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Morphological Structures

A dissertation submitted in partial satisfaction of the requirements for the degree Doctor of Philosophy in Linguistics

by

Tracy Georgia Thomas-Flinders

1983
The dissertation of Tracy Georgia Thomas-Flinders is approved.

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1983
This is dedicated
to the one
I love: CTF
ACKNOWLEDGEMENTS

First things first: if it weren't for my parents, I would never have had an opportunity to do anything. Beyond this, my mother instilled in me an interest in and love of language in many forms. My father, on the other hand, has lent his support to all of my harebrained schemes, not the least harebrained of which culminated in the writing of this dissertation. I want to thank them both for their continuing help and encouragement.

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Pat Keating and former committee chairman Steve Anderson, have greatly
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VITA

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ABSTRACT OF THE DISSERTATION

Morphological Structures

by

Tracy Georgia Thomas-Flinders

Doctor of Philosophy in Linguistics

University of California, Los Angeles, 1983

Professor Bruce Hayes, Chair

This dissertation investigates two problems in morphological theory: (1) the nature of complex words formed by non-affixational operations; and (2) formal differences between inflection and derivation. Data from a variety of languages (e.g., Scottish Gaelic, Maricopa, English, Pula, Chaha, Navajo) are examined, and it is argued that a number of apparently unrelated observations and generalizations follow from a theory of morphology in which word-internal properties are expressed by a distinct level of structural representation which contrasts with a level of surface representation that expresses those properties of words relevant to sentence grammar.

The first chapter considers the hypothesis that words formed by affixation have certain syntactic properties best described by inserting morphemes into phrase-structure-like (word) trees. It is demonstrated in detail that words formed by simultaneous means (e.g.,
internal vowel change, consonant mutation, palatalization, infixation) have the same syntactic properties as affixed words—a significant, but previously unexpressed, generalization about the structure of complex words. By distinguishing between syntactic properties and the rules that express particular sound-meaning relations, a theory of word syntax is developed in which the class of possible words is constrained by one set of criteria, thus capturing this generalization. Formal differences between affixes and non-affixational operations proposed in the literature are evaluated and found to have empirical difficulties or to be dependent on theory-particular definitions.

Constraints on possible word structure rules—those rules that create these purely structural representations—are proposed in the second chapter. In particular, it is argued that there are two rule schemata, one for inflectional structures and one for derivational structures. It is argued that a number of well-documented differences between derivation and inflection are actually differences in the formal properties of these rule schemata. The claim made by these schemata that inflectional operations follow derivational operations is examined in detail; several counterproposals and possible counterexamples are investigated. It is argued that the counterproposals are not sufficiently restrictive and that putative counterexamples to this strict ordering hypothesis fail for a variety of reasons.

Further, it is demonstrated that a theory in which (a) morphological structures are distinct from surface representations and (b) inflectional structures are distinct from derivational structures provides an insightful account of inflectional operations that do not
meet traditional criteria for being morphemes. A formal distinction is drawn between operations that support the notion of substitution classes and those that do not.

Combined with the account of derivation rules developed in the theory of Lexical Phonology, this theory presents a more constrained view of the class of possible complex words and the class of possible sentence-level rules, while resolving several problems of long standing, previously viewed as problems with the definition of the morpheme or as problems with developing a coherent view of internal word structure.
Chapter 1:

The structural level of morphological representation

1.0 Preliminaries. Recent work in formal morphological theory (e.g., Kiparsky, 1982; Selkirk, 1982; Williams, 1981) supports two distinct, even contradictory hypotheses:

A Complex words have significant internal structure.

B This internal structure is irrelevant to sentence grammar.

Consider a very simple case: it is a significant observation about the word undrinkable that it contains three "components" or units, each of which can combine with other units only in very specific ways. This can, it has been argued (Williams, 1981; Selkirk, 1982), be described by assigning internal constituent structure of a certain type to complex words in English. This fact and associated generalizations, however, seem to be relevant only to the description of (English) morphology. The syntactic component seems not to care whether a complex or simplex adjective is inserted into a phrase structure tree; and, there are no syntactic rules sensitive to this distinction. Similarly, the fact that un- has scope over drinkable is important for semantic interpretation at the word level, but does not affect interpretation at sentence level. And, the identification of these three components and their combinatory restrictions is central to the derivation of the correct surface form of undrinkable. However, only the segmental string
is relevant to the operation of the post-syntactic phonological component.

The goal of this thesis is to demonstrate that both aspects of complex words can be represented in an adequate theory of grammar by distinguishing two levels of morphological representation. In particular, it will be argued that the description of words requires a distinct, highly constrained level of representation expressing all and only the syntactic properties of words. This entails the existence of another level, one that expresses the word's surface properties—those that are relevant to the description of sentence grammar. By carefully formulating the principles that hold on each level, the class of possible grammars may be restricted to (1) those in which only morphological rules (no rule of syntax, semantics, or post-syntactic phonology) can refer to the internal structure of words; and (2) those in which every complex word meets a unique set of structural criteria.

This chapter has the following form. It begins with a review of the kind of data that suggest the existence of significant internal structure in words, concentrating on parallels with the internal structure of sentences. The hypothesis presented in Selkirk (1982), Williams (1981), and Lieber (1980) is that these parallels are best captured by using phrase structure-like rules for their description. However, the particular structural representations developed there are also intended to account for most of the details of the surface forms of words. It will be shown that this excludes a large class of complex words from the domain of the description, even though their purely structural properties are identical. We will illustrate at length the existence of the same set of properties in complex words formed by
structural properties are identical. We will illustrate at length the existence of the same set of properties in complex words formed by affixation and in those formed by other phonological changes in the string: infixation, internal vowel and consonant change, reduplication, and combinations of these. The solution we propose is to restrict the description of morphological internal structure to all and only syntactic properties, thus capturing this generalization.

Successfully motivating a purely structural level of representation necessitates the justification of another level of morphological representation, one that describes the sentence-grammar-relevant properties of words. If there are indeed two levels of representation, then we expect to them to have distinct properties. The indifference shown by sentence grammar to purely structural information indicates that, in fact, this surface level of representation does have different characteristics; in particular, it has no internal structure. We will show that this result is confirmed by work in the theory of Lexical Phonology (Kiparsky, 1982), in which it is argued that morphologically relevant internal structure is not accessible to sentence grammar.

1.1 The syntactic properties of words. At one point in the development of modern linguistic theory, the structure of words provided the central line of inquiry; the nature of sentence structure was strictly a peripheral question. In Zellig Harris' 1946 paper, "From morpheme to utterance," it is suggested that one of the basic techniques of morphological analysis (substitution) could be profitably extended to

3
the analysis of sentences. Harris indicates that, by enlarging the
domain of substitution to include sequences of morphemes, the task of
writing syntactic analyses based on strictly formal criteria would
become much easier. Indeed,

The paucity of explicit methods in this work has made
syntactic analysis a tedious and often largely intuitive
task ...  

[Harris, 1946]

It seemed then that the appropriate techniques for analyzing
sentences could simply be extrapolated from those used for
morphological analysis.

Since the appearance of Chomsky's Syntactic Structures, however,
the role of morphology vis à vis syntax has changed substantially.
Subsumed for a time under phonology, morphology has reappeared in
recent years as a distinct subfield. But now it appears that it is the
investigation of morphological structures which may benefit from
applying some of the techniques used in syntactic analysis.

This is the line of investigation to be pursued here. The
"syntactic" (i.e., syntax-like) properties of words will be examined,
focusing on the properties of morphologically complex words that are
not formed by the linear concatenation of morphemes. It will be argued
that there is a single theory of morphological structure that
characterizes the syntactic properties of words, whether or not they
are derived by stringing together chunks of phonological material.
There is a certain degree of abstraction involved in correlating these
structures with the surface structure forms of words not created by
concatenation; however, it will be argued that this abstractness is well motivated in light of the generalizations captured.

There are striking parallels between word structure and sentence structure. Words, like sentences, may consist of a limited number of units subject to ordering and combinatorial requirements. So, for example, unhealthy can be segmented into three parts which must be combined in certain ways. The possible strings *unhealth and *uny are ruled out because they do not meet the restrictions on combination for words in English. These restrictions are superficially similar to restrictions on the combinatorial possibilities for words themselves. Just as there are only two correct combinations of the elements un, health, and y (unhealthy and healthy), there are only two correct combinations of the words the, healthy, and dog: the healthy dog and the dog, but not *the healthy or *healthy dog.

The units which are combined to form sentences are typically analyzed as belonging to a limited class of syntactic categories, or substitution classes (Harris, 1946; Wells, 1947). For example, the sentence The small dog sleeps quietly may be broken up into a sequence of words from the classes DETERMINER, ADJECTIVE, NOUN, VERB, ADVERB. Other members of these classes may be substituted to form an infinite variety of sentences with the same basic structure\(^1\); e.g.,

(1) That healthy dog sleeps quietly.

The brown dog sleeps quietly.

The healthy child sleeps quietly.
The healthy dog plays quietly.
The healthy dog sleeps soundly.

Similarly, words may be analysed as consisting of forms from a limited number of substitution classes; e.g., undigested can be parsed into the units un, digest, and ed, where digest belongs to the categorial substitution class V, ed to a class of suffixes which can combine with Vs to form members of the adjective class, and un to a class of prefixes which attach to A. The combinatorial restrictions on the members of these classes are typically more stringent than those holding for sentential substitution classes. Still, it is possible to do the same kind of substitution of other items within the same class:

(2) un-digest-ed un-digest-ed un-digest-ed
    re-digest-ed un-relate-ed un-digest-able

Forms can be assigned to substitution classes in inflected words in the same way. Just as healthy and brown may be assigned to the same class because of their interchangeability in the structure DET_____NOUN, the German forms -e, -er, -en, and -em can be classed together because they can all occur in the structure ADJ____; e.g.,

(3) gut-e Mann (masculine nominative singular)
gut-er Mann (masculine genitive singular)
gut-en Mann (masculine accusative singular)
gut-em Mann (masculine dative singular)
Thus, {-e, -er, -en, -em} form a subcategorial substitution class that marks number/gender/case when combined with members of the adjectival categorial class.

Syntactic phrases are also characterized by having heads which determine the syntactic category of the phrase and which may be subcategorized for certain kinds of complements. Verb phrases, for example, are headed by verbs; and, verbs are lexically specified for the number of complements they may take, what kind of complement, whether or not an NP complement may be sentential, and what kind of complementizers a sentential complement may bear.

Words seem to have heads in this sense as well. Williams (1981) takes the position that the right-hand member of a word is its head. Thus, in words like readable, it is the constituent able that indicates the categorial status of readable. In addition, -able may only be combined with a subset of the members of this substitution class. It must be subcategorized so that it is added only to transitive verbs (cf. *seemable, *beable).

These heads of words may also be subcategorized for a purely idiosyncratic subset of the members of the classes it combines with; Williams notes, for example, that the past tense ending in English cannot combine with verbs whose stems are ablauted; e.g., *sanged, *understood. Similarly, the German past tense marker /te/ is subcategorized to combine only with the weak verbs; e.g., machte, but *sehte. Data of this type, then, support the idea that words, like sentences, are headed.
Finally, the internal structure of words, like that of sentences, may make some contribution to the semantic interpretation of the word. In English, for instance, there are three ways in which structure contributes to the interpretation of sentences: word order, category assignment, and hierarchical relations. So, the sentence \textit{The dog bit the man} means something quite different from \textit{The man bit the dog}. Similarly, \textit{Visiting relatives can be boring} has two possible interpretations, depending on the category that \textit{visiting} is assigned (gerund or adjective). Phrases like \textit{smart girls and boys} can be disambiguated by assigning internal hierarchical structure. The by-now familiar observation that there are facts about sentences beyond the parsing of the phonological string that contribute to semantic interpretation comes from data like these.

Similar phenomena occur in derivationally complex words. In languages like Maricopa [Yuman], in which quantification of various kinds may be expressed derivationally, the order of the suffixes contributes to the meaning:

\begin{align*}
(4) \quad \text{wal´-? - axam-ma- xot´-k} & \quad \text{"I really didn´t hit him"} \\
& \quad \text{neg 1-S hit neg very aspect}
\end{align*}

\begin{align*}
(w)\text{al´-? - axam-xot´-ma- k} & \quad \text{"I didn´t really hit him"} \\
& \quad \text{neg 1-S hit very neg aspect (=hit him hard)}
\end{align*}

[from Gordon, 1980]
The same type of distinction occurs in certain transitive verbs in Sierra Miwok (Freeland, 1951). In some cases, the same suffixes may indicate person/number agreement with the subject or with the object. The order of the suffixes indicates which argument has which features.\(^3\)

\[(5)\] nakáp'¬e — te'— ni? "You (sg) followed me"

follow recent-past 1sg-o 2sg-s

nakáp'¬e — ni'— te? "I followed you"

follow recent-past 2sg-o 1sg-s

[Lengthening of the object marker's vowel is predictable.]

Other agreement markers which are identifiable with the right argument only by virtue of their order include:

\[(6)\] tokni'¬te 2 pl object/1 sg subject

te'¬tokni 1 sg object/2 pl subject

me'¬ni 1 pl object/2 sg subject

ni'¬me 2 sg object/1 pl subject

Further, the internal structure of words is relevant to their interpretation. unhappier, for example, means "more unhappy", not "not more happy". This fact can be indicated by assigning unhappier an internal constituent structure in which -er has scope over a
constituent consisting of un- and happy. (Proposals in Williams, 1981, Pesetsky, 1979, 1983, Allen, 1978, Selkirk, 1982, and Lieber, 1980 concern the account of this kind of information in word structure.) It is primarily on the basis of data like this that the notion of word-internal structure plays a role in morphological theory.

There is also evidence that internal structure plays a role in disambiguating complex words, along the lines of the smart girls and boys example from sentence syntax. That is, one surface structure may have two (or more) structural descriptions. In Basque, for example, the sequence /ote/ can be analyzed as (1) a sequence of two affixes in which /o/ indicates agreement with a third singular dative argument and /te/ agrees with a second or third person plural subject; or (2) a single affix /ote/, showing agreement with a third plural dative argument (Allièrès, 1979; Lafitte, 1962).

(7)

\[ \text{zioten} = z - i - o - te - n \quad "\text{They had it for him}" \]

\[
\begin{array}{l}
3-S \quad \text{root} \quad 3sg-Dat \quad 3pl-S \quad \text{past} \\
\end{array}
\]

\[ z - i - ote - n \quad "\text{He had it for them}" \]

\[
\begin{array}{l}
3sg-S \quad \text{root} \quad 3pl-Dat \quad \text{past} \\
\end{array}
\]
zinioten = z - ini - o - te - n  "You (pl) had it for him"
2-S root 3sg-Dat 2pl-S past

z - ini - ote - n  "You (sg) had it for them"
2-S root 3pl-Dat past

The difference in meaning can be expressed by assigning two distinct "syntactic" structures to these forms.

It is properties of this type that have led to proposals in which the syntax of words is described in a way analogous to that of the syntax of sentences (see, for example, Selkirk, 1982; Williams, 1981; Lieber, 1980). For example, on this view, unhealthy might have the following internal structure.

(8)

```
  A
 / \ 
A   
/ \   
un health y
```

The tree in (8) shows (1) the substitution classes that un, health, and y represent, (2) their correct linear order, (3) the head of the construction (-y), and (4) the hierarchical arrangement that yields the information that unhealthy means "not healthy", that it is not the adjectival form of a noun *unhealth.

It is an explicit claim in Selkirk (1982), Williams (1981) and Lieber (1980) that these trees only represent words formed in a
particular way. On this view, trees with empty nodes are generated and then matched up with items from the lexicon: root morphemes and affix morphemes. These "match-up" theories of word syntax account for the structure of unhealthy, but not the structure of, for example, clung. Morphological operations not representable as conventional lexical items (e.g., umlaut, ablaut, lenition, palatalization, reduplication) are expressed by means of rules; words formed by the application of these rules do not, on this view, have "syntactic" structures. Match-up theories, then, distinguish two (or more) kinds of morphological system, both across languages and within the same grammar. The morphological representation used in these theories accounts not only for purely syntactic properties, but also for crucial aspects of the surface forms of certain words.

In Williams' theory of word syntax, for example, the following word structure rules generate the trees into which roots and affixes are inserted:

(9)  \[
\begin{align*}
\text{root} & \rightarrow \text{af root, root af} \\
\text{stem} & \rightarrow \text{root} \\
\text{stem} & \rightarrow \text{af stem, stem af} \\
\text{word} & \rightarrow \text{stem} \\
\text{word} & \rightarrow \text{word word}
\end{align*}
\]

"Headless rules" relate forms like the following:
(10)  breath ~ breathe
       life ~ live
       bath ~ bathes

Thus, this view of word syntax makes the claim that only words formed by affixation have (1) heads and (2) internal hierarchical structure, as expressed in word structure trees. The nature of headless rules is not elaborated, so it is difficult to tell exactly what properties they do have.

In contrast, Lieber (1980) argues that only one context-free re-write rule is necessary for the description of affixed words. Node labelling is performed by a series of conventions for assigning features to nodes. The operation of non-affixational or "string dependent" rules is independent of the procedure in which lexical items are inserted into trees. In 1.4, putative differences between the two kinds of operations, as argued for by Lieber, will be evaluated in detail.

Selkirk (1982) offers another theory of word syntax based on the notion of lexical items inserted into freely generated word trees. Derived words are described by rules of the form in (11).

(11)  derivation:  (1)  X ~→ γ^af X
       X ~→ Y X^af
(2)  X ~→ X^root
(3)  X^root ~→ γ^af X^root
       X^root ~→ γ^root X^af
Again, the claim is made that there is a fundamental distinction between words formed by juxtaposing chunks of phonological material and those formed by altering the internal segmental content of the root or stem. Syntactic properties are ascribed only to words of the former class.

Match-up theories of word syntax, then, lead us to expect significant formal differences to be correlated with the distinction in phonological marking of tense in German and Gaelch, as indicated in (12).

(12) a. German \textit{mach-st} "you (sg) make"
\textit{mach-te-st} "you (sg) made"

b. Gaelch \textit{bual} [buəl] "you (sg) strike"
\textit{bhual} [vuəl] "you (sg) struck"

In German, past tense is indicated by the affixation of \textit{te}, while in Gaelch, it is shown by lenition of the initial consonant, where lenition is a cover term for several phonological changes, including spirantization. The description of the structure of words like those in (12b) falls outside the domain of match-up theories of word syntax, since lenition is not segmentable.

It is the description of these words—those derived by non-sequential or "simultaneous" means—that interests us. "Simultaneous" will be used here as a cover term for all morphological
operations that fall outside the domain of match-up theories: stem
internal vowel changes (e.g., umlaut, ablaut, lengthening, shortening),
stem–internal consonant changes (e.g., lenition, nasalization,
labialization, palatalization), infixation, intercalation, metathesis,
deletion, reduplication. Affixation, then, refers exclusively to
prefixes and suffixes whose phonological form does not depend primarily
on the phonological form of what they are attached to. In this chapter,
a number of cases involving simultaneous operations will be examined
and answers to the following questions sought:

(1) Do simultaneously inflected and derived words have syntactic
properties? Are there, for example, substitution classes
whose members are combined in specific ways to represent
certain aspects of meaning?

(2) What would a theory look like that accounts for these
properties? In what ways would a theory of simultaneously
formed words differ from theories of sequentially formed
words?

In what follows, we will demonstrate that non-sequentially formed
words do have significant "syntactic" structure; we will then develop a
theory of word syntax to handle these cases, as well as affixationally
derived and inflected words. On this view of word syntax, morphological
structure represents purely syntactic facts about complex words.

15
Finally, we will show how our results support and are supported by the view of word formation taken in the theory of Lexical Phonology (Kiparsky, 1982).

1.2 The syntax of simultaneously inflected and derived words. In this section, several kinds of words inflected simultaneously (and some derived simultaneously) will be examined and their characteristics compared with those of affixed words, as pointed out in 1.1. This leads to the conclusion that, in fact, these properties are shared by all complex words and that a theory of word syntax that treats these cases as distinct misses a significant generalization.

1.2.1 Substitution classes in simultaneously inflected words. In this section, we will demonstrate that simultaneously inflected words, like sequentially inflected ones, are formed by combining operations associated with distinct substitution classes. Substitution classes can be determined in the same way, they have the same function as in affixed words, and they are equally manipulable by native speakers. These data seriously undermine the case for match-up theories of word syntax which differentiate words on the basis of their phonological make-up, implying some concomitant distinction in syntactic properties.

Consider a typical affix-based example: the strong declension of German adjectives in the masculine singular.
(13) gut-er "good (nominative)"
gut-en "good (accusative)"
gut-em "good (dative)"
gut-en "good (genitive)"

Here, number, case, and gender are all expressed by a set of interchangeable phonological markers. The features indicating these inflectional categories can be grouped together into a single substitution class. These are the sole indicators of these categories in adjectives, and there does not seem to be any principled way to segment these markers into smaller units corresponding to more than one substitution class.

Compare this situation with that in Gaelic, which also has agreement marking on adjectives. (There is, though, no distinction between strong and weak declensions.) In Gaelic, masculine singular adjectives are unmarked in the nominative/accusative and dative. In the genitive, however, the initial consonant is lenited, and the final consonant is palatalized. Plural masculine adjectives are marked by the suffixation of a schwa if they are monosyllabic and a lenited initial consonant in the nominative/accusative and dative.

(14) singular

<table>
<thead>
<tr>
<th>Nom/Acc</th>
<th>cat mór</th>
<th>[kat mo:r]</th>
<th>&quot;a big cat&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dat</td>
<td>air cat mór</td>
<td>[e³ kat mo:r]</td>
<td>&quot;on a big cat&quot;</td>
</tr>
<tr>
<td>Gen</td>
<td>cait mhóir</td>
<td>[kɛt' vo:i³]</td>
<td>&quot;of a big cat&quot;</td>
</tr>
</tbody>
</table>
plural

Nom/Acc cait mhóra \[k\epsilon \mathord{\text{t}}\, \text{vo:ra}\] "big cats"
Dat air cait mhóra \[e\theta\, k\epsilon \mathord{\text{t}}\, \text{vo:ra}\] "on big cats"
Gen chat móra \[x\epsilon\, m\epsilon\, r\epsilon\] "of big cats"

As in German, number, case, and gender are phonologically marked together. There is no interesting way to break up the marking of, say, the genitive adjective into meaningful bits. In addition, these words, like the German adjectives, are analyzable into two components: (1) a class of simple or complex stems, and (2) a class of morphological operations that mark gender, number, and case. And, these operations are interchangeable in the same way that the set of suffixes for German adjectives are interchangeable. The same set of features is associated with substitutable operations in the feminine and in the plural. On the basis of these facts, then, we may conclude that, in both Gaelic and German adjectives, number, case, and gender features constitute a single substitution class. But, only in German does this substitution class correspond to the traditional notion of "position class"—a consistent location within a morphologically complex word that is filled by morphemes from the same substitution class.

It is the phonological changes correlated with the German and Gaelic substitution classes that are quite different; one set consists of only suffixes, while the other includes a suffix and two simultaneous operations. It seems appropriate, then, that the
descriptions differ in their phonological aspects, since it is the phonology that distinguishes these cases. It is the statements of how certain combinations of the features in these classes correlate with changes in phonological strings that express the fact that German adjectives are suffixed, while Gaelic ones are suffixed, lenited, and/or palatalized. Any other difference in their description implies the existence of correlated differences for which there is no evidence. (But see 1.4 for a discussion of proposed distinctions.) There seem to be no significant ways in which the semantic or syntactic properties of German adjectives differ from Gaelic ones.

If this analysis of the internal structure of German adjectives is correct, then we expect German speakers to be able to isolate the markers associated with the substitution class for gender/number/case and associate them with all adjectives including newly coined or borrowed ones, demonstrating their knowledge of the components that make up this kind of morphologically complex word. Similarly, we expect Gaelic speakers to be able to analyze words into a root or stem and the lenition, palatalization, and suffixation rules and to perform these operations in all relevant contexts. And, in fact, words borrowed from English do undergo these processes, indicating that speakers are not just memorizing individual words, but constructing generalizations.

In illustration of this point, consider the ways in which nouns are marked for gender/number/case in Gaelic:
(15) Nom /laːr/ "floor" (lər)
    Acc /laːr/
    Dat /laːr/
    Gen /laːθ/

Like the adjectives, nouns may be lenited, palatalized, and suffixed. And, nouns borrowed from English are subject to the same inflectional operations:

(16) collar
    Nom kəlar
    Acc kəlar
    Dat xəlar
    Gen kəlaθ

In fact, nouns and verbs borrowed from English are, in general, subject to the many morphological and phonological uses of (for example) lenition, as the following examples illustrate:

(17) [ɾəsidigʰ] ride-ig "to ride"
    [ʰpəwgiʃ ɾəsidigʰ] briogais ride-ig "riding pants"

    [meːnləNd] mainland "mainland"
    [xənə veːnləNd] chun a´mhmainland "to the mainland"
In this regard, Lewis and Pedersen (1937) note that borrowings into Celtic languages are often taken as lenited forms; e.g., Modern Irish taisteal "hackle" comes from the English hatchel; the Welsh mantais "advantage" from English vantage; Scots Gaelic sainnseal "handsel" from English handsel. In Colloquial Modern Welsh, /ɬ/ in borrowed words is sometimes lenited, on analogy with the spirantization aspect of lenition, to /ʃ/; e.g., /dain/ "chain" and /ʃain/ "the chain".

In view of this evidence that speakers of Celtic languages can analyze, isolate, and manipulate simultaneous operations as morphological entities, we conclude that determining the inflectional substitution classes of a language does not depend on the segmentability of the phonological string and its parsability into discrete segments or strings of segments. Instead, these classes may be
identified on the basis of (1) the grouping together of morphological features and (2) the mutual exclusivity of those features and their associated phonological marking, without regard to the particular form that marking may take.

This result is reinforced by the existence of morphological systems in which the same inflectional category is marked by affixation or some word-internal change, depending on the identity of the stem. Those words formed by simultaneous and mixed markings do not exhibit distinctions from each other or from affixationally formed words. Again, the differences among these markings seem to be exclusively phonological; the markings are phonologically distinct manifestations of the same substitution class.

In Maricopa, plural subject agreement takes a variety of forms, depending on the verb. Although most verbs are marked by the infixation of u:, suffixes and internal vowel changes (in quantity and/or quality) may occur alone, together, or simultaneously with the infix, as indicated below.
As far as we can determine, however, nothing follows from these differences in plural marking. All of the verbs receive the same interpretation with respect to this feature. Other agreement and non-agreement morphology proceeds without reference to the shape of the plural form. Their syntactic distribution is identical.

Of course, we don’t have to look so far afield to make this point. English has a similar array of examples: went, hid, kept, clung, rang, wrote, read, brought, were, and walked all have the same semantic, syntactic, and morphological properties. Their distinctive phonological properties are irrelevant except to the generation of their proper phonetic forms. The generalizations in these two cases are that in English, past is marked inflectionally on verbs and in Maricopa, agreement with plural subjects is inflectionally marked on verbs. Each language uses a variety of phonological means for indicating these inflectional categories, according to the verbs themselves.

Our conclusion, then, is that speakers know at least these three things about the inflectional systems of their language: (1) the inventory of categories; (2) the substitution classes these categories
form; and (3) the phonological markings associated with values for the features. We will see in the following sections that simultaneous inflectional operations are associated with substitution classes in a wide variety of languages.

What is significant here is that this is not what we are led to expect from theories that assign these syntactic properties only to words inflected sequentially. But it would follow from a theory of word syntax in which the structure of inflected words is indicated by phonological properties in general: their distribution with respect to the inflectional categories of the language, not specific kinds of phonological change.

1.2.2 The ordering properties of simultaneously inflected words. However, it is not sufficient to demonstrate that delineation of substitution classes is independent of the kind of phonology used to mark it. Match-up theories of word syntax also account for the ordering of affixes with respect to each other, as well as with respect to the root itself; that is, their word structure trees account for this aspect of the surface forms of these words in addition to their syntactic properties. If simultaneously inflected words share this property—crucial ordering restrictions—then we expect to find cases in which two or more non-affixational processes are ordered with respect to each other (and cases in which non-affixational and affixational processes are ordered). The data presented in this section support this prediction. By demonstrating another parallel between words formed by sequential and simultaneous means, we will further
support our hypothesis that words have morphological structures that should be described by a single theory.

Cases of this type are relatively rare, compared to cases where affixes must be strictly ordered. There are two reasons why this should be true. The first follows from the nature of the rules themselves, from their string dependency. This means that the structural descriptions of such rules may be sufficiently detailed so as to insure their correct ordering or simply their correct application in spite of the effects of other rules applying. For example, initial consonant mutation and final consonant palatalization in Gaelic have structural descriptions that permit them to be unordered; e.g., \( C \rightarrow C' / X \) ___ vs. \( C \rightarrow C_{\text{Lenited}} / X \). But, suffixes and prefixes often have very general structural descriptions; e.g., \( X \rightarrow XY \) and \( X \rightarrow YX \). When two or more rules of the same type are applied, some independent provision must be made to ensure that "X" has the right shape.

The other reason has to do with the difference between rule-governed morphological relations and suppletion (un-rule-governable morphological relations). In general, affixation per se produces minimal distortion of the string, typically influencing only the segments at the edges of the morphemes; e.g., president suffixed by \(-y\) requires a change in the shape of the /t/, but the rest of the word is left unaffected. In contrast, simultaneous operations by definition affect the shape of the root or stem. Applying more than one of these may distort the root so much that the distinction between phonologically related forms and suppletive ones will get fuzzy. The nature of the rules themselves, then, predicts that only a limited
number of such operations will apply to any one form; in contrast, affixation constantly provides new phonological material to be operated on. We would predict that simultaneous operations, like sequential ones, tend to affect different or "new" parts of the word, rather than the same part over and over.

Notice, though, the central role played by the notion "rule-governed" in determining whether a form is suppletive or related by non-affixational means. A non-speaker of Gaelic might have some difficulty in determining the status of morphological relatedness in forms like these:

(19)

a. call [kauL] "to lose" [xail'] "lost"
cumail [kǔal] "to hold" [xǐum] "held"
tilleadh [t'īl'īy] "to turn" [heil'] "turned"
pronnadh [prōnāy] "to harrow" [frōun] "harrowed"
b. dol [dɔl] "to go" [xaj] "went"
tighinn [t'īn] "to come" [hā:nig'] "came"
radha [gray] "to say" [hu:Rd] "said"

But the native speaker, on the basis of evidence from other forms, would have no difficulty. The phonological changes in (19a) are quite common; those in (19b) are specific to each word (cf. bring/brought).

With this caveat, let us examine some cases in which crucial ordering of non-affixational rules seems well motivated.
1.2.2.1 The crucial ordering of non-affixational processes. One case that involves only simultaneous operations comes from German. German strong verbs are characterized by internal vowel change in the past indicative and in the past subjunctive.

<table>
<thead>
<tr>
<th>present</th>
<th>past indicative</th>
<th>past subjunctive</th>
</tr>
</thead>
<tbody>
<tr>
<td>trag-</td>
<td>trug-</td>
<td>trüg-</td>
</tr>
<tr>
<td>komm-</td>
<td>kam-</td>
<td>küm-</td>
</tr>
<tr>
<td>sitz-</td>
<td>sass-</td>
<td>süss-</td>
</tr>
<tr>
<td>verlier-</td>
<td>verlor-</td>
<td>verlör-</td>
</tr>
</tbody>
</table>

The past subjunctive forms are rather easily derivable from the past forms, but not so easily from the (presumably) underlying present forms. The typical description in pedagogical grammars is that the a, o, and u of the past tense forms are umlauted in the past subjunctive of strong verbs.

This suggests that the rule(s) deriving past indicative from the present tense form need to be ordered before the rule(s) deriving past subjunctive; e.g., trag → trug → trüg, *trüg. In other words, it looks as if one non-sequential rule must be crucially ordered before another, exactly the case we are looking for. If, as we are claiming, there are only phonological distinctions among inflectional markings, not significant structural differences, these are the kind of data we would expect to find in languages with more than one simultaneous process. To the extent that this is a well motivated analysis of German strong verbs, our hypothesis finds support here.
Another case of this type comes from Chaha [Semitic]. According to McCarthy (1983a, b), there are several non-affixational processes in Chaha, including palatalization, labialization, and reduplication. For example, agreement with second person feminine singular subjects is indicated in imperative verbs by the palatalization of final consonants; e.g.,

(21) \( w\dot{\text{a}t}\dot{\text{a}}q \) \( w\dot{\text{a}t}\dot{\text{a}}q^y \) "fall"
    \( f\acute{\text{a}r}\acute{\text{a}x} \) \( f\acute{\text{a}r}\acute{\text{a}x}^y \) "be patient"

And, in the perfective, the right-most labializable consonant (b, p, f, g, k, x, q) is labialized if the verb has a third person masculine singular object.

(22) \( d\acute{\text{a}n}\acute{\text{a}g} \) \( d\acute{\text{a}n}\acute{\text{a}g}^w \) "hit"
    \( n\acute{\text{k}}\acute{\text{a}x} \) \( n\acute{\text{k}}\acute{\text{a}x}^w \) "bite"
    \( q\acute{\text{a}t}\acute{\text{a}r} \) \( q\acute{\text{a}t}\acute{\text{a}r}^w \) "kill"

Both processes operate in impersonal verbs.

(23) \begin{tabular}{ll}
     personal & impersonal \\
     \( k\acute{\text{a}f}\acute{\text{a}t} \) & \( k\acute{\text{a}f}\acute{\text{a}t}^y \) "open" \\
     \( n\acute{\text{k}}\acute{\text{a}x} \) & \( n\acute{\text{k}}\acute{\text{a}x}^y \) "bite" \\
     \( q\acute{\text{a}t}\acute{\text{a}r} \) & \( q\acute{\text{a}t}\acute{\text{a}r}^y \) "kill" \\
     \( n\acute{\text{k}}\acute{\text{a}b} \) & \( n\acute{\text{k}}\acute{\text{a}b}^w \) "find"
\end{tabular}
Crucial evidence that these rules must be ordered in the case of the impersonals, with labialization applying first, comes from the following forms, in which velars or uvulars are the final consonants. These are the only consonants in Chaha that can be either labialized or palatalized; the others may be only palatalized (d,t,t,z,s), only labialized (b,p,f), or neither (n,r,y). [These forms involve triliteral roots associated with CVVCVCV skeleton, so $C_3=C_4$, including the property of being labialized or palatalized.]

(24) personal impersonal

a. $g\text{\u0103}zd\text{\u0103}$  $g^\text{\u0103}zd^\text{\u0103}$  "cut in big pieces"

b. $m\text{\u0103}q^\text{\u0103}$  $m\text{\u0103}q^\text{\u0103}$  "scratch in a straight line"

\* $m\text{\u0103}q^\text{\u0103}q^\text{\u0103}$

c. $b\text{\u0103}g^\text{\u0103}$  $b\text{\u0103}g^\text{\u0103}$  "be startled"

\* $b\text{\u0103}g^\text{\u0103}g^\text{\u0103}$

As in the examples in (23), both final consonant palatalization and rightmost labialization apply in these impersonals. Thus, in (24a), the palatalizable consonant /d/ become /d\text{\u0103}/ and the rightmost labializable consonant /g/ becomes /g\text{\u0103}/. It is the forms in (24b) and (24c) that show that labialization must apply first. /q/ and /g/ are both labializable and palatalizable, but the correct forms have /q\text{\u0103}/ and /g\text{\u0103}/, not /q\text{\u0103}/ or /g\text{\u0103}/. Rightmost labialization must be ordered before final palatalization in the impersonal forms in order to get this result. Language-particular redundancy rules ensure that no segment is both palatalized and labialized.
This is further evidence that non-affixational operations may be subject to strict ordering requirements in the same way that affixational operations may be. To describe the past subjunctive of strong verbs in German, it seems to be necessary to derive a past indicative form through stem alternation before subjecting the verb to another stem alternation associated with past subjunctive. In this case, two simultaneous processes operate on the same segmental material. In Chaha, on the other hand, two non-affixational processes must be ordered, although they can only apply to distinct segments. These data indicate that ordering is part of the syntax of words formed by simultaneous phonological changes as well as those formed by sequential modification.

Another case of this type comes from Fula (Arnott, 1970), whose verbal morphology is characterized by several simultaneous processes, including initial consonant mutation and reduplication. Iterative reduplication, for example, involves the addition to the root of /i/, followed by a second occurrence of the root, suffixed with /in/ and tense markers; e.g.,

(25) ʻo - som - i - som - in - ii  < som  "be tired"
     "he kept on being tired"

     ʻo - war - i - war - in - ii  < war  "come"
     "he kept on coming"

Alternations in the form of root-initial consonants occur when the root is changed by the addition of certain prefixes; e.g,
(26)  `o - war - ii      "he came"
    be - ngar - ii     "they came"
    `o - dill - ii     "he went away"
    be - ndill - ii    "they went away"

The following iterative forms show that the change in the
root-initial consonant must take place before root reduplication:

(27)  `o - som - i - som - in - ii
    but be - shom - i - shom - in - ii *be - shomisominii
        "They kept on being tired"

    `o - war - i - war - in - ii
    but be - ngar - i - ngar - in - ii *be - ngariwarinii
        "They kept on coming"

1.2.2.2 **Mixing sequential and simultaneous inflectional processes.** A
further prediction made by a unified theory of morphological structure
is that sequential and simultaneous inflectional operations can be
crucially ordered with respect to each other. Two cases of this type
arise in the description of Gaelic verbs. The data suggest that certain
string dependent rules need to be ordered before certain affixational
rules.

In the future tense, verbs in Gaelic take a suffix, [ə] or [i],
depending on the following segment. Certain verb stems, however,
undergo a phonological change (depalatalization of stem-final
consonants) correlated with the meaning "future".

(28)  

<table>
<thead>
<tr>
<th></th>
<th>stem</th>
<th>future</th>
</tr>
</thead>
<tbody>
<tr>
<td>fagail &quot;to leave&quot;</td>
<td>[faːɡ] ~ [faːki]</td>
<td></td>
</tr>
<tr>
<td>scuabadh &quot;to sweep&quot;</td>
<td>[skuːb] ~ [skuapi]</td>
<td></td>
</tr>
<tr>
<td>seideadh &quot;to blow&quot;</td>
<td>[seidʰ] ~ [seitʰi]</td>
<td></td>
</tr>
<tr>
<td>tuigheail &quot;to understand&quot;</td>
<td>[tuːɡʰ] ~ [twkʰi]</td>
<td></td>
</tr>
<tr>
<td>cromadh &quot;to stoop&quot;</td>
<td>[krom] ~ [kromʰi]</td>
<td></td>
</tr>
<tr>
<td>diol &quot;to pay&quot;</td>
<td>[dʰiːl] ~ [dʰiLi]</td>
<td></td>
</tr>
</tbody>
</table>

There are two possible accounts of this data: one in which devoicing in the stem-final consonant takes place first, followed by suffixation and one in which the rules are unordered, with the devoicing rule's structural description appropriately more complex:

(29)  

\[ X \ C (/i/) \rightarrow 1 2 3 ]^{n +future}_{\text{[-voiced]}} \]

where \( n = \text{fag, scuab, seid, tuigbh, crom, diol, ...} \)

The unordered account seems to be able to generate the correct output, but this kind of solution requires more complex rules and misses the point. It is the feature "future" that triggers devoicing; a rule of the type in (29) suggests that the phonological shape of the stem is somehow relevant. Further, we would expect the rule not to apply, if the ending changed to zero, on the unordered analysis; on the ordering account, devoicing would still apply. Similarly, if a suffix added more segments for some reason, (e.g., if the conditional's
person/number suffixes were extended to this domain) we would expect either (1) the rule's application to be blocked or (2) a significant change in the rule's structural description. Again, the ordering account predicts that such information is irrelevant to the operation of this rule. We know of no other evidence from Gaelic pertinent to these predictions, but the claims of the two analyses are clear.

Another case of this type arises in Chimwi:ai [Bantu]. Here, a perfective form of the verb requires two operations: (1) a suffix /i:z/ and (2) mutation of the stem-final consonant (Kenstowicz and Kisseberth, 1979). Like lenition and palatalization in Gaelic, "mutation" is a cover term for several phonological changes: (a) labial, dental, and alveolar stops become /s/; (b) /k/ becomes /ʑ/; (c) voiced stops change to /z/, if preceded by a nasal; and (d) /ʑ/ becomes /z/. The combination of mutation and suffixation produces forms like the following:

(30)  

<table>
<thead>
<tr>
<th></th>
<th>infinitive</th>
<th>perfective</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>x-kul-a</td>
<td>kus-il-e</td>
</tr>
<tr>
<td>b.</td>
<td>x-shi:k-a</td>
<td>shi:sh-il-e</td>
</tr>
<tr>
<td>c.</td>
<td>x-shi:nd-a</td>
<td>shi:nz-il-e</td>
</tr>
</tbody>
</table>

Given just these forms, there is no reason to think that mutation and suffixation need be crucially ordered. It is their interaction with a third rule that indicates that affixing must be done before the consonant change.
The rule in question changes the /l/ in the suffix to /z/, just in case the verb stem ends in /s,z,s,ž/:

(31) a. bus-i:z-e "he kissed"
    b. uz-i:z-e "he sold"
    c. faň-i:z-e "he did"
    d. uš-i:z-e "he hid (it)"

The contrast between the form of the suffix in (30a) and the form in (31a) indicate that the /l/ → /z/ rule applies only after unmuted consonants. If it were allowed to apply freely, this rule would produce the incorrect form *kus-iz-e. If, however, suffixation of /i:l/ and, crucially, the /l/ → /z/ rule, apply prior to consonant mutation, the correct forms are derived:

(32) /bus/ "kiss" /kuţ/ "fold"
suff. busi:k kuţi:k
l→z busi:z ---
mut. --- kusi:k
other busi:ze kusiže

A third case comes from Gaelic nominal inflection. The most common marking for noun plurals is the suffix /ən/. Many of these nouns (including some English borrowings) also undergo a rule that palatalizes the stem-final consonant (and, idiosyncratically, other segments in the stem-final syllable); e.g.,
(33) \textit{lāmh} \quad /\textit{Laːv}/ \quad "axe"

\textit{lāmbadh} \quad /\textit{Laːvəjən}/ \quad "axes"

\textit{sugar} \quad /\textit{Šuːkəɾ}/ \quad "sugar, a sweet"

\textit{sugaran} \quad /\textit{Šuːkaɾən}/ \quad "sugars, sweets"

Again, there seem to be two ways to describe these data: one with
and one without crucial ordering of suffixation and palatalization.

On the ordering analysis, the application of the palatalization
rule precedes that of the more general suffixation rule; the rules may
be stated in maximally simple form; roughly,

(34) a. \textit{XC} \rightarrow \textit{XC} \ 1\ a\ N\ \textsc{pl}

\quad +\textsc{p}

b. \textit{X} \rightarrow \textit{Xən} \ N \textsc{pl}

This derives the correct forms, and, in fact, this ordering
(special before general) may be predictable (see Kiparsky, 1982).

However, these rules need not be ordered, if their structural
descriptions are made appropriately complex; e.g.,

(35) \textit{X} \rightarrow \textit{Xən} \ N \textsc{pl}

\textit{XC} (\textsc{\-an}/) \rightarrow \ 1\ 2\ 3\ \textsc{\-n}\ N\ \textsc{pl}

1\ 2\ 3\ \textsc{\+p}

35

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The specific segments must be mentioned, so that stems ending in /ən/ will palatalize; e.g., /ɛsgəN/ \(\rightarrow\) /ɛsgiMən/ "eels". But this account must be further complicated in those dialects of Scots Gaelic (including the standard dialect) that do not differentiate between /N/ and /n/. In this case, the /ən/ in the rule must be identified as "N pl", in order to prevent the derivation of */ɛg'ən/ as the plural of "eel".

(36) \[ X \subset (/ən/_{N \, pl}) \rightarrow 1 \ 2 \ 3 \ ] N \, pl \\
1 \ 2 \ 3 \quad +p

This seems to be an undesirable complication in the rule whose purpose is transparently to avoid crucial ordering.

Thus, it seems that we have cases in which (1) a simultaneous rule must be ordered with respect to other rules, just like certain sequential rules must be; (2) a simultaneous rule must be ordered after the operation of a sequential rule; and (3) a simultaneous rule must be ordered before a sequential rule. This constitutes evidence, then, for our claim that phonological markings of both kinds have the same general formal properties, including ordering restrictions.

1.2.3 Headedness and simultaneously formed words. Another syntactic property that seems to characterize words as well as sentences is the notion of a head. As noted above, heads determine the syntactic category of phrases and words and have subcategorizational requirements. If morphologically complex words formed by
non-affixational processes have the same kind of syntactic properties as those formed by affixation, then we expect these words, too, to have identifiable heads. In fact, there is evidence that words derived by all phonological means are headed.

Leaving aside for the moment the issue of how to determine heads uniquely, it is possible to consider whether or not non-affixational processes have the two major properties attributed to heads: (1) category determination and (2) subcategorization frames. These will be considered in turn.

1.2.3.1 Category determination. One of the ways in which verbal nouns are derived in Gaelic involves the depalatalization of the final consonant (often accompanied by some internal vowel change in the stem-final syllable).

(37) amais [amiʃ] "aim" amas [amɔs] "aiming"
caidil [katˈil] "sleep" cadal [katʃl] "sleeping"
caill [kalˈ] "lose" call [kauʃ] "losing"
caraich [karɨʃ] "mend" caradh [karaχ] "mending"

Depalatalization is the head of these words; i.e., the category determiner. That is, it is the application of that rule which changes the category from verb to noun.

A similar case arises in American Sign Language. Although it has been claimed that there is no principled distinction between nouns and verbs in ASL, recent work by Newport (1982) and Newport and Supalla
(1980) indicates that, in fact, there are nouns which are derived from verbs by altering the manner in which the sign is made; e.g., the verb _fly_ is interpreted as the noun _airplane_ when the sign for _fly_ is performed in the nominal fashion: with sharper, quicker hand motions and a quick return to the original position. Again, although there is no question here of linear ordering, it is felt by native speakers that it is the verb sign that is being altered and made into a noun. The composition of the complex sign proposed by Newport suggests that the nominal manner of signing is the category determiner\(^\text{10}\).

1.2.3.2 **Subcategorization: ordering.** As described in the literature (Selkirk, 1982; Williams, 1981; Lieber, 1980), the subcategorization properties of affixes include not only category selection, but linear ordering (i.e., indication of the properties already marked on the stem to be selected) and idiosyncratic selection (some subset of the otherwise eligible members of the category or subcategory). In match-up theories of word syntax, only affixes (or affixes and roots) can have subcategorization properties; however, we have already presented evidence that non-affixational processes may have strict ordering restrictions. They may specify the point in the derivation of morphologically complex words at which they can apply. For example, it appears that the umlaut rule that produces past subjunctive strong verbs in German takes past indicative strong verbs as input. Similarly, iterative verb formation in Fula requires previously marked verbs showing subject agreement.
1.2.3.3 Subcategorization: diacritics. In this section, we will give several examples of cases in which simultaneous processes select some arbitrary subset of input forms.

There are basically two kinds of diacritics. The first involves cases like grammatical gender; the members of some syntactic category are arbitrarily divided into classes for the purposes of the operation of several rules. Diacritics like +masculine and +feminine can be used to signal the operation or attachment of more than one affix to the members of these classes.

Palatalization in Gaelic nouns makes crucial reference to this kind of diacritic. Nouns are divided into two classes, masculine and feminine; the rules for indicating number and case are sensitive to this distinction. In particular, certain final consonants are palatalized in the dative singular of feminine nouns, but not in the dative singular of masculine nouns.

\[
\begin{array}{llll}
\text{Feminine nominative/dative} & \text{Masculine nominative/dative} \\
\text{brog} & [\text{brɔːg}] & [\text{brɔːg}'] & \text{"boot"} & \text{trosg} & [\text{trɔːsg}] & \text{"codfish"} \\
glas & [\text{gLaːs}] & [\text{gLaːs}] & \text{"lock"} & \text{bas} & [\text{baːs}] & \text{"death"} \\
clach & [\text{kLaːx}] & [\text{kLaːx}] & \text{"stone"} & \text{balach} & [\text{baLɔːx}] & \text{"boy"} \\
muc & [\text{muk}] & [\text{muk}'] & \text{"pig"} & \text{mac} & [\text{mak}] & \text{"son"} \\
slat & [\text{sLæt}] & [\text{sLæt}'] & \text{"rod"} & \text{cat} & [\text{kat}] & \text{"kat"} \\
grian & [\text{gɔːn}'] & [\text{gɔːn}'] & \text{"sun"} & \text{dun} & [\text{duːn}] & \text{"heap"} \\
\end{array}
\]

Although these palatalized consonants are the historical remnant of suffixes beginning with high front vowels, palatalization in the
synchronic grammar takes place in borrowed words as well, for which no historical account is available:

(39)  a chollair  [ø xɔlaʁ]  "his collar" (gen sg)
cf.  collar  [kɔlar]  "collar"

puist  [puʃd̪ʼ]  "postman (gen sg)"
cf.  post  [pɔsd̪]  "postman (nom/dat sg)"

puind  [paind̪ʼ]  "pounds"
cf.  pound  [pʌnð]  "pound"

Rules for deriving the genitive singulars and for indicating case and number in adjectives also refer to the classes of nouns identified here as masculine and feminine.

German strong and weak verbs constitute another example of this type. The umlaut rules that derive the past indicative and past subjunctive forms of the strong verbs are non-affixational rules that must make crucial reference to a subset of verbs.

The second kind of use that diacritic features may be put to involves cases in which a single rule picks out an arbitrary subset; these are normally called simply irregular rules. Again, non-affixational rules pick out these subsets, just as affixes do. In English, for example, the rules that perform internal vowel changes in irregular noun plurals apply only to a few of the nouns fitting the morphological and phonological structural description:
(40)  mouse/mice    *house/hice
      goose/geese    *moose/meese
      man/men       *pan/pen, *fan/fen
      tooth/teeth   *booth/beeth

Thus, both affixes and non-affixational rules may have subcategorization requirements. And, both can determine the syntactic category of the word. This suggests that the property of being headed is not restricted to words formed by affixation; instead, it appears that morphologically complex words in general have heads.

1.2.4 Contributions to meaning. As indicated in 1.1, affixed words may have internal structures that contribute to their semantic interpretation. For example, the order of the agreement suffixes in Sierra Miwok indicates which argument—subject or object—each agreement marker corresponds to. And, internal structure can differentiate two or more possible analyses of forms that have identical phonological structures; e.g., the Basque verb zioten has two possible meanings. The /te/ suffix can indicate a third plural subject, or it can be part of the suffix /ote/ which indicates agreement with a third plural dative argument.

Here, evidence will be presented that the structure of simultaneously inflected words makes the same kind of contribution to meaning. This provides further support for the idea that all morphologically complex words have significant internal structure.
We know of no cases in which the order of application of simultaneous rules indicates a meaning difference. However, there are instances in which apparently identical forms can be distinguished by their morphological structural properties.

For example, in Gaelic, some verbs and verbal nouns have the same form, leading to ambiguous cases. The form [g\'li\'asi] can be analyzed in two ways: first, as the verbal noun "grinding" in the genitive singular (with the ending /i/) occurring in attribution to a feminine noun (thus, with a lenited initial consonant), as in [k\'Lax\'g\'li\'asi], "grind stone". Or, it could represent the first person plural form of the conditional verb [g\'li\'as\'iy], "to grind". Here, the /i/ is the 1 pl suffix and the lenited initial consonant, the marker for conditional; e.g., [g\'li\'asi \'sin\'i] "if we grind".

The same kind of problem arises with the unlenited form [g\'li\'asi]. This can be interpreted as the genitive singular of the verbal noun in attribution to a non-leniting masculine noun, or as the third person form of the future tense verb. The internal structure of these two words distinguishes them:

\[(41) \quad [[g\'li\'as]_{v}^{y}, i]_{N} \quad \text{genitive sing masc}\]

\[[g\'li\'as]_{v}^{y}, i]_{\text{future}, 3rd \text{ person}}\]

The segmental string [g\'li\'asi] is not bracketable in the same way as [[g\'li\'as]i]; the change from /g/ to /g\'/ does not lend itself to isolation within brackets in the way that the addition of /i/ does.
Still, the identification of the different operations with distinct meanings disambiguates in the same way. That is, at the level of morphological (not phonological) structure, simultaneously inflected words can be disambiguated by reference to their structural properties.

This evidence supports the hypothesis that all kinds of inflected words may have aspects of meaning indicated by their morphological structure. This seems to hold whether or not the morphological components of the word are parsable into linearly concatenated strings of phonological material.

1.2.5 Conclusion. Detailed examination of the properties of morphologically complex words formed by non-sequential means yields an unexpected result: it appears that these words have syntax-like properties of the same type that sequentially inflected words have. They have heads, they are formed from the (perhaps strictly ordered) combination of members of substitution classes, and their morphological structure can contribute to their semantic interpretation. In the next section, a proposal for accounting for these properties will be presented.

1.3 The structural level of morphological representation. The next question we want to consider is what kind of theory best describes the structural properties of simultaneously inflected and derived words pointed out in 1.2. Match-up theories of morphological structure are concerned with the syntactic properties of words made up of chunks of phonological material that can be aligned or matched up with the

\[43\]
terminal nodes of tree structures, (as sketched briefly in 1.1) and
with accounting at the same time for certain aspects of the surface
representation of these words as well. In this section, we will present
the details of one of these theories and its application to
inflectional structures of that type. Then, we will argue that this
same theory can be used to describe simultaneously inflected words,
simply by (1) liberating the theory from its reliance on these
typologically limited characteristics of the surface form of the word
and (2) distinguishing between the internal structure of a word and its
sentence-grammar-relevant form. Without this dependence, tree
structures are free to represent generalizations about internal
structure for words formed by the full range of possible phonological
operations. The existence of the same syntactic properties in all kinds
of morphologically complex words, then, can be captured by a single
theory of morphological structure. Then, we will briefly sketch how
this can be extended to the description of derivation. This distinct
level of structural representation will be explored further in chapter
2.

1.3.1 Selkirk's model of inflectional structure. In Selkirk (1982), a
comprehensive theory of word syntax is presented. On this view of
inflection, a set of word structure rules generate tree structures that
specify (1) the inflectional categories, (2) substitution classes, and
(3) crucial ordering properties of language-particular grammatical
systems, as revealed in the surface forms of inflected words.
In Selkirk’s analysis, a set of context-free word structure rules generate all and only the possible trees for inflected words formed by affixation. Substitution classes are represented by associating each $X^{af}$ with a (set of) feature(s). Linear order is expressed by the order of the $X^{af}$'s in each expansion. Non-affix X's receive a superscript which identifies them as word ($X^{0}$), stem ($X^{-1}$), or root ($X^{-2}$), each of which is a recursive category. Tree structures in general meet the requirements of X' theory, with one exception: no maximal projections are allowed to occur on the right side of a rule.

This arrangement of the grammar's inventory of inflectional features accounts for position class phenomena. For example, a rule like the following specifies that the full range of person/number/tense markings has the same structural relation to the stem.

\[(42) \, v^n \rightarrow v^{n-1} \, z^{af}\]

\[
\begin{align*}
\text{m plural} \\
\text{m person} \\
\text{m tense} \\
\end{align*}
\]

[where m(arked) = +, -, or an integer]

In general, affixes correlated with the same set of features do have the same subcategorization properties. This fact is lost (as Selkirk points out) in theories in which subcategorizational information of this type is expressed separately for each affix, as in Lieber (1980) and Williams (1981).

This view of the syntax of inflected words accounts for the properties of the hypothetical systems that Selkirk discusses and seems
to be appropriate for the description of real language systems with the same characteristics: substitution classes that are always associated with chunks of phonological material ordered in the same way (for all possible feature values) with respect to the root or stem and any other substitution class markings. Trees are generated by the word structure rules and associated with lexical material by the insertion of roots/stems and affixes represented as lexical entries, matching their subcategorization requirements with the features indicated in the tree.

Consider an example from German. Past tense is indicated in weak verbs by the suffixation of /te/ before the suffixation of person/number markers; present tense is unmarked.

(43)  
mach-te-∅      "I made"
mach-te-st     "You (sg) made"
mach-te-∅      "He/she/it made"
mach-te-n      "We made"
mach-te-st     "You (pl) made"
mach-te-n      "They made"

On this basis, we might propose that tense forms a single substitution class in German, a class that is crucially ordered before the person/number substitution class. In Selkirk's system, this would be represented in the following way:
Thus, the theory of inflectional structure presented in Selkirk (1982) is intended for the description of a subset of affixational systems. But, within this narrow range, it works in the way intended. In Chapter 2, problems for this kind of account, like German mach-t ("he/she/it makes"), in which /t/ marks both tense/mood and person/number, are discussed in detail. It will be shown how these cases receive a satisfactory account within the theory being developed here.

1.3.2 Extension to non-affixed words. But, our concern here is primarily with inflected words that do not fit into this subset, not because their structural properties are exceptional, but because the words cannot be segmented and inserted under the terminal nodes of trees, as in the German case above. Although these cannot be appropriately segmented, recall from the discussion in 1.2 that these inflected forms do have syntactic properties: for example, their components are members of identifiable substitution classes, and there is a particular ordering relation among them. How can these parallels
in syntactic properties between affixed and non-affixed words be represented?

In fact, the means for doing so are already available. The only roadblock to associating tree structures of the type described above with this kind of inflected word is reliance on a particular kind of match-up relation between the phonological string and the nodes of the tree. If, instead, we distinguish between the structural properties of words and their surface or grammatically relevant properties, and consider there to be a mapping relation that maps structural representations onto surface representations, then the result we are looking for follows in a very simple way. This can be done formally by constraining the form of word structure rules in two ways: (1) by eliminating dummy elements into which morphemes are inserted as the terminal nodes; and (2) by limiting the rules to single direction branching. Where phonological changes are represented by affixes, it is technically possible to recapitulate the surface form of the word by lining up strings of segments with the terminal nodes of the word structure tree; where the changes are by non-affixational processes, it is the word as a whole whose structure is indicated by the tree. Thus, German and Gaelic adjectives, as discussed in 1.2.1, have the same internal structure: each consists of two components, a root and a morphological operation that marks number/gender/case, and together, these components form a morphologically complex word, an inflected adjective; i.e.,
(45) \[ A \rightarrow A^{-1} Y \]

number
gender
case

It is strictly the phonological manifestations of the non-root substitution class (Y) that distinguish the form of these inflected words. Their structural representations are identical and their surface forms differ only in the phonological string; e.g., guten, "good" (Adj, masc sg gen) vs. mhoir "big" (Adj, masc sg gen). The claim, then, is that the derivational history of these forms (and, thus, all complex words) is relevant only to word-level grammar; it is irrelevant to the operation of the other components of the grammar; i.e., to sentence grammar. No syntactic, semantic, or post-syntactic phonological rule needs to know, for example, that guten is formed by suffixation, while mhoir is not.

Consider a more elaborate example. Recall that in Maricopa, agreement with a plural subject is indicated by a variety of phonological changes, including sequential (a), simultaneous (b), and both sequential and simultaneous (c).
(46) a. uːseːy → ŋuːseːy
    "make someone drink"

b. ʔayuːmeːv → ʔayuːmiːv
    "work"

c. amel → aʃuːmiːl
    "wear a belt"

mše → mštuːxaːv
    "be afraid"

Our claim here is that the same inflectional structure rule will permit the correct derivation of all of these forms; all of the rules marking plural subject agreement may be applied in the same order with respect to the application of other rules inflecting verbs. For example, Maricopa verbs are also marked for subject person (a) and tense/aspect (b).

(47) a. ʔ-amel
    "I wear a belt"

u-amel
    "you wear a belt"

∅-amel
    "he/she/it wears a belt"

b. ʔ-amel-k
    "I am wearing a belt"

ʔ-amel-uum
    "I will wear a belt"

These rules must be crucially ordered after subject number agreement in the derivation of these forms in order to produce the correct linear order in those verbs that use affixation as part of their plural marking:

(48) ʔ-čuː-seːy
    1-S pl-S make-s.o.-drink
    "we made him/her drink"
m₅tu:-₇a: - v - u:m *mstu: a:u:mv
pl-S be-afraid pl-S future
"they will be afraid"

There are, of course, cases in which individual inflection rules (simultaneous or sequential) are not crucially ordered with respect to each other. For example, the plural marking of /m₅be/ to /m₅stu:₇a:v/ need not be ordered with respect to subject/object person marking, since the latter involves prefixation and the former, infixation and suffixation. But this is a property of these individual rules; as members of sets of rules, each set developing a distinct substitution class, the ordering properties of these rules do not contradict the order of substitution classes determined on the basis of other rules in the set.

A partial inflectional structure rule for these verbs might be:

(49) \( V \rightarrow V^{-1} Y Z W \)

subject subject tense
number person aspect
aggr. aggr.
(SNA) (SPA) (T/A)

The left-to-right order of the substitution classes indicates the direction of the derivation:
Thus, our inflectional structure rule correctly predicts that the application of subject number agreement rules, irrespective of the phonological operation used, never follows tense/aspect or subject person marking. The rules associated with "y" form a substitution class, even a position class \(^{13}\), if "position" is interpreted as "place in the derivation", rather than "place in the string".

Of course, in sequential morphological systems, position class may have both the literal and extended interpretations: as place in the derivation and as place in the word. To see this more clearly, consider the description of some aspects of Basque verbal morphology. As the following examples show, Basque verbs can be marked for conditional,
subject person/number, object person/number, in that order, suggesting
an inflectional structure rule of the form:

(51) $V \rightarrow V^{-1} \ Y \ Z \ W$

conditional subject object
(person/ number number
(number (SPN) (OPN))

\[ e.g., z - intzaz-ke - te - t \]

2-S root cond 2plS lsg0

$"$if you (pl) could have me"$

\[ z - intzaz-ke - te - gu \]

2-S root cond 2plS lpl0

$"$if you (pl) could have us"$

\[ g - intzaz-ke - zu \]

1plS root cond 2pl0

$"$if we could have you (pl)"$

Although these data are of the type that match-up theories of word
syntax are intended to account for (except for the discontinuous
morpheme marking 2 pl), the kind of mapping theory presented here
handles them equally well (in fact, better, as will be demonstrated in
chapter 2). And, it does so in exactly the same way that the partially
simultaneous, partially sequential system in Maricopa is handled above.
The derivations specified by the inflectional structure rule produce
the correct output forms.

(52) a. 

$$
/ \text{intzaz/} \ \text{cond} \ 2\text{pl} \ \text{lsg}
$$
These partial grammars serve to illustrate our main point: the language-particular differences between Basque and Maricopa are restricted to: (1) the choice of features and their association with positions in the inflectional structure rule(s); and (2) the choice of phonological changes and feature values in the inflectional mapping rules. That is, the difference between the simultaneous rules in Maricopa and the sequential rules in Basque (and Maricopa) is merely a difference in the phonological details of the mapping rules; it is claimed, then, that no significant distinction in syntactic properties follows from this difference, that, in fact, the syntactic properties are the same.
On this view of inflectional structure, it is easy to see why languages tolerate non-sequential rules, in spite of their relative opacity. Such words do not require a completely different kind of morphological structure; the exact same kind of structure is involved. It is the phonology associated with such words that (apparently) is somewhat more complicated to acquire. This is expressed by relative complexity in the formal statement of simultaneous operations, as opposed to affixation;

\[ \text{cf. } X \rightarrow Xd ] \text{ past and } X /l/ /\eta/ \rightarrow l /\epsilon/ 3 ] \text{ past.} \]

\[ 1 2 3 \]

Another benefit of this view of inflectional structure is that we need not posit distinct inflectional structures for cases like German weak verbs, marked by affixes in the past tense (e.g., machte < mach) and strong verbs, marked by stem alternation (e.g., sah < seh). On this view, the distinction is a phonological one; only one kind of internal structure need be proposed (and learned).

The same holds true for English irregular and regular noun plurals and past tense verbs. Apparently, children acquiring English first learn words inflected in both ways in unanalyzed form. Then, the appropriate morphological analysis (= the structural representation) is made in the case of the affixed forms. The generalization is typically extended to non-affixed forms, producing the incorrect *mouses, *goed, and so on. Finally, the correct phonological correlates in the irregular forms are isolated and *mouses and *goed are reduced to occasional speech errors.

In addition, this view of morphological structure offers an interesting solution to a long-standing morphological problem: how to
ascertain the number of morphemes in inflected forms. The difficulty arises when inflectional features are (1) not overtly marked, (2) untypically marked together, or (3) marked more than once. The actual account of cases like these will be discussed in chapter 2. But notice that inflectional structures suggest a particular formal view of morpheme counting: simply put, the number of morphemes is equal to the number of components in the structural representation. For example, in English, verbs are only overtly marked in the past tense and in third singular present. This indicates a structural representation of the form:

\[(53) \quad v \rightarrow v^{-1} \ x\]

<table>
<thead>
<tr>
<th>person</th>
</tr>
</thead>
<tbody>
<tr>
<td>number</td>
</tr>
<tr>
<td>tense</td>
</tr>
</tbody>
</table>

Structurally, then, inflected verbs in English are bi-morphemic, and this holds no matter how many or how few mapping rules apply. This view eliminates the temptation to postulate zero morphemes or zero marking in order to capture this generalization in the case of those forms that are not phonologically distinct from untensed verbs. In chapter 2, we will present cases in which more than one mapping rule refers to the same feature(s); there, the number of phonological changes may exceed the number of structural components. Again, reference to the components in the structural representation will produce a unified account of the number of morphemes in inflected words.
within the same paradigm. As will be detailed there, this notion of an independent structural representation addresses this central problem in the theory of inflection (see Matthews, 1974 for detailed discussion; also see Anderson, 1977 and the papers in Thomas-Flinders, 1981) and offers a very appealing and simple solution.

1.3.3 Derivational structures. The account of the inflectional structural level of representation for inflected words can easily be extended to the description of derived words. (The exact formulation of the rules generating morphological structures of both types will be taken up in chapter 2.) Derivational structures, too, can be limited to the analysis of purely syntactic properties, while surface representations are generated by the interaction of mapping rules and a structural representation.

On this view, Gaelic verbal nouns (a) (repeated here for convenience) have the structural representation in (b) (where $V^{-1}$ may have internal structure).

(54) a. amais [amiː] "aim" amas [aməs] "aiming"  
caidil [katˈil] "sleep" cadal [katəl] "sleeping"  
caill [kaɪl] "lose" call [kaɪl] "losing"  
caraich [kariç] "mend" caradh [karəx] "mending"
A mapping rule that converts verbal stems to nominal stems will associate this structure with the surface representation of a particular word; e.g., a representation which lacks internal structure (but not information) of the type given in (b).

Notice that the structure in (b) also describes the surface forms in (55), which are generated by distinct mapping rules.

(55) crathadh [krahɔy] < [krah] "making"
lubadh [Luːbɔy] < [Luːb] "bending"
sgriobhadh [sgɔiː:vɔy] < [sgɔiːv] "writing"

This captures the generalization that all verbal nouns in Gaelic consist of at least two derivational components: a verbal stem and an operation converting verb stems into noun stems. This generalization however is irrelevant to rules of sentence grammar; no post-syntactic phonological rule, syntactic rule, or semantic rule cares about the number of components or the way in which they are arranged. What is relevant is the surface phonological form and the syntactic and semantic features associated with that form.
1.3.4 Wrap-up. In this section (1.3), we have argued that the syntactic properties of words should be expressed in a distinct level of morphological representation. We have shown that rather minor changes in the account of inflectional structure given in Selkirk (1982)—the elimination of bi-directional branching and empty terminal nodes—permits us to capture the fact that the class of possible words is constrained by the same set of structural criteria. So, the English past tense verbal forms 

*drank* and *swigged* have the same structural properties and, thus, the same representation at the structural level. It is the derivation of their surface phonological forms that is different.

The view that tree structures are only relevant to phonological strings of a particular, restricted type is, no doubt, based on the strong parallels to syntactic structure discussed in 1.1. But, notice that this assumes a very concrete theory of syntactic representations. In a number of current theories of syntax, for example, the Government/Binding theory proposed in Chomsky (1982), it is claimed that certain aspects of the internal structure of sentences may be independently motivated, even though there is no word in the surface structure which can be aligned with an otherwise well-motivated structural position. For example, it is assumed that there are terminal nodes in English WH-questions that are not associated with any phonological material in the structural description of the sentences; e.g., *Who do you trust ---?* and *What were you asked to bring --- to the party?*. And, empty terminal nodes with somewhat different properties are postulated in constructions like: *She wants --- to go*
and John seems —— to be trustworthy.

The analogy between this view of syntactic structure and the view of morphological structure taken here will not be further pursued. The relevance of this point concerns the degree of abstractness that seems to find strong motivation in both kinds of grammatical structure. To a certain degree, these structures are motivated by considerations that are not exclusively phonological; they are syntactic or morphological. Just as the structural properties of sentences outlined in 1.1 find some correlate in words, so this abstractness aspect of internal structure finds a correlate in the internal structure of words.

1.4 The surface level of representation. It has been argued here that there exists a distinct level of morphological representation that encodes the purely syntactic properties of words. And, we have argued that there are generalizations about and constraints on these syntactic properties that are irrelevant to the operation of the sentence grammar. So, for example, it is significant to the understanding of how to form complex words in English to know that (1) undrinkable has three components, one from a class of verbs (drink), one from a class of operations that take verbs and (at least) change them into adjectives (able), and one from a class of operations that don’t change categorial assignment, but alter the interpretation of adjectives in some consistent way (un). This is in sharp contrast to the information about this and other complex words required by the non-morphological rules of the grammar. Syntactic rules, for example, need to access categorial features, but not their internal organization or word-level
subcategorizational information. The semantics requires some interpretation of the word as a whole, but not information about how various features came to be assigned to the word. And, the post-syntactic phonology ignores the internal structure relevant to the operation of morphologically conditioned cyclic rules: only the string (and, perhaps, information added by the syntax, like word boundaries) is accessed by these rules.

Many of the crucial aspects of the kind of unstructured or flat representation that is necessary in order to make the correct claims about the interaction of words and larger units receive an interesting account in the theory of Lexical Phonology (Kiparsky, 1982). In this section, a brief sketch of the relevant aspects of that theory will be given and its intersection with the kind of theory being developed here pointed out. Arguments against the view taken here and in LP that there is a single kind of mapping rule are evaluated in 1.4.2. Our main concern here is with the nature of the structural level of morphological representation, so no detailed discussion of the surface level will be presented.

1.4.1 Word structure and Lexical Phonology. The theory of Lexical Phonology (Kiparsky, 1982) accounts for many aspects of what we have termed here the surface level of morphological representation. In particular, Lexical Phonology provides accounts for two notions that, it has been argued here, are crucial to the adequate description of words and their relation to sentence grammar: (1) surface forms have no internal structure; and (2) a single kind of mapping operation is used
for all morphological operations; i.e., there is no principled non-phonological distinction between (a) mapping operations that prefix or suffix phonological material to stems and (b) those that alter the segmental string in some other way. Affixes and non-affixational processes alike are performed by morphological rules of the form $X \rightarrow X'$. The discussion begins with some background information; then, we will show how LP handles these notions in turn.

The theory of Lexical Phonology attempts to characterize distinct rule types through (1) the organization of the lexicon into levels corresponding to different kinds of morphological and phonological rules, and (2) the organization of the grammar into both lexical and postlexical phonological components, as indicated by the model in (56).

(56)  
```
level 1 morphology ←→ level 1 phonology
level 2 morphology ←→ level 2 phonology
level n morphology ←→ level n phonology
syntax ←→ postlexical phonology
```

Morphologically complex words are derived by the lexical phonology. This component is divided into ordered levels which consist of unordered morphological rules that trigger cyclic phonological
rules. The proposed model for English includes level 1, consisting of unproductive, semantically opaque derivation rules and irregular inflection rules plus a set of cyclic rules applying in this limited domain. Level 2 describes productive derivation and compounding; level 3, regular inflection.

\[(57)\]

\[\text{underived lexical entries} \quad \downarrow \]

\[+ \text{boundary inflection} \quad \text{stress, shortening} \quad \text{level 1}\]

\[\text{and derivation}\]

\[\# \text{boundary derivation} \quad \text{compound stress} \quad \text{level 2}\]

\[\text{and compounding}\]

\[\# \text{boundary inflection} \quad \text{tapping} \quad \text{level 3}\]

\[\text{syntax} \quad \text{postlexical phonology}\]

At the end of the lexical phonology, fully derived and/or inflected words are inserted into syntactic trees which then provide the input to the postlexical phonology—phonological rules that apply without regard to morphological complexity.

A number of interesting results fall out from this model; details can be found in Kiparsky (1982), Mohanan (1982). Notice, for example, that significant differences between rule types are captured by the organization of the model. Lexical rules apply cyclically, only in derived environments; in contrast, postlexical rules are not sensitive to the cycle and apply across the board. In addition, a strict distinction between irregular and regular rules is drawn by the levels.
This seems well motivated, especially in the case of derivation; see, e.g., Allen (1978) for empirical support from English and Welsh.

The aspect of this theory that supports our hypothesis about the lack of internal organization in surface forms concerns the way in which these forms are constructed—how mapping works. LP uses a weaker version of the Bracketing Erasure Convention formulated in Pesetsky (1979) in order to constrain the amount of information that mapping rules can access.

On this view, the operation of each mapping rule adds a layer of labeled bracketing; e.g., \([\text{happy}]_A \rightarrow [\text{un}[\text{happy}]_A]_A\). This convention can potentially create any number of brackets; but, it has been noted in a number of studies (e.g., Siegel, 1974; Allen, 1978) that derivation rules seem to ignore all but the outermost brackets. So, for example, \([\text{un-}]\) attaches to adjectives, but doesn’t seem to care about the derivational complexity of the adjective; e.g., \([\text{un} [ [\text{drink}]_V \text{able}]_A]_A\) \([\text{un} [ [\text{texture}]_N \text{ize}]_V \text{able}]_A]_A\). Bracketing Erasure accounts for this by erasing internal brackets:

Bracketing Erasure: Internal brackets are erased at the end of a level.

In this way, the class of possible derivation rules is restricted to those that make crucial reference to only local information: the result of the last operation, if there was one. Simultaneously, though, the convention produces flat — single bracketed — surface representations; that is, \([\text{un} [ [\text{texture}]_N \text{ize}]_V \text{able}]_A]_A \Rightarrow [\text{untexturizable}]_A\). The claim being made, then, is that no syntactic,
semantic, or post-syntactic phonological rule needs to access the morphologically relevant internal structure shown by the internal brackets. This kind of surface representation, then, has properties and constraints distinct from those that characterize the structural level of representation motivated above, exactly the result predicted by the description of complex words being developed here.

Another aspect of this theory that is relevant to our concerns is the way in which the mapping of morphological features onto phonological form is done. Roots are represented as lexical entries, with the usual idiosyncratic information. These are freely inserted into frames—brackets with syntactic category features and zero or more morphological features. The morphological rules in the lexical phonology apply to develop these features; these rules are all of the form \(X_{\beta}\beta \rightarrow X'_{\beta} \beta\). That is, there is no distinction between affixational and non-affixational processes in terms of how they are associated with roots. The structural change can be \(XVC \rightarrow XV:C\) or \(X \rightarrow Xd\). This is exactly what we expect from the evidence presented in this chapter. There seems to be no principled reason for classing roots and affixes together in contrast to non-affixational operations.

Instead, there is considerable evidence that morphological operations in general form a single class with one set of non-phonological properties. The theory of abstract morphological structure developed here, then, provides some support for the model of grammar in Lexical Phonology, and vice versa.

There are, however, some arguments in the literature (especially Lieber, 1980 and Williams, 1981) for distinguishing two kinds of
mapping operation: (1) lexical entries inserted into word structure
trees and (2) morphological rules. In the next section, we consider
these arguments.

1.4.2 Putative differences between sequential and simultaneous
morphological processes. A number of potential problems and putative
difficulties with proposing a tree-based theory of internal structure
associated with non-affixationally formed words have been pointed out
in the literature. In this section, these claims will be examined in
detail and found to be (1) unsupported by the data or (2) inapplicable
to the theory presented here.

Many apparent problems stem from putative differences between the
properties of lexical entries and those of string dependent rules. In
1.2, it was demonstrated that both have category-determining and
subcategorizational properties. Here, we will show that additional
distinctions proposed in Lieber (1980) and Williams (1981) do not
justify a radical distinction between the way affixes and non-affixes
are represented in the grammar. Thus, we will argue that (1)
significant differences between affixational and non-affixational
operations do not exist, and (2) rules, not lexical entries, are the
appropriate way to describe these operations.

In Lieber (1980), a model of the lexicon is proposed in which
there is a sharp distinction between affixation and non-affixation or
string dependent rules (these include infixation, reduplication, and
internal stem changes). In particular, she argues that affixes are
lexical entries which are combined with stems by a word formation component. String dependent rules, on the other hand, form a distinct subcomponent of the lexicon which is crucially ordered after the word formation rules. This distinction, it is argued, is further characterized by an array of distinct formal properties (beyond the distinct phonological properties). It is this array that we will examine in detail here.

Based on analyses of German umlaut and Tagalog reduplication, Lieber proposes that the following generalizations hold for string dependent rules, as opposed to affixes\textsuperscript{15}:

(1) \textbf{pervasiveness and semantic neutrality:} String dependent rules are associated with a variety of morphological processes, both inflectional and derivational and are, therefore, impossible to associate with specific, unique semantic properties in the way that affixes are.

(2) \textbf{non-independent and non-category changing:} String dependent rules are generally triggered by affixes and stems listed in the lexicon.

(3) \textbf{structure-preserving:} String dependent rules do not themselves create structure; the internal structure of the word has already been specified by the word formation rules on the basis of (and taking into account) only roots and affixes.

67
1.4.2.1 Pervasiveness. We will begin by considering the claim that string dependent rules, in contrast to affixes, cannot be assigned unique semantic interpretations because of their pervasiveness throughout the morphological system they occur in. There are two parts to this claim: (1) only string dependent rules are pervasive, and (2) pervasiveness means that semantic interpretation must come from somewhere else.

The first part of this claim has been seriously questioned in Janda (1982). It is pointed out that while German umlaut does indeed characterize a large number of morphological processes, the affixes in German are "pervasive" in just the same way. For example, the suffix -(e)r may serve to indicate (1) comparative adjectives; (2) an adjective ending; (3) plural of some masculine and neuter nouns; (4) deverbal agentive nouns; (5) denominational relational nouns; and (6) deverbal derived nouns.

(58) a. comparative adjective: **zahmer** "tamer"

b. adjective ending: **roter** "red" masc nom sg
    fem gen sg
    fem acc sg
    genitive pl (strong decl.)

c. certain plural nouns: **Würmer** "worms"
    **Rinder** "cattle"

d. indeclinable adjectives from place names: **Berliner**

e. deverbal agentive noun: **Maler** "painter"
f. denominal "relational"
   noun: Stüdter "townsman"

g. deverbal derived noun: Kratzer "scratch"

In fact, it seems that there are no less than four suffixes in German marking five or more morphological categories (-(e)r, -(e)n, -(e), ge-) and four that mark two or more categories: -(e)l, -(e)s, -(e)t, -(e)st.

The same kind of data shows up in Gaelic. The string dependent operation of lenition is pervasive; it marks (1) preterite verbs, (2) conditional verbs, (3) genitive plural nouns, and (4) nouns and adjectives in attribution to feminine nominative or dative singular nouns and to masculine dative or genitive singular nouns. But there are also suffixes that enjoy a wide range of morphological meanings (although the case is not as spectacular as that of German); e.g., -(i) marks genitive singular and all plurals in some nouns; it is a future and the conditional ending, as noted above; and it marks a few verbal nouns.

Nor is this phenomenon limited to Indo-European languages. As we have seen, Maricopa uses a number of string dependent operations. As shown in (59), vowel lengthening shows up (with or without a change in vowel quality) in a variety of morphological processes.

(59) a. N singular → plural
   xumar       xumar:r      "children"
   nčen        nči:n        "older sibling"
b. causative

xot' "be good" --> txu:t' "make good"

c. plural subject agreement

puy --> po:y "die"

xaw --> xa:w "shatter"

d. plural action verb

otox "gamble" --> u:stu:x "be a gambler"

u:kwer "hunt" --> u:skwi:r "be a hunter"

However, there are also a large number of suffixes with multiple uses, of which the suffix /y/ is, perhaps the most prolific:

(60) a. noun singular --> plural


akoy        aškoy:y        "old women"

b. plural possessives on nouns

? - i:me --> ? - i:me:-y "our legs"

l-poss legs   l-poss legs   pl-poss
c. causatives
mi: "cry" \(\rightarrow\) tmì:š "make cry"
męe "be sweet" \(\rightarrow\) tmęeyš "sweeten"

d. dual subject agreement in verbs
a:y \(\rightarrow\) a:yš "give"
u:l’eš \(\rightarrow\) u:l’ešš "break, transitive"

e. plural subject agreement in verbs
pa: \(\rightarrow\) u-paš "lie down"
čmi: \(\rightarrow\) ču:mi:š "put"
vtay \(\rightarrow\) vtaš "be big"

f. plural action verb
ma: "eat" \(\rightarrow\) ma:š "eat often"
šma: "sleep" \(\rightarrow\) šma:š "sleep a lot"

g. perfect marker on verbs
puy-š "he died, is dead"
xwet-š "it is red"

h. action nominalizations
i:ma "dance" \(\rightarrow\) i:maš "dancing"

[Gordon, 1980]
Data like this constitute a serious challenge to the idea that string dependent rules have a special status with respect to distribution within systems and with respect to semantic interpretation. A glance at any language with a substantial morphological system leads to the same observation: grammars tend to use the same phonological operations, of whatever type, over and over. This seems to be a general property of grammars, not confined to operations of any particular phonological type.

The implication in Lieber (1980) is that this proliferation is acceptable with affixes because they have distinct lexical listings that can express the relevant information. Since, on that view, string dependent rules are generally triggered by affixes marked with the appropriate diacritic feature, the properties that we might think are associated directly with those rules fall out instead from their association with particular lexical items (affixes or stems). Elsewhere, Lieber presents a convincing case against zero affixation (on the basis of the lack of parallels with real affixation). So this is a very strong claim about possible morphological systems. The generalization seems to hold in many cases, but there are examples from Gaelic which do not seem analyzable as string dependent operations triggered by affixes.
(61)  

<table>
<thead>
<tr>
<th>verb stems</th>
<th>preterite</th>
</tr>
</thead>
<tbody>
<tr>
<td>cuir</td>
<td>[ku-Oct]</td>
</tr>
<tr>
<td>togl</td>
<td>[hog]</td>
</tr>
<tr>
<td>seas</td>
<td>[hgs]</td>
</tr>
<tr>
<td>gearr</td>
<td>[ja-R]</td>
</tr>
<tr>
<td>buain</td>
<td>[vu-Oct]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>singular nouns</th>
<th>plural nouns</th>
</tr>
</thead>
<tbody>
<tr>
<td>bard</td>
<td>bard</td>
</tr>
<tr>
<td>each</td>
<td>eich</td>
</tr>
<tr>
<td>fear</td>
<td>fir</td>
</tr>
<tr>
<td>ceann</td>
<td>cinn</td>
</tr>
<tr>
<td>toll</td>
<td>tuill</td>
</tr>
</tbody>
</table>

Both palatalization and initial lenition seem to occur without triggering affixes. Of course, it is always possible to set up abstract, non-occurring segments as triggers. But there is no independent motivation for a move like this in Gaelic. While many of these alternations may be traced to what were historically phonological processes involving triggering segments, this is not the case synchronically; and, in fact, many alternations have been triggered only by inflectional features for centuries. And, as indicated in 1.2.1, these rules apply productively to English borrowings.

The account Lieber offers for cases like these seems unsuited to these data. The proposed analysis (a) assigns to the lexical entry a diacritic feature referring to the string dependent rule and (b)
includes a special lexical semantic rule that interprets the combination of the stem and the diacritic as, for example, noun plural (e.g., Vater "father" + [+U] = "fathers"). In a language like German, these cases affect just a subset of forms in any particular syntactic category. But, in Gaelic, string dependent rules operate alone (as shown in (61)) on every member of the relevant category, extending to new lexical items. To assign the same set of diacritics ([+lenition] and [+palatalization]) to every member of a category makes the productivity of these rules look accidental. This kind of account misses the crucial generalization that these two string dependent rules may operate on entire syntactic classes without supporting affixes.

There are also stem-internal changes in Maricopa that occur without triggering affixes (62a). In this case, however, the string dependent rules typically (though not always) co-occur not with affixes, but with at least one other string dependent rule, the infixation of uu (62b).

(62) a. puy --> po:y "die (dual)"
     kman --> kma:n "start (dual)"
     ?ox --> ?u:x "cough (plural)"
     xwet' --> xwa:t' "be red (plural)"

b. amel --> ašu:mi:l "wear a belt (plural)"
     nmak --> ntu:ma:k "leave (plural)"
     tpuy --> tu:po:y "kill (plural)"
     u:kwer --> u:škwi:r "be a hunter" (plural action)
Data like this constitute a serious problem for the hypothesis that string dependent rules have an array of unique non-phonological formal properties. There is evidence from a variety of languages that affixes as well as string dependent rules can be pervasive. In addition, there seem to be some problems in accounting for cases in which a string dependent rule applies without an associated affix. Assigning diacritic features to trigger lenition and palatalization in Gaelic involves giving the same feature or features to every member of the syntactic classes, N, V, and A; the generalization about the distribution of these rules is being missed. The Maricopa case involves a fairly large number of diacritics and co-occurrence restrictions on them.\footnote{17}

1.4.2.2 Theory-dependent arguments. The next two claims are very much theory-bound. That is, it is difficult to evaluate them outside the framework set up by Lieber. In other theories, in particular the one being developed here, they do not represent significant arguments, but they do hold in her model.

Consider, for example, the claim that string dependent rules are structure-preserving. This depends crucially on how structure is defined. On our view, internal structure is based on relations between features and phonological marking; it represents the purely syntactic properties (e.g., categorial identification, number of components and their interrelations) of morphologically complex words. On Lieber's view, it is based on the segmentability of the phonological string and
one-to-one association of bits of that string with morphological
categories, as well as more strictly syntactic properties. It follows,
then, that string dependent rules cannot influence structure; in fact,
they can only apply after the creation of such structure in that model.
Thus, it is true that they are structure preserving in this sense, but
it is difficult to see how things could be otherwise, given this notion
of structure. A number of examples have been presented here, indicating
that, on an alternative view of internal structure, string dependent
rules influence tree structures in the same way that affixes do. In
fact, it has been argued here that significant generalizations about
the syntactic properties of words are lost on the view that string
dependent rules are not "constituents" or analyzable components of
complex words.

Similarly, the claim that string dependent rules are
non-category-changing relies heavily on theory-internal considerations.
On this view, category changes may be described in one of two ways: (1)
by affixation, where the affix is a lexical entry associated with a
syntactic category different from that of the stem it may attach to;
and (2) by a relation that permits the association of two distinct
(stem) lexical items of different syntactic categories. In particular,
Lieber argues against two other possible analyses (zero suffixation and
conversion) as accounts of category changes that do not involve overt
affixation. Thus, the reason that string dependent rules can be
characterized as non-category-changing is because category changing is
declared as the result of affixation; in cases not involving an affix,
category changing is defined as a relation between lexical entries. If,
as in the case of certain German noun-verb conversions (e.g., Affe "monkey" and Haffen "to mock"), a string dependent rule is involved, this is not characterized as category-changing. Instead, there are two lexical entries, one for the noun and one for the verb which is also assigned the appropriate diacritic ([+U]). In spite of the fact, then, that verbal nouns in Gaelic may be formed strictly by stem internal changes (with no concomitant changes in other properties), this cannot be called category changing in Lieber's model because of the way this process is defined. In a theory where category changing is not defined in this way, it can be accomplished through the usual variety of phonological markings, which includes sequential and simultaneous changes in the string.

1.4.2.3 Headedness. Another putative difficulty with assigning tree structures to simultaneously formed words has to do with the identification of the head of such words. One of the basic observations that led to the formulation of match-up theories of word syntax concerns the apparent existence of heads in words, where head receives its interpretation on analogy with the use of head in sentence syntax. In particular, it is proposed in Williams (1981) that words formed by affixation are headed and that various properties of such words follow from the internal structure of this type of word and a string and structure-dependent definition of the head of a word.

In a word whose inflection is expressed simultaneously, it is then impossible to identify the head in this way. Such words are classified as headless; we expect, on this view, not to find the properties
associated with heads at work in these cases.

Although Williams' tree structures are crucially based on the
segmentability of linear strings, notice that the definition of head is
available directly from the tree itself. That is, once the tree
structure has been established, reference to the phonological string is
unnecessary for the identification of the head. In the last section, we
proposed a theory of word syntax in which tree structures are based on
morphological constituents, not just linear strings. On this view, tree
structures for words formed by a variety of phonological means may have
identical internal structures and, therefore, should have identifiable
heads.

To illustrate, let us consider one of Williams' examples using
string-generated trees; then, we will show how the facts that he wants
to follow from headed trees hold for other kinds of morphologically
complex words, given the independent tree structure system proposed
here.

(63)

\[
\begin{array}{c}
\text{stand} \\
\text{[-ed]} \\
[+\text{ablaut}] \quad \quad \quad [-\text{ablaut}]
\end{array}
\]

The subcategorization frame for /-ed/ excludes the possibility of
a root like \text{stand}, which is marked [+ablaut], being inserted into the
same tree.
If, instead of identifying terminal nodes with phonological strings, we identify them with features that specify morphological substitution classes, we can see that the same phenomenon holds for non-affixed words. On this view, the inflectional structure of English verbs has the following form:

(64) \[ V \rightarrow V^{-1} Y \]

\[ \begin{array}{c}
\text{person} \\
\text{number} \\
\text{tense}
\end{array} \]

where \( V \) represents the form insertable into syntactic structures and \( V^{-1} \), the pre-inflected form.

So, the tree structure is always the same:

(65) \[
\begin{array}{c}
V \\
V^{-1} \\
Y
\end{array}
\]

\[ \begin{array}{c}
\text{person/number/tense}
\end{array} \]

Where \( Y \) represents the operation that suffixes /d/ to the underlying representation associated with \( V^{-1} \), the result is like Williams’. But where \( Y \) represents a rule that changes the features of the stem vowel (e.g., run \( \rightarrow \) ran), \( Y \) still represents the same structural unit, and thus can be subcategorized appropriately in the inflection rule itself. \( Y \), then, has head properties; i.e., \( Y \) and all of its associated operations have the same syntactic category as the whole word (see also 1.3.3), and these operations have subcategorizational requirements.
Some problems with Williams' definition of head as the righthand constituent in that particular kind of internal structure tree are pointed out in Selkirk (1982), Lieber (1980), Thomas-Flinders (1982), and Joseph and Wallace (1982). The point here is that a structure-based definition need not exclude words formed by non-affixational processes from its domain, if the more abstract notion of morphological structure developed here is used to motivate those structures.

1.4.2.4 On mapping rules. We have seen that there are serious weaknesses in the point of view that non-affixational operations have formal properties (beyond the obvious difference in phonology) that are distinct from those of affixational operations. We have shown, for example, that the pervasiveness and semantic neutrality attributed to this type of word in Lieber (1980) is actually a very general property of morphological operations of all types. So, affixes, as well as string dependent rules, may be used for a variety of inflectional and derivational operations, as we illustrated from German, Gaelic, and Maricopa. Also, we have presented evidence that there are a number of cases across languages in which string dependent rules operate without triggering affixes, in contradiction to the claim that these are regularly affix-dependent, as well as string-dependent. Finally, we saw that a number of claims from Lieber (1980) and Williams (1981) rely crucially on theory-internal definitions. For example, where heads are defined on trees which can only be set up for words whose strings can be analyzed into discrete morphemes, it follows that words without this property cannot have heads. But, we have shown that, in fact, these
words do have heads in the syntactic sense, where trees are formed with reference only to morphologically significant structure. In the same same way, we argued that the ability to change categories depends on a theory's definition of category changing. Where, as in Lieber (1980), category changing can only be done by affixation of real phonological material or by lexical semantic rule, then the issue of whether or not string dependent rules can change categories is moot.

1.5 Conclusion. In this chapter, evidence has been presented in support of these hypotheses: (1) words have significant syntactic properties; (2) there are no interesting distinctions between the syntactic properties of affixationally derived and non-affixationally derived words; and (3) a single theory of morphological structure can describe these facts, if the structures are determined on the basis of morphological, not strictly phonological, considerations.

By Liberating the notion of word syntax from any reliance on the segmentability of the phonological string, strong constraints are placed on the class of possible grammars. In particular, any constraints that are well-motivated for describing sequentially inflected or derived words must hold for simultaneously inflected or derived forms.

Also, we have tried to reconcile two apparently disparate generalizations about complex words: (1) words have significant internal structure, and (2) the details of this structure are largely irrelevant to the operation of the non-morphological parts of the grammar. To account for this, we have introduced the notion of
morphological levels of representation, each level governed by distinct
principles. One level, we have argued, describes the set of syntactic
properties that words must have in order to qualify as possible complex
words. In particular, we demonstrated that this set of properties holds
for all complex words: those formed by affixation and those formed by
other changes in the phonological string. This level of structural
representation, then, captures generalizations about words that
transcend the phonologically-based distinctions proposed as central in
Williams (1981), Selkirk (1982), and Lieber (1980) (also in Matthews,
1974).

In addition, having a single sort of structural representation
explains an assortment of facts that are anomalous on other views;
e.g., why the intercalative morphological system of Classical Arabic
should observe the same locality principles as English derivation
(McCarthy, 1979); why the same morphological categories can be
expressed by quite different phonological changes across languages,
and, crucially, within the same language; why morphological operations
are often neither strictly affixational nor strictly simultaneous; why
both productive and non-productive affixational and simultaneous
processes are found in natural language; and why non-suffixes can have
head properties.

To account for the properties of words that are crucial to the
operation of the sentence grammar, we suggested a level of surface
representation, in which phonological, syntactic, and semantic
information is stripped of its internal structure. This severely
constrains the class of possible grammars: rules accessing information
about the internal structure of words cannot be formulated (or can be formulated only at great cost to the grammar).

In the next chapter, the properties of structural representations will be examined in detail. In particular, we will argue that certain well-known and some obscure facts about inflection and derivation can be expressed as similarities and differences in the rules describing possible word structure trees.
Footnotes to Chapter 1:

1 The set of sentences is infinite because NOUN, VERB, and ADJECTIVE are open classes to which new items are constantly being added.

2 This entails the existence of a crucial distinction between the head of a word and the head of a phrase. The head of a phrase has the same distribution as the phrase itself (Jackendoff, 1977). But, if the head of a word can be a suffix or other sub-word unit, this property of heads does not hold consistently in the smaller domain.

3 It is argued in Freeland (1951) and Broadbent (1964) on the basis of prosodic properties that these pronominal suffixes are part of the phonological and morphological word.

4 In the transcription of the Gaelic examples, these symbols have the following interpretations:

[L] = velarized [l]
[N] = velarized [n]
[R] = trill
[r] = flap
[j] = voiced palatal fricative
[b,d,g,d',g',] = unaspirated, voiceless stops
[p,t,k,t',k',] = aspirated, voiceless stops

The data are generally from the Leurbosd dialect of Scots Gaelic described in Ofstedal (1956); supplementary examples have been taken from the standard dialect (Mackinnon, 1971). Other sources consulted include MacLeod and Dewar (1883) and Dorian (1978).

5 On an analysis of reduplication such as that presented in Marantz (1982), it seems possible to describe the properties of words formed in this way by match-up theories. However, this has not been done in that literature. Lieber, who cites Marantz’ analysis, argues nevertheless that reduplication does not affect the internal structure of complex words and thus falls outside the domain of word syntax theories. This will be discussed in more detail in 1.4.

6 "Lenition" is a cover term for the following phonological changes (Ofstedal, 1956):

\[ \begin{align*}
p &\rightarrow f \\
b &\rightarrow v \\
m &\rightarrow n \\
f &\rightarrow \emptyset \\
t &\rightarrow h \\
d &\rightarrow \gamma \\
\tilde{m} &\rightarrow n \\
s &\rightarrow h \\
t' &\rightarrow h' \\
d' &\rightarrow j \\
N &\rightarrow n \\
\xi &\rightarrow h' \\
k' &\rightarrow \varsigma \\
g' &\rightarrow j \\
l' &\rightarrow l \\
k &\rightarrow x \\
g &\rightarrow \eta \\
L &\rightarrow l \\
R &\rightarrow r \\
\end{align*} \]

Similarly, "palatalization" includes several kinds of phonological change:

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t → t'  d → d'  N → n
k → k'  g → g'  n → n
x → ɕ  y → j  L → l' or ʃ
h → j  r → ʃ
s → ʃ

In addition, Ofstedal (1956) lists over thirty different types of vocalic palatalization.

7 Another important claim that needs to be investigated is the predictions of these two theories in regard to historical change. Our view claims that phonological markings can change types without requiring significant changes in the grammar as a whole, just in individual mapping rules. In this case, it is simply a matter of changing the phonology of the rule(s) in question. Since there is no fully developed multiple rule system theory available, it is difficult to evaluate the claims of the other view in detail. But the notion of distinct rule systems leads us to expect some kind of interesting interaction when inflectional marking changes from affixed to simultaneous or vice versa.

8 Recall that, on our definition of simultaneous and on the view of affixation taken in match-up theories, reduplication is a simultaneous operation, even though it literally adds, not changes, phonological material.

9 Or, a stem-final consonant (or one followed only by /l/) is devoiced in the future tense in a certain subset of verbs.

10 In fact, there seems to be a case of this type in English, pointed out to us by Paul Schachter. Certain noun–verb pairs are differentiated only by their stress patterns:

<table>
<thead>
<tr>
<th>noun</th>
<th>verb</th>
</tr>
</thead>
<tbody>
<tr>
<td>import</td>
<td>impórt</td>
</tr>
<tr>
<td>convict</td>
<td>convict</td>
</tr>
<tr>
<td>álly</td>
<td>allý</td>
</tr>
</tbody>
</table>

Although we have not specifically included cases involving suprasegmental phenomena like stress and tone, we suspect that morphologically complex words formed by these operations follow the general pattern argued for here.

11 For discussion of why this might be so, see 1.2.2.

12 We are maintaining a very strong version of this claim. We know of no data that contradicts this, but would not be surprised if such cases exist. In fact, we would like to hear about them. The work being presented in this thesis represents our own attempt to account for data that has been considered strong evidence against the notion of significant internal structure (see Anderson, 1982). Thus, our interest
lies not only in the construction of maximally restrictive grammatical theories, but in the careful analysis and incorporation into such theories of data that seem to lie outside their purview.

13 The Extended Word-and-Paradigm Theory (Anderson, 1977; Thomas-Flinders, 1981; Anderson, 1982) expresses the same generalization by imposing extrinsic ordering and internal organization directly on the mapping rules. We will see in 2.3.2.2 that there are crucial differences in the predictions made in that theory by not having a distinct level of structural representation.

14 Agreement for second plural subject is marked by a discontinuous morpheme: /z...te/. It is the suffix that must be crucially ordered with respect to other rules.

15 In fact, Lieber discusses another property: locality. This is primarily an argument against the analysis of Tagalog given in Carrier (1979) in which reduplication is described by rules containing variables. By judiciously assigning diacritic features to trigger reduplication processes, Lieber is able to reformulate the string dependent rules without variables.

16 Lieber is not unaware of the possibility of homophony in the lexicon. However, she states that the normal state of affairs involves a one-to-one relation between a stem or affix and a semantic representation. Homophonous morphemes require multiple lexical entries, but this is considered to be a rare occurrence.

17 An associated claim made by Lieber is that the single statement of string dependent rules, as opposed to distinct statements of homophonous affixes, captures a significant generalization. Again, evidence has been presented in the literature indicating that facts about ordering, exceptions, and historical change (as well as just accounting for the data) argue for distinct statements of certain string dependent rules, too. See Janda (1982) on German umlaut and Kiparsky (1983) on Old Icelandic umlaut.
2.0 Introduction. In Chapter 1, we argued that words have syntactic properties and that generalizations about these properties can be captured by assigning words a particular kind of structural representation. On the basis of differences between information relevant at the word level and information relevant at sentence level, we argued that this structural representation forms a level distinct from that of the word's surface level of representation.

In this chapter, we will elaborate this notion of a distinct structural representation. We will propose two rule schemata, one for inflectional structure and one for derivational structure. We will argue that rules meeting the requirements of these rule schemata form the unmarked case in word structure rules; these are the expected, usual forms for these rules. Word structure rules not conforming to these schemata may exist (although we have no examples to present here), but only at a cost to the grammar, representable as formal complexity in the rule itself. Discovery and further investigation of apparent violations to the rule schemata argued for here will, we expect, show that they are limited to a relatively narrow, clearly definable class. (It will be assumed here that it is possible in principle to define an upper and lower limit on the number and type of marked rules tolerated by a grammar (Kean, 1978).)
After introducing these rule schemata, we will present evidence supporting the hypothesis that inflection and derivation have a number of different formal properties. It will be argued that inflection and derivation differ in their syntactic properties, ordering requirements, the organization of their mapping rules, and their interpretations of "locality". We will argue that the predictions made by our structural rule schemata for inflection and derivation are borne out. In the course of investigating these predictions, we will look at some contradictory hypotheses presented in the literature. For example, the arguments presented in Halle (1973) and Lieber (1980) that inflection and derivation do not have distinct properties that should be expressed formally in an adequate theory of grammar will be examined in detail. Although that work correctly points out that both inflection and derivation (1) can be non-productive and (2) can use the same kind of phonological operation, we will conclude that too many generalizations are left unaccounted for and made to seem purely accidental on that view. Further, we will argue that the model of grammar in Lexical Phonology (Kiparsky, 1982), which permits the intermixing of irregular inflection rules with derivation rules, both over- and under-generates. A more restrictive view of the relation between these kinds of rules will be proposed, in which derivation is strictly ordered before inflection; several types of possible counterexamples will be evaluated. Finally, we will propose a specific view of how morphology is organized.
2.1 Defining inflection and derivation. As a preliminary, let us make clear exactly what morphological phenomena we classify as inflectional, as opposed to derivational. Although linguists typically have strong intuitions about what constitutes derivation and inflection, rigorous formal definitions have eluded grammatical theory. The evidence presented later in this chapter suggests that there is a cluster of formal properties that distinguish inflection from other word formation processes.

In brief, we accept the arguments in Chomsky (1970) to the effect that syntactic rules ignore the derivational structure of words; derivationally simple and derivationally complex words show no associated syntactic distinctions. This state of affairs is in sharp contrast to the syntax's view of inflection; the placement of words in syntactic structures often depends on the existence or non-existence of inflection in a word and/or the kind of inflection shown by the word (Anderson, 1982). Other syntactic rules, like Move $\alpha$ (Chomsky, 1977) show the same kind of sensitivity to inflection, but not to derivational complexity. For example, fronted WH words cannot be arbitrarily inflected in English:

(1) a. Who(m) did she talk to?
   b.*Whom talked to her?

But, noun phrases can be "moved" without reference to depth of derivation; e.g.,
(2) \{John  
  \{Antidisestablishmentarianism\} \} seems to be unpopular.

In English, for example, tense in verbs is inflectional for the following reasons. First, tensed and non-tensed verbs occur in complementary syntactic environments; e.g., only tensed verbs can serve in main clauses, while only untensed verbs can occur in construction with the infinitive marker to:

(3)  
a. She walks to work.  
   walked  
   *walk  

b. She wants to walk to work.  
   *walks  
   *walked

Secondly, the particular inflection on a verb may be constrained by syntactic structure, especially in certain subordinate clauses whose verb tense depends on the tense of the main clause verb:

(4)  
a. She went home after she left here.  
   *leaves  
   (*leave)  

b. She goes home after she leaves here.  
   *left  
   (*leave)

Similarly, number is inflectional in English nouns because of its mutual dependence on other aspects of sentence structure; i.e., the form of inflected verbs.
(5)  
a. The dog is healthy.
    *dogs

   b. The dogs are healthy.
    *dog

In general, then, neither verbs nor nouns in English can be freely inserted into syntactic structures without some reference to their inflectional status. Compare this with derivation:

(6)  
a. Her dog is healthy.

   b. Her antidisestablishmentarianism is healthy.

Of course, it is not accurate to say that derivation has nothing to do with the syntactic component. There is, in fact, one crucial distinction between inflection and derivation in which it is derivation that interacts with the syntax and not inflection. This is in the area of strict subcategorization and selectional restrictions (Chomsky, 1965). Derivational rules typically change the syntactic configurations into which words can be inserted. In contrast, members of an inflectional paradigm (words with the same inflectional structure, on our view) all have the same subcategorization requirements and selectional restrictions; it is generally not the case that, say, a verb with third person singular agreement subcategorizes for an object with a different thematic role than the same verb with first person plural agreement.

It is on the basis of this kind of sensitivity or insensitivity of the syntax to their operation that inflection and derivation will be tentatively distinguished here. The goal of this chapter is to expand
this definition by formally characterizing other grammatically significant distinctions.

2.1.1 The monolithic morphology hypothesis: Halle. In Halle (1973), the position is taken that the description of inflection requires the same grammatical mechanisms as the description of derivation. However, a closer look at the arguments presented in favor of this hypothesis (and at various other facts brought out in the article) reveals that some significant generalizations would be ignored if the suggested program were carried out in full. Still, this work represents an important step in the effort to free the definitions of inflection and derivation from their still-current association with levels of productivity.

2.1.1.1 The argument. Halle bases his case on the existence of exceptions to inflection, arguing against exceptional behavior as a derivation-specific property. For example, he argues that semantic opacity can arise in connection with both kinds of morphological process. Thus, deverbal nouns in English formed by suffixation of -al do not always show entirely consistent meanings that follow simply from the stem's meaning (7a); in some cases, the noun refers only to a subset of the stem's possible interpretations (7b).

(7) a. recital (cf. recite)
    b. transmittal (cf. transmit)
To illustrate that a parallel situation occurs with inflection, Halle cites the existence in Russian of some nouns for times of year and times of day which, in the instrumental case, have unpredictable adverbial uses:

(8) a. letom "in summer"
    cf. obedom *"at dinner (or noon) time"
   
   b. noč'ju "at night"
   
   c. zimoj "in winter"
    cf. avgustom *"in the month of August"

Next, he observes that both derived and inflected forms may exhibit phonological unpredictability. (9) shows that, while most de-adjectival nouns formed with -ity undergo Trisyllabic Shortening (9b), not all do (9a); the distribution is apparently idiosyncratic.

(9) a. entirety/entire cf. b. serenity/serene
    nicety/nice           divinity/divine
    obesity/obese         profanity/profane

Again, examples from Russian are used to show that phonological exceptionality shows up in inflected forms; the feminine nouns in (10a) take stress on the case ending in all forms, while those in (10b) take initial stress in the nominative plural, and those in (10c) take initial stress in the nominative plural and accusative singular with desinential stress elsewhere.
(10)  

<table>
<thead>
<tr>
<th>(10)</th>
<th>nominative sg</th>
<th>nominative pl</th>
<th>accusative sg</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>kočergá</td>
<td>kočergí</td>
<td>kočergú</td>
</tr>
<tr>
<td></td>
<td>gospožá</td>
<td>gospoží</td>
<td>gospožú</td>
</tr>
<tr>
<td>b.</td>
<td>skovorodá</td>
<td>skóvorody</td>
<td>skovorodú</td>
</tr>
<tr>
<td></td>
<td>arbá</td>
<td>árby</td>
<td>arbú</td>
</tr>
<tr>
<td>c.</td>
<td>borodá</td>
<td>bórody</td>
<td>bórodu</td>
</tr>
<tr>
<td></td>
<td>golová</td>
<td>gólový</td>
<td>gólovú</td>
</tr>
</tbody>
</table>

Finally, the phenomenon of defective paradigms, where certain otherwise expected inflectional forms simply do not occur, is offered as a parallel in inflection to unpredictable combinatorial possibilities in derivation. For example, certain stems in English can combine with both -al and -(at)ion to form nouns (11a), although others may add only one or the other (11b,c).

(11) a.  
approval/approbation  
recital/recitation  
proposal/proposition  
transmittal/transmission

b.  
arrival/*arrival  
acquittal/*acquitation  
rehearsal/*rehearsion

c.  
derivation/*derival  
description/*describal  
confusion/*confusal  
observation/*observal

Halle notes that, in Russian, approximately one hundred verbs show this kind of "accidental gap" in their inflectional patterns; unlike other Russian verbs, these have no first person singular forms in the non-past tense; e.g.,
(12) *lažu  "I climb"
    *pobežu (or *pobeždu)  "I conquer"
    *deržu  "I talk rudely"
    *mužu  "I stir up"
    *erumžu  "I behave foolishly"

The existence of exceptional behavior in inflection as well as derivation leads Halle to the conclusion that the mechanisms independently required for the description of derivation should also handle inflection.

2.1.1.2 Evaluation of the argument. Here, we do not intend to argue with Halle's facts, but with his conclusion, especially in light of some rather strong arguments against that conclusion in the paper itself.

Reconsider, for instance, the Russian instrumentals cited in (8); these are exceptional, but not in the way that the English nominalizations in (7) are. It is pointed out in Pesetsky (1979) that these forms exist in addition to forms of the same phonological shape, with the predicted semantic interpretation; thus, these are idioms existing side-by-side with regularly inflected forms. This is not the case with the English verbal nouns cited in (7); these possess only specialized meanings. No parallel set of regularly derived and interpreted deverbal nouns exists. Instead, a different process may (but need not) produce a noun with a predictable interpretation; e.g., recitation (cf. recital). In inflection, the compositional form always
exists; in derivation, it only exists sometimes. While the same mechanism may be used to account for the existence of semantically opaque morphologically complex words, the data show that some property of that mechanism must predict that inflection and derivation have different kinds of semantic exceptionality.

In the same way, the fact that both derived and inflected forms may show phonological eccentricities is misleading. What is interesting about this aspect of morphological relations is the kinds of exceptionality each can have. On most views of derivation, a high degree of formal identity is required to establish the existence of a morphological relationship; e.g., bachelor and spinster, though they parallel the relation between duke and duchess, are not generally considered to be derivationally related. Inflection, on the other hand, tolerates total phonological aberrance; were and went are typically viewed as inflected forms of be and go. Again, the facts Halle brings out are indisputable, but their relevance to the argument has been overconstrued. Exceptions to morphological rules of all kinds occur, but their character is significantly different and dependent on the kind of morphological relation involved.

The final point—that inflection has anomalies, just as derivation does—is subtle. The example are not parallel (undergeneration of inflection in the form of defective paradigms vs. overgeneration of derived forms with differentiated meanings). Of course, there are no truly parallel cases. In order for derivation to be "paradigmatic", thus forming a real parallel with inflection, two requirements need to be met: (1) the expectation that all available morphological
possibilities are realized (e.g., each verb having (a) an agentive noun; (b) an action nominalization; (c) an adjectival form, meaning "tending to v"; (d) a causative, and so on); and (2) each member of the "derivational paradigm" would have to have the same argument structure or strict subcategorization frame and selectional restrictions. What requires explication on the view that inflection and derivation have the same properties is why derivational paradigms are generally unattested. The unifying factor here seems to be the unpredictability of which paradigms and which derivational relations are irregular and, thus, the non-practicality of using productivity or predictability as a criterion for distinguishing the two. So, for example, all English verbs are expected to have tensed and untensed forms. However, it is a matter of (historical) chance whether or not any particular verb in English takes part in some or all of the derivational possibilities available to it. As with phonological and semantic exceptionality, it is the type of deviation found, not the mere possibility of it, that draws the line between inflection and derivation, suggesting again that their descriptions need to differ in some way in order to reflect this.

2.1.1.3 The argument against. After presenting these arguments, Halle proceeds to offer some interesting and relevant observations on how derivation and inflection differ in their grammatical properties. For instance, he proposes that both fully derived and fully inflected forms be inserted into syntactic structures. But then he points out that, in this case, the grammar will need some way to check up on inflected forms to ensure that they are properly inserted. (Cf. the working
definition of inflection given above: the syntax cares about whether or not and how words are inflected.) Here is a specific case in which, on his view, the description of inflection will require some mechanism beyond what derivation needs.

Halle also notes that inflected words seem to form paradigms and that these paradigms appear to be grammatically relevant entities that organize morphologically complex words in a way that seems necessary for the description of inflection, but unnecessary for that of derivation. Once more, inflectional relations are arguably distinct from derivational ones; they exhibit internal organization of a type that derivational relations do not.

Despite the attempt to group all morphological relations together in terms of their treatment by the grammar, then, this discussion suggests that inflection and derivation do form distinct classes: (1) relations characterized by internal organization in the form of paradigms and by restrictions on lexical insertion, and (2) relations without these properties.

Thus, we conclude that Halle is correct in his assertion that inflection, as well as derivation, shows idiosyncrasies. We have seen, though, that this view is insufficient for the characterization of (a) the different kinds of eccentricities that inflection and derivation exhibit and (b) the classes that morphological relations form, both of which should be accounted for in an acceptable theory of grammar.

2.1.2 The monolithic morphology hypothesis: Lieber. Lieber (1980) continues the effort to demonstrate a lack of formal distinctions
between inflection and derivation, pursuing Halle's proposal that all morphologically complex words be generated in the lexicon prior to insertion into syntactic trees. The details of such a model are developed, along with a very different view of what constitutes grammatically significant classes of morphological relations. (See discussion of rule types in 1.4.) Rules are distinguished by (a) degree of predictability in their phonological relations, and (b) the extent of the operation's dependence on the phonological shape of the stem. In this way, non-productive stem allomorphy and regular affixation are described by distinct mechanisms, while string dependent rules like umlaut and reduplication require yet another mechanism. It is argued that each device has distinct properties, but inflection and derivation are treated uniformly.

In this section, we will outline Lieber's view of morphology and then examine more closely some of the individual descriptive devices, arguing that, in fact, each discriminates between inflection and derivation in a systematic way.

2.1.2.1 Lieber's model of morphology. On Lieber's view, the morphology has three parts: a permanent lexicon, a word structure component, and a string dependent rule component. The explicit claim is that each component's devices describe all morphological relations in the same way; variations, then, are considered accidental and not associative with the traditional division between inflection and derivation. Instead, morphological operations are divided into three groups on the basis of their phonology: (1) morpholexical rules describe
unpredictable stem allomorphy; (2) lexical entries account for regular affixation; and (3) string dependent rules express regular but non-affixational relations. These will be considered in turn.

Lieber’s view of the organization of the permanent lexicon is predicated on several interesting observations, one of which is that stem allomorphy in derivation frequently mimics unpredictable stem allomorphy in inflection. Consider these examples:

(13) a. from Latin:

\[
\begin{align*}
\text{certā} + \text{re}, & \quad \text{certē + bundus,} \quad \text{certē + men,} \\
\text{"contend,"} & \quad \text{"contending," A} \quad \text{"contest" N} \\
\text{monē} + \text{re}, & \quad \text{monē + la,} \\
\text{"warn"} & \quad \text{"admonition"} \\
\text{cupī} + \text{re}, & \quad \text{cupī+ dus,} \\
\text{"desire"} & \quad \text{"desirous"}
\end{align*}
\]

b. from German:

\[
\begin{align*}
\text{Mann (N singular)} & \quad \text{Mannloch} \\
\text{"man"} & \quad \text{"manhole"} \\
\text{Männer (N plural)} & \quad \text{Männerkleidung} \\
\text{"men"} & \quad \text{"man’s dress"}
\end{align*}
\]

The verbs, nouns, and adjectives in (13a) share stems that include a theme vowel; it is argued that, because of its unpredictable occurrence, the theme vowel must be considered part of a verb’s underlying representation and, thus, must be specified in the lexicon. Similarly, (b) shows that both singular and plural noun stems can be used in German compounds. Lieber argues that certain aspects of plural formation, like the occurrence of umlaut, must be indicated on a word-by-word basis; i.e., they must be accounted for in the permanent
lexicon.

Since the same kind of allomorphy can be found in both inflected and derived forms, Lieber proposes a method of description that is independent of this difference. Morpholexical relations show possible, but not predictable, phonological alternation in stems; e.g., the morpholexical relations $X\ddot{a} \rightarrow X$, $X\ddot{e} \rightarrow X$, and $X\ddot{i} \rightarrow X$ account for the alternations between the forms in (13a) and what Lieber terms their associated roots (the stem without the theme vowel), while $C_0V C_0 \rightarrow C_0V C_0$ describes the relation in (13b). Formal simplicity is achieved by unique statements of these phonological relations; their occurrence in more than one kind of morphological operation is anticipated by their independence from statements of other kinds of relations (syntactic, semantic, etc.). In this way, unpredictable stem allomorphy is held to be a different kind of process from the combination of morphemes.

Also in the permanent lexicon are lexical entries for stems and for affixes. The significant division here is between stems and affixes (and not, for example, between inflectional affixes and derivational affixes): only affix entries can specify combinatory requirements. Otherwise, these entries contain the same kinds of information: idiosyncratic phonological, syntactic, and semantic properties. In particular, entries for inflectional and derivational affixes, it is claimed, do not differ systematically. Only affixes are directly associative with morphologically expressed meaning; morpholexical rules are simply statements of possible relations between phonological forms.

The third kind of phonological operation associated with morphological relations is described in the string dependent rule
component. These rules exhibit sensitivity to the internal composition of the stem. For example, reduplication requires reference to some of the segments in the string being operated on; various stem-internal changes need to know segmental content. Lieber argues that these rules share a number of other properties that distinguish them from morpholexical rules and affixes; these properties are discussed at length in 1.4.

Structure dependent rules share some properties with morpholexical relations in distinction to affixes. In both cases, the single expression of the phonological process without reference to any specific morphological operation provides a formally simple account that predicts their widespread use for various morphological purposes in the grammar. In addition, neither morpholexical relations nor string dependent rules are associated directly with meaning; it is generally the responsibility of the affixes to indicate the association of form with semantic content. Finally, the actual phonological relations expressed by these two devices may look the same, but they always differ in these respects: (1) morpholexical relations are necessarily non-productive; and (2) morpholexical relations can be string independent: e.g., the alternations above for Latin. These facts, among others, motivate their separation into distinct components.

In this way, Lieber constructs a theory in which morphological operations are divided into classes of processes whose different phonological properties are intended to be correlated with other facts, which crucially do not include a distinction between inflection and derivation. We will now consider the validity of the claim that these
devices treat all morphological relations equally and ask whether this particular kind of classification is entirely justified.

2.1.2.2 The homogeneity of the classes. For the moment, let us accept Lieber's division of the phonological aspects of morphological operations into three distinct groups on formal grounds. We will look more closely at the devices sketched above and at how inflection and derivation respond to them.

Consider first morpholexical relations. While Lieber presents ample evidence that stem allomorphs of the same shape show up in all kinds of morphologically analyzable words, there is a generalization being lost or obscured; namely, the distribution of allomorphs is not completely random. In one set of cases, some aspect of meaning, beyond the form's basic semantic interpretation, specifies its distribution; e.g., Männner's distribution in certain cases is clearly correlatable with plurality, as in Männer (nominative, accusative, genitive plural) and Männern (dative plural). This contrasts with the distribution of its allomorph Mann- in Mann (nominative, accusative, dative singular) and Manne (genitive singular), where the correlation is with non-plurality or singularity.

Compare this with the use of these allomorphs in Mannloch "manhole" and Männerkleidung "man's dress". The glosses could just as well be "menhole" and "men's dress", since presumably manholes are used by more than one man and the manner of dress is that of more than one man; this is precisely because the plural inflection marking is not a crucial aspect of the interpretation of these compounds (Wurzel, 1970).
(Cf. *Mannschaft*, "men, team, crew", in which the singular form of *Mann* is used, although the meaning is clearly plural.) In these cases, *Mann-* and *Männer-* are simply different phonological manifestations of one stem; distribution must be specified on a word-by-word basis (or perhaps by some other means to the same end). This point is strengthened by the existence of forms like *Prüfungstag* "examination day", *Brunnquell* "fountain head (of a spring or well)", and *Glätthobel* "smoothing plane", in which the forms in the first half of the compounds do not exist independently; their distribution cannot be specified in a way that refers to inflectional features. This aspect of derivation—the occurrence of pseudo-inflected forms within compounds and derived words— is discussed at length in 2.2.1.3.

This distinction in how the distribution of allomorphs is specified correlates exactly with a distinction between inflection and derivation. Inflectional stem allomorphy participates in the association of meaning to form. Allomorphy in derived forms is typically the result of co-occurrence with certain affixes or compounds of a particular type and does not, in itself, contribute to meaning.

Another area in which unanticipated distinctions show up is in lexical entries. There is supposed to be a difference between stem frames and affix frames; as illustrated in (14a) and (14b), only the latter indicates how these elements may be combined, by including a subcategorization frame.
(14) a. -ize /phonological representation/
    semantic representation: causative
categorization/subcategorization: \( \text{\text{\[N \quad \]\text{\text{\[V}}}} \)
insertion frame: NP \( \quad \) (NP)
diacritics: Level 2

b. product /phonological representation/
    semantic representation: ...
categorization: \( \text{\text{\[N \quad \]\text{\text{\[N}}}} \)
insertion frame: (whatever it is for Ns)
diacritics: +Latinate

[Lieber 1980]

But contrast the frame in (a) with that in (c), concentrating on information content. (Lieber's only examples of inflectional affix frames are from Latin.)

c. -s /phonological representation/
    + V
[2 pers, -pl, ø perf, ø pres, ø fut] = 2 sg
subcategorization: \( \text{\text{\[V \quad \]}\text{\text{\[V}}} \)

Notice that the semantic representation in (c) is expressed in terms of a collection of subcategorical feature values; the semantic representations for derivational affixes (a) do not have this complex form and those for lexical items (b) are complex in a different way. In addition, the subcategorial frame in (c) is redundant; the category
feature for the input and the output of inflection is always the same, and the relative location of the affix with respect to the stem may be part of the phonological representation. These distinctions between (a) and (c) are directly correlatable with derivation and inflection. Specifying that these entries are identical implies that these regular differences are random and need not be accounted for.

A final point on the interaction of stems and affixes: Lieber notes that the combination of inflectional affixes with stems is obligatory and, thus, some kind of checking device will be required to make sure that this is done appropriately. No indication is given that this framework predicts or explains why this should be true for inflection, but not for derivation.

Lieber demonstrates very effectively that inflection and derivation do not differ in the kinds of phonological operations they employ. Both utilize unpredictable alternations, affixes, and string dependent rules of several kinds. And, in many cases, the same operation is used for both inflection and derivation in the same grammatical system. Less successful is the attempt to demonstrate that there are no formal differences at all. As indicated here, actual differences show up even on the view taken there.

2.1.3 Conclusion. In this section, we have argued that there is little evidence in favor of the hypothesis that the same formal properties characterize inflection and derivation. In fact, we have indicated that there are a number of significant distinctions, some of which are pointed out in Halle (1973) and Lieber (1980), even as they argue for
the opposite position.

The contribution of the monolithic morphology hypothesis lies in its delineation of those aspects in which all morphological relations are alike: (1) in the phonological operations that can be used to mark inflectional and derivational categories and (2) in their susceptibility to exceptional behavior. Ultimately, though, it leaves open questions about systematic differences which escape characterization on that view. The conclusion that inflection and derivation do not have distinct formal properties that should be expressed in the grammar does not receive adequate empirical support; too many differences are left unaccounted for and, thus, are claimed to be entirely accidental.

2.2 Some formal distinctions between inflection and derivation. The data presented in Halle (1973) and Lieber (1980) indicate that both inflection and derivation (1) exhibit exceptional behavior and (2) use the same kinds of phonological operation. However, there are still a number of differences between inflection and derivation unaccounted for in those theories, suggesting that the traditional distinction is a valid one. In this section, the predictions made by our rule schemata for inflectional and derivational structures will be explored. It will turn out that many of the differences between inflection and derivation are formal ones that are expressed directly in these rule schemata.

2.2.1 Structural properties of morphologically complex words. We will accept here the arguments in Selkirk (1982) in favor of the type of
inflectional structure rule discussed in 1.3.1 and those in Williams (1981) and Lieber (1980) in favor of binary branching derivational structure rules, with some minor variation in the exact formulation.

First, consider the claims made by schema (A), which does not generate hierarchical structures and those made by (B), which produces hierarchical trees.

(15)
(A) inflection: \( X \rightarrow X^{-1} Y^* \), where each \( Y \) = pre-determined set of 1(+)
(B) derivation: \( X^{-1} \rightarrow X^{-1} Y \)

The flat structure described by (A) predicts that there will be no contributions to meaning in inflected words of the type typically represented in tree structures by having one node take scope over another. This makes the claim that the meanings associated with the stem and with all inflectional operations are "equal" and that any change or difference in these structural relations will not be associated with a change in semantic interpretation. Thus, we expect that there will be no significant semantic difference representable in hierarchical terms between verbs inflected for tense, number, and person in German, where tense marking is ordered before person/number marking and those inflected for the same features in Basque, where the opposite order holds.

(16) German: lieb-te - t 
love past 2pl "you (pl) loved"
Basque: \(z\)-\text{inez-te} - n \quad \text{"you (pl) were"}
2pl past

This prediction is borne out, as far as we can determine; these features have the same interpretation with respect to the stems and to each other in both languages, despite the difference in the relative ordering of their phonological markings.

This claim is in contrast to the claim made in Williams (1981) and Lieber (1980), in which inflectional structures, like derivational structures, are necessarily hierarchical. On that view, the structures for German and Basque would be of the following types:

(17) German:

```
(\(x^n\) \(\text{person/number}\))
/            \
\(x^{n+1}\)      \(z\)\text{person/number}
/    \         /  \
\(x^{n+2}\)   \(y\)\text{tense}  \(x^{n+1}\) \(z\)\text{tense}
/  \
\(x^n\)  \(y\)\text{tense}  \(x^n\)  \(y\)\text{tense}
```

As noted above, this predicts the existence of meaning differences that are possible in principle, but are unattested.

Now, contrast this situation with that indicated by rule (8). This rule requires hierarchical relations when more than one derivational operation is involved. The occurrence of meaning differences following from the order in which derivational rules apply is predicted by the form of this rule. This prediction is borne out. For example, compare
the meanings of *unhappiness* and *unlovable* and their internal structures on this view.

(18)

```
  X-1
   /   \
lovable  Y_un
  / \
love   Y_able
```

```
  X-1
   /   \
unhappy  Y_ness
  / \
happy   Y_un
```

[Remember that our structures are abstract, in that they need not literally match up with parts of the phonological string.]

As these structures indicate, *un* has scope over *lovable*; i.e., *unlovable* means "not lovable". But *ness* has scope over *unhappy*; it indicates the state of being "not happy". What is negated by *un*, then, depends on the order of the operations, as indicated in the derivational structures. Thus, there is at least one difference between derivation and inflection reflected in the form of their structural rules, as given in (A) and (B).

Another area in which these rules predict a difference concerns recursion: inflection is non-recursive, derivation, recursive, on this view. This particular aspect of morphological relations has already been noted (e.g., Dell, 1970). On the one hand, derived words are potentially infinitely long. The already complex word

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antidisestablishmentarianism can undergo further derivation to, e.g., non-antidisestablishmentarianism. But, inflection does not have this property; inflection is limited to certain specific sets of features. One cannot freely create new inflections or words with new depths of inflectional complexity.

On the other hand, one can re-submit derived forms to the same rule, producing industrializational, pre-pre-Columbian art, post-post-war, and so on. Again, this is, in principle, potentially infinite. And, again, it is impossible with inflection. Forms like wanteded, churcheses, etc. are ungrammatical, in contrast to these derived forms which are unusual but possible words in English. This is another difference between derivation and inflection that is expressed formally as a difference between their structural rule schemata.

A further claim is made by this aspect of these rules (A's $X \rightarrow X^{-1}$ and B's $X^{-1} \rightarrow X^{-1}$). We are claiming that there are only two significant levels of word structure: the word ($X^0$) and the stem ($X^{-1}$). We take the word to be the form that can be inserted directly into the syntactic structure and the stem to be a pre-inflection form. If the stem is underived, then it is equivalent to a root; if it has undergone some derivational process(es), then stem has its usual interpretation. The prediction here is that inflection, like the syntax, is not sensitive to derivational complexity. In addition, it is predicted that the distinction between root and stem will not be significant to derivation rules, that derivation rules do not subcategorize for either underived forms (roots) or derived forms (stems) only. This will be explored in more detail later in this chapter. Here, we merely point
out that a significant distinction exists between our account and that of, e.g., Selkirk (1982), in which a crucial difference between root and stem is proposed.

There are, then, at least two properties that distinguish inflection from derivation: lack of recursion and non-hierarchical structures. Derivation is potentially recursive, with significant hierarchical structure. According to our rule schemata (A, B), these are formal properties that characterize the internal structures of inflected and derived words.

2.2.2 Ordering inflection and derivation. Another claim is made by the form of our inflectional and derivational structure rules. Our morphological structure rules require all inflection to be ordered after all derivation. Inflection takes place exclusively at the $X$ level; derivation, only at the $X^{-1}$ level. These rule schemata prevent intermixing inflection with derivation.

This claim is in contradiction to the claim in the theory of Lexical Phonology. Elsewhere, we have adopted aspects of this theory and offered evidence in support of it (e.g., chapter 1 supports the non-discrimination of affixes from rules and the existence of internal structure not expressed in the surface forms of words). And, we continue to assume the account of derivational mapping proposed in Kiparsky (1982). But, on that view, a certain class of inflection rules is ordered before a certain class of derivation rules. Here, we will argue that that view of the internal organization of morphological rules is not sufficiently restrictive, that it predicts the occurrence
in natural language systems of various kinds of morphologically complex words that are unattested. Instead, we will argue, inflection rules are strictly ordered after derivation rules, as predicted by our rule schemata.

First, we will sketch the theory of Lexical Phonology, focusing on the claims it makes for rule interaction. Then, we will demonstrate that several of its predictions are incorrect, that putative cases of inflection/derivation intermixing are not really counterexamples and, in some cases, actually support our hypothesis. This result follows, we will argue, from a theory in which derivation necessarily precedes inflection. Thus, this prediction, like those discussed above, is borne out, and the more restrictive view of morphological rule interaction given in the theory developed here can be maintained.

2.2.2.1 Problems with the account of rule ordering in Lexical Phonology. In the theory of Lexical Phonology presented in Kiparsky (1982) (sketched briefly in 1.4.1), a very restrictive view is taken of the relation of inflection to derivation. +boundary inflection is assigned to level 1 and #boundary inflection to level 3, producing a model of the following type for English:
(19) underived lexical entries

+boundary inflection \[\rightarrow\] cyclic rules
and derivation

#-boundary derivation \[\rightarrow\] cyclic rules
and compounding

#-boundary inflection \[\rightarrow\] cyclic rules

syntax \[\rightarrow\] postlexical phonology

Only certain kinds of interaction between inflection and derivation are permitted in this model. Assigning inflection rules and derivation rules to distinct levels in this way rules out a number of otherwise logical possibilities. In particular, it predicts that (1) level 1 inflected forms can be input to the rules associated with level 2 (#-boundary derivation and compounding); and (2) level 3 inflected forms can never be input to any derivation rule.

This arrangement of morphological rules captures the generalization that inflection typically follows derivation. It also offers an account of a number of otherwise anomalous facts about English, in particular, cases in which inflection seems to occur inside derivation. For example, certain compounds in English tolerate irregularly inflected forms, but not regularly inflected ones, as their
first member.

(20) lice-infested, but *fleas-infested teeth-marks, but *fingernails-marks

This result is predicted by ordering irregular inflection of louse to lice on level 1 before level 2 compounding.

Another claim made by this organization of rules is that words formed by level 2 derivation or compounding will only be inflected by level 3 rules, never by level 1 rules. This explains why verbs formed from nouns of the form Cing (e.g., ding, wing) do not undergo ablaut, even though they fit the structural description. So, the verb wing has the past tense winged, not *wang or *wung, since it is derived from the noun wing.

This kind of evidence from English for the model in (19) seems to provide strong support for the hypothesis made there about the ways in which inflection and derivation can interact in natural language systems.

Inflection is further constrained by the use of the Elsewhere Condition in restricting rule application. The version of the Elsewhere Condition invoked here is:

(21) Revised Elsewhere Condition (Kiparsky, 1982)

Rules A, B in the same component apply disjunctively to a form if and only if

(i) The structural description of A (the special rule)
properly includes the structural description of B
(the general rule)

(ii) The result of applying A to $\emptyset$ is distinct from the
result of applying B to $\emptyset$

In that case, A is applied first, and if it takes effect,
then B is not applied.

This says, in effect, that when more than one morphological rule
develops the same feature value or set of feature values, only one—the
more specific, if possible—can apply. In particular, given two rules

(1) $X \rightarrow X' \uparrow_n \not\prec F$
(2) $X \rightarrow X'' \not\prec F$

where $\not\prec F$ represents one or more morphological features (and $\not\prec F$ in
(1) = $\not\prec F$ in (2)), and where the variable X represents the form
being developed (and $X \neq X' \neq X''$)

Rule (1), being limited to the subset of forms indicated by the
subscript, tries to apply first; if it can, then rule (2) cannot apply.

Again, evidence in favor of this use of the Elsewhere Condition
comes from the facts of English inflection. The irregular rules for
noun plurals and verb past tenses must apply to forms like *goose,
woman, ring, and run in order to prevent the derivation of incorrect
forms like *gooses, *womans, *ringed, and *runned by the application of
more general inflection rules. In addition, the irregular rules must
apply disjunctively; otherwise, the following forms would be produced: *geeses, *womens, *ranged, and *ranned. Thus, the Elsewhere Condition seems to predict exactly the right result for the description of English inflection.

The hypotheses that (1) inflection rules are organized into groups in the same way that derivation rules are, and (2) certain kinds of inflection rules are ordered before certain kinds of derivation rules, together with the Elsewhere Condition, provide a very narrow view of the possibilities for interaction between derivation and inflection, on the one hand, and for interaction among inflection rules, on the other.

One of these hypotheses, that rule application is restricted by the Elsewhere Condition, turns out, on closer view, to be too restrictive and to make incorrect predictions about possible inflectional systems and about the acquisition of inflectional systems. In 2.3, an alternative account will be presented.

Further investigation of the Level Ordering Hypothesis indicates that (1) there are empirical reasons to think that inflection rules are not organized in the same way that derivation rules are; and (2) the desirable results follow from our theory of inflectional structures. This will be discussed in detail in 2.3.

In this section, we will look more closely at the claim in LP that there are derivation rules that regularly take the result of irregular, but not regular inflection rules as input. We will argue that the description of inflection and derivation rule interaction in that model must be further constrained. The association of one kind of inflection with level 1 and another with level 3 predicts the occurrence of a wide
range of phenomena which are unattested; e.g., the existence in English of derived (non-compound) words using irregular plurals or past tenses, the irregular inflection of words derived at level 1, and the non-occurrence of regular plurals inside compounds.

Although we will detail a number of significant problems with the Lexical Phonology framework, we adopt the view that they are not insurmountable, but rather areas for further refinement. Given the more fully developed theory of inflection that we present here, these difficulties disappear, while most of the areas in which LP makes the most interesting predictions remain intact. In essence, these modifications are intended to elaborate the view of inflectional relations taken within that theory, increasing substantially its empirical coverage, while further constraining the class of grammars that are possible on this view.

2.2.2.1.1 Unexplained gaps. One difficulty with the Lexical Phonology account of the interaction of inflection rules with derivation rules is that it predicts the occurrence of more kinds of interaction than are attested. In particular, it predicts the existence of regular, productive rules (those on level 2) that subcategorize for inflected forms in the same way that these rules can subcategorize for input of other kinds; e.g., -able (on level 2) subcategorizes for +V, + transitive. But, there do not seem to be any rules of this type at all in English. There are cases in which noun plurals occur as the first member of a compound, but this is not the result of a productive rule of English. This suggests that the account is still not sufficiently
restrictive, that further measures need to be taken to prevent predicting unattested morphological systems.

For example, the model for English predicts the use of any irregularly inflected form in level 2 derivation and as the first member of compounds. But, in fact, it seems to be the case that only noun plurals, within compounds, actually occur; we know of no words in which an inflected verb is part of a derived word or the non-head of a compound. Of course, compounds of the type [[ V ] [ X ] ] are rare in English (Lieber, 1983; Selkirk, 1982); but there is, in principle, no reason why inflected verbs could not appear in level 2 derived forms in this model of grammar\(^5\). For example, agentive nouns are formed from verbs by adding /-er/ on level 2; however, only the uninflected form of the verb can be taken as input (22a). Similarly, no irregularly inflected form is used in forming gerunds (22b).

\[\begin{align*}
\text{(22) a.} & \quad \text{write} \rightarrow \text{writer} & \ast \text{wroter} & \ast \text{writener} \\
& \quad \text{sing} \rightarrow \text{singer} & \ast \text{sanger} & \ast \text{sunger} \\
& \quad \text{run} \rightarrow \text{runner} & \ast \text{ranner} \\
\text{b.} & \quad \text{ride} \rightarrow \text{riding} & \ast \text{roding} & \ast \text{riddening} \\
& \quad \text{write} \rightarrow \text{writing} & \ast \text{wroting} & \ast \text{writening}
\end{align*}\]

There is another overgeneration problem: there do not seem to be any cases in English in which irregular plurals are used in derivation rules; the examples are all compounds.
(23) childlike *childrenlike manly *menly
    mouselike *mice-like womanly *womenly

Such forms do occur in German, but we will see that there are other reasons to reject the idea that real inflected forms are what is involved.

Another prediction is that words formed on level 1 may undergo level 1 inflection. There do not seem to be cases in which a level 1 derivation rule creates a word that receives level 1 inflection. For example, nouns formed by suffixing \textit{ation, ity}, etc. all undergo regular plural formation (where the result is a count noun)

(24) able $\rightarrow$ ability $\rightarrow$ abilities
    organize $\rightarrow$ organization $\rightarrow$ organizations

This model accounts for the failure of noun-to-verb conversions to take irregular inflection; e.g., \textit{wing} $\rightarrow$ \textit{winged, *wang, *wung}. But, at the same time, it predicts that any new but undervived lexical item is eligible for irregular inflection. New words go into the lexicon and thus seem to be acceptable input to level 1 inflection rules.

But, in fact, the generalization seems to be that subscripted rules (=irregular rules whose lexical domain must be specified) have domains that get smaller, not larger. New words in general receive regular inflection, no matter what their source

A final problem with this organization of inflectin rules and derivation rules: there is no account of the regular plurals (and

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genitives) that occur (on our view, idiosyncratically, as with irregular plurals) inside compounds; e.g.,

(25) nouns: systems analyst/analysis
     Parks Department
     human subjects committee
     ratings book
     numbers racket
     parts department
     jobs program
     reservations desk
     girls club/dorm(itory)
     boys club/dorm(itory)
     ladies auxiliary
     childs play
     menswear

adjectives: hands-on
           hands-off
           hands-down
           ladies-only

2.2.2.1.2 Subcategorization. If we were to adopt the LP view that both singular/uninflected forms and irregularly inflected plural forms are available to level 2 operations, then we would need some principled account of exactly which forms are used when. The rules on level 2 would have to specify whether they take as input forms with category frames of type 1 or type 2:

(26)  1: [ ] N sg  2: [ ] N pl

The following show that singular and plural forms are not used interchangeably; some account would have to be offered for the selections that are made:
(27) lice-infested *louse-infested
feet-first *foot-first
teeth-marks ?tooth-marks
feet-first ?foot-first

But, in fact, the task of providing subcategorization frames that will predict the occurring forms is impossible. There are no level 2 rules that subcategorize for plural forms; the generalization is that level 2 rules use singular/uninflected forms as input. The best we could do would be to have a subcategorization frame saying "Take the plural form, if it is available; if not, take the singular (or uninflected) form." But, even in cases where a plural form is available, having been created at level 1, rules typically do not select it.

(28) footless manlike childhood goosestep
childless womanlike manhood footstep
toothless childlike
mouselike

The forms in which an inflected word occurs must be specified as idiosyncratic. In English, the occurrence of such words is exceptional and unpredictable; instead, it is the occurrence of uninflected forms within derivationally complex words that is predictable, or, at least, the general case.
Further evidence that inflection within derivation is exceptional comes from Gaelic. As the following words indicate, pseudo-inflected words can occur as the first and/or second part of a compound in Gaelic:

(29)

a. cruith-fhearr "creator" < cruth "form, shape"
   fear "man, male individual"

b. croinn-chluiche "lottery" < crann "lot" (plural: croinn)
   cluich "game, sport"
   (gen sg: cluiche)

c. bunachainnte "etymology" < bun "root, base"
   cainnt "speech, language"

d. gàrlaoch "screaming infant" < gàir "outcry, shout"
   laoch "hero, champion, warrior"

e. gràn-chist "granary" < gràin "dried grain"
   ciste "chest, box"

f. gràdh-dhaione "philanthropy" < gràdh "love; charity, benevolence"
   duine "man, person"

g. glaisneulach "pale complexioned" < glas "grey, pale, wan"
   neul "hue, complexion"

In all of these examples, at least one member of the compound occurs in a form that could be produced by inflection; e.g., cluiche in (b) is also the form of the genitive singular of cluich. However, the first members of (a,b,c,d,g) and the second members of (e,f) do not

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occur in these words in underlying form or in an inflected form; instead, they have been changed in a way that can indicate inflection in other words, but not in these.

Further, as in English, it does not seem to be possible to predict when an inflected form, as opposed to an uninflected form, is used.

(30) bun-chiall "moral" √ bun "root, base"
    ciall "reason, sense"

bun-chuis "first cause" √ bun "root, base"
    cùis "affair, cause, circumstance"

glas-bhàn "pale, wan" √ glas "grey, pale"
    bàn "white, pale, fair"

cùl-chainnt "calummy" √ cùl "back"
    cainnt "speech, language"

A comparison of (30a,b) with (29c) shows that noun-noun compounds in Gaelic do not necessarily pick out one form: base, as in (30a,b) or pseudo-inflected, as in (29c). Similarly, (29a) and (30c) illustrate the point with respect to adjective-adjective compounds. This also holds for the second member of noun-noun compounds, as shown in (29c) and (30d); a pseudo-inflected form in used in the first case, the base form, in the second case.

From this data, we are forced to the conclusion that, as in English, the existence of apparently inflected forms in derived words is unpredictable, not rule-governed, in Gaelic. In general, compounds are formed by combining uninflected stems and leniting the initial
consonant of the non-initial member.

German derivation also seems to include cases involving inflection within derivation (Lieber, 1980; Wurzel, 1970); e.g.,

(31)
Wärterstrasse "mammens of our forefathers" < Vater
Mütterverschickung "evacuation of expectant mothers" < Mutter
Geisterseher "visionary seer" < Geist
Bücherfolge "series of books" < Buch

The first part of these compounds takes the shape of one of the inflected versions of the word. But, again, there is evidence that this is not because an inflection rule has already applied; we will argue below that these forms are really only pseudo-inflected, that these are not cases involving rule-governed inflectional processes providing part of the necessary input to rule-governed derivational processes ordered later.

In fact, it seems that German nouns must be lexically specified for the forms they may take in compounds and derived words. As described in Wurzel (1970), some stems always take the same form, the stem (32a); others always take the same form, one that is the same as an inflected one (32b); still others take different forms, according to the lexical identity of the rest of the word (32c).

(32)
a. Tisch, Tischdecke, Tischtuch, Tischbesteck, Tischwein
   Bahnhof, Bahn

b. Strasse: Strassenbau, Strassenbahn, Strassendorf, Strassenverkehr
   Huhn: Hühnerauge, Hühnerleiter, Hühnerrei, Hühnerhund

c. Geist: Geistesgrüße, but Geisterseher
   Pferd: Pferdesport, but Pferdsprung
   Kalb: Kalbfleisch, but Kalbsleber and Kälbermagen

As in Gaelic, there are also words in which forms seem to be incorrectly inflected; that is, they cannot occur independently, although the same operation can produce the correct inflection when combined with other words.

(33) Arbeits-zeit "Arbeits
   Geburts-tag "Geburts
   Sternen-schein "Sternen

In fact, the occurrence of some of these incorrect pseudo-inflections can be quite regular and predictable. For example, the suffixes ung and heit always take an /s/ suffix in compounds, even though they never occur in isolation with an /s/.

It is difficult to see how rules could be constructed to account for these facts. Despite the widespread use of pseudo-inflected forms
in German word formation, the exact form of the "pseudo-inflection" represents part of the unpredictable, idiosyncratic information about particular morphologically complex words.

A case of the type we expect on the LP account (one which can be ruled out on independent grounds discussed in 2.2.2.1.3) occurs in French. The regular rule for forming adverbs from adjectives involves adding the suffix -ment to the adjective in its feminine form, if it has one; e.g., franchement "frankly" < franche < franc "frank", doucement "carefully, softly" < douce < doux "soft". In this case, it appears that a regular, productive level 2-type rule takes as input a form of the base word that is (if possible) the same as a particular inflected form (the feminine). We know of no cases of this type in English.

For example, any noun formed on level 1 can be the first part of a noun-noun compound, productively formed on level 2; e.g., compatibility test, subcategorization frame. This is not true of level 1 irregularly inflected nouns; e.g., tooth fairy, *teeth fairy; tooth doctor, *teeth doctor; foot-building (process, rule), *feet-building (process, rule). The generalization here is that any uninflected noun can be used as the first half of a noun-noun compound; this includes pluralia tantum like pants, scissors, stacks (as in library stacks), and so on. Inflected nouns of either type (regular or irregular) are rare in this position and, on the view taken here, must simply be learned.
2.2.2.1.3 Inflectional meaning in derived forms. Morphology, of course, involves the description of how languages associate sound with meaning. Here, we take a strict view of what it means to have words with inflection inside derivation. If these embedded forms are really inflected, then we expect to find the meaning correlated with the form as part of the semantic interpretation of the word as a whole. The mere occurrence of some phonological string or phonological operation in a word, where the phonology is also associated with some inflectional meaning in other words, does not necessarily constitute an example of inflection inside derivation (e.g., sat in Saturday or satisfied, or sang in sanguine).

One of the well-known characteristics of derivation is that it does not always involve strictly compositional semantic interpretation. As noted in the discussion above in 2.1.1 of Halle (1973), the word recital is not merely the result of combining the interpretation of the verb recite and the nominalizing interpretation of the suffix -al. But what changes in the interpretation of recital is the meaning of recite, not the meaning associated with -al; it is not derivational meaning that is changed or lost, but some aspect of the base word's meaning. So, during the course of deriving a complex word, we can expect some alteration in the meaning associated with the base form in its lexical
entry (especially if the operation is on level 1), but no change in the interpretation(s) assigned to the word by virtue of some derivational rule applying; e.g., -ize → ization; unhappy → unhappier.

In this section, we will take another look at the forms cited above. Although there are some borderline cases in which some aspect of inflectional meaning seems to be present, we will see that, in general, the use of an inflected form is neither necessary nor sufficient for the semantic interpretation of the whole word. In contrast to what happens to derivationally assigned meaning, these pseudo-inflections are typically not associated with the same (if any) interpretation that they receive when used independently. On the view that both irregular inflectional operations and derivational operations can feed productive derivation, this contrast between the two is unaccounted for; indeed, the prediction seems to be that inflectional meanings will be preserved in the same way that derivational ones are.

English, in fact, seems to present a good case for real inflection inside derivation. In all of these words, the inflectional meaning reflected in the form is appropriate:

(34) feet-first
   men-at-war
   lice-infested
   teeth-marks
   alumni club
   menfolk
These contrast with compounds in which a non-plural interpretation of the first member is possible, though not required.

(35) spoon-fed truck driver home-made firetruck hand-picked

However, there is a much larger group of words in which the singular/uninflected form is used, even though the meaning is obviously plural (e.g., a file-cabinet is a cabinet that is intended to hold more than one file; hand-made items usually involve the use of both hands). Here, plural forms are not used, even when an irregular plural is available (b).

(36) a. hand-wash(able) girl-crazy flower-arranger hand-woven street cleaner ballad-singer

b. toothless footgear womanchaser toothy footbinding womanhater toothbrush footpath womanize(r) toothpaste footwear toothpowder

If the use of inflected forms within these compounds is intended to carry inflectional meaning, then the existence of forms like those in (a), and particularly, those in (b), is difficult to account for.
The explanation here seems to be that nouns in this position are interpreted as generic. (This point was suggested to us by Sandra Chung.) Both plurals and singulars (with an article) can be interpreted in English as generic; e.g., The lion/a lion/lions are dangerous. If this is true, then it is easy to understand the lack of change in the interpretation of compounds depending on which form of the noun is used.

The same seems to hold true for the Gaelic and German words given above: although the strings correspond to inflected forms, there is no consistent contribution made to the meaning of the words by the existence of such inflection.

We conclude, then, that there is no semantic evidence for these forms being truly inflectional.

2.2.2.2 Possible counterexamples. Evidence has been presented here consistent with the prediction made by our rule schemata that all inflection rules are ordered after all derivation rules. We have argued that morphologically complex words that include forms that appear to have been inflected (1) are not describable by rule; (2) do not make crucial use of any of the associated inflectional meanings; and thus (3) should not be derived by ordering some inflectional operations before some derivational operations. If, instead, we require the idiosyncratically used stems to be included as part of the word's lexical entry, the correct prediction is made: derivation rules may access more than one form of a stem. On this view, some German words will have only one stem in their lexical entries, accessed by both
derivation and inflection rules. Others will have more than one; in this case, the subscripts on the rules themselves indicate which stem is to be used. The same kind of account can be constructed for Gaelic. English has few examples of pseudo-inflection; this can be expressed by assigning these exceptional forms their own lexical entries. Unlike German and Gaelic, subscripted rules in English refer to lexical entries with only one stem.

In fact, there are cases in which fully inflected words, with both form and meaning the same as in underived words, seem to be submitted to derivational processes. The differences between words of this type and those discussed above is dramatic and suggest a quite different account of apparent cases of inflection within derivation than the one offered in LP.

One potential counterexample to our claim that all inflection rules are ordered after all derivation rules comes from the verbal morphology of Navajo, which is characterized by a large number of prefixes. Sapir and Hoijer (1967) assign these prefixes to the following nine classes, from word-initial to immediately preceding the verb stem:

(1) adverbial
(2) iterative
(3) distributive plural
(4) object agreement
(5) deictic subject agreement
(6) adverbial
(7) aspect, mode, tense (except for iterative = (2))
(8) subject agreement (except for deictic = (5))
(9) classifier
What is interesting here is that two kinds of adverbial prefix, which are typically considered derivational rather than inflectional, are interspersed with inflectional prefixes. Indeed, one set (1) occurs outside all inflection. It looks as if our hypothesis is incorrect, that our theory must allow inflection rules to be ordered both before and after derivation rules.

However, there is a serious problem with this kind of account. In general, it is these prefixes that subcategorize for which of three perfective markers (ni, si, yi) and which of three imperfective markers (ø, n, y) occur in position (7). The selection is typically made by the adverbial in slot (1) or (6), if there is one. If there are markers in both (1) and (6), the imperfect or perfect marker selected by the adverbial element closer to the stem prevails.

(37)

a. dásédá "I am sitting up here"
< dâh...dá "be sitting here"
< dâh-, slot (1) adverbial that takes an s-perfect marker, a
ø classifier, combined here with root dá

s < si, perfect
é, 1 subject
b. nášiddořtə̀h "you (pl) pick me up"
< ná...diŋ...tə̀h "pick up an animate object"
< ná  slot (1) adverbial +
  di  slot (6) adverbial, which takes a y-imperfect marker
  ľ  classifier
  tə̀h  root
  ŝī  1 sg object
  o  reduced version of yī-imperfect
  o  reduced from oh, 2 pl subject

In dáséda, the (1) adverbial prefix dàh specifies the shape of the perfect marker as s; in nášiddořtə̀h, it is the (6) position adverbial di that specifies which imperfect marker is used (/y/).

In addition, some subject markers (slot 8) are chosen on the basis of which imperfect marker is used; ni is the 2sg subject marker used with the y-imperfect marker, while just a high tone on the previous syllable is used with the Ø and y imperfect.

It is difficult to see how the correct selection could be made if the adverbial prefixes are added to the stem by rules ordered after those that are supposed to attach the right inflectional prefixes. The adverbials do not combine freely with roots; the roots must subcategorize for the slot (1) adverbials, the slot (6) adverbials, and the combinations of slot (1) and slot (6) adverbials that they can co-occur with. Which perfect and imperfect allomorphs can be used depends on the identity of the root and which, if any, adverbials are added. Somehow, the inflection rules would have to know which
adverbials are added later and what their subcategorizational restrictions are.

However, this kind of situation, in which a derivational operation subcategorizes for particular inflectional operations, is predicted by a theory in which derivation precedes inflection. The difficulty here is a phonological one; inflectional markings must be infixed in the right positions. Exactly how this is to be done is beyond the scope of this paper. But this case, and others like it, offer support for our hypothesis; they do not constitute a counterexample to our proposal.

2.2.2.2 Real inflection inside apparent derivation. Although most of the cases cited in the literature are like those sketched above, there are a limited number of instances in which fully inflected forms seem to provide input to a regular derivational rule. Interestingly, these cases involve a category change: a fully inflected word of category X is converted to category Y, and then fully or partially inflected as a Y. In this section, a case that seems to involve a verb-to-noun conversion will be presented. We will argue that these data do not represent a counterexample to our claim that derivational and inflectional processes cannot be mixed.

One language in which verb-to-noun conversion apparently follows the inflection of the verb is Maricopa [Yuman]. It is argued in Hamm (1981) that all verbal markers except Ṣa "when", -k and -m the switch reference markers, and -uum the future marker, can occur in nominalizations of this type.
(38) ?ám - u: - tra:y - Ś xot’-k

2-sub/1-obj nom’re root, sg S-mkr good realis

"the fire you built for me was good"

cf. ?ám - tra:y - k "you built a fire for me"

2-sub/1-obj root, sg realis

There are many irregularities in the marking of subject plurals in Maricopa, but this does not affect the verb-to-noun conversion.

(39)
verb: ?ám - u: - tra:y-Ś "you (pl) built a fire for me"

2-sub/1-obj nom root pl-subj

nom’n: ?á - u:- t-u: - ra:y-Ś - á - Ś xot’ k

3-sub/1-obj nom pl-subj pl-sub demon Subj

"the fire they (3+) built for me was good"

verb: u:man "cure, sg" u:Śman "cure, pl"

nom’n: ?i:pa: u:man-á - Ś xomar -k

man root demon Subj young-sing realis

"The man he cured was young"
"the men they (3+) cured were young"

Unlike the German and Gaelic cases cited in 2.2.2.1.1, the inflectional markings in the Maricopa forms have their regular interpretations, as the glosses indicate. Thus, it appears that these verbs undergo their usual inflection rules, are then converted to nouns, which can then be marked in the usual way with /-₄/ if used as syntactic subject, the demonstrative /-₅/, and other nominal case markings.

However, there are two reasons to think that these nominal markings are actually attached to NPs, not Ns; that is, there is evidence that /₄/ and /₅/ are clitics that attach to the final member of NP, rather than the result of inflection rules developing N.

One piece of evidence comes from the surface forms of sentences including these nouns. As the following examples show, overt subjects of the converted verbs cannot be marked as subjects (Gordon, 1980). Instead, it is the rightmost member of the NP (the verb) that the subject marker attaches to. This can lead to ambiguity, as shown in (a).
(40) a. ?i:pa: səʔak a:šu:xam-ŋ puy-k  
man     woman hit-sg    die realis  
"the man that the woman hit is dead" or  
"the woman that the man hit is dead"  
b. kwixo Bonnie Pam u: - aty - a? - yu: - k  
basket Nom'k give-sg * I-S/3-0 see-sg realis  
"I see the basket that Bonnie gave Pam"  
*Gordon (1980) calls this a vowel augment that can be added to  
consonant-final nouns.  

Another piece of evidence is that nouns and adjectives in  
attribution to a noun take nominal marking, not the head noun itself.  

(41) a. ?i:pa: xmiš sper-ŋ h wik-k  
man tall strong Sub 3-S/1-0 help realis  
"A tall, strong man helped me"  
b. pi:pa: srap-ŋ vakpal' tev - k  
people five Sub Phoenix be-loc-pl realis  
"there are five people in Phoenix"  
c. qwaq̌ ʔmaroy ?lwe - k  
horse toy I-S/3-0 make-sg realis  
"I made a toy horse"  
d. kwes?ul?ul xavsú: Ɂqaw - m  
apple green eat-sg realis  
"he ate a green apple"  

These data indicate that nominal case and demonstrative markings  
in Maricopa are cliticized to the right-most boundary of NPs. This is  
not, then, a case of derivational conversion intermixed with verbal and  
nominal inflection.
2.2.3 **Scoreboard.** In this section, we have argued that a number of differences between inflection and derivation are formally characterized by our rule schemata:

\[
A: \quad X \rightarrow X^{-1} Y^* \quad \text{(where each } Y = \text{pre-determined set of } 1(+) \text{ features)}
\]

\[
B: \quad X^{-1} \rightarrow X^{-1} Y
\]

In particular, we have demonstrated that non-recursivity and non-hierarchicalness are formal properties of inflected words that are required by the grammar. The theories of word structure proposed in Williams (1981) and Lieber (1980) are less restrictive; it is claimed that inflectional systems can be hierarchical and recursive, although this seems to be unattested, or, at least, not the kind of general case that a theory of grammar should predict.

In addition, we have argued that the requirement made by these schemata that all derivation rules precede all inflection rules receives strong empirical support. We have shown that the predictions about morphological rule intermixing made by the theory of Lexical Phonology are not sufficiently restrictive and imply that a much wider range of data is possible. Putative examples of such intermixing, we have argued, are neither rule-governed nor parallel to other cases of rule intermixing. It appears that grammars may or may not use forms of stems that look as if they have been inflected; even if they do, it is impossible to predict which version of every stem is used in which derivation rule. In the next section, we will continue to explore the
claims about distinctive properties made by (A) and (B).

2.3 More formal properties. In this section we will investigate the differences predicted by another aspect of our rule schemata: the \( Y^* \) in (A) and the \( Y \) in (B). The nodes in the inflectional part of the word tree are pre-specified for the features they represent. Furthermore, the ordering of inflectional operations is encoded in inflectional structures by the left-to-right ordering of the nodes. This means that the order of application for all the inflection rules developing features associated with a particular substitution class must be compatible with the order given by the language-specific inflectional structure rule.

This part of our rule schema constrains inflectional systems in a particular way; we expect to find no cases in which a language has forms of the type shown in (42). [Note: For expository convenience, this example assumes a strictly suffixational inflectional system; however, the notation \( Xabc \), etc. should more properly be interpreted as a series of operations, \( a < b < c \), on \( X \). As argued in chapter 1, affixation is simply an operation that can be parsed in sequential chunks.]

(42) \[ Xabc \]
\[ Xbca \]
\[ Xcba \]
\[ Xcab \]
where \( a = 1, 2, 3 \) person marking

\( b = \) singular/plural marking

\( c = \) past/present marking

Instead, rule schema (A) makes the claim that a language with substitution classes \( a, b, c \) will exhibit one and only one ordering; for example, all person marking ordered before all number marking ordered before all tense marking.

Thus, the \( Y \) nodes in inflectional structures represent sets of inflection rules with the same ordering properties, as well as the same set of inflectional categories. In 2.3.2, we will argue that, in the general case, inflectional structures specify all the ordering properties of inflection rules.

The claim made here for derivation is quite different. \( Y \) is unassociated, predicting that the same operation may be ordered differently in different words. An example of this was given above with \underline{unhappiness} and \underline{unlovable}. The prefix \underline{un} takes adjectives and negates them; it must "wait" until \underline{love} is turned into an adjective by the addition of \underline{able}. Similarly, \underline{un} cannot be added to \underline{happy} if \underline{ness} has already turned that adjective into a noun. The affixation of \underline{un} must precede affixation of \underline{ness}, but follow the rule that affixes \underline{able}.

The claim here is, in effect, that ordering restrictions for derivation rules are independently specified; the only constraint placed on derivation rules by morphological structures is that they apply before inflection rules, as discussed in 2.2. In this section, the Level Ordered Hypothesis about the organization of derivation rules
will be discussed in detail. The claim of that hypothesis is that (1) there are sets of derivation rules which are crucially ordered with respect to each other; (2) these sets are determined by degree of phonological and semantic transparency or opacity; and (3) rules within sets are freely or intrinsically ordered. What is relevant here is that these sets of rules are determined independently, not on the basis of the meanings or features associated with the phonological changes. It is the rules as a group that have internal organization specifying their relative ordering, not derivational structures. For example, English has three prefixes with a negative meaning: un, in and non. Although they express the same meaning, their phonological, semantic, and ordering properties are distinct. Thus, they do not form a "substitution class" developing the feature +negative. Instead, each prefix belongs to a different group of derivation rules, each group with characteristic properties.

This difference between derivation and inflection is predicted by the formal distinction between (A) and (B). This is one of an array of properties that distinguish inflection from derivation: lack of recursion, non-hierarchical structures, strict ordering of sets of rules developing the same features. Derivation, on the other hand, is potentially recursive, with significant hierarchical structure, and rules ordered independently, insofar as they are ordered at all. According to our rule schemata (A, B), these are formal properties that characterize the internal structures of inflected and derived words.
2.3.1 The organization of derivation rules versus the organization of inflection rules. Our claim here is that the ordering properties of derivation rules are not given directly in derivational structures, but are specified independently, where necessary. This is in contrast to the ordering of inflection rules, which follows directly from the specifications in inflectional structures. In 2.2, we argued that one claim about morphological rule ordering made by our rule schemata—the ordering of inflection rules after derivation rules—receives strong empirical support, contra the claim made in the theory of Lexical Phonology. In this section, we will argue that another part of that account of the ordering of morphological rules is incorrect. We will show that there is no support for the notion of level ordered inflection to be gained from the Level Ordering Hypothesis that underlies the organization of derivation rules in that (and this) theory\(^9\). Thus, we can maintain the more restrictive account provided in the theory developed here.

The data presented in 2.2.2 already suggest that the level assignments in LP for inflection rules are inappropriate; the absence of rule-governed (regular or irregular) inflection inside derivation indicates that that model makes incorrect predictions by extrinsically ordering certain inflection rules before certain derivation rules via level assignment.

In fact, there are additional reasons for thinking that inflection rules are not organized in the same way that derivation rules are. The other (i.e., non-ordering related) motivations for proposing distinct levels of derivation rules are generally lacking in inflectional...
relations. In order to make this clear, we will review here the arguments in favor of assigning internal organization to a grammar's derivation rules, as presented in Allen (1978). Then, we will show that these arguments do not apply in the case of inflection rules.

2.3.1.1 Level ordering and derivation rules. The Extended Ordering Hypothesis, developed in Allen (1978) based on work by Siegel (1974), draws together a number of apparently disparate facts about certain morphological processes in English. A theory of derivation is constructed from which these facts may be shown to fall out in a very natural way. The facts are essentially these:

(1) Derivational processes vary in the degree of transparency shown in their phonological relations; some words are obviously the result of simple concatenation, while others are subject to a high level of distortion produced by the subsequent operation of phonological rules.

(2) Derivational processes display different degrees of compositionality in their meanings; some are derived strictly from the sum of their parts, but others develop their own idiosyncratic, unpredictable aspects of meaning that obscure the source of the relation to some extent.

(3) Derivational processes seem to form groups based on their ordering with respect to each other and show strict co-occurrence
restrictions; some groups of affixes can co-occur only with other affixes of a certain type.

Allen illustrates these points by comparing the properties of three negative prefixes in English: in-, un-, and non-. For example, nasal assimilation applies to words derived by the prefixation of in-, but not un- or non-; this obscures the identity of the prefix in (43a), while the prefixes in (43b) and (43c) are immediately recoverable.

(43) a. illegal *inlegal
imbalance *inbalance
irrational *inrational

b. unlawful *ullawful
unbalanced *umbalanced
unrationalized *urrationalized

c. non-lethal *nollethal
non-broken *nombroken
non-real *norreal

Another possible source of phonological distortion is stress reduction; certain words with prefixed in- have initial stress which triggers vowel reduction elsewhere. This is never possible with un-; moreover, words prefixed with non- have two primary stresses, one on non- itself.
(44) a. impotent (cf. potent); infinite (cf. finite)
b. non-potent
   non-finite
   non-christian
   non-wearable
c. unarmmed
   unadjusted
   unchristian
   unwearable

Similarly, words derived by these three processes differ in their
semantic properties; in- words frequently have unpredictable aspects to
their meanings, the meaning of un- words are usually predictable, and
those of non- words always are. As Allen points out, the sharpest
distinction is between in- and non-.

(45) a. informal b. unformal c. non-formal
   irreligious unreligious non-religious
   incredible non-credible
   incoherent non-coherent
   independent non-dependent

In- and un- are also distinguishable on the basis of the other
affixes they can occur with, even using the same stem. Non- can occur
with some affixes of both types.
(46) a. inanimate   b. unanimated   c. non-determinate
    injustice       unjustness   non-friendly
    indeterminate  undetermined   non-organic
    inoperative    unoperable     non-operable
    incessant      unceasing      non-operative
    incertitude    uncertainty    non-decisive

The significant generalization that Allen makes from these facts is that the various degrees of transparency are directly correlated with one another. Words formed with in- tend to be not just more opaque phonologically, but semantically as well; un- and non- prefixed words show relatively transparent relations of both kinds. These facts are explained by dividing derivational processes into groups, each marked with boundary symbols; e.g.,

(47)  # [in+] [X] #
     # [un#] [X] #
     # [#non#] [#X#] #

Derivation rules, then, must apply in the order indicated by relative boundary strength, which also determines degree of possible phonological and semantic distortion. This ordering of derivation rules by levels (but not within levels) also explains a number of co-occurrence facts.
(a) only *in-* (+ level) can occur with non-words: *inert, insipid, intrepid* \[^{10}\]

(b) *in-* (+ level) only occurs with affixes associated with + level (-ion, -itude, -ity, -ate)

(c) only *un-* (# level) can co-occur with other affixes associated with # level (-ness, -ing, -ed)

(d) only *non-* (## level) can occur with certain compounds (also ## level); e.g., *non-habit-forming, *inhabit-forming, *unhabit-forming

2.3.1.2 Inflection and levels. There do not seem to be the same kinds of motivations for assigning internal organization to a grammar's inflection rules. For example, the motivation for levels based on ordering properties does not hold for inflection rules. The inflectional structures argued for in Chapter 1 specify all crucial ordering properties. The only advantage to maintaining a model in which some inflection rules are assigned to level 1 is for the description of the interaction of those rules with level 2 rules. But, it has been argued here that putative cases of this type are, in fact, exceptions that should be noted in the lexicon.

In addition, there is no semantic motivation for the level assignment of inflection rules. One of the basic characteristics of
inflection rules is their strict compositionality; "past" has the same interpretation with respect to every verb. Assignment of certain inflection rules to level 1, as opposed to level 3, predicts that the same kind of distinction in semantic transparency that characterizes distinct derivation rule levels holds for the two inflection rule levels. But there is no evidence for this.

So, the assignment of inflection rules to the kind of levels used for the description of derivation rules makes incorrect predictions of several types: (1) it predicts certain rule-governed interactions between level 1 inflection and level 1 and 2 derivation that are not attested; (2) it predicts a distinction in semantic compositionality that is unsupported; and (3) it claims that the same kind of arbitrary grouping and crucial ordering necessary to describe derivation rules extends to inflection rules.

The lack of evidence for these claims supports our hypothesis that the ordering of inflection rules is encoded directly in inflectional structures, not determined by the same kind of level ordering system as derivation. There does not seem to be any evidence that inflection rules form sets characterized by the same properties as sets of derivation rules. The claim made by our rule schema (A) is that inflection rules are ordered on the basis of the order of the substitution classes. Further evidence in favor of this claim will be presented in 2.3.3.

2.3.2 Locality and inflectional structures. The binary vs. flat aspect of our morphological structure rules also makes predictions about the
form of morphological rules. Derivation rules seem to meet a locality constraint on how much information they can access: (1) the result of the last operation (X⁻¹) and the current operation (Y). This follows (to some degree) from the fact that Y is unassociated with features prior to the application of a derivation rule; rules cannot look up at the features associated with a higher node.

Inflectional structures, on the other hand, have information about inflectional features available at all times. On the view taken here, the nodes of an inflectional structure tree are pre-associated with features. In this section, we will examine the nature of derivational locality constraints; we will see that they are dependent on the hierarchical structure found in derivation but not in inflection. Then, we will look at the claim made by having non-hierarchical structures and pre-associated features for inflected words: rules are able to access more than one node at a time. Evidence indicating that this is the correct claim will be presented; data from a variety of inflectional systems indicate that inflection rules do refer to features associated with more than one substitution class. The implications of this claim for rule ordering will be explored in detail.

The theories of morphology presented in Kiparsky (1982), Lieber (1980), Williams (1981), and Selkirk (1982) all include some account of the fact that morphological operations seem to care only to a limited extent about the derivational history of their input. These constraints are all motivated primarily on the basis of derivational relations; but, it is an explicit or implicit claim in each theory that the same

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kind of "locality" constraint applies to inflected forms and that it performs the same kind of work. In this section, we will argue that locality has a very different interpretation in inflection, one that follows directly from inflectional structures.

2.3.2.1 Locality in derivation rules. A number of proposals have been presented to account for the fact that derivation rules typically need to know only the result of the last operation performed. Further, derivation rules seem not to distinguish between simplex and complex input. So, for example, the negative prefix un generally combines with adjectives, whether they are given as adjectives in the lexicon, as with unhappy or unclean, or they are derived in the lexicon, as with unavailable. In addition, the depth of derivation does not seem to be relevant; un can combine with available, the result of one previous derivational operation, or to forms like enfranchisable, which involves several operations. What is crucial is that the preceding operation creates or preserves the form as an adjective.

Allen (1978) accounts for this by means of an adjacency condition.

(48)  No word formation rule can involve X and Y, unless Y is uniquely contained in the cycle adjacent to X.

This prevents rules from accessing any non-local information about input forms.

Lieber (1980) proposes a revised adjacency condition, stated in terms of the subcategorization frames that account for combinatory
possibilities in her theory.

(49) No subcategorization frame can state a dependency between X and Y if there is more than one bracket between X and Y.

Williams (1981) argues that his Atom Condition (50), but not the Adjacency Condition (48), can account for the fact that -ion can combine with conduct, where duct is a latinate root.

(50) A restriction on the attachment of af_x to Y can only refer to features realized on Y.

[+latinate]    ion
     /       \
    /         \
con     duct

This is because his theory includes the percolation of the feature [+latinate] to the immediately dominating node, thus allowing ion to access the feature. According to the Adjacency Condition, he argues, the feature is no longer accessible after con and duct are joined together.

Pesetsky’s Bracket Erasure (1979) provides the same kind of constraint in a slightly different form. On this view, all but the outermost set of brackets are erased after the application of every morphological rule; e.g., [...]_N \rightarrow [...]_N}_v, then by Bracket
Erasure, \( \rightarrow [\ldots]\)_y. In this way, the generalization is captured that further operations on a form of this type will not have to refer to \( [\ldots]\)\(^N\).

Lexical Phonology (Kiparsky, 1982) uses a variation of Bracket Erasure. Instead of the brackets being erased at the end of every operation, they are erased at the end of each level or set of derivational rules.

Each of these constraints makes slightly different predictions, while handling roughly the same data. Here, we will assume that this kind of constraint on the locality of derivational operations is well motivated.

2.3.2.2 Locality and inflection. The locality constraints proposed to account for the properties of derived words all make crucial reference to the internal structure of the word, in particular, to its hierarchical structure. These derivational locality constraints prevent rules from accessing information about any but the most recent step in the word’s derivational history. Notice, too, that derivation rules cannot look ahead to some later process; that is, there do not seem to be rules of the type "do x to a noun just in case it becomes a verb later". This result follows from the fact that the nodes in a derivational word tree are not pre-associated with any features. The combination of unspecified Y nodes and some version of locality, then, makes the claim that derivation rules can look only at the last step in the derivation and no farther ahead than the current operation.
It has been argued here that inflectional structures are different from derivational structures; they are non-hierarchical, flat, n-ary trees whose nodes are pre-associated with inflectional features. This structure predicts that inflection rules will have different properties from those attributed to derivation rules. On this view, all inflectional rules are "local"; some are local in the sense that they refer to features in the same substitution class; others are local in the sense that they refer to features on the same level. For example, the structure of inflected words predicts that inflection rules can access features on more than one node; i.e., from more than one substitution class. Given an inflectional structure of the form in (51a), we expect to find rules of the type in (b).

(51) a. 

\[
\begin{array}{c}
\text{X} \\
\text{X}\text{-1} \quad \text{Y} \quad \text{Z} \quad \text{W} \\
\alpha F \quad \beta G \quad \gamma H
\end{array}
\]

b. \( X \rightarrow X' | \alpha F \) \quad \( X \rightarrow X' | \beta G \) \quad \( X \rightarrow X' | \gamma H \)

[Note: "X" in inflectional structures = lexical categories; "X" in inflection rules = phonological shape of the stem as developed thus far in the derivation (Anderson, 1977).]

In addition, we expect to find inflection rules that access \( X^{-1} \); that is, irregular rules that apply only to a proper subset of relevant lexical items.
(52) for example,
X \rightarrow X' \, l_n \, \alpha \, F
X \rightarrow X' \, l_n \, \beta \, G
\, \gamma \, H

In fact, there is considerable data to support these predictions.

In this section, we will present evidence that inflectional systems
exploit the whole range of possibilities for accessing nodes in
inflectional structures. We will show how these data support our
proposed inflectional and derivational structures and how they support
our hypothesis that inflection and derivation have different structural
properties.

First, we will introduce some terminology. Let us call those rules
that refer to features on a single node (= in a single substitution
class) **strongly local** rules. This is the kind of rule we expect to find
in every inflectional system, the canonical rule that motivates the
selection of substitution classes in the inflectional structure.

However, we will present evidence in this section that there is another
kind of inflection rule, one that is also local if inflectional
structures are n-ary and non-hierarchical. Rules that access features on
more than one node, we will call **weakly local** rules. These are also
expected, on the theory of inflectional structures developed here.

However, they are not so numerous as strongly local rules in any given
grammar. Typically, they form just a small subset of all inflection
rules. Given a rule \( X \rightarrow X' \, l_n \, \alpha \, F \, \beta \, G \), it is the inflectional
structure that indicates whether the rule is strongly or weakly local.
A grammar in which it is strongly local (53a) has an inflectional structure which is formally simpler (and, thus, by the usual view of the evaluation metric, more highly valued) than that of a grammar in which it is weakly local (b).

![Diagram](image)

2.3.2.2.1 Strongly local rules. Maricopa's verbal morphology contains mostly strongly local rules. The rules for subject number marking apply before those for subject and object person marking, which apply before that for object number marking. Thus, for example, the singular form of "rob" ci:s, must be inflected for subject number before the markers for subject/object person can be added:

(54) ći:s → u: -ći:s "rob, pl" → ? - u: -ći:s "we robbed pl-S rob 1-S/ pl-S rob him/her" 3-0

Applying subject/object person marking first produces the incorrect *u:-?ći:s. In the same way, the marking for plural object cannot be added until after both subject number and subject/object person have been marked:
(55) \(\ddot{c}i:¥\) \(\rightarrow\) \(u:\ddot{c}i:¥\) "rob, pl" \(\rightarrow\) \(?u:\ddot{c}i:¥\) "we robbed him/her" \(\rightarrow\)
\(\ddot{r}i\) \(-?\) \(- u: -\ddot{c}i:¥\) "we robbed them"

pl-0 l-S/ pl-S rob

3-0

These data can be represented by the inflectional structure in (56).

(56)

```
/\ddot{c}i:¥/
   /\   \   /
   \ \   \   \
   Y Z W
```

- subject/ object number
- subject/ object person

e.g., \(X(C)V(:)C_0 \rightarrow X/u:(C)V:C_0\) ] plural S

\(X \rightarrow ?X \) ] l S/3 0

\(X \rightarrow \ddot{r}i\) ] plural 0

The rules developing these features refer exclusively to single terminal nodes/substitution classes. The inflectional structure specifies the order in which these rules can apply: subject number < subject/object person < object number. That is, the substitution classes are accessed left-to-right: \(Y < Z < W\).

Much of German verbal inflection is characterized by strongly local rules. In the weak past and subjunctive, the rules for tense and mood marking are applied before those for person and number marking.
(57)  \( \text{mach-te-}\emptyset \)  "I made"
\( \text{mach-te-st} \)  "you (sg) made"
\( \text{mach-te-}\emptyset \)  "he/she/it made"
\( \text{mach-te-n} \)  "we made"
\( \text{mach-te-t} \)  "you (pl) made"
\( \text{mach-te-n} \)  "they made"
\( \text{mach-e-}\emptyset \)  "I make/made (subj)"
\( \text{mach-e-st} \)  "you (sg) make/made (subj)"
\( \text{mach-e-}\emptyset \)  "he/she/it make/made (subj)"
\( \text{mach-e-n} \)  "we make/made (subj)"
\( \text{mach-e-t} \)  "you (pl) make/made (subj)"
\( \text{mach-e-n} \)  "they make/made (subj)"

These data suggest that the inflectional structure for German is:

(58)  
```
    X
   /
  /  \
X-1  Y  Z
```

    tense  person
    mood   number

Only strongly local rules apply to produce the forms in (57); the rules developing these inflected words refer exclusively to the features on \( Y \) or on \( Z \), and they apply in the order specified by the inflectional structure: \( Y < Z \).
(59)e.g.,  \( X \rightarrow X_{te} \) past
\( X \rightarrow X_{e} \) present subjunctive

\( X \rightarrow X_{st} \) 2 sg
\( X \rightarrow X_{t} \) 2 pl
\( X(e) \rightarrow X_{en} \) 1 pl
\( X(e) \rightarrow X_{en} \) 3 pl

The verbal system in Maricopa and part of German verbal inflection, then, are described by strongly local rules, representing (we hypothesize) the expected or unmarked case in inflectional systems.

2.3.2.2.2 Weakly local rules. There are actually two kinds of weakly local rule. Weakly local rules can access features in more than one substitution class, or they can access one or more substitution classes, along with the stem (\( X^{-1} \)). The latter are irregular rules, ones that have subscripts restricting their input. These will be discussed in turn.

Consider the following data from Basque; here, certain inflection rules must access two terminal nodes, in spite of evidence that the nodes otherwise represent distinct substitution classes.

Person marking in Basque is generally independent, forming a single substitution class. First person singular and plural and second person singular and plural are correlated with the same set of marking throughout the verbal paradigm: n-, 1 sg; g-, 1 pl; z-, 2 sg; z...te, 2 pl. But in the third person, both past tense and potential can
influence the phonological shape of the prefix. Inflected verbs in Basque show a high degree of stem allomorphy.

(60) \[ \begin{array}{ll}
    d & - a \\
    & 3\text{-pres-ind stem}
\end{array} \]
"he/she/it is"

\[ \begin{array}{ll}
    d & - ire \\
    & 3\text{-pres-ind stem}
\end{array} \]
"they are"

\[ \begin{array}{ll}
    z & - e - n \\
    & 3\text{-past-ind stem past}
\end{array} \]
"he/she/it was"

\[ \begin{array}{ll}
    z & - ire - n \\
    & 3\text{-past-ind stem past}
\end{array} \]
"they were"

\[ \begin{array}{ll}
    l & - aite-ke \\
    & 3\text{-poten stem poten}
\end{array} \]
"he/she/it can be"

\[ \begin{array}{ll}
    l & - itez-ke \\
    & 3\text{-poten stem poten}
\end{array} \]
"they can be"

These and other data indicate that there are distinct constituents for person/number, for tense (past is marked independently by the suffix /n/), and for potential, which is marked distinctively by a /ke/ suffix, as shown above. Notice that these constituents must be strictly ordered: person/number, + potential, and + past.

(61) \[ \begin{array}{ll}
    z & - in - te - ke - n \\
    & 2\text{-S stem 2pl-S pot past}
\end{array} \]
"you (pl) could have been"

This indicates that the relevant part of the inflectional structure for Basque verbs is:
The rules for first and second person and number marking are strongly local; they refer exclusively to Y. But, in the case of third person marking, the rules need to access both Y and a node to the right, either Z or W.

Left-to-right accessing specifies rule ordering in the case of weakly local rules, as well as in the case of strongly local rules. For example, rules (63e) and (63f) both access features associated with Y, but (e) also accesses a feature associated with Z.

(63) a. X → Xke ] potential  
b. X → Xn ] past  
c. X → dX ] 3 present indicative  
d. X → zX ] 3 past indicative  
e. X → lX ] 3 potential  
f. X → nX ] 1 singular

By left-to-right accessing, rules referring to Y are ordered before rules referring to Z; e.g.,
derivations:

(1) access Y /u/ → /nu/ /u/ → /lu/
(2) access Z /nu/ → /nuke/ /lu/ → /luke/
(3) access W

Since the weakly local rule (63e) accesses Y, it is applied in the same order as strongly local rules accessing only Y, like (63f), as the sample derivations show.

A slightly different case occurs in Persian. In general, person/number marking follows tense marking; e.g.,

(65) geréf-t - am "take (past absolute)"
    stem past 1sg-S
    geréf-t - i
    stem past 2sg-S
    geréf-t - ia
    stem past 1pl-S
    geréf-t - id
    stem past 2pl-S
    geréf-t - and
    stem past 3pl-S

Third person singular marking, however, is sensitive to tense:
(66)  gerɛf-t - Ø "he took (past absolute)"
      stem  past 3sg-S

      raf -t - é - ast "he has gone (past narrative)"
      stem past narr 3sg-S

Here, the rules marking features associated with one substitution
class (person/number) need to access features associated with a
substitution class to the left (narrative).

(67)  
      V
    /   \   
 /     \  
v-1 Y Z W

      past  narr  person/number

Weakly local rules, then, can look in either direction at the
features on other nodes.

We will need to add a corollary to left-to-right accessing, in
order to ensure that the rule marking narrative applies before the rule
marking 3sg narrative; e.g.,

(68)  a.  X → Xɛ ] narrative (i.e., access Z)

      b.  X → Xast ] 3 sg narrative (i.e., access Z and W)

These rules both access the same node (Z), but must apply in a
specific order: (a) < (b). Let us adopt the following convention: where
left-to-right accessing fails to uniquely determine rule order (because both rules access the same, left-most node), apply a strongly local rule before a weakly local rule. This will require the rules to apply in the order shown above; (a) is strongly local and (b) is weakly local.

Notice that the existence of weakly local rules of this type signal a crucial difference between inflection and derivation, one that is represented formally in our morphological structures. Only inflected rules have flat structures in which this kind of "violation" of locality can occur, in which a rule can look ahead or more than one step back. As argued above, inflectional categories are pre-specified: all the relevant feature values are given directly in the inflectional structure. Thus, the feature values are, in a sense, "available" before and after mapping rules apply. Derivational features, on the other hand, are not pre-specified, but filled in by the application of mapping rules. Thus, there should be no phenomena of this type involving derivation rules.

There is another kind of weakly local rule; irregular inflection rules, like irregular derivation rules, must be able to access the stem, $X^{-1}$. Thus, the rule that changes $\text{seh}$ to $\text{sah}$ in the past tense in German must know that $V^{-1}$ is associated with $\text{seh}$, as opposed to $\text{mach}$.

\[(69) \quad X \rightarrow X' \mid_{n=\text{seh}} \cdots \text{past}\]

As predicted by the view of inflectional structures argued for in chapter 1, the inflectional structure for German proposed in (58)
also describes German strong verbs in the past indicative and present subjunctive.

(70) sah-∅ "I saw"
    sah-st "you (sg) saw"
    sah-∅ "he/she/it saw"
    sah-en "we saw"
    sah-t "you (pl) saw"
    sah-en "they saw"
    seh-e-∅ "I see/saw (subj)"
    seh-e-st "you (sg) see/saw (subj)"
    seh-e-∅ "he/she/it see/saw (subj)"
    seh-e-n "we see/saw (subj)"
    seh-e-t "you (pl) see/saw (subj)"
    seh-e-n "they see/saw (subj)"

Although the phonological marking of past tense (internal stem change) cannot be matched up with the nodes in (58), the ordering of the rules stipulated by this structure (past < person/number) is not violated. Thus, the same inflectional structure describes all of these cases.

There are also some weakly local rules of this type in Maricopa. Recall that some of the plural subject agreement rules must refer to particular lexical items; e.g., the rule lowering vowels to /a:/ for plural subject agreement must be subscripted.
(71)  mśđe → mśtu:w:av  "be afraid of"
čew → u:ča:w  "build"
but, swen → tsu:wi:n  "hang"
e: → u:e:$/  "leak"

In fact, it seems to be possible for inflection rules that access
the stem to also access features associated with non-adjacent nodes;
that is, there are cases in which stem allomorphy is triggered by
features associated with substitution classes other than Y. The
following data from Navajo indicate that local inflection rules are
very different from local derivation rules.

Recall from 2.2.2.2 that Navajo verbs include a string of
inflectional prefixes; verbs also have a number of stem allomorphs
whose shape is determined by tense. For example the stem di...bááh
"start off to war" has the following allomorphs:

(72)  di...bááh  imperfect, optative
di...báá?  perfect
di...báh  progressive, future, iterative, customary

The inflection rules that describe this allomorphy must refer to
the stem ($V^{-1}$) and the substitution classes for the tenses. Based on
the description in Sapir and Hoijer (1967), we can construct the
inflectional structure:
Thus, weakly local inflection rules must be able to access \( V^{-1} \) and \( Z \) or, even \( U \); e.g.,

\[
\begin{align*}
\text{(74)} & \\
\text{di... èèh} & \text{imperfect "begin to carry (a pack or burden)"} \\
\text{di... ́} & \text{perfect} \\
\text{di... ééY} & \text{future} \\
\text{di... ééh} & \text{iterative} \\
\text{di... è?} & \text{optative}
\end{align*}
\]

These data provide strong empirical support for the idea that inflectional structures are flat and, therefore, inflection rules are always local; if Navajo's inflectional structures were binary and hierarchical, the fact that stem allomorphy is triggered by iterative tense would be difficult to account for. We would have to adopt a very different view of locality for inflectional hierarchical structures than the one that seems to be correct for derivational structures.

Again, the existence of local rules of this type is predicted by the pre-specified, flat inflectional structures proposed here. And, left-to-right accessing provides the correct ordering: these rules access \( X^{-1} \) as well as \( Y \); so, by left-to-right accessing, they must apply first, before any other inflection rules. Notice that our

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strong-before-weak convention requires all the rules accessing $X^{-1}$ to precede rules accessing $X^{-1}$ and $Y$; that is, all derivation precedes irregular inflection. Thus, our inflectional structures and accessing constraints capture several generalizations about morphologically complex words, some of which must be simply specified in other theories: (1) derivation precedes inflection; (2) irregular inflection rules apply before regular inflection rules; and (3) rules marking the same substitution class have the same ordering properties. In contrast, on the view taken here, each of these generalizations is captured directly in the form of the structural representations. The constraints placed here on the form of these representations place strong limitations on the class of possible grammars.

2.3.2.3 Double marking and blocking. Another example of irregular weakly local rules comes from Albanian verbal morphology. Albanian has two verb classes — C-final and V-final, but certain verbs in the C-final class undergo stem alternations, even though their inflected form is otherwise identical with those of non-alternating C-stems. In the present and aorist tenses, inflectional markings indicate person/number as well as tense:
(75)  present            aorist
      1 sg   fal          fal-a        "to give"
      2 sg   fal          fal-e
      3 sg   fal          fal-i
      1 pl   fal-im       fal-Ŷm
      2 pl   fal-Ŷn       fal-Ŷt
      3 pl   fal-in       fal-Ŷn

[Note: Ŷ is a schwa. The other orthographic symbols have roughly their IPA values, except as noted.]

The imperfect and the optative ("may I ...") are marked by an additional suffix /Ŷ/, orthographically Ŷh, ordered before the person/number/tense markers.
(76)  imperfect          optative
      1 sg  fal-sh-e       fal-sh-a
      2 sg  fal-sh-e       fal-sh-ë
      3 sg  fal-t-e        fal-t-ë
      1 pl  fal-sh-im      fal-sh-im
      2 pl  fal-sh-it      fal-sh-i
      3 pl  fal-sh-in      fal-sh-in

These data indicate that Albanian verbs have the following inflectional structure:

(77)

```
  V
 /\   \\      \
|   |   |      |
V-l Y Z
```

impf   person
opt.   number

present/aorist tense

The stem internal vowel changes that characterize certain Albanian verbs are: (1) the last vowel of the stem becomes /i/ in the imperfect and in the second plural present indicative; and (2) the last vowel of the stem becomes /e/ in the second and third singular present indicative.
(78)  present  imperfect  "to hit, beat"

1 sg  rraf  rrif-sh-e
2 sg  rref  rrif-sh-e
3 sg  rref  rrif-t-e
1 pl  rraf-im  rrif-sh-im
2 pl  rrif-ni  rrif-sh-it
3 pl  rraf-in  rrif-sh-in

[Note:  rr is strongly trilled, contrasting with weakly trilled r.]

It is the alternation in the imperfect that concerns us here. In order to produce the correct inflected forms, we need (a) a rule changing the stem vowel in the imperfect of certain verbs; (b) a rule adding the characteristic /ŋ/ to all verbs in the imperfect; and (c) rules for person/number. Rule (a) accesses Y and V⁻¹, so it is weakly local. In addition, the rules for 1sg, 2sg, 3sg, and 2pl are sensitive to whether the verb is imperfect or optative, as shown in (76); these are also weakly local.

These data further support the claim made by our theory of inflectional structures: inflection rules can access one substitution class, more than one substitution class, or one or more substitution classes and X⁻¹. This result provides strong empirical support for our claim that inflectional structures are not hierarchical. If they were hierarchical, then we would expect inflection rules to be constrained in the same way that derivation rules are. But, we have shown here that they are not constrained in the same way; inflection rules can access features that have not already been marked (as in Basque third person

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agreement), and they can access the stem, even though other rules have applied to that stem (as in Albanian imperfect marking). These kinds of rules are unattested in derivational systems. In addition, our claim that the nodes in inflectional structures are pre-associated with features is supported. On this view, all the feature values are accessible, whereas only the current and most recent features are available in derivational structures. Thus, these data provide further evidence in favor of our claim that inflection has distinct formal properties.

However, there is nothing in the theory developed so far that will account for grammars like that of English, where most forms that are marked by an irregular rule cannot also undergo the regular rule (e.g., *geeses, *clunged). On the account given above, we expect these forms to be grammatical. These inflectional structures say nothing about how many times a rule can access the same substitution class. English seems to require a theory in which accessing is constrained so that rules cannot access a feature more than once, whether alone (in regular rules) or along with \( X^{-1} \) (in irregular rules). Albanian, on the other hand, seems to require a theory in which features can be accessed more than once. "Imperfect" must be accessed once (along with \( V^{-1} \)) to produce the vowel change in verbs like rraf and then again, in all verbs, to suffix /ʃ/.
(79) \[ \begin{array}{c}
\text{V} \\
\text{V}^{-1} \quad \text{Y} \quad \text{Z} \\
/\text{rraf}/ \quad \text{impf} \quad \text{lpl} \\
\end{array} \quad \begin{array}{c}
\text{V} \\
\text{V}^{-1} \quad \text{Y} \\
/\text{foot}/ \quad \text{pl} \\
\end{array} \]

derivations:

(1) access $V^{-1}$ \hspace{1cm} \text{rrif} \hspace{1cm} \text{feet}

(with Y)

(2) access Y \hspace{1cm} \text{rrifsh} \hspace{1cm} *

(3) access Z \hspace{1cm} \text{rrifshim}

German, in fact, has instances of both phenomena. The derivation of the strong past indicative is like English; the suffixation of the weak past ending /te/ must be blocked just in case the stem has undergone internal vowel change:

(80) \[ \begin{array}{c}
\text{seh} \rightarrow \text{sah} \rightarrow *\text{sahte} \\
\text{bleib} \rightarrow \text{blieb} \rightarrow *\text{bliebte} \\
\end{array} \]

However, the so-called mixed verbs are like the Albanian imperfects; they are double marked for past tense:

(81) \[ \begin{array}{c}
\text{brenn} \rightarrow \text{brann} \rightarrow \text{brannte} \\
\text{bringen} \rightarrow \text{brach} \rightarrow \text{brachte} \\
\text{senden} \rightarrow \text{sand} \rightarrow \text{sandte} \\
\end{array} \]
We have, then, a paradox: cases in which rules cannot access the same feature(s) more than once exist alongside cases in which rules can access the same feature(s) more than once.

W. Leben and S. Anderson (p.c.) have suggested an alternative account of these cases. The idea is that, in double marking, the relevant rules actually have larger domains. For example, the /ষ/ that marks Albanian imperfects also marks optatives; and the vowel change that is used in a subset of verbs in the imperfect also takes place in the second person plural present. Thus, the story goes, the domains are not identical, and the Elsewhere Condition has nothing to say, allowing conjunctive application. This is supposed to be in contrast to English, where /z/ is used only for noun plurals, not for other nominal marking (assuming that the genitive /z/ is cliticized). In English, then, the plural rules apply disjunctively because of the proper inclusion relation and because the feature domains are identical, not overlapping, as in Albanian, thus triggering the Elsewhere Condition.

There are several problems with this account. First, it requires a view of inflection rules in which a single phonological operation can be associated with a non-natural class of inflectional features: non-natural, in that only curly brackets or diacritics can be used to collapse the features; e.g.,

\[(\exists) \ x \to Xs \begin{cases} \text{imperfect} \\ \text{optative} \end{cases} \text{ or } +D, \text{ where } +D = \text{imperfect or optative}\]
The other problem is empirical. The English past tense rules are
disjunctively applied, too. In this case, however, the regular rule
applies to past participle and past non-participles; e.g., walk,
walked, have walked. But the irregular rules may have two different
domains, depending on the operation and on the particular lexical item:

(83) a. sing, sang, have sung \( I \rightarrow \wedge \) past participle
    b. ring, rang, have rung \( I \rightarrow \not\wedge \) past non-participle
    c. cling, clung, have clung *clang \( I \rightarrow \wedge \) past
    d. ride, rode, have ridden
    e. keep, kept, have kept

The prediction made by the account sketched above is that the
rules that apply to both past and past participle (c, e) will block the
application of the regular /d/ rule, because their feature
specifications are identical. But, in those cases where the irregular
rule applies only in the past or only in the past participle (a, b, d)
, the regular rule can apply as well, since the domains are not
strictly identical. This predicts that the correct forms are: *sanged
and *riddened, for example. This interpretation of the Elsewhere
Condition, then, accounts for the form of English plurals, but not the
form of English inflected verbs. Therefore, we conclude that the
account offered here is to be preferred; English is primarily a
blocking language, and this is a language-particular fact about English
that must be learned by its speakers.
Given the contradictory nature of the data, it seems impossible at this point to provide an account in which both phenomena follow from general principles. A survey of the world’s inflectional systems might reveal some statistical preference for one case or the other, but, here, we will find support for our decision from a more abstract base: morphological errors.

We are familiar with errors of this type from only one language (English). But this provides exactly the kind of information we need. English is primarily a blocking language; there are few cases in which double marking occurs. (It seems possible to analyze better, wives, houses, baths as double marked.) If, then, we accept blocking as the universal and double marking as the exceptional, this makes relevant predictions about learning and speech errors in English. In particular, children will have no positive evidence for the existence of double marking. If blocking is the unmarked case, the result that follows automatically from the universal rule systems, then we expect only one kind of error to occur: failure to realize or remember the limited domain of an irregular rule. And, in fact, this is quite common: *foots, *goed, etc. There should be, however, no attested occurrences of double marking errors (e.g., *geeses, *womens, *sanged, *clunged). Without positive evidence that double marking is an available, if unused, option for inflection, speakers will remain unaware of its existence. We expect, then, a clear distinction between errors in languages with double marking and in those without: the former, but not the latter, will produce forms like *feets, *hunged, and so on.
The problem, of course, is that double marking errors do occur in English. If the account that we set up has blocking as the usual case, it is difficult to see how these forms could be produced. If, on the other hand, we propose that double marking is built into the rule system, the existence of forms like these is predicted: speakers of English must learn that double marking is, in general, not permissible in English, even though it occurs in other languages. Notice that positive evidence for blocking is easily available; irregular blocked forms are quite common, in everyday use. But errors of the double marking type still show up in adult speech (Stemberger, 1982), indicating that the possibility of double marking is still available. Taking double marking as the unmarked case in our account makes the correct predictions: in English, two kinds of errors occur. On the opposite view, only one of these is accounted for; half of the relevant data is left unexplained. The prediction made for children learning Albanian is that they will not produce errors of the sort involving blocking; e.g., *rrife instead of rrifshe for the 1 sg and 2 sg imperfect.

Another interesting prediction made by allowing rules access to features on non-terminal nodes is that n-tuple marking can occur. That is, there should be cases in which more than one irregular rule applies to a form, marking the same feature(s). Striking confirmation can be found in the details of plural agreement in Maricopa, given above. Not only can two rules mark plural subject agreement, but several can apply to the same form.
<table>
<thead>
<tr>
<th>Singular</th>
<th>Plural</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>čew-</td>
<td>uːčaːw-</td>
<td>&quot;build&quot;</td>
</tr>
<tr>
<td>mške-</td>
<td>mštuːgaːv-</td>
<td>&quot;be afraid of&quot;</td>
</tr>
<tr>
<td>yuː-</td>
<td>uːyoːv-</td>
<td>&quot;see&quot;</td>
</tr>
<tr>
<td>maː-</td>
<td>uːmaːv-</td>
<td>&quot;eat&quot;</td>
</tr>
</tbody>
</table>

Many Maricopa plurals, then, are formed by (1) regular infixation and (2) irregular stem changes; i.e., double, even triple or quadruple marking (e.g., mške → mštē → mštə: → mštəaːv → mštuːgaːv).

And, all of the irregular changes can be accounted for by rules with a small domain; these are not suppletive stem changes, but different combinations of the same basic changes: (a) vowel lengthening or shortening; (b) raising or lowering of non-low vowels; (c) prefixation or infixation of ʰ, r, n; and (d) suffixation of ʰ or v. For example, the vowel change in uːčaːw is of the same character as that in mštuːgaːv, suggesting that a single irregular rule, making crucial reference to these lexical items, generates this aspect of plural marking. Similarly, the suffixation of /v/ occurs in a number of forms, along with regular /uː/ infixation and, in some cases, additional rules.

Here, we seem to have the kind of case predicted by this account of inflectional structures: two or more rules refer to the same feature(s).

On this view, then, it is blocking that is exceptional—those cases in which the same feature cannot be accessed by another rule. We might ask why blocking enjoys such popularity (especially in English),
if it is indeed not the usual situation. Notice that, formally, a derivation with blocking is simpler; only one rule applies. Once a speaker learns when double marking isn't acceptable (through positive evidence), a simpler (i.e., one-step as opposed to two-or-more-step) analysis results. The most restrictive account of these phenomena would be one in which a language were either a blocking language or not; however, the data from German (81) and English suggest that a neat bifurcation of this type is not possible. At least, it does not seem possible, given our current level of understanding about how inflectional systems work. Further research can be expected to reveal more interesting hypotheses about the blocking phenomenon. On the account offered here, we expect a continuum of inflectional systems, ranging from those with lots of double marking to those with little or no double marking. While less than maximally restrictive, this seems like an appropriate characterization of Maricopa, Albanian, German, and English.

This account does place certain constraints on possible inflectional systems, though; for example, it predicts that languages do not occur in which forms like *geeses are neither acceptable nor attested errors. The regular operation of the rules in accordance with the inflectional structure will produce forms like this, even in blocking languages like English. Once the language learner starts to analyze morphologically complex words into their component parts, errors like *womens show up, even though it is highly unlikely that the learner has ever heard forms of this type.
2.3.3 Conclusion. The theory of inflection developed here claims that the only kind of inflectional system possible is one characterized by substitution class phenomena; that is, inflectional features and the rules that develop them can be organized into sets over which generalizations about ordering can be stated. In the morphological theories of Williams (1981) and Lieber (1980), there is no account of substitution classes; the fact that rules developing the same features tend to have the same ordering properties (the same subcategorization frames, on that view) appears entirely accidental. On Selkirk's (1982) view, there is no account of weakly local rules, whose existence in natural language has been supported here; it is implied there that rules access only single substitution classes, that only strongly local rules (lexical entries, in fact) describe inflectional systems. It is not clear how the facts of languages like those discussed in this section could be accounted for in that theory.

We have argued here that morphological mapping rules and their application are distinct in their formal non-phonological properties: derivation rules have limited access to the output of other rules and are organized by their transparency/opacity; inflection rules have access to all the feature values generated in a particular inflectional structure. We have also presented an account of double marking; there does not seem to be an analysis of the double marking data available in other theories.

Finally, the account offered here solves a number of long-standing problems in inflectional morphological theory. These problems revolve
around two contradictory observations about inflectional systems. The first is the one noted above in the discussion of Selkirk's (1982) view of inflection: inflection rules tend to group together on the basis of the features that they mark. The other observation is that inflectional systems typically include rules that "violate" this generalization. Thus, in the same inflectional system, we may find: (1) rules of the type that motivate the postulation of substitution classes; (2) rules that mark features across these groups; (3) rules that mark features more than once; and (4) no marking of features at all. The difficulty, then, in describing inflectional systems is how to account for the existence of both phenomena: consistent groupings of rules and inconsistencies in those groupings.

In the account of inflection presented here, the first generalization is expressed directly in the inflectional structure; each node in inflectional structure trees represents those features whose rules are grouped together. The "exceptions" are what we have termed weakly local rules. These are possible, but less highly valued rules. Not only are both aspects of inflectional systems accounted for here, but this theory provides a formal characterization of the difference between them, in terms of their relative cost to the grammar.

In addition, this theory makes the claim that all inflected words described by the same inflectional structure have the same number of components; the number of components is not necessarily equal to the number of rules plus the root or stem. Given an inflectional structure of the form $X \rightarrow X^{-1} Y Z$, the claim is that members of category $X$
consist of three components (excluding the number of components in $X^1$ itself): a base form plus two substitution classes. This holds if there are, for example, two strongly local rules applying to the base form, as in the German verb mach-te-st "make-past-2sg". But it also holds for forms in which only one rule has applied, as with machte, macht, and sah, in which person, number, tense, and mood are all marked by a single rule. And, it would also hold for forms in which no rule at all applied—in which both person/number and tense/mood were zero-marked, if such forms existed in German.

One consequence of this interpretation of component identification is that there is no need in this theory to posit zeroes of any kind: zero affixes or zero rules. "Zero" here is simply the failure of any rule to overtly mark some category or categories that otherwise receive some overt marking. The inflectional structure provides the inventory of features that are marked, the inflection rules provide the inventory of phonological manifestations of those features.

An account of inflection that has some interesting similarities, but crucial differences, to the view presented here may be found in the Extended Word-and-Paradigm theory (Anderson, 1977, 1982 and the papers in Thomas-Flinders, ed. (1981)), as well as in the Word-and-Paradigm theory (Matthews, 1974) on which it is based. This theory shares the view taken here that there are no principled differences between morphological rules and affixation. However, the Extended Word-and-Paradigm theory takes a very different view of the substitution class phenomenon. On that view, rules are organized into extrinsically ordered blocks. This captures the notion of position
classes. But there are two differences between that view and the one
taken here. First, there is no distinct level of structural
representation; thus, the kind of syntactic information expressed in
our word structure trees is held not to be grammatically significant
(for discussion, see Anderson, 1982). One may extrapolate some of the
information from the rules themselves, but the claim is that this
information has no grammatically relevant properties or distinct
constraints of the type we have argued for here. One may, for example,
assume that the number of components is equal to the number of rules
that apply plus the root or stem. But, this means that members of the
same paradigm may have different numbers of components. This becomes
especially tricky in the case of zero marking; it is argued in Anderson
(1977) that some zero rules are necessary. In other cases, zero marking
is indicated by the lack of any rule. Thus, one form that isn’t overly
marked for a feature may undergo a rule to indicate this, while another
form, also without overt marking, may simply not undergo any rule at
all. On that view, then, the number of components in a word, the
classes they belong to, and their combinatorial restrictions (along with
any universal constraints on possible syntactic properties in words)
are not considered significant information about word structure.

The lack of distinct structural representations in that theory has
another unfortunate consequence; although rules are organized into
blocks that correspond to position classes (the rules within blocks
apply disjunctively, by convention, while rules in distinct blocks
generally apply conjunctively), nothing in the theory prevents rules in
the same block from developing different features. In general, blocks
in which the same set of features are developed (our substitution classes) may be rendered more highly valued through various formal simplification techniques. But nothing prevents the existence of inflectional systems of the type sketched in (42) above, in which each block contains rules developing features from a different set; e.g., block (1) with rules for (a) first person, (b) past, (c) plural; block (2) with rules for (a) future, (b) singular, (c) third person; block (3) with rules for (a) dual, (b) second person, (c) present. This type of system would simply be less highly valued.

Also, there is no distinction made there between strongly local and weakly local rules. The claim made here is that strongly local rules are more highly valued than weakly local ones.

There are similarities, then, in the way that that theory and our theory look at morphological operations. But there are significant differences. Here, we are making the claim that the content of the substitution classes is restricted (and thus the class of possible inflectional systems); on that view, the rules within blocks need have no internal consistency (although such consistency may be more highly valued). Also, we are claiming that the number and type of components in a word (and their associated syntactic constraints), is grammatically significant information and that words within the same paradigm share these properties. In the Extended Word-and-Paradigm theory, however, there is no consistent way to determine this information. Also, there is an ambivalent attitude in that theory toward the lack of overt phonological marking in inflected forms: some forms undergo a special zero rule, some don’t. On our view, zero

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marking results from the failure of any rule to apply to mark those features. Finally, there is no account in that theory of the two kinds of inflection rules distinguished here: strongly local and weakly local.

Overall, then, we conclude that our view of inflectional structure resolves some interesting problems in inflectional theory, problems that do not receive an account in these other theories. In particular, we have offered an account of the contrast between operations exhibiting substitution class behavior—the same ordering of the rules marking different values for the same features—and operations that do not fit this generalization. Other theories either cannot account for the existence of both phenomena or do not distinguish between them.

2.4 A more restrictive model of the lexical component. In this chapter we have argued that inflection and derivation have distinct properties and that their mapping rules are not intermixed, but crucially ordered so that derivation feeds inflection in the general case. Let us now consider what an appropriate model of grammar would look like on this view.

The model that we will propose here consists of (1) lexical entries containing the usual kind of idiosyncratic information, (2) word structure rules, (3) internally organized derivation rules and (4) unorganized inflection rules; this constitutes the lexical component\textsuperscript{13}. Its output is inserted into syntactic trees (at s-structure, we think) which provide the input to the interpretive components.
Lexical entries are inserted into freely generated word structure trees, "freely generated" in regard to (1) depth (or lack) of derivation, and (2) inflectional feature values. This gives us an account of a difference between derivation and inflection which is often characterized as optional vs. obligatory. Derivation is optional because both simplex and complex stems are characterized in the same way (here, as $X^{-1}$); i.e., it is not necessary for any rule to apply in
order to derive a stem. However, there is a crucial distinction between an inflected form (X) and a pre-inflected form (X^{-1}), and pre-inflected forms must undergo some rule in order to be characterized as X or, as insertable into a syntactic structure. The properties that a word must be inflected for are specified by the structural rule. The derivational structure rule may or may not apply, any number of times; thus, it is "optional".

The lexical item and its associated structure are then submitted to the morphological mapping rules. Derivation rules are internally organized into levels with associated cyclic phonological rules (Kiparsky, 1982). They apply freely, as long their subcategorizational requirements are met. When enough rules have applied to produce the highest X^{-1} or "stem" (which may be just the lexical entry), the form then undergoes the relevant inflection rule(s), applying in accordance with the inflectional structure assigned to the stem, its feature values and the arrangement of the substitution classes. It is this final X or "word" that is associated with the syntactic structure by lexical insertion. The output of the syntax is operated on by the postlexical phonology and the semantic component. Notice that there are only two places in this model where ordering must be specified: (1) the ordering of levels and (2) the ordering of nodes in inflectional structure rules. This represents a substantial formal simplification of the model. But the model is also more restrictive than, say, that of LP; it requires (1) all derivation rules to be ordered before all inflection rules; and (2) all inflection rules accessing the same substitution class to have the same ordering properties.
It has been argued here that the formal properties of inflection and derivation follow from the distinct properties of morphological structural rule schemata. On this view, inflection is non-recursive, does not show hierarchical relations, and is marked by sets of rules developing strictly ordered sets of inflectional features. In contrast, derivation is recursive, with strictly hierarchical relations, and is ordered independently, where ordered at all. In addition, derivation must be ordered before inflection.

Thus, these rule schemata capture a number of oft-noted distinctions between inflection and derivation. None of the morphological theories discussed here (Williams, 1981; Selkirk, 1983; Lieber, 1980; Kiparsky, 1982; Anderson, 1977, 1982) offer an account for (all of) these generalizations. Notice, though, that the insights offered in that literature have not been lost. For example, the observation that inflection and derivation use the same kind of phonological operation (Lieber, 1980) is formally expressed. There is no distinction here between the rules that map inflectional structures onto phonological form and those that map derivational structures onto phonological strings. In fact, it is argued in chapter 1 that all mapping rules, those that affix segments and those that change the form internally, have the same formal expression. But, here, this generalization has been captured without making incorrect predictions about rule-governed interaction among morphological rules; we have argued that other theories predict a high degree of unattested intermixing of inflection rules and derivation rules.
And notice that the attempt to delineate rule types has not been abandoned. It has, instead, been re-focused into an area for which considerably more evidence exists in favor of a distinction. That is, the division of grammatical rules into inflectional and derivational has a great deal of intuitive support; the distinction persists (we have shown) even in analyses drawing parallels between them. It has been argued here that this distinction receives considerable support at the formal level, as well.

Also, the kind of account of (a) non-affixational and (b) weakly local inflectional operations proposed in Matthews (1972) and Anderson (1977) has been incorporated here; the use of a single type of mapping rule for (1) affixation, (2) simultaneous operations, (3) strongly local rules, and (4) weakly local rules brings out the generalizations that characterize all morphological systems. However, on this view, differences among these types of rules are neither lost nor over-emphasized. There are still formal distinctions in the complexity of mapping rules and word structure rules.

Finally, we have argued that grammars with inflection rules like those in English, must include special ordering statements in order to specify certain instances of disjunctive rule application that are not predicted by inflectional structures (and do not occur in the general case). Whether or not this statement can be correlated with other facts about English and English-style grammars is left as an area for future research.
Footnotes to Chapter 2

1 There are cases in which "gapping" takes place after certain prefixes in English: e.g., pro- and anti-abortion, pre- and post-docoral. It is probably significant that (1) only prefixes, (2) only contrastive prefixes, and (3) only prefixes separated from the gapped word orthographically by a hyphen seem to be involved. Thus, the following, which do not have all three properties, do not seem acceptable: *child-like and -less, *post- and anti-war, *un- and re-do, *en- and un-tangle.

2 Sandra Chung informs us that Chamorro seems to have derivation rules meeting the first criterion, but (crucially) not the second.

3 There are, of course, languages in which not all syntactic categories are inflected. Our proposal here is that in these cases, the grammar contains a rule of the form: \( X \rightarrow X^1 \), where \( X \) is the non-inflected category; e.g., \( V \rightarrow V^1 \). This means that any verb, derived or undervied, can be inserted directly into the syntactic tree. There is a reason for not saying simply that these are \( X \)'s, for maintaining that they are members of the category \( X^1 \) prior to the application of the special rule. This has to do with the checking device—the mechanism that ensures that the correctly inflected form is inserted into trees. Let us say that the checking device is local; it only has access to the information immediately dominated by \( X \): i.e., the highest \( X^1 \) and the inflectional nodes (\( Y^* \)). On this view, the checking device can only see the information about the stem associated with the highest \( X^1 \)—its subcategorizational information and its inflectional features, which, in this theory, are simply a particular kind of subcategorizational information. If uninflected categories are also dominated by \( X \), then we capture the generalization that the checking device never looks at information below this level (the one immediately dominated by \( X \)). If, instead, we say that uninflected words are members of category \( X \), then we have no explanation for why the checking device does not treat these forms differently, having access to some of their derivational history.

4 The Elsewhere Condition is also a crucial part of the theory of inflection presented in Anderson (1977, 1981, 1982) and Thomas-Flinders (1981). In that theory, inflection rules are organized into conjunctively ordered blocks, which approximate our substitution classes. Within blocks, rules are strictly ordered, but apply disjunctively. By invoking the Elsewhere Condition, the inflectional feature part of the structural description can be formally simplified in the same way that phonological rules can be. For example, the Elsewhere Condition permits the following kind of simplification in phonological rules:

\[(i) \ a. \ A \rightarrow B / C \ D \quad \Rightarrow \quad A \rightarrow B / C \ D \]
\[ A \rightarrow B' (C \ D) \]
\[ \{ C \ D \} \]

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This can be extended, it is argued, to the part of the inflection rule that expresses the features being marked; e.g., an internally ordered block like (iia) can be simplified to (iib), if the Elsewhere Condition is invoked to ensure the correct interpretation of the underspecified structural description in b (2).

\[(2) \ A \rightarrow B' \] 
\[\{F \rightarrow G\} \]
\[\{F \rightarrow G\} \]
\[\{F \rightarrow G\} \]
\[\{F \rightarrow G\} \]

In addition, the Elsewhere Condition is incorporated into the theory in a way that is more like its use in Lexical Phonology. The Blocking Principle (Platt, 1981) states that no rule can apply marking the same feature value(s) as an earlier rule; e.g., the rule suffixing /d/ to past tense verbs in English cannot apply to a form which has already been marked for past tense by some irregular rule. This phenomenon is discussed in more detail in 2.3.2.3.

5 broken in broken-hearted is arguably an adjective, like other forms that appear in this slot: cold-hearted, hard-hearted, stout-hearted. Other adjectival forms, homophonous with past participles, occur in noun-adjective compounds; compare strife-torn, care-worn with head-strong, nation-wide, skin-deep (Selkirk, 1982).

6 Verbs can be inflected if they are in the head position of a compound (withstood, overrun, etc.) or of a productively prefixed form (re-wrote, re-written, undone, etc.). The same seems to be true of nouns; e.g., boat-children, super-women. This follows from the subcategorial properties of the head position, as discussed in Chapter 1.

7 Will Leben informs us that the borrowing from French milieu is being pluralized in certain idiolects of English as milieux, rather than the predicted milieus via the regular English plural rule. We assume that the spelling indicates knowledge of French on the part of the users of this plural; it is difficult to see how speakers of English without prior knowledge of French could come up with this form.

8 Paul Schachter has pointed out to us that some aspect of the inflectional meaning "past" seems to be retained in certain adjectives with the same form as a small subset of past participles in English; e.g., broken, well-traveled, badly-written. It is not obvious to us how these forms should be derived or how they can be accounted for in a theory like Lexical Phonology, which predicts that only the irregularly formed participles (e.g., broken, written) can be used in this way.

It is also not clear to us exactly what inflectional meaning past participles convey; that is, it seems to be the tensed auxiliary in constructions with participles that convey the meaning. One can easily
imagine a dialect of English in which, say, the base form of the verb was used instead of the participle without loss of meaning; e.g., instead of *She has broken the window* or *She had broken the window*, *She has/had break the window*. Compare this with the use of these forms in adjectival slots; this is where these forms seem to have clear contributions to meaning to make; e.g., *The window is broken* vs. *The window is breaking*.

9 We are not claiming that no level-ordered inflectional system exists; we are arguing that, if such systems exist, the levels do not have the same criteria for membership that derivational levels do, and thus, levels of inflection are distinct from levels of derivation. The claim in LF is that inflection and derivation are assigned to the same kind of level.

10 Allen (1978) notes that cases in which *un-* is combined with a non-word (e.g., *unkempt, uncouth*) are all cases in which the stem was once a full word, though now archaic.

11 A different kind of locality in inflection rules is proposed in Hammond (1981). This constraint, formulated within the Extended Word-and-Paradigm Theory, says that inflection rules can only access features which are assigned to adjacent layers, where layered representations are constructed in a way quite different from the bracketed representations used here.

12 There are two main dialects of Albanian (Mann, 1932). In the Gëg dialect, imperfect and optative are both marked by the suffix */$i*; but in the Tosk dialect, imperfect, but not optative, is marked by the suffix */$a/*. In addition, there are certain paradigm regularization patterns that occur in the imperfect, but not the optative, in both dialects. It appears that, no matter what kind of feature we might propose in order to make optative and imperfect into a single class formally, there is dialectal evidence that it is not a natural class.

13 Evidence that the lexical component includes a morphological LF is presented in Pesetsky (1983).
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