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Representations of multiply suffixed words: Implications for grammatical and psychological models of the lexicon

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REPRESENTATIONS OF MULTIPLY SUFFIXED WORDS: IMPLICATIONS FOR GRAMMATICAL AND PSYCHOLOGICAL MODELS OF THE LEXICON

by

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INTRODUCTION

This study examines grammatical and psychological models of the lexicon and various theoretical issues raised within the respective approaches. First, a grammatical analysis of the structure of multiply-suffixed complex words extends morphological theory by proposing an account of the order of suffix morphemes which does not invoke extrinsic level ordering. Secondly, in the cognitive psychology domain, two lexical decision experiments using multiply-suffixed words address the question of the representation and storage of suffixes. Psychological evidence is presented suggesting that the mental lexicon is organized according to a grammatical property: affix boundary type. Further, it is proposed that multiple-suffix patterns are stored in the lexicon as paradigms or schemas which may be sensitive to the frequency effect. Finally, the relationship of morphological productivity and frequency is examined from a linguistic and psycholinguistic perspective.

Part of the research is corpus-based, whereas other parts are based on linguistic intuition and psychological experimentation. Linguistic intuitions regarding the structure of complex derived forms are supported by data extracted from a 25-million word corpus. The corpus, obtained

by IBM in the early 1970's from the American Publishing House for the Blind (APHB) contains 204,128 distinct words collected from over 553 sources of contemporary American English, including novels, short stories and magazine articles from diverse publications such as *Reader's Digest*, *Fortune*, and *Datamation*. An obvious advantage to the use of the APHB data is the size of the corpus: it is 25 times larger than the standard Kucera and Francis (1976) one-million word count. Consequently, it forms a substantial empirical base against which linguistic claims can be checked.

Chapter 1 introduces the notion of the lexicon in grammatical and psychological theories and poses the question of whether these two areas of research share points of convergence that might deepen our understanding of morphological phenomena and lexical processing.

Chapter 2 surveys the major developments in morphological theory since Chomsky's (1965) proposal that the lexicon be considered a separate subcomponent of the grammar (base). The seminal concept of autonomous morphology motivated models of the linguistic lexicon which contain a discrete set of primes and rules for their combination which are independent of syntax. The development of Lexical Phonology introduced the notion that a subset of phonological rule applications takes place in the morphological component and that morphological processes are ordered into a series of levels. Current alternative theories to the Lexical Phonology model

are described and Selkirk's (1982) general theory of word structure is adopted as the framework of the present morphological analysis. Selkirk's (1982) approach is based on the assumption that word structure rules are phrase structure rules and that word formation can be characterized in terms of a context-free grammar.

Chapter 3 addresses the issue of the multiple suffix as a grammatical unit. The hypothesis that two or more suffixes collocate in the lexicon to form a compound is rejected in favor of a process of affix concatenation; i.e. Affix-> Affix Affix, represented as Affix-> Affix*. Multiple suffix patterns are represented in the lexicon as schemas or paradigms which express morphological relatedness and define the morphological family.

Chapter 4 reviews current cognitive models of the lexicon and various competing theories of lexical storage and access. Evidence from previously published studies is presented in support of the respective models.

Chapter 5 describes a lexical decision experiment conducted by Kane and Roth (1988) which tests the hypothesis that complex words are decomposed in the mental lexicon and accessed through the base word. The assumption that certain derivatives are represented in memory as whole units, while others are broken down and their affix morphemes represented as distinct entries, is corroborated by the results. The processing of multiply-suffixed forms is shown to be dependent

on the type(s) of phonological boundaries present in the internal structure of the derivatives, independent of the degree of the phonological transparency of the derivatives (cf. Bradley 1980).

Chapter 6 reports a second lexical decision experiment which investigates the role of suffix frequency in predicting acceptability judgements of multiply-suffixed words formed according to six different morphological patterns. Contrary to previous claims that the type frequency of a morphological pattern determines a speaker's acceptance of potential words (Aronoff 1982), the results indicate that neither type nor token frequency are reliable predictors of acceptability. Other salient factors which must be considered in conjunction with type frequency are 1) the selectional restrictions on suffixation and 2) the extent to which the phonological transparency of the base is maintained in the derivative.

Chapter 7 further explores the notion of productivity. A strong correlation is shown to exist between the actual number of complex derivatives which appeared only once in the 25-million word APHB corpus, and the percentage of acceptance of possible words formed by identical morphological patterns in Experiment II. More novel forms appear for those patterns which were rated as highly acceptable and conversely, the number of novel forms decreases significantly as the rate of acceptance for the suffix pattern decreases. This finding, though unforeseen, strengthens the claim that speakers have

intuitions regarding the strength of a morphological pattern. It is argued that complex word formation is both rule-governed and analogical and that both processes are predicated on grammatical knowledge.

CHAPTER 1

DEFINITIONS OF THE LEXICON

Interest in the nature and organization of the lexicon has attracted researchers in the fields of linguistics and psychology for the past twenty years. Although both disciplines make use of the term *lexicon*, the concept of its referent differs markedly.

1.1 Linguistic lexicon

For most generativists, the linguistic lexicon (LL) is an autonomous component of the grammar which encodes a formal representation of a speaker's knowledge about the words of his language. This knowledge includes the semantic representation of words in the lexicon, their syntactic functions, pronunciation, and orthography. Lexical knowledge also includes the rules of word formation, such as compounding and affixation in English, as well as the constraints on those rules which prohibit unacceptable forms in the language.

The data base of morphological theory is the distribution of actual words and morphemes in the language, supplemented by the potential words formed by rules or analogy. The construction of theory is based on observation and analysis of word formation and the induction of rules to explain why those words and only those, can be generated in the language.

Since the theory describes the intuitions that a speaker has about possible combinations of morphemes and their orderings, it also must account for the relationships that a speaker knows to exist among words morphologically, syntactically, phonetically and semantically. For example, an English speaker *knows* that the words man, mannish, manly, unmanly, and manhood, are acceptable forms in the language which refer in some way to the concept of MAN, but that *nam, *menly, *unlyman, *manor, and *mans are neither acceptable, nor related in the same sense.

Chomsky and Halle (1968) claim that all regular, predictable derivatives are analyzed and that none are listed in the lexicon. It is assumed that the lexicon contains only idiosyncratic items which do not conform to the laws of form and meaning. In contradistinction, Jackendoff (1975) argues that all words are listed, whether or not they are predictable, accompanied by redundancy rules which indicate the computational *cost* of lexical items. Various proposals have been offered in the literature to support or reject Halle's (1973) theory of lexical organization in which the morpheme is the basic unit of the lexicon. Despite differences regarding the set of atoms proper to the lexicon, all linguistic models provide for representation of morphemic structure and derivational relation. While the long-term goal of generative linguistic theory is to discover how speakers acquire knowledge of word formation, the immediate concern is

to develop a theory of morphology which will define the characteristics of all natural language.

1.2 Psycholinguistic lexicon

In psychology, the term *lexicon* generally refers to that part of memory, often called the mental or internal lexicon (ML) where words of a language are stored. Cognitive psychologists are concerned with 1) the mechanisms by which words are stored and represented in the mind, and 2) how words are accessed and processed during written or aural comprehension. Morphologically complex words have been studied through experiments designed to discern the processes involved in their recognition. Psycholinguistic data support hypotheses about the mechanisms which allow the mental lexicon to be consulted in word processing operations. Like linguists, cognitive psychologists are concerned with the composition of morphologically complex words as a key to understanding how words are represented in a speaker's memory.

Generally, there are two main schools of thought regarding the way in which words are processed. In the first, each derived word has a separate listing in memory and therefore requires no analysis before it can be accessed. Critics of this view contend that separate listing places a heavy burden on memory since it has been estimated that the number of words known by the educated adult is no less than 50,000 and may be as high as 250,000 (Aitchison 1987). Also,

separate listing does not capture the semantic and morphological relations among derived forms. The other view is that only roots are listed in the internal lexicon along with a list of affixes with which they may combine. This approach implies that word recognition and processing occurs after the root has been accessed from memory. Therefore, words sharing the same stem are accessed through the same shared entry--providing economy of storage and an explanation for the relationships among derived forms. Critics of both schools propose that word analysis takes place either just after, or simultaneous to whole word analysis and that complex words have both full and morphologically decomposed representations in the internal lexicon. Nevertheless, there is no conclusive evidence regarding the form of the lexical entry--a root, a stem, a morpheme, a syllable, the first few letters--all have been proposed.

Although the issue of lexical representation has yet to be resolved by psychologists, many generative linguists favor the notion of a simplifying lexicon because it is compatible with theories of language that are rule governed and appeal to formal simplicity as a criterion for linguistic representation. However, there is no reason to assume a relationship between the linguistic lexicon and the mental lexicon. There is an important distinction between formal linguistic representations in a generative grammar and

psychological representations in a mental lexicon. As Bradley notes (1980:38), "grammars do not dictate the ways in which the perceptual apparatus of speaking and listening proceed, although they may suggest the linguistic information that must be available to sentence processing systems."

Given the fact that the theoretical goals, data base and methodology of linguistics and psychology are quite distinct, the question arises as to what extent the findings from research in each field can inform the other (Carlson and Tanenhaus 1982). Does the organization of the mental lexicon (ML) influence the way that language is acquired? If so, are there conditions on the nature of the linguistic lexicon (LL) which are universal? The question is complicated by the absence of a generally accepted theory of morphology or of word processing with which to compare points of convergence. The first two sections of this work present the important developments in the respective disciplines in order to delineate areas of mutual concern.

CHAPTER 2

DEVELOPMENTS IN THE LINGUISTIC LEXICON

In his early generative framework in *Syntactic Structures* (1957), Chomsky assumes the linguistic lexicon (LL) to be part of the categorial component of the base. This component consists of phrase structure rules (e.g., S -> NP+AUX+VP) and lexical insertion rules of a similar nature (e.g., N -> aunt, book, boy...). There is no formal distinction between these two rules of the base.

Base
Categorial Component
PS rules
Lexical insertion rules

Figure 1. The lexicon (Chomsky 1957).

In *Aspects of the Theory of Syntax*, (Chomsky 1965:142) the lexicon is separated from the categorial component of the base in the syntactic component of the grammar. The LL is considered to be a depository for an unordered set of lexical entries and certain redundancy rules. Lexical entries, or formatives are formed from a pair of sets of features--one member consisting of inherent features and the other member consisting of non-inherent features introduced by transformations. The redundancy rules of the lexicon add and specify features wherever they can be predicted by general

rule. These non-inherent features are determined by context. Thus, when inserted in a phrase marker, a lexical item can acquire such features as number, case, and gender which often depend on aspects of surface structure, rather than deep structure. This view of the LL depends greatly on the power of transformations to derive complex words from a base word, (e.g. destroy -> destruction).

Base
I. Categorial component
   Rewrite rules
   Rule schemata
II. Lexicon
   Unordered list of formatives
   Idiosyncratic morphological properties
   Phonetic representation
   Semantic representation
   Subcategorization
   Syntactic information/ argument structure

Figure 2. *Aspects* model of the lexicon (Chomsky 1965).

Chomsky recognises the problems that these derivational processes present in a theory which grants power to the syntax in word formation. It was assumed that some operations, such as nominalizations, operate directly on the inherent features associated with the items in lexical entries, i.e., features which determine which form of nominalization is appropriate. As a result, words such as destruction, refusal and sincerity were not thought to be listed in the lexicon because their nominalizations are predictable by transformational rules. The lexical entries for destroy, refuse and sincere were directly listed along with the phonological features, semantic

properties, and other features indicating the place at which a particular formative could occur.

Nevertheless, in entering words for which there are paradigmatic gaps, such as horror, horrid, horrify; terror, *terrid, terrify; candor, candid, *candify, there had to be a separate listing for each. Such separate listing is undesirable since the semantic interpretation is somewhat predictable, and because the internal structure of these forms must be assigned, in order for phonological rules to apply correctly. Therefore, Chomsky (1965:187) proposes to extend the lexicon to permit some "internal computation, in place of the general lexical rule" and suggests that stems such as tele-, horr-, -ify, and -graph might be listed in the lexicon.

2.1 The lexicalist hypothesis

Five years later in *Remarks on nominalizations* (1970:190), Chomsky develops the lexical hypothesis in answer to the concerns regarding derivational processes raised in *Aspects*. In so doing, he reduces the power of the transformational component and enriches the lexicon by separating it from the categorial component of the base. By comparing English nominals, (e.g., amusing, amusement), he argues that Lees'(1960) transformational approach for English derived nominals is inadequate since the productivity, semantic regularity and internal structure of gerunds and derived nominals is different. On the basis of these facts, Chomsky concludes

that transformations could operate on totally regular processes such as gerunds, but not on processes governed by lexical idiosyncracies, such as derived nominals. Entries are listed in the lexicon with fixed selectional restrictions and strict subcategorizational features, free from categorial features. Idiosyncratic morphological rules determine the phonological form of words such as refuse and destroy, when these items appear in the noun position. Regularities are expressed by redundancy rules in the lexicon. The lexicalist hypothesis proposes that all derivation be handled in the lexicon, whereas gerunds and other inflectional processes remain syntactic. Scalise (1984) points out that the lexicalist hypothesis laid the foundation for treating all word formation in a single, autonomous place in the grammar: the lexicon, the position taken by Halle (1973) and Aronoff (1976).

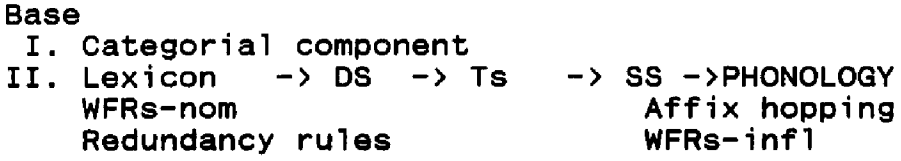


Figure 3. The standard theory lexicon (Chomsky 1970).

2.2 First model of the lexicon in generative tradition

In 1973, Morris Halle advanced a proposal of an autonomous morphological component and outlined the organization of the lexicon within generative grammar. In his seminal article,

entitled *Prolegomena to a theory of word formation*, Halle corroborates the lexicalist hypothesis, strengthening the view that complex words are not formed by transformations, but are listed in the lexicon along with word formation rules (WFRs). Further, he diverges from the transformationalists and from the view advanced in Chomsky's *Remarks* paper, by locating all word formation processes, including inflection, reduplication, ablaut and others directly in the lexicon. The list of morphemes and derivational and inflectional affixes and the WFRs together define the *potential* words in a given language.

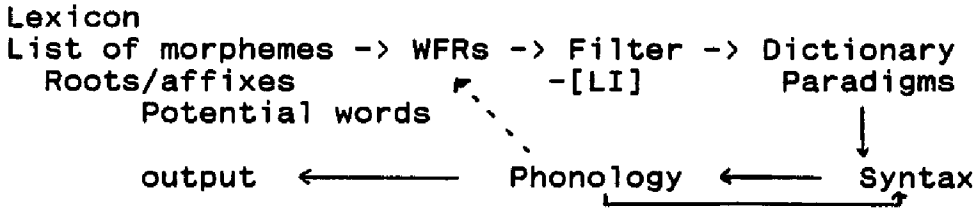


Figure 4. Halle's model of the lexicon (1973).

In his model, the WFRs determine the possible linear ordering of morphemes, their syntactic categories, information about subcategorization and selectional restrictions and hierarchical structure. Since all natural language contains irregularities and exceptions, not all of the potential words of a language are realized, or realized in the same sense as the WFRs dictate. For example, the facts that recite/recital are not semantically compositional; obese/obesity do not conform to the phonological rule of trisyllabic shortening; or that some verbal stems such as transmit allow two types of

nominals, transmittal/transmission, while others allow only one or none, acquit/acquittal/*acquission, must be accounted for in the lexicon. Halle proposes that these unpredictable idiosyncracies be listed in a special filter, through which all words must pass, after they have been generated by the WFRs. The information found in the filter under each entry is then added to the representation of the actual words in the language and stored in the dictionary of the lexicon. The filter acts to rule out all the potential, but non-occurring words (e.g., *conversal,*arrivation) and marks them as ineligible for lexical insertion.

In Halle's model, the lexical insertion rules have access only to the filtered words in the dictionary, i.e., the actual words. Yet, Halle is careful to note that surface structure position often determines the final form of a given noun or other part of speech. Since lexical insertion takes place at a much earlier stage of derivation than surface structure, he proposes that the lexical insertion transformations enter partial or entire paradigms into the deep structure. A general convention would then eliminate all but the one inflected form appropriate to the syntactic position in the sentence. Lexical insertion transformations can only draw upon the actual words and thus the paradigms would also be located in the dictionary of the lexicon. This in turn implies that the dictionary be organized in a more complex fashion than the mere listing of morphemes, the WFRs and the filter.

Unfortunately, Halle leaves this issue unexplored.

Finally, Halle shows how word formation rules are fundamentally different from phonological rules in that they have access to different stages in a derivation, whereas phonological rules are restricted to overt information in the string at the point in the derivation where the rule applies. This step greatly advanced generative morphology, which was now considered as a separate component of the grammar, independent of both syntax and phonology.

2.3 Word based model

In Word Formation in Generative Grammar (1976), Mark Aronoff develops a theory of derivational morphology which does not depend on the "morpheme" as the basic meaning bearing unit in word formation. His word-based theory of word formation evolves from the observation that bound morphemes (roots and stems) have no constant meaning or no meaning at all, for example the -ceive of receive, perceive, or conceive seems to bear no clear semantic meaning which is the same in all examples, nor does the cran- in cranberry seem to have meaning in his view. Only fully formed, meaningful units can serve as the base for the attachment of prefixes, suffixes and compounds. Aronoff's lexicon separates the processes of derivational morphology from grammatical morphological phenomena such as noun incorporation, cliticization and inflection which, because of their syntactic properties, are

handled by syntactic movement rules in the grammar.

Each item listed in the lexicon is a "fully specified, independent whole word--each a complete sign." Complex words are formed by word formation rules (WFRs) containing for each rule, the particular affix, its syntactic label and a subcategorization frame, a unique phonological operation on the base, a set of words on which it can operate, and a semantic reading. WFRs are "once only" rules in that once a rule has applied to a base, that word is entered into the lexicon where it is subject, as other monomorphemic words, to semantic drift. Aronoff cites transmission as an example of this process. The WFR of -ion applies to the base transmit to form transmission which is entered into the lexicon. Over time, the compositional meaning of transmission as " the act of transmitting" is broadened to include the sense of "the gears of a car which transmit power." The speaker no longer applies the -ion WFR every time the word is encountered; rather, the derived form has become part of the permanent lexicon.

Along with WFRs, Aronoff's model requires adjustment rules of allomorphy and truncation. In the lexicon, there is a rule of allomorphy which adjusts the shape of a designated class of Latinate morphemes, so that, for example, -mit -> -miss in transmission and permission, and -ceive -> -cept in reception and perception. The rules of truncation delete morphemes which are attached with formative boundary affixes,

e.g., the +ate is truncated from nominate. In a word-based theory of morphology, only whole words can serve as bases for affixation; thus, the English suffix -ee attaches to transitive verbs and takes animate objects, e.g., employee and payee. However, in words such as nominee and evacuee, the suffix -ee does not appear to be attached to a verb, but rather to a root. To avoid this, Aronoff proposes that the -ee WFR applies to the verb nominate and the rule of truncation subsequently deletes the -ate. Truncation intrinsically follows all WFRs and "serves the same function as the separate statement of morphological conditions on the base. In this way each rule will be uniform and will not vary with the morphology."

```
Lexical Component
     Dictionary
       List of words and features
       WFRs
         Affixes
       Adjustment rules
         Allomorphy
         Truncation
      Output  -> Lexical insertion -> Ts   -> SS
```

Figure 5. The lexical component (Aronoff 1976).

The morphological operation of the WFR assigns a boundary, formative (+) or word (#), to the affix it produces. This boundary is then dependent on the level of phonology at which the operation applies--either the input to phonology; between the cyclic and word level rules; or at the output of phonology. What is important in this theory is that the

morphological rules do not interact among the phonological rules.

Aronoff's noteworthy contribution to a unified theory of word formation lies in his proposal to separate morphological theory from phonology and syntax. He demonstrates that word formation rules have distinct properties from both phrase structure rules of syntax and the cyclic rules of phonology. Word formation rules add words to the dictionary and also function as rules of morphological analysis. As a result of his work, and the developments in the field of lexical phonology described below, formal theories of autonomous morphology began to emerge, consistent with the modular approach of transformational generative grammar.

2.4 Level ordering

The interdependence of morphology and phonology motivated Dorothy Siegal to propose the Level Ordering Hypothesis (1974) for morphology. Level ordering relies on the facts of cyclic stress assignment in phonology and on the differentiation of two types of derivational affixes in English morphology. Prefixes and suffixes in English can be categorized into two groups: those which affect the stress pattern and other phonological features of a word (non-neutral), and those which do not affect stress (neutral). To illustrate, the non-neutral suffix -ity attaches to a base word, e.g., monster, and shifts the stress of the word to the penultimate,

mon'strosity. In contrast, the (neutral) suffix -ness attaches to a base, e.g., happy, and the derivative maintains the original stress on the first syllable, 'happiness.

In Siegal's hypothesis, Class I (non-neutral) affixation occurs before the phonological rules apply. Cyclic phonological rules are then ordered after the attachment of Class I affixes, but before the attachment of Class II (neutral) affixes. This ordering accounts for all of the properties associated with the formative and word boundary devices proposed by Chomsky and Halle in Sound Patterns of English (1968) in terms of stress placement, since the cyclic stress rules operate before Class II affixation.

The Level Ordering Hypothesis purports to explain other properties of neutral affixes: the fact that Class II affixes cannot attach to stems; that they attach only to stressed words and that Class II affixes are always external to Class I affixes. Extrinsic ordering of Class I and Class II affixation and cyclic stress assignment also make it possible to eliminate boundary devices, at least in the case of stress. Phonological rules such as trisyllabic shortening, vowel shift, coronal assibilation and others apply to the base at the level at which the affix is attached. However, it is unclear whether boundaries are needed to indicate the location in the derivation for the application of these rules.

Allen (1978) elaborates on Siegal's ordering hypothesis by proposing that morphological rules are extrinsically

ordered into blocks or levels, the rules of each block being unordered with respect to one another. For English, the order is the following:

CLASS I AFFIXATION
CYCLIC PHONOLOGICAL RULES
CLASS II AFFIXATION
INFLECTION
COMPOUNDING

Figure 6. Level ordering (Allen 1978).

The notion of level is that of a subcomponent of rules in the lexicon which follow strict linear order from one level to the next.

2.5 Lexical phonology

In 1983, Kiparsky advanced a model of the lexicon which was very similar to the ordered blocks of Siegal and Allen. Both derivational and inflectional properties are organized in a series of levels (strata) associated with a set of phonological rules. Each affix has a place at a certain level of the lexicon according to both morphological and phonological criteria. The ordering of levels defines the possible orderings of morphological processes, so that productivity can be accounted for by positing that processes with restricted applicability be ordered before more general processes. For example, a less productive affix in modern English such as -ity is found at Level I, whereas the highly productive -ness affix, with fewer restrictions on the base is found at Level II.

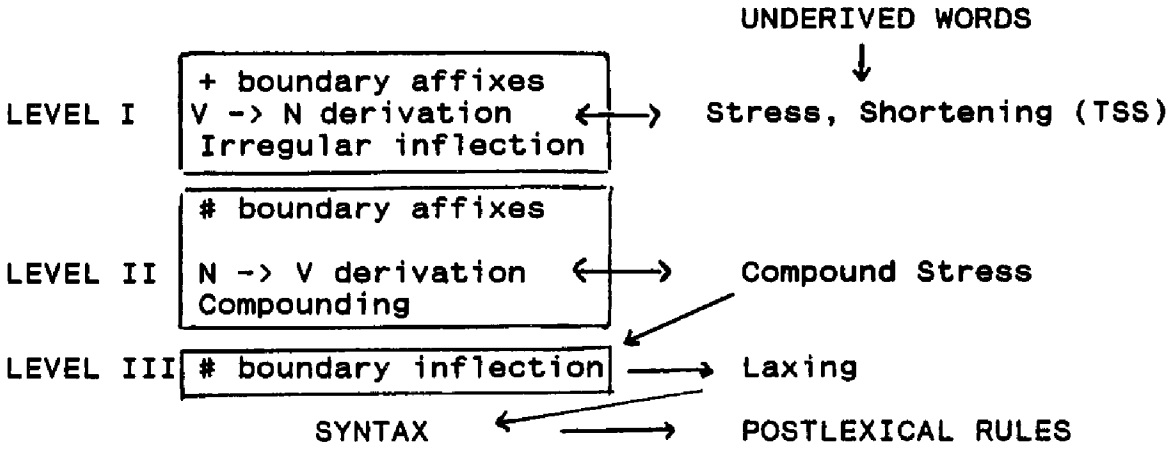


Figure 7. Level ordering (Kiparsky 1983).

This theory also accounts for the phenomena of *blocking* (Aronoff 1978) in the same manner. Zero derivation V -> N occurs at Level I for such forms as cook, bore, guide etc., thereby preventing the -er agentive suffix from applying at a later level to form lexical items with synonymous semantic features, e.g., *cooker,*borer,*guider. Given the strict ordering of levels, it is impossible for a process to cancel an earlier process because the previous one, blocking in this instance, has precedence. This explains why both morphological and phonological processes which occur at later strata are commonly more productive than processes at earlier strata.

In Kiparsky's framework, the intersection of morphological and phonological rules also accounts for the behavior of compounds. For example, irregular inflection is

derived at Level I, and therefore should be available to derivational processes at Level II; whereas regular inflection, which is found at Level III should not. Thus, the presence of Level I plurals such as teeth marks vs. *claws marks or mice-infected vs. *rats-infested can be predicted by the ordering of levels.

The model also accounts for the difference in inflection between exocentric and endocentric compounds such as milkteeth (endocentric) and sabertooths (exocentric). Kiparsky proposes that exocentric compounds are assigned zero derivational suffixes which cannot be added to derived plurals; therefore, exocentric compounds exit from Level II as singulars and receive plural endings at Level III where they are added to the whole compound. Lexical phonology directly predicts the relation between boundary strength and affix order expressed by the word and morpheme boundary devices. Kiparsky shows that by deriving the prefix -in and the phonological rule for assimilation at the same level, no boundary symbol is needed to block the assimilation of -non on Level II:

Level I	in-legible	assimilation
	illegible	
Level II	non-legible	
	nonlegible	
	*nollegible	
	non-illegible	

Kiparsky's position is that boundaries are superfluous as theoretical devices given level ordering. Boundaries are replaced by brackets as the following:

[[[nation]al]ity]	lexical representation
nation al ity	bracketing erasure
nationality	post lexical representation

Bracketing is claimed to be an advantage over boundary devices as shown by Kaisse (1985), since if lexical elements were to be identified solely by boundary symbols, there would be no way to differentiate right-branching from left-branching compounds:

#neighbor# hood# gang#	[[[neighbor]hood] [gang]]
#re air ## condition	[re [[air][condition]]]

or, to distinguish the suffixation of a # affix before compounding from the prefixation of a # affix after compounding. Overall, the effect of Kiparsky's model transfers some of the phonological rules to the lexicon where they form an integrated part of the morphological component.

2.6. Non-word based morphology

Selkirk (1982) claims that the systems of word syntax and phrase syntax are the same in that they can both be generated by a context free rule writing system. Thus, she rejects Kiparsky's model and Siegal and Allen's claim about level ordering in word formation. If level ordering were correct, then it would provide evidence that the general properties of morphology and syntax were dissimilar; however, she maintains that the general formal properties are the same and that the rule system is the same in both subcomponents of the grammar.

2.6.1 Morphological categories

In Selkirk's framework the difference in the behavior of neutral and non-neutral affixes is explained in terms of an expanded general theory of word formation. This theory includes morphological category types: Word, Root and Affix. The differing phonological patterns of the two classes of affixes derives from the position that the affix occupies in word structure. Affixes are treated as individual entries in the lexicon which subcategorize for their bases, either Word or Root, or in some cases both. In other words, affixes do not have to be specified for boundary type or level/strata, but instead, for the type of base to which they can attach, specifically the syntactic category feature--noun,verb adjective-- and the morphological category type--word, root as shown in these examples:

Root (Class I)	Word (Class II)
-ous: [N^{r} ___]	-less: [N ___]
-ity: [A^{r} ___]	-ness: [A ___]
in-: [___A^{r}]	ex-: [___ N]
de- [___V^{r}]	non-: [_____N]
	[_____A]

2.6.2 Stress placement

There is no need in this theory to invoke boundary devices for stress placement or other phonological properties. The grammar of English word formation specifies that the morphological category type Root is the domain for cyclic stress assignment of syllable structure and foot structure. It then follows from the grammar that Word affixes will be

stress neutral, and Root affixes will be non-neutral with regard to stress placement and syllabification. For example, the Root affix -ic will subcategorize for a noun root, -ic: [N' ___] and will syllabify with the base as in rhythmic, where the 'm' forms a syllable with -ic. This can be compared with the Word affix -y which is represented in the lexicon as -y: [N ___] and explains why the 'm' in rhythmy is syllabic in itself.

Lexicon
  Dictionary
    List of monomorphemic words
  Extended dictionary
    List of affixes and roots
    Idiosyncratic information
    Category of affix (Word/Root)
    Subcategorization frame
    Semantic representation
    Phonological representation
      Distributional features matrix
      Other phonological properties
    Word Structure rules
                -> Lexical Insertion

Figure 8. The lexicon (Selkirk 1982).

Selkirk's theory of word formation obviates the kind of level ordering proposed by Kiparsky and Mohanan since stress assignment and other phonological behavior result from the general properties of morphological structure and the idiosyncratic properties of its morphemes, i.e., the category of each morpheme and the set of subcategorization frames associated with it.

The theory does retain the notion of affix ordering as conceived by Siegal in the form of the Affix Ordering Generalization (AOG). The justification for this principle is that the order of the Root and Word affixes is not free; although within the class there is no ordering restriction as seen in the following: -ous, -ity (monstrosity) or -ity, -ous (proclivitous) for Root affixes and -less, -ness (fearlessness) or -ness, -less (tendernessless) for Word affixes. Similarly, the combinations of prefixes and suffixes within a class are allowed for Root affixes as in [in[[sensit] ive]] and [in [[sensit] iv] ity] and for Word affixes as in [[in-hospitable] ness] but not outside Word affixes * [in [glutton-ish]].

In addition to the AOG, Selkirk proposes the Compound Affix Ordering Generalization (CAOG) to account for the fact that Word affixes can attach both inside or outside compounds; whereas Root affixes can only appear inside compounds:

un-self-sufficient vs. * in-self-sufficient
laid-back-ness vs. * laid-back-ity

In order for Siegal and Allen to account for these examples, Class II affixation would have to be ordered both before and after compounding. This of course would violate the principle of strict linear ordering.

Selkirk's theory also proposes to better account for the occurrence of inflectional affixes inside compounds, prohibited by a level ordering account which separates

compounding, affixation and inflection and prohibits inflectional rules from applying before compounding. Selkirk treats these processes as part of the same component so that distributional data such as the following present no problem:

parks commissioner	vs.	park commissioner
programs coordinator	vs.	program coordinator
buildings inspector	vs.	building inspector

In short, Selkirk's context free grammar for word structure makes it possible to express the distributional properties of affixes without recourse to extrinsic ordering. The theory allows the model of word formation to retain the nature of a context-free grammar in which ordering is not required. Stress assignment and other distributional regularities are accounted for by the postulation of the morphological category types Word/Root/Affix along with the principles expressed in the AOG and CAOG and the rewrite rules summarized here as:

Suffixation: $X^n \rightarrow Y^n$ Xaf, where n= Word or Root
Prefixation: $X^n \rightarrow$ Yaf X^n, where n= Word or Root
Word structure: $X \rightarrow X^r$, Word -> Root, where Root is always "lower" or contained within the Word
Compounding: $N \rightarrow \left\{\begin{matrix} N \\ A \\ V \\ P \end{matrix}\right\} N$; $A \rightarrow \left\{\begin{matrix} N \\ A \\ P \end{matrix}\right\} A$; $V \rightarrow P\ V$

Figure 9. Word structure rules (Selkirk 1980).

2.6.3 Context-free word structure rules

In her dissertation, *On the organization of the lexicon*, Lieber (1980) elaborates on Halle's 1973 model of the structure of the lexicon. Like Selkirk, Lieber proposes that all lexical

items including words, stems and affixes have lexical entries which combine with a set of re-write rules similar to phrase structure rules which produce trees into which affixes and stems are inserted. Her disagreement with Selkirk lies in the nature of the context-free word structure rules. She adopts binary branching lexical structure rules along with feature percolation conventions which comprise lexical structure.

2.7. The organization of the lexicon

Lieber's morphological component is divided into three parts: the permanent lexicon containing morpholexical rules and redundancy relations; the lexical structure component consisting of lexical structure rewrite rules and a number of feature percolation conventions; and a series of operations for morphological processes which are non-affixational and string dependent, including reduplication, infixing, vowel ablaut and umlaut.

The permanent lexicon, Halle's dictionary, contains all of the unanalyzable lexical terminal elements. Included are affixes and bound and free morphemes along with information regarding category and declension class, phonological and semantic representation, subcategorization restriction, diacritics and insertion frame. The stem allomorphy that is normally found in inflectionally rich languages is described by means of morpholexical rules in the permanent lexicon. The morpholexical rules are purely classificatory in

describing the relation between pairs of lexical items in the lexicon. They are different from redundancy rules as conceived by Jackendoff (1975) in that they are non-implicational (not if x, then y), but state absolutely x is related to y.

Permanent Lexicon

Category N Category V Category A
Lexical class
Morpholexical rules
Affixes/stems/ derived/underived forms

Lexical Structure

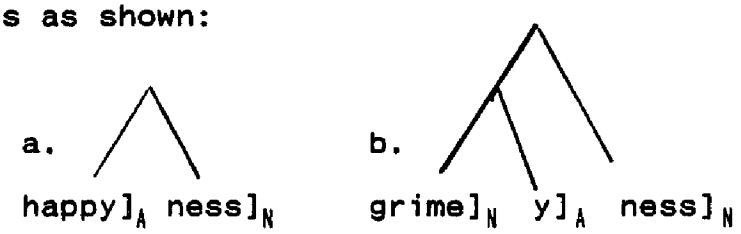
Rewrite rules
Feature percolation conventions
Conversion N <-> V
String dependent T-rules
Reduplication/Umlaut/ Ablaut

Figure 10. Organization of the lexicon (Lieber 1980).

2.7.1 The lexical structure component

The lexical structure component is parallel to the phrase structure subcomponent in syntax. The context-free rewrite rules generate the possible phrase structures in syntax and the possible word structures in morphology. The lexical structure rules generate a tree structure into which terminal elements may be inserted. Lieber's rewrite rules differ from those proposed by Selkirk because she does not include terms such as affix or root as primitives in morphological theory. Instead, she claims that this information is already encoded in the permanent lexicon since affixes are morphemes with subcategorization frames and stems are morphemes without

subcategorization frames. In order to reduce the redundancy in the grammar, Lieber proposes a single context-free rule which will generate unlabelled binary branching tree structures as shown:



Lexical terminal elements are inserted with their subcategorization restrictions. Node labelling proceeds according to feature percolation conventions a bit different from those described by Williams (1981) in his lexical head theory.

2.7.2 Percolation conventions

In Williams theory, the notion of lexical head and the Right-Hand Rule (RHR) determine the categories and other syntactic properties of a derived word or compound. Features can percolate only from the right hand constituent, or head, giving the whole word category and diacritic features. In contrast, Lieber's percolation conventions do not include a RHR. Features may percolate to branching nodes regardless of whether they are on the left or right as illustrated in Figure 11:

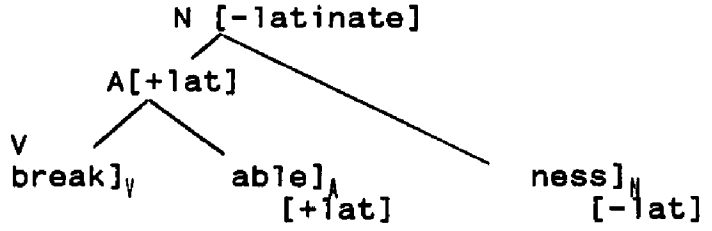


Figure 11. Lieber's (1980) percolation convention.

This approach accounts for the transparent affixes such as counter which have no features to percolate but are nonetheless accommodated by a convention which ensures that all branching nodes receive labels. Lieber cites evidence from English and other languages to demonstrate that the RHR cannot be maintained since there also exist category changing prefixes, e.g., en-: $rage_N$ -> $enrage_V$, which require left heads. However, Williams maintains the RHR in these cases claiming that they are systematic exceptions, where the leftmost member is the head, or, as in the case of exocentric compounds, e.g., [push up]$_N$ or [run down]$_N$ there is no head at all. Williams suggests that these compounds are derived by headless rules which are not binary branching: word -> phrase (N -> VP). Lieber insists that a theory which directly accounts for these facts is superior to one in which exceptions must be claimed.

2.7.3 The Adjacency Condition

As noted by Lieber, Selkirk's framework and her own theory eliminate the WFRs by demonstrating that affixation follows general lexical structure rules and does not proceed as a series of separate processes (cf. Aronoff 1976). As a consequence, the Adjacency condition is no longer a constraint on WFRs, but as a condition on subcategorization:

Adjacency (revised)
No subcategorization frame can state a dependency between X and Y if there is more than one bracket between X and Y; i.e.
* X/Y]Z]__
* X/___[Z[Y
where Z may be 0

In short, affixation is viewed as a form of lexical insertion analogous to lexical insertion in syntax.

2.7.4 String dependent rules

The third subcomponent in Lieber's organization of the lexicon contains string dependent rules which apply in a block to the structures formed in the lexical structure component. These rules characterize productive morphological processes which occur in many unrelated languages: reduplication, infixing, vowel ablaut and umlaut and are dependent upon the linear concatenation of the string.

2.8 Arguments against extrinsic ordering

Although their concept of the rules of word formation differ from those of Selkirk and Lieber, Aronoff and Sridhar's (1983) treatment of morphological levels also excludes level ordering. Moreover, they maintain that the AOG and CAOG conventions proposed by Selkirk to explain affix ordering generalizations are unnecessary. In their view, word formation is not constrained by extrinsic ordering of any type, but by constraints on the base to which affixes can

attach. Aronoff and Sridhar refute Selkirk's argument by demonstrating that Class I /Root affixes do indeed attach outside Class II /Word affixes in English. Words such as ungrammaticality and developmental must be analyzed as:

[[un [grammatical]] ity]

[[develop] ment] al]

In the first case, there is a restriction on the category to which the word formation rules (WFR) for the prefix un- can attach, i.e. the major lexical category Adjective; and in the second case, developmental is stressed on the penult with the addition of the -al suffix, a characteristic of Class I affixation.

Further, Aronoff and Sridhar cite whole classes of the productive forms X#ability, X#istic, and X#ization all of which are composed of nonneutral suffixes outside of neutral suffixes. Selkirk's explanation of the counterexamples to the AOG invokes a reanalysis of words as derived roots. When development is reanalyzed as a Root, it retains the same stress pattern listed in the lexicon as it would if the word had preceded a neutral affix. Selkirk suggests that on analogy to the -ment in ornament, the suffix -ment in developmental is reanalyzed as a nonneutral affix. However, Aronoff and Sridhar do not accept Selkirk's reanalysis, citing a host of individual cases of open classes of counter examples to be accounted for. They set forth empirical claims concerning the distribution of the two classes of affixes

based on the existence of two levels, Word and Root, but not dependent on level ordering of any nature.

2.8.1 Two types of WFRs

According to Aronoff and Sridhar's theory, there are two distinct types of word formation rules: stem based WFRs (e.g., produce/production/productive) and word based WFRs (e.g., feminine/feminism). Word affixes attach to words under these conditions:

1) the base to which they attach retains its phonological form,
2) they attach productively only to words of major lexical categories (N,V,A)
3) they do not fuse semantically with the base,
4) they are not sensitive to the internal morphology of the words to which they attach.

Word affixes (ClassII) attach only to major categories, rather than to the content of those categories, in contrast to Root affixes (Class I) which, though sensitive to lexical categories, are also sensitive to the immediately adjacent morpheme. The two types of affixes, independent of any ordering, indicate two types of morphological operations and describe the domain of phonological rules.

2.8.2 Phonological words

Aronoff and Sridhar show that "adherence to level ordering and its popularity despite evidence which shows it to be false, is motivated by the relationship of the phonological cycle to hierarchical morphological structure." They claim that when ordering is contradicted, so too is the

correspondence between hierarchical structure and phonology. To illustrate the authors show that hierarchically, the word comparmentalization has the internal structure:

[[[[compartment] al]ize] ation]

Based on their assumption that only root affixes must always be contained within phonological words and that metrical foot structure is isomorphic with phonological structure, the phonological structure of compartmentalization is:

compart mental ization

In the above analysis, the single morphological word (mword) compartmentalization consists of three phonological words (pwords), all of which are neither mwords or members of a major lexical category. No structural relationship is assumed between the pwords, and since the string has no head, it does not receive compound stress, but phrasal stress similar to the stress of :

combat mental elation

or to the stress of the monomorphemic word:

Appalachicola

Aronoff and Sridhar compare their concept of phonological words to Selkirk's Words in that pwords are the domain of stress placement and syllabification rules. Therefore, if a member of a lexical category contains more than one pword, as in judgemental, which is derived as judge and mental, each pword is stressed individually. If the last pword within a member of a major category is by itself a member of a major

lexical category, it is considered to be a compound and is given compound stress. If not, stress is determined by a general system that applies to phrases and monomorphemic words. Thus, judgemental and Judge Mendal have the same stress pattern.

This approach classifies affixed members of major lexical categories into three divisions:

Type I: X + no word affix

Type II: X + word affix(es) or, word affix(es) + X
In this category, each word affix is considered to be a stressless clitic, not a pword (e.g., relentless contains one clitic; relentlessness, two clitics; unrelentlessness, three clitics.

Type III: X + word affix + stem affix
pword (e.g., interpretability)

word affix + X + stem affix
pword
(e.g., misrepresentation)

Aronoff and Sridhar provide rules for dividing any member of a major category into pwords and clitics. The pwords differ from other analysis in three ways. First, there is no simple relationship between members of major lexical categories as defined hierarchically and pwords. Second, there is no exhaustive division of a string into pwords. Third, there is no assumption that boundaries are assigned purely hierarchically, but instead they are assigned by a combination of linear and hierarchical principles.

In their view, all that is needed to account for the processes of word formation is the distinction between the

two types of affixes Word and Root and Kiparsky's Elsewhere Condition which states that if two rules compete for the same structural condition, the more specific rule takes precedence over the more general one, i.e. *blocking*. The authors contend that once a theory of morphology is separated from theory-bound devices such as: the phonological cycle, the distinction between cyclic and word level rules, the boundaries # and +, and the blocking of cyclic rules by #, it has an empirical advantage over those which rely on them.

CHAPTER 3

MULTIPLY SUFFIXED WORDS

This chapter investigates the relationship that exists between a base word and the possible multiple suffix combinations that can be formed by the word structure rules. With the exception of Fabb (1988) and Aronoff (1976), there have been no empirical studies of word formation processes that primarily concern recursive suffixation in English. The question addressed in this section is whether the word formation process of compounding applies to affixes as well as to words and roots to form bound units such as -istic, -ability, and -osity. Since the morphological rules of a language capture the intuitions of speakers that words have internal structure, and because the rules allow compounding of words and roots, it would seem plausible that affixes also compound to form complex structures. The linguistic analysis is supported by corpus-based data consisting of multiply-suffixed words, demonstrating that there are a few cases for which the notion of compound is justified on morphological or semantic grounds. However, these potential suffix compounds are too few and exceptional to warrant the redundancy in the lexicon that free compounding of multiple affixes would necessitate. Further, the exceptional cases for which no

singly-affixed base form occurs, can be generated by the same set of context-free rewrite rules and marked "grammatical, but non-occurring". The conclusion reached is that there is no theoretical advantage to positing a formal rule mechanism for generating compounds at the level of Affix. Instead, a single affixation rule that allows affixes to subcategorize for other affixes is proposed in order to capture the relations that hold between forms in a morphological family.

There is a set of suffixes which regularly occurs as the terminal sequence in complex words, e.g. -ional, -ical, -mental, -ivity, -ality, -ionalize, -ization. In order to account for this restricted set of multiple suffix patterns in English, this proposal extends the Selkirkian X-bar morphological framework to permit suffixes to combine with other feature-specified suffixes, as well as with words and roots. Multiple affixation can be accounted for by the same type of context-free rewrite rules available for the other category types, Word and Root, i.e.: Word -> Word Word; Root-> Root Root; and Affix -> Affix Affix.

Unlike inflectional suffixes (-s,-ing,-ed,-ly) which are, for the most part, paradigmatic and regular, derivational suffixes require that stricter conditions on the base word be met before affixation can occur. For example, the suffix -ous attaches to nouns to form adjectives with the sense of "causing or having" the particular quality of the noun; hence dangerous/glamorous. However, because of the irregular nature

of derivation, -ous does not automatically attach to all nouns, *shiverous, *symbolous. This fact has been noted, and much has been written in the linguistic literature on the word formation rules and subcategorization requirements for single suffixes. With the exception of Fabb (1988) and Aronoff (1976), there have been no empirical studies of word formation processes that primarily concern recursive suffixation. Consequently, this section investigates the relationship that exists between a base word and the possible multiple suffix combinations that can be formed by the word structure rules.

3.1 Theoretical framework

Following Selkirk (1982) and Lieber (1980), I assume that word formation operates in an autonomous component of the grammar: the lexicon. Words are generated by context-free lexical structure rules which produce tree structures into which items are inserted. The lexicon contains:

1) word structure rewrite rules
2) dictionary of entries
    a) monomorphemic words (boy, rose...)
    b) bound forms (aggress-,tele-,-cieve/-cept, ...)
    c) affixes
        1) inflectional (-s,-ing, -ed...)
        2) derivational (un-,re-,-ity,-ic,-ment...)

and the corresponding phonological, syntactic, semantic, and orthographic features of the entries. However, given only lexical entries and rewrite rules, the morphology of the language overgenerates; consequently, derivations must be constrained to rule out ungrammatical items. The lexical

phonologists (e.g., Kiparsky 1982 and Mohanan 1982) constrain lexical derivations by extrinsically ordering morphological processes and phonological rules to interact in cyclic fashion. Other linguists place local selectional restrictions on suffixation (e.g., the role of final syllable stress, Siegal 1974; etymological origin and length in syllables, Anshen *et al.* 1986; and the restriction against suffixation to a previously suffixed word, Fabb 1988).

3.2 Multiple suffix as a grammatical unit

As in the generation of syntactic structures, although there is no theoretical basis for positing a limit on the length of a complex word, the distributional facts of English reveal that consecutive derivations rarely go beyond four "slots," Af1-Af2-Af3-Af4, (e.g.,-ion-al-ist-ic) and that the productivity of multiple suffixes is highly restricted. The purpose of this chapter is to delineate the conditions allowing the recursive attachment of multiple suffixes to English bases and to explore the possibility that certain combinations of suffixes are attached to the base as a whole and can themselves be thought of as a grammatical unit.

3.3 Evidence for long suffixes

Fabb (1986) proposes the notion of a "long suffix" including -istic,-ional,-ency and -ificatory from his observation that most suffixes are restricted from attaching to previously suffixed words, that is, they are never found in the

environment of [X-Af1-___]. However, there is a subset of suffixes which may attach to one of the many potential suffixes in the Af1 slot. For example, -ic can appear in the Af2 position following one specific Af1, namely -ist. Therefore, Fabb claims that -ic never attaches to a suffixed form and that -istic is a separate, though related, "long suffix." A problem with this definition concerns -ical, an intuitive candidate for long suffixhood since -ic and -ical are often not synonymous, e.g., classic/ classical and since there are numerous non-occurrences of Xic forms in the presence of Xical, e.g., farcical. Even more compelling is the fact that the suffix -al subcategorizes for nouns, not adjectives and must make an exception for adjectives ending in -ic; a plausible reason to propose a separate affix. However, the fact that Af2-al is free to attach to other Af1 suffixes, e.g., -ion, and -ment, thereby excludes -ical from the set of long suffixes. Fabb implicitly defines long suffixes in terms of their frequency of occurrence in view of the distributional fact that some suffixes do not attach to previously suffixed words, but does not state any grammatical principle which differentiates them from single suffixes.

In a revised version (Fabb 1988) of the earlier paper, he argues for the stronger notion of "compound" suffix based on the same criterion that Af2 only attaches to one specific Af1. Fabb assigns the feature +Latinate to the subset of other suffixes that are semi-productive in that they can attach to

previously suffixed forms and select for each other. This analysis obviates the need for level ordering, since the facts to be accounted for by extrinsic ordering are encompassed by the restriction that only a subset of affixes may fill the Af2 slot and that they are marked either to compound with one particular suffix or to affix with a marked subset. For example, in Fabb's approach, -istic is constructed as a compound suffix as follows: -ic selects for a non-complex base or has the option of selecting for one specific suffix, -ist. Af2 -ic attaches to Af1-ist to form a compound which as a unit subcategorizes for the same base as -ist.

Unfortunately, Fabb's analysis of compounds falls short when multiple affixation is considered. Since it is also possible for the suffix -ic to occur in the Af3 slot, as in collectivistic or exhibitionistic, in these cases, one presumes that Af1 and Af2 have already attached to the base, producing [[[collect]iv]ist] and [[[exhibit]ion]ist]. If Af3 -ic cannot select a complex base, then it is wrongly constrained from attaching to the doubly-suffixed base form. Fabb bases his approach on the assumption that all internal brackets are visible to all derivational suffixes; therefore, the Bracket Erasure convention (Williams 1982) which erases every bracket after each application of a word formation rule, cannot be invoked to permit the Af3-ic to attach. Even if the rules for affix compounding were somehow ordered prior to those for derivation, the restriction on non-attachment to a

complex form cannot hold. To illustrate, in the above examples, -istic compounds and selects for a feature-marked Af1, e.g., -ive or -ion, but when -ic is in the Af4 position, e.g. sensationalistic, it is prevented from attaching. Thus, any theoretical status that may be granted the compound affix remains questionable.

Fabb's work, though problematic in terms of formal explanatory requirements, is important in that it reveals that the approach based on level-ordering and category selection fails to rule out a very large number of affix pairs which do not exist. He concludes that selectional restrictions and the proviso that certain affixes do not attach to already suffixed words are all that are necessary to describe the order of most affix morphemes.

Church (1988) also includes certain combinations of double suffixes in his taxonomy of formative boundary affix classes: Ia: -ancy, -ency; Ib: -ality, -ation, -ative, -atory, -osity; Ic: -istic, -ability, -ization, -ification, -mental, -mentary. Church supports Aronoff's (1976) claim that there are two different types of word formation rules, those which apply to roots and those which apply to whole words. He expands the former class of formative boundary affixes into three sub-classes: Ia, Ib, and Ic. Class Ia affixes (e.g., -ion, -ive, -or) exhibit allomorphy and obey a different set of word formation rules because they only attach to latinate stems and not bound morphemes (i.e., truncated roots); Class Ib affixes

(e.g., -al, -ic, -ity), do not attach to Latinate stems, but only to bound forms and words which subsequently undergo stress retraction; Class Ic affixes (e.g., -ist, -ize, -er) attach to bound forms and obey a different set of stress assignment rules whereby the internal metrical structure of the base remains unaffected.

As Church himself admits, his claims are weakened by the presence of counterexamples in every category, due to the fact that suffixes can have membership in more than one class. For instance, the suffix -ive would need classification in all three classes of formative boundaries: Ia, to account for the allomorphy in permit/permissive; Ib, to account for the word base in the case of combat/combative, and given alternate phonological stress of the verb com'bat and 'combat, the fact that there is stress retraction in com'bative; and finally Ic, to account for the word base in cases like secret/secretive and the lack of stress retraction. More crucially, his distributional claim that Class Ia affixes are distinct from class Ib and Ic depends on his observation that the latter two do not attach to latinate stems. In Church's view, stem-based word formation rules relate words which share a common Latinate stem. He claims that there exist 100 to 1,000 of these stems of which he lists 250. These appear to be the exact forms from which Class Ia Latinate prefixes and/or suffixes have been stripped, e.g., ceive, fer, merge, struct. The definition of and criteria for status as "stem"

is called into question by the presence of words formed by the attachment of Ib and Ic affixes to bases which are etymologically Latin. An examination of several long suffixes from his Ib and Ic classes will suffice to illustrate the apparent arbitrariness of the distinction:

Ib: fin-ality, ME. and O.Fr. < L. finalis < fin, finis
Ib: gener-osity, ME. and O.Fr.; L. generositas, < generosus
Ic: funda-mental, Late ME.; ML. fundamentalis < L. fundamentum
Ic: vulner-ability, LL. vulnerabilis < vulnerare
Ic: glor-ification, LL. glorificatio < glorificare < gloria

The first two examples, fin and gener are considered to be bound truncated roots, yet they can also appear with Latin prefixes e.g., refine and regenerate, thus questioning the motivation for the stem-bound form distinction. If a long suffix such as -ality belongs to Class Ib, purportedly it attaches to a bound form and is not related to a word formed by a Class Ia suffix. Consider words formed from the base stru/struct which Church includes in the list of stems, e.g., construction (Ia), construal(Ib), construable (Ia, Ib, Ic). Although they are formed from the Latin construere, pp. constructus, their relationship is not reflected, since they are putatively formed from different types of word formation rules.

Furthermore, Church's classification of double affixes such as -ability and -istic (Ic) is made without reference to the fact that they are, by their collocations, counter

examples to level-ordering, a hypothesis that Church endorses. Selkirk (1984), among others, has shown that there is no need to posit two separate types of word formation rules. Affixes do not have to be specified for boundaries, but rather for the type of base to which they attach, specifically the syntactic category features [N,V,A] and the morphological category type [Word or Root]. There is no need to invoke boundary devices within this framework, given that the domain for cyclic stress assignment is Root. The order of the affix morphemes falls out from the general properties of morphological structure. It must be noted that in such a system, the status of an item as Root does not imply that it is bound, but rather that every monomorphemic non-affix morpheme is redundantly a Root ($X\ X^r$). Finally, although both Fabb and Church classify and label certain combinations of suffixes, neither has satisfactorily formalized their representation or the rules for the generation of the highly restricted set of multiple suffixes in English.

3.4 Affix Compounding

In order to formalize the rules for the generation of compound affixes, it is first necessary to establish the criteria to determine which combinations of suffixes (Af1+Af2+...Afn) potentially collocate in the lexicon and to decide whether the notion of long suffixes can be defined in terms of the word structure rules called compounding. In Selkirk's (1982)

framework, the rewrite rules for native compounds are the following:

$$N \rightarrow \begin{Bmatrix} N \\ A \\ V \\ P \end{Bmatrix} N \qquad A \rightarrow \begin{Bmatrix} N \\ A \\ P \end{Bmatrix} A \qquad V \rightarrow P \quad V$$

According to Selkirk, these rules reflect the distributional fact that there are gaps in the combinations of categories of words that may collocate to form English compounds. Those combinations which do not occur are compound verbs and adjectives whose left hand member is a verb: V+A, N+V, A+V, V+V. The rules for compounding must explicitly mention the syntactic category names Noun, Adjective, Verb in order to encode the non-universal systematic gaps which occur in English.

3.4.1 Recursion

Selkirk's theory holds that compounds and their constituents are of the same category level and that compounding is recursive; structurally, embedding is permitted for both categories Word and Root as in bottle green/coke bottle green and electro-encephalo-gram. However, Selkirk maintains that the word-category Affix has certain properties that distinguish it from the categories Word and Root. First, the category Affix is preterminal, i.e. affixes cannot occur on the surface, and recursive embeddings of affix within affix have not been attested. Second, Selkirk claims that affixes are always sister to a non-affix category type in word

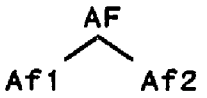
structure. Therefore, she rejects an affix compounding rewrite rule such as AFFIX -> Affix Affix:

-istic [[-ist]-ic]
-ability [[-able]-ity]
-ionalization [[[[-ion]-al]]ize]ation]

In a study on recursion, Tyler (1988) observed that free application of the prefixation rules for root-level prefixes results in overgeneration of unacceptable forms e.g., *irirrelevant, whereas the class of word-level prefixes allows recursion within a defined domain, e.g., non-non-hostile. It is clear that the affixation rules of English do not permit reduplication, that is, the recursive embedding of the same suffix, e.g.,*glorifyify, *fabulousous; however, since recursion is generally viewed as the right or left embedding of identical categories, rather than identical morphemes, there is no reason not to explore the possibility of recursive embeddings of suffixes within suffixes.

3.4.2 Criteria for affix compounds

In the strictest sense, if XAf1Af2 is a morphologically complex word, where X is a word and Af1 and Af2 are separate affixes, but XAf1 is not a word, then it is logical to propose that Af1Af2 is a compound affix attached to X. The internal constituents of such compounds would collocate at a level different from and below Word and Root to generate the structures:

COMPOUND AFFIX : 

where AF represents a compound affix, Af a single affix, and the numerals 1,2,3, the order that the compound affixes attach. Like single affixes, compound affixes would have independent, but possibly related, entries in the lexicon, and be accompanied by the same type of idiosyncratic phonological, semantic, syntactic, and orthographic information as any other lexical item.

Secondly, if compound affixes share a relationship to other affixes, the lexicon must be hierarchically organized to reflect this relationship in some fashion (e.g., redundancy rules (Jackendoff 1974) or morpholexical rules (Lieber 1980)). The fact that individual Af2 suffixes can only affix to a restricted set of suffixes in the first slot (Af1) must be accounted for in the grammar. For example, the -al suffix in the Af2 slot can collocate with -ion, -ic, and -ment in the Af1 position, but not with -ist, -ive, or -al. More complex processes require more restrictions and hence, more notational devices in the rule formalisms. Since there is a natural tendency in languages toward simplicity, the attachment of a compound affix to a base, as opposed to a series of cyclic attachments might be a reflection of the general tendency toward simplification.

Let us suppose that the following letter strings of

suffixes are potential compound affixes: -ional, -ical, -mental, -ality, -ability, -osity, -iveness, -ivity, -istic, -ification, and -ization. Next, let us examine their distribution over the APHB 25-million word count. Table 1 illustrates the ratio of single suffixes to their compound suffix types. It is evident that double suffixes are far less common than the singly-suffixed forms.

Table 1. Ratio of single suffix and compound suffix types

Suffix	Types	Compound Suffix	Types	Ratio
-ion	2594	-ional	186	14:1
-ic	1555	-ical	342	5:1
-ment	565	-mental	41	14:1
-al	949	-ality	141	7:1
-able	950	-ability	143	7:1
-ous	810	-osity	24	34:1
-ive	677	-ivity	41	17:1
		-iveness	112	6:1
-ist	765	-istic	161	5:1
-ify	74	-ification	74	1:1
-ize	280	-ization	192	1.4:1

An examination of the distributional data reveals that of all of the complex words formed by the 11 potential compound suffixes, only 3 suffix patterns occur in words which have non-occurring XAf1 forms: -istic, -ical, and -osity. However, the non-occurring forms are the exceptions rather than the rule.

The Xistic forms that do not have a corresponding Xist are: simplistic, cannibalistic, vandalistic, characteristic, vulturistic, logistic, mediumistic, heuristic, ballistic,

agonistic, voyeuristic, holistic, and voluntaristic (cf. Aronoff 1978). Yet, if it is assumed that these complex forms have been generated via word structure rules, then a derivation must be possible. Can it be that these Xistic forms are derived from a base (X) and a compound suffix, i.e., -istic, since no X ± ist base exists? For example, the compound -istic would have the structure shown in Figure 12.

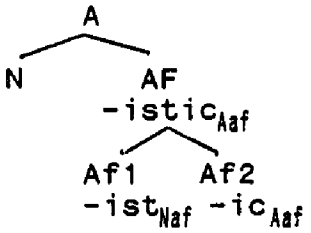


Figure 12. The structure of compound suffixes

To account for similar phenomena in Italian, Scalise (1984) supports the rule of cyclic attachment of suffixes. He claims it is necessary to have an overgenerating morphology, which generates a possible but non-existent form e.g., Xista, marked "minus lexical insertion," thus preventing it from insertion into terminal strings. Aronoff (1976) rejects this notion by showing that the actual base for the -istic forms is not the transparent Xist, but rather the Xism form which subsequently undergoes a phonological allomorphic change (m -> t) with the affixation of -ic. The fact that certain of these forms (e.g., cannibalistic, vandalistic etc.) do not have Xist forms is further explained by the blocking phenomenon which constrains subsequent derivations when the

base fills a categorial and semantic slot which the potential rival would fill (e.g., cannibal$_N$, vandal$_N$).

In contrast, in the Xical examples, the recourse to blocking cannot be invoked since the affixation of Af2-al to Af1-ic to form -ical is redundantly adjectival and in many cases both Xic and Xical words occur synonymously, (e.g., academic/academical). In fact, the OED labels -ical as a "compound" suffix, adding that -ical is the earlier form and more frequently used. In contradistinction, Marchand (1960) characterizes -ical as a secondary derivative, derived from adjectives in -ic by means of -al. Marchand asserts that there is a tendency in the language toward the elimination of co-existing synonymous forms resulting in the loss of commonly used -ic words. The assertion that -ical is more commonly used is challenged by the distributional data from the APHB corpus which shows 1555 instances of words ending in -ic, and only 432 words formed by -ical. These figures suggest that the suffix -ical may be losing its lexical strength in contemporary usage.

However, in other co-existing -ic and -ical forms, there is a semantic difference between the two, with the latter form more removed from the meaning of the base, (e.g., economic/ economical, poetic/poetical, historic/ historical). Further, there is a group of medical adjectives which rarely have -ical counterparts, e.g. anemic, antiseptic, gastric. On the other hand, the following forms ending in -ical have no

corresponding forms in -ic: biblical, oratorical, hypocritical. Marchand (1960:188), lending some support to the compound affix hypothesis, attests that -ical is directly appended to several learned words and to a set of non-scientific words with the sense of "queer, odd, spleeny" e.g. despotical, conical, quizzical, twistical.

Thus, the suffix ending -ical is a strong candidate for compound suffix status in those cases where it is restricted to attaching to a semantically marked base, or when there is no existing -ic form.

The last example of a multiple suffix with a non-occurring XAf1 form is -osity. Of the 84 examples of Xosity, only one Xous/ose base did not occur independently: *animous/animosity (cf., animus); hardly sufficient to warrant compound status to -osity. In short, the absence of an existing XAf1-base is insufficient reason to support the hypothesis that Af1Af2 is adjoined as a compound suffix. There is no utility for morphological theory in positing the process of affix compounding on this criterion.

3.5 Compounds and non-native combining forms

Let us now consider the compounding of non-native combining forms (bound Roots) for which no such strict criterion for compounding is required. The distinction between combining forms and affixes is often blurred. Combining forms are sometimes listed as affixes, as in Church (1987), where

-ectomy, -ology, -olysis, -ometer, -ographer, and -oscopy are listed as Class Ic suffixes and behave similarly when added to words, e.g., music+al/music+ology. In contrast, Allen (1978) claims that there are forms which attach to words by means of compounding rather than a "true" affixation process, e.g., extra-, super-and non-, as in non-[class-conscious] vs. *un-[class-conscious]. Bauer (1983) makes the distinction between final combining forms (FCF's) e.g., -phobe, and suffixes in that only FCF's can combine with initial combining forms (ICF's). Thus, electrolyte, electroscope, are possible, whereas *electroness and *electroization are not. Among linguists, there has been little agreement on whether these forms should be classified as affixes or combining forms and dictionaries and other word lists vary considerably.

However, in Selkirk's (1980) framework, Classical Greek and Latin roots compound to form autonomous words, i.e., Root -> Root Root, e.g., bio+crat, homo+phile, or may serve as bases for derivational processes, e.g., socio-path-ic. This process is extremely productive in forming scientific and technological neologisms. Selkirk assumes, following SPE, that Greek compounds [erythro-cyte] combine at a level "lower" than Word and she classifies the compound constituents as Root (cf., Stem, SPE):

There is a subset of these combining roots which do not attach directly to affixes, e.g., *pre+logy,*hydro+ical and must be assigned a subcategorization frame that selects for

Word or Root or other combining root. There are also combining forms which cannot occur on the surface unless they have undergone affixation, e.g. photo-gen-ic, poly-cephal-ous. Structures formed by non-native compounding are generated by the rules: Root -> Root Root; Root -> Root Affix.

Selkirk makes no provision for the subset of suffixes which can combine with other suffixes, (i.e., Affix -> Affix Affix) as in: -ability, -mental,-ional which subsequently attach to the category types Word or Root or Affix; the only difference is that compound affixes, unlike some of the combining forms which are free forms, do not occur on the surface as independent lexemes, e.g., ization, osity.

3.6 Heads of compounds

Compounds are morphological units that contain a "head" which assigns the entire word its category by means of percolation (Williams 1981). The head of the compound in English is generally its rightmost member and it determines both the syntactic category and plurality of the whole, e.g.,[$\underline{\text{bar}}_{N}$ $\underline{\text{tend}}_{V}]_{V}$,[$\underline{\text{jobs}}_{Npl}$ $\underline{\text{developer}}_{Nsg}]_{Nsg}$ A few compound types do not conform with this general description, e.g., the VP collocations [$\underline{\text{grow}}$ $\underline{\text{up}}]_{V}$ or [$\underline{\text{step}}$ $\underline{\text{out}}]_{V}$, and there are a small number of compounds which appear to have no head, e.g., [$\underline{\text{sit}}$-$\underline{\text{in}}]_{N}$ or [$\underline{\text{run}}$-$\underline{\text{away}}]_{N}$. In order to account for these apparent counter examples the Right-Hand Rule, Di Sciullo and Williams (1987:26) preserve the notion *head of a word* by relativizing the

notion *head*:

(10:26) Definition of *head*$_F$ (read: head with respect to feature F): The head of a word is the rightmost element of the word marked for the feature F.

Because the left-heads of verb-particle compounds are by default the rightmost elements of the forms marked for category, they are *headcategory* that is, head with respect to category and receive the features of head$_F$. Relativized heads permit the possibility that words can have more than one head where F_1 and F_2 refer to different features. Derivational suffixes are marked for category and inflectional suffixes are marked for category and number and tense features but are bound forms like some roots (e.g., -cieve/-cept), whereas prefixes are unspecified for category and other features and therefore, do not compound. The potential compound suffixes (given the capital letter notation AF to distinguish them from single affixes, Af) must be formed below Word and Root level and marked minus lexical insertion, or assigned subcategorization frames which permit them to select for Word or Root, e.g. [NAF-ality: N+Latinate___]:

Since prefixes are unmarked for category, prefix compounding is not permitted:

A serious problem with this proposal arises in distinguishing exactly which cases are words containing two separate affix morphemes and the cases which contain the compound affix. In principle, the compounds should have distinct features associated with them, but empirically, there is no difference between the compound -ionary in revolutionary and the single suffixes -ion and -ist in revolutionist. That is, since suffixes are heads, the collocation of two will, without exception, have the categorial features of the rightmost constituent; +N in both of the above words, whether derived by compounding or affixation. Moreover, stress and other phonological features of the whole will be determined by the head of the affix compound. The leftmost suffix, -ion in both cases above, will always determine the selectional restrictions.

Therefore, there is no principled way to determine the derivation of a word such as perfectionistic. AF-istic selects for a N, N^R, or a N^{af}-- exactly the same base type for which Af-ist subcategorizes. The primary stress of the word does not retract until the final suffix morpheme, Af-ic is attached, or alternatively, until the penult-stressed compound AF-istic adjoins the complex base perfection, showing that the distinction is useless.

3.7 Theoretical status of compound affixes

Thus far, in a generative account, the proposal that affixes compound in the lexicon in the same way that words, roots and combining forms compound must be rejected in that it offers no theoretical advantage over the traditional view of the cyclic attachment of individual affix morphemes. The few cases for which it can be shown that AF (Af1Af2) is semantically distinct from Af1, e.g.,historical / historic, and those exceptional cases where XAf1 does not exist, e.g., quizzical, can be handled within the Selkirkian framework by requiring that the non-existing XAf1 be marked minus lexical insertion. The fact that a very small subset of suffixes in the Af2 slot, e.g., -ic attach to one specific Af1 and therefore result in a "compound" suffix is not sufficiently general to justify invoking a word formation process for generating compounds at the level below Root, nor does the presence of the subset predict which suffixes in the Af2, Af3, Af3 position will compound.

A further problem with the notion of compound affix concerns the interaction between affixes, i.e. prefixes and suffixes. It is traditionally assumed that the structure of a word such as unapproachability is $[un[[approach]_{V}able]]_{A}ity]_{N}$. The prefix un- subcategorizes for adjectives with the sense of "no, not, or opposite of," or for verbs with the sense of "reversal of the action of the verb." This case of un- appears to be the former, and the cyclic

attachment of affixes allows Af2 un- to attach to the adjective approachable prior to Af3-ity attachment. If AF-ability as a compound attaches directly to its base, approach, un- would be constrained from attaching to approachability, since the features of -ity would percolate to assign the category +N to the word. Likewise, any prefixed form of a word ending in Af2-ity needs access to the category of Af1: [un[[origin]al]]+ity]; [non[[luminous]]+ity]; and [non[[exclusive]]+ity] and the attachment of the compound would prevent this. Even Williams' revised notion of relativized head can not permit the same features to percolate from the left and right heads.

Finally, there is no utility in preserving the notion of compound suffixes in order to preserve stratum ordering. Level ordering has been rejected because it does not accurately describe the facts of large open classes of Xability, Xistic, and Xization forms, all of which are composed of Level I, non-neutral suffixes outside of Level II neutral suffixes. In a taxonomic system such as Church's, the classification of strings of suffixes into different classes might presume monomorphemic entities, e.g., -istic, -ability, -ization; however, if the morpheme is not derived as a Level I suffix outside of a Level II suffix, but rather a non-compositional Level II affix, there is no way to explain the stress retraction evident in all of the XAf1Af2 derivatives e.g., dependa'bility, govern'mental, pian'istic.

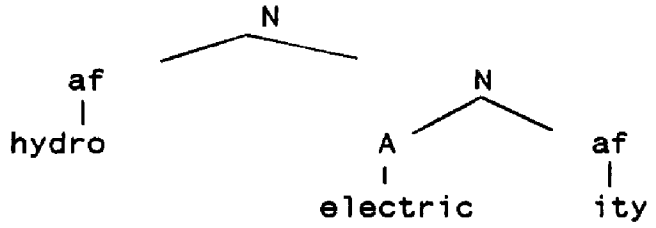
In summary, the proposal that the word formation process of compounding applies at the level of affix cannot be maintained in any convincing manner; yet, the distribution of the putative "long suffixes" shows that a subset of particular suffixes are recursive with respect to certain others in prepositional slots. The ratios of tokens for single and double affix patterns confirm that multiple suffixation is strictly constrained, yet some morphological patterns are recurrent and it seems that the grammar must account for this in some way.

3.8 Multiple suffix patterns

To claim that a morphological relation exists between Af1 and Af2, Af3, ...Afn implies a theory of possible relations between the category Affix in morphological structure. Although the relation is not that of elements in a compound, certainly it is one in which the affix sisters are members in a pattern which is regular and predictable and is generated by the word structure rules. If we assume that speakers have intuitions about exactly which suffix morphemes can fill the Af2 or Af3 slot and in which environments each one is likely to do so, then that knowledge must be encoded in the grammar. Since certain suffixes have an affinity for a group of others and combine to form patterns, then the morphological component must include these associative patterns which describe the morphological family and the relationships among each member.

Saussure (1959:161) defines the lexicon as a repository

where "productive forms are arranged according to their syntagmatic and associative relations," and it is precisely these associative relations that are present in the morphological patterns. Similarly, Williams'(1981) notion of relatedness or "constellations" of words relies on the thesis that words have heads and that complex words are related if one can be gotten from the other by varying one of its heads e.g., hydroelectric can be derived from hydroelectricity by substituting 0 for the head -ity. Williams claims that the constellations capture a semantic relation which cannot be expressed by morphological structure, however, this is because he accepts the traditional framework imposed on the derivation of words by the lexical phonologists. He gives the structure of hydroelectricity as:



and asserts that although hydroelectricity is related to hydroelectric, it cannot be derived by suffixation because -ity, as a Level I affix, cannot attach to a word formed by a Level II affix, hydro-. The inadequacy of level-ordering has elsewhere been discussed as has the status of hydro- as a combining form, and thus there is no reason not to derive one form from the other morphologically; consequently, there

is no need to introduce an interpretive definition that is not part of the rules of word formation. The relation that can be expressed morphologically concerns the paradigm of affixes that can co-occur and be derived from one another by varying the heads of the affix pattern, e.g.:

-ive-0
-ive-ity
-ive-ism
-ive-ist-ic
-ive-ize
-ive-ize-ation
-ive-ize-ation-al

These associative patterns reflect the morphological rules that specify the shape or well-formedness of multiple suffixes, as well as the phonological relation that connects identical morphemes. They are not interpretive in the semantic sense, although each affix is marked in the lexicon with a semantic representation including a characterization of what sort of function it has. When attached to a base, the paradigm defines the morphological family to which a complex form belongs, e.g.,:

relative
relativity
relativism
relativistic
relativize
relativization
relativizational

Interpretive semantics is not the purview of the morphological word structure rules. The meaning of the lexicalized forms is determined in a separate semantics component. For example,

the meaning of relativity and relativism can be traced etymologically to a kernel of the Latin root relatio/ relatus and in this sense both forms are semantico-morphologically "related" and this information is encoded in the lexical representation for the entry. However, morphology concerns the well-formedness of lexical items, and its primary function is to capture all of the possible morphological patterns which occur. The meanings that the forms have assumed historically are factors which are not determined by the morphological component.

The associative paradigm which results from the concatenation of multiple affixes is represented as a schema in the rules for affix combination in the lexicon. To illustrate, the patterns of suffixes in Tables 2-4, in Appendix I, are partial lists of the most salient patterns of suffix combinations. Table 2 lists the nominalizing suffix patterns, Table 3, the adjective-forming suffix patterns and Table 4, the verb-forming suffix patterns. Once the patterns are condensed into rule-schemata, there result the following rewrite rules for generating multiple suffixes:

$$N^{AF} \rightarrow \left\{ \begin{matrix} N \\ A \\ V \end{matrix} \right\}^{af} N^{af} \qquad A^{AF} \rightarrow \left\{ \begin{matrix} N \\ A \\ V \end{matrix} \right\}^{af} A^{af} \qquad V^{AF} \rightarrow \left\{ \begin{matrix} N \\ A \\ V \end{matrix} \right\}^{af} V^{af}$$

These schemata mirror the context-free rewrite rules for Word and Root-level compounds suggested by Selkirk (1983:82), minus the category preposition (P). The gaps in the schema for word

compounding do not predict the same gaps in affix combining; since there are affixes which are of the category A^{af} which subcategorize for [A^{r}___], and there are affixes of the category V^{af} which subcategorize for [V^{r}___]. For example, the suffix -al in the Af2 slot subcategorizes for any -ic adjectival in the Af1 slot, and the inflectional affixes in the Af2 slot -s, -ed, or -ing can attach to the verbal suffixes -ate, -ify, or -ize in the Af1 slot. Thus, distributionally, the schema for multiple suffixes is more complete in that there are no gaps. Without the schema, it is accidental that Af2-ity attaches to Af1 -ive, -ic, -al, -ous, and -able, and not vice versa.

As mentioned, the rules overgenerate and the actual words formed by the schema shown in Tables 2-4 vary in number with the productivity of the suffix combination. To take an example, the attachment of the suffix pattern -ize-ation-al results in only two actually occurring words:

organ]$_{N}$ -izational and civil]$_{A}$ -izational.

A word structure rule for long suffixes of the type N^{AF}-> V^{af} N^{af} generates -ization, and Af3-al selects for the pattern N^{AF}; or alternatively, the three affixes collocate simultaneously A^{AF} -> V_{af} N_{af} A_{af} and are marked with the same subcategorization frames as Af-ize, the categorial and grammatical features on the rightmost affix, Af3 -al determining the features of the whole. However, whether a potential Af4-ity must be constrained from attaching to the output: *civilizationality

is questionable since it freely attaches to Af-al in other contexts (e.g., personality). Rather than constrain Af4-ity from attaching, it is preferable to mark the output with the feature [-Lexical Insertion], since *civilizationality is structurally well-formed, but may be semantically constrained. In fact, Halle (1973) proposes to mark all words formed by "non-productive rules" as [-Lexical Insertion] in the filter component in his model; the smaller subset of actually occurring words formed by such rules are listed with the feature [+Lexical Insertion]. In contrast, words formed by productive morphological rules are assumed to be actually occurring and only exceptionally excluded from insertion (see Chapter 7 for a discussion of the issue of productivity).

To conclude, it has been shown empirically that certain affixes have a preferred relationship with others in a positionally defined domain. These multiple affix combinations could be accommodated by: a) a template morphology, in which each slot is prescriptively filled by a particular affix or set of affixes; or b) listing positive conditions on each word formation rule (Aronoff 1976), stating the classes of bases to which the suffix attaches in the order of their productivity, e.g. -ity: [Xic___,Xal___Xable___]. The solution favored in this proposal is to include in the grammar the sets of rules for generating the associative patterns for multiple suffixes. In essence, it argues that complex affixes are permitted and are formed according to the

same type of rewrite rules as are complex words. The rules permit affixes to attach to the category types Word, Root and Affix. A rule such as N-> V^{r} $N^{af}N^{af}$ along with the subcategorization frames for each affix generates survivalist, consumerism, regimentation, exhibitionist and reflects the categorial relationship that the affix sisters share.

3.9 Summary

First, it was demonstrated that there is no linguistic principle that justifies compounding at the level of Affix. However, there is a relationship between suffixes that share an affinity for one another that can be captured by productive morphological patterns. These patterns, or schema, can be generated by rewrite rules of the form Affix -> $Affix^{*}$. It is claimed that morphological competence includes knowledge of the relationships that hold between affixes and their associated affixes as well as between words and their associated affixes. The grammar is capable of describing a morphological family and the derivational relation of its members.

CHAPTER 4

DEVELOPMENTS IN THE PSYCHOLINGUISTIC LEXICON

4.1 Lexical access and storage

One of the central areas of interest in psychology is to determine how words are represented in the mind and how they are accessed in perception and production. Lexical access is the process of contacting the mental lexicon (ML) during language processing. A word is accessed when the encoded representation of the visual or auditory stimulus finds a matching entry in the ML (Lima 1985). Most psychologists assume that the large part of the ML stores data that a speaker needs in order to understand and produce each word in the language. Minimally, this information must include the facts of pronunciation (including stress), orthography, morphology (both inflection and derivation), syntactic category, subcategorization restrictions, semantic representation and pragmatic constraints.

It is also believed that the entries in the ML express the frequency of occurrence of the words they represent. It is possible that this information may be encoded by the position of the entry in lexical memory with the most frequently used words at the top of the search. Alternatively, an individual entry may be sensitive to a

linguistic environment which reduces the uncertainty of the existence of that entry and its location in memory need not be serial.

Thirdly, the information in lexical memory must in some way express the morphological or semantic relationships between words. Much of the psychological literature has probed the notion of a simplifying lexicon in which lexical representation of an affixed form, or relative, is subsumed under the representation of its base. For example, do speakers conceive of inflected forms such as walked as one unit in the ML or as two, walk and -ed past tense? Is a word like dancer accessed through the base word dance or do both words have separate listings in the mind? Does a polymorphemic word such as idealization share a common location in memory with its relatives ideal, idealism, ideally, idealist, idealistically...etc.? The answers to these questions lead to hypotheses regarding the organization of the internal lexicon and to whether it contains generative processes which can combine morphemes and word phrases or decompose complex derivative forms.

4.2 Experimental models of the ML

For the last two decades, psychologists have investigated speaker's lexical knowledge by means of experiments designed to illuminate both the nature of lexical representations and the access mechanisms that the speaker employs to retrieve the

information needed to recognize surface forms. Whether words are decomposed in the mental lexicon or given full representation imply different models of the ML. Decomposition minimizes storage requirements in that not all items need be explicitly listed. However, decomposition incurs maximum processing load on the system because words must first be broken down and later derived from rules on line. Full listing, in contrast, incurs no such load because all words are given representation in memory and can be accessed wholly. Thus, decomposition minimizes storage and maximizes processing load, while full listing maximizes storage and minimizes processing load: there is a trade-off between speed and storage.

4.2.1 Logogens

One of the earliest models of word processing, called the logogen system, was developed by Morton (1965). Initially, the system was word-based, that is, the phonological and orthographic units which activated the logogens were words and not parts of words (morphemes). As the model evolved, (Morton and Paterson 1980 and Kempley and Morton 1982), the auditory and visual systems have specific lexicons which independently interact with the semantic information of the cognitive apparatus and the logogens in each lexicon were sensitive to morphemes. In the logogen system, thresholds of frequently used words are lowered by the repetition of the words in

stimulation; therefore, high frequency words require less activation to be accessed than do words of lower frequency. Fowler *et al.* (1985) believe that this model has an advantage in that it can account for the way in which speakers are able to make predictions regarding the existence of a word in a particular environment.

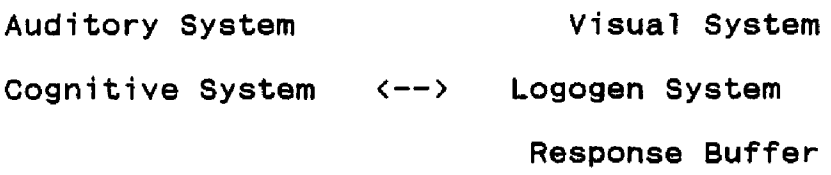


Figure 13. Logogen System (Morton 1965).

Kempley and Morton (1982) describe two possible organizations of the ML. In the first, words and morphemes are recognized separately and have separate frequencies. In processing the word walking, both the logogen for walk and for -ing would be activated and reaction time for perception would depend on the frequency of occurrence of each morpheme. In the other possible organization, the root morpheme is associated with its own set of affixes with which it may combine. These affixes have separate units in the lexicon but can only be activated once the associated root has been accessed. The presentation of the visual stimulus walking will cause the unit walk to activate the corresponding logogen which in turn will activate the associated inflectional endings for walk.

4.2.2 Decomposition

The Taft and Forster model of lexical access (1975, 1976) assumes a lexicon which has a master file and peripheral semantic, phonological and orthographic files. The master file, or lexicon proper, contains the complete specification of a surface word and is accessed through the base entries in one of the peripheral files. According to this model, a prefixed word is stored in the lexicon as a representation of its stem, with information stored within this lexical entry regarding the affixes which can combine with the stem to form a word (Taft 1981). To recognize a prefixed word, the reader must decompose the word into its prefix and stem and lexical access is obtained via the stem. When the stem entry is located in the lexicon, the affix information is obtained and the word is recognized. To illustrate, the word retrieve is accessed by stripping off the re- prefix, locating the lexical entry -trieve and determining that re- attaches to trieve to form a word. In this manner, words sharing the same stem are accessed through the same single shared entry; e.g. persuade and dissuade are accessed through the stem -suade.

The assumption that affix-stripping occurs as part of the lexical access process is supported by Taft's finding (1981) that pseudo-prefixed words such as relish take longer to classify as words than do truly prefixed words such as relive. His explanation is that the prefix re- is first stripped, revealing the stem lish; whereupon the subject searches the

lexicon unsuccessfully for the stem and a second search for the whole word must be conducted necessitating more time.

In a corroborating finding, Taft and Forster (1976) attested to the feasibility of affix stripping based on the facts that stems such as vive took longer to classify as non-words than pseudo-stems such as lish. They conclude that stems are represented in memory to serve as access codes and since lish will not be retrieved from the files, its nonword status can be determined quickly. Proponents of a decomposition model claim that it achieves economy of storage since words can be accessed through a shared stem entry. Moreover, a shared entry allows related forms to be listed together in the lexicon.

4.2.3 Network activation

Dell and Reich (1981) present a model of production which includes morphemes as part of lexical representation. This model differs from the ones previously described in that it does not presume that decomposition must take place before lexical access, nor are words listed in separate access files (Taft and Forster 1976). In the network model, the lexicon is a hierarchy of nodes including words, morphemes, syllables, syllable constituents, phonemes and phonetic features. Words have separate entries in the lexicon which connect to a shared stem morpheme, to a shared syllable, and to a shared phoneme node. Words also connect to the semantic memory where they

are similarly organized both to common and distinct elements. Retrieval occurs by spreading activation to all related nodes in the network. The lexicon is not compartmentalized or organized into peripheral files, but contains all of the information needed at each stage of production. Each stage is sensitive to the activation of all other stages due to the spreading of activation. This network is able to show the relationship between words in the lexicon without requiring morphologically related words to share a single, common entry. Rather all words are represented fully in both full and decomposed form. Andrews (1986) points out the utility of assuming that decomposition is an optional, not obligatory process. In two experiments she found that the same stimuli provided evidence for decomposition in an environment involving compounds and suffixes whereas in an isolated context, there was no evidence that morphological analysis had taken place. Morphemic analysis may be a strategy that the reader employs in processing and not a prerequisite for lexical access. There is a need for an explicit model of the effects of morphological structure which specifies levels of representation; the relationship among levels and the mechanics by which activation spreads within and between levels.

4.2.4 Parallel processing

Stemberger (1983) describes a similar network model for language production to explain malapropism errors. His parallel interactive model describes the levels of representation and their interaction in speech production. Following Dell and Reich (1981) the lexicon contains a series of interconnected linguistic levels. Production begins with meaning and proceeds through "the selection of words and the spelling out of the phonological units" (Stemberger, 1983: 585). When processing begins on one level, it sends activation to all associated units on higher or lower levels. However, the activation level of a unit will inhibit the units on the same level and the unit will be uniquely selected by the language system.

As a word becomes activated in word selection, it begins to activate all lower units, i.e. the phonological segments, the syllable structure, the stress patterns and so on. Once the lower units are activated, activation spreads back to the word level giving secondary activation to words. Stemberger gives the following illustration of the system to explain how speech errors such as "you used coupons" when the target word was croutons:

COUPONS			CROUTONS		
K	R	U:	T	A:	N

The target crouton sends feedback to all two-syllable words with stress on the first syllable, particularly to those with

the same initial phoneme, and to a lesser extent, to those words which have the same phonemes in different syllable positions. The spread of activation from the phonemes back up to the morphological units is therefore an integral part of the selection of words and errors in feedback from the phonological level play a causal role in malapropism errors. The secondarily activated words are selected in place of the targets.

4.2.5 Addressed morphology

A reading model that also accommodates full and partial entries is the Addressed Morphology Model (Caramazza *et al.* 1985) as described in Rossman-Benjamin (1986)). There are two main components in the model: the lexical address procedure which contains both a whole word processor and a morphological parser; and an orthographic input lexicon which consists of root morphemes, affixes and function words. Both the whole word and morphological parsing procedures operate in parallel to activate forms in the orthographic input lexicon.

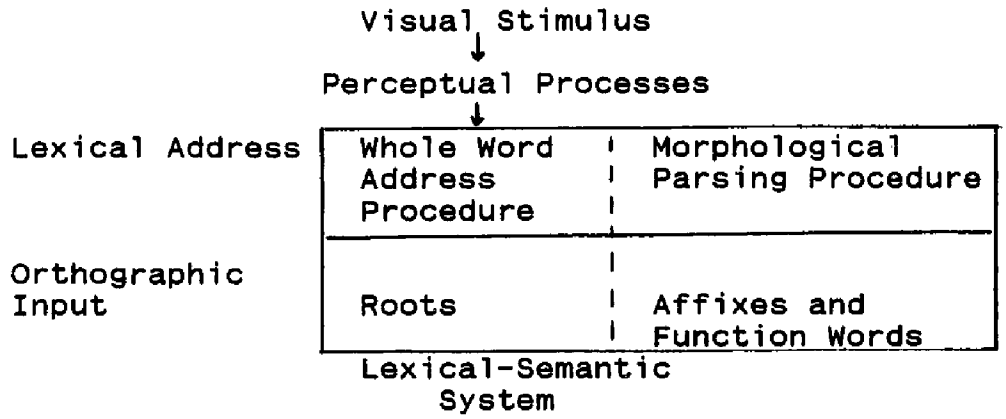


Figure 14. Addressed Morphology (Caramazza et al. 1985)

When high frequency morphologically complex words are presented, they are subject to both address procedures; however, the whole word processor is assumed to be faster than the morphological parser. If the word search in the lexicon is unsuccessful, recognition will depend on the parser.

4.2.6 Cohort

The cohort model (Marslen-Wilson 1978, 1987) of spoken-word recognition assumes a distributed, parallel processing system, that is, each entry in the mental lexicon corresponds to a separate computationally active recognition unit. The unit of recognition is an intersection of the acoustic, phonetic, semantic and syntactic features associated with a given entry. This model treats the initial access phase as a separate aspect of the recognition process, not as an independent processing component similar to Forster's (1976) peripheral files.

The word initial cohort (two to three phonemes) introduces the search in the lexicon. Once the cohort sequence has been accessed, the model enters into the selection phase and context (top-down) sensory and contextual factors influence decision. Marslen-Wilson uses the word trespass as an example to illustrate the concept of the recognition point when the word is uniquely identified. If the word is encountered in isolation, the uniqueness point is the /p/ phoneme, in order to distinguish trespass form tress and trestle. However, the

recognition point for the word in context may be /s/ if additional syntactic and semantic factors are derivable form the context and work together to reduce uncertainty. Sequential models cannot accommodate the dependency of the recognition response on the relationship between the word and its initial cohort. Sequential search models cannot reflect the possible competing alternates since the access files are organized into "bins" with words stored in each bin according to frequency of occurrence. Search continues serially through the bin until the match is encountered permitting no simultaneous search through the bins of its competitors.

Proponents of the cohort model reject the logogen-based theories which depend on a threshold as the basis of word recognition. They claim that logogen models have no mechanism for allowing the accumulation of positive evidence in one word to take into account the thresholds of other words. In contrast, in the cohort model, incoming information is made available to all of the processing units to allow for the discrimination of the appropriate word from the set of possible words. The model differs from network-based models in this same regard where contextual variables have no access to affect the selection process.

4.3 Experimental paradigms

Part of the difficulty in distinguishing between the various models of word processing is that they lack detail. Only the

Taft and Forster model (1974, 1975), since it is sufficiently explicit, has been critically examined and experimentally tested in the psychological literature of the past decade. Yet, the results are inconclusive and have failed to attest to the superiority of one model over another. There are no definitive findings as to whether words are given full listing in memory; are morphologically decomposed and a set of affixational morphemes instantiated in memory; or represented as both full and decomposed entries. Empirical evaluation of the Taft model has relied on several laboratory techniques for investigating a range of semantic, morphological, phonological and orthographic variables which might affect the speed of lexical access. One of the most popular experimental techniques is the lexical decision task.

4.3.1 Lexical decision

In this task, the subject is asked to judge whether various letter strings are examples of words in the language. Both the decision and the amount of time taken to reach the decision provide data for testing hypotheses about the effect of the variable in word recognition. Lexical decision, although widely accepted by most psychologists, has been criticized by some researchers, notably Balota and Chumbley (1984), who argue that the decision processes which have nothing to do with lexical access accentuate the word frequency effect. They claim that the results from this task

are questionable in testing the general belief that word frequency orders the lexicon and affects access to the internal lexicon.

In three experiments they found "striking differences in the unique effect of word frequency across tasks" even though each task should have involved a similar lexical access. The researchers urge further investigation of the decision stage in this task and/or the development of a different task which more accurately reflects the processes involved in word recognition.

4.3.2 Repetition priming

Another much employed method of psychological experimentation is the repetition priming task in which words presented for lexical decision are preceded by other words, morphologically, semantically, or orthographically related or not. A stimulus will facilitate the greatest response when it is repeated, or primed by itself. Full priming is priming of a word by another which is as large statistically as priming a word by itself. Partial priming is priming a word by another that is present statistically, but at a significantly lower level than full priming. Stanners *et al.*(1979) has shown that the priming of a base word by its inflected forms is nearly the same as priming a word by itself. In other words, presenting a subject with walked before walk involves the same response latency as priming walk with walk. Kempley and Morton (1982)

found that whereas priming with inflected forms is full, only partial priming occurs with derived forms.

Fowler *et al.*(1985) investigated the priming patterns reported in Stanners' research and found that the difference between inflected and derived words in priming may have an "episodic" origin relating to the less formal relationship which holds between derived words and their bases than to inflected words and their unaffixed morphological relatives. Fowler *et al.* concede that their findings do not adjudicate between the models of the lexicon proposed in the literature; however, their data demonstrate morphological effects depend on the nature of the stimulus environment which implies that they have their basis in processes which occur at access rather than in structural aspects of the memory system.

4.4 Evidence supporting the Full Listing Hypothesis

In the Full Listing Hypothesis (FLH) each word is given a separate representation in memory. Acceptance of the FLH disconfirms a theory which states that the domain of a lexical entry includes only those words which can be generated by productive, grammatical rules (Butterworth 1983). Many linguists have rejected the FLH on the grounds that language is rule governed and that the language learner maximizes the development of lexical rules. They maintain that learning rules for word formation simplifies, not complicates the load on memory since rules express generalizations which are

regular and therefore predictable.

Experimental evidence for the hypothesis that morphologically related words are stored together in the lexicon has been gathered in several studies; however, there is no clear support as to whether all words are represented fully (FLH), or arranged in satellite fashion or around a base form or other more abstract lexical heading. This section describes the various studies on word recognition and production which have failed to support the decomposition hypothesis (DH) and thus conclude that the FLH can be maintained.

Manelis and Tharp (1977) compared lexical decision times for pairs of affixed words with the reaction times for pairs of non-affixed words (e.g., printer/drifter vs. slander/blister) to determine the cost of morphemic analysis. If prelexical decomposition occurs prior to access, they reasoned that the reaction time would be faster for the truly affixed pairs. On the other hand, if a search for the whole item occurs first and decomposition later after an unsuccessful search than lexical decision time should be slower for affixed words. The data indicate that pairs of the same type were recognized faster than pairs of the mixed type (e.g., slander/printer), but that the reaction times for affixed and non-affixed pairs did not differ. They conclude that analysis of the internal structure of words controls performance in some way but there is no cost to this analysis.

Consequently, this study lends some support to the FLH.

Stronger support for a version of the FLH comes from a study of inflected Serbo-Croatian nouns. Lukatela *et al.*(1980) hypothesize that all cases of nouns are represented individually in the internal lexicon with the nominative singular functioning as the nucleus and the embodiment of the noun's frequency and around which the other case forms cluster uniformly (cf., Bradley (1980) combined frequency count). The nucleus is viewed as a logogen as are the other case forms and there is a common threshold level for each logogen that is of equal value to the threshold of the nominative singular, incremented by a constant.

This study and a previous experiment (Lukatela *et al.* 1978) tested the extreme version of the FLH. If there is an independent entry for each separate case, reaction time for a given inflected surface form should vary according to the frequency of occurrence for that particular form. The data did not support this hypothesis. Reaction time was the fastest for the nominative singular case of both masculine and feminine nouns despite the fact that the nominative singular is not high in frequency for feminine nouns. They conclude that all grammatical cases are not qualitatively alike in lexical status and not ordered serially according to frequency. This view refutes the DH in which reaction time involves a correlation with successive stages of decomposition since the reaction times to related cases did not differ

significantly even when the surface forms differed in frequency.

Segui and Zubizarreta (1985) support the notion that morphologically derived words are listed in the lexicon as autonomous but related items. In their view, this organization of lexical items aids memory as morphological relatives can be grouped together. A common root (bound or free) also constitutes a lexical entry and functions as the head or nucleus of the morphological family. Although evidence for the internal structure of the family has not been adduced, the authors suggest that items within the family are directionally related to reflect derivational history. Segui and Zubizarreta claim that processing proceeds from left to right. When the parser hits a form which corresponds to the morphological head, the family is accessed and a matching procedure applies to select the correct form. There will be no matching procedure for prefixed forms given that the affix precedes the root. However, accessing the root triggers a suffix detection process which may be necessary in sentence processing. It is the suffixed form of derived words which determine their syntactic properties (at least in English and related languages). The authors propose that their view of the nature of the internal lexicon and access highlights the importance of a suffix detection mechanism to ensure the efficiency of syntactic parsing.

Another view of the FLH assumes that there is no shared

entry of related forms, but that all variants are listed separately and that the presentation of one word causes the activation of other morphologically related words which influence the recognition process. Fowler *et al.*(1985) examined repetition priming effects among morphological relatives in auditory and visual presentations to investigate this conception of the FLH.

An initial experiment replicated Stanners'*et al.* (1979) finding that both base and inflected forms produce full priming and derivatives produce partial priming. However, based on the responses to non-word stimuli, Fowler *et al.* proposed that repetition priming may have episodic effects, that is, subjects remember having seen letter strings and having made certain responses and that this non-lexical effect contributes to subjects' responses. In a second experiment, when they controlled for episodic effects, they found that repetition priming of a base form by a derived form was as full as priming by an inflected relative. They view these results as evidence of Butterworth's (1983) claim that repetition priming is not a consequence of repeated access to a shared entry.

Further experimentation failed to support the finding of Lukatela *et al.*(1980) that morphological relatives have a satellite organization since priming among all relatives was strong. Instead, they propose an organization of the ML which derives from the network model (Dell 1984 and McClelland and

Rumelhard 1981). This model allows words to share syllable, morpheme, or phoneme nodes and also have connections to semantic memory. It does not require relatives to share a common word/root level node nor does it view morphological relations as necessarily semantic.

4.5 Evidence supporting the Decomposition Hypothesis

As mentioned previously, in contrast to the FLH, the partial listing, or the Decomposition Hypothesis (DH) assumes that stems are entered into the lexicon along with their associated affixes. The lexicon is simplified to reflect morphological relation. Much of the experimental literature, like Andrews (1986), has attempted to verify the DH through lexical decision, priming and naming tasks.

Murrell and Morton (1974) found that the recognition process takes advantage of the internal structure of words. Pretraining subjects with a word containing the same root morpheme e.g., reader/reading, facilitated recognition, whereas learning a word with visual or acoustic similarity but no morphemic relation e.g., reader/ready, resulted in insignificant facilitation. Working within the logogen model, Murrell and Morton conclude that the threshold of a logogen is lowered through the particular semantic associations of the morpheme from which the word is derived. This implies a version of the DH which allows morpheme effects to influence word recognition.

Mackay (1978), in a production task, presented subjects with verbs which they had to nominalize, e.g. conclude/decide, to test the cost of morphemic analysis. He predicted that more complex derivational operations involving phonological changes (i.e., those characteristic of non-neutral affixes) would require more time to produce. The FLH would predict no difference in reaction time since all forms would be directly accessed from the lexicon. His data show that production time for more complex forms took longer supporting his hypothesis and the DH. His view of the internal lexicon contains a derivational component where base words are stored along with independently stored derivational suffixes.

Smith and Sterling (1982) describe four experiments which investigate readers' awareness of morphemic structure and whether this knowledge affects performance. Based on their subjects' judgement on five criteria of prefixed forms and on data from letter cancellation tasks, they propose a model of reading that perceives prefixes as separate units independent of semantic content. They replicated Taft and Forster's (1975) experiments with pseudoprefixes indicating that affix-like nonaffixes are treated as prefixed forms prior to lexical access. In support of the DH, they propose a model of reading which involves a prelexical parser which can identify potentially significant units, independent of their meaning, in order to speed word recognition.

Corroborating their work, Lima (1985) in two experiments

using a display change technique involving perception of prefixed and pseudoprefixed words, e.g., revive/rescue, demonstrates that the pseudoprefixed words require more fixation time than prefixed words. Her data support the traditional view of the DH in which word processing is seen as a left-to-right process which detects prefixes, strips them and proceeds until a letter string matching a stem is reached and activated.

Jarvella *et al.*(1987) in naming and lexical decision tasks using Dutch and Italian verb forms provides support for a morpheme-based lexicon. In the Italian experiments, withholding inflectional information which distinguished full word forms from other related forms failed to have any effect on lexical decision or naming tasks. The decision latencies for the Italian data suggest that the form of the word required for recognition corresponds to the root and a sufficient number of letters to determine the stem. This implies that inflections are processed after lexical access.

In the Dutch experiments, initially viewing less than the full form slowed naming latencies, but presentation of a root or stem portion led to faster latencies than initial presentation of only affixed portions of the word. Also, initial viewing of stem substrings tended toward faster latencies than smaller word-initial substrings, even when sufficient information to determine the root was present. Jarvella *et al.* posit that sub-word forms are stored in the

lexicon and may be looked up and bound together in hierarchical structure on two levels of representation: root+ derivational affixes and stem+inflectional affixes. It may be that Italian and Dutch speakers have internal lexicons which are structurally different; however both recognize morphemic structure as an essential component in word processing.

4.6 Evidence supporting a hybrid model

Finally, evidence for a hybrid FLH/DH model of the ML derives from recent experiments by Andrews (1986) which were designed to test the underlying assumptions of the affix stripping component of the decomposition model (Taft 1981). Taft assumes that access to the master file occurs through the basic orthographic syllable structure (BOSS) which is primarily an orthographic, not phonological or semantic unit which corresponds to "the part of a word's first morpheme that includes after its first vowel all consonants that do not violate morphemic structure constraints." He claims that it is the BOSS and not the phonological syllable which enables morphologically related words to be accessed through the same representation. For example, the BOSS hypothesis claims that a reader recognizes a word like lantern by access through the BOSS lant, not the phonological syllable lan, yet his experimental results have not been replicated in any later studies.

In the Taft model, before a prefixed word can be accessed, the prefix must be stripped in order for the parser to proceed in left-to-right fashion. When the BOSS parse is reached, the location of the correct access code in the peripheral file results in a matching procedure in the master file. If this were true, Andrew reasons that decomposition effects should be observed in all word and non-word environments.

Secondly, Andrews wanted to test the claim that the ordering of the access codes in the peripheral files is based on the frequency of the word's stem, not surface frequency (Taft 1979). Although suffix-stripping does not occur for derived words, Taft predicts that stem frequency will affect their recognition.

The third prediction of the Taft model Andrews investigated was the belief that delayed classification of suffixed words results from the sharing of access codes by unrelated items, e.g., ten/tenant.

In lexical decision tasks Andrews found that the frequency of both the first and second syllable of compound words influenced reaction times, suggesting that compounds are decomposed into their constituent morphemes which do not necessarily correspond to the BOSS. It may be that decomposition is an optional strategy that the reader adopts in recognizing the complex word. If the compound is composed of two high frequency words, it may be faster to access the two constituents and check for a compound match in the master

file than to search for the whole word composition.

In another experiment Andrews found no support that reaction time for suffixed words (-ive,-ment,-en,-age) depended on stem frequency. High frequency first morphemes for real words and non-words yielded no differential effects, suggesting that a decomposition procedure to locate stems is not obligatory. However, in a third experiment, the same suffixed words when presented in an environment including compound words showed that stem frequency affects the classification of real and pseudo-stem words differently. This contradicts the claim that morphological effects are a function of the access code used to locate words in the lexicon since the effects should be demonstrated whenever the word is accessed; further, the data could not locate any interference effects supporting Taft's claim. Andrews points out that since the morphological effects depend on the nature of the stimulus environment, they are not part of the structural aspects of memory, i.e., located in peripheral files, but are strategic effects which occur at the time of lexical access.

4.7 Summary

In summary, proposed models of the mental lexicon fall into three general approaches. The first centers around the assumption that the unit of representation in the mental lexicon is the word itself. Various mechanisms are proposed

for relating the entry to its morphological relatives and to other entries with similar syllables, morphemes and phonemes. A second approach includes only base forms as lexical entries with derivational and inflectional affixes stored in peripheral files and retrieved post-access. The last generic position is a hybrid approach which stores complex forms as separate units but the model may also include lexically conditioned rules.

Experimental research in psychology, augmented by advances in linguistics, especially theoretical morphology, has led to the maturation of psycholinguistic theories of lexical processing. Whereas the early psychological experiments with complex forms were relatively naive in their presentation of "morphological" stimuli, more recent studies make use of linguists' data and interpret their results against the background of generative morphology, lexical phonology and various other morphological approaches. The following section traces some of the overlapping interests and developments in cognitive science and linguistics.

CHAPTER 5

EXPERIMENT I

5.1 The frequency effect

The frequency effect is often employed as a variable in studies of lexical access and storage. Word recognition studies have shown that more frequent words are recognized and accessed faster than less frequent ones, suggesting that word frequency orders the lexicon and affects access to it. Given this fact, if an affixed form is accessed through its base lexical entry, as the DH holds, its recognition time should be affected by the frequency count of the base or, possibly, a count that includes the frequency of the affixed form as well, as opposed to the frequency of the affixed form by itself. Most psycholinguists agree that at least the base form of a word, if not all of its morphological relatives, is stored in memory, and that more frequently used forms are recognized and produced faster and more accurately than less frequent forms (MacKay 1982). The most common index of word frequency is frequency of occurrence in print, usually measured by an objective word count such as Kucera and Francis (1967) or Carroll, Davies and Richman (1971).

5.2 Surface and combined frequency measures

In perceptual studies, frequency is generally measured in

either of two ways: the logarithm of the frequency of the word (surface frequency) or the logarithm of the frequency of the word including the frequency counts for all its inflected and derived forms (combined frequency).[1]

Taft (1979) found subjects' reaction times to prefixed derivatives whose bases also occur in higher frequency words are accessed more quickly than words whose stems only occur in low frequency words. For example, the word reproach has a surface frequency count of 3 from Kucera and Francis (1967) count; whereas the surface frequency of approach is 123. Base frequency is the frequency of the root contained in the word; for example -proach has a total frequency of 126 because it appears in approach and reproach with respective frequencies of 123 and 3. For Taft, the two frequency counts influence two different stages of lexical processing: the combined frequency serves the access to the peripheral file where all of the morphological relatives are accessed through the same stem (proach); whereas surface frequency influences the lexicon proper where the affix is attached to the stem. Taft (1985) demonstrates that even when two suffixed whole words are of equivalent frequency, e.g. fearless and flawless, the one with the higher base frequency (fear) will be recognized more quickly than the base with low frequency (flaw). The results of the experiment show how base frequency exerts a

[1] Logarithms are used to prevent very high frequency words from carrying too much weight in the analysis.

separate effect on lexical decision time apart from surface frequency. Based on these findings, Taft (1985) revised his earlier views on affix-stripping, claiming that only prefixes and inflectional suffixes are stripped before access but that suffixed derivatives require morphological left-to-right parsing in order to isolate the access code (the stem) which mediates the location of the full representation of derived forms. Burani *et al.* (1984) corroborated Taft's results showing that the frequency of the base of Italian inflected forms affects recognition time independently of whole word frequency.

In a study of derived forms, Bradley (1980) exploits the two frequency effects and shows that reaction times to transparent, derivationally related words ending in -ment, -er, and -ness correlate with the *cluster* frequency count, and not with *surface* frequency; whereas reaction times to opaque forms, derivatives ending in -ion, correlate with neither frequency count. Bradley's paradigm was constructed to determine which of the possible frequency counts better predicted the contribution of frequency to reaction time to affixed forms. She contrasted the two frequency counts: the cluster which corresponded to the combined frequencies of the stem, the form itself, and forms derived from it; and the surface which was the frequency of the particular word form. In the experiment, subjects' reaction times to suffixed words generally associated with a word boundary in SPE (#ness, #ment

and #er) correlated with the cluster frequency count, but not with the surface frequency count. These results of the cluster frequency effect lend support to the hypothesis that word boundary derivatives are not given a separate entry in the ML, but share representation with their base forms and are accessed through the same lexical entry. In contrast, subjects' reaction times to the words ending in the formative boundary suffix (+ion) did not correspond to either the cluster or to the surface frequency counts. Unfortunately, these results could not confirm the stronger hypothesis that formative boundary affixed forms are generally stored separately from their bases. However, Bradley tentatively proposed that word stress is a crucial factor determining the form of lexical representation and that forms which are derivationally related but differ in the placement of main stress have independent lexical representation., leading to the hypothesis that the phonological and orthographic features of opaque derivatives may influence lexical storage and access.

In two visual lexical decision experiments with Italian transparent derived words ending in the suffixes -zione, -mento, -tore, etc., Burani and Caramazza (1987) partially corroborate Bradley's findings in that they found an effect of combined frequency on transparent derived words; however, in contrast to Bradley, they also found a significant effect of surface word frequency for derived words. Their results

lead to the conclusion that roots and derivational affixes are represented separately, at least for the type of stimuli used in the experiment, namely medium-to-low frequency derived forms whose roots do not show any ortho-phonological change from the base. They suggest, however, that for opaque derived forms of higher frequency, the representational entry might be other than the root, as in Bybee (1985) where the representation is the stem (root+derivational suffix) for high frequency derived forms.

5.3 Experiment I (Kane and Roth)[2]

Since previous published studies utilized only singly suffixed forms to investigate lexical organization, the present study was designed to determine whether multiply affixed forms are processed differently. Specifically, we wanted to discover the access mechanisms for the derived forms resulting from the attachment of the double affixes -ability, -iveness, and -ional. Potentially, lexical access can be gained:

1) through the base form, thus supporting the DH;

2) through the singly suffixed derived form (base-$Affix_1$), supporting the morphological theory that affixation is sensitive only to the surface properties of the form with which it combines, and

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[2]I am expressly grateful to Leslie Roth for the implementation of the procedure and for the statistical regression analysis. Technical portions of this chapter were edited and expanded by Ms. Roth.

3) through the surface form of the combined base and both affixes (base-$Affix_1$-$Affix_2$), thereby supporting the FLH that all words are autonomous in the lexicon.

5.3.1 Method

We employed a lexical decision task and correlated subjects' reaction times with surface frequency counts obtained from the Kucera and Francis (1968) word list. Frequency values per million words for the base, the singly suffixed form and the doubly suffixed form were calculated in order to predict the processing and lexical storage of multiply suffixed derivatives. We expected that if a form is accessed through another, i.e., its base form, its recognition time will be correlated with the frequency of the form with which it is stored and through which it is accessed.

In addition, in a *post hoc* analysis of the subjects' performance on the lexical decision task, reaction times were correlated with two separate combined frequency counts: the frequency of the base forms plus all of their inflected forms; and the frequency of the base forms plus all their inflected and derived forms combined.

5.3.2 Subjects

Subjects were thirty Hunter College students who volunteered and were paid for their participation in the experiment. All were native speakers of English and had normal or corrected vision.

5.3.3 Stimulus materials

The stimuli used in the experiment consisted of forty-one pairs of morphologically matched English words and pseudowords (see Appendix 3). Each word and pseudoword existed in 3 versions; a whole word (or pseudoword) base, a base-Af_1 and a base-Af_1-Af_2 (e.g., profit, profitable, profitability; *extrol, *extrolable, *extrolability). The three affix combinations were:

base	base-ion	base-ion-al	N= 9
base	base-able	base-able-ity	N= 12
base	base-ive	base-ive-ness	N= 9

The numbers of each stimulus type (N) were dictated by the constraints on the stimuli. The principle restriction in choosing the stimuli was that the base form be a whole word, e.g., profit-able, so that its frequency count could be obtained (cf., the base of funct-ion is a bound form, therefore, it has no frequency measure). Spelling and pronunciation changes between morphological variants were allowed and were factored into the regression analysis. Stimulus frequency was not controlled as that was also one of the regression factors. These constraints limited the number

of exploitable stimuli from the Kucera and Francis word list.[3]

Subjects saw only one form from each morphological triplet and saw equal numbers of each type of morphological form for both words and pseudowords. Since there were three morphological forms for each item, three experimental stimulus groups were created. The order of presentation of stimuli was randomized for each subject.

5.3.4 Design

Ten subjects were randomly assigned to one of three stimulus groups. For the regression analysis, the independent variables were frequency of each of the stimuli, lexical decision times for each form, and the number of spelling and pronunciation changes from one morphological form to another. The dependent variable was lexical decision time.

5.3.5 Procedure

Subjects were seated in front of a microcomputer. Stimuli were presented, one at a time, in lower case for lexical decision and stayed on the screen until a response was made. The subject responded by pressing the "+" key on the number pad for a word response and the "0" key on the number pad for a nonword response. After a response, there was a one second

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[3]Two other stimulus types were included as pilot materials; but statistical analyses were precluded due to the small sample size:

base	base-ist	base-ist-ic	N=6
base	base-ive	base-ive-ity	N=5

intertrial interval, the next stimulus was presented and it stayed on until a response was made, etc. Each subject saw 20 practice trials after which 84 experimental trials were presented. During practice trials, subjects received feedback about the correctness of each response. They were instructed to respond as quickly and accurately as possible. Reaction times were recorded directly by the computer.

5.3.6 Results and discussion

Errors were excluded from the analysis. Subject responses beyond two standard deviations from their mean were trimmed to two standard deviations to offset skewing introduced by longer latencies in reaction time studies. Table 5 presents mean reaction times to each affix type for words and pseudowords.

Table 5. Mean Lexical Decision Times (msec) for Each Suffix Type

Suffix	Base	Base-Af1	Base-Af1-Af2
WORD STIMULI:			
X-ion-al	681	703	711
X-able-ity	724	833	1020
X-ive-ness	697	776	877
NONWORD STIMULI:			
X-ion-al	1091	1083	1117
X-able-ity	912	1155	1199
X-ive-ness	949	1113	1137

The results of the regression analyses for the three stimulus types, -ional, -ability, and -iveness are shown in Table 6. Independent factors in the regression were base frequency,

base-Af_1 frequency, base-Af_1-Af_2 frequency, and number of orthographic and phonological changes from the base to the base-Af_1-Af_2 form. Regression analyses were carried out using the two different frequency measures: surface frequency and cluster frequency. These two analyses yielded the same results. The dependent variable was reaction time to each type of stimulus. Only significant values from the analyses are reported.

Table 6. Regression Analyses for Single and Double Suffixed Forms

Dep. Variable		Regression Variable		Contribution to R^2	Probability
RT	X+ion	LF	X+ion:	.43	.04*
RT	X+ion+al	LF	X+ion+al:	.66	.008**
RT	X#able	LF	X:	.60	.000***
RT	X#able+ity	LF	X:	.21	.03*
RT	X+ive	LF	X:	.29	.000***
		LF	X+ive:		.03*
RT	X+ive#ness	RT	X+ive:	.74	.001***

RT= reaction time, X= base form, LF= log frequency

The data can not be accommodated by either the DH or the FLH. In fact, the data support all three of the alternate hypotheses concerning lexical access of doubly suffixed forms. It appears that the internal structure of the complex words determines how frequency affects reaction time. Whether a form is stored autonomously or subsumed with its morphological relatives under a common entry in the ML depends on the boundary type(s) of the Af_1 and of the constituents of the

combined Af_1-Af_2. The case is simplest for singly suffixed forms. If the suffix belongs to the formative boundary class (+ion and +ive), the reaction time to the derivative (base-Af_1) is predicted by the frequency of the surface form. This suggests that formative boundary affixes are not stripped before lexical access. The derivative is not decomposed but given a full independent listing in the lexicon, corroborating the FLH. This finding, then, is evidence of Bradley's stronger hypothesis that all formative boundary suffixed forms are stored and processed similarly. In contrast, if the suffix is a word boundary suffix (#able), the surface frequency of the base, and not the cluster frequency, predicts the reaction time to suffixed form, implying common storage in the ML supporting the DH.

The case for the doubly suffixed form is somewhat more complicated. Whether the doubly suffixed form is stored under the base (e.g., #able-+ity), under the base-Af_1 form (e.g., +ive -#ness), or autonomously (e.g., +ion -+al) depends both on the type of boundary of Af_2 and how Af_1 was processed and stored. It is significant that the reaction times to base-#able-+ity forms show no correlation with the base-#able frequency count. This suggests that #able-+ity is processed as a single unit and not decomposed. Further, it implies that Af_2 (+ity) is not added serially to the base-Af_1 but that #ability is attached to the base as if it were a single suffix. In the ML, lexical access for the #ability form would

be through the base.

The statistical analysis of the +ive-#ness forms yielded a slightly different pattern. It was the *reaction time* to the frequency of the base-+ive form, and not its surface frequency count that best predicted the reaction time to the base-+ive-#ness form. However, since the reaction time to the base-+ive form was predicted by the frequency of the base-+ive form, this measure indirectly points to the same conclusion regarding storage. Morphologically, +ive-#ness is a combination of two separate affixes, a formative boundary (+ive) and a word boundary (#ness). As predicted from the above, the former is attached to the base in the ML and the latter is subsumed under the base-Af1.

Lastly, autonomous storage was predicted for formative boundary suffixes and confirmed in the case of the double suffix +ion-+al. The recognition of these forms correlates with the surface frequency count (base-+ion-+al) and not with the frequency of the base or with the base-+ion because there is no internal word boundary.

Our results suggest that the process of visual word recognition of morphologically complex words proceeds from left to right until a word boundary affix is detected, much like the assignment of stress described in SPE. Heuristically, in a derivative, the letter string preceding a word boundary affix constitutes the lexical entry. The remainder of the letter string is treated as a unit,

regardless of how many formative boundary affixes are attached. For example, in the complex word profess-+ion-+al-#ism, the primary lexical entry is professional and the word boundary suffix, #ism, is subsumed under it. If the word profess-+ion-+al-+ity were encountered, we would expect it to be stored separately because it has no internal word boundary.

These results confirm Bradley's speculation that there exists a principled account governing access which depends on the morphological structure of complex words and can be defined by the rules of word formation; i.e., formative and word boundary affixes. Whether boundaries are units in a string, distinct from theoretical devices such as labelled brackets is not the concern here. The point is that in their recognition of complex words, subjects differentiated between words formed by formative boundaries and those formed by word boundaries.

Di Sciullo and Williams (1987) dispute claims that boundaries or any grammatically defined form (e.g., root, stem, word) might determine lexical access of complex forms. They interpret Bradley's failure to locate surface frequency or combined frequency effects for formative boundary derivatives as evidence that the relevant variable is not grammatical, but that it is the relative transparency of the stem that determines whether the combined or surface frequency governs retrieval. A form is considered to be transparent if it is clearly analyzable into its constituent morphemes.

Derivatives ending in the suffix -ion are generally considered to be non-transparent, or opaque because they do not preserve all of the base form or have primary stress on a different syllable from the one stressed in the base form. The following examples progressively illustrate the degrees of transparency:

execute	execution
posit	position
produce	production
revolve	revolution
compete	competition

Cutler (1983) claims that the criteria for functional transparency depends on whether the segmental values and relative syllable stress up to the base word's recognition point are preserved.

If transparency were the factor that influenced frequency effects, then one would expect that the stimuli formed by formative boundary affixes which did not undergo any phonological or allomorphic variation (i.e., transparent, or functionally transparent derivatives) would be processed exactly like the word-boundary stimuli. For example, the Experiment I stimuli in a) and b) below have relatively the same degrees of transparency, and their derivational suffixes have the same frequency of occurrence:

a) formative boundary derivatives

direct	direction	directional
except	exception	exceptional
confess	confession	confessional

b) word boundary derivatives

profit	profitable	profitability
accept	acceptable	acceptability
compress	compressible	compressibility

however, the reaction times for the cases in a) correlated with the surface frequency counts for the entire word, in contrast to the cases in b) in which latencies correlated with the frequency of the base form. In this study, the placement of stress remained constant in the stimuli formed by formative boundary affixes +ion-+al or +ive-#ness, but the affixation of -ive conditioned allomorphic changes, [d -> s], e.g., defend-> defensiveness. Again, in these cases, as predicted by the type of boundary, the reaction times correlated with the frequency of the surface form. In the word boundary derivatives #able-+ity and #ible+ity allomorphy was also evidenced in [t,d-> s] e.g., permit-> permissible and respond -> responsible with no diverse effect on lexical processing. These derivatives are processed as uniformly as #able word boundary forms with no orthographic variation where lexical access is through the base.

Thus far, these results have been interpreted within the theoretical language of the DH, that is, for example, of affixed forms being "stripped" and "subsumed" under base forms in the ML. The affix-stripping hypothesis predicts that lexical access of the entry for the base morpheme for transparent derivatives, that is, words formed by the

attachment of a word boundary suffix, e.g., #ness or #able occurs before the processing of the suffix morphemes, in contrast to opaque derivatives formed by formative boundary suffixes, e.g., +ity, or +ive which are accessed as whole words, along with their suffix morphemes attached. In the former case, it is unclear whether the frequency of the suffix morphemes is relevant to their subsequent access since frequency effects derive from storage and this presumes that affixes are stored as separate units and that frequency orders the lexical search.

However, these results are not inconsistent with a hybrid network model as in Cole *et al.*(1989); Fowler, *et al.*(1986) and Andrews (1986) in which morphologically related forms are connected. For example, in an activation model, access of the root, e.g., effective, activates all of the morphological relatives accessed through that same base, presumably all word-boundary derivatives, e.g., effectiveness. This process is equivalent to long term priming; usage effects spread to connected neighboring relatives causing frequency effects to accumulate across related words. The prediction from these results is that words with no internal word boundary suffix are stored separately, that is, they do not share any morphological connections with derivational relatives and, thus, are not affected by their frequency. On the other hand, derivatives formed by word boundary suffixes are interconnected with their lexical entry form in the network

and are sensitive to its frequency.

CHAPTER 6

EXPERIMENT II

6.1 Suffix frequency effects

Within a network model of the lexicon, all complex words are listed separately with their affixes attached to their bases (Andrews 1986, and Bybee 1986) and the presentation of a word causes activation of its morphological relatives. Individual members of a morphological family are thought to be accessed in the order of their frequency of occurrence. This study investigates the hypothesis that suffixes may also be subject to the frequency effect, and may affect acceptability judgements, independently of either surface or cluster frequency of the full derivative. That suffixes are sensitive to the frequency effect was originally proposed by Murrell and Morton (1974) and substantiated more recently by Colé, Beauvillain, and Segui (1989).

To illustrate, Colé *et al.* studied reaction times to derived French words of medium to low frequency as measured by the counts obtained in The Trésor de la Langue Francais (1971) and found that the combined frequency count determined the latencies to suffixed words, but not to prefixed words. Their results demonstrate the contribution of the effects of

both frequency counts. First, they found that the combined frequency count for suffixed words affected lexical decision time regardless of the surface frequency. They hypothesize that once the combined frequency detects the root, the set of morphological relatives, that is, forms that share the same root (e.g., jardinier/jardinage), is activated and the search for the particular family member proceeds according to its relative surface frequency.

Regarding the effect of suffix frequency, they found that the magnitude of the surface frequency effect was intensified when the derivative contained a high frequency suffix. They selected pairs of words which shared the same root, but differed in surface frequency. In the first set, the form with the higher surface frequency also had the suffix with the higher frequency, in contrast to the second set where the higher surface frequency form had the lower suffix frequency, e.g. equipage/equipier; jardinage/jardinier. Single suffix frequency was calculated by counting the number of occurrences of the two or three-letter suffix in the terminal part of a word in French. Their results show that even when the more frequent relative contains a less frequent suffix, there was a significant surface frequency effect indicating that suffix frequency alone does not order the search; however, the surface frequency was intensified when the derivative contained a high frequency suffix suggesting that suffix frequency does facilitate the surface frequency effect. Their

view argues against prelexical decomposion for all complex forms and implies that affixed forms are represented as whole words in the lexicon.

6.2 Lexical decision and multiply suffixed forms

In Experiment I, Kane and Roth employ three separate surface frequency counts: the frequency of the base; the frequency of the derived word formed by the attachment of the first suffix (Af1); and the frequency of the derived word formed by the attachment of two suffixes (Af1+Af2). Contrary to Bradley's, results, our data show surface frequency effects for root-level, multiply-suffixed derivatives. Latencies correlate with frequencies for the surface form of (X+Af1+Af2), not with the surface frequencies of either of the other possible bases (X or X+Af1). Moreover, Kane and Roth find no combined frequency effects for either word-level or root-level complex forms.

6.3 Frequency as determinant of morphological productivity

Aronoff (1982:170) demonstrates that frequency of morphological patterns (e.g., Xiveness/Xivity) plays an important role in determining the productivity of word formation rules and claims that "linguistic theory must recognize the distinction between actual words and potential words and the related notions of productivity and frequency as part of grammatical competence." Several studies (Aronoff and Schvaneveldt 1978 and Anshen and Aronoff 1981) have shown

that when presented with possible but non-occurring words formed by different morphological patterns, speakers will accept more words formed according to some patterns than others and that this correlates with numerical measures of productivity. For example, speakers accepted forms such as stimulativeness over forms such as stimulativity reflecting an internalized knowledge of the relative frequencies of the morphological patterns. Because no frequency count for affixes was available, the frequency counts for these studies for each morphological pattern and their respective bases was determined by the mean frequency per million words from Kucera and Francis (1968).[4]

6.4 Experiment II

The second experiment extends Aronoff's investigation of the notion of possible word and examines the role of suffix frequency as a variable in subjects' acceptability judgements. Based on Aronoff and Schvaneveldt (1978), we expect that a subject's ability to distinguish words from non-words will be affected by the frequency of the morphological patterns of the stimuli. Previous results show that as a morphological

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[4]

Examples:	N	Base word	Derived word
Xivenes	134	10.08	0.49
Xivity	23	27.26	9.57

pattern becomes more frequent, the subject's ability to discriminate between actual and potential words is weakened. If subjects' acceptance of forms in a lexical decision task is solely a function of the numerical productivity of the morphological pattern, then based on either the type or token frequency counts, we can predict that the ability to distinguish actual from potential words would decrease as they are presented with more frequently occurring suffix combinations.

It may also be the case that other criteria, such as the internal constituent structure of the morphemes which constitute the pattern and related phonological features such as stress and vowel reduction affect acceptability judgments. In her studies on possible words, Cutler (1980) demonstrates that speakers prefer transparent derivations over opaque derivations (e.g., sinister#ness over sinister+ity) where both are possible alternatives, but no preference when both alternatives are transparent, that is, when the word stress up to the recognition point for lexical access is not affected (e.g., jejune#ness, jejun+ity). We hypothesize that in the present study, speakers'judgements may be affected by these factors as well.

6.4.1 *Method*

We employed a pencil and paper test including 120 total test words which were randomized, resulting in five different test

formats and distributed them to eight sections of freshman English composition classes at New York University (N students = 100). The experimenter read aloud the directions for the pencil and paper test which instructed the subjects to judge whether each form was an English word and to circle Y = yes, or N= no if the form was not a word. The subjects were urged to work as quickly and accurately as possible.

6.4.2 Subjects

Subjects were one hundred New York University first-year students who volunteered to participate in the experiment. All were native speakers of English.

6.4.3 Stimulus materials

The stimuli used in the experiment consisted of a list of singly and multiply-suffixed words from the APHB (American Publishing House for the Blind) on-line word list, referred to earlier. To repeat, this 25-million word corpus, compiled from over 550 different sources of American English publications such as Readers' Digest, Fortune, Datamation, novels and short stories, contains 204,128 distinct words and provides a word data bank which is 25 times larger than the Kucera and Francis (1967) one-million word corpus. All words formed from six morphological patterns ending in -ional, -istic, -ality, -ability, -mental and -osity and the corresponding singly suffixed patterns -ion,-ist,-al,-able, -ment and -ous/-ose were extracted. The APHB data provided

a rich source of distinct words (types) in actual use and their frequency of occurrence over the 25-million word store. The productivity of the derivational affixes was determined by calculating the frequency of occurrence of the suffix endings of distinct words in the sample, their total frequency of use (tokens) and the number of novel forms in which the suffix appears.

6.4.4 Design

The six morphological patterns or final letter strings consisting of double suffixes were ranked according to their frequency in derived forms. Three frequency counts were obtained: 1) *type*, that is, each word ending in a particular suffix pattern; 2) *type-1*, that is, type minus the number of forms which occurred only one time in the 25 million words (referred to henceforth as "solo" forms); and 3) *token*, or the total number of instances the types appeared in the corpus as shown in Table 7.

Table 7. Suffix frequency counts

Affix	Type	Type-1	Token
-ional	186	123	18555
-istic	169	120	3105
-ality	141	99	4995
-ability	137	72	1461
-mental	40	26	2538
-osity	24	18	1066

A word which occurs only one time in 25 million is either extremely rare or is specialized, e.g. ptotic; a nonce form,

e.g. jillion; or simply a misspelling or misused form, e.g. orspital. For this reason, the Type-1 frequency count was thought to be a more accurate description of the distinct word totals (see Chapter 7 for further discussion and analysis of the "solo" forms). To illustrate the three frequency types, the suffix pattern ending in -ional formed 186 different words (Types); 63 of those forms appeared only once in the corpus and were subtracted in the Type-1 count to yield 123; throughout the corpus, there were 18,555 instances of -ional words comprising the Token count.

For the lexical decision task stimuli, each double suffix was attached to a base to form an actual word, a possible word and a non-word. Possible words were generated by adding a second suffix (Af2) to an actual derived word previously suffixed by Af1 (e.g., management + al). Although the combination of Base+Af1+Af2 does not appear in the dictionary, the form does not violate any word structure rules; i.e. it is a possible but non-occurring word. Non-words, in contrast, are formed by the addition of Af1 to a base which violates subcategorization restrictions for category (e.g., -mental: V^{r}-__;*$percept_{Nr}$-mental) or in some cases is blocked by the existence of a word formed by a rival suffix (e.g., *calor-ous/calor-ic).

All stimuli were controlled for frequency of occurrence so that all forms in the same morphological pattern were closely matched in surface frequency in the APHB corpus. The

frequency of occurrence for doubly suffixed forms is distributionally quite low and therefore finding sufficient stimuli from the same frequency range for the experimental design requires a selection of forms with the same numerical frequency but which may not in fact have the same familiarity to the subjects. For example, it has been pointed out that although ducal and bridal have the same relative token frequency (33 and 37 respectively) bridal is subjectively more familiar. Incidently, the token frequency of bride is 466, in contrast to duc with a token count of 111, suggesting that the root frequency might play a role in determining familiarity.

The purpose of restricting the surface frequencies of the stimuli was to ensure that the variable influencing the subject's response for each word was the suffix frequency and not the base word frequency. For the possible and non-words, the Base+Af1 form was chosen from the same token frequency range as the actual words. For the stimuli ending in the pattern -ional, all of the actual words (Base+Af1+Af2) had token frequencies in the range of 41-49; all of the possible base forms (Base+Af1) matched in the range of 40-49 and the non-words were formed by the truncation of an Af1 suffix, in this case -al from actual words with a token frequency of 38-49. The stimuli ending in the pattern -istic were controlled at the frequency range of 36-51; the possible word bases (Base+Af1) in the range of 33-48; and the non-word bases were

formed by truncating the Af1 -ion from actual words in the token frequency range of 41-49. The actual word stimuli ending in -ality were chosen from the (Base+Af1+Af2) frequency range of 31-37; the possible word bases (Base+Af1) from the range 32-37; and the non-words were formed by the truncation of the Af1 -ive suffix from actual words in the 31-34 range. The stimuli for the -ability pattern were taken from actual words from the 24-32 range; the possible word bases (Base+ Af1) were from the 24-35 frequency range and the non-words were formed from bases at the 21-34 range from which Af1 -ify was truncated.

For very infrequent morphological patterns, i.e., -mental and -osity, where the number of actual types is less than 50, it was impossible to control the base forms for token frequency since the existing forms did not cluster around the same frequency of occurrence. In these cases the bases for the possible and non-words were matched individually with the frequency of actual words. Thus, for an actual word with a token frequency of 40 (e.g., detrimental) a possible base form also had a token frequency count of 40 (e.g., armament); and a non-word base was formed by the truncation of Af1 -ion from an actual word with a matched token frequency (e.g., hibernation (40) -> hibern+ment). Other stimuli for -mental had frequencies ranging from 63-400, but in all cases they were equally matched with possible and non-word base frequencies. The same frequency matching procedure was

followed for forms ending in -osity, where the non-word forms were obtained by truncation of the Af1 -ic.

6.4.5 Procedure

Each subject was asked to judge 20 forms for each of the six double suffixes: 5 actual words, 10 possible words and 5 non-words. This ratio enables the subjects to evaluate clear instances of actual words and non-words and double the number of forms which might be judged either way. The expected outcome is that the possible words formed by the attachment of less frequent suffixes will be evaluated as non-words more often than those formed with more frequent suffixes.

6.4.6 Results and discussion

The data indicate that there is some effect of suffix frequency on acceptability, but because of the relatively small number of suffixes, it is statistically impossible to state the extent. Subjects' ability to discriminate between actual words and possible words increases as the frequency of the suffix pattern decreases for the stimuli ending in -ional, -istic, -mental, and -osity as shown by the means of acceptance for the possible- word stimuli in Table 8. It is not clear whether stronger frequency effects would be found given a larger sample size; or whether the anomalies in the pattern would persist. Table 9 presents the total means of acceptance for all stimuli.

Table 8. Total means of acceptance for possible word category by suffix pattern

Suffix	Type	Type-1	Token	Acceptance
-ional	186	123	18556	.52
-istic	169	120	3105	.43
-ality	141	99	4995	.29
-ability	137	72	1461	.59
-mental	40	26	2538	.33
-osity	24	18	1066	.28

Table 9. Total means of acceptance of all word categories by suffix pattern

Suffix	Actual	Possible	Nonword
-ional	.94	.52	.27
-istic	.95	.43	.16
-ality	.89	.29	.13
-ability	.92	.59	.39
-mental	.94	.33	.15
-osity	.95	.28	.21

For the possible word stimuli, the correlation between Type frequency and acceptability was not statistically significant, nor was the correlation between Type-1 frequency and acceptability. The possible word acceptability data for the six suffix types were also evaluated with two analyses of variance. In one ANOVA, subjects served as the repeated measure, and in the other, the stimulus items were the repeated measure. The main effect for suffix type was significant in both analyses ($F(5,445)= 50.96$, $p<.001$ by subjects, and $F(5,54)= 6.34$, $p<.001$ by stimuli).

For non-words, none of the correlations was statistically significant. The non-word acceptability data for the six suffix patterns were also evaluated with two analyses of variance. In one ANOVA, subjects served as the repeated

measure, and in the other, materials were the repeated measure. The main effect for suffix type was significant in the subject analyses ($F(5,445)) = 30.44$, $p<.001$), but only marginal in the materials analysis $F(F(5,24) = 2.60$, $p<.06)$.

Tukey test[5] comparisons between suffix means show that the acceptance of possible-word stimuli ending in the terminal strings -ional and -ability is significantly higher than the acceptance of the stimuli ending in -ality, -mental, and -osity; while the acceptance means for the -istic strings were not reliably different from either group.

The exception to the trend in the pattern of results in Table 1 is the mean (.29) for the morphological pattern -ality. The suffix ending -ality does not differ significantly in Type frequency from the patterns of -istic and -ability; in spite of the fact that its Token frequency count is much higher than either. If Token frequency influences acceptability judgements, possible words formed by -ality would be judged as actual words more often than -istic or -ability. Clearly this is not the case. It appears that none of the frequency measures can account for the low acceptability of words formed by the -ality pattern. Further evidence suggesting the type/token frequency is not solely responsible for predicting acceptability judgments for -ality is the fact that the morphological patterns -ality and -osity

[5] A test of significance of difference between means in an analysis of variance.

have nearly the same mean of acceptance (.29 and .28 respectively) for the possible forms; yet these two patterns vary widely in all frequency counts (148/40 Type; 99/18 Type-1; and 5057/1066 Token).

It is true that the possible-word test items (Base+ Af1) for -_ality_ were controlled at a token frequency of 31 to 37; whereas the frequencies of the possible-word stimuli for -_osity_ had to be matched with actual-word token frequency, due to the lack of distribution of forms in the same frequency range. However, this fact cannot be offered as an explanation for the difference since it is not apparent that the surface frequencies of the Base+Af1 for the -_osity_ forms have influenced subjects' responses. For example, we would expect that Base+Af1 forms with very high token frequencies such as _mysterious_ (699) and _marvelous_ (452) with a spelling variant _marvellous_ (160) would be less subject to suffixation error than would bases with low frequencies such as _timorous_ (23) or _studious_ (24) and all of the Base+Af1 (30-37) forms to which the other suffix -_ality_ were attached. Yet the data show that 43% of the subjects accepted _timorosity_ as an actual word and only 10% accepted _studiosity_ ; in contrast to 26% and 13% acceptance for _mysteriosity_ and _marvelosity_.

Another way of analyzing the data is to assert that it is not the suffix pattern -_ality_, but -_ability_ that interrupts the pattern of results in Table 1. The suffix ending -_ability_ has the highest acceptance rate for the possible-word category

and, is reliably accepted more than -ality, -mental, and -istic. Moreover, with an acceptance rate of.39 for the non-word stimuli, it is accepted over the possible-stimuli formed by -ality, -mental, and -osity.. One possible explanation of this phenomenon may be reflected in the ratio of words suffixed by -ability in the corpus which appeared only one time. Nearly half of the -ability types (47%) appear only once, in contrast to the ratio of the other morphological patterns: -ional, 34%; -istic, 29%; -ality, 33%; -mental, 35%; and -osity, 25%. In other words, the double suffix -ability appears to behave much like the single suffix -ness in that it is a word-level, transparent suffix which potentially attaches to a variety of morphological and categorial bases. The subcategorization frame of -ability indicates the types of categorial bases and category type, e.g., word or root, to which it may attach:

Subcategorization of -ability:

V^{r}____ e.g., irritability
V^{vt}___ e.g., adaptability
V^{vi}___ e.g., laughability
N_{+Lat}___ e.g., impressionability
Root___ e.g., durability

From the above discussion, it can be seen that a crucial factor in acceptability judgements concerns the subcategorization frames of a given morphological pattern.

Another factor that can account for acceptability is etymology of the base word. By using a computerized

morphological analyzer on a large data base of English words, Anshen *et al.* (1986) show the etymological preferences of single affixes for either Germanic or Latinate bases. Extending their analyses, five of the morphological patterns in the stimuli in Experiment II can be considered to be sensitive to Latinate bases, given that the suffix in the Af1 position determines the subcategorization frame of the double suffix. Only the -osity suffix does not significantly discriminate ethnicity of the base form. However, not all of the patterns *categorically* select for Latinate bases to the same degree. Of the suffixes which select for verbs in the Anshen *et al.* data, -able admits 21.99% Germanic bases, in contrast to -ment which takes 10.63%; whereas -ion, with only 1.43% words containing a Germanic base, is considered to be categorically Latinate. Among the affixes that attach to nouns which rarely allow Germanic bases, -al admits 0.45%, -ism 0.85% (assuming that -ist selects for the same type of base), in contrast to -ous with 24.05% Germanic bases, indicating no significant preference. Thus, the selection restriction +Latinate suggests a variable tendency or a sensitivity toward a particular ethnic base. In Experiment II, in the case of -ability, subjects showed a readiness to accept the Germanic bases e.g., likeability (.77) and laughability (.59) in contrast to the -mental cases in which Germanic bases were not highly acceptable, e.g., ailmental (.26) and merrimental(.25).

Certainly these factors argue against type or token

frequency as the sole predictors of acceptability, since of the six suffixes tested, -ability ranks fourth in type frequency and fifth in token frequency. It appears that what best explains the high rate of acceptance is a combination of factors, the lack of constraints on suffixation by -ability seeming quite strong.

Coupled with the lack of constraint on ethnicity of the base, the lack of constraint on attachment to category type (-ability selects for +N and +V) might lead to the interpretation that -ability is not perceived as an affix, but rather as a word, and that the ability-suffixed forms are processed as compounds, N-> VN or N-> NN. Unlike the suffixes in the other possible-word stimuli which subcategorize for a specific category (±N or ±V), ability is cross-categorial. Since there also exists an independent word, ability which occurs freely as a noun, the complex forms in the possible-word stimuli might have been processed as examples of compounding rather than affixation. However, this interpretation is misguided; it can be shown that the suffix -ability is phonologically more closely bound to its sister than is the compound formed by the right-hand constituent noun, ability. To illustrate, the primary stress of likability, observability, personability, impressionability, etc. is on the penultimate syllable as predicted by the suffixation of Af2-ity. In contrast, compound stress generally falls on the left member of the compound as in

writing ability, jump shot ability, impersonation ability. Further, the semantics of the affix -ability are different from those of the noun ability; the former having two senses, "that can be ____ed," and "having the quality of" and the latter, the sense of "a being able, talent, special skill." Thus, writing ability can be interpreted as "talent for writing" but impressionability does not carry that sense. The high acceptance of the stimuli formed by -ability may have been independently influenced by the co-occurrence of and the high frequency of the separate word ability (1702 occurrences), but the stimuli in the experiment are clearly not compounds.

6.5 Possible words

Productivity, in its most basic sense is the likelihood that an affix or affix pattern will combine with a base to form a new word. In this chapter, the term has also been used in conjunction with frequency, or how often the word pattern appears throughout the APHB corpus. The issue here is not whether productivity distinguishes morphology from syntax (see Chapter 7), but simply how productive or frequent the occurrence of a morphological pattern is in new contexts. The error rate, i.e., acceptability, of the possible-word stimuli for individual items varies significantly by suffix, as noted above.

Table 10. Means of Possible-Word/Non-Word Acceptance

	ional	istic	ality	ability	mental	osity
Possible	.52	.43	.29	.59	.33	.28
Non-Word	.27	.16	.13	.39	.15	.21

Subjects' errors, far from being viewed as "mistakes" in this analysis, indicate an acceptance of what is possible in word formation, and it is obvious when contrasted with the non-word data, that subjects' judgements are guided by an internalized knowledge of frequency of the pattern and /or selection restrictions operating on the base forms in morphological structure.

The grand mean of acceptance for all of the possible-word stimuli was .41. This percentage reflects only a mean, an intermediary position; another approach to the data is to examine the acceptance rate of individual items which fall above the mean in order to extract and analyze stimuli which were judged as real words, although they are not, Table 11.

The four words in the highest category of acceptance between 70-77% are all transparent, word-level derivatives, ending in -ability and -istic. Orthographic spelling changes [e-> 0, y-> 0 ___/V, where V= vowel] occurred in three of the words.

In the second highest category between 60-69% of acceptance rate, four of the seven possible words ending in the root-level suffix pattern -ional were thought to be real words, and two word-level -ability and one word-level -istic derivatives. It is important to point out that although the

-ional stimuli were formed by root-level suffixes, they are functionally transparent (Cutler 1980) in that they maintain the relative stress pattern of the base word's lexical entry, assumed to be (Base+Af1).

Table 11. Acceptance rate for Individual Possible-Word Stimuli

.77	likability	.43	separatistic
.74	personability	.43	damnability
.72	pacifistic	.42	tribunality
.70	sizability	.39	remediality
.69	observability	.39	zoologisitic
.69	impressionability	.34	perversional
.67	dictational	.33	alignmental
.64	habitational	.32	fraternality
.62	botanistic	.30	ointmental
.62	inceptional	.29	sonorosity
.60	emigrational	.29	ducality
.59	laughability	.28	hibernational
.58	pathologistic	.26	tremulosity
.58	unionistic	.26	mysteriosity
.57	allusional	.26	ailmental
.56	passability	.25	merrimental
.55	convulsional	.25	nauticality
.55	allowability	.24	dramatistic
.52	testamental	.21	deliriosity
.51	extremistic	.20	trecherosity
.50	barbarosity	.18	immemoriality
.47	basality	.17	pitiability
.47	detachmental	.16	enrollmental
.46	parchmental	.16	diplomatistic
.46	attachmental	.13	marvellosity
.45	venomosity	.12	installmental
.45	formulational	.12	guitaristic
.45	torrentiality	.12	homocidality
.45	indigestional	.10	studiosity
.43	timorosity	.03	bridality

In the next category, between 50-59% of acceptance rate, there were three each of the -ability and -istic derivatives; two -ional derivatives and one instance each of -osity and -mental forms.

Finally, the twelve possible words distributed in the between 42-47% of acceptance category, just above the mean, were formed by the attachment of all six suffix patterns. However, it can be seen from statistics in Table 3 that the acceptance rates for the individual items formed by the suffixes -_ality_, -_mental_, and -_osity_ are well above their respective means. These data suggest that subjects prefer word-level derivatives -_ability_ and -_istic_ and the functionally transparent root-level suffix -_ional_ in their word judgements.

It has been demonstrated that speakers' acceptance of possible words ending in a particular morphological pattern cannot be accounted for solely by frequency. Various criteria converge to determine acceptability: 1) type frequency, or the number of distinct forms containing the pattern; 2) the subcategorization frame of the Af1 and its potential to apply to a large number of morphological and categorial bases; and 3) the phonological transparency of the derivative up to the recognition point.

The findings of Experiment II suggest that morphological patterns may be sensitive to the frequency effect. As Stemberger and MacWhinney (1988) point out, frequency effects are uniquely germane to storage of lexical items. If items are not stored, they are not subject to these effects. Since none of the possible-word stimuli in Experiment II are actually occurring words, we might assume that the frequency

of the morphological patterns in actual words influences acceptability judgements in a fashion similar to the *gang effects* described by Stemberger and MacWhinney (1988). Gang effects arise in interactive models where several similar forms reinforce the patterns they have in common. The strength of the gang is determined by the number of contiguous, shared phonemes and the number of members in the gang. Gang effects are viewed as a form of extended analogy when a word being processed is matched against the gang. Each member of the gang affects processing by contributing a small amount of reinforcement to incline the system toward a particular pattern.

Bybee's (1988) psycholinguistic model of lexical organization can accommodate these experimental results. In this model, morphological rules and lexical representations are not separate from one another. Rather, the rules emerge from the intrinsic organization of the lexicon. Lexical patterns which occur in numerous forms are reinforced or strengthened and then apply to new items. Patterns that occur in only a small number of items are weaker, and therefore less productive. All items are listed separately and lexical relatedness is determined by matching the number of phonological and semantic features they share. For example, the word <u>cats</u> forms both a semantic and phonological connection with the singular form <u>cat</u>, as well as connections with other plurals on the basis of their shared semantic

feature and the final phoneme /s/. When a new morphologically complex word is learned, it forms connections with other existing lexical material on the basis of its meaning and phonological shape. This assumes that morphological analysis proceeds directly form the observation of relations among parts of words.

This theory of lexical organization is attractive because it foregrounds an index of word frequency. The incorporation of frequency in a linguistic model is justified because it captures two major language universals which cannot be accounted for in traditional linguistic models: 1) irregularity and suppletion generally occur among high frequency words and paradigms and 2) the more frequent form of a pair of items is the one that serves as the basis of analogical reformation of the other. Traditionally linguists have minimized the role of analogical word formation. The hypothesis was that analogy is restricted and based on the existence of one existing lexeme. Postulating an index of an index of word frequency, in conjunction to morphological schemas, extends simple analogy so that a series of phonemes or a string of affixes can serve as the basis for forming new words. This is precisely the type of model which can account for the multiple suffix patterns detailed in Chapter 3.

6.6 Summary

What constitutes a potentially acceptable derived word is rather unpredictable. Word formations are blocked or aided by a number of factors which preclude the ability to state precisely which potential words will come to exist in future generations, or even which are acceptable to native speakers at the present. The frequency of occurrence of morphological patterns varies and the gang effect seems to be one important determiner of acceptability in that the more frequent the gang, the more likely derivatives formed by that pattern will be accepted. However, as in the case of the -_ality_ examples, frequency of occurrence is a factor which may be ignored entirely, in favor of stronger criteria such as transparency and/or ethnicity and syllabicity of the base.

Nevertheless, the results of Experiment II indicate that acceptability is not totally arbitrary. Subjects' judgements of low-frequency derivatives rely on the strength of lexical patterns already stored in the lexicon. Widely applicable patterns such as -_ability_ are accepted by some speakers attached to any categorial or morphological base, e.g., _personability_, _sizability_, and _clarability_. On the other hand, subjects are quite discriminating when judging potential words formed by less frequent morphological patterns such as -_mental_ and -_osity_, unless other morphological or phonological factors are also present to bias the subjects toward acceptance, e.g. _testamental_ and _barbarosity_.

A comparison of the two suffixation patterns -ification and -ization serves to illustrate the non-indiscriminate nature of complex word formation. The two affixes share a common sense (among others unique to each one) of "the act of making, or becoming; or causing to become." Superficially, each competes for the same type of base; distributionally, this is not the case. Possible bases for each can be hypothesized on the basis of the criteria discussed in 7.5. First, the higher frequency of the pattern Xization (192) compared to Xification (74) confirms its greater productivity as attested by Bauer (1983) and others. Type frequency predicts that subjects will accept more words formed by the suffixation of -ization than by -ification.

Second, it can be determined from subcategorization facts that neither will select for a verbal base, e.g., *growification or *growization but that Word and Root level noun and adjective bases would be more acceptable, e.g. polemification or polemization.

Ethnicity and syllabicity of the base are included in the subcategorization restrictions on suffixation, as has been shown. The pattern -ification selects either ± Latinate bases, whereas -ization is categorically + Latinate. Thus, the speculation that doomification or steamification would be acceptable over doomization and steamization. Also, since -ification prefers Latinate monosyllables, as opposed to the polysyllabic Latinate-base preference of -ization, we expect

the following: *XAf1-ification and *chocolatification and possible acceptance of XAf1-ization and chocolatization.

As a final hypothesis regarding these two patterns, we expect that possible words are accepted more readily if the derivative preserves the primary stress pattern and vowel quality of the base. For example, if one were to generate a possible word to describe the process of installing coin-operated meters on computers, of the two, metrification and meterization, the latter would be preferred.

CHAPTER 7

PRODUCTIVITY

In linguistics, a process or a rule is considered to be productive if it is activated in the production of novel forms. The notion of productivity is not limited to morphology, but applies to each component of the grammar: syntax, semantics and phonology. Although the structural linguists dismissed the idea of productivity as being outside the domain of descriptive linguistics, Marchand (1960:5) admonishes that the linguist who neglects this particular factor in a description of a linguistic system "will be counting dead souls as live people." Nonetheless, in the contemporary linguistic literature, there remain conflicting views regarding the extent to which morphological productivity is comparable to syntactic productivity, and more importantly, how to interpret this phenomenon in theoretical terms.

In *Syntactic Structures* (1957:16), Chomsky remarks that the statistical probability of occurrence that a given utterance has been heard/produced by a hearer/speaker approaches zero. This cannot be said of the probability of words, since frequency counts of a given form depend on its reoccurrence throughout a corpus. However, it is assumed in this chapter that these facts regarding probability of occurrence do not

constitute a principled distinction between the productivity of sentences and the productivity of word formation; rather, the difference is one of degree, not of kind.

7.1 Productivity in morphology

Corbin (1987) has aptly characterized the definitional criteria of productivity in morphology as variable between quality and quantity. The qualitative aspect refers to the regularity of derivations produced by a given affix, or to the small number of constraints which restrict its attachment. The quantitative criterion is applied either to the number of bases or to the number of derivatives. In a unified manner, productivity designates at the same time, 1) the regularity of the products of a word formation rule; 2) the availability of an affix, i.e., the possibility of potential derivatives to fill in the gaps of the actual lexicon; and 3) the *rentabilité* of an affix, i.e., the possibility of its applying to a large number of bases and/or producing a large number of actual derivatives.

Further, the qualitative and quantitative criteria, is applied to the actual/ potential distinction in word formation. For Corbin, the availability of a morphological process is discrete, and not subject to diachronic variation. Between each class and each rule, affixes can be distinguished linguistically by degrees of availability and unavailability based on qualitative factors, e.g., the restriction on bases.

In contrast, quantitative data define potential word formation but, according to Corbin, hold little theoretical interest for linguistics since the degrees of availability and unavailability can possibly be submitted to historical drift.

The interesting point about Corbin's definition is that it synthesizes qualitative and quantitative morphological facts. The point at issue is whether knowledge of frequency (the quantitative facts) is indeed, a part of linguistic competence. There is no dispute that productivity conforms to a theory of performance. Results of psycholinguistic experimentation in Experiment II indicate that speakers do make use of frequency information in forming acceptability judgements. However, the stronger claim has been made that an index of frequency underlies morphological competence. Aronoff (1976) initiates the formalization of the notion of frequency and its relation to productivity in the actual-potential word distinction in his theory of the lexicon.

7.2 Listed forms

Aronoff defines affix productivity as the likelihood that a new form will occur when the affix is attached to words of a particular class. Productivity then, concerns probability of use based on the number of actual words already formed from a particular pattern. In Aronoff's (1976) word-based theory, the distinction between actual and possible-but non-occurring words differentiates morphology from syntax. To illustrate,

when a novel word is learned, it is listed in the lexicon along with actual words whose meanings are non-compositional, in order to 1) serve as a base for subsequent derivations and 2) allow the word to undergo semantic drift. The meanings of potential words, formed by the regular rules of affixation are predictable from the meanings of the sum of their parts. In contrast, the use of a novel syntactic phrase does not result in the phrase being listed in the lexicon.

Di Sciullo and Williams (1987) contest Aronoff's claim that the actual-potential distinction separates syntax and morphology because both systems are productive in the same way. The authors assert that there is no essential difference between the Latinate prefix-stem system and the verb-particle system with respect to either productivity or compositionality, except for the fact that one is lexical and the other syntactic. Some examples they consider for comparison are the following:

	-ject	-sist	-fer	-duct
de-	*	*	*	*
in-	*	*	*	*

Di Scuillo and Williams deny that this morphology is productive on the grounds that the class of Latinate prefixes and stems is closed, and because there are no productive semantics for the prefixed bound roots; therefore, all the words must be listed. They compare this morphological subsystem to the phrasal syntactic subsystem:

	give	throw	stand	call
up	*	*	*	*
out	*	*	*	*

The phrasal VP with the head verb on the left is restricted to a subvocabulary of non-Latinate verbs the authors contest, and similarly there are no rules to determine the meaning of the forms. They conclude that listedness is not a property that is unique to words and propose a hierarchy of units where each unit is composed of previous units reflecting the same hierarchy of listedness:

unit:	morpheme	> word	> compound	> phrase	> sentence
listed:	all	most	many	some	several

They maintain that the lexicon is merely a collection of the lawless, i.e., irregularities, and that morphology is about potential "objects" rather than a theory of the lexicon.

7.3 Measures of productivity

Linguistic scholars also argue over which quantitative measures constitute the index of productivity of an affix. Lieber (1980) illustrates that productivity is concerned with the number of derivatives ending in a particular affix, not with the size or type of base to which it attaches. For example, the suffix -ity subcategorizes for +Latinate adjectives. Since it is assumed that affixes are also members of major lexical categories (N,A,V), a base previously suffixed by Afi-al]$_{A,+Lat}$ is no different from other Latinate adjectival bases, e.g., real, stupid, etc. Therefore, the

contribution of a base form Xal to the total productivity of -ity is the same as the contribution of any other base, (i.e., one), regardless of its own productivity determined by the subcategorization of -al.

However, measuring productivity in this way fails to capture the strength of the relation that Af2-ity holds with Af1-al. According to the APHB data, referred to in earlier sections, the suffix -ity attaches to 862 distinct bases to form complex words. Yet, 141 of those bases are words that end in the terminal string Af1-al; 143 are bases that end in Af1-able; 84 in Af1-ous; and 41 in Af1-ive. This shows that 47% of the words suffixed by -ity are previously suffixed words, and further, that the attachment of Af2-ity is "potentiated" (Williams 1981) by a predictable set of suffixes in the Af1 slot. When Af2-ity attaches to words ending in -al, the number of distinct words (its type size) is roughly equal to the size of the class of Xable-ity forms. Xality and Xability forms are more likely to occur than are forms consisting of Af2-ity attachment to bases ending in Xous or Xive. The probability that -ity will affix to a previously suffixed word ending in a certain morphological pattern can be weighed against its lexical strength, i.e., frequency of that pattern. These data strongly support the idea that a definition of affix productivity must include quantitative facts regarding the morphology of the base, as Aronoff (1982) has demonstrated.

7.4 Solo forms

Corpus-based data provide an opportunity to examine "unlisted" forms which, though they have appeared in print, are unlisted, in that they do not appear as headwords in *Webster's Seventh New Collegiate Dictionary*. In the APHB corpus, there are numerous instances of morphologically complex words which appear only once in the 25 million word count. These "solo" forms fall into several word categories: 1) neologisms, 2) infrequent or obsolete items formed from earlier productive patterns, 3) specialized terms, 4) nonce forms, or 5) errant misspellings. An analysis of the internal structure and derivation of these "solo" forms reveals the nature of the word formation processes that speakers are willing to exploit. That is, since morphological productivity concerns both actual words and the production of possible words, an examination of the solo forms reveals both 1) evidence of speakers' knowledge of morphological rules and their relative productivity, and/or 2) evidence of their ability to generalize and form analogical patterns based on existing morphological schemas. In either case, the knowledge is grammatical in that it is predicated on the rules of word structure.

7.5 Pattern frequency in novel forms

As shown in Chapter 6, the productivity of a morphological pattern cannot be predicted solely on the number of distinct types it represents, nor, on its token frequency, i.e., the

total distribution of the types in a corpus. Type and token frequencies are measures of forms already generated and therefore contribute only part of the measure of productivity. A curious test of other measures results from the examination of the distribution of word formation patterns in a corpus consisting of unlisted forms. Such study renders evidence of the creativity in word formation. Table 12 is a summary of solo forms from the APHB data for eleven morphological patterns and a description of their basic lexical structures.

Table 12. Percentage of solo forms and their structure

	%solo	#	XAf1]+Af2	Af2XAf1]+Af3	ZXAf1]+Af2
Af2-ITY					
-ality	18%	26	13	5	8
-osity	25%	6	5	1	0
-ivity	20%	8	3	0	5
-ability	45%	65	43	21	1
-iveness	34%	39	26	7	6
Af2-ATION					
-ification	19%	15	9	0	6
-ization	38%	75	50	18	9
				Af3+[XAf1Af2	Z+[XAf1Af2
Af2-AL					
-ional	33%	63	31	11	21
-mental	34%	14	4	5	5
-ical	39%	168	58	22	88
-istic	28%	49	25	9	15

X= base, Af= affix, Z= combining form

7.6 Af2-ity

Xality Total= 141, Solo= 6 (18%)

There are 26 solo words ending in the -ality suffix pattern. Of those, 13 were formed by suffixation of Af2-ity to Xal, e.g., factual+ity, natal+ity; 5 by suffixation of Af3-ity to previously suffixed and prefixed words (Af2XAf1) e.g.,[in[[effect]ual]]+ity],[un[[origin]]al]]+ity], and the other 8 by suffixation of Af2-ity to a compound Z-Xal, e.g., [inter[person]al]]]+ity]].

In light of the fact that these forms are recurring counter-examples to the level-ordering hypothesis, a more plausible account of their derivation is to regard them as the output of productive rules forming multiple suffixation patterns, as advocated in Chapter 3 and illustrated in Appendix 2. Simply stated, the affixation of Af2-ity to a base word ending in -al to produce a novel form such as comicality, or the affixation of Af3-ity to an -al base such as insubstantiality, doubly reinforces the preference that -ity has for an Xal-base. In Lieber's view, this fact is unrecognized, since the subcategorization of -ity to +Latinate adjectives does nothing to indicate the probability (productivity) of Af2-ity attachment to Xal.

Xosity Total=24, Solo= 6 (25%)

Six of the words in the -osity pattern were represented only once in the corpus. All but one were derived by the suffixation of Af2-ity to the Xous form, e.g., sinuous+ity.

The one exception, is the suffixation of -ity to a previously prefixed word, e.g., non-luminos+ity. The contexts of this pattern contrast with that of -ality in that there is only one example of the Xosity pattern that was formed from a complex prefixed word, e.g., insubstantiality, unoriginality, *incuriosity, and *unanimosity). The attachment of -ity to -ous base words is generally limited to fewer contexts, specifically the Af2 position.

Xivity Total= 41, Solo= 8 (20%)

Of the words ending in the -ivity pattern in the corpus, 8 solo forms appear: 3 derivatives formed by suffixation of Af2-ity to Xive, e.g., connective+ity; 2 by suffixation of Af2-ity to a compound Z-Xive, e.g., hyper-active +ity; 1 by Af3-ity suffixation to a previously prefixed form, e.g., nonexclusiv+ity, and 2 by compounding of a non-native root with Xivity, e.g., multi-+ activity. The compounds formed by a combining form with Xivity cannot be said to strengthen the -ivity suffix pattern in contrast to the examples of solo forms formed by the suffixation of -ity to a compound or to prefixed forms.

Xability Total= 143, Solo= 65 (45%)

Forty-three of the 65 solo forms ending in the ability pattern were derived by Af2-ity suffixation to Xable, e.g., hatchable+ity. The remaining 21 were formed by suffixation of Af3-ity to a prefixed, not compounded, Af2 + Xable form, e.g., [un[[attain]able]]+ity], [in[[oper]able]]+ity]. There

is little evidence that the non-native combining forms attach in the Xability contexts, with the possible exception of interchangeability. In support of Williams' (1981) claims for the percolation of features from the affix in head position, consider the fact that -ity subcategorizes for +Latinate nouns; yet, examples of solo forms include cleanability, callability, and suckability, all Anglo-Saxon roots which could only inherit the +Latinate feature from the Af1-able, in contrast to the other complex bases to which -ity attaches which are +Latinate themselves e.g., sociality, primitivity, and otiosity.

7.7 Af2-ness

Xiveness Total= 112, Solo= 39 (34%)

Of the thirty nine solo forms, 26 were derived from the attachment of Af2-ness to Xive, e.g., expensiv+ness, demonstrative+ness. Seven were derived by affixation of Af3-ness to previously prefixed forms, e.g., [in[[communicative]]+ness], [un[[inventive]] +ness]. The six compounds are formed by the attachment of Af2-ness to the compound Z-Xive, e.g., all-inclusive+ness, non-defensive+ness. Aronoff and Anshen (1988) comment on the paucity of listed Xiveness words in standard dictionaries and view it as evidence that -ness words are coined as needed and do not constitute lexical entries. The advantage of the APHB corpus over standard dictionaries is that it is a record of words in print and therefore, reflective of usage. The issue here is

productivity, not listedness, since none of the forms is listed. In comparison to the Xivity pattern with 20% solo forms, the Xiveness pattern has 34% solo forms all of which were derived by -ness suffixation, evidence of its greater productivity with Xive bases.

7.8 Af2-ation

Xification Total= 74, Solo= 15 (19%)

Fifteen words appear as solo forms; 9 were formed by suffixation to Xify, e.g., humidify+ication, signify+ication, and six by suffixation to the compound Z-Xify, e.g., self-glorify+ication, mis-identify+ication.

Xization Total= 203, Solo= 75 (38%)

Seventy five of the Xization words appear as solo forms and of those, 50 were formed by suffixation of the Af2-ation to the Xize form, e.g., motorization, pollenization; 18 by the attachment of Af3-ation to previously suffixed forms particularly with de- and re-, e.g.,[de[[mineral]]ize]+ation], [re[[utilize]]ation], and 9 compounds formed by the attachment of non-native roots to Xization, e.g., super +industrialization. It is interesting to note that the -ization pattern is particularly sensitive to complex bases ending in -ar or -al, e.g., intellectualization, verbalization, rehospitalization, de-animalization, regularization.

7.9 Af2-al

Xional Total= 186, Solo= 63 (33%)

There are 63 words ending in the suffix ending -ional which appear only once. Of those, 31 derivatives were formed by the suffixation of Af2 to the nominal Xion, e.g., objection+al, definition+al, vegetation+al. Eleven words are derived from prefixation of the Xional form, e.g., [un+[[function]al], [sub+[[ration]all]. The other 21 words were derived by compounding Xional with non-native roots e.g.,[sub+[[profession]al], [supra +[[region]al], [anti+ [[nutrition]al]. In this pattern, the probability that -ity will attach to Xion bases is strengthened by the 31 derivatives formed by suffixation, and is reinforced by the multi-contextual appearance of -ional.

Xmental Total= 41, Solo= 13 (34%)

Of the 13 solo forms, 4 were derived by suffixation of -al to Xment, e.g., firmament + al; 5 were formed by compounding with the Xmental base, e.g., ultra+sentimental, 3 with the same base, (extra-/quasi-/semi-+ governmental); and 5 by prefixation to existing Xmental forms. Only 4 out of 13 forms (30%) can be said to strengthen the productivity between Af2-al and -ment to form the suffix pattern mental, in contrast to 46% of the words formed by Af2-al attachment to Xion to form the ional pattern.

Xical Total= 434, Solo= 168 (39%)

The morphological pattern ending in ical is especially

productive in the coining of scientific or technological terms, yielding 168 solo forms. There appear 58 derivatives formed by suffixation of Af2-al to Xic, e.g., demonic+al, democratic+al; 22 words formed by prefixation to Xical, e.g., semi+classical, non+hierarchical; and 88 compounds formed with non-native roots to Xical, e.g., photo +mechanical, pseudo +liturgical, geo +morphological.

7.10 Af2-ic

Xistic Total= 169, Solo= 49 (29%)

Of the 49 solo forms ending in the suffix pattern -istic, 25 were formed by suffixation of the Af2-ic to Xist, e.g., violinist+ic, revivalist+ic, in apparent violation of level ordering, and 9 were formed by prefixation with the Xistic form. Whereas the prefixed examples, e.g., unlegalistic and unimperialistic are clearly derived from un + Xistic in order for un- to satisfy categorial selection restrictions (e.g. *un-legalist), the derivation of the compounds with non-native roots is not as straightforward as the above examples. For instance, the structure of quasi-naturalistic is ambiguous: [quasi-[[[naturallist]]]+ic] or [quasi-+[[[naturallist]]ic]]. Therefore, the non-native compounds may or may not strengthen the suffixation of -ic to the Xist base, but since -ic can only occur in Af2, Af3, Afn slots following -ist, there is no way to compare its productivity.

7.11 Number of solo forms and pattern productivity

In Experiment 2, discussed in Chapter 6, it was determined that native speakers' acceptance of potential words is in part a function of the frequency of the suffix pattern. The results show that speakers are unable to make a principled distinction between actual complex words and possible complex words formed by multiple suffixes. It was concluded that frequency of the morphological pattern influenced acceptance to some degree, as certain more frequent patterns were accepted more readily than others. As illustrated in Table 13, the percentages of acceptance of possible-words as actual words, correlate with the actual number of solo forms from the APHB corpus for each morphological pattern.

Table 13. Number of solo forms and acceptance of possible words

Suffix	# solo	% possible words judged as actual
-ability	65	59
-ional	63	52
-istic	49	43
-mental	14	33
-ality	26	29
-osity	6	28

A priori, there is no reason to expect that idiosyncratic coinages extracted from a large corpus will have any connection with acceptability judgements of distinct potential-word stimuli obtained through psycholinguistic experimentation. However, because there exists a

statistically significant correlation ($r(4)=.846$, $p,.05$), it is reasonable to infer that knowledge of the relative strength of a morphological pattern is a critical factor in productivity. The number of solo forms reflects the availability of each suffix pattern to be used in the production of novel complex forms. The size of the schema, or morphological pattern, strengthens the probability that the speaker will accept it in novel forms and/or use it productively.

Another insight to be gained from the analysis of these novel forms is the determination of the morphological processes which derive these complex multiply-affixed forms. From the above descriptions, it is apparent that speakers have a variety of concatenative processes at their disposal for the coinage of novel forms: prefixation, suffixation, and compounding. Furthermore, the formation of these "solo" forms is to a large extent affected by the inventory of actual words. Forms such as intellectuality, femality, ovational, ethnical, compartmental, disrespectability, sumptuosity and liberalistic-capitalistic are clearly modelled on existing lexical patterns on the basis of morphological and phonological similarity. This process is specific to the particular suffix combinations and varies in productivity with the number of distinct items in each pattern, as illustrated in Table 12. For example, the degree of difference in the productivity of the Xical pattern and Xivity pattern can be

seen both in the types of derivational processes and in the numbers of solo forms:

	Total	Suffixation	Prefixation	Compounding
-ical	168	58	22	88
-ivity	8	3	0	5

Whether the attachment of multiple suffixes and combining forms is viewed as the result of a single concatenative rule (Wolff 1984) or separate word formation processes, both rule and process are productive in the most basic sense; i.e., they are used to make new words.

Other solo forms found in the APHB data can be considered to be agglutinations of affixes and combining forms to existing words, e.g., ultra-neo-nationalistic, non-workability, geomorphological, extraterritoriality and intergenerational. This type of formation is more general and requires fewer restrictions on bases; therefore, the process is more capable of producing a large number of actual derivatives. In addition, because of the regularity of the collocations, they are less dependent on existing schema.

The above discussion suggests that the manner in which speakers determine whether a complex form is actual, parallels the general principles of lexical creativity. First, it is assumed that the speaker has knowledge of the rules of affixation and a representation of morphological schema in the lexicon. If the base form matches the morphological shape

required by the pattern (in more formal terms, the categorial and selectional restrictions), and the schema is sufficiently reinforced by individual lexical entries, the collocation is accepted.

7.12 Concluding remarks

Aronoff (1982:170) has argued that a speaker's knowledge of the productivity of word formation patterns is a part of linguistic competence. This is a strong claim, since traditionally, competence has been narrowly defined as knowledge of linguistic structure. By contrast, productivity measures are continuous, variable factors and to include them in a theory of competence would fundamentally change its discrete character. Yet, Labov (1966) established precedent in sociolinguistic theory by formally relating variable rules to conventional generative grammar. Variation in language is accounted for by positing that for every possible constraint on a rule, there is an associated probability as to whether it will apply. Variable rules differ from traditional optional rules in that a variable rule assigns to the output a number p, indicating the probability of the application of each rule. An elaboration of how variable rules might be incorporated into morphological theory is beyond the scope of this discussion; however, it seems likely that morphological rules are constrained by a set of factors, not the least of which is frequency, or probability of occurrence.

In the present work, linguistic analyses and psycholinguistic evidence are discussed under separate topics; however, the proposals regarding the representation of multiply suffixed forms in the linguistic and psychological lexicons converge at several points. To illustrate, the results of the experimental data obtained in Experiment II reveal that psychological testing is an effective means of analyzing productive processes in word formation. The findings refute the claim that type frequency alone is a reliable predictor of speakers' acceptance of potential complex words. Certainly speakers' lexical decisions reflect knowledge of morphological and phonological principles. However, because of the relatively small number of suffix patterns tested (N= 6), the data do not warrant a statement of certainty regarding the extent of productivity (frequency) effects. The tenable position arrived at here is that knowledge of productivity is only a part of the ability to perform linguistic judgements. Based on this conclusion, it is clear that additional evidence is needed to support the stronger claim that productivity is part of a theory of competence. Current research among cognitive psychologists on suffix frequency effects in the recognition and access of derived words has the potential to enrich the discussion of productivity in the linguistic lexicon.

In another instance of the interaction of linguistics and psychology, formal grammatical principles are invoked to

interpret the results of psychological testing. Experiment I presents evidence that a grammatical property pertaining to the internal structure of words is relevant to lexical access and storage. Because the affix boundary distinction has been well attested for English, as well as for other languages, these findings strengthen the claim that morphological structure determines the composition and organization of the lexicon.

Finally, in the analyses of the corpus-based data, a strong correlation was discovered between the rates of acceptance of words formed by six morphological patterns and the number of "solo" tokens conforming to those patterns. This finding is interpreted as evidence that morphological creativity depends on knowledge of the word structure rules of a language in conjunction with knowledge of the viability of the word formation patterns that result from the combinatory rules and principles.

APPENDIX I

Table 2. Noun-forming suffix patterns

Subcategorization	Af1	Af2	Af3	Example
V				
V^r___	-ion$_{Naf}$	-ism$_{Naf}$		impressionism
		-ist$_{Naf}$		revolutionist
		-al$_{Aaf}$	-ism$_{Naf}$	professionalism
			-ist$_{Naf}$	conversationalist
	-al$_{Naf}$	-ist$_{Naf}$		survivalist
	-er$_{Naf}$	-ist$_{Naf}$		consumerist
	-ment$_{Naf}$	-ation$_{Naf}$		regimentation
	-ment$_{Naf}$	-al$_{Aaf}$	-ism$_{Naf}$	developmentalism
			-ist$_{Naf}$	fundamentalist
			-ity$_{Naf}$	instrumentality
	-ive$_{Aaf}$	-ism$_{Naf}$		activism
		-ist$_{Naf}$		collectivist
		-ity$_{Naf}$		relativity
		-ness$_{Naf}$		attractiveness
	-able$_{Aaf}$	-ity$_{Naf}$		reliability
N				
N^r ___	-al$_{Aaf}$	-ity$_{Naf}$		personality
	-ous$_{Aaf}$	-ity$_{Naf}$		nervosity
	-ose$_{Aaf}$	-ity$_{Naf}$		verbosity
	-ize$_{Vaf}$	-er$_{Naf}$		organizer
		-ation$_{Naf}$		memorization
	-ify$_{Vaf}$	-ication$_{Naf}$		glorification
A	-ize$_{Vaf}$	-able$_{Aaf}$		generalizability
A^r___	-ize$_{Vaf}$	-ation$_{Naf}$		modernization
	-ify$_{Vaf}$	-ication$_{Naf}$		falsifier

Table 3. Adjective-forming suffix patterns

Subcategorization	Af1	Af2	Af3	Example
V				
V^r___	-ion$_{Naf}$	-able$_{Aaf}$		impressionable
		-al$_{Aaf}$		constitutional
	-ment$_{Naf}$	-al$_{Aaf}$		developmental
		-ary$_{Aaf}$		elementary
	-ive$_{Aaf}$	-ist$_{Naf}$	-ic$_{Aaf}$	collectivistic
	-al$_{Aaf}$	-ist$_{Naf}$	-ic$_{Aaf}$	formalistic
	-ion$_{Naf}$	-ist$_{Naf}$	-ic$_{Aaf}$	exhibitionistic
	-ate$_{Vaf}$	-ive$_{Aaf}$		fixative
N				
N^r___	-ist$_{Naf}$	-ic$_{Aaf}$		pianistic
	-ic$_{Aaf}$	-al$_{Aaf}$		symbolical
	-ize$_{Vaf}$	-able$_{Aaf}$		organizable
	-ify$_{Vaf}$	-able$_{Aaf}$		classifiable
	-al$_{Aaf}$	-ize$_{Vaf}$	-able$_{Aaf}$	normalizable
A				
A^r___	-ist$_{Naf}$	-ic$_{Aaf}$		realistic
	-ify$_{Vaf}$	-able$_{Aaf}$		justifiable
	-ize$_{Vaf}$	-ation$_{Naf}$	-al$_{Aaf}$	civilizational

Table 4. Verb-forming suffix patterns

Subcategorization	Af1	Af2	Af3	Example
N				
N^r___	-al$_{Aaf}$	-ize$_{Vaf}$		normalize
	-ic$_{Aaf}$	-ize$_{Vaf}$		romanticize
V				
V^r___	-er$_{Naf}$	-ize$_{Vaf}$		computerize
	-ion$_{Naf}$	-al$_{Aaf}$	-ize$_{Vaf}$	institutionalize
	-ment$_{Naf}$	-al$_{Aaf}$	-ize$_{Vaf}$	compartmentalize
N				
N^r___	-ify$_{Vaf}$	-ed$_{Vaf}$		glorified
		-ing$_{Vaf}$		horrifying
		-s$_{Vaf}$		beautifies
	-ate$_{Vaf}$	-ed$_{Vaf}$		gravitated
		-ing$_{Vaf}$		hyphenating
		-s$_{Vaf}$		originates

APPENDIX 2

Table 14. Solo forms extracted from APHB corpus by suffix pattern

Xality	Xosity
beastiality*	adiposity*
controversiality*	non-luminosity*
commonality	sumtuosity*
factuality*	sinuosity
interpersonality*	otiosity*
unoriginality*	style-monstosity*
ineffectuality*	
externality	
a-tonality*	
mayorality*	
lethality*	
polymodality*	
bisexuality*	
natality	
multi-potentiality*	
submarginality*	**Xivity**
femality*	
cross-modality*	multi-activity*
hypersexuality*	quasi-captivity*
extraterritoriality	primitivity*
sociality	hyperactivity*
antihomosexuality*	hypersensitivity*
evidentiality*	nonexclusivity
intellectuality*	therapeutic-activity*
supernormality*	motivity
insubstantiality*	connectivity*

Table 14. Solo forms extracted from APHB corpus by suffix pattern (continued)

Xability

improvability
impregnability
disrespectability*
nonnegotiability*
incommensurability
unsuitability*
perfectability*
repairability*
distinguishability*
saleability*
indominability*
patentability*
distractability*
infallability*
wearability*
inscrutability
unbearability*
palatability
nonacceptability*
perishability
cleanability*
unsalability*
discussability*
nonliability*
creditability
interchangeability
impalpability
inoperability*
hatchability*
washability*
venerability
programmability*
habitability
inexorability
generalizability*
presentability
undependability*
knowability*
disposability
preservability*
understandability*
indefatigability
manoeuverability*
unbelievability*
tolerability
indefinability
merchantability*
impressionability
malleability
non-workability*
justifiability
quotability*
permeability
pliability
infectability*
countability*
questionability*
callability*
indistinguishability*
navigability
marriageability*
suckability*
unattainability*
steerability*

Table 14. Solo forms extracted from the APHB corpus by suffix pattern (continued)

Xiveness

expensiveness*
extensiveness*
effusiveness*
nondefensiveness*
amativeness*
all-inclusiveness*
plaintiveness*
demonstrativeness*
restrictiveness*
exploitiveness*
incommunicativeness*
electiveness
evasiveness*
objectiveness*
deceptiveness*
nonresponsiveness*
philoprogenitiveness*
pensiveness*
obsessiveness*
uninventiveness*
assualtiveness*
unaggressiveness*
apprehensiveness*
non-assertiveness*
repressiveness*
alimentiveness*
competiveness*
super-sensitiveness*
comprehensiveness*
imaginativeness*
presumptiveness*
overpossessiveness*
imperativeness*
illusiveness*
appreciativeness*
reproductiveness*

Xification

humidification
voice-amplification*
graph-specification*
solidification
bourgeoisification*
reification
signification
variable-magnification*
deification
rigidification
asset-diversification*
transmogrification
self-glorification
mis-identification*

Xization

familiarization
de-imperialization*
customization*
retribalization*
catechization
ionization
ordinalization*
Europeanization*
anti-organization*
demineralization*
cannonization
systemization
suburbanization*
exterioralization*
proselytization*
pan-Arabization*
suboptimization*
demonetization
Koreanization*
summarization
Holidization*
revolutionization*
trivilization*
metallization*
fascistization*

Table 14. Solo forms extracted from the APHB corpus by suffix pattern (continued)

Xization

mongrelization*
dry-sterilization*
decommercialization*
galvanization
detribalization*
reutilization*
pollenization
demarijuanization*
Hellenization
magazine-serialization*
improvization*
Naderization*
de-Stalinization*
iconization*
intellectualization*
verbalization
mesmerization*
deodorization*
journalization*
superindustrialization*
oxidation*
bolshevization*
deputization*
rehospitalization*
superorganization*
pro-Westernization*
particularization
popular-frontization*
pylorization*
cardinalization*
pro-legalization*
artificialization*
anticivilization*
antiorganization*
palletization*
pasteurization
southernization*
post-synchronization*
homogenization
de-Salazarization*
subvocalization*
quantization
regularization*
itemization
monopolization
motorization
transitorization*
cannabalization*
desalinization*
deanimalization*
cauterization
latinization*

Table 14. Solo forms extracted from the APHB corpus by suffix pattern (continued)

Xistic

Eucharistic*
non-moralistic*
deterministic*
dadaistic*
egoistic*
negativistic*
Zen-Buddistic*
non-terroristic*
theistic*
fascistic*
atomistic
anti-humanistic*
quasi-naturalistic*
non-artistic*
overmaterialistic*
ultramodernistic*
feudalistic*
vulturistic*
semi-socialistic*
unlegalistic*
liberalistic-capitalistic*
universalistic*
ologopolistic*
semi-monopolistic*
preartistic*
liberalistic*
unimperialistic*
violinistic*
simplistic*
anti-capitalistic*
anti-ballistic*
heuristic
behaviouristic*
ultramaterialistic*
antiphlogistic
nonmaterialistic*
gradualistic*
non-impressionistic*
revivalistic*
voluntaristic*
state-monopolistic*
nonaltruistic*
holistic
nepotistic*
collectivistic*
expansionistic*
quietistic*

Xmental

unmonumental*
complemental
extragovernmental*
quasi-governmental*
firmamental*
ultra-sentimental*
presentimental*
undepartmental*
compartmental*
nonjudgmental*
semigovernmental*
untemperamental*
cultural-environmental*
unfundamental*

Table 14. Solo forms extracted from the APHB corpus by suffix pattern (continued)

Xional

non-occupational*
uni-dimentional*
foundational*
erosional*
associational*
intraregional*
distributional*
extensional
objectional*
concessional*
subrational*
binational*
tri-national*
nonsensational*
affectional
non-nutritional*
anticivilizational*
cross-generational*
intra-regional*
supra-national*
maturational*
multi-directional*
formational*
conservational*
definitional*
antigravitational*
vegetational*
inquisitional*
unregional*
extra-constitutional*
intergenerational*
multidivisional*
bi-directional*
intersectional*
unfunctional*
interjectional
ovational*
antinutritional*
constructional*
semifictional*
locational*
dispensational*
antigravitational*
meditational*
subprofessional*
vibrational*
many-dimensional*
interprofessional*
non-representational*
septentrional
supra-regional*
amotivational*
astrogational*
malnutritional*
fourth-dimensional*
intonational*
dispositional*
prepositional*
notional
coalitional*
five-dimensional*
half-fictional*

Table 14. Solo forms extracted from the APHB corpus by suffix pattern (continued)

Xical

phantasmigorical*
iconographical*
hieroglyphical*
morphological
non-archeological*
half-quizzical*
noncritical*
unhistorical*
symphonic-symetrical*
literary-musical*
moderate-to-radical*
ultra-radical*
semi-Druidical*
anthropomorphical*
bio-medical*
political-mystical*
anti-cholerical*
whimsical*
mock-medical*
antipolitical*
subcortical*
psycho-psychical*
post-Americal*
pretechnological*
socio-historical*
comerical*
electro-mechanical*
hypocritical*
cosmological*
revolutionary-ideological*
neoclassical*
immethodical
half-whimsical*
unpolemical*
anti-lyrical*
seismological
unmathmatical*
nonsurgical*
psycho-analytical*
socialogical*
double-helical*
antipaedobaptistical*
scatological*
satyrical*
near-hysterical*
uncynical*
academical*
unradical*
acheological*
electro-chemical*
criminological*
nonbotanical*
tecnological*
politico-ideological*
charlatanical*
semi-musical*
stratigraphical*
toxicological*
half-hysterical*
supramusical*
electronical*
magical-mathematical*
preclinical
demogogical
prejudical*
antihistorical*
quasi-theatrical*
unpsychological*
nonmathmatical*
climatological
cystological*
non-sensical*
unsymmetrical*
abstractmathematical*
heroical*
homely-liturgical*
dramatico-musical*
scatological*
non-polemical*
hydrological*
ethnical*
prophetical*
untheological*
semiautobiographical*
parapsychological*
unhypocritical*
unclerical*
over-cynical*
scholastical*
metatechnical*
metamusical*
acousto-optical*

Table 14. Solo forms extracted from the APHB corpus by suffix pattern (continued)

Xical

pseudo-liturgical*
Chirurgical*
antipsychical*
prototypical*
encephalographical*
adrenocortical
serological*
polytechnical*
finical
neuropsychological*
semiclassical
antichemical*
phenological
psychochemical*
aeromedical
diacritical*
thearical*
untechnical*
musical-philosophical*
herpetological*
episodical*
metronomical*
anti-musical*
stereotypical*
extramedical*
oenological*
governmentical*
contra-biological*
neotropical*
psycho-physical*
uncanonical*
lethargical*
centrifical*
alchemical-mystical*
unphysiological*
commonsensical*
countercyclical*
eschatological
artifical*
hydrographical*
sarcastical*
extrametrical*
socio-critical*
hieratical*
romantical*
petrological*
fantastical*
democratical*
horological*
semiautobiographical*
semimedical*
demonical*
biomathematical*
teleological
sociophilosophical*
halfautobiographical*
vortical
geomorphological*
paradisaical*
photomechanical
harmonicomathmatical*
microscopical*
untheoretical*
astrologo-phisical*
nonhierarchical*
hypermetrical*
alchemystical*

* = not found in *Webster's Seventh New Collegiate Dictionary*

APPENDIX 3

Experiment I Stimuli

WORD BASE	BASE-ION	BASE-ION-AL
confess	confession	confessional
profess	profession	professional
except	exception	exceptional
direct	direction	directional
process	procession	processional
educate	education	educational
emote	emotion	emotional
promote	promotion	promotional
operate	operation	operational

WORD BASE	BASE-ABLE	BASE-ABLE-ITY
profit	profitable	profitability
respect	respectable	respectability
account	accountable	accountability
accept	acceptable	acceptability
suit	suitable	suitability
predict	predictable	predictability
deduct	deductible	deductibility
compress	compressible	compressibility
access	accessible	accessibility
permit	permissible	permissibility
reverse	reversible	reversibility
respond	responsible	responsibility

WORD BASE	BASE-IVE	BASE-IVE-NESS
effect	effective	effectiveness
assert	assertive	assertiveness
express	expressive	expressiveness
decide	decisive	decisiveness
elude	elusive	elusiveness
include	inclusive	inclusiveness
defend	defensive	defensiveness
expand	expansive	expansiveness
allude	allusive	allusiveness
exclude	exclusive	exclusiveness

WORD BASE	BASE-IST	BASE-IST-IC
capital	capitalist	capitalistic
social	socialist	socialistic
ideal	idealist	idealistic
style	stylist	stylistic
art	artist	artistic
moral	moralist	moralistic

Experiment I Stimuli (continued)

WORD BASE	BASE-IVE	BASE-IVE-ITY
act	active	activity
select	selective	selectivity
subject	subjective	subjectivity
object	objective	objectivity
create	creative	creativity
NONWORD BASE	**BASE-ION**	**BASE-ION-AL**
themate	themation	thematIonal
emphate	emphation	emphational
dramate	dramation	dramational
provend	provention	proventional
cirvate	cirvation	cirvational
impest	impestion	impestional
arupt	aruption	aruptional
gast	gastion	gastional
ript	ription	riptional
NONWORD BASE	**BASE-ABLE**	**BASE-ABLE-ITY**
propulse	propulsion	propulsability
insast	insastible	insastibility
profeture	profeturable	profeturability
assept	asseptible	asseptibility
assuave	assuavable	assuavability
tuss	tussible	tussibility
sempt	semptible	semptibility
reat	reatable	reatability
brade	bradable	bradability
tulse	tulsable	tulsability
extrol	extrolable	extrolability
eluct	eluctible	eluctibility
NONWORD BASE	**BASE-IVE**	**BASE-IVE-NESS**
remort	remortive	remortiveness
rass	rassive	rassiveness
nebiate	nebiative	nebiativeness
incrate	incrative	incrativeness
collise	collisive	collisivness
carmote	carmotive	carmosivness
relude	relusive	relusiveness
pulmerate	pulmerative	pulmerativeness
expude	expusive	expusiveness

Experiment I Stimuli (continued)

NONWORD BASE	BASE-IST	BASE-IST-IC
eruct	eructist	eructistic
cruman	crumanist	crumanistic
siccal	sicalist	sicalistic
seban	sebanist	sebanistic
dille	dillist	dillistic

NONWORD BASE	BASE-IVE	BASE-IVE-ITY
plast	plastive	plastivity
florse	florsive	florsivity
expute	exputitive	exputitivity
pervict	pervictive	pervictivity
hortent	hortentive	hortentivity

APPENDIX 4
Experiment II Stimuli

Suffix	Actual Words	Possible Words	Non-Words
-ional	promotional	formulational	spational
F=41-49	divisional	emigrational	differentional
	fictional	dictational	evidentional
	instructional	allusional	arousional
	sectional	habitational	sequentional
		perversional	
		inceptional	
		indigestional	
		hibernational	
		convulsional	
-istic	ritualistic	unionistic	defectistic
F=36-51	capitalistic	guitaristic	coercistic
	antagonistic	botanistic	inceptistic
	sadistic	dramatistic	exaltistic
	journalistic	separatistic	devinatistic
		extremistic	
		pacifistic	
		pathologistic	
		zoologistic	
		diplomatistic	
-ality	tonality	remediality	abrasality
F=31-37	actuality	fraternality	divisuality
	sensuality	nauticality	abusality
	eventuality	bridality	cohesality
	normality	ducality	reflectality
		tribunality	
		basality	
		homicidality	
		laterality	
		torrentiality	
-ability	durability	sizability	purability
F=24-32	adaptability	damnability	clarability
	desirability	likability	certability
	irritability	allowability	nullability
	suitability	laughability	diversability
		impressionability	
		personability	
		observability	
		pitiability	
		passability	

Experiment II Stimuli (continued)

Suffix	Actual Words	Possible Words	Non-Words
-mental	governmental	attachmental	projectmental
	monumental	testamental	perceptmental
	regimental	ointmental	nominamental
	developmental	parchmental	frictmental
	elemental	alignmental	injunctmental
		detachmental	
		ailmental	
		merrimental	
		enrollmental	
		installmental	
-osity	curiosity	mysteriosity	panosity
	generosity	marvellosity	calorosity
	virtuosity	barbarosity	aromatosity
	animosity	venomosity	metallosity
	monstrosity	sonorosity	esoterosity
		deliriosity	
		preciosity	
		trecherosity	
		timorosity	
		studiosity	

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