance, where once-syntactic phrases are reinterpreted as word-level units with affixes that derive from original free words or clitics, as in the Oscan locative discussed above, the same segmental material is involved, but with a different grammatical status. Sometimes, though, such reanalyses are accompanied (or even triggered) by phonological reductions, so that the result is just added segmental material with no clear morphological value; the *-t* of Old English *wit* 'we two', for instance, comes from a phonologically regular reduction of the stem for 'two' in an unstressed position – that is, from *we-dwo – and similar cases involving old compounds – for example, *sheriff* and *lord* – were noted above. Moreover, when sound changes obscure the conditioning factors for a phonologically induced effect, and a new morphological process arises, as with umlaut in German, again what has occurred is the reanalysis of already existing material, in this case the fronting of a stem vowel that accompanies the addition of an affix; the new process is then available to spread into new contexts, having been freed from a connection to a particular phonological trigger.

Sometimes semantic shifts are involved in such reanalyses. The well-known example of the new suffix *-gate* in English is a case in point. This suffix originated from the phrase *Watergate affair* (or *scandal* or the like), referring to the events in the aftermath of a burglary at the Watergate apartment complex that brought down the Nixon administration in the early 1970s, through a truncation of the phrase to *Watergate* (e.g. *Nixon resigned because of Watergate*) and a reanalysis in which the *-gate* part was treated as a suffix and not the compound member it originally was in the place-name *Watergate*. It then spread, giving coinages such as *Irangate* (for a scandal in the 1980s involving selling arms to Iran), *Goobergate* (for a scandal alleged in 1979 to have involved then-President Carter's peanut warehouse), and numerous others.[30] What is especially interesting about this reanalysis is that in the process of *-gate* becoming a suffix, there was a shift in its meaning, so that in *X-gate*, the suffix *-gate* (but not the free word *gate*) itself came to mean 'a scandal involving X', an abbreviation, as it were, for 'a scandal involving X reminiscent of the Watergate scandal'.

Other processes similar to these that create pieces of words produce as well new lexical items, and thus contribute to the morphological component, to the extent that it includes the lexicon. Without going into great detail, one can note active processes of word formation such as compounding, acronymic coinage (e.g. *cpu* (pronounced [sipiyu]) for *central processing unit, ram* ([ræm]) for *random-access memory, rom* ([ram]) for *read-only memory*), clipping (e.g. *dis* from (*show*) *disrespect, rad* from *radical, prep* from *prepare* and from *preparatory, vet* from *veteran* and from *veterinarian*), lexical blends (e.g. *brunch* from *breakfast* crossed with *lunch*), phrasal truncations (such as the source of the word *street* via a truncation, with a semantic shift, of Latin *via strāta* 'road (that has been) paved' to simply *strāta*), and so on. It is worth noting here that whereas virtually any piece of a word, even suffixes, can be "elevated" to the status of a free word via clipping, inflectional morphemes seem to be resistant to such an "upgrading"; thus although *ism* as a free word meaning 'distinctive doctrine, system, or theory' (*AHD* 1992) has been extracted out of *communism, socialism*, etc., instances in which suffixes like English *-ed* or *-s* become words for 'past' or 'many' or the like appear not to exist.

One final language-internal path for the development of morphology involves instances in which the conditions for an analysis motivating a sequence of sounds as a morpheme arise only somewhat accidentally. In particular, if a situation occurs in which speakers can recognize a relation among words, then whatever shared material there is among these words can be elevated to morphemic status. This process is especially evident with phonesthemes, material that shows vague associative meanings that are often sensory based, such as the initial sequence *gl-* in English for 'brightly visible', as in *gleam*, *glitter*, *glisten*, *glow*, and the like. Some linguists are hesitant to call these elements morphemes, and terms like quasi-morpheme, submorphemic unit, and others have been used on occasion, even though by most definitions, they fulfill the criteria for being full morphemes. Leaving aside the synchronie issue they pose for analysis, it is clear that they can come to have some systematic status in a grammar, for they can spread and be exploited in new words (e.g. *glitzy*, which, whether based on German *glitzern* 'to glitter' or a blend involving *ritzy*, nonetheless fits into the group of other "bright" *gl-* words). A good example of this process is afforded by the accumulation of words in English that end in *-ag* (earlier [-*ag*], now [-æg]) and have a general meaning connoting 'slow, tired, or tedious action', specifically *drag* 'lag behind', *fag* 'grow weary', *flag* 'droop', and *lag* 'straggle', all attested in Middle English but of various sources (some Scandinavian borrowings, some inherited from earlier stages of English); at the point at which four words with both a similar meaning and a similar form were present in the language, by roughly the thirteenth century, an analysis was possible of this *-ag* as a (sub-) morphemic element. That it had some reality as such a unit is shown by the fact that these words "attracted" a semantically related word with a different form into their "orbit" with a concomitant change in its form; *sag* 'sink, droop' in an early form (sixteenth century) ended in *-k*, yet a perceived association with *drag*/*fag*/*flag*/*lag* and the availability of *-ag* as a marker of that group brought it more in line with the other members, giving ultimately *sag*.

The example of *-gate* above also shows language contact as a source of new morphology in a language, for it has spread as a borrowed derivational suffix into languages other than English; Schuhmacher 1989 has noted its presence in German, Kontra 1992 gives several instances of *-gate* from Hungarian, and Joseph 1992 provides Greek and Serbo-Croatian examples. Numerous examples of borrowed derivational morphology are to be found in the Latinate vocabulary in English, but it should be noted also that inflectional morphology can be borrowed. Various foreign plurals in English, such as *criteria, schemata, alumnae*, illustrate this point, as do the occurrence of Turkish plural endings in some (now often obsolete) words in Albanian of Turkish origin – for example, *at-llarë* 'fathers', *bej-lerë* 'landlords' (Newmark et al. 1982: 143)[31] – and the verb paradigms in the Aleut dialect spoken on the island of Mednyj, which show Russian person / number endings added onto native stems – for example, *uŋuçiju* 'I sit' / *uŋuçi-it* '(s)he sits' (Thomason and Kaufman 1988: 233-8). Although it is widely believed that inflectional morphology is particularly resistant to borrowing and to being affected by language contact, Thomason and Kaufman (1988) have shown that what is crucial is the social context in which the contact and borrowing occur. Thus the intense contact and the degree of bilingualism needed to effect contact-induced change involving inflectional morphology simply happen not to arise very often, so that any rarity of such change is not a linguistic question *per se*. Moreover, the spread of derivational morphology across languages may actually take place through the spread of whole words, which are then "parsed" in the borrowing language; the *-gate* suffix in Greek, for instance, occurred first in labels for scandals that followed the English names

directly (e.g. "Irangate") before being used for Greek-internal scandals.

3 What triggers change in the morphology?

Historical linguists tend to divide causes of change into those internal to the linguistic system itself and those that are external – that is, due to language contact. The discussion in section 2 shows that language contact is indeed one potential cause of morphological change, and that under the right social conditions for the contact, virtually any morphological element (inflectional, derivational, bound, free, whatever) can be transferred from one language to another. Examining contact-induced morphological change then becomes more a matter – an important one, to be sure – of cataloguing the changes and determining the sociolinguistic milieu in which the contact occurs.[32] There is far more to say, however, about internal forces triggering change in the morphology.

From a consideration of the examples above, it emerges that much morphological change involves "analogy," understood in a broad sense to take in any change due to the influence of one form on another.[33] This process is most evident in blending or contamination, where there is mutual influence, with a part of one form and a part of another combining; but it extends to other types of morphological change as well.

For instance, the spread of *-t-* described above in the stem of Greek neuter nouns in *-ma* involved the influence of the genitive singular forms, the original locus of the *-t-*, over other forms within the paradigm. Such paradigm-internal analogy, often referred to as "levelling," is quite a common phenomenon. An interesting example, to be reexamined below from a different perspective, involves the reintroduction of *-w-* into the nominative of the adjective for 'small' in Latin: in early Latin, the adjective had nominative singular *parw-os* and genitive *parw-ī*, and paradigmatic allomorphy *par-os* versus *parw-ī* resulted when a sound change eliminated *-w-* before a round vowel; paradigm-internal analogical pressures led to the restoration of the *-w-*, giving ultimately the Classical Latin forms *parvus* / *parvī*.

Analogical influence among forms is not restricted to those that are paradigmatically related. Two elements that mark the same category, but with different selectional properties, can exert analogical pressures, leading to the spread of one at the expense of another. Examples of such analogies include cases across form classes where the elements involved are different morphemes, as with the spread of the *-s* plural in English at the expense of the *-(e)n* plural, discussed in section 1, as well as cases in which one conditioned allomorphic variant extends its domain over another, thereby destroying the once-conditioned alternation, as with the spread of the Greek 2SG.MEDIOPASSIVE ending -SAI, also discussed above.

Similarly, in cases of folk etymology, speakers reshape a word based on other forms that provide what they see as a semantically (somewhat) motivated parsing for it; for example, *tofu* for some speakers is [tofud], as if a compound with *food*, and *crayfish*, first borrowed from French in the fourteenth century as *crevise*, was remade as if containing the lexeme *fish*. In such cases, which are quite common with borrowings or words that are unfamiliar for reasons such as obsolescence, there is influence from one form being brought to bear on the shape of another. More generally, many cases of reanalysis/reinterpretation involve some analogical pressures, especially when the reanalysis is induced by models that exist elsewhere in the language; for instance, when Middle English *pease*, a singular noun meaning 'pea', was reanalyzed as a plural, allowing for the creation (by a process known as "backformation") of a singular *pea*, the influence of other plurals of the shape [... V-z] played a role.

Thus there is a cognitive dimension to (certain types of) morphological change, in the sense that it often involves speakers actively making connections among linguistic forms and actively reshaping their mental representations of forms.[34] Indeed, analogy as a general mode of thinking and reasoning has long been treated within the field of psychology, and studies by Esper (e.g. Esper 1925 and the posthumous Esper 1973) were an early attempt to determine the psychological basis for analogical change in language.[35] More recently, analogical change has been viewed from the perspective of a theory of signs; Anttila (1972), for instance, has argued that the semiotic principle of "one form to one meaning" drives most analogical change, in that levelings, form-class analogies, folk etymology, and the like all create a better fit between form and meaning, while proponents of Natural

Morphology[36] similarly work with the importance of degrees of iconicity in the form–meaning relationship and, for example, evaluate changes in the marking of inflectional categories or derivational relationships in terms of how they lead to a better fit with universal iconic principles. Even the process of grammaticalization has been given a cognitive interpretation; Heine et al. (1991:150), for instance, have argued that "underlying grammaticalization there is a specific cognitive principle called the 'principle of the exploitation of old means for novel functions' by Werner and Kaplan (1963: 403)," and they note that in many cases grammaticalization involves metaphorical extension from one cognitive domain – for example, spatial relations – to another – for example, temporal relations (as with behind in English).[37]

Moving away from these more cognitive, functional, and/or mentalistic views of what causes morphological change, one can find various formal approaches to analogy. The most notable[38] is the generative approach, in which analogy is nothing more than changes in the rule system that generates a given paradigm. The Latin case mentioned above whereby a paradigm of *parw-os* / *parw-ī* yielded *par-os* / *parw-ī* by sound change and finally *parvus* / *parvī* by paradigm leveling could be seen as the addition of a rule of $w \rightarrow \emptyset$ before round vowels (the sound change) operating on an underlying form for the nominative with the *-w-*, and then the loss of that rule giving the underlying stem-final *-w-* a chance to surface once again. What is left unexplained in such an account is why the rule would be lost at all; early generative accounts (e.g. R. King 1969, Kiparsky 1968) simply gave a higher value to a grammar with fewer rules or features in the rules (but then where, as Andersen (1973: 766) asked, would added rules come from, and why would they even be added in the first place?) or unnatural rule orderings, whereas later accounts (especially Kiparsky 1971) gave higher value to grammars that generated paradigm-internal regularity, a condition that tacitly admits that the traditional reliance on the influence of related surface forms had some validity after all. Another type of generative reinterpretation of analogy is that given by Anderson (1988a), who, as observed in footnotes 7 and 9, sees analogies such as the spread of the English *-s* plural or the loss of morphophonemic voicing in certain English plurals as being actually changes in the lexically idiosyncratic specifications for the inflectional markings, derivational processes, and the like selected by particular lexical items.

Finally, any discussion of causes must make reference to the fact that, as is the case with all types of language change, the spread of morphological innovations is subject to social factors governing the evaluation of an innovation by speakers and its adoption by them. Indeed, if one takes the view that true language change occurs only when an innovation has spread throughout a speech community,[39] then the various processes described here only provide a starting point for a morphological innovation, but do not describe ultimate morphological change in the languages in question. The presence of synchronie variation in some of the changes discussed above, as with the loss of morphophonemic voicing in English plurals, shows how the opportunity can arise for nonlinguistic factors to play a role in promoting or quashing an innovation.

4 Is a general theory of morphological change possible?

Over the years, there have been numerous attempts to develop a general theory of morphological change, and the approaches to the causes of morphological change outlined in the previous section actually represent some such attempts. To a greater or lesser extent, there have been successes in this regard. For instance, the recognition of a cognitive dimension to analogy and to grammaticalization has been significant, as has the corresponding understanding of the role of iconicity. The generative paradigm has been embraced by many, but a few further comments about it are in order.

Most important, as noted above, an account of analogical change in paradigms that is based on changes in the rules by which the paradigms are generated does not extend well to analogical changes that cannot involve any rules, such as blends or contamination. As Hock (1991: 256) points out, a development such as Middle English *femelle* (a loan word from French) becoming *female* by contamination with *male* does not involve any generative rules; yet it still took place, and one would be hard-pressed to account for the change in the vocalism of this word without some reference to pressure from the semantically related *male*. Similarly, the change discussed by Anttila (1972: 89), in which the nominative singular of the uniquely inflected word for 'month' in the Elean dialect of Ancient Greek became *meús* (with genitive *mēn-ós*, versus e.g. Attic nominative *meís*), based on the

uniquely inflected word for the god Zeus (nominative *Zeüs*, genitive *Zēn-ós*), could not involve any generative phonological rules, since both words were the only members of their respective declensional classes, and thus were probably listed in the lexicon rather than rule-governed in terms of their inflection.[40] On the other hand, the semiotic and cognitive views of analogy – for instance, invoking a one-form-to-one-meaning principle – can provide a motivation not only for the putative cases of analogy as rule-change, but also for those that could not involve rule change.[41] Moreover, cases of bi-directional leveling, as presented by Tiersma 1978 with data from Frisian, in which some paradigms involving a particular phonological rule are leveled as if the rule had been lost, while others involving the same rule are levelled as if the rule had been generalized, make it difficult to give any predictive value to a rule-based approach to analogy.[42] Finally, the recognition of paradigm uniformity as a part of the evaluation metric in Kiparsky 1971 is tantamount to recognizing analogy in its traditional sense. As Anttila (1972: 129, 131) puts it: "What rule changes always describe, then, is the before-after relationship. They give a mechanism for description, not a historical explanation… Rule change is not a primary change mechanism, but an effect."

This is not to say, however, that traditional analogy is not without some problems. As has frequently been pointed out, it often seems unconstrained, and there is an element of unpredictability about it. When will analogy occur? What direction will leveling take? Which forms will serve as models? And so on. In part to address this uncertainty about the workings of analogy, some scholars have attempted to formulate a set of general tendencies or regularities governing analogy. The two most widely discussed schemes are those of Kuryłowicz (1945–9)[43] and Mańczak (1958). A full discussion of these proposals is beyond the scope of the present chapter,[44] but it is generally held that Kuryłowicz's "laws" are, as Collinge (1985: 252) citing Anttila (1977: 76–80) puts it, more "qualitative and formal" in nature, whereas Mańczak's tendencies are more "quantitative and probabilistic." It can be noted also that some of their specific proposals complement one another, some are contradictory, some are tautologous and thus of little value, but some[45] – for example, Mańczak's second tendency ("root alternation is more often abolished than introduced") and Kuryłowicz's first "law" ("a bipartite marker tends to replace an isofunctional morpheme consisting of only one of these elements") are valuable tools in analyzing analogical changes, as they reflect tensions present in language in general: respectively the need to have redundancy for clarity and the desire to eliminate unnecessary or unmotivated redundancy. Moreover, Kuryłowicz's fourth "law" has, in the estimation of Hock (1991: 230), proved to be "a very reliable guide to historical linguistic research." This "law," which states that an innovative form takes on the primary function and that the older form it replaces, if it remains at all, does so only in a secondary function, can be exemplified by the oft-cited case[46] of English *brethren*; this form, originally a plural of the kinship term *brother*, is now relegated to a restricted function in the meaning "fellow members of a church" or the like, and, significantly, cannot be used in the primary sense of *brothers* as a kinship term.

Other general tendencies of morphological change have been proposed and have proved quite useful. For instance, there is the important observation by C. W. Watkins 1962 that third-person forms are the major "pivot" upon which new paradigms are constituted.[47] However, as with other proposed principles, "Watkins' Law" is also just a tendency; the change of the 3PL past ending in Modern Greek to *-ondustan* discussed in section 1, which shows the effects of pressure from 1PL and 2PL endings on the 3PL, might constitute a counterexample, for instance.

In the end, it must be admitted that much morphological change involves lexically particular developments, and it is significant that even the spread of analogical changes seems to be tied to particular lexical items; thus, unlike sound change, which generally shows regularity in that it applies equally to all candidates for the change that show the necessary phonetic environment, morphological change, especially analogical change, is sporadic in its propagation. Thus, as shown in section 1, even with the vast majority of nouns in English now showing an innovative -s plural, a few instances of the older -(*e*)*n* marker remain in *oxen, children*, and *brethren*.

Thus, it may well be that for morphological change, a general theory – that is, a predictive theory – is not even possible, and that all that can be done is to catalogue tendencies, which, however valid they may be, do not in any sense constitute inviolable predictions about what types of changes will necessarily occur in a given situation. In that sense, accounts of morphological change are generally retrospective only, looking back over a change that has occurred and attempting to make sense of it.

5 Conclusion

Although morphological change in general shows much that is unpredictable, the examples listed herein provide a good overall view of the types of changes that are likely to be encountered in the histories of the languages of the world, the causes underlying these changes, and the ways linguists have gone about explaining the observed changes.

One final observation on the extent of the domain of morphological change is in order. Much morphological change, as described here, involves change in lexical items – in their form, their selectional properties, their relations to other lexical items, and so on – and this is all the more so if inflectional affixes are listed in the lexicon instead of being introduced by morphological rules. It is generally accepted that at least certain types of sound changes involve lexemeby-lexeme spread (the cases of so-called lexical diffusion – cf. Wang 1969 but especially Labov 1981, 1994), and it seems that in some instances, at least, the impetus for the spread of a pronunciation into new lexical items is essentially analogical in nature.[48] Also, there are many so-called irregular sound changes – for example, metathesis or dissimilation – that apply only sporadically, and thus end up being lexically particular rather than phonologically general. Moreover, at least certain types of changes typically relegated to the study of syntactic change, for instance, changes in agreement patterns, grammaticalization, movement from word to clitic to affix, reduction of once-biclausal structures to monoclausal,[49] and the like – that is to say, much of syntactic change other than word order change – ultimately involves morphology or at least morpho-syntax in some way. Thus it is possible to argue that much – perhaps most – language change has a morphological/morpholexical basis, or at least has some morphological involvement. Such a view would then provide some diachronic justification for the importance of morphology in language in general, and thus for a morphological component in the grammars of particular languages.[50]

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1 This statement conceals a large controversy which cannot be discussed adequately here: viz. whether sound change is a purely mechanical phonetic process that is blind to the specific morphemes and words it operates on, and to their morphological composition, e.g. whether they are morphologically complex or monomorphemic. Thus, in principle, one could imagine that sound changes could be morphologically conditioned, and so could fail to apply in, or could apply only to, certain categories or particular morphemes. The evidence, however, seems to favor viewing sound change as being only phonetically conditioned in its outcome at least, with apparent cases of nonphonetic (so-called grammatical) conditioning being the result of phonetically conditioned sound change followed by analogical (morphological) change. See Hock 1976 for some discussion and relevant literature.

2 These endings all have the form *-as* in Sanskrit, but, as comparisons with other Indo-European languages show, they derive from three different sources (GEN.SG *-os, cf. Greek *pod-ós* 'of a foot'; NOM.PL *-es, cf. Greek *pód-es* 'feet'; ACC.PL *-ns, cf. Greek *pód-as* 'feet').

3 These examples are drawn primarily from the languages I know best and thus am best able to vouch for; they therefore have what might be perceived as an Indo-European bias. However, there is every reason to believe that the same types of examples are to be found in other languages, and that the phenomena illustrated here are not just Indo-European types of changes. See e.g. Bloomfield 1946: §§18–20; Anttila 1972: 91, 97; Robertson 1975; Hock 1991: 200–2; and Dai 1990 for some examples from Algonquian, Estonian, Mayan, Maori, and Mandarin Chinese, respectively, to mention just a few well-established cases from other language families.

4 But see below regarding forms like *deíknusai* that disturb this otherwise regular allomorphic pattern.

5 The Ancient Greek innovative 1DUAL.MEDIOPASSIVE ending *-methon*, which filled a gap in the paradigm (note the absence of a 1DUAL.ACTIVE form) and seems to have arisen as a blend of 1PL.MEDIOPASSIVE ending *-metha* with the 2DUAL.MEDIOPASSIVE ending *-sthon* (note also the 2DUAL.ACTIVE *-ton*), provides another example of a change in a personal ending due to blending/ contamination.

6 The enclitic form, occurring as it does with a stop, presumably reflects a combinatory variant of *pu* after a sibilant.

7 See Anderson 1988a for discussion of the spread of the s-plural in English; he argues that the mechanism is one of the elimination of lexically specified idiosyncrasies and the emergence of the default marking; he notes that this interpretation is consistent with, and in fact predicted by, the principle of disjunctive ordering for morphological rules. For a similar example from German, where an -s marking for plural is spreading, see Janda 1990.

8 For instance, [owθs] and [(h)worfs] are given in *AHD* 1992 as (innovative) variants; [hawsəz], while common in Central Ohio at least, has not yet been enshrined in the dictionary.

9 As with the spread of the s-plural (see n. 7), this loss of morphophonemic voicing can be seen as the removal of an idiosyncratic specification from the lexical listing of each such noun. See also Anttila 1972: 126–7 for discussion of this example and of parallel ones involving consonant gradation from Baltic Finnic. It should be noted that occasionally the idiosyncratic marking has spread to a noun not originally undergoing this process; e.g. *dwarf* originally had no overt plural marker in Old English, so that the variant plural *dwarves*, alongside the synchronically more regular *dwarfs*, represents a spread of the synchronically irregular pattern.

10 See e.g. Prokosch 1938 for this reconstruction.

11 The situation is actually a bit more complicated, as is clear from the fact that early OHG had *-ir-* in some singular forms, specifically the genitive, the dative, and the instrumental; but as the suffix came to be interpreted purely as a marker of number, as the nominative forms would lead a speaker to surmise, it disappeared from the singular. Still, Salmons (1994: 224–5), in his recent discussion of these facts, notes variability, in particular with regard to *-ir-* less plural forms, throughout the OHG period and dialect space, and concludes that *-ir-* as marking only plurality was not "firmly established in many dialects." See also Anderson 1988a for an interpretation in terms of changes in lexical specifications.

12 Note also that since in earlier stages of Germanic, *Wort* did not have this plural marking (cf. OHG SG wort / PL *wort*), the extension of this umlaut-plus-(*e*)*r* plural marking is a process parallel to the example given of the -s plural in English; see also nn. 7 and 11.

13 That this archaic inflection is embedded in a fixed phrase (likewise Vedic Sanskrit *dan* 'house/ GEN.SG', from *dem-s, found in the fixed phrase *patir dan* 'master of the house') is not surprising, for it shows the retention of an older pattern in what is in essence a synchronically unanalyzable expression (like an idiom). From a methodological standpoint in doing historical morphology and morphological reconstruction, it is often useful to look to such expressions for clues as to earlier patterns.

14 The reconstruction of the root for this word is somewhat controversial, and only the stem suffix is at issue here, so no attempt is made to give a complete reconstruction.

15 The *-os/-es ending in these languages may itself be a late PIE replacement for an earlier simple *-s ending, based on such forms as the Old Irish genitive singular *anmae* 'of a name', where the ending is from *-men-s (so Thurneysen 1970: 60); hence the specification "pre-Greek" is used here for the ending, since it may not be the oldest form of this inflectional ending with this noun in PIE.

16 A *-t-* extension is found with several other nominal stem classes in Greek – e.g. the neuter *-as-* stems – but it is not found with all members of the class, and a few specific nouns – e.g. *kréas* 'meat' – show it earliest in the genitive singular (4th century BC), with spread to other case forms coming much later. Even with a noun like *ónoma*, which, as noted below, shows the extension of the *-t-* into other case forms, early (Homeric) Greek shows no (metrical) trace of the *-t-* in the dative plural (see Chantraine 1973: 74–5, 82–3).

17 See Thomason and Kaufman (1988: 242–3) for some discussion of the substratum hypothesis, though

Stang (1966: 228–9) argues against this view.

18 That this one-time postposition has become a true case ending in Oscan is shown by its appearance on an adjective, in apparent agreement with the noun it modifies; see Buck 1928: 114 for this interpretation. This innovative form presumably replaced an inherited locative, still found to a limited extent in Latin.

19 Within the literature on grammaticalization (e.g. Traugott and Heine (eds) 1991a, b; Hopper and Traugott 1993) there is much discussion of the claim that developments in grammaticalization are subject to a principle of unidirectionality, whereby movement supposedly is always from less grammatical to more grammatical, with meanings always going from concrete to abstract; see Joseph and Janda 1988, Campbell 1991, Janda 1995, and Joseph 1996a for discussion of some counterevidence to this claim.

20 Compare the situation with morphophonemic voicing in English plurals, discussed above (and see n. 8), and note the ongoing variation in the marking of past participles in English, with older *-(e)n* in some verbs giving way to the more widespread *-ed* (as in *sewn* / *sewed, shown* / *showed, proven* / *proved*, etc.).

21 The Spanish example suggests that changes in case-marking systems are not restricted to the distant past, though the failure of *-go* to spread to other pronouns (indeed, it has retreated somewhat from wider use in older stages of the language) or to be used with other prepositions argues that it is not really a casemarking device. Similarly, the innovative use in certain varieties of written English of *inwhich*, as in *Shopping is a task inwhich one should enjoy*, has led some researchers – e.g. J. R. Smith 1981 and Riley and Parker 1986 – to analyze it as a new case form of the relative pronoun, though Montgomery and Bailey 1991, in an extensive study of the use of the form, argue persuasively against that interpretation. Nonetheless, such examples provide the opportunity to witness the fate of case-like forms that occur in a restricted domain of the grammar, and thus provide some insights into the general processes by which such forms can arise and take hold in a language.

22 Most likely, the path of development was through the conditional tense (past tense of the future) shifting first to a pluperfect (compare the fluctuation in Modern English between a pluperfect form and what is formally a past tense of the future utilizing the modal *would* in *if* clauses – e.g. *If I had only known* = *If I would have known*), from which a present perfect and other perfect formations could have developed. See Joseph 1983: 62–4; 1996b, for some discussion.

23 The exact path from *thélō grápsein* to *θa θrápso* is a bit convoluted and indirect; see Joseph 1983: 64–7; 1990: ch. 5; 1996a for discussion and further details. The only material that can intervene between *θa* and the verb in Modern Greek is other bound elements, in particular the weak object pronouns.

24 Even in Old Church Slavonic, there was some variability in category membership, and nouns for 'slave', 'child', various animals, etc. showed some fluctuation between animate and nonanimate inflection; see Lunt 1974: 46 and Meillet 1897 for some discussion. The descriptions in Comrie and Corbett (eds) 1993 provide a useful overview of the realization of animacy throughout the various Slavic languages. Thomason and Kaufman (1988: 249–50) suggest that this category may have developed through a Uralic substratum shifting to Slavic.

25 For English, the *American heritage dictionary of the English Language*, 3rd edn (1992), with its "Indo-European Roots Appendix" by Calvert Watkins (see also C. W. Watkins 1985), is an excellent example of such a resource.

26 *yellow* is from Old English *geolu*, from proto-Germanic *gelwaz; *gall* is from Old English *gealla*, from proto-Germanic *gallōn-.

27 Note also that words that are etymologically unrelated can come to be perceived by speakers at a later stage as related, perhaps even merged into different meanings of the same word: e.g. the body part *ear* and *ear* as a designation of a piece of corn are etymologically distinct (the former from PIE *ous- 'ear', the latter from *ak- 'sharp'), but they are felt by many speakers to be different meanings of one polysemous lexical item.

28 See Janda 1982, 1983, for a thorough discussion of the relevant facts supporting this analysis of German umlaut. The productivity of umlaut does not in itself argue for it still being phonological; in that sense, the German situation is now similar in nature, though not in scope, to the very limited umlaut effects still present in English, e.g. in a few irregular plurals (*man*/*men*, *foot*/*feet*, etc.) and verbal derivatives (*drink*/

drench, etc.).

29 Thus there is an important interaction with sound change to note here, for sound change can obscure or remove the conditioning elements for a phonological process, thereby rendering the process opaque from a phonological standpoint and making it more amenable to a morphologically based analysis. Recall also that sound change can play a role in the reduction of compounds to monomorphemic words and of phrasal units, such as noun plus postposition, to monolexemic expressions.

30 Many such *-gate* forms are documented in notes in *American Speech*; see Joseph 1992 for references.

31 Of course, some of these English forms are susceptible, seemingly more so than native plurals, to reanalysis as singular; *criteria* is quite frequently used as a singular, and a plural *criterias* can be heard as well. Similarly, the Albanian plurals in *-llarë*/*-lerë* show the native plural suffix *-ë* added to the Turkish *-lar*/*ler* ending, somewhat parallel to forms like *criterias*.

32 The distinction drawn by Thomason and Kaufman (1988) between borrowing and language shift is a crucial one, with the latter situation being the contact vehicle for some of the more "exotic" morphological changes. Their discussion is perhaps the most complete enumeration of the wide range of possible contact-induced changes, including those affecting the morphology. See also n. 24 above concerning a languageshift source for the introduction of the new animacy subcategory in Slavic.

33 See Anttila 1977 and Anttila and Brewer 1977 for basic discussion and bibliography on analogy in language change.

34 Analogy can also provide direct evidence for the existence of the tight relations among members of clusters of forms that allow for an inference of a (psychologically) real category. For instance, the fact that *drag*/*fag*/*flag*/*lag* could affect [sæk] and draw it into their orbit as *sag* is *prima facie* evidence of the strength of the connections among these four words. Similarly, the dialectal extension of the *-th* nominalizing suffix, which shows limited productivity within the domain of dimension adjectives (cf. *wide*/*width*, *deep*/*depth*, etc.) to *high*, giving [haytθ] (thus also with some contamination from *height* to explain the occurrence of the *-t-*) can be seen as evidence of the subcategory within which the suffix is productive.

35 Another perspective on the cognitive dimension in analogy is provided by Andersen's introduction of the role of abductive reasoning in analogical reanalysis, as discussed most notably in Andersen 1973, 1980.

36 Especially the work by Wolfgang Dressler, Willi Mayerthaler, Wolfgang Wurzel, and others; see e.g. Dressier et al. 1987, Mayerthaler 1981, Wurzel 1984. See also Shapiro 1990 (with references), where a somewhat different view of the role of semiotics in language change, as applied to morphophonemics, can be found.

37 Of course, not all grammaticalization involves morphological change, except insofar as it affects lexical items. The papers in Traugott and Heine (eds) 1991a, b contain numerous references to the cognitive dimension of grammaticalization; see also Hopper and Traugott 1993 for discussion and references.

38 See also the recent work by Skousen in which an explicit and formal definition of analogy is used to create a predictive model of language structure; among the tests for this approach (in Skousen 1989: ch. 5) is its application to historical drift in the formation of the Finnish past tense.

39 This view has long been associated with William Labov, and is expressed most recently in Labov 1994: 45: "In line with the general approach to language as a property of the speech community, I would prefer to avoid a focus on the individual, since the language has not in effect changed unless the change is accepted as part of the language by other speakers."

40 One could say of course that there has been a change in the morphological rules that introduce the stem variants for 'month', but that still brings one no closer to understanding why the change occurred. Once 'Zeus' and 'month' share the same patterns of alternation, then a generalization over these two forms is possible, allowing for some simplification in the grammar. However, the change cannot have occurred just to simplify the morphological rules for 'Zeus' somewhat by giving them wider applicability, since a greater simplification would have arisen had the stem alternation for this noun been eliminated altogether (as it was in some dialects that innovated a nominative *Zēn*).

41 Thus *female* makes more "sense," and thus is a better fit between form and meaning, when formally paired with its antonym *male*; similarly, providing a "partner" for the unique stem alternations of 'Zeus' makes the *Zeu-*/*Zēn-* alternation less irregular, and thus more motivated and easier to deal with from a cognitive standpoint.

42 Similarly, note forms such as *dwarves* in English, mentioned above in n. 9, that run counter to the general leveling out of stem differences due to voicing of fricatives in the plural.

43 See Winters 1995 for an English translation, with some commentary, of this important oft-cited yet generally little-read paper.

44 See Vincent 1974; Collinge 1985: 249–53; Hock 1991: ch. 10; and Winters 1995 for more detailed discussion and comparison of the two schemes.

45 The statements of these principles and their comparison are taken from the illuminating account in Hock 1991: ch. 10.

46 See Robertson 1975 for an example of the fourth law from Mayan.

47 See Collinge 1985: 239–40 for discussion and references.

48 For example, a possible scenario for lexically diffuse spread of a sound change is the following: if lexical item X shows variation in pronunciation between X and X', and item Y has some of the same phonological features as item X, speakers may extend, analogically using X as the model, the variant pronunciation X' to Y, so that Y comes to show variation between Y and Y'. If the competition is ultimately resolved in favor of X' and Y', the sound change would have been generalized.

49 See e.g. DeLancey 1991, regarding such clause reduction in Modern Tibetan (discussed in Hopper and Traugott 1993: 198–201).

50 In Joseph and Janda 1988, the claim is advanced that grammars are "morphocentric," and the prevalence noted above in section 1 of diachronic movement into morphology (from syntax and from phonology), as opposed to the relative rarity of movement out of morphology, is taken as diachronic evidence for the centrality of morphology. This claim is based on an assumption that facts from diachrony can have relevance for the construction and evaluation of synchronie grammars, and to the extent that it is valid, provides some support for treating such facts as important.

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19. Morphology in Language Acquisition

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1 Language acquisition

Children typically begin to say their first words between twelve and twenty months of age. And they produce systematic morphological modulations of those words within their first year of talking. As they move to more complex expression of their meanings, they add grammatical morphemes – prefixes, suffixes, prepositions, postpositions, and clitics. On nouns, for example, they start to add morphemes to mark such distinctions as gender, number, and case; on verbs, they add markers for aspect, tense, gender, number, and person. Within a particular language, children's mastery of such paradigms may take several years. There are at least three reasons for this: (a) some meaning distinctions appear to be more complex conceptually than others, and so take longer to learn; (b) some paradigms are less regular than others, and they too take longer to learn; and (c) language typology may affect the process of morphological acquisition: suffixes, for instance, are acquired more readily, and earlier, than prefixes.

In order to acquire noun and verb morphology, children must first analyze the structure of words heard in input, identify stems and affixes, map consistent meanings onto them, and then begin to use those stems and affixes in new combinations. This process of analyzing form and assigning meaning is a prerequisite for the acquisition of inflectional morphology. It is also a prerequisite in the acquisition of word formation. Children begin to use some word-formation processes at around the same time as their first inflections. In particular, they produce novel compounds formed from simple stem combinations (often called *root* compounds). Next, during their second year of speech, as some inflectional paradigms become established, they also begin to produce a few derivational affixes in novel word forms. These emerge in greater numbers between ages three and four, in both derived and compound innovations.

1.1 Some issues in acquisition

The acquisition of morphology in inflection and word formation raises a number of questions about both morphology and the process of acquisition. Languages differ in the extent to which they rely on inflectional morphology to mark grammatical distinctions and grammatical relations. In essence, languages range from analytic (with virtually no inflectional morphology, as in Chinese) to synthetic (with fairly extensive reliance on inflections, some for grammatical relations and agreement, and many marking several distinctions at once, as in Spanish), to agglutinative (with highly regular and systematic inflections, each marking a separate distinction, as in Turkish). In word formation, there is just as much variety, with some languages relying almost exclusively on compounding to form new words, others relying mainly on derivation, and many others relying on some mix of the two. Derivation may include both affixal and zero-derived forms, and some affixes commonly appear in compounds too. One issue for acquisition, then, is the extent to which language typology affects the

process of learning: Do particular typologies help or hinder?

In acquisition, the domain of morphology is the word. Inflectional affixes are added to words or stems to form words. Each one must be identified and assigned some meaning. But inflections also mark grammatical relations through agreement within or across phrases, so the domain of an inflection may go beyond the word. Take number. Children acquiring English or Spanish must learn that nouns denoting more than one instance of an entity are used in a plural form, with the addition of the relevant inflection. In Spanish, though not in English, any adjective that accompanies that plural noun must also be marked for plural. In addition, if that noun happens to be the grammatical subject, its verb must also be marked for plural. So although children appear to begin with inflections as modulations of the word meaning, they go on to learn the grammatical functions of each inflection, and hence the full domain for each one. Learning inflections ultimately demands attention to both lexical meaning and syntax.

When children learn inflections, they must also learn which words belong to which paradigms. That is, whether a noun takes the regular plural, or which two or three distinct regular plurals, versus an irregular form. In English, this typically amounts to a choice of a regular allomorph (/-s/, /-z/, or /-ɪz/) versus an irregular form – for example, *-en* (as in *ox*/*oxen*) or a vowel change (as in *tooth*/*teeth*). Some languages have one highly regular paradigm and a scattering of small irregular ones, as in English plurals. Others may have several regular paradigms, with word membership in each dictated by phonological form, plus some smaller, irregular ones. In each language, children have to learn which paradigm a particular word belongs to for purposes, say, of plural formation. Where children have not yet learnt this, they may regularize some forms by assigning them to a major paradigm. At issue here is the extent to which they learn an inflection like the plural on a word-by-word basis versus a constructional, rule-like basis. That is, once they have extracted the form of the plural affix, when can they add it, as needed, to any unfamiliar stem? Do children shift, at some point in development, from word-by-word acquisition of an inflection to rule-like application? And do all children go through a similar sequence of stages as they learn this?

Some affixes are more complex than others and are typically acquired later. Both meaning and form appear to contribute to their complexity. The complexity of the conceptual distinction underlying the meaning should affect how early and how readily children assign the pertinent conventional meaning to an inflection. In addition, the mapping of meaning onto an inflection may be affected by the complexity of the form itself. If the boundary between stem and affix is obscured by morphophonological rules, children will have a harder time identifying both, and so will acquire the inflection later. If they have to map a particular meaning onto discontinuous elements (e.g. a case ending and a preposition), that form too should take longer to acquire than one where the mapping involves a single element. In short, children must analyze the word forms they encounter, identify stems and potential affixes, and assign meanings to both. Their ability to do this may be taxed by the complexity of the meaning to be assigned, or by the complexity of the form for that meaning, or both. Only after this will they be in a position to produce the pertinent affixes.

Finally, are inflection and word formation treated in a similar way by children acquiring morphology? Inflectional paradigms tend to be complete, and so are generally more regular than word-formational ones. To what extent does this make word formation harder to acquire than inflection? Word formation also involves the construction of new forms to carry new meanings. Is constructing a new word harder than adding an inflection to a familiar or an unfamiliar one? In short, word formation seems to demand attention to, and hence knowledge of, the lexicon as a whole, unlike inflection. It also depends on knowledge of other typological properties of the language.

The discussion that follows will review some of the findings pertinent to these issues, and raise some additional questions about morphology in first- language acquisition. The next section focuses on inflections and their contribution to syntax. The third section takes up morphology in the lexicon through its role in new-word formation.

2 Inflections

Children's acquisition of inflectional morphology has been studied for a variety of different languages. Most of the data come from longitudinal records of children's speech. The data currently available

come from a number of language families, including Indo-European (e.g. French, Spanish; English, German, Swedish; Polish), Semitic (Arabic, Hebrew), Uralic (Finnish, Hungarian), Altaic (Japanese, Korean, Turkish), Caucasian (Georgian), Australian (Walpiri), Niger-Kordofanian (Sesotho), and Sino-Tibetan (Mandarin). For some of these languages, there are also systematic elicitation data available on some topics.

2.1 What is acquired when?

Children start to acquire inflections from their earliest word use on. But they may only produce them after some weeks, or even months. Consistent use of an inflection can be assessed against use in appropriate contexts on the one hand, and against use of other inflections (including use of no inflection) on the other. In highly inflected languages, children may produce their first contrasting inflections within two or three months of beginning to speak (e.g. in Hungarian, Turkish, Polish, Russian). But the production of the first inflections depends on several factors, including complexity and typology.

The typical sequence in the acquisition of an inflection such as the English plural suffix goes as follows: (a) no use at all in contexts that call for a plural form (hence *cat* in lieu of *cats*); (b) sporadic use on a few forms where a plural seems to be called for; followed by (c) general use and over-regularization (the inflection *-s* applied to *cat* and to words like *foot* and *man*; (d) identification of the relevant limits on use along with acquisition of irregular plural forms (*cat/cats* versus *foot/feet*). Some researchers have proposed that prior to learning the regular inflection for plural, for example, children learn the irregular forms, but then give them up in favor of regularized ones. But such a development seems quite unmotivated. If children have learnt the meaning of a form like *feet*, why drop it again to express the *same meaning* with a different form (*foots*)? An alternative account goes as follows. Children often identify irregular forms as base stems. For example, they may identify both *break* and *broke* as stems, or both go and *went*, without realizing, in either case, that these pairs each "belong" to just one verb. On this view, one prediction is that children will add regular inflections to both stems, and that is what they appear to do: they produce both *breaked* and *braked*, as if for two distinct verbs, and they produce both *goed* and *wented* (Clark 1987, Kuczaj 1977). What have not been investigated, though, are the meanings that children who inflect both forms might assign to a pair like *goed* and *wented*.

The order in which children acquire inflections has been studied in some detail for grammatical morphemes in English (R. Brown 1973, Cazden 1968). There, the best predictor of relative order is semantic complexity, with morphemes that are cumulatively more complex being acquired later. A morpheme marking *x* is acquired before one that marks x + y, and so on. This is consistent with Slobin's (1973) identification of conceptual complexity as one major determinant of overall order of acquisition. What has not been established is a general conceptual base for measuring the complexity of specific morphological distinctions within or across languages.

A second major determinant of order of acquisition in production is formal complexity in the expression of a specific meaning. If a language marks *x* with a single suffix, invariant across noun types, *x* should be simpler to acquire there than in a language where the same meaning is expressed through a combination of affix and preposition, with the shape of the affix also varying with the gender and number of the noun that it is attached to. Children should acquire the simpler type earlier than the more complex one, and they do. This can be seen in bilingual children's early expression of locative relations in Hungarian (early) versus Serbo-Croatian (late) (Mikes 1967). In addition, children learn to produce a distinction marked by a regular inflection – where this applies to a large range of stems – earlier than the same distinction marked by a large number of different forms applying to small paradigms. This is the case, for instance, in children's acquisition of plural marking in English versus Egyptian Arabic (Omar 1973, Slobin 1973).

2.2 Rote learning, rules, and regularization

Do children need to hear each inflected form before they can use it? Or do they realize, after a time, that unfamiliar forms typically take the same inflections as familiar ones? That is, can they generalize about how to mark plurality, for instance, or past time, and then apply this knowledge to new forms? In 1958, Berko argued that if children learnt inflected forms by rote, they would be unable to add inflections to unfamiliar words. But, as she showed, five-to seven-year-olds readily added different

inflectional endings to nonsense words. That is, children were applying a consistent procedure in marking a noun as plural or possessive, or a verb as ongoing or past. These procedures can be represented as rules for constructing the appropriate forms. (Whether such procedures involve templates or internalized procedures analogous to rules is unclear; see further Bybee and Slobin 1982, Clahsen and Rothweiler 1993, MacWhinney 1978, and Marcus et al. 1992.)

Once children have identified an appropriate affix to mark some distinction inflectionally, they can apply it wherever they wish to modulate a stem meaning in that way. They can add a past tense inflection, for instance, to any newly encountered verbs. The problem is that not all such verbs will be regular in form. So addition of the regular inflection will result in an over-regularized form such as English *breaked* or *doed* (for *broke* and did), or French *metté* 'put' or *pleuvé* 'rained' (for *mis* and *plu*). Children commonly over-regularize irregular forms during the earlier stages of acquisition. However, the extent, consistency, and contexts of such over-regularizations are in some dispute. Some researchers have observed them at very high rates (from 20 to 50 percent of the time at certain ages), but others, averaging rates across children and ages, have estimated them at no more than 3–10 percent (Kuczaj 1977, Maratsos 1993, Marcus et al. 1992). The issue is the following: do children simply go to a regularized form on those (perhaps rare) occasions when their memory fails, or do they go through a stage, during acquisition, where they assume that irregular forms are actually regular, and only later shift over to the conventional irregular forms? If initial over-regularizations represent a stage in acquisition, they are liable to be more frequent initially for each irregular form and then to taper off as children begin to register that adults never produce the form that they themselves are using.

Which affixes do children identify as "regular"? Children latch on to some affixes very early, and others, with near-equivalent meanings, not until much later. Does frequency play a role here, and if so, do children attend more to token- or to type-frequency in the language they hear? Findings so far show that children attend more to types than to tokens in the input. The first affixes they produce are those that appear on the largest number of types (Guillaume 1927), and typically represent the most widespread paradigms in a language. Once these are established, children begin to acquire affixes marking smaller, irregular, and specially conditioned paradigms. But the latter can take many months or even years to master.

2.3 Case marking

In languages with case marking, children typically begin with just one form of each noun, generally the nominative or the accusative. Contrasting cases on the same noun in some languages begin to appear very early (around twelve to fourteen months), in others a few months later. One determinant appears to be the nature of the case system: where a single affix serves all forms of nouns, children master the case contrasts much faster, even with phonological conditioning, than where the forms of each case ending vary with the gender and number of nouns. Children show much earlier mastery of case marking in languages like Hungarian and Turkish than they do for German or Serbo- Croatian (Slobin (ed.) 1985, 1992).

The first contrast acquired seems to be between the nominative and accusative cases, associated with subject and direct object respectively. Contrasting uses of cases may appear with single-word utterances. In two-word combinations, where word order may offer no clues, case can distinguish the object of a transitive verb from the subject of an intransitive one. As children add other cases such as the dative and genitive, these too serve to distinguish direct objects, for example, from indirect objects (e.g. recipients and possessors) from the two-word stage on. In general, acquisition of nominative and accusative cases is followed by the remaining oblique cases. This may involve only two or three other cases in a language like German, versus many other case forms in one like Finnish.

Several factors make case difficult to learn. The most notable may be the number of forms that children have to deal with in some languages. For example, both gender and number interact with case. In a two-or three-gender language, there are typically multiple affixes for each case. And within each gender, languages may have several noun paradigms, with each paradigm identified by the phonological shape of the root or stem. Children have therefore to deal with several different affixes as they learn how to express each case in a language. When it comes to number, they also have to deal with the fact that some gender distinctions in the singular forms are lost in the plural. In fact, children tend to learn first how to mark case in the singular, and only later in the plural. Languages

differ, therefore, in the number of affix shapes to be learnt for each case, as well as in the number of cases – from a minimum of two or three to more than twenty. Where more shapes are associated with a particular case, children are more likely to opt initially for just one affix shape to mark a particular case on every stem. This reliance on a single affix shape, regardless of gender and number, has been dubbed "inflectional imperialism" (Slobin 1973). What this does is allow children to mark case with some consistency prior to the acquisition of gender or of subparadigms within genders. In languages where case affixes are invariable, or vary only, say, with vowel harmony, children acquire adult-like case marking very early, typically before the age of two – for example, in Turkish and Hungarian. In languages where case interacts with gender and number, children acquire the full system of case marking, with all the different affix shapes, much more slowly, and may still make some errors as late as age five or so – for example, in Russian. Adult- like case marking may also take more time in languages where complex morphophonological rules obscure stem-affix boundaries, and so make it harder for children to identify stems and affix shapes. Form, and in particular the range of forms for each affix, depending on gender and noun paradigms within genders, is a major determinant of how long children take to acquire adult-like case marking.

2.4 Person, number, and gender

Verbs are generally marked for person and number, and in some constructions and tenses for gender. The earliest verb forms used are typically third-person singular present, imperative, or infinitive in form. Children may focus on one or more of these as their earliest verb form(s), depending on the language being acquired. For example, in English, the first-or second-person present, the imperative, and the infinitive are all realized as an uninflected or zero- affix form of the stem, while the third-person singular present is marked by *-s*. Children begin with the uninflected form, and only later mark the third-person verb form in the present. In Portuguese, however, children favor the second-or third-person singular form as their starting point in verb use, and only later produce first-person forms (Simoes and Stoel-Gammon 1979). Several factors probably contribute to children's initial choice of a verb form: frequency in adult input and a tendency to make use of third-person forms in self-reference alongside some level of minimal inflection (compared to other verb forms). But the initial form favored by children differs somewhat with language, with choices converging on an imperative form alongside some present-tense form, often in the third person (see languages surveyed in Slobin (ed.) 1985, 1992, 1997).

Number is marked in both verbs and nouns. In verbs, the plural forms are typically learnt some time after their singular counterparts. That is, children usually learn the singular forms for all three persons (first, second, and third) before they master the plural ones in languages that distinguish person and number in the verb. Number is mastered earlier in the noun than in the verb, and typically begins to be marked before age two. The distinction between one versus more than one may be signaled nonconventionally at first through modifiers such as *more* or a numeral (e.g. English *more book* for '(several) books', or *two magnet* for '(many) magnets'). Then children begin to add the regular plural affixes to nouns and to over-regularize irregular plurals. In English, for instance, children add the regular *-s* in lieu of the irregular forms required for nouns like *man, tooth, ox, child*, or *sheep*. In languages where there are a large number of irregular plural forms, children still identify the regular plural forms early and use them when they over-regularize (e.g. Clahsen et al. 1992). But irregular forms may take many years to master, with children continuing to make errors in their plural inflection as late as age twelve, as in Egyptian Arabic (Omar 1973). This shows that the formal complexity, in terms of the number of plural affixes and the conditions on their use, affects the point of acquisition for children. The smaller the number of affixes to be acquired in marking a distinction like plural number, the easier it is for children to master the adult options.

In adult speech, distinctions like plural are often marked redundantly in the sense that "plural" may appear not just on the pertinent noun but also on the accompanying demonstrative (e.g. *those trees*), and in the case of subject noun phrases on the verb (e.g. Those trees have *been cut down* versus That tree has *been cut down*). Three-year-olds acquiring English, for example, do better on a variety of comprehension tasks for the plural when they hear multiple or redundant marking of that distinction (Nicolaci-da-Costa and Harris 1983). This suggests that earlier uses of numerals or *more* may in part also reflect the forms used by adults for marking plurality that children hear in the input.

In mastering plurals, children often have to deal with gender as well, in nouns, and often in verbs too.

Here again, factors related to the forms of gender marking appear to be an important determinant of how early and how easily children acquire gender marking. Where gender is marked consistently, with the same affix, for example, on the noun and on any adjective modifying that noun, children seem to find it easier to acquire. The same goes for gender marking in the plural: consistency in the form across nouns of the same gender, plus use of the same affix on adjectives and even verbs marked for that gender, makes for earlier acquisition, as in Hebrew (Levy 1983). But where form offers a less clear guide to gender marking, children take longer to master gender, and may rely initially on semantic rather than formal factors in adding the pertinent affixes, as in Icelandic (Mulford 1985). Similar considerations apply in the acquisition of Sesotho noun-class markers, which are also used on any adjectives or verbs agreeing with the noun (Demuth 1988), and in the acquisition of noun classifiers in a language like Thai (Carpenter 1991).

2.5 Tense and aspect

Several researchers have suggested that children may initially assign an aspectual meaning of completion to past tense markers. One type of evidence is that children appear to be selective in which verbs they first mark with past tense inflections. In both English and Italian, they begin using the past tense on accomplishment (telic) verbs before other verb types (Antinucci and Miller 1976). One interpretation of these data is that children use the past inflection to mark the result or completion of the action referred to by the verb. This does not, of course, imply that aspect is easier to acquire than tense. What it does suggest is that the result or completion of certain action types is highly salient to young children. But in languages where both aspect and tense are marked on the verb, children appear to acquire both forms of inflection at an early age (starting well before two), with no clear ordering of the two (e.g. Weist et al. 1984).

The first tense contrast that children seem to introduce is that between present and nonpresent. The first nonpresent inflections usually mark completed, hence past, actions; but they may also mark future time. (In similar fashion, two- year-olds often use *yesterday* to mark either past or future (e.g. Decroly and Degand 1913, Harner 1975).) Slightly older children, around age four, commonly choose past-tense forms to mark *irrealis*. They do this in pretend play, for example, when assigning roles and planning future series of actions, as in the following exchange which preceded the relevant acting-out (Lodge 1979: 368):

A: I wanted to go.

B: But I wouldn't let you and you argued about it.

After acquisition of the initial present/nonpresent contrast, children add other tense inflections to mark the future and to distinguish past forms for background versus foreground events (typically, imperfect versus perfect forms). Some tenses such as the present perfect may not be fully mastered until age four to five, but the basic present/past/future contrasts are generally well established by around age three.

Aspect marking is acquired early in languages that mark aspect as well as tense through inflections on the verb. In Slavic languages, perfective and imperfective inflections, usually prefixes, appear at the same time as tense marking (Slobin (ed.) 1985). Aspect also appears to interact with the inherent aspectual meanings of verbs (Aktionsart). English-speaking children, for instance, add the limited duration suffix, *-ing*, initially only to activity verbs, and at first apply the past-tense suffix, *-ed*, only to verbs for change of state (e.g. Bloom et al. 1980; Clark 1996).

2.6 Agreement

One basic function of inflectional systems is to indicate which elements in an utterance "go together." One finds agreement in number, person, and sometimes gender, for example, between a subject noun phrase and the verb, and agreement in number and gender between nouns and adjectives that modify them. There can also be agreement between articles or demonstratives and the nouns they go with – in gender, number, and case – and between pronouns (independent, possessive, or relative) and their antecedents – again in gender, number, and case. Agreement markers therefore help group together those elements that belong together for semantic and grammatical purposes. The acquisition of inflections must be measured, therefore, not just by the acquisition of specific

paradigms, but also by children's use of agreement more generally.

Overall, children appear to rely on phonological cues to gender and gender agreement. In French, for instance, children omit articles at the one-word stage, and they make some errors in their choices of article early on. But phonological form in French is correlated with gender (masculine or feminine), and children quickly become sensitive to such cues. In one elicitation study, where phonological form and natural gender were correlated, even the youngest children (aged three), having heard an indefinite article, produced the appropriate definite article nearly all the time. With phonological cues only, they did equally well; but with neither phonological clues in the shape of the word nor information about natural gender, they made errors in their choice of definite articles about 20 percent of the time. Where indefinite articles and word shapes conflicted (e.g. a feminine article with a masculine word shape), children up to six would change either the article or the noun shape to make the two agree (e.g. *le bicronne* would be changed to *la bicronne* or *le bicron*). Older children also took account of the natural gender of the dolls being labeled and assigned feminine articles and word shapes for female dolls (Karmiloff-Smith 1979).

Phonological cues to gender agreement also predominate in the acquisition of agreement in other languages. In Hebrew, for example, children rely on word shape in plural formation as they learn to apply *-im* (masculine) or *-ot* (feminine), and they extend these inflections to adjectives for noun-adjective agreement, without apparently taking any account of natural gender (e.g. Levy 1983). Similar observations hold for the acquisition of gender agreement in German, Polish, Russian, and Serbo-Croatian (see Ferguson and Slobin (eds) 1973; Slobin (ed.) 1985). In languages where there are apparently only minimal clues to gender in the actual word shapes, though, children instead seem to rely on semantic criteria, information about natural gender, in interpreting various forms of agreement (e.g. antecedent noun-pronoun). This suggests that children may have recourse to semantic factors in learning gender agreement only when the phonological clues are inconsistent (Mulford 1985).

Finally, in Sesotho, children again seem to focus on phonological cues to word type as they learn gender and agreement. As in other Bantu languages, words in Sesotho belong to one of about fourteen word classes marked by prefixes that appear on the noun and corresponding forms for agreement on verbs, adjectives, demonstratives, and possessive, relative, and full pronouns. Children may begin to mark agreement with the noun on other elements, even before they can produce the noun-prefix reliably. This suggests that they are focusing on the whole noun or verb phrase in the input, so they treat the domain for agreement as some kind of prosodic and grammatical unit (Demuth 1988, Slobin (ed.) 1992). This would be consistent with children's trying to mark linguistic elements as going together if they help pick out the same entity or same activity together with its participants. That is, agreement is not simply an arbitrary set of markings: it has a readily accessible function for the language user.

2.7 Typology and acquisition

Children's patterns of acquisition suggest that they can process some kinds of information more readily than others. For example, they consistently learn suffixes before prefixes, even when these express equivalent information. Children learning a prefixing language like Mohawk acquire the inflectional prefixes later than children learning a suffixing language (e.g. Mithun 1989). This asymmetry is consistent with the more general asymmetry among languages: suffixing systems by far outnumber prefixing ones (Hawkins and Cutler 1988). When children are given nonsense prefixes and suffixes to imitate, they find suffixes easier than prefixes (Kuczaj 1979). In short, children seem to find it easier to process information added to the ends of words than to the beginnings.

Children also show a general preference for marking added meaning with an affix. For example, when presented with plural forms that differed from their singular counterparts (a) by the addition of an affix, (b) by subtraction of an affix, or (c) by zero, children prefer option (a), an added affix (Anisfeld and Tucker 1967). This is consistent with Greenberg's (1966) observation that added complexity (of meaning) is typically marked in languages by added morphemes.

Children learning different language types typically follow similar timelines, but several factors make for differences in the acquisition of inflectional morphology: (a) the consistency of the paradigms (Bybee 1991); (b) the nature of the meaning-to-form mapping, with one meaning to one affix shape

being the easiest; and (c) the role of each inflection in syntactic constructions. Children exposed to a Semitic language first, for example, take for granted that it is the root consonants that provide the core meaning for each word, while those exposed to an Indo-European or Turkic language take both consonants and vowels into account in identifying words. That is, the effects of typology are relative, so they may be hard to assess. It appears possible, however, in bilinguals with languages of different types. Children growing up with Hungarian and Serbo-Croatian, for example, show that, to express the same meaning, it is easier to use suffixes than a combination of suffixes and prepositions, and that consistency of meaning makes affixes easier to acquire.

3 Word formation

As children learn more words, storing them in memory and producing them themselves, they come to analyze their internal morphological structure. They begin to identify roots and stems inside complex words, in both compound and derived forms, and simultaneously isolate any derivational affixes attached to those roots. Such analysis is a prerequisite for new-word formation. And children do form new words, starting as young as age eighteen months to two years. In English, for example, they construct compounds and form verbs from nouns with no affixation. In the next few months (two and a half to three), they come to use affixes as well in the construction of new words.

Languages differ in the options they offer for coining new words. Some languages rely extensively, or even exclusively, on compounding; others rely mainly on derivation; and others rely on both. Are some options acquired more easily than others? If so, children learning different language types should follow different routes in their acquisition of word formation. The sections that follow review first what is known about children's acquisition of derivational options in word formation, and then their acquisition of compounding. Overall, children begin to use inflectional morphology before they coin new word forms, although there is considerable overlap in some languages. But derivational affixes in general begin to emerge later than inflectional ones.

Lastly, when children coin new words, they fill semantic gaps. Children do not wait until they have learnt the appropriate word before they try to express a particular meaning. Instead, when they need to, they construct a form for the meaning they want to convey. In doing this, they observe two general constraints on the coining of new words. Conventional words – forms that express meanings agreed on by the language community – take priority. If a word is already known to the child for the pertinent meaning, that is the word they use. And there is then no reason to coin another word with the selfsame meaning. New words must therefore contrast in meaning with existing words within any semantic domain (Clark and Clark 1979; Clark 1990, 1993). These two assumptions appear to be observed by both children and adults.

3.1 Derivation

Evidence that children are using derivation comes from their construction of novel words. To use an affix appropriately, for example, requires children to have analyzed that affix in established words and to have assigned it some meaning before they can use it in constructing new words. The first novel derived forms children construct are derived with no affix. Somewhat later, around age three, they begin to produce an increasing number of novel forms with affixes.

Children coin new verbs in English from around age two. They form them mainly from nouns but also, on occasion, from adjectives, as in to *scale* 'weigh', to *key* 'insert a key', to *sand* 'grind', or to *water* 'paddle in water'. Such verbs require no affixation to indicate the change from noun to verb: they need only the appropriate suffixes and syntax (Bowerman 1974, Clark 1982, Maratsos et al. 1987). In effect, children are exploiting a zero-derivation option when they construct new verbs from familiar nouns. This effectively allows them to form new words from words with meanings already known to them, and to do so without having to make any changes in form. Even when they get older, children often omit to palatalize consonants, change vowels, or shift stress where these are required. For example, four-year-olds typically fail to recognize the root *magic* in *magician*, and when asked what they would call someone who does magic, the commonest response is *magic-man*. Equally, in forming an adjective from the noun *volcano*, five- and six-year-olds often construct *volcanic*, without the required change in the stressed vowel. Zero derivation is also favored early on in Hebrew, but there children use it to form new nouns from verbs (Clark and Berman 1984).

Between two and two and a half, children begin to produce derivational affixes, mostly suffixes, but these may be rare before age three. In English, for instance, children start to produce agent and instrument *-er*, though they do not use this suffix consistently until around age four (Clark and Hecht 1982). In other languages, the earliest suffixes to be used to form new words are generally diminutive endings and agent and instrument markers. Children typically show good comprehension of such suffixes for some time before they produce them themselves, and in elicitation tasks will produce other, non- derived forms instead. Finally, children also show distinct preferences for some derived forms over others with closely related meanings. The first agentive suffix they produce, for instance, is normally the one adults favor too (Clark 1993). For example, in English, children misremember novel agentive nouns as using -er even when they in fact have *-ist* or *-ian*, or even the non-agentive *-ly*, as a suffix (Clark and Cohen 1984).

These findings suggest that children rely on certain general principles as they analyze word forms and then construct new words themselves. They attend to the *transparency* of the components used; that is, they make use only of elements whose meanings they already know. This would account for why they initially rely on zero derivation, making use of stems or roots of familiar words. Only once they have assigned some meaning to an affix, do they begin to use that too in constructing new words. They also attend to the *simplicity* of the form produced; the fewer the changes to be made in the component elements, the easier it is to construct and produce. This again would lead children to favor zero derivation early on. And they are sensitive to the *productivity* of the affix being used; they follow adult usage in favoring the most productive option first, unless there is some reason not to (Clark 1993).

Finally, there is strong evidence that children analyze affixes and assign some meaning to them some time before they start to produce them themselves. For instance, when asked, they can offer glosses of what novel words might mean well before they will coin words using the same affix. English *-er* and Hebrew *-an*, for example, are readily identified as having agentive meaning by three-year-olds acquiring these languages, but not until age four or later do children produce those suffixes to mark agentive meaning (Clark and Berman 1984, Clark and Hecht 1982).

3.2 Compounding

In some languages, children begin to construct new compounds from as young as one and a half; in others, they make little use of novel compounds before age six or seven. The difference, in general, appears to depend on whether or not compounding is productive within the language. In addition, children are attentive to the *transparency* and *simplicity* of the elements they use in compounding. As a result, their earliest compounds typically consist of combinations of familiar bare nouns which are both transparent in meaning and simple in form (root compounds). It is only later that they begin to use affixes or produce any adjustments in form required for specific types of compounding in the language.

Children learning Germanic languages construct root compounds from an early age, often before age two. They form them mainly from familiar nouns, as in English *crow-bird* (one year, seven, months, for 'crow'), *oil-spoon* (one year, eleven months, 'spoon for cod-liver oil'), or *coffee-churn* (two years, 'coffee-grinder'); German *Korb-wagen* (two years, seven months, 'basket-wagon', for a small doll's pram of woven straw), *Löchern-teller* (two years, nine months, 'hole(s)-plate', for a glass table mat with metal filigree on it), or Icelandic *kubba-bill* (two years, four months, 'block-car', for a car made of blocks), *flösk- bill* (same age, 'bottle-car', for a milk-truck), or *fiata-bill* (same age, 'Fiat-car'). And, by age two to two and a half, children have learnt to identify the modifier and head in such root compounds. In comprehension tasks, children acquiring English consistently identify the second (rightmost) noun as the head and the first as the modifier, while those acquiring Hebrew choose the first (leftmost) noun as the head and the second as the modifier (Berman and Clark 1989, Clark et al. 1985). But children acquiring languages that make less use of compounding do not produce compounds at this age. For example, children acquiring Romance languages produce virtually no root compounds until around age five or later (Clark 1993).

Children acquire synthetic compounds only rather later, and they often make errors in their construction. Elicitation tasks reveal that, in learning the structure of compounds like *button-thrower*, children seem to go through several stages. At around age three, they construct forms like *throw-*

man (or, less frequently, *throw-button*) for the agent. They then begin to add the appropriate affix to the verb stem, and now construct *thrower-button*. This form has the affix added to the head, and has incorporated the noun for the generic object affected; but the word order is the head + modifier characteristic of verb phrases (i.e. *throw preceding button*), instead of the modifier + head order of compounds. Only around age five do children acquiring English get both affix and order right when asked to coin such compounds. At that point, they begin to construct forms like *button-thrower* or *wagon-puller* with no errors (Clark et al. 1986). Children acquiring other Germanic languages make similar word-order errors, but children learning languages where the verb phrase head and compound head have the same order relative to any modifiers never make these word- order errors (Clark and Berman 1987).

Children rely on transparency and simplicity in their novel compounds just as much as in their derived words. Their earliest compounds are all root compounds, typically forms from two or more 'bare' nouns already known to them. They begin to form novel synthetic compounds only later, after analyzing and assigning some meaning to suffixes such as the English agentive *-er*. This sequence is predicted by both transparency of meaning and simplicity of form. Further evidence for simplicity comes from the sequence observable in the acquisition of Hebrew compounds. In Hebrew, different noun types differ in their bound forms, the ones required in compounds: some make no change; feminine nouns in final *-a* add a *-t*; masculine plural nouns change final *-im* to *-ey*; and so on. In production, three-year-olds favor no change in their compounds, and so make many errors. As children get older, they successively master the final *-t*, then plural *-im* to *-ey*, and, last of all, stem-changing heads. That is, the greater the change required in the form of the head, the longer before it is acquired (Clark and Berman 1987).

Productivity also plays a role in compounding. Children favor the patterns that are more productive over those that are less productive, or no longer productive. This suggests that here too children attend to the relative frequencies of different compound types in the input around them. In level-ordering models of word formation, all compounding is assumed to occur at the same level with all of it productive. But contemporary speakers favor only certain patterns among those possible, and the most productive of those are the ones that children typically acquire first. Frequency, then, presumably makes for accessibility during acquisition.

4 Conclusion

In general, children start to acquire inflections before they begin on novel- word formation. The earliest noun and verb inflections to emerge appear in some languages before age one and a half. Compounding with no affixation emerges soon after the first inflections, but novel derived forms do not emerge until after age two. The first to appear are zero-derived forms with no affix.

Then come some derivational affixes, with sporadic use up to age three, followed by more extensive use from age three or four on. In languages that make little use of compounding or zero derivation, therefore, the first novel-word formations may not appear until age three or later. It is unclear whether typology affects the acquisition of morphology elsewhere. Although it appears easier to process suffixes than prefixes, there are too few data on the acquisition of prefixing languages to see how consistently this holds overall. At the same time, children acquire locative affixes, for example, much earlier in languages that use invariant forms on all stems than in languages that rely on a mix of case marking (varying in form with gender and number) and prepositions. It may be easier in general, then, for children to map inflectional meanings in agglutinative than in synthetic languages.

Overall, the sequence of acquisition for morphology, whether in inflectional systems or in word formation, appears to depend on at least two factors: the complexity of the meaning being expressed – where children have to discover this for each affix – and the complexity of the form to be used – where children have to work out the conditions that govern different allomorphs. However, what counts as easy versus difficult in adjusting the form of a word is not easily measured.

In short, children work with words. Their earliest inflections are typically learnt as parts of words, and only later are analyzed for forms and meanings. Once this is done, children appear able to extend paradigms with rule-like application of an affix to new instances. In doing so, they also regularize irregular forms until they learn to produce the appropriate irregular forms. This holds for both

inflections and word formation.

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20. Morphology and Aphasia

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The study of acquired language deficits can have one or more of a variety of research goals, but one that is most easily motivated is the use of the observed patterns of impairment (along with other sources of evidence) to motivate particular theories of the normal system. Given certain reasonable assump tions about the consequences of damage to the normal system (e.g. that the derived system will not involve the generation of compensatory mechan isms that themselves had no status in the premorbid condition), the possible patterns of deficit are limited to what could be derived from the normal sys tem under a limited variety of transformations (see Caramazza 1984, Ellis and Young 1988). By identifying the constraints that acquired deficits appear to respect, one can hope to infer the character of the normal system that would impose such constraints. While there are certainly other worthwhile goals that one might wish to pursue using data from aphasia (e.g. to explain a particular language deficit in terms of where and how the language-processing system has broken down, or to use patterns of language deficit and lesion informa tion to deduce how the cognitive mechanisms underlying language processing are anatomically distributed), these goals almost inevitably are intertwined with the first goal that we identified (that of shedding light on the functional organization of the premorbid system). Hence, for most of our discussion of acquired language impairments that appear to affect the comprehension or production of morphologically complex words, we will focus on what insight they can give us into the properties of the normal processing apparatus.

1 Morphological impairments

Morphological paraphasias – for example, producing “walking” for “walked” – are an often observed feature of language impairment. Errors of this type are prominent in the major, clinically defined disorders of sentence production – agrammatism and paragrammatism (see Bates et al. 1987, Butterworth and Howard 1987, Caplan et al. 1972, Goodglass 1976, Jarema and Kehayia 1992, Kean 1978, Miceli et al. 1989, Saffran et al. 1980, and Tissot et al. 1973 for recent discussions) – and in various disorders of single-word production in reading, writing, and naming (see De Bleser and Bayer 1990, Job and Sartori 1984, Nolan and Caramazza 1982, Patterson 1982; see also papers in Coltheart et al. (eds) 1980). In addition, failure to differentiate among morphologically related forms has been implicated in comprehension impairments (Tyler et al. 1990; Tyler and Cobb 1987). As one might expect, these phenomena are of interest not merely because of their pervasiveness, but also because they offer an oppor tunity to explore the cognitive mechanisms that underlie lexical processing.

For example, from such errors one might hope to be able to determine whether a speaker's active lexicon is dealt with largely by mechanisms of storage and retrieval of whole-word forms, or whether there are also mechanisms of morphological composition that are invoked during normal processing. Unlike the domain of phrasal processing, where an individual's capacity to produce and comprehend an infinite number of novel and well-formed sentences trans parently motivates rule-based processing, the productivity of word formation does not make as clear a case for active word-building

operations in the produc tion system. While the need for word-formation rules of one sort or another is necessitated by the capacity to understand and produce word forms that one has never before encountered, the processing issue is when and where these mechanisms come into play. Are they invoked only in order to give structure and content to lexical entries for complex words when they are first learned? Such an arrangement would be compatible with each word of the language having its own, independent entry in a vast lexicon of fully specified forms (see e.g. Butterworth 1983; Bybee 1988,1995b; Halle 1973; Segui and Zubizarreta 1985). Or are the cognitive mechanisms that underlie lexical production and comprehension rule-based in much the same way that one sees sentence pro cessing to be? As we will show, the study of acquired lexical impairments is an important source of evidence regarding such issues. Other issues that we will discuss relate to evidence from aphasia concerning the relevance of morphological productivity to the issue of compositionality, processing differ ences relating to the inflection/derivation distinction, and the contribution of morphological processing to the comprehension and production of sentences.

Before we can discuss these issues in detail, though, we must begin by con sidering the first obstacle one faces in any effort to motivate a deficit that is specific to one or another aspect of morphological processing. The mere exist ence of morphological paraphasias is not sufficient to show that the locus of the processing impairment actually implicates lexical morphology. One must show, for example, that paraphasias like *darkness* → darkly do not result from whole-word substitutions (analogous to errors like index → insect, or *center* → cent) or from sublexical, nonmorphological substitutions (as seen in word and nonword paraphasias like *belt* [belt] → bell [bel] and *index* [mdeks] → [mdek]). If morphological errors were the only variety of lexical errors that a patient produced, the argument for a "true" deficit to lexical morphology would be relatively straightforward (although not entirely unproblematic, since even in this case we could conceivably lack any other evidence that these errors arise from a morphological processing deficit). As it is, though, there is a notable absence of such pure cases. Even when morphological lapses are the predomin ant type of lexical paraphasia, they do not appear to occur as the only variety of lexical error in any reported case. In an ongoing project involving the study of nearly a hundred patients who produce morphological paraphasias in read ing and repetition tasks, none presented with a "pure" morphological deficit (in the sense that no other type of lexical error occurred). This may not be a matter of coincidence. Given that lexical morphology embodies the capacity to relate (in a rule-governed fashion) an extended set of lexical meanings to an extended stock of lexical forms, a deficit affecting this capacity may invariably induce semantic and/or phonological and/or orthographic errors as well. In any event, the two most common patterns of performance in reading tasks include the production of morphological errors in conjunction with visual errors (e.g. Job and Sartori 1984, Patterson 1982) or visual and semantic errors (Badecker and Caramazza 1987, Coltheart 1980, Patterson 1980); while two recent cases have been described whose paraphasias are limited to morpho logical and semantic paraphasias (Caramazza and Hillis 1990a). (Examples of these error types are provided in table 20.1.) Similar cases of acquired dysgraphia present written morphological errors co-occurring with phono logical paragraphias (Bub and Kertesz 1982, Shallice 1981) and semantic errors (Patterson and Shewell 1987).

Table 20.1 Error types observed in patients who produce morphological paraphasias in reading tasks

Patient S.J.D.		
halted	→ halts	(morphological substitution)
rustle	→ rustled	(morphological insertion)
frequently	→ frequent	(morphological deletion)
tuber	→ tumor	(phonological error)
excited	→ [Isáysest]	(phonological nonword error)
Patient P.B.		
wanted	→ want	(morphological deletion)
cooked	→ cooking	(morphological substitution)
dig	→ dog	(visual error)
ride	→ drived	(semantic error)

Patient V.O.		
hidden	→ hiding	(morphological substitution)
upward	→ upwards	(morphological insertion)
neutral	→ natural	(visual error)
Patient H.W.		
drainage	→ drains	(morphological substitution)
huge	→ big	(semantic error)

Setting aside for a moment those instances where segmental errors can result in the production of forms that coincidentally are related morphologically to the target (as when consonant cluster simplification at a peripheral stage of lex ical processing derives weld [weld] from the intended *welds* [weldz]), morpho logical paraphasias must be contrasted with whole-word substitutions in order to assess the possible involvement of disrupted mechanisms of morpheme composition or parsing. For example, Badecker and Caramazza (1987), Funnell (1987), and Pillon et al. (1991) argue that factors such as the relative frequency of an affixed word and its stem, semantic abstractness, and the visual similarity of lexically related forms can account for some patients' tendency to produce morphological errors on affixed words. If this were true in every patient, there would be little neuropsychological evidence for morphological composition as a normal (and disruptable) component of lexical production. What we discuss next are case studies that suggest that the picture is not all that bleak.

2 Errors of morphological composition: retrieval versus composition

Patient S.J.D. is an English-speaking patient who presents with an acquired lexical output impairment affecting spontaneous speech and a variety of single-word processing tasks such as reading and repetition (Badecker and Caramazza 1991). Morphological errors are the predominant error type in S.J.D.'s reading performance: S.J.D. also produced whole-word substitutions (e.g. reading *summit for summon*) and phonemic paraphasias (e.g. *shrilly* [srili] → [sruli]). The fact that S.J.D. produced relatively few nonword phonemic paraphasias by comparison with the proportion of morphological errors (13 percent versus 65 percent of her reading errors, respectively) speaks strongly against the possibility that her morphological errors were merely the product of submorphemic, phonological errors. This possibility is also ruled out by the fact that she produced morphological errors (affix omissions and substitutions) in reading words like *bowled* [bold] and *links* [links], but no comparable errors for their monomorphemic homophones bold [bold] and *lynx* [links]. Had errors like *bowled* → *bowling* [bolm] arisen as the product of segmental substitutions (as opposed to morpheme substitutions), one should observe similar errors (e.g. *bold* → *bowls* [bolz]) for the monomorphemic items as well. Since errors like *bold* → *bowls* did not occur, it is implausible that the difficulty which S.J.D. encounters with affixed words could derive from whole-word phonological substitutions. Barring the use of ad hoc stipulations to derive such a pattern, there is no self-evident reason why the accessibility of whole-word forms should differ for monomorphemic words and precompiled representations for affixed words. At a minimum, though, this pattern indicates a selective difficulty in producing affixed forms.

Other features of her performance pattern reveal that S.J.D.'s morpholo gical output errors could not be reduced to whole-word substitutions. The most striking of these was the production of illegal combinations of mor phemes (e.g. poorest → "*poorless, the most poorless Indians have very little money*"). If S.J.D.'s morphological paraphasias were simply a special case of whole- word misselection (analogous to the substitution of monomorphemic forms in her error *fluid* → *fluent*), then one would expect all of her affix insertion and substitution errors to consist of grammatically well-formed combinations. Instead, morphologically illegal forms like youthful → **youthly* were evident in her reading, repetition, writing to dictation, and spontaneous speech. This leaves sublexical, phonological substitutions as the only plausible alternative to an account that says that errors like *sinking* → *sinkly* arise from compositional procedures gone awry. The competing (nonmorphological) account is seriously undermined, though, by the facts that S.J.D. produced more illegal morpho logical paraphasias than phonological paraphasias, and that the phonological paraphasias she did produce for morphologically complex targets tended to affect either the entire word (i.e. the stem and suffix) or the stem only, a pat tern that makes it difficult to view the morphological paraphasias as simply the

chance outcome of phonological paraphasias.

Furthermore, both the legal and illegal combinations of morphemes in her insertion and substitution errors tended to involve inflectional and product ive derivational affixes. A preference for inflection and productive derivation over nonproductive derivation would not be expected if mechanisms of word formation were not directly implicated in the generation of the morphological paraphasias. Hence, one conclusion that can be drawn from this case is that, in some patients, the production of morphological errors reflects an impair ment to mechanisms that are devoted to morphological composition (and/or decomposition) in normal performance.

2.1 Does composition reflect a primary system or a back-up component?

The pattern of performance observed in the case of patient S.J.D. clearly points to compositional procedures as part of the normal lexical apparatus. Might one still worry, though, that the apparatus in question merely represents a set of back-up procedures that are available when the normal whole-word-based system falters (either because there is a temporary failure of retrieval, or because there is no entry for the target word in the first place)? While such an account is not without its advocates (e.g. Butterworth 1983), it is difficult to reconcile this view with certain facts of the case we have discussed. The central problem for this view is that the failures of a back-up system should be observed only when the primary system fails (in this case, the whole-word-based mechanisms hypothesized to operate over both the monomorphemic and affixed vocabu laries). But unless there is some property of affixed words that can be shown to have an independent influence on the likelihood of producing an error, then the failures of the back-up system should be observable only in the range of cases in which the whole-word system would fail. In other words, if the back-up were entirely intact, then the performance on affixed words should be better than what one can get out of the whole-word system (because it should be able to do the back-up work it's there for). On the other hand, if the back up system is completely impaired, then the level of performance will be en tirely determined by the retained capacity of the whole-word system. The only chance of getting worse performance on affixed words than on monomorphemic words in such a system is if there are properties of affixed words that would make the whole-word system more susceptible to error on these words than on monomorphemic words, or if the input to such a system failed to preserve the morphosyntactic specification of marked forms.

S.J.D.'s performance on the affixed and unaffixed homophones discussed above (e.g. *bowled and bold, links and lynx*) bears on the likelihood of one such possible source of difficulty: namely, the properties of form that coincide with affixation. Given that these items were matched in form (and that the lists were matched for frequency, category, and length), this is not a candidate for a feature that would render a whole-word system more likely to fail for affixed words than for unaffixed words. This leaves the one lexical feature that this test did not control (since it will coincide by definition with the feature that was explicitly contrasted): the meaning that is encoded by the affixation. That is, one might suppose that it is not the affixation per se that makes the lexical system fail (because of a disruption to compositional procedures), but some feature of the content (e.g. the morphosemantic or morphosyntactic complexity) that accounts for the poorer performance of the lexical system on affixed words. This too can be excluded, though. If the input to the form-retrieval system were affected in such a way that the content associated with the morphology were not preserved, then this effect should be observed for both regular and irregu lar morphology (Badecker, to appear). On frequency- and length-matched lists of regularly inflected, irregularly inflected, and uninflected verbs (e.g. *walked*, *bought*, and *stand*, respectively), S.J.D. showed comparable performance on the uninflected and irregularly inflected verbs (90 and 92 percent correct, respect ively), and significantly poorer performance on the regularly inflected items (60 percent correct; Badecker and Caramazza 1991). The account of normal processing that relegates compositional procedures to the status of a back-up system is seriously undermined by such performance.

2.2 Jargonaphasia and word-formation mechanisms

It is also possible to find evidence concerning processing of affixed words that does not crucially involve the production of morphological errors. Studies of preserved inflectional capacity in patients who present with severe semantic and syntactic deficits have been proposed as evidence that mechanisms for inflectional morphology are functionally independent of the sentence-level mechanisms they must interact with (De Bleser and Bayer 1986). The classic cases of preserved

inflection that motivate compositional mechanisms of inflection involve aphasic patients whose speech includes neologistic jargon. Examples of neologistic jargon are provided in table 20.2.

Table 20.2 Reported examples of neologistic jargon

. . . one of the nicest [féndlowz]
. . . these little [tréftiz]
a lot of those [kístɪsis]
(Buckingham and Kertesz 1976)

. . . put over two [baɪlz] that were [sneɪkt] in
I was [pleizd] to see the other [dakjumen]
(Butterworth and Howard 1987)

Yes, because I'm just *persessing* to one . . .
. . . and I *persets* abowth abrow
(Caplan et al. 1972)

Table 20.2 Reported examples of neologistic jargon

Several studies have reported patients whose neologisms cannot all be de scribed as phonological deformations of a target word (e.g. Buckingham 1981, Butterworth and Howard 1987; Caplan et al. 1972). There is no evidence that, in every instance, abstruse neologisms require the retrieval of a phonological form from an output lexicon. One reason for holding this view is that in many instances the neologisms bear no phonological similarity to their target. In addition to being segmentally dissimilar, they may differ from a target form in the number of syllables and in stress pattern (Buckingham 1981). Never theless, the production of neologistic jargon often co-occurs with a preserved capacity to inflect words, and this capacity extends to neologisms as well.

In some cases, patients' use of inflections (on neologisms and on actual stems) will, on occasion, be grammatically inappropriate. However, of the five patients described by Butterworth and Howard (1987: 24), two never made inflectional errors on neologisms, and the remaining three were reported to have exhibited "good control of inflectional processes." For the latter, the number of inflections occurring in obligatory contexts (as well as the number of uninflected neologisms in syntactic contexts that excluded inflections) far outweighed the few cases where they failed to occur in contexts that required them or where they intruded ungrammatically. Regardless of their syntactic appropriateness, though, the very presence of the inflection on the nonlexical base forms suggests that the lexical system distinguishes stem and affix rep resentations. In particular, inflected neologisms provide an additional form of evidence for the existence of mechanisms for morphological composition in the phonological output lexicon. (See also Semenza et al. 1990 for a discussion of three Italian-speaking patients who produce prefixed and derivationally suffixed neologistic forms.)

2.3 Composition and acquired dysgraphia

Evidence that affixed forms are composed in the lexical output system has been observed in various patterns of dysgraphic performance as well. In one such case, patient B.H. (Badecker et al. 1996), an acquired dysgraphia rendered certain stem forms irretrievable from the orthographic output lexicon. When B.H. could not spell words lexically, he resorted to a sublexical approach to spelling based on regular phonology-orthography correspondences. For example, he spelled *census as sensis, and benign as benine*. When asked to write affixed words for which he could not retrieve a stored form, though, there was clear evidence that the stem and affix spellings are differently derived. Sublexical spelling is implicated by the phonologically plausible errors made on the stem portion of the target,

while retrieval of a stored form is implicated by the absence of such errors on the suffix portion of the target. That is, B.H. would spell *surfed as sourphed* (not as *sourpht*) and cabooses as cabuses (not as cabusiz). One can verify that the selective preservation of affix spellings is not merely apparent. For example, he would spell *wolfed as woulphed*, but *concoct as concauct, not as concauked*, as one might otherwise expect if the suffix spelling that he used were simply the most likely phonology-orthography mapping that his sublexical mechanisms would generate.

The pattern of errors that B.H. presented would not easily be explained if the lexical system were to store the affix as part of a whole-word repres entation of an inflected form. If as a consequence of the patient's deficit the hypothesized whole-word representation for a word (e.g. for *surfed*) could not be retrieved, and if instead a spelling could be generated only by using mechanisms whose input-output relations are specified in terms of regular phonology-orthography correspondences, then one would expect that these correspondences would derive just the sort of misspellings that were not observed (e.g. spelling *surfed as sourpht*). On the other hand, the interpretation is rather straightforward on the view that affixed forms like surfed are norm ally composed in the output system. If the stem is inaccessible to the retrieval mechanisms, but the (separately stored) affix form remains available, then the orthographic form of the stem, but not the affix, will need to be generated by some other means: in particular, by the rule-based mechanisms based on phonology-orthography correspondences. On this model, then, the rule-based spellings of stems can be combined with the lexically specified spellings of the inflectional affix in virtue of the compositional approach to the production of affixed forms that is taken even when both components of a complex form are retrieved from the lexicon.[1]

The role of morphological composition in the orthographic output sys tem also finds motivation from cases of acquired dysgraphias that arise at a somewhat more peripheral processing stage: the level of the Graphemic Buffer (Badecker et al. 1990, Caramazza and Hillis 1990b). The general pattern of per formance associated with a deficit at this processing level includes (a) spelling errors that can be construed as simple letter substitutions, deletions, insertions, and transpositions; (b) similar performance on both word and nonword targets, in both written and oral spelling tasks; (c) comparable performance in spon taneous writing, writing to dictation, and written naming tasks; and (d) effects for properties such as length (but not for lexical properties like grammatical category, lexical frequency, semantic abstractness, etc.). In one such case, that of patient D.H. (Badecker et al. 1990), the distribution of spelling errors was asymmetrically bow-shaped for monomorphemic words: D.H. produced few spelling errors at the beginnings of words, with most of his errors occurring to the right of the medial letters of the target. However, for suffixed words the error rate and error distribution were significantly different. D.H. misspelled fewer suffixed words than matched monomorphemic targets; and though the asymmetric distribution of errors that was characteristic of his performance on monomorphemic words was seen on the stem portion of the target, the letters that comprised the suffix portion of the target (e.g. E-D in *handed* and I-N-G in *walking*) were much less likely to be misspelled than the corresponding letters in monomorphemic words (like *wicked and awning*).

The contrast between D.H.'s performance on monomorphemic and suffixed words is easily accounted for on the following analysis of his dysgraphia. The likelihood of producing a spelling error is a function of the size of the lexical unit that is placed in the buffer, and the reason why suffixed words appear to be less susceptible to error is that (at the level of the deficit) these words are processed not as a single unit, defined in terms of the whole word, but as a sequence of two such units, defined in terms of their morphemic components.[2] This account is further supported by D.H.'s performance on prefixed and com pound words. Prefixed and compound words were less likely to be misspelled than matched monomorphemic items; and when they were misspelled, the prob ability of an error for a particular letter position was clearly affected by the morphological structure of the target. Whereas frequency- and length-matched unaffixed controls for both types induced the characteristically asymmetric error distribution across the whole word, prefixed words induced fewer errors in the initial portion of the target than their controls, and the distribution of errors in compounds clearly exhibited the bimodal pattern one would expect if the whole word were processed as a concatenation of constituent stems (Badecker et al. 1990).[3]

The processing accounts we have offered in order to explain the perform ance patterns of D.H. and B.H. converge on a single model of orthographic processing. On this model, monomorphemic words are retrieved from the Orthographic Output Lexicon as whole-word units, while morphemic con

stituents of words like *farming, repay, and drugstore* are separately retrieved and then concatenated at the level of the Graphemic Buffer.[4] The selective preservation of suffix spellings in the case of B.H. derives from the fact that when attempting to spell an affixed word, a failure to retrieve a stored form for a lexical stem will not have as its necessary consequence that the affix spelling will also be irretrievable. The better performance on morphologically complex words than on monomorphemic items observed in the case of D.H. derives from the fact that this patient's deficit asymmetrically affects the prob ability of producing an error on the orthographic constituents that make up the (morpheme-sized) processing units that are deposited, and temporarily stored, in the Graphemic Buffer.

2.3.1 Productivity

Productivity, the measure of a speaker's capacity to employ a particular Word Formation Rule in order to add new forms to the set of meaningful words, is a property of the lexical system that continues to receive much attention. (Cf. recent discussions in Anderson 1992, Baayen 1994, Baayen and Lieber 1991, Lieber 1992.) The predominance of a particular form for encoding a particular content has long been known to be a poor predictor of productivity (Aronoff 1976), and though there are properties of morpholo gically complex words that correlate most highly with the productivity of the rules that derive them – phonological transparency and semantic composition- ality – it is still an open issue as to how the correlations are best understood (see Anderson 1992 and Aronoff 1976 for discussion). The present discussion will focus on neurolinguistic indications that the productivity of the morpho logy involved is a primary determinant as to whether the performance system uses compositional versus retrieval mechanisms for producing familiar, mor phologically complex words.

In our earlier discussion of the legal and illegal morphological paraphasias produced by patient S.J.D., we indicated that the affixes that appeared in these paraphasias were inflections and productive derivations. We took the predom inance of productive morphology in these paraphasias as one piece of support for the view that forms involving productive morphology may be processed compositionally, while forms involving nonproductive morphology must be listed in, and retrieved from, the lexicon in whole-word format. This process ing distinction is further supported by evidence from acquired dysgraphia. When D.H. was asked to write productively derived words (e.g. *brightness*, *cloudless*), the distribution of errors showed a clear effect for the morphological structure of the target: the error rate increased from a low rate stem-initially to a high rate stem-finally, but then fell again to a very low rate at the beginning of the suffix region. By contrast, the distribution of spelling errors for derived words with nonproductive endings (e.g. *similarity, clearance*) showed no effect of the morphology of the target, and was in fact indistinguishable from the asymmetric distribution observed with monomorphemic targets (Badecker et al. 1990). This contrast offers a clear form of support for the view that product ivity determines whether the output system takes a compositional approach to the production of morphologically complex words.

Recent studies of patients who present with acquired naming impairments – and in particular, patients who have difficulty naming objects with compound names – also bear on the role of productivity in determining how words are processed. Unlike derivation, where productive affixation will generally encode a fully transparent extension of the meaning of the base form, the mechanism of compounding, though it is productive, can result in forms that have largely unpredictable semantic properties. In general, the meaning-form relation is not entirely arbitrary (e.g. the meanings for clothes and for pin are not wholly unrelated to the meaning of *clothespin*), although the relation is typically idio syncratic in the sense that it is not determined by the grammar. Compounds may differ from one another in terms of the WAY in which their whole-word meaning relates to the meanings of their constituent words (compare *fertility pill, nausea pill, garlic pill, and horse pill*) and also in the EXTENT to which these meanings are related (cf. *butterfly, butterball, buttercup, butter dish*). Hence, this particular type of word formation is interesting in that evidence for or against a compositional approach to the production of compounds can give us a tool to pry apart the effects of productivity from those of semantic predictability.

In a study of twelve unselected German-speaking aphasic patients, Hittmair- Delazer et al. (1992) found that their patients had a greater tendency to pro duce compound responses when naming objects that had compound names than when the objects had monomorphemic names, even when their responses were incorrect. Furthermore, a single case study of English-speaking patient C.S.S.

has replicated this and other features of the group tendencies reported in the Hittmair-Delazer et al. (1992) group study. Perhaps one of the most not able features of C.S.S.'s performance with regard to evidence for a compositional approach to the production of compounds is his production of compound neo logisms (e.g. naming a cheerleader as *gym master*, or a trash can as a *can trash*). These substitutions and misorderings of the constituents of the target form are analogous to illegal morphological paraphasias in the extent to which they implicate composition. Interestingly, C.S.S.'s compound neologisms are not limited to targets that can be thought to be semantically compositional (e.g. butterfly → *butter flower*, south paw → *south ball*, and sundial → *sunclock*). Hence, even when there is no clear parallel between the meaning of the com pound target and its form, there is at least some evidence that these words are produced by retrieving constituent lexical items and a structural specification of the target form into which the two constituents must be fit. What this sug gests is that morphological productivity may be the determining factor with regard to whether morphologically complex forms are composed in the pro cessing system, even when the productivity of the word-formation type is paired with lexical idiosyncrasy regarding the meaning-form mapping.[5]

3 Inflection versus derivation

A case of acquired impairment which provides some indication of the mor phological distinctions that are made in the language-processing system is that of patient F.S., an Italian-speaking patient who presented with a lexical impairment that resulted in morphological paraphasias in spontaneous speech and in single-word-processing tasks such as repetition (Miceli and Caramazza 1988). F.S. produced a substantial number of morphological substitution errors in a variety of tasks, but these errors predominantly affected the inflectional specification of a word (gender and number markers for nouns and adjectives; and tense, aspect, person, and number specifications of verbs). Derivational morphology was virtually unaffected. F.S.'s errors also included phonological paraphasias, but these can be distinguished from his inflectional substitutions in a relatively straightforward manner. For example, F.S.'s morphological para phasias tended to result in the production of "citation forms" – that is, infinitival forms of verbs, singular forms for nouns, masculine singular forms for adject ives – regardless of whether the particular inflected forms were among the least frequent items of an inflectional paradigm.[6] Furthermore, the tendency to produce citation forms could not be reduced to a tendency to produce par ticular phonological shapes, since the preference for citation forms held con stant even when the phonological form of the citation-form suffix varied. For instance, when F.S. repeated adjective forms, he exhibited a strong tendency to use the masculine singular form for those adjectives that allow a four-way inflectional contrast (masc. sg., masc. pl., fern, sg., fern, pl.), and the singular form for those adjectives which allow only a two-way contrast (sg. vs pl.). Notably, the maximally disfavored inflection for the former adjective type (fern, pi., as in car-e) was phonologically identical to the favored inflection for the adjectives showing a two-way contrast (sg., as in *fort-e*). Indications that these inflectional errors do not arise as simple whole-word substitutions derives from the fact that the misselected inflections that occurred in F.S.'s performance would occasionally result in the production of a morphologically illegal com bination of stem and affix, as in the spontaneous speech error *studi-o* ('office', masc. sg.) → *studi-a (*fem. sg.), where the contextually appropriate noun is inflected with the wrong gender ending; or the repetition error *mor-issimo* ('die', third conjugation inflection) → *mor-este (second conjugation ending) (Badecker and Caramazza 1989). Hence, F.S.'s performance is significant both for the evidence it provides for morphological composition and for the motivation it provides for the lexical distinction between inflectional and derivational morphology.

Other cases of acquired language impairment have also exhibited inflection- derivation dissociations: the Finnish-speaking patients H.H. and J.S.[7] (Laine et al. 1994, 1995) and the English-speaking patients P.M. (Badecker, to appear) and P.B. (Badecker et al. 1995). It should not be assumed, however, that all impairments resulting in a disruption of inflection, but not derivation, are alike in their functional origins. Given that there are multiple ways in which derivation and inflection differ with respect to the language-processing system, current models of normal performance allow for a variety of deficits with a production and/or comprehension pattern that distinguishes these morpho logical types.

4 The nature of lexicality constraints: an open issue

As we have observed, it is not always the case that a patient's morpholo gical paraphasias will result in potential word forms. S.J.D.'s **involveness* (for *involvement*) and F.S.'s **studia* (for studio) are clear instances of morpheme sub stitution that do not preserve lexicality at the level of morphotactics. Neverthe less, there does appear to be one lexicality constraint on morphological errors in spoken output: morphological paraphasias conform to the phonotactics of the language (Grodzinsky 1984, Miceli and Mazzucchi 1990). In languages such as English, morphological deficits often result in affix deletion errors (e.g. *farming* → *farm*). The occurrence of such errors is governed by the well-formedness of morphological "zero forms." In languages which lack zero forms, correspond ing deletion errors are absent. Grodzinsky (1984) notes that Hebrew-speaking patients will produce inflectional substitutions like *kašarti* (tie, past tense) → *likšor* (tie, infinitive), but they will not simply omit the vocalic prosody that corresponds to the verb's inflection (**kšr*). However, evidence indicates that this constraint is not based merely on the unpronounceability (in some language- independent sense) of bare consonantal strings like **kšr*. For example, an English-speaking patient may produce morpheme-deletion errors of the form *farm-s* → *farm*, while an analogous error for an Italian-speaking patient (e.g. *fil-e* 'lines' → **fil*) does not occur. Here the phonological constraint on para phasias exhibited by Italian aphasics must be attributed to conformity to a more abstract notion of phonotactic or morphological well-formedness than what one must invoke in the case of Semitic languages. Perhaps the constraints that are operative here are among the familiar variety of shape rules (e.g. a phonological word-edge constraint such as a condition that, in Italian, a word- final syllable must end in one of the vowels a, e, i, or o[8]); or perhaps they reflect the mechanisms that restrict, by one means or another, the occurrence of bound morphemes. For example, the fact that items in the open-class vocabulary bear morphosyntactic features that are spelled out by the morphological system, and the fact that there are no regular "zero form" options for the spelling out of these features in Italian (though there are in English) might jointly lead to the effects in question. The nature of the often observed, though poorly understood, lexicality constraints that govern aphasic production is a topic of inquiry that still awaits serious attention.

5 Morphological deficits in sentence comprehension and production

Several studies have documented cases of sentence comprehension impairment that strongly implicate morphological deficits. A case analogous to that of F.S. (Miceli and Caramazza 1988) has been reported in which the patient, D.E., was found to be selectively impaired in processing inflections in normal speech comprehension (Tyler and Cobb 1987). For example, in a word-monitoring task, D.E. was sensitive to the contextual appropriateness of a word when the wrong derived form was used (as in *He was the most wasteful/*wastagel*wastely cook she had ever met*), but not when an inappropriate inflection intruded (as in It often causesl**causingl***causely pain in my loose filling*). Given that different inflectional forms can often motivate diverging syntactic expectations (as when the contrast between chasing and chased signals the transitive/intransitive dis tinction in *The boy was chasing/chased* …), it is plain that D.E.'s sentence com prehension can be explained in part by this morphological impairment.[9]

In a similar study (Tyler et al. 1990), patient B.N. exhibited a more pervasive morphological impairment, in that his monitoring performance indicated an insensitivity to both syntactic ill-formedness, based on the use of inappropri ate inflected or derived forms (the examples with *wastage* and *causing*), and lexical ill-formedness (the examples with *wastely and *causely). B.N. also failed to exhibit sensitivity to these morphological distinctions in a grammaticality judgment task. However, his lexical monitoring showed a strong effect for prag matic, semantic, and syntactic appropriateness when the stem of a properly inflected form was varied (e.g. in the context *The crowd was very happy. John was playingl? buryingl*drinkingl*sleeping the guitar and* …). B.N.'s good performance on a lexical decision task (which included legal and illegal affixed forms like *wasteful* and *wastely* in the word and nonword stimuli respectively), along with his performance on a lexical gating task (Grosjean 1980), indicated that it was not impaired recognition of the phonological form of morphologically com plex words that was implicated in his sentence-processing deficit. Instead, B.N. appears unable to integrate the syntactic and semantic information encoded in the inflectional and derivational affixes with the semantic (and grammatical) information encoded in lexical stems. It is not apparent whether this impairment arises out of a lexical impairment (i.e. to the mechanisms that derive syntactic and semantic information from affixes) or a deficit to sentence-processing mech anisms that normally

exploit this lexical information. In either case, the contribu tion of the morphological deficit to BN's sentence-comprehension impairment appears well established.

Current theories of sentence production (e.g. M. F. Garrett 1982,1984; Lapointe 1985) predict that morphological paraphasias (e.g. agreement errors) can result from deficits to sentence-processing mechanisms while single-word processing remains unimpaired. Two recent studies (Caramazza and Hillis 1989, Nespoulous et al. 1988) describe patients who are intact in single-word-processing tasks, but who exhibit selective deficits in processing grammatical morphemes in sentence-processing tasks. In the case of patient "Clermont" (Nespoulous et al. 1988), only free-standing grammatical morphemes were affected. Patient M.L. (Caramazza and Hillis 1989) produced some inflectional (morpholexical) sub stitutions in addition to omitting and substituting free-standing grammatical morphemes, although the proportion of such morphological agreement errors was small by comparison with the number of function word errors. While the presence of agreement errors in M.L.'s speech supports the hypothesis that "morphological deficits" can arise from damage to syntactic (nonlexical) pro cessing components, a stronger case for this position can be envisioned. Studies which document contrasting patterns of inflectional impairment (e.g. Miceli et al. 1989) have provided some indications that grammatical agreement may be differentially affected (resulting e.g. in divergent error rates for subject-verb, noun-adjective, and determiner-noun agreement), although the relative con tribution of lexical and syntactic deficits in most of the reported cases has not been established. Clearly this is one distinction that deserves greater attention.

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1 Independent considerations require the hypothesized routes of the spelling system to intersect at a point that accepts the output of both the orthographic lexicon and the nonlexical rule-based mechanisms. For discussion, see Caramazza et al. 1987, Hillis and Caramazza 1989, and Posteraro et al. 1988.

2 Note that composition at this level cannot be handled by simple concatenation, since there are several orthographic accommodations that must accompany affixation (e.g. consonant doubling as in *hit/hitting*, e-deletion as in *drive/driving*, etc.). For discussion of the mechanisms that might effect such accommodations at this processing stage, see Badecker 1996 and McCloskey et al. 1992.

3 For reasons that are unclear, the morphology-sensitive performance pattern observed in the case of D.H. is associated with the clinical features of attentional neglect (e.g. Hillis and Caramazza 1989): e.g. in a well-studied patient who presents with a deficit at the level of the graphemic buffer but does not exhibit signs of neglect, Italian- speaking patient L.B. (Caramazza et al. 1987), the pattern is not observed.

4 Note that this description is not meant to prejudge the issue of whether affix forms are retrieved from the lexicon in the same way that whole words or bound stems are retrieved (e.g. Lieber 1992, Selkirk 1982), or as the output of Word Formation Rules of the sort envisioned by Anderson (1992), Aronoff (1976), and others.

5 This is not to say, however, that composition in the lexical processing system is in all instances rule-derived. Whereas spellout rules that interpret morphosyntactic features would be appropriate in the case of regular inflection, the sort of compositional process evidenced in C.S.S.'s compound errors would be more aptly described in terms of a lexically driven process (e.g. the 'minor rules' of Stemberger 1985c).

6 By this term we mean the minimally marked members of the inflectional paradigm, a distinction that may have consequences throughout the grammar, which regularly serve as the base forms for the word-formation processes that derive other paradigm members. Burzio (1989) observed that phrase-level phonological processes can delete the vowel corresponding to the inflectional suffix of the citation form, but not any other. As an example, consider the four-ending adjective *buono* and the two-ending adjective *grande*:

buon ragazzo	
(*buono ragazzo)	masc. sg.
*buon ragazza	
(buona ragazza)	fern. sg.
*buon ragazzi	
(buoni ragazzi)	masc. pl.
*buon ragazze	
(buone ragazze)	fern. pl.
gran ragazzo	
(*grande ragazzo)	masc. sg.
gran ragazza	
(*grande ragazza)	fern. sg.
*gran ragazzi	
(grandi ragazzi)	masc. pl.
*gran ragazze	
(grandi ragazze)	fem. pl.

7 Patient J.S. is a bilingual subject (Finnish and Swedish) who presented with a dissociation between inflection and derivation in both languages.

8 This is not likely to be a satisfactory candidate on its own, given that there are a number of (albeit exceptional) forms that end in consonants (e.g. loan words like golf and jeep).

9 Patient D.E. was retested on these materials shortly after the study reported in Tyler and Cobb 1987, and on this occasion his monitoring performance failed to show the dissociation of inflection and derivation (Tyler 1992: ch. 12). On retest, D.E.'s monitoring performance failed to demonstrate sensitivity to morphologically inappropriate forms for both inflection and derivation. Tyler (p.c.) suggests that this difference may derive from the patient's over-familiarity with the testing materials (as evidenced by the overall faster reaction times in the retest).

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21. Morphology in Word Recognition

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1 Introduction

This chapter reviews the psycholinguistic literature on the representation and processing of morphological structure in the recognition of spoken and written words. To anticipate more than a little, this is how we will conclude: psychological morphology does not map neatly on to linguistic morphology. We will argue that the processing and representation of morphologically complex words are determined by performance factors, including order of occurrence of stems and affixes, transparency, productivity and frequency of usage. For this reason, linguistic distinctions – for example, between derivational and inflectional relations – may not map neatly on to processing distinctions.

In psycholinguistic descriptions of the mental lexicon it is common to distinguish between access representations and central representations. Access representati|ons are modality-specific processing structures involved in the mapping of visual or auditory input on to the lexicon. They provide the link between more peripheral levels of processing and the central lexicon, and they code form information (orthographic or phonological). Central representations are modality-independent structures coding words' meanings and their syntactic and thematic roles. We will be concerned with the role of morphology at both the access and the central levels.

There are two core issues to be addressed in this chapter. The first concerns the representation of morphological structure in the central lexicon. Is the mental lexicon organized in a way which codes morphological relationships? For example, is the fact that two words share the same stem, or the same affix, coded in the lexicon? This is primarily a question of representation: what information about the internal structure of words is stored in long-term memory, and how? But it is also a question of processing. When a word and its morphology are recognized, does this involve contact with other entries (words and /or morphemes) in the lexicon?

The second issue is that of lexical access. What role does morphological structure play in the process of mapping perceptual information, from spoken or written input, on to the mental lexicon? Is morphological analysis necessary, optional or impossible prior to lexical access? Again, there are questions of both processing and representation: what type of morphological parsing might take place, and what form of access representations might be the product of such a process?

These two issues are in fact not independent. Underlying both is a question which is fundamental in many areas of psychology: the relative importance of rule-based processing and rote storage. Is it more 'efficient' to hold in memory only that which cannot be derived by rule and to be dependent on the smooth operation of such rules, or to store every piece of information and to be dependent on efficient access procedures and the availability of storage space? In the case of morphology, this question becomes one of whether morphologically complex words are decomposed into their component stems and affixes before access to a central lexicon, in which lexical entries are

considered to be shared by the morphological derivatives of each stem (Taft and Forster 1975), or whether each word form in a language has a separate, undecomposed entry in the mental lexicon, with no morphological analysis of any word form prior to lexical access (Butterworth 1983). The former of these alternatives assumes that all morphology is completely transparent to the word-recognition system, the latter that it is all opaque. Between these extremes, as the following sections show, fall numerous intermediate positions.

2 Lexical representation of morphological structure

2.1 Are morphological relationships represented?

Words may be recognized faster if a morphologically related word has recently been processed; thus recognition of the 'target' *pour* in a lexical decision task (in which subjects judge whether a written or spoken item is a real word or not) is speeded by prior presentation of the 'prime' *pours* (Stanners et al. 1979a). This 'repetition priming' effect has been extremely influential in psycho- linguistic studies of morphology. To be sure that it is a true morphological effect, however, one has to rule out alternative explanations invoking formal or semantic similarity. *Car* overlaps (both orthographically and phonologically) with *card* as much as it overlaps with *cars*; likewise, *sameness* and *same* have shared meaning, but to no greater extent than *equivalence* and *same*. A large body of research has been devoted to the question of whether morphological relationships are indeed represented independently of both formal and semantic relationships.

One such line of research has demonstrated that morphological effects pattern differently from effects of formal similarity. For instance, orthographic priming is absent where morphological priming occurs, both in brief visual recognition following list learning (Murrell and Morton 1974) and in repetition priming tasks (Feldman and Moskovljevic 1987, Napps and Fowler 1987). Morphological priming is long-lived, while orthographic priming is very transient (cf. Napps 1989 with Napps and Fowler 1987). In the masked-priming paradigm, in which primes are presented very briefly and then immediately masked by the target, morphological priming is facilitatory, while orthographic priming is inhibitory (Drews and Zwitserlood 1995, Grainger et al. 1991). In unmasked lexical decision, in which the prime immediately precedes the target, orthographic priming is again inhibitory where morphological priming is facilitatory (Drews and Zwitserlood 1995, Henderson et al. 1984). Feldman and Moskovljevic (1987) alternated the two alphabets of Serbo-Croatian (Roman and Cyrillic), and showed an effect of morphology in repetition priming which was just as large when visual similarity was very low (prime and target in different alphabets) as when visual similarity was high (prime and target in the same alphabets). A similar result has been obtained with Hebrew (Feldman and Bentin 1994), in which, due to vowel infixation, words sharing the same root morpheme can have different orthographic forms. Feldman and Bentin found equivalent morphological priming when prime and target either had the same or different orthographic structures.

All of these results suggest that there is a level of representation of morphological information independent from the representation of orthographic information. As, for example, Drews and Zwitserlood (1995) have argued, one way of conceptualizing these separate levels is to distinguish between more peripheral access representations, where entries overlapping in form inhibit each other, and central representations, where morphological relationships are coded.

In the auditory modality, morphological priming occurs when phonological priming is absent. Kempley and Morton (1982), assessing priming of words spoken in noise, found effects of regular inflectional overlap (*hedges* – *hedge*) but not phonological overlap (*pledge* – *hedge*). Emmorey (1989), in an immediate priming task (50 milliseconds between prime and target), found priming between morphological relatives (e.g. *submit* – *permit*), but no priming between purely phonological relatives (e.g. *balloon* – *saloon*). These results again suggest that form information (here, phonological form) is represented independently of morphological information.

Semantic priming, like form-based priming, also appears to have a different time course to morphological priming. L. Henderson et al. (1984) showed priming for morphological relatives when the prime preceded the target by both 1 and 4 seconds, but priming of semantic relatives (synonyms) at the 1-second interval only. Bentin and Feldman (1990) found semantic priming for written Hebrew with no intervening items between prime and target, but none with fifteen intervening items. When

prime and target were morphologically related, there was priming at both lags, even when the prime and the target (derived from the same root) had only weak semantic association. Likewise, Emmorey (1989) showed priming between spoken words which were morphological relatives but not semantic associates (e.g. *submit–permit*). These results suggest that a model in which all morphological relationships in the lexicon are purely semantic (Butterworth 1983) is untenable. As Stolz and Feldman (1995) have argued, it appears that morphological effects cannot be reduced to either form-based effects (whether due to orthography or phonology) or effects of associative semantics.

2.2 Models of representation

How, then, is morphological information represented in the central lexicon? A number of alternative schemes have been proposed. One is that morphological relatives share a single lexical entry (e.g. Taft 1985, 1988). In this framework all morphological derivatives of a stem are listed fully within the same entry, but in morphologically decomposed form (Taft 1988). A related, shared-entry model is the Augmented Addressed Morphology (AAM) model for inflectional morphology (Caramazza et al. 1988; see also Chialant and Caramazza 1995). In this model, entries consist of stems positively linked to the inflectional suffixes with which they can combine, and (for irregular verbs) of stems negatively linked to suffixes with which they cannot combine.

Alternative accounts make the assumption that words have separate entries. One of these assumes that morphological relatives are linked together as 'satellites' under a main entry, the 'nucleus' (Feldman and Fowler 1987; Günther 1988; Lukatela et al. 1978, 1980; but see Kostić 1995 for problems with the satellite approach). Another type of separate-entries model envisages a network containing entries for words and, separately, for morphemes: lexical entries for morphologically related words are linked by a node which represents their shared-stem morpheme (S. Andrews 1986; Fowler et al. 1985; Grainger et al. 1991; Schreuder et al. 1990; Schriefers et al. 1991, 1992).

Schriefers et al. (1992), using the repetition-priming paradigm, provided evidence consistent with network models. Their study compared the size of priming effects between German inflectional and derivational forms, each form acting as both a prime and a target. The effects were asymmetrical: adjectival forms with the dative singular suffix *-em* primed suffixed relatives with *-e* and *-es* and their stem forms, but *-em* forms were themselves *not* primed by any of these three types. In network models, each word is represented as a processing node; when a word has been presented, its node has a high degree of activation. Each stem morpheme also has a node associated with it. The word nodes of all the morphological relatives of a given stem have bi-directional facilitatory connections to the stem node. The basis of the priming effect is that activation of a word node in a morphological cluster boosts the activation of the stem node, and, indirectly, the activation of connected word nodes. On the assumption that the facilitatory connections can vary in strength (such that a word node can prime a stem node more or less than that stem node can prime either that or other word nodes), these priming asymmetries (and similar results of Feldman and Fowler 1987 and Feldman 1991) can be accounted for. It is not yet clear, however, which processing or linguistic factors may determine the relative strengths of these associative connections.

These results seem problematic for decompositional models such as that of Taft (1988), since in such models stem access should produce the same amount of priming irrespective of the form in which the stem occurred. They also seem problematic for satellite models. For Serbo-Croatian, Lukatela et al. (1980; see also Feldman and Fowler 1987) operationally defined nominative singular nouns (because they were responded to most rapidly) as the nuclei around which were clustered other nominal inflected forms. There was, however, no clear nucleus in the German adjectives studied by Schriefers et al. (no one form stood out as having faster response times associated with it).

Grainger et al. (1991) also interpreted their finding of facilitatory morphological priming and inhibitory orthographic priming in the masked priming task in terms of a network, suggesting that inhibitory connections might exist between visually similar words (morphologically related or not), with negative priming operating alongside positive morphological priming. Schreuder et al. (1990) examined the processing of Dutch verbs using a partial priming technique (Jarvella et al. 1987), in which part of a word is briefly displayed prior to presentation of the complete word (for naming). Priming of whole words by either affixes or stems was found only for verbs with separable particles. Since these particles can be separated from their stem by several words when the verb is inflected,

and since the meanings of the complex forms are often not predictable from the joint meanings of particle and stem, there is good reason to suppose that both particle and stem have separate but closely linked representations. Again, Schreuder et al. account for their results in terms of a network model. More recent research on the processing and representation of separable verbs in Dutch, using a grammaticality judgement task, has provided further support for a network approach, where 'morphological integration' nodes provide the links between separate representations for particles and stems (Frazier et al. 1993).

Other results support lexical representation of morphological structure. For example, Tyler and Nagy (1990) found that readers made fewer semantic errors and more syntactic errors in selecting paraphrases of sentences with suffixed than with matched non-suffixed words. They argued that a morphologically structured lexicon would give the reader immediate access to morphological relatives of a suffixed form, increasing the likelihood of accessing the appropriate semantics (hence the low semantic error rate), but also increasing the likelihood of misidentifying a suffixed form as one of its relatives (hence the high syntactic error rate). Using eye fixation time data, Holmes and O'Regan (1992) found gaze durations for both prefixed and suffixed words to be shortest when the first fixation on a word included the stem.

Laudanna et al. (1989, 1992) employed a stem homograph priming technique with Italian materials, in which pairs of words were presented (either simultaneously or sequentially) for lexical decision. Laudanna et al. (1989) showed that lexical decisions to pairs with homographie stems that were morphologically unrelated (e.g. *portare 'to carry'* and *porte 'doors'* with the stem *port-*) took longer than those to pairs with non-homographic stems (e.g. *collo* 'neck' and *colpo* 'blow' with the stems *coll-* and *colp-*), which in turn were slower than those to pairs where the stems were morphologically related (e.g. *porta* 'door' and *'porte'* 'doors'). Laudanna et al. (1992) replicated the inhibitory effect of orthographic overlap (relative to non-homographic controls) for word pairs sharing an inflectional stem (e.g. *mute* 'mute' and *mutarano* 'they changed' with the stem *mut-*), but did not find any effect for words sharing a homographie (but unrelated) derivational root (e.g. *mute* and *mutevole* 'changeable', where *mutevole* has the derivational root *mut-* but the inflectional stem *mutevol-*). Nevertheless, these authors also showed that derived words (e.g. *mutevole*) and inflected words (e.g. *mutarano*) were equally effective as primes for lexical decision on infinitival forms (e.g. *mutare* 'to change') in a priming experiment.

Laudanna et al. (1992) argue that words must therefore be represented in terms of their morphemic constituents, and that these constituents are inflectional stems and affixes, rather than derivational roots and affixes. They interpret their findings as evidence for their AAM model, in which lexical entries are morphologically decomposed (Caramazza et al. 1988). Lexical entries containing stems with the same orthographic structure (stem homographs) are considered to inhibit each other in order to resolve ambiguity. Morphological relatives facilitate each other through repeated access to the same stem. These results, however, can also be accommodated by network models, although they suggest that morpheme nodes should be based on inflectional stems rather than derivational roots, with inhibition between homographie stem nodes.

The data presented by Schriefers et al. (1992) also constrain network models. In addition to asymmetric inflectional priming, these authors obtained different patterns of priming for inflectional and derivational suffixes (of the same adjectival stems). Although not all priming effects were equal, both inflected and derived words primed, and were primed, by their stems, and inflected words primed other inflected words. However, there was no priming between derivational forms (e.g. *Röte, rôtlich*). Feldman (1994) also compared inflectional and derivational priming in Serbian (the same language previously referred to as Serbo-Croatian). Although both inflectionally and derivationally related words produced facilitatory priming effects, those involving inflections were larger. The results for derivations thus contrast with the German findings. Further cross-linguistic experiments will be required before such differences can be explained. Nevertheless, it seems clear across several studies that inflectional priming is more robust than derivational priming.

Other results have indicated different patterns of priming dependent on the nature of the derivational relationship under test. Marslen-Wilson et al. (1994) used English materials in a cross-modal priming task (measuring lexical decision speed to written words, presented immediately after the offset of spoken word primes), and found that suffixed forms (e.g. *friendly*) primed and were primed by their

stems, but that suffixed forms did not prime each other (e.g. *confession, confessor*). Derivationally prefixed forms (e.g. *unfasten, refasten*) primed and were primed by their stems, but, in contrast to suffixed forms, they also primed each other. Prefixed and suffixed forms sharing the same stem also primed each other (e.g. *distrust, trustful*).

Marslen-Wilson et al. argued that these results support a model in which lexical entries are morphologically decomposed, with affixes clustered around shared stem morphemes (their account is thus similar to the lexical component of Caramazza et al.'s (1988) AAM model). Priming takes place through repeated access to stems. All members of a cluster therefore prime each other. Suffixed forms do not prime each other, however, because additional inhibitory links between the suffixes in a cluster cancel out any benefit due to repeated access of the stem. Marslen-Wilson et al. justify these inhibitory connections on the grounds that during spoken word recognition, when the listener has only heard a stem, different suffixes of that stem are possible completions and should therefore all be activated. When evidence for one suffix arrives, the activation of incorrect suffixes needs to be suppressed – hence the inhibitory connections. No such connections are required between prefixes: a given prefix will not activate other prefixes of the same stem, so they need not be suppressed.

Although Marslen-Wilson et al.'s account is confined to derivational morphology, it suggests a more general way in which priming asymmetries (such as those reported for inflected words by Schriefers et al.) could be accommodated in shared-entry models (including their own model and Caramazza et al.'s AAM model). The basic claim would be that the shared entry does not consist of a simple listing of the affixes appropriate for a stem, but rather that the affixes are themselves structured processing units. In addition to the inhibitory connections postulated by Marslen-Wilson et al. for derivational suffixes, there could also be inhibition between inflectional suffixes. If the strengths of the connections between stems and affixes, and between affixes, were allowed to vary independently, then priming asymmetries between and within inflected and derived words could be explained. Such a model makes very similar predictions to those made by the network account proposed by Schriefers et al., where the strengths of connections between whole-word entries and their shared stems can vary.

An important constraint on the lexical representation of morphological information, both for network models and for internally structured shared- entry models, is that of semantic transparency. Marslen-Wilson et al. (1994) examined this issue explicitly. They asked subjects to rate the semantic relatedness of morphologically related word pairs, and found high estimates of relatedness for pairs such as *confession – confessor*, which they then defined as transparent, and low estimates for pairs such as *successful – successor*, which they defined as opaque. The effects of morphological structure described above could be obtained only when the morphological relationship between stem and affixed form was transparent; that is, *friendly* primed *friend*, but *casualty* did not prime *casual*. In other words, morphological relationships in the mental lexicon, however they may be represented, cannot be defined purely on formal linguistic grounds. Most studies of derivational morphology have failed to control for semantic transparency/opacity; some of the variability of morphological effects in the literature may result from this lack of control (as pointed out by L. Henderson 1985,1989, and by Marslen-Wilson et al. 1994). Note that although Emmorey (1989) did obtain priming between opaque forms (such as *submit – permit*), she employed a task in which both prime and target were presented auditorily (in contrast to Marslen-Wilson et al.'s cross-modal task). Furthermore, the morphological relationships between primes and targets tended to be less transparent in the Marslen-Wilson et al. study than in the Emmorey study.

Marslen-Wilson et al. also examined phonological transparency. They found as much priming in pairs such as *elusive – elude* and *serenity – serene* as in pairs such as *friendly – friend*. Fowler et al. (1985) and Downie et al. (1985) also found no effects of phonological transparency on the size of morphological priming effects. These results suggest that the locus of these effects is in the central lexicon, where representations have abstracted away from surface forms.

To summarize so far, the large priming literature indicates that morphological information is represented in the central lexicon. Recent research has shown that this includes detailed information on the relationships between the forms of a morphological family, more than just that they are related. This evidence therefore supports refined models of lexical organization: either those with separate entries for each word form which are linked with variable connections to entries representing

their shared-stem morphemes (network models; Schriefers et al. 1992) or those with decomposed shared entries, with variable connections between stems and affixes, and between affixes (internally structured shared-entry models; Marslen-Wilson et al. 1994). As has often been pointed out (e.g. by Burani 1993), it can be difficult to distinguish between these alternative theoretical accounts.

It should be clear from the previous section that inflectional and derivational morphology could in principle be represented similarly in the lexicon, with semantic transparency of the morphological relationship being the main determinant of the strength of connections between related words. As Feldman (1994) has suggested, one reason why priming effects tend to be stronger for inflections than for derivations may be that inflectional relationships are in general more transparent than derivational relationships. There may be no need for a qualitative distinction in the way in which inflections and derivations are mentally represented.

Research on the representation of compounds leads to similar conclusions. Separate whole-word representations are often posited for compounds. Several authors (e.g. L. Henderson 1985; Sandra 1990, 1994) have argued that since the meanings of nominal compounds such as *blackbird* are not fully recoverable from their components, they require independent meaning representations in the central lexicon. These whole-word representations are usually considered to be linked in a network to representations of their component morphemes (see e.g. network accounts offered to explain the storage of Chinese compounds: Taft and Zhu 1995, Zhou and Marslen-Wilson 1994). When novel nominal compounds are encountered, they appear to be interpreted via activation of the meanings of their constituents (Coolen et al. 1991, 1993).

As in the account of inflections and derivations, semantic transparency also plays a role in the representation of compounds. Sandra (1990) has argued on the basis of a study of Dutch compounds that although semantically opaque compounds (*like blackbird*) have independent central representations, fully transparent compounds may lack such representations, and may be recognized on the basis of activation of their constituent morphemes. Zwitserlood (1994), again from a study of Dutch compounds, has proposed a multiple-level lexicon. In addition to access (form) representations, she proposes two further levels: a morphological level, where the relationships between compounds and their component morphemes are coded, even for fully opaque compounds like *klokhuis* (lit. '*clock-house*', but meaning core, as of an apple); and a semantic level, where fully opaque compounds are not connected to their constituents.

A structured central lexicon, with morphological relationships coded in an activation network, is therefore the favoured account of the representa- tion of all complex words: inflected, derived and compound forms. It appears, however, to be unnecessary to posit qualitatively different representational accounts for these different classes. Factors such as semantic transparency, which apply to all classes, appear to determine the strength and nature of the connectivity between morphemes.

3 Prelexical processing of morphological structure

2.1 Derivational morphology

As we pointed out earlier, questions of the structure of central lexical representations are closely bound to questions of lexical access. What is the nature of the pre-lexical processes and the lexical access representations via which the central representations are contacted during word recognition? An influential paper by Taft and Forster (1975) argued for an obligatory process of pre-lexical decomposition, whereby words are broken down into their constituent morphemes prior to lexical access. This decomposition model (and its modifications – Taft and Forster 1976, Taft 1979a; see also Taft 1979b, 1981,1985,1988; Taft et al. 1986) proposes that all affixes are detected and stripped from a word before lexical access is attempted using the remaining stem morpheme. *Revive*, for example, would be accessed via its stem, *vive*. Taft and Forster (1975) based their proposal on non-word interference effects in a lexical decision task in English; non-words were rejected more slowly when they were bound stems (e.g. *vive* from *revive*) than when they were pseudo-stems (e.g. *lish* from *relish*). Subjects also found it more difficult to reject prefixed non-words with real stems (e.g. *dejoice*) than prefixed non-words containing no real stem (e.g. *dejouse*). This second interference effect has been demonstrated in both the visual and the auditory modalities (Taft et al. 1986). Taft (e.g. 1985,

1988) proposed that stem morphemes are the access codes used in lexical lookup; in contrast to pseudo-stems, they cannot be rejected immediately because they succeed in making contact with a central lexical representation (but see also Taft 1994 for an alternative account based on interactive activation, in which pre-lexical prefix stripping is not required).

L. Henderson (1985) has argued, however, that data from processing of non-words may not reflect normal word recognition; rather, morphological decomposition of non-words may be attempted only when access based on whole-word representations fails to find a lexical entry. Experiments involving effects with real words avoid this problem. Consider a pair of words such as *misplace and misery*. Pre-lexical decomposition should, at least when these items are presented visually, strip *mis* from both words, delaying recognition of the pseudo-prefixed form *misery* (due to erroneous lookup of the false stem *ery*). Rubin et al. (1979) indeed found this pseudo-prefixation effect using a lexical decision task in English, but only when there were prefixed non-words in the experiment, not when there were no prefixed non-words. On the basis of this result, they argued that decomposition was only an optional strategy – not normally employed, but invoked by the presence of prefixed non-words. However, Taft (1981) has provided an explanation for the failure to find decomposition effects when prefixed non-words were absent: subjects were able simply to say 'yes' to any item beginning with a prefix. Any effect of decomposition would thus be masked. Taft (1981) also observed a pseudo-prefixation effect in a naming task when there were neither non-words nor truly prefixed words in the experiment. In this situation, strategic decomposition would be impossible; subjects were nevertheless slower to initiate the pronunciation of pseudo- prefixed words than non-prefixed words.

Bergman et al. (1988) also found pseudo-prefixation effects in lexical decision, in Dutch. L. Henderson et al. (1984), however, using a lexical decision task with a small proportion of potentially prefixed English words and non-words (thus avoiding the problem of strategic decomposition), found no difference in lexical decision latency between pseudo-prefixed words and monomorphemic control words; prefixed words were, if anything, responded to slightly more rapidly than both of the other word types.

Pseudo-affixation has also been studied with suffixes. Manelis and Tharp (1977) presented pairs of English suffixed forms (e.g. *bulky – dusty*) and pairs of pseudo-suffixed forms (e.g. *fancy – nasty*) in a lexical decision task in which subjects had to decide on the lexical status of both forms. They found no difference between these pairs. In addition, Henderson et al. (1984) and Bergman et al. (1988) both found no differences in lexical decision latencies for individually presented suffixed, pseudo-suffixed and monomorphemic control words. However, Manelis and Tharp (1977) also tested mixed pairs of words (i.e. one suffixed and one pseudo-suffixed, e.g. *bulky – nasty*) and found that such pairs were responded to more slowly than the unmixed pairs. When pseudo-suffixed forms are paired with genuinely suffixed words, the processor may be misled into attempting their decomposition, increasing processing difficulty.

Bergman (1988) has argued that the fact that pseudo-prefixation effects are stronger than pseudo-suffixation effects can be accounted for by a left-to-right parsing process. If visual input is processed letter by letter, pseudo-prefixes will be recognized as prefixes, inducing a processing cost while the system recovers from its incorrect analysis. Pseudo-suffixes, on the other hand, are less problematic because they can be processed as a continuation of the stem.

Libben (1994) showed that lexical decisions to ambiguous novel compounds, like *busheater* (bus-heater or bush-eater) took longer than those to unambiguous compounds like *larkeater*. Libben argued that this result provided evidence for a decomposition process, and also suggested that parsing operates left-to- right. As further evidence for a decomposition procedure, Libben (1993) has shown that subjects are slower reading aloud morphologically illegal nonsense words like *rebirmity* (re- only attaches to verbs, while -ity only attaches to adjectives) than legal nonsense words like *rebirmize* (where the selectionai restrictions of the affixes are compatible). This latter finding is open to the same criticism as the older non-word studies, however; it does not indicate that morphological decomposition is a necessary pre-lexical procedure in the recognition of words.

Two further paradigms which have been used recently also suggest that readers can use morphological information in processing written material. In the first, the segment-shifting task (Feldman et al. 1995), subjects are required to shift an underlined portion of one word (e.g. *harden*)

on to another word (e.g. *bright*), and then to say the resulting form (*brighten*). This task was found to be easier when the shifted portion was morphemic (e.g. *harden*) than when it was non-morphemic (*garden*). Similar results have been obtained in Hebrew, where affixes were infixed and no longer formed contiguous units (Feldman et al. 1995), and in Serbian (Feldman 1994). In the second paradigm (Beauvillain 1994), French subjects saw two French words, presented sequentially, and had to identify whether the second word was the same as the first. Parts of the words were presented in higher contrast. Judgements that the words were the same were faster when the high-contrast part corresponded to the stem of the word (e.g. reflux 'ebb') than when it did not (e.g. reflet 'reflection'). But again, although the data from both these tasks suggest that readers can take advantage of morphological information, they show neither that morphological parsing is obligatory nor that it is pre-lexical.

There is one particularly strong argument against mandatory pre-lexical decomposition of derived forms. An autonomous morphological parser, given an input which *could* be affixed, has to attempt decomposition on this form. For items which are not in fact morphologically complex, there will be a processing cost associated with recovery from the mis-parsing (this is the thinking behind the pseudo-affixation studies). Clearly, such a mechanism would be inefficient if the language it operated on contained a large number of pseudo-affixed forms. Schreuder and Baayen (1994) have shown that pseudo-prefixed forms occur frequently in both Dutch and English. In a corpus of Dutch text, around 30 per cent of words beginning with strings which could be prefixes were actually not prefixed, while the corresponding proportion for an English corpus was a staggering 80 per cent. Laudanna and Burani (1995) have shown that pseudo-prefixation rates in Italian are also very high. Baayen (1993) has shown, however, that high proportions of pseudo-suffixed forms do not occur.

These statistics suggest that mandatory pre-lexical decomposition of derivational prefixes would be highly inefficient. But they do not rule out decomposition completely. It may be the case that the recognition system is sensitive to the distributional properties of affixes. If so, decomposition may be more likely for prefixed forms where the orthographic string forming the prefix tends to occur only very rarely as a pseudo-prefix, and less likely when pseudo- prefixation is common for that string. Laudanna et al. (1994) performed multiple regression analyses on lexical decision data from prefixed Italian non-words, and found support for this hypothesis. Laudanna and Burani (1995) have also shown that other factors, such as prefix length and affix productivity, may determine how derived forms are processed. There is a very important point here: experiments which treat all affixes as alike may fail to reveal either clear or accurate results (Laudanna and Burani 1995, Sandra 1994). Lack of sufficient control of affix types (and indeed stem types) may account for some of the variability of previous results; it is to be hoped that tighter controls will be adopted in the future.

The balance of the evidence indicates that lexical access of derived forms does not *depend* upon morphological decomposition, but that decomposition can occur. Except for the Taft et al. (1986) non-word study, however, all studies described so far in this section have assessed visual word recognition. In spoken word recognition, there is evidence that prefixed words are not decomposed. Tyler et al. (1988) compared recognition performance on English prefixed words and their free stems (e.g. *amoral and moral*). In a gating task, in which listeners were asked to identify successively longer stretches of a word, Tyler et al. (1988) showed that the prefixed forms could be confidently identified earlier than the stems. There was a similar advantage for prefixed items over stems in both lexical decision and naming tasks when response time was measured from word onset. All these results support models of word recognition in which incoming information is processed continuously; they do not support discontinuous decomposition models, which predict processing costs associated with prefixation. Schriefers et al. (1991), avoiding some potential methodological confounds in the Tyler et al. study, also found that prefixed Dutch words were recognized earlier than their stems in a gating task. They used a phoneme monitoring task as well. They reasoned that if listeners use lexical knowledge in detecting target phonemes, and if lexical access depends on decomposition into stems and affixes, than detection of a phoneme in a stem should be equally fast whether the stem occurs in isolation or in a complex form. Subjects in fact detected target phonemes faster in prefixed words than in stems, suggesting that decomposition does not occur in the processing of spoken prefixed words.

3.2 Inflectional morphology

The picture that is emerging from the analysis of derivational morphology is that, at least in the visual modality, pre-lexical decomposition is an optional process. It is a strategy available to the language user, but it does not play a mandatory role in normal word recognition. Furthermore, it may be more likely to occur for some prefixes than for others. Is the picture the same for inflectional morphology?

Non-word interference effects have been obtained for inflected Italian words (Caramazza et al. 1988). Non-words composed of verbal stems with inappropriate inflections (e.g. *cantevi*, in which the first-conjugation verb root *cant-* occurs with the second-conjugation suffix *-evi*) were harder to reject than non-words composed either of genuine stems with illegal suffixes (e.g. *cantovi*) or of illegal stems with genuine suffixes (e.g. *canzevi*). These in turn were harder to reject than non-decomposable forms made from illegal stems and affixes (e.g. *canzovi*). Caramazza et al. argued that Taft's decomposition model would predict *cantovi* and *canzovi* to be equivalent, since both have an illegal suffix which cannot be stripped pre-lexically. They claimed, in contrast, that pre-lexical decomposition is non-mandatory. In their Augmented Addressed Morphology model, lexical access is achieved by two procedures operating in cascade, one based on whole-word forms (for known words) and one based on morphemes (for novel words). Caramazza et al. assume that the morphemic access procedure exercises an effect only when the whole-word procedure fails (e.g. when it is presented with non-words containing legal morphemes). Thus their model claims that morphological decomposition is optional to the same degree for inflected as for derived words.

Caramazza et al.'s study, however, given its non-word materials, is open to the same criticism as other non-word interference studies. Studies with real words suggest a different picture. For example, Stanners et al.'s (1979a) repetition-priming studies showed differences between derived and inflected words. Regularly inflected verbs primed later decisions on their bases as much as the base verbs primed themselves. Irregularly inflected verbs (e.g. *hung -hang*) and adjectival and nominal suffixed derivatives of verbs (e.g. *selective -select* and *appearance - appear*) were less efficacious as primes for the verbs than the verbs themselves. Stanners et al. (1979a) interpreted their results as evidence of pre-lexical decomposition of regularly inflected forms. They argued that the weaker priming for derived and irregularly inflected forms was due to the representation of morphological structure in the lexicon, while the equivalence of repetition priming and regular inflectional priming indicated a pre-lexical morphological process. The regular inflectional suffix on a verb like *pours* could be stripped pre-lexically, and the verb would then be recognized via the access code *pour*. If repetition-priming reflects repeated use of access codes, then the regular inflectional priming effect would indeed be predicted to be as large as the identical repetition effect.

However, it now seems clear that there are components of the priming effect which are not due to normal processes of lexical access, but instead are due to episodic memory processes (remembering that a prime occurred while processing the target) or to strategies adopted by subjects in response to the demands of the experimental task (see e.g. Fowler et al. 1985, Monsell 1985, Napps 1989). It is necessary to control for these factors before we can interpret any morphological effects. Fowler et al. (1985) provided these controls. In order to reduce episodic effects, the lag between first and second presentations of the critical word pairs (regular form-base and derived form-base pairs with matched base-base pairs) was increased from an average of nine intervening items (as in Stanners et al.'s design) to forty-eight; practice effects were also controlled. Under these conditions, both inflectional and derivational priming were statistically equivalent to repetition priming. With a similarly long lag condition, Stanners et al. (1979b) also found priming from prefixed words to stems to be equivalent to repetition priming. Furthermore, Fowler et al. compared derived and inflected forms in both the visual and auditory modalities. They found very little difference in the size of the priming effects for regular and irregular forms (irregular items were orthographically and/or phonologically opaque when compared to their stems, including some supplétive past-tense forms of verbs). These findings appear to undermine the pre-lexical decomposition account of regular inflectional priming, because they indicate that the priming effect is insensitive to surface-form transparency (see also Downie et al. 1985). Since irregular forms are not open to surface-form decomposition, the locus of the priming effect cannot be pre-lexical. Instead, it must be lexical. This is the position adopted by Fowler et al. (1985): that priming effects are due to the morphological structuring of the lexicon. This view is consistent with the results on central lexical representation reported in section 2.

A decomposition procedure for inflected forms predicts that under certain circumstances there may

be a processing advantage for uninflected forms (but note that this is not a general processing advantage – overall, inflected forms are no more difficult to recognize than uninflected forms: Cutler 1983). Taft (1978) and McQueen et al. (1992) have shown that homophone pairs made up of a regularly inflected form and an uninflected form (e.g. *billed* – *build*) are more often recognized (written down in dictation) as the uninflected form, even when the inflected form is much more frequent (e.g. *based* – *baste*). This result suggests that the extra processing required in decomposition may delay recognition of the suffixed form. Jarvella and Meijers (1983) asked subjects to make same–different judgements on either the stems or the affixes of pairs of words. Subjects were faster to judge stems than inflections; Jarvella and Meijers argued that stem judgements were easier because they could be based on lexical representations of the stems, while inflection judgements were hard because they could not be based on independent representations of the inflected forms. Decomposition of inflected forms would prevent them having independent representations. It would also make them more difficult to remember: in a task where subjects had to recall lists of words, 17 per cent of the plurals in the lists were misremembered as their singular forms (Van der Molen and Morton 1979). Data from letter cancellation tasks is also consistent with the decomposition of inflected words; Smith and Sterling (1982; see also Drewnowski and Healy 1980) found that subjects were more likely to miss the letter *e* in affixes or pseudo-affixes than in other syllables. The fact that the effect appeared in both affixes and pseudo-affixes suggests a pre-lexical procedure which would be blind to the true status of a possible affix. Finally, Gibson and Guinet (1971) presented written words very briefly for identification. Fewer errors were made on inflectional endings than on non-inflectional endings, suggesting that the suffix acted as a separate unit in perception. This result again favours decomposition of inflected words.

In summary, the evidence for decomposition reviewed so far is stronger for inflectional than for derivational forms. Decomposition may be an optional strategy for derived words, available when normal access procedures fail. It would therefore appear that derived words have independent whole-word access representations. Inflected words may not have their own access representations, and access to the central lexicon for inflected forms may be via decomposition, leading to access representations of their component stems and affixes.

4 Frequency of occurrence

We have already seen that processing factors appear to determine the role of morphological information in word recognition. At the level of representation in the central lexicon, factors such as semantic transparency influence which morphological relationships are represented and how they are coded. During pre-lexical processing and lexical access, factors such as the likelihood of letter strings appearing as genuine prefixes may determine whether or not decomposition of derived forms takes place. One important processing factor, the frequency of occurrence of words, has so far been overlooked. Word frequency is treated separately, since its analysis has had implications both for lexical access and for central lexical representations. This body of work exploits the well-established finding of 'frequency effects' – lexical decisions are faster to high- than to low-frequency words.

Taft (1979b) manipulated independently surface frequency (the frequency of occurrence of any particular surface form) and combined stem frequency (the summed frequency of occurrence of a stem across all the inflected forms in which that stem occurs). He found that lexical decisions to inflected and uninflected words were faster both for higher combined stem frequency (when surface frequency was controlled) and for higher surface frequency (when stem frequency was controlled).

Taft's materials included both nouns and verbs; other studies, however, have examined frequency effects for each syntactic class separately. Burani et al. (1984) replicated Taft's results with Italian regular verbs: both combined stem frequency and surface frequency predicted lexical decision time of inflected forms. However, Katz et al. (1991) found that only surface frequencies, not combined stem frequencies, could predict lexical decision time for uninflected English verbs. (Their results for inflected English verbs are ambiguous: decision latencies for past-tense forms were predicted by surface frequency alone, but those for present participles were predicted by both surface and combined stem frequency.) Sereno and Jongman (1992) found surface frequency effects for both inflected and uninflected verbs, but they observed no effect of combined stem frequency for uninflected verbs (combined stem frequency effects in inflected verbs were not tested).

Although effects of combined stem frequency are fairly reliable for inflected verbs, the evidence is somewhat contradictory for uninflected verb forms. A similar pattern emerges for nouns. Sereno and Jongman (in press) used a set of nouns matched on combined stem frequency but differing on the relative frequency of their uninflected and inflected forms, such that one subgroup had higher-frequency singular forms and lower-frequency plurals (e.g. *river*(s)), while the other group had higher-frequency plurals and lower-frequency singular forms (e.g. *window*(s)). Surface frequency effects in lexical decision latency were observed for plurals (e.g. *windows* faster than *rivers*). Although there was a similar effect for singulars (e.g. *river* faster than *window*), this effect was not significant. For nouns matched on surface frequency of their singulars but differing in combined stem frequency, no effect of combined stem frequency was observed in lexical decisions regarding the uninflected nouns, while there was a non-significant trend for the plurals (high combined frequency plurals were responded to somewhat faster than low combined frequency plurals). The failure to find surface and combined stem frequency effects for uninflected nouns appears to contradict Taft's (1979b) results.

The results for both nouns and verbs are therefore somewhat inconclusive. The picture is little clearer for derivational morphology. Taft (1979b) found that lexical decisions regarding prefixed words, matched in terms of their surface frequency, were faster for those with higher combined root frequency than for those with lower combined root frequency (the summed frequency of occurrence of a root across all the derived and inflected forms in which that root occurs). Extending Taft's result, Burani and Caramazza (1987) found surface and combined root frequency effects for Italian suffixed derived words.

But Burani and Caramazza's finding appears to conflict with one reported by Bradley (1980). She found no effects of surface frequency for English suffixed words ending in *-ment, -er, -ness* and *-ion*, and effects of combined root frequency only for the first three of these types of word (i.e. she found no frequency effects whatsoever for words ending in *-ion*). As Burani and Caramazza note, however, Bradley's word lists contained a high proportion of items with the same suffix. This could have induced a decompositional strategy, and hence reduced surface frequency effects. Strategic decomposition, since it would depend on the detection of decomposable forms, would also produce the apparent effect of transparency which Bradley obtained: *-ion* suffixes alter pronunciation, spelling and stress (and therefore by implication impair detectability) of their roots, while *-ment, -er* and *-ness* do not.

Cole et al. (1989), in support of Burani and Caramazza, have also observed surface and combined root frequency effects for French suffixed words. However, in contradiction of Taft (1979b), they found no effect of combined root frequency for prefixed words. S. Andrews (1986) observed a reliable frequency effect in bisyllabic compound words, such that those with a high-frequency word in their first syllable were responded to, in lexical decision, more rapidly than those with low-frequency first syllables (replicating Taft and Forster 1976). But she found that stem frequency influenced the recognition of bisyllabic suffixed words only in the context of compound words. Andrews argued that this was evidence for strategic rather than mandatory decomposition. Finally, in the eye-fixation study mentioned earlier (Holmes and O'Regan 1992), it was found that gaze durations for prefixed words matched on surface frequency were longer for those with low-frequency stems than for those with high- frequency stems.

Clearly, the evidence from all these studies of morphological frequency effects is ambiguous. Certainly, the fact that there are combined frequency effects at all further supports claims that morphological information is used during word recognition; but not only are there differences in the patterns of results obtained, there are also differences in the way in which these results have been interpreted. Taft (1979b) argued that combined stem frequency effects occurred because the stem acts as the access representation for all words with that stem. However, these results are also consistent with any model in which morphological information is represented in the central lexicon and in which lexical entries are frequency-sensitive. If representations of stems are linked to those for whole-word forms in a cluster, either within a shared entry or in a network, then recognition of any word in that cluster should be sensitive both to combined stem frequency and its own surface frequency. For example, Burani and Caramazza (1987) interpreted their findings as support for the AAM shared-entry model.

One finding does suggest that combined stem frequency effects are due to the central representation

of morphology. Kelliher and Henderson (1990) found combined frequency effects for irregular past-tense inflected verb forms of English such as *bought* and *shook*, matched on surface frequency; responses were faster on those with higher-frequency infinitive forms (e.g. *buy* is more frequent than *shake*). As Kelliher and Henderson point out, it was impossible to determine whether this was indeed an effect of infinitive form frequency, of combined paradigm frequency (summing over both regular and irregular inflected forms) or even of combined root frequency, since these measures are very highly correlated. Nevertheless, the result suggests that the recognition of inflected verbs is influenced by the frequency of occurrence of their morphological relatives. Furthermore, the demonstration of this effect on the recognition of *irregular* past-tense forms, since by definition these do not share the same form as their stems, indicates that the morphological combined frequency effect has its locus in the central lexicon.

The clearest evidence of combined stem frequency effects was seen for inflected forms (both nouns and verbs). This is consistent with the evidence supporting pre-lexical decomposition of inflected forms, reviewed in section 3. If an inflected form is decomposed, it will be recognized via contact with an access representation and a central representation of its stem. Since all inflections for a given stem would be recognized in this way, the lexical representations (if frequency-sensitive) would show combined stem frequency sensitivity.

Considering all the evidence on decomposition, therefore, it would appear that neither extreme theoretical position (all complex words decomposed or no decomposition at all) is tenable. Dual-route models, where some words are morphologically parsed prior to access via their constituent morphemes and others are accessed directly via whole-word representations, appear best suited to account for the data. Dual-route models do not suffer from the criticism that decomposition is inefficient given high proportions of pseudo-prefixation, since in these models decomposition is not obligatory. On the other hand, dual-route models can account for the evidence that decomposition, at least under certain circumstances, does occur.

One dual-route model is the AAM model (Caramazza et al. 1988). As previously discussed, in the original formulation of the model the parsing route was slower than the whole-word route, and its behaviour could be observed only during the processing of forms composed of known morphemes but lacking in whole-word representations (novel words or non-words). In more recent formulations (Chialant and Caramazza 1995), parsing may also operate for complex words which occur rarely, but which have high-frequency constituents; but parsing is still considered to be slower than whole-word access.

An alternative dual-route account has been offered by Schreuder and Baayen (1995; see also Frauenfelder and Schreuder 1992). In this model, there are two routes which operate in parallel; they race with each other, such that whichever route finishes first will be responsible for lexical access on a given occasion. In general, the parsing route tends to be slower than the whole-word access route, since it involves more computational steps; but the two routes are assumed to vary in their processing times, with overlapping distributions in their completion times. Access representations are considered to be sensitive to combined stem frequency through a process of activation feedback. For some forms (low-frequency transparent inflections), there may be no whole-word representations, so their recognition can only be achieved via the parsing route. But high-frequency inflected forms are able to develop their own whole-word access representations. The development of whole-word representations depends both on frequency and on the complexity of the computations performed during parsing. Words of high frequency whose morphological parsing is complex (and hence more time-consuming) are the most likely to have their own access representations (thus speeding up their recognition).

Lexical decision experiments examining the recognition of singular and plural nouns varying in their relative frequencies in both Italian (Baayen et al. 1997a) and Dutch (Baayen et al. 1997b) support the detailed predictions of the dual-route race model and challenge those of the AAM model. Baayen et al. argue that the data from Italian suggest that storage of full-form representations does not occur for forms with singular suffixes (whose parsing is considered to be less complex), but can occur for forms with plural suffixes (whose parsing is considered to be more complex). But, in keeping with the race model, the evidence also suggested that not all plurals have whole-word access representations: Baayen et al. argue that those with higher frequency of occurrence are more likely to have their own

representations.

Word frequency effects therefore appear to inform the debate on morphological processing, particularly on the nature of morphological parsing. Although results for derived forms are rather unclear, those for inflected forms combine with other evidence to suggest that at least some inflections may be decomposed prior to lexical access. Note again, however, that there need not be a qualitative distinction made between inflections and derivations. Dual-route models suggest that morphological decomposition is attempted on all complex forms, but it is only likely to be responsible for normal word recognition on a subset of forms, according to constraints such as transparency, productivity and word frequency (low-frequency transparent forms involving productive affixes, such as noun plurals, may be the most likely candidates for normal parsing – a word such as *napes* may well be recognizable only via decomposition).

One final cautionary remark needs to be made about word frequency effects. Schreuder and Baayen (1997), in a study of the recognition of monomorphemic Dutch nouns, have found that at least in tasks requiring higher-level processing of visually presented words, the size of the morphological family of the noun (the number of different derived or compounded words containing the noun as a constituent) influenced performance. Nouns were responded to more rapidly in lexical decision if they came from larger families, and they elicited higher subjective familiarity ratings. There was no effect, however, of family frequency (the combined frequency of all members of the complete morphological family). The lack of control of family size may account for some of the previous variability in morphological frequency effects.

5 Conclusion

The evidence we have reviewed leaves no doubt that morphological information is represented in the mental lexicon in a quite detailed way. Moreover, the most recent evidence suggests that there is variability between the strengths of the connections between different members of a morphological family. Models which state that morphological relatives are simply linked are not sufficient. Network models (e.g. Schriefers et al. 1992) and internally structured shared-entry models (Caramazza et al. 1988, Chialant and Caramazza 1995, Marslen-Wilson et al. 1994) can both deal with the variability requirement. Access to morphologically structured lexical representations, on the other hand, need not involve morphological structure overtly; decomposition of derived forms may be an optional procedure, available when the normal whole-word access procedure fails. Here the evidence differs according to type of morphological relationship: regular inflectional forms may be decomposed, perhaps depending on their frequency of occurrence, but derived forms probably are not.

Of course, lexical representation and lexical access are not independent; they form part of a unified word recognition system. This system, we would argue, is structured for the processing of spoken language. (Thus it is unfortunate that so large a proportion of studies of morphology in recognition, like studies in many other areas of psycholinguistics, have been based on written materials.) As described above, Tyler et al. (1988) and Schriefers et al. (1991) have argued that lexical access of spoken words is a continuous process from the beginning of the word's presentation. In accounting for differences in priming between prefixes and suffixes, Marslen-Wilson et al. (1994) depend on this beginning-to-end assumption. The temporal nature of the speech input also forms the basis for Cutler et al.'s (1985) explanation of the bias towards suffix morphology in the world's languages; listeners prefer to process stems before affixes. Arguments have also been made for beginning-to-end processing in visual word recognition (Bergman 1988, Cole et al. 1989, Hudson and Buijs 1995).

Both network and decomposed shared-entry models are compatible with temporally continuous access. For network models, there are separate entries for each word form, so access would be direct to each entry. Effectively, any stem has multiple representations, one for each inflectional variant (in addition to its representation in the stem-morpheme node binding the entries together). Shared-entry models economize by representing each stem only once. Access for prefixed words would begin with contact being made with a representation of the prefix, and access of suffixed words would begin at a representation of the stem. But in both cases, decomposition would take place as more information arrived in a temporally continuous manner.

Given that the vast majority of inflections are suffixes, temporally continuous access is obviously

consistent with the decomposition of inflected forms suggested by the evidence reviewed in sections 3 and 4. Initially, the stem portion of a word is mapped on to its lexical representation. When the suffix arrives, it can be mapped on to the representation of the inflected form. Suffixed words are therefore accessed via their stem. Decomposition is not delayed until contact has been made with a full form in the lexicon; it is achieved *before* the form has been identified. In this sense, decomposition takes place before word recognition. But it takes place *during* lexical access, not prior to it.

Temporally continuous processing has further implications. One is that it may underlie observed differences between prefixed and suffixed forms. Cole et al. (1989) argued that combined root frequency effects were detectable on suffixed but not prefixed words, because recognition of prefixed forms does not initially entail access to the stem. Root frequency thus has less opportunity to influence recognition time in prefixed words than in suffixed words. Another implication is that not only suffixed inflectional forms, but also suffixed derived forms – as long as they are sufficiently transparent – should be decomposed during lexical access. In other words, processing distinctions between inflectional and derivational morphology arise not from a categorical distinction between these types, but strictly from processing considerations: the relative ordering of stem and affix and the relative transparency of the relationships involved. Note that Marslen-Wilson et al.'s (1994) results suggest that it is *semantic* transparency, rather than phonological (or, by extension, orthographic) transparency, which determines whether a morphological relationship is lexically represented. This suggests that lexical representations are abstract: that they represent the underlying phonological structure of a morphological family, rather than each individual surface form.

A related factor which may determine morphological representation is productivity. Forms with highly productive affixes are more likely to be semantically transparent, and hence represented in a decomposed way. Badecker and Caramazza (MORPHOLOGY AND APHASIA) describe patients who show morphological errors (in production) on inflections and productive derivations but not on non-productive derivations. Finally, frequency of usage may determine the strength of connections between suffixes and their stems; for example, Schriefers et al. (1992) found the weakest priming for the low-frequency adjectival suffix *-em*.

The most important characteristic of the above list is that order of occurrence, transparency, productivity and frequency are all essentially performance factors. Processing factors, we would argue, underlie both our general conclusions: that lexical representations are morphologically structured, and that lexical access involves decomposition of some morphologically complex words but not of others. Clearly, there are likely to be differences across languages in the extent to which morphological structure is lexically represented. Here, again, it is particularly unfortunate that most of the evidence available is from English and other closely related languages. Speakers of languages with very transparent, productive or simple morphologies may have a much richer mental morphology than speakers of complex, opaque languages. Hankamer (1989) has convincingly argued for the necessity of morphological parsing in agglutinative languages such as Turkish (but see also Niemi et al. 1994 for related arguments concerning Finnish, another language with rich combinatorial morphology). Such cross-linguistic differences will be motivated, however, not by the nature of the morphological systems themselves, but rather by the processing considerations which determine the structure of the human word recognition system.

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22. Morphology in Language Production with Special Reference to Connectionism

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Modern work on morphology in language production was begun by Meringer and Mayer (1895) and Meringer (1908). They observed that adult (and child) speakers of German occasionally regularize irregular verbs:

(1)

(a)	*erzieht*	for	*erzogen*	(infinitive *erziehen* 'educate')
(b)	*gedenkt*	for	*gedacht*	(infinitive *denken* 'think')
(c)	*heisste*	for	*hiess*	(infinitive *heissen* 'name')

After a long hiatus, MacKay (1970) brought attention back to these data, using them to argue that speakers actively use morphological rules to construct inflected forms, and that misapplication of those rules underlies the errors in (1). MacKay's work set the pattern for more recent work in several ways. First, most of it has focused on errors, rather than speed (reaction time). Second, most of it has focused on the question of whether speakers use morphological rules.

Early work was heavily based on linguistic theory, using the phonological and morphological concepts of linguistic theory and trying to demonstrate that they were psychologically real. Some researchers had no overt psychological theory of performance (e.g. Fromkin 1971), while others used a symbol-based serial theory of psychological processing in which it would be possible to instantiate a performance version of linguistic theory (e.g. M. F. Garrett 1975). G. S. Dell (1986) and Stemberger (1985b, c) introduced local connectionist models into research on morphology, but still focused on evidence for linguistic concepts such as rules. Rumelhart and McClelland (1986) brought distributed connectionist models into the picture, along with an attempt to eliminate rules from consideration. Researchers using symbolic models (e.g. Pinker and Prince 1988, Pinker 1991, Marcus et al. 1992) have argued that rules are necessary.

In this chapter, I explore the data and issues that have been brought up. First, I review the studies of the characteristics of morphology in language production. Given the focus of the field, most of this discussion addresses inflectional morphology. Next I review psychological models of morphology in language production, with an emphasis on connectionist models. A common theme is the question of whether there is any evidence that speakers use morphological rules during language production. I provide a summary of work thus far and comments about where the future will lead.

1 Empirical work on language production

Work on morphology in language production has focused heavily on errors. Much of it has to do with the expression of particular morphosyntactic features in a particular position in the syntactic structure. The phenomena can be typologized as follows:

(1) Right features, right place
(1) wrong morphological pattern (regularization)
(2) wrong base lexical item (and attendant agreement)

(2) Wrong features, right place
(1) no affix when one should be there
(2) an affix when none should be there
(3) wrong affix (expressing the wrong features)

(3) Right features, wrong place
(1) affix shifts, exchanges, anticipations, and perseverations
(2) overtensing

Most of these error types occur with both inflectional and derivational affixes. A second area of interest is more overtly phonological (sections 1.4 and 1.5): when there is allomorphy, the allomorphy can be incorrect (right affix, wrong allomorph), or the allomorphy can be altered to accommodate a conditioning factor that was in error.

These errors provide information about several diverse areas. Errors where the wrong lexical item is present, or where the affix is expressed in the wrong syntactic position, reveal how syntax constrains the expression of morphosyntactic features. Getting an incorrect alternative pattern that expresses the same features has more to say about lexical processing. And allomorphy errors bear on the phonological processing of lexical items. As I discuss the phenomena, I briefly note what they reveal about processing. More details are provided in the later discussion of models of language production.

1.1 Right features, right place

1.1.1 Wrong morphological pattern: regularization and irregularization

Regularizations (as in (1) above in German) are commonly observed in English and other languages. In English, they have been observed with all inflectional affixes where irregulars are found: past tense, perfect aspect, present tense, and plurals.

(2) (a) I carefully looked at 'em & *choosed* – *chose* that one.
(b) She's always *goed* – *gone* into these weird things.
(c) She goes and *do-s* – *does* that.
(d)…but two *childs* – two *children* usually isn't.

Regularizations are easily obtained from adults in experimental tasks such as *morphonaming*, in which speakers are asked to produce a particular morphological variant of a word given a different morphological variant presented visually or auditorily (MacKay 1976; Bybee and Slobin 1982; Stemberger and MacWhinney 1986a, b). To derive such errors, there must be some mechanism by which morphological patterns can generalize. One such mechanism, rules, adds an affix to a base form, and is blocked by irregular forms (e.g. Aronoff 1976, Kiparsky 1982a). In regularizations, a speaker fails to access the irregular form and instead accesses the base; the addition of the regular suffix is then automatic.

In some cases, the irregular form is accessed, but there is a failure of blockage: the regular rule applies anyway, to yield a *partial* regularization.

(3) (a) It *tooked* a while, *'took'*
(b)… he doesn't have any… *lices*. *'lice'*

Full regularizations as in (l)–(2) are more common than partial regularizations (MacKay 1976, Bybee

and Slobin 1982, Stemberger 1985c). From this, we can infer that failure to access an irregular is more of a problem than failure of blockage. This does not derive from any independent principle, but must be stipulated as an empirical finding.

Less common, and receiving less attention in the literature, are *irregularizations*: when an irregular pattern generalizes to another word, whether that word is properly regular or irregular (but following a different pattern; Bybee and Slobin 1982):

(4) (a) *cloamb 'climbed'*
(b) *crull 'crawled'*

(5) (a) *flang 'flung'*
(b) *brung 'brought'*

There must be some means to generalize irregular patterns as well. One issue is whether regular and irregular patterns can be treated (and generalized) in a parallel fashion, differing primarily in terms of likelihood of generalization, or whether they are produced via different mechanisms.

There are strong phonological influences on both regularization and irregularization. Bybee and Moder (1983) reported that nonce forms are more likely to be irregular if they bear a family resemblance to known irregular verbs (often referred to as the *hypersimilarity effect;* the errors in (5) above rhyme with known irregulars like *rang* and slung, and so are more common than the errors in (4) above, which are far less common. Stemberger and MacWhinney (1986b) showed that regular verbs with base forms that rhyme with families of irregulars (e.g. *thank*, which rhymes with *drank, sank*, etc.) are more likely to be produced without the *-ed*, so that they appear to be irregular: *thank* rather than *thanked*. Daugherty and Seidenberg (1994) show that regulars whose base forms rhyme with the base forms of irregulars take longer to produce than other regular verbs, suggesting interference from these groups of irregulars. Overall, data suggest that regulars and irregulars are both considered as candidates for the pathway used for irregulars.

Stemberger (1993), Stemberger and Setchell (1994), and Marchman (1995) show that the relationship between the vowel of the base form and the vowel of the irregular past-tense form is important. Given any two phonemes involved in a phonological error, phoneme A (the recessive phoneme) tends to be mispronounced more as phoneme B (the dominant phoneme) than the reverse (see Stemberger 1992b for discussion of English vowels and the underlying mechanisms). If the dominant vowel is in the base form, there is a phonological bias for the vowel of the past-tense form to be mispronounced as the vowel of the base form. Given that mispronunciation, regularization often follows; regularizations like *falled* (/a:/ dominant over the /ɛ/ of *fell*), *sinked* (/ɪ/ dominant over the /æ/ of *sank* or the /æ/ of *sunk*), and *throwed* (/ow/ dominant over the /u:/ of *threw*) are common. By contrast, if the dominant vowel is in the past tense, regularizations are rarer: *getted* (/ɛ/ recessive to the /a:/ of *got*) and *see-ed* (/i:/ recessive to the /a:/ of *saw*). Stemberger (1994a) further found that phonological priming from the subject NP also affects regularizations: when subjects must take an NP like *THE BALL* and a verb like *FALL* (where the noun and base form of the verb rhyme) and construct a sentence in the past tense, regularizations like *falled* are common (between 6 and 11 percent of tokens, depending on the nature of the priming); but regularizations are much less common if the noun is phonologically unrelated (as in *THE CONE* and *FALL*; c. 4 percent of tokens in error) or if the noun rhymes with the past-tense form (as in *THE BELL* and *FALL*; c. 3 percent of tokens). Such effects reveal that the processing system considers both the base and pasttense forms when producing the past-tense form, and that factors that favor the vowel of the base form (dominance or priming) lead to the system failing to retrieve the correct irregular past-tense form. As discussed below, not all models predict such phonological effects.

1.1.2 Stranding and accommodation

There are errors that occur that could be analyzed as either lexical or syntactic, in which a word is inserted into a sentence at the wrong place. For example, given a sentence with an embedded VP under the main VP (as in *wanted to watch*), the two verbs involved could be reversed. When this occurs, we commonly observe two phenomena: *stranding*, in which the morphological affixes remain

at the place in the sentence where they belong, and *accommodation*, in which the misordered words take on the inflected form that is appropriate to their new locations in the sentence (M. F. Garrett 1976, 1980). In (6a), for example, when *sound* is anticipated, it leaves *-ing* behind and acquires *-s*.

(6) (a) It *sounds* up - *ends* up sounding like 'split'.
(b) You just count *wheels* on a *light*. ('… *lights* on a *wheel*')

Stemberger (1985c) points out that these two phenomena are equally true of purely lexical errors, in which the wrong lexical item is accessed, since the form produced almost invariably has the inflected form appropriate to the syntactic context.

(7) That *understands* why he was that way. ('… *explains* why…')

Stemberger (1985c) also notes that there is one common exception to both stranding and accommodation: the plural *-s* affix often is exceptional, a fact that Stemberger attributes to the low level of syntactic constraints on plurality (8) and (9b) below).

(8) Your *teeth are* all red. ('Your *tongue is* all red.')

Stemberger argues that stranding and accommodation invariably occur when words of different syntactic categories are involved, but there can be exceptions when the two words are of the same category.

These facts are expected, given that we know from linguistic studies of syntax that inflections are often limited to particular positions in the sentence, such as tensed clauses, heads of NPs (but not nouns embedded in compounds), etc. They have no bearing on the issue of morphological rules, but reveal only that syntax constrains where inflections appear. If a word appears at an unexpected place in the sentence, it is subject to the constraints on that location in the sentence, so it loses any inflections that it would have had if it had appeared in its correct location, and takes on any inflections demanded by its erroneous syntactic position, with any irregularity appropriate to the word involved.

In syntactic environments in which one word agrees with another along some dimension, these lexical errors can lead to changes in other words. Stem- berger (1985c) shows that changes in the subject (pro)noun can lead to changes of the verb from singular to plural or vice versa.

(9) (a) *You're* too good for *that*! (for *'That's* too good for *you*!')
(b) Most *cities are* true of *that*. (*That's* true of *most cities*.)

Berg (1987), however, has shown that articles in German rarely accommodate to the gender and number of the displaced noun.

(10) Die wollen auch das *Welt* - das *Licht* der Welt erblicken.
('They want to see the (n.) world (f.) - light (n.) of day, too.')

Accommodation seems to be strong within a lexical item, but is less common in agreement with other words, which often agree with the word that they would have agreed with had the error not occurred.

1.2 Wrong features, right place

1.2.1 Base form errors

In some cases, a speaker drops out inflections and produces the uninflected base (as found in English in singular nouns and in non-third-person present verb forms, infinitives, and imperatives).

(11) (a) They had cute little *mouse* on - *mice* on it.
(b)Boy, that *draw* him out. - *Drew* him out.

1.2.2 Affix addition

Stemberger (1985a) reports that speakers are more likely to drop affixes than to randomly add them. He argues that this is a frequency effect, since the base form in English is usually more frequent than any particular inflected form. One contrast is particularly interesting: in the present-tense forms of most verbs, speakers tend to drop the -s affix, substituting the (more frequent) plural for the singular; but with the irregular verb *to be*, most errors involve replacing the plural form *are* with the (more frequent) singular form *is*. While such errors are compatible with the notion of rules, they occur with irregularities as well (to an even greater extent than with regular affixes; Stemberger and MacWhinney 1986a), and reflect only lexical accessing errors. Congruent with this, Stemberger and MacWhinney (1986a) show that base form errors are more likely for low-frequency verbs, even for regulars (though there is a much larger frequency effect for irregulars than for regulars).

Prasada et al. (1990), using reaction-time data rather than error data, have argued that irregular forms show frequency effects, but regular forms do not. They argue that this difference suggests that regular and irregular forms are processed in fundamentally different ways, with the irregular forms showing more word-like properties than the regular forms. Daugherty and Seidenberg (1994) also report this difference, but show (via a connectionist simulation) that a single mechanism can handle the differences. (See below for further discussion.)

1.2.3 Wrong affix

Speakers sometimes produce forms with the wrong inflectional affix, given the meaning and/or the syntactic position of the word.

(12) She has *paying* – *paid* $15 for a blouse.

This seems to be an accessing error, where either the wrong inflected form is accessed in the lexicon, or the wrong inflectional rule is applied.

1.3 Right features, wrong place

1.3.1 Affix shifts, exchanges, anticipations, and perseverations

Affixes can themselves be misordered: anticipated or perseverated, either being added to a word or replacing a different affix, being exchanged with another affix, or simply shifting so as to appear on the wrong word; these are rare but do exist (Stemberger 1985b, *contra* M. F. Garrett 1975).

(13) (a) I can't keep their *name straights*. ('… *names straight*')
(b)… where the safe *part* of the *cities* are. (… *parts* of the *city*)[1]
(c)… may take several years to be *masters*, ('to be *mastered*')
(d)I *wind* up *rewroting* 12 pages. ('I *wound* up *rewriting*')
(e)Rosa always *date shranks*. (*'dated shrinks'*)
(Fromkin 1971)

Stemberger argued that such errors suggest that the affixes are separate morphemes, but the errors involving irregularities suggest rather that a syntactic error has been made, whereby the morphosyntactic features of the inflection are expressed in the wrong place in the sentence, in a way that violates the normal mapping rules of English syntax, rather than movement of affixes per se. Fromkin's example in (13e) suggests that shifts of features can even take place between words of different syntactic classes.

1.3.2 Overtensing

In some instances, the morphosyntactic features are erroneously expressed twice. In particular, verbs are normally inflected for tense, but are uninflected when embedded under an auxiliary or modal. In overtensing errors, the verb is erroneously inflected for tense.

(14) (a) Did you *found* her? (for 'did you *find* her')
(b)Who does he *thinks* he is? (for 'does he *think* he is')

Irregular verbs are more likely to be overtensed than regular verbs. Stemberger (1992a) has shown experimentally that this may be due to the vowel-changing nature of most irregular past-tense patterns versus the suffixation nature of regular patterns; perfect *-en* is much less often involved in overtensing than other irregulars. Stemberger further shows that overtensing is more common with low-frequency verbs than high-frequency verbs. Stemberger and Setchell (1994) have demonstrated that vowel dominance has an effect: verbs with the dominant vowel in the past tense are more likely to be over tensed. Apparently, the phonological bias to produce the vowel of the past-tense form combines with the semantic appropriateness of the error to make the error more likely.

1.4 Allomorphy

1.4.1 Accommodation to Other errors

In many cases, an affix has multiple phonological realizations, depending on the phonological environment. The English *-ed* affixes have three allomorphs: /əd/ after /t/ and /d/, /t/ after other voiceless phonemes, and /d/ after other voiced phonemes. The *-s* affixes have /əz/ after strident phonemes, /s/ after other voiceless phonemes, and /z/ after other voiced phonemes. When phonological errors lead to a crucial change in the final segment of the base morpheme, the affix usually (but not always) takes on the appropriate shape for the new phonological environment.

(15) (a) The infant *tucks* (/tʌks/) – *touches* (/tʌəčəz/) the nipple.
(b)The Swedish got *gooed* (/u:d/) up – *goofed* (/u:ft/) up.

This accommodation also is observed with the suppletive variants of the articles: *a* and /∂ə/ before consonants versus an and /∂i/ before vowels.

(16) (a)… gets 20 miles *an allon* – *a gallon*.
(b)Put the (/∂ə/) *hoven* – put the (/∂i/) *oven* on 'hot'.

The most extreme form of phonologically conditioned allomorphy in human languages is reduplication, in which the affix takes on consonants or vowels from the base form. Stemberger and Lewis (1986) investigated reduplication in Ewe, using an experimental task that combined morphonaming with phonological priming designed to lead to phonological errors, and found that the affix usually took on the form of the initial consonant and vowel of the base when that was in error.

(17) (a) *haha fo* (for *'fafa ho'*)
(b) *xaxa si* (for *'sasa xi'*)

Phonological accommodation demonstrates that the *form* of the affix has not (usually) been finalized at the point in processing where phonological errors occur; allomorphy is determined either at the same time as or subsequent to phonological errors.

1.4.2 Wrong allomorphy

In some instances, the wrong allomorph appears.

(18) Queen *Elizabeth'es* (/θəz/) – Queen *Elizabeth's* (/θs/) mother

Such errors are unusual, because incorrect allomorphs usually lead to a phonologically illegal sequence in the language (such as */kd/ or */čs/); speakers rarely produce illegal sequences (see Fromkin 1971) even in phonological errors. The allomorphs /əz/ and /əd/ are the only ones that are always legal, but even these rarely replace the other allomorphs, because /əz/ and /əd/ are low in frequency, and because these allomorphs require the addition of a syllable, something the phonological system is biased against (Stemberger and MacWhinney 1986a).

1.4.3 Affix checking

Base form errors are especially prevalent when there is a close phonological similarity between the

base and the affix. Bases that end in /s/ and /z/ (like the nonsyllabic allomorphs of the -s affixes) tend to drop the -s affix. Bases that end in /t/ and /d/ (like the nonsyllabic allomorphs of the -*ed* affixes) tend to drop the -*ed* affix.

(19) (a) So we -*test* 'em on it. (for '… we *tested* 'em')
(b)It just *lose* something, (for '… just *loses* something')

This is true of both adult speech (Bybee and Slobin 1982, Stemberger and MacWhinney 1986b), and child speech (Berko 1958, Bybee and Slobin 1982). MacWhinney (1978), Stemberger (1981), Bybee and Slobin (1982), and Menn and MacWhinney (1984) suggest that such errors arise because the base already appears to be inflected, and so the speaker does not add an "additional" inflection. Pinker and Prince (1988) suggest that it might be phonological dissimilation between the base and affix consonants (but see Stemberger 1981, Menn and MacWhinney 1984). Rumelhart and McClelland (1986) and Pinker and Prince (1988) suggest that it might be the overgeneralization of the no-change pattern of verbs like *hit* and *hurt;* but this is not the whole story, since such errors are also common with the -s affixes, where no-change irregulars do not exist.[2]

1.5 Derivational morphology and compounding

The bulk of studies of language production in normals has focused on inflectional morphology, but something is known about derivational morphology (MacKay 1978, 1979; Stemberger 1985c). The small number of studies is related to the fact that inflectional morphology is more frequent in spontaneous speech, so errors there are more noticeable.

1.5.1 Derivational morphology: base form/ wrong affix errors

As with inflectional morphology, derivational affixes can be left out, added, or replaced by an inappropriate affix.

(20) (a) It's not *mass* enough – *massive* enough for a sun.
(b)If you're *hunger* – *hungry*, you should've…

(21) (a) I'm Tony's *brother-in-law*. (for 'Tony's *brother*')
(b)It was when they were first *marriaged* – *married*.

(22) (a) He was a *philosophist*, wasn't he? (for 'a *philosopher*')
(b)It's an arbitrary *decidal*. (for 'an arbitrary *decision*')

Inappropriate affixes are usually only inappropriate lexically; they represent a competing affix with the same meaning that simply cannot be used with that particular word; these might be called "regularizations," though it is often hard to determine which derivational affix is the "regular" one. With semantically transparent derivational affixes, loss errors are common, but addition errors are not (Stemberger 1985c). Apparently, the transparency of the semantics leads to the base form being a strong competitor which, because of its higher frequency, is more likely to win out when inappropriate (similar to the "hypernym problem" of Levelt 1989); but the derived form is unlikely to win out when it is inappropriate. With semantically opaque affixes, however, loss and addition errors are more balanced. Apparently, the differences in meaning between base and derived form lead to less semantic interference between them, so that the base is not activated as much when the derived form is appropriate, and vice versa; thus, substitution of one for the other is likely in either direction.[3]

Affixes can be anticipated or perseverated from a nearby word.

(23) (a) This longish *woodish* – longish wooden object is…
(b)… brood reduction and hatching *asynchrontion* – asynchrony.

1.5.2 Stranding and accommodation

As with inflections, derivational affixes can be left behind when a word is inserted into the wrong

syntactic position in the sentence, whether regular or irregular (MacKay 1979, Stemberger 1985c).

(24) … makes no pretense of *pretending* – of *preparing* you for…

This may be purely lexical, with the syntactic demands of a particular position in the sentence requiring a particular derived form. It should be noted that the *addition* of a derivational affix to render the correct part of speech seems to be uncommon, while the *loss* of a derivational affix to yield the right part of speech seems to be common. It appears that derivational affixes *require* that the words containing them be of a particular part of speech, and they can readily be eliminated when the word appears in the wrong syntactic position. However, errors rarely occur in which a derivational affix is added *solely* to change the part of speech of a word. The part of speech of a monomorphemic word in English is quite labile, and can change (e.g. from noun to verb, or vice versa) without the addition of any overt affix. If a monomorphemic word erroneously finds itself in a syntactic position requiring a different part of speech, it follows this no-affix pattern. This suggests that derivational affixes may be added partly for semantic or pragmatic reasons, and that syntax alone does not force the addition of derivational affixes.

1.5.3 Stress and VOWel patterns

Fromkin (1971) first noted errors where the wrong stress and vowel patterns were present.

(25) (a)… inherent linguistic *suPERiority* in women, (for *'superiORity'*)
(b)*ecoNOMists* (for *'eCONomists'*)

(26) (a) Oakland gets all the *inDUStry*. (for *'INdustry'*)
(b)… in the paper at the *secreTARy* jobs… (for *'SECretary'*)

Fromkin interpreted these as demonstrating that the stress and vowel reduction rules posited for English by Chomsky and Halle (1968) were psychologically real. However, the exact details of how the errors occur were not given. Those in (25) seem reasonable, since an affix is simply ignored (thus shrinking the phonological domain of the rule, which entails a different resulting stress pattern). But it is unclear how the errors in (26) occur, where the rules act as if additional syllables were present.

Cutler (1980) (replicated by Stemberger 1985c) showed that such errors rarely occur unless the target has a derivationally related word with a different stress pattern. It seems as if speakers are "borrowing" the stress and vowel patterns from another form of the word. Cutler argues that suppletive stems are stored and retrieved without application of stress or vowel reduction rules (e.g. *econom-* as both /ˌiːkəˈnam/ and /ˌiːˈkanəm/), and that different suffixes choose different allomorphs. Stress errors arise when a suppletive stem is accessed that does not normally go with the suffix (or lack of a suffix) that is present in the target word. No one has yet proposed a stress-rule-based solution that accounts for the facts.

1.5.4 Compounding

Errors of compounding are rare. They are of two types. First, one member of a compound may be dropped, sometimes leading to a blend between the two parts of the compound.

(27) (a) This is *scotch*. – *Hopscotch*.
(b)How many *blerries* did you get? (for *'blueberries'*)
(c)… a lot of Welch's *jape* commercials… (for *'grape jam'*)

Second, the two words in the compound can be reversed (Meringer and Mayer 1895, Stemberger 1985c).

(28) (a) You were just closing the *lidboxes*. – The *boxlids*.
(b)That's a *busbike*. – I mean, a *bikebus*.

These errors implicate a processing of compounds that is vaguely syntax- like, with two positions available. Loss of a position (yielding a more frequent non-compound noun) leads to loss of the occupying noun, or to a word blend. Errors can occur in which the two nouns exchange their positions, just as errors occur in which any two nouns in a sentence are exchanged. In compound-noun reversals the stress is stranded (so that both the target and the error compounds have the same stress pattern; stress does not stay with the particular nouns, so that the stress pattern would change when the nouns exchange; the stranding of stress is also observed with true word exchanges (Stemberger 1985b). Lexical processing in compounds seems to engage some of the same mechanisms as lexical processing in general.

2 Morphology in models of language production

2.1 Rule-based models

There has been relatively little work on morphology in language production in nonconnectionist models that involves the building of explicit models. Fromkin (1971) assumed something roughly corresponding to morphology in linguistic theory, but gave few details about organization, how regularizations occur, etc. Cutler (1980) also assumes such a system, but focuses primarily on derivational affixes; she assumes that, for example, *-ity* and *-ness* are produced via rules, but that the bases to which they attach may be suppletive from the independent base word (i.e. /owpæs/ is suppletive from /owpeyk/ in *opacity*). Butterworth (1983) addresses regularizations: irregular forms and known regular forms are stored in the lexicon; if a speaker is unable to access a stored form (in error, or because the target word is a novel word), then the base form is accessed, and the regular inflectional rules of the language are applied. M. F. Garrett (1975, 1976) discusses morphology and stresses the difference between regular and irregular forms, but the details of the morphological component of the system are left unspecified. MacKay (1970, 1976, 1978, 1979) argues that rules are used for both regular and irregular forms, but provides little detail about the workings of the rule component.

Currently, the main psycholinguistic work in this area is being done by Pinker and his colleagues (Pinker 1991; Pinker and Prince 1988; Kim et al. 1991; Marcus et al. 1992,1995), with a focus on language acquisition. Although the details of the model are still being worked out, the basic outline is clear. There are two different ways in which inflected forms are processed, one path for irregulars and one for regulars.

Regular inflected forms are not stored in the lexicon at all (except at *very* early stages in language acquisition). The base form of the word is accessed. Then, the regular default rule is applied. The exact details of the rules have never been stated, but in English they are simple and concatenative (such as “add /d/ at the right edge of the base verb”). Rules are not sensitive to accidental phonological properties of the base word (though they can apply to words with only specific phonological characteristics, such as those that end in consonants).

There is a separate system to handle irregular words, set up in such a way that it has priority over the regular rule. The exact nature of this priority has not been spelled out. It could be serial priority: try the irregular system first to see if the word being processed is irregular; if it is irregular, bypass the regular system; if it isn't irregular, proceed to the regular system. It could be speed-of-processing priority: try both the regular and irregular systems, so that both a correct irregular like *chose* and the regularization *choosed are computed simultaneously, and select for production whichever pathway finishes first (a standard horse-race model); the irregular pathway would be faster for known irregular forms, so *chose* would usually win.

The irregular system is *not* one in which the irregular form is simply stored in the lexicon, either as an independent lexical entry or as a sub-entry under the base form. Instead, it is an associative network (much like a distributed connectionist model, on which see below). The reason for this is that some account must be given for hypersimilarity effects (section 1.1.1 above), and the symbolic processing model that is assumed apparently cannot compute such similarity naturally (though no details of the system are given, so this is uncertain). Because all verbs (regular or irregular) are checked for irregularity, regulars are subject to the same effects of similarity to families of irregular verbs (error rates and reaction times) as irregular forms (Daugherty and Seidenberg 1994). On occasion, an

irregularization results, when an irregular pattern generalizes incorrectly. Note that a concession is made that connectionist models are needed to account for language production, but only for the irregular forms of a language. Bybee (1985, 1995a) disagrees with this concession, and provides a mechanism for accounting for these effects within a symbolic model (based on schema theory).

The standard linguistic account of irregular forms (e.g. Kiparksy 1982a) assumes that irregular forms are also produced via rules, but the rules are lexically bound (i.e. they apply only to words that are marked to undergo them). There is one argument against this: the lexical frequency effect, whereby error rates are higher on low-frequency words. A lexical frequency effect seems easy to derive as a lexical-accessing effect if irregulars are stored in the lexicon, but seems difficult to derive if all irregulars of the same pattern are produced via the same rule. The facts seem to demand lexical storage for irregulars rather than minor rules. However, this is not necessarily the case. If a verb has a feature such as [+æ-rule), that feature will be strong in frequent words and weak in infrequent words. If the mechanism responsible for applying irregular rules has a more difficult time reading the weak feature of the low- frequency verb, then low-frequency verbs would be more likely to be regularized. A lexical frequency effect is thus compatible with a system that uses rules for irregulars, and this is still a possibility (however unpopular).

None of the (nonconnectionist) rule-based accounts have really attempted to work out in detail how morphology works in a psychological processing model, or how most of the phenomena surveyed above are derived by the model. There has been a general feeling that this would not be difficult, but no one has actually attempted to do it.

2.2 Connectionist models

Within connectionism, one can distinguish several major types of models. Although there are many dimensions involved, the major division between classes of models lies in the way that information is represented. If a concept (semantic, lexical, etc.) is represented as a *single node*, then the representations are *local*; thus the word *dog* is represented with a discrete node in the system (McClelland and Rumelhart 1981, Dell 1986, Stemberger 1985b). If a concept is represented as a *pattern of activity across a set of nodes*, however, then the representations are *distributed*; there is no single node that corresponds to the word *dog*, but only a particular pattern of activation over a set of units that are used for all words (and each word has its characteristic pattern of activation). The local/distributed distinction is not that clear; as noted below, no local connectionist model has ever been truly local. However, the distinction is correlated with another very important factor: learning. There is no explicit learning algorithm for local connectionist models, while distributed models are linked to learning algorithms (such as back propagation). The field underwent a shift in the latter half of the 1980s from local to distributed models, primarily because it was judged important to have a model of learning.

There are other major dimensions that distinguish models, however, which cut across the local versus distributed distinction. The one that I consider the most important deals with the direction of flow of information. In local models, information flows in both directions between any two connected nodes. This means that there is no strict modularity between adjacent levels (though Dell and O'Seaghdha 1991 demonstrate that functionally there is modularity between levels that are not directly connected). Lexical and phonological processing are done simultaneously and interactively, with each influencing the other; such interactions dominated the local connectionism literature. Early distributed models, by contrast, were entirely unidirectional (or *nonrecurrent*). In language production models, information flowed from semantics, through the lexicon, to the phonology, and never in the reverse direction. More recently, *recurrent* models have been developed, in which lexical and phonological processing are intermixed.

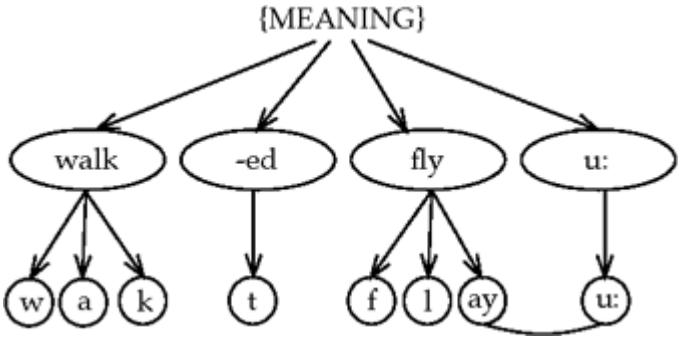

Figure 22.1 General rules within a local connectionist model.

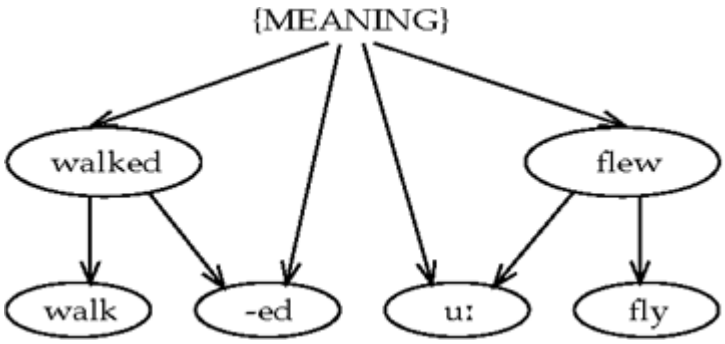

Figure 22.2 Lexically bound rules within a local connectionist model.

All varieties of connectionist models have a lot in common, and show many of the same behaviors. The current theoretical preference is for distributed models. However, in models of language production, local models are at this point more complete; their usefulness is limited primarily by the fact that there is no learning algorithm associated with them. Recurrent distributed models show many of the strengths of local models, and future morphology models will probably be of this type.

2.2.1 Local connectionist models

All lexical and phonological elements are represented as discrete nodes and are activated simultaneously. For example, the node *walk* connects to the nodes /w/, /a:/, and /k/, and /k/ connects to the nodes [Dorsal], [-voice], [-continuant], etc. There are many schemes for encoding serial order (so that the words *cat, tack*, and *act*, which have identical sets of segments in different orders, can be distinguished; Rumelhart and McClelland 1981, Dell 1986); this issue goes far beyond morphology, and I will not address it here. Within a local model, it is possible to have something corresponding to a morphological rule: there may be a node for a suffix such as *-ed* (Stemberger 1985b, Dell 1986); if this node is activated along with the node for a verb, the verb is inflected for the past tense. Stemberger (1985b) distinguishes three positions: general rules (with nodes for affixes activated only by semantic/syntactic information, see figure 22.1), lexically bound rules (with the affix activated both by semantic/syntactic information and by lexical items, see figure 22.2), and non-rule-based representations (where inflected forms are just stored as words; *walk* and *walked* are separate nodes, as are *tree* and *sky*, see figure 22.3). In theory, the three positions can be distinguished, but in practice, this is difficult, because they predict many of the same phenomena. Irregular patterns are lexically bound and cannot appear freely with just any word. This rules out only the general-rule approach. Regular patterns could in theory be instantiated in any of the three ways.

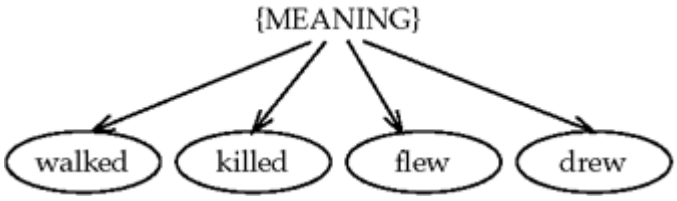

Figure 22.3 A rule-less local connectionist model.

In local connectionist models, co-activated items reinforce each other. A co-|activated base verb reinforces the syntactic slot with which it is associated, and thus indirectly reinforces any rule that is based on that slot. In the case of a lexically bound rule, the base verb also directly reinforces the rule. The amount of activation that a node passes is correlated with the frequency of the node: low-frequency nodes pass less activation than high-frequency nodes. Consequently, low-frequency elements provide less activation for all other connected nodes in the system, putting all other nodes at greater risk for error. Stemberger and MacWhinney (1986a) and Dell (1990) report that low-frequency words are more likely to undergo phonological speech errors than high- frequency words. This explains why low-frequency verbs (whether regular or irregular) are more prone to morphological errors: regularizations, base form errors, and overtensing errors (sections 1.1.1, 1.2.1, 1.3.2). Lexical frequency effects are compatible with any of the ways to store inflected forms.

If the system uses rules, generalization of patterns is easy to derive. The most frequent rule will tend to be accessed with most verbs, especially if it is not lexically bound. The less frequent (irregular) rules tend to be suppressed by the regular rule except under those circumstances where they get the most reinforcement. The most favorable circumstances include phonological rein- forcement by groups of irregular verbs that take that rule: hence hypersimilarity effects (section 1.1.1). (Any hypersimilarity effects on regulars are swamped out by frequency effects, so it is not surprising that none have been detected.) Also favorable would be those situations where the past-tense vowel is dominant over the base vowel, so that it does not require as much activation to suppress the base vowel: the vowel-dominance effect. And phonological priming (as from the subject noun) should have an effect, positive or negative.

Local connectionist models do not require morphological rules. Inflected forms can be stored as words, parallel to any other word (fig. 22.3). The processing of known words is straightforward. Stemberger (1994b) discusses how generalization occurs via *gang effects*. Within local models, similarity between different lexical items leads to a group of partially activated nodes called a *gang*; gangs form on the basis of both semantic and phonological similarities. Via inhibition between competing lexical items, nontarget words are kept at a low level of activation, but they still contribute small amounts of activation to the phonological level. In general, nontarget words contain sounds that cover the full spectrum of the phonological space of English, and activation from nontarget words has little effect on the output; different words cancel each other out, and just raise the level of noise in the system. However, if the words in a semantically based gang are correlated phonologically, then the effects are quite different. For example, if we consider 1,000 nontarget verbs that are past-tense forms, we would find that about 850 of them end in *-ed*, with the frequency of allomorphy being /d/ > /t/ > /əd/. Hundreds of words contribute a small amount of activation to /d/. The /d/ unit sums this activation, and the result is that /d/ gets more activation than any phoneme within the target word. However, when /d/ is unlikely because it creates a consonant cluster that is impossible in English (as in **walk-d*), it attains a lesser degree of activation|, and the second most frequent past-tense pattern, /t/, wins. If neither /t/ nor /d/ is phonologically possible (as in **need-d* or **need-t*), then the third most frequent pattern, /əd/, wins. No irregular pattern has more than thirty exemplars, and so none gains enough activation to win – *unless* the irregular lexical item suppresses the regular gangs (which is usually the case in adults) or *unless* a phonologically based gang can also form, reinforcing a particular sequence of vowel + consonants that does not end in *-ed*; thus families that end in *ank* and *unk* can generalize to new forms, but only by supplementing semantic information with phonological information. The regular patterns are present in so many lexical items that phonological information is not needed for generalization; phonological effects are swamped out, and

hypersimilarity effects are not observed with regular patterns. If the target irregular verb fails to suppress the regular gang, a regularization results; failure should be greatest for low-frequency verbs, whose phonological information is least well encoded. Failures decrease if phonological effects like vowel dominance favor the past-tense form.

Gangs give the lie to the characterization of local models as "local," as opposed to "distributed." All past-tense forms are processed whenever any past-tense form is processed, and together all these forms influence the out- put. One could say that the representation of any particular past-tense form is distributed across all the past-tense-form nodes in the system. Stemberger (1994b) raises an interesting possibility. How does a learner know when to add a new word to the system? Suppose that a new word is added only when the speaker would otherwise produce the wrong output. When regular gangs reach a certain size, they automatically cause generalization, so that the correct (regular) past-tense form is produced for less-frequent and novel verbs. The speaker would reach a point where new regular past-tense forms would not be added to the system, because the right output would arise without them. The gang comes to function as a distributed rule, and like a rule, the *-ed* pattern is relatively independent of any individual lexical item.

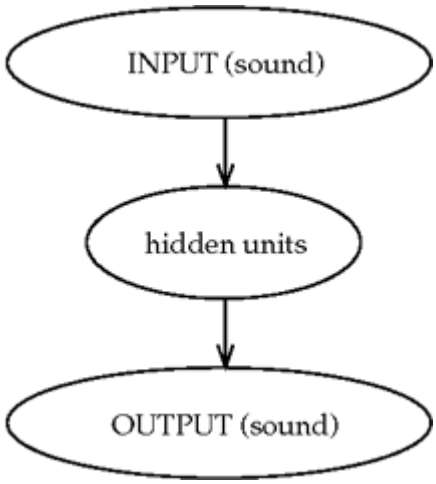

Figure 22.4 A nonrecurrent distributed connectionist model.

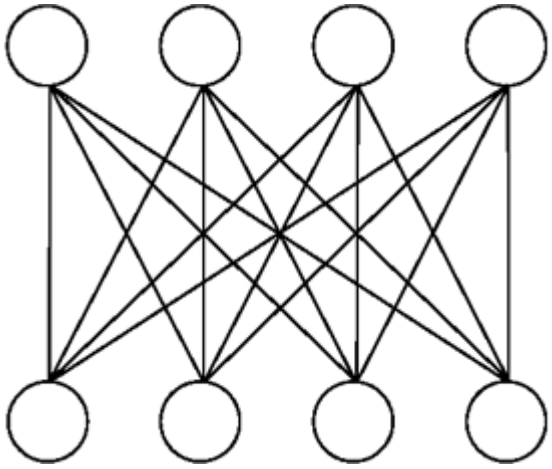

Figure 22.5 Connections between layers in a distributed model.

An important aspect of this model is the interaction between the lexical and phonological levels. Any phonological bias is predicted to affect morphology, including vowel dominance and priming. Additionally, the morphological system should tend to avoid outputs that contain less-frequent

phonological patterns. Thus, there would be a tendency to avoid consonant clusters, to out- put words with fewer syllables, to favor high-frequency phonemes, etc. In this context, it is interesting that Clahsen et al. (1992) and Marcus et al. (1995) argue that for German the regular suffixes are perfect *-t* and plural *-s*, and that this would not be predicted on the basis of frequency. Perfect *-t* and *-en* are equally frequent as perfect suffixes for the 1,000 most frequent verbs of German (tied in both type and token frequency), so (morphological) frequency cannot explain why *-t* is the regular suffix for the perfect form, and not *-en*.[4] Plural *-s* is the least frequent plural suffix in German, but, they argue, is the regular suffix. However, phonological frequency may be relevant here. It happens that *-t* and *-s* are the only overt suffixes that (in general) do not add a syllable to the word; I note below that shorter words are more frequent than longer words in German. The predictions of connectionist models are unclear when two types of frequency conflict: high morphological frequency combined with low phonological frequency, versus low morphological frequency combined with high phonological frequency. German morphology may be an instance where phonological frequency outweighs morphological frequency in terms of which pattern is preferentially generalized; see below.

2.2.2 Distributed connectionist models I: nonrecurrent networks

A typical nonrecurrent net is shown in figures 22.4 and 22.5. McClelland and Rumelhart (1986) developed the first nonrecurrent distributed model of morphology. The input was a distributed representation of the base word's pronunciation (e.g. /wa:k/ *walk*, and /gow/ *go*), with all phonemes represented simultaneously. These were mapped directly onto an output representation of the pronunciation of the past-tense form (/wa:kt/, /wɛnt/); all input nodes connected to all output nodes, as in figure 22.5. Both regular and irregular forms were stored in the same set of units and connections. The advantage of this model over local models was that there was an algorithm for learning (back propagation). The model produced regularizations, and (given family resemblance) irregularizations. Regularizations predominated, because the learning algorithms of distributed models extracted the most frequent pattern as the default one.

This was a primitive model (lacking even a layer of hidden units between the input and output layers), and has been heavily criticized, for example, by Pinker and Prince (1988). Most of the criticisms are of non-essential details, such as (a) the nature of the phonological units (wickel features) used to encode serial order, (b) the inability to differentiate homophones, (c) the temporal structuring of the training (done in an artificial way so that a U-shaped learning curve was derived), (d) the presence of a "teacher," disagreements over whether certain types of errors occur during acquisition, and (e) "cheating" by including standard aspects of linguistic representations in the input and output, (a) More recent models have used more conventional phonological representations (MacWhinney and Leinbach 1990, Plunkett and Marchman 1991, Hare and Elman 1992, Daugherty and Seidenberg 1994), and have derived similar results, (b) MacWhinney and Leinbach include semantic information, and have found that this allows the system to differentiate homophones (such as *ring - rang* vs. *wring - wrung* vs. *ring - ringed*) without compromising the system's ability to generalize patterns on a phonological basis. Marcus et al. (1995) have criticized the fact that MacWhinney and Leinbach used only a handful of semantic features, but this is a non-essential aspect of the model, deriving from limitations on the size of simulations; Marcus et al. admitted that the homophone problem can be solved in this way. (c) The artificial and incorrect way that Rumelhart and McClelland (1986) derived U-shaped learning is not a concern, because it now appears that U-shaped learning of the sort that had been assumed is unattested in children's acquisition of morphology (Marcus et al. 1992). (d) The "teacher" that told the system whether the output was correct or incorrect has been criticized, because children rarely get overt correction from adults. This is a misunderstanding of the nature of the "teacher," which is simply another cognitive subsystem, possibly the comprehension system. *All* models require some subsystem that can recognize that an error has occurred, (e) Although Pinker and Prince protested against outputs like *membled* as the past-tense form of *mail*, it should be noted that young children often pronounce words in ways that are quite different from adults (e.g. Priestly 1977, in which a child pronounced words such as *panda* /panda/ as [pajan], and *dragon* /drægən/ as [dajak]), and all theories of acquisition probably predict that child forms like [mɛmbəld] for adult /meyld/ are possible.[5] This criticism is not based on any theory of language or of acquisition, and seems to lead to a position that would be unable to account for normal language acquisition. As a result, it cannot be taken as a failing of connectionist theories. (f) Connectionist models often make the same assumptions about representations as linguistically based models. This is not a problem if

we accept that all approaches to cognition have something of value to offer. It is no more "cheating" to include such analyses in connectionist models than it is to include them in symbolic models.

Current arguments about the feasibility of connectionist models concentrate on three issues: the lack of hypersimilarity effects for regular patterns, the role of semantics in determining whether a verb form is regular or irregular, and whether it must always be the most frequent morphological pattern that is the regular one. (a) As with non-rule-based local models, the most frequent pattern tends to generalize so readily that it is difficult to detect effects of factors like hypersimilarity or even lexical frequency (Daugherty and Seidenberg 1994). (b) The role of semantics is unclear. Kim et al. (1991) and Marcus et al. (1995) have maintained that semantic effects are irrelevant, and that symbolic rule-based deletion of features for irregularity (as when a verb is nominalized and then subsequently changed back into a verb, or when an irregular noun is made into a proper noun) are unaffected by how similar the resulting form is semantically to the regular verb or noun. They also maintain that meta- phorical and semantic extensions of verbs and nouns always preserve the irregularity of the word. However, extensions of words always involve close semantic similarity, whereas denominal and deverbal verbs are usually more distant semantically. Kim et al. and Marcus et al. actually show that their predictions are incorrect: the probability that a denominal verb will be irregular is linearly correlated with the semantic similarity of the denominal verb to the prototypical usage of the homophonous verb. Thus, sink 'to put in a sink' (which has no semantic similarity to the usual verb *sink* 'to go down') has regular past *sinked*, but *fly* 'to hit a fly ball' (which is more similar to the usual verb *fly*, almost 'to cause a ball to fly high') has two equally acceptable past- tense forms, regular *flied* and irregular *flew*. The role of semantics is far from clear. And while it is possible to make the effects of semantics indirect (as in Kim et al.'s and Marcus et al.'s models, where they arise only during the process of learning lexical items), it remains possible that semantics has a direct effect.[6] (c) As noted above in the discussion of local models, it is an oversimplification to focus just on the frequency of the morphological pattern, ignoring the frequency of the phonological patterns that result. In some cases, a less frequent morphological pattern may be preferred because it creates the most frequent phonological pattern. When different measures of frequency conflict, predictions are not clear, for any connectionist model.

In relation to this last point, it should be noted that many nonrecurrent models (e.g. Rumelhart and McClelland 1986) do not predict that general phonological frequency in the language will affect morphological patterns. The reason is that such models have a special dedicated network, the sole purpose of which is to create past-tense forms. Such a network will pick up on statistical properties of past-tense forms only. If, however, the network produces all words (singular nouns, plural nouns, possessive nouns, infinitives, present-tense forms, past-tense forms, progressive forms, adjectives, adverbs, etc.), then the statistics for all words will matter, not just the statistics of pasttense forms. In all probability, models cannot have subnetworks dedicated to particular morphological patterns. However, nonrecurrent networks do not require dedicated subnetworks (MacWhinney and Leinbach 1991), and so are still viable candidates for describing morphology in human languages.

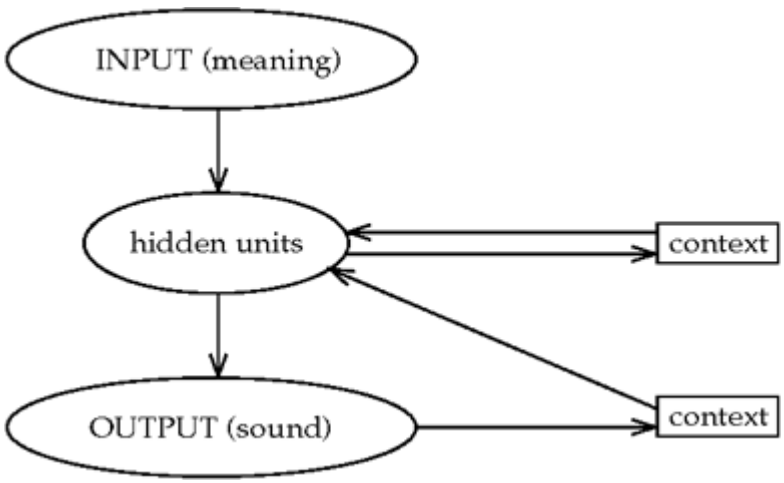

Figure 22.6 A recurrent distributed connectionist model.

2.2.3 Distributed connectionist models II: recurrent networks

Recent connectionist models are most often recurrent in nature: they contain loops that allow multiple passes through the system, with each pass corresponding to a phoneme (in models that generate the phonological output of words). Only a few models of morphology have been recurrent (e.g. Corina 1991), but this is likely to change. The basic structure of such a system is illustrated in figure 22.6 with the model of Dell et al. (1993), which was designed to address phonological processing; the model takes meaning as input and gives phonological features as output.[7] Each word is a pattern of activity across the meaning feature nodes and a pattern of activity across the phonological feature nodes, and these two layers are mediated by a layer of hidden units that maps the input onto the output. This model has two context layers to keep track of previous outputs.

Early distributed models, like local models, output all the segments of a word simultaneously. Recurrent models output a single segment at a time. The first pass through the system outputs the first segment of the word. The pattern of activity in the hidden units is saved in an *internal context* layer. The pattern of activity in the output layer is stored in an *external context* layer. Both context layers are then input into the hidden units on the second pass through the system, along with the *same* semantic pattern that was used during the first pass. That semantic pattern, in combination with context information about what was just produced, leads to the output of the second segment of the word on the second pass; without the context layers, the first phoneme would be output again. The pattern of activation in the hidden units and output units in the second pass are stored in the context units and input through the hidden units on the third pass, resulting in the third segment of the word. This continues until the system returns a null element that corresponds to the word boundary.

This recurrent model has interesting ramifications for morphology, especially for the regular/irregular distinction. First, the system can learn statistical probabilities between meaning units and phonological segments. Thus, it learns that there is a strong statistical correlation between the meaning {past tense) and a word-final /t/, /d/, or /əd/. Second, the system extracts statistical properties of a phonological nature as well, including *phonological constraints*. This phonological information can interact with morphology in predictable ways. The difference between the three allomorphs depends on phonological information contained in the context units; it is predictable from general phonological distribution patterns on voicing and sequences ending in /t/ and /d/ that are present even before any morphology is learned by the system. The correlation between any particular semantic unit and these final segments is small, and is equal for most input patterns; thus, the system will not tend to learn that a particular verb (like *walk*) takes *-ed*, but will learn that {past tense) maps onto *-ed*. The two local models in figures 22.1 and 22.2 above resemble this model; it is most like figure 22.2, in that there is input from both the meaning unit {past tense} and the /d/ output unit, and there is a lexical-item-specific compon- ent; but it approximates figure 22.1 in that the lexical-item-specific component for -ed is small. Unlike the distributed models with dedicated subnetworks for each inflectional category, this network outputs all morphological variants of the base word, including uninflected forms. As with local models, there is no mapping from the phonology of the base onto the phonology of the past tense.

Irregulars behave quite differently. Statistically, irregulars like *sang* and *fell* contain vowels that in general do not correlate with past tense any more than any other vowel (cf. base verbs such as *crack* and *rest*), and they fail to end in the -ed which correlates very strongly with past tense. The system must learn to output a vowel different from that of the base, as well as to suppress the final *-ed*. It learns both of these by being sensitive to the co-occurrence of elements in the semantic input; thus, given the co-occurrence of {past tense} and {fall}, the output will contain the vowel /ϵ/ but not the final consonant /d/. The final /d/ will also be suppressed using phonological context; given that the vowel /ϵ/ occurred with this semantic input, the system suppresses the final /d/, and outputs just /fϵl/.

Consider what happens when the system attempts to output the past tense of the word *fall*. The meaning maps onto /f / in the first pass. In the second pass, in combination with the context units, the meaning of (fall) could map over onto either /a:/ (*fall, falls, falling, fallen*) or /ϵ/ (*fell*). Given that {past tense} is present, /ϵ/ will usually be accessed, but consider what happens if /a:/ is erroneously

accessed. This will alter the information in the context units. This will not affect the phoneme accessed on the third pass, since /1/ appears in all forms of the word. However, the altered feedback makes the system less able to suppress the /d/ that is activated in the word-general meaning-form mapping. If this word-general mapping is weak, as in early speech, a base form error (*fall*) will usually result. If this mapping is strong, as later in learning, then the /d/ will not be suppressed, and a full regularization (*failed*) will usually result. Which output results depends on two things: the strength of the word-specific suppression of /d/ and the strength of the word-general mapping to /d/. In adults, the word-specific suppression is better learned, and base form errors are relatively more likely than they are in later child speech.

This system is capable of generalizing morphological patterns, whether inflectional or derivational, whether regular or irregular, using a single pathway. In fact, the system does not need to know that there are rules.[8] All that is necessary is the learning of particular lexical items, something that is present in all models of language.

This model is sensitive to a variety of factors, including the frequency of a pattern, but also including phonological factors. Marcus et al. (1995) have recently argued that connectionist models are inherently wrong, because frequency is irrelevant to the generalization of inflectional patterns in German. In fact, their own data require some frequency sensitivity (since Clahsen et al. 1992 are forced to normalize the competing noun-plural affixes for frequency in order to account for how affixes generalize in the speech of children with language disorders), but show that there are additional factors. Recurrent models, like local nets, intermix lexical and phonological processing, and do not pre- dict that morphological frequency is the *only* factor that affects processing, just that frequency is *one* factor. For German, it appears that there is a preference for patterns that keep words short. Regular perfect -t and irregular perfect -en are about equally frequent as morphological markers of the perfect form, but *-t* generalizes preferentially because it leads to words with fewer syllables. Similarly, noun-plural *-s* generalizes more than expected when compared to the more frequent suffixes *-en*, *-er*, and *-e*, because those other suffixes add a syllable to the word and *-s* does not. The preference for shorter words may be based on frequency; Zipf (1935) reports that 49.8 percent of word tokens in German are monosyllabic, 22.9 percent are disyllabic, 12.9 percent are trisyllabic, and only 8.4 percent are longer. Frequency may be important here, but not the frequency of the morphological pattern.

This recurrent system is basically driven by meaning-sound mappings, just like the local model discussed above. It avoids the problems with the Rumelhart and McClelland model raised by Pinker and Prince (1988), Pinker (1991), Marcus et al. (1992, 1995), and Clahsen et al. (1992), in the same way that local models do. There is no basis for the claim that data from language production (whether of adults or of children) require the use of discrete inflectional rules and show that connectionist models (which lack such rules) are wrong in principle. Further, by highlighting the interactions of different sources of knowledge, connectionist models are inherently more likely to provide a non-arbitrary, non- stipulated *explanation* of why the facts are the way they are. Pinker's model requires us to accept that all the basic properties of morphology are random, due to the capricious nature of the genes that by chance have become a part of the human genetic endowment that controls the acquisition of language (e.g. Pinker 1991). One would hope that there is a more interesting reason for the basic properties of morphology than that.

3 Summary and conclusions

I have reviewed the types of morphological errors observed in language production in normal adults. Many of these phenomena derive from the way that syntax constrains morphology, and I did not dwell on them in the section of the chapter on models, since none of the models have addressed the syntaxmorphology interface. But many phenomena concern the way that particular morphological patterns generalize, and all models have focused on that. Recent debates have focused on lexical frequency effects, semantic effects, and phonological effects of various types. We looked at three types of connectionist model: local, distributed nonrecurrent, and distributed recurrent. All can, in principle, handle the data that are currently known. However, extant non- recurrent models have included dedicated subnetworks for inflected forms, and seem unable to handle phonological priming effects from nouns to verbs. Local models have the drawback of lacking an explicit algorithm for

learning, putting them at a disadvantage relative to distributed models (though symbolic models suffer from the same problem).

Connectionism is still a young field. Models, especially ones that have actually been implemented, are still quite primitive, and have addressed relatively small sub-areas of any cognitive domain. This is a reflection of the short timespan in which connectionist models have been addressing these questions, and of the great complexity of interactions in these models, rather than a limitation of the models per se. Basic issues concerning the organization of these models are still being worked out. Models will be in a state of flux for many years to come. Morphology is being addressed more and more frequently, both in modeling and in following up empirical predictions of models. Future models will focus even more on lexicon-phonology interactions. Whether they will ultimately be able to account for all the known facts without morphological rules remains to be seen. But any facts that ultimately derail this endeavor will be subtle in nature, and have yet to be found.

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1 Note that the verb is plural *are*, and does not accommodate to *is*.

2 The four irregular present-tense singular forms of English (*is, has, does*, and *says*) all arguably end in the -s suffix.

3 Productivity is not the culprit here, since causative/inchoative *-en* (as in *redden*), which occurs in only a small number of words but is semantically transparent, is lost but never added.

4 The *-t* suffix is overwhelmingly more common than *-en* for less frequent verbs, but this is probably irrelevant. Young children generalize the *-t* suffix even when their lexicon is limited to the most frequent verbs.

5 All words containing a long vowel or diphthong followed by /1/ are often pronounced as two syllables by young children, and an onset is provided for the second syllable, e.g. mailed [meyiowd]. A harmonic onset is sometimes present, e.g. *piano* [pmænow]; a similar harmonic onset in *mailed* would yield [meymowd]. Other attested pronunciations in child phonology are intervocalic /m/ as [mb] and the simplification of diphthongs in closed syllables (such as before intervocalic [mb]); if we add in those two processes, *mailed* becomes [mɛmbod]. This is quite close to the "desired" output. Since no theory of phonology rules out such a pronunciation, it does not constitute a failing on Rumelhart and McClelland's model.

6 The mechanism is termed "short- circuiting." Semantic similarity leads a learner to conclude that a verb such as *fly* 'to hit a fly ball' is an extended use of the verb *fly* rather than a denominal verb based on the noun *fly* 'fly ball'. Any learner who (erroneously?) draws that conclusion will prefer the irregular past-tense form *flew*. Any learner who concludes that it is a denominal verb will prefer the regular past-tense form *flied*. Semantics has an effect only on learning in that model. It never has an effect on on-line processing of past-tense forms. However, the same predictions seem to be made whether semantics affects processing or learning. The only difference (so far untested) is the following: if semantics has a direct effect on processing, responses should be monomodal, with all speakers showing the same effect; if semantics has only an indirect effect, via learning, responses should be bimodal, reflecting the two different learning outcomes outlined above.

7 Dell's model uses two context layers. Corina (1991) used only internal context, and other models use only external context.

8 Rumelhart and McClelland (1986) make a similar claim, but their system actually needs to know that a dedicated subnetwork for each inflectional category is necessary.

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