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PHONETICS and PHONOLOGY

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PHONETICS and PHONOLOGY

VOLUME 4

Studies in Lexical Phonology

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ON THE SIMULTANEITY OF MORPHOLOGICAL AND PROSODIC STRUCTURE

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1. INTRODUCTION

In recent years, much attention has been devoted to the internal organization of complex words and to their prosodic structure. Less attention has been devoted to the relationship between prosodic and morphological structure. In this article we explore this relationship in some detail, arguing that there is good reason to believe that morphological and prosodic structure are built in tandem and are available simultaneously.¹ We show further that it must be possible to make reference to the two coexisting structures of a single string both in phonological rules and in the lexical entries of affixes. The theoretical benefits that we derive from this proposal are large and concern several outstanding problems in morphological theory, including head operations (Aronoff, 1988), bracketing paradoxes (Pesetsky, 1985; Sproat, 1985; among many others), and the status of clitics.

The theory of morphology we assume here is that of Lieber (1989, 1992), which shares with previous work in morphology the notion that complex words are hierarchically structured and with Lieber (1980) the idea that morphological struc-

tures are built from the bottom up, as follows. According to this theory, all morphemes have lexical entries which indicate their category and subcategorization (what category, if any, they attach to, and in what direction), as well as their phonological representations, lexical conceptual structures (LCSs), and predicate argument structures (PASs).² Morphemes are put together according to their morphological subcategorization requirements, and hierarchical structure is projected from lexical information and labeled using general principles of X-bar theory and feature percolation.

With respect to prosodic categories, we assume the following. Phonological segments are grouped into a number of hierarchically organized prosodic categories. It is relatively uncontroversial to include among these prosodic categories the syllable σ , the foot F , the phonological word Wd , and the phonological phrase ϕ . McCarthy and Prince (1986) argue that reference is sometimes necessary as well to particular sorts of syllables—the light syllable σ_μ , the heavy syllable $\sigma_{\mu\mu}$, and the core syllable σ_c (that is, a constituent consisting of a simple CV)—and to a constituent which they refer to as the minimal word (Wd^{MIN} , which is equal to a foot (see McCarthy and Prince, 1986:8, for technical details). Nespor and Vogel (1986) also argue for a number of prosodic constituents above the level of the word. For our purposes it is not necessary to determine what the exact inventory of prosodic constituents is. We will be most concerned with constituents at or below the level of the prosodic word: σ (with variants σ_μ , $\sigma_{\mu\mu}$, σ_c), $F (=Wd^{MIN})$, and Wd .

Another point in prosodic theory that we take to be uncontroversial is that morphological structure and prosodic structure need not always be isomorphic. Syllable and foot boundaries do not always coincide with morpheme boundaries, nor does the phonological word always match exactly with the morphological word (see Booij, 1985; Booij and Rubach, 1984).

It is at this point, however, that we part company with the abovementioned theories of prosodic phonology. Both Selkirk (1984) and Nespor and Vogel (1986) assume that prosodic structure is built only after construction of words and sentences has been completed. Selkirk (1984:82) dubs this a SYNTAX-FIRST approach. Prosodic structure is created in two stages. Below the word level, prosodic structure is built after all morphological operations have been completed. Above the word level, prosodic structure is built as part of the postlexical phonology. Nespor and Vogel (1986) are somewhat less explicit than Selkirk about the overall organization of the grammar, but the picture that emerges from their work is one in which all prosodic structure is created as part of the postlexical phonology.

We argue in what follows that neither of these models is correct. Rather, there is good reason to believe that morphological and prosodic structure are built at the same time, from the bottom up, so that representations of words consist of two simultaneous structurings coexisting on distinct planes. This assumption has always been made in the standard version of the theory of lexical phonology, as

proposed in Kiparsky (1982, 1985), but not always very explicitly. It is our aim to show that this assumption is correct and that there is substantial evidence that below the word level, morphology and prosodic phonology interact and apply in tandem.

2. EVIDENCE FOR SIMULTANEITY

In this section we argue that lexical entries of morphemes may refer simultaneously to both syntactic and prosodic requirements on their environment, and that therefore the syntactic and prosodic structuring of segmental strings must be derived in tandem.

A first example comes from Dutch. In this language, there are a number of productive nonnative suffixes that derive adjectives from nonnative nouns ending in *-ie* [i], among them *-isch* /is/ and *-ief* /iv/. The choice between these two suffixes with respect to base nouns in *-ie* crucially depends on the stress patterns of the base words: *-isch* is selected if the final syllable of the base noun bears main stress, whereas *-ief* is the correct suffix for nouns in unstressed *-ie*. This is illustrated in (1).

- | | | | | | |
|-----|----|--------------------|----------------|---------------------|----------------|
| (1) | a. | <i>sociologíe</i> | 'sociology' | <i>sociologisch</i> | 'sociological' |
| | | <i>blasfemíe</i> | 'blasphemy' | <i>blasfemisch</i> | 'blasphemous' |
| | | <i>allergíe</i> | 'allergy' | <i>allergisch</i> | 'allergic' |
| | b. | <i>prevéntíe</i> | 'prevention' | <i>preventief</i> | 'preventive' |
| | | <i>constrúctíe</i> | 'construction' | <i>constructief</i> | 'constructive' |
| | | <i>integrátíe</i> | 'integration' | <i>integratief</i> | 'integrating' |

The final segment [i] of the base noun is subsequently deleted before the initial [i] of the suffix.

The two suffixes are also different in that *-ief* only productively attaches to nouns in unstressed *-ie*, whereas *-isch* also occurs with nouns that do not end in *-ie*. In the latter case, there is no stress condition involved.

- | | | | | |
|-----|--------------------|-------------|------------------------|------------------|
| (2) | <i>proféet</i> | 'prophet' | <i>profetisch</i> | 'prophetical' |
| | <i>álgebra</i> | 'algebra' | <i>algebraísch</i> | 'algebraic' |
| | <i>organisátor</i> | 'organizer' | <i>organisatorisch</i> | 'organizational' |

That is, the stress properties of the base noun are only relevant in the domain in which the two suffixes compete.

Given these facts, the lexical entries for the morphemes *-ief* and *-isch* must contain the following subcategorization.

- | | | |
|-----|--------------|-----------------------------------|
| (3) | <i>-ief</i> | (i) $\sigma_w]_N \text{ — }]_A$ |
| | <i>-isch</i> | $]_N \text{ — }]_A$ |

We assume that attachment of an affix with a more specific subcategorization takes precedence over that of a competing affix with a more general subcategorization (the elsewhere principle, cf. also van Marle, 1985). Therefore, it suffices to mention the prosodic condition in the lexical entry of *-ief*. This lexical entry then requires both the morphological and the prosodic properties of the base word to be available. Note that stress properties of words are to be expressed in terms of strong/weak labeling of prosodic categories such as the syllable and the foot. Therefore, a word must be prosodified before the stress rules can assign a prominence pattern.^{3,4}

The relevance of prosodic information for morphology is not restricted to information concerning stress. In Polish, the choice between one of the two allomorphs of both the comparative and the imperative suffix appears to depend on another prosodic property of the base word, namely, whether its final consonant can be syllabified by the syllabification algorithm of Polish, or remains extrasyllabic. The facts are as follows (we base ourselves here on the analysis in Rubach and Booij, 1990). The comparative morpheme is either *sz* [s] or *ejsz* [ejs]. The general form is *sz*, and the allomorph *ejsz* has to be selected when the stem ends in an extrasyllabic consonant. For instance, in the following examples the stem ends in a cluster of an obstruent followed by a sonorant consonant, which is an impossible coda because it violates the universal sonority sequencing generalization (Selkirk, 1984) (4a), or by a cluster of two sonorant consonants (4b), an ill-formed coda in Polish, and therefore, the final consonant of these stems remains unsyllabified (*-y* is the nominative singular ending; the *i* before *ejsz* indicates palatalization of the preceding consonant).

(4)	ADJECTIVE:	COMPARATIVE:
a.	<i>podt-y</i> 'mean'	<i>podl-ejsz-y</i>
	<i>szczodr-y</i> 'generous'	<i>szczodrz-ejsz-y</i>
b.	<i>czarn-y</i> 'black'	<i>czarn-iejsz-y</i>
	<i>ogóln-y</i> 'general'	<i>ogóln-iejsz-y</i>
	<i>skromn-y</i> 'modest'	<i>skromn-iejsz-y</i>
	<i>fajn-y</i> 'nice'	<i>fajn-iejsz-y</i>

Therefore, the lexical entry for the more specific comparative allomorph *ejsz* will be as follows, where *C** indicates an extrasyllabic consonant.

(5) *ejsz* C*]_A —]_A

As above, we assume that in the case of competing affixes, the more specific one takes precedence over the more general, unrestricted one.⁵

Normally, the imperative morpheme of Polish does not surface directly, but only indirectly, in the form of palatalization of the stem-final consonant. Therefore, it is assumed that it consists of a so-called *yer*, a floating segment that only surfaces phonetically in specific contexts. For our purposes it suffices to point out

here that we also find an allomorph in which the *yer* is preceded by the sequence *ij* [ij]. This allomorph only occurs when the final consonant of the stem is extrasyllabic, as is illustrated in (6). As in the previous case, there are two types of coda clusters that give rise to extrasyllabic consonants: clusters that violate the universal sonority sequencing generalization (6a), and clusters that violate the Polish prohibition on clusters of sonorants (6b).

(6)	VERBAL STEM:	IMPERATIVE:
a.	<i>nagl-</i> 'to hurry'	<i>nagl-ij</i>
	<i>spulchn-</i> 'to make soft'	<i>spulchn-ij</i>
b.	<i>zwoln-</i> 'to cover'	<i>zwoln-ij</i>
	<i>utajn-</i> 'to cover up'	<i>utajn-ij</i>

Hence, the allomorph /ijE/ (E stands for the *yer*) is subcategorized as follows.

- (7) /ijE/ C*]V —]V

In sum, for the selection of the proper allomorph of both the comparative and the imperative morpheme it is crucial that both the morphological and the prosodic structuring of the stem be available. These facts thus support both the theory of lexical phonology that claims that phonology and morphology are interspersed, and the claim that is the subject of this article, the simultaneity thesis.

The requirement of simultaneity not only manifests itself in the subcategorizations of bound morphemes in the lexicon, but also in the fact that there are phonological rules that refer simultaneously to both types of structuring. Let us call such rules **BIPLANAR RULES**.⁶

Hayes (1982) proposed such a biplanar rule for English, namely the rule of Adjective Extrametricality. This rule states that in English adjectives the final syllable is extrametrical. Thus, we get correct stress assignments such as *magnánimous* and *relúctant* instead of the incorrect **magnanímous* and **reluctánt*. This rule is a typically biplanar rule, because it refers to both morphosyntactic information (the notion "adjective") and to prosodic structure (the notion "extraprosodic syllable").

A second example of such a rule is the stress rule for Dutch nominal compounds. This rule assigns main stress to the left constituent of such compounds (Visch, 1989:84).

- (8) DUTCH COMPOUND STRESS RULE:
In a configuration [AB]_N, A is strong.

Visch correctly restricts this rule to nominal compounds because adjectival compounds such as *reuze-sterk* 'very strong' and *donker-groen* 'dark green' clearly have a different stress pattern in which both constituents are felt to be equally stressed. Therefore, rule (8) must refer to morphosyntactic information, the category label N. On the other hand, this rule clearly refers to prosodic structure, since

the constituents that receive the labels "strong" and "weak" are prosodic categories (usually called PROSODIC WORDS) which dominate prosodic categories like syllable and foot.

The stress rule for nominal compounds of Dutch is a typical lexical rule, because it can also have exceptions (cf. Booij, 1977). That is, it cannot simply be part of the mapping procedure that maps morphosyntactic structure into prosodic structure. It is, therefore, an instance of a lexical phonological rule that refers simultaneously to the two kinds of hierarchical structuring of words discussed here.

A final example of a biplanar rule is the German rule of Schwa Insertion in nouns (Hall, 1989; Wiese, 1988). This rule inserts the German default vowel schwa before an extrasyllabic consonant. For instance, the underlying form of *Uebel* 'evil' is /ybl/. When we syllabify this underlying form, the /l/ remains extrasyllabic, because a coda cluster /bl/ would violate the sonority sequencing generalization. A schwa is then inserted to "save" the /l/. As Hall (1989:835) points out, this rule only applies to nouns: Schwa Insertion before consonants also occurs in adjectives, but at a later level, and not only before extrasyllabic consonants. Therefore, the structural description of this rule has to refer simultaneously to the morphosyntactic category "noun" and the prosodic notion "extrasyllabic consonant."

The conclusion of this section is that both subcategorizations of morphemes and phonological rules sometimes have to refer simultaneously to morphological and prosodic information, and both thus have a biplanar character. In the next section we show how the concept of biplanarity can be used to solve a number of theoretical problems with respect to the interaction of phonology and morphology.

3. THEORETICAL CONSEQUENCES

3.1. Head Operations

The first problem we consider concerns the existence of what Aronoff (1988), following Hoeksema (1985), calls head operations.⁷ Hoeksema (1985) defines the notion HEAD OPERATION as in (9).

- (9) F is a head operation if $F(Y) = Z$ and $W = XY$ (where Y is the head of W) together imply that $F(W) = X + F(Y) = X + Z$.

(9) says simply that a morphological rule is a head operation if it reaches into a word W to perform an operation on its head Y , changing Y to Z . Aronoff applies the notion of head operation to several recalcitrant cases of reduplication, among them a classically problematic case in Tagalog. Tagalog has a prefix *pang-* which

attaches to nouns. As the data in (10a) show, [ŋ] plus a following stop appears in the derived form as a single nasal homorganic with the underlying stop.

- (10) a. *atip* 'roofing' *pang-atip* 'that used for roofing'
 pu:tul 'cut' *pa-mu:tul* 'that used for cutting'
 b. *pa-mu-mu:tul* 'a cutting in quantity'

The example in (10b) shows further that when the second form in (10a) is reduplicated, the reduplicating stem shows the effects of having already undergone affixation; the stem-initial [p] has become [m] prior to reduplication. This analysis is of course problematic in traditional frameworks in which morphology strictly precedes phonology; in such cases the sandhi rule operating between prefix and stem seems to have "overapplied." The ordering of the phonological rule with respect to reduplication is not necessarily problematic in frameworks where morphological rules can apply to the output of phonological rules and vice versa, as in the theory of lexical phonology we assume here. Nevertheless, even in frameworks in which phonological and morphological rules can be interspersed, it must still be explained why the reduplication rule seems to reach into an already prefixed word.

Aronoff suggests that the derivation of the form in (10b) involves a head operation. After affixation of *pang-*, which triggers sandhi, reduplication reaches into the word to copy the first two segments of the stem. The notion that certain morphological operations must be "head operations" is a problematic one. It is not at all clear that the item operated on by the "head operation" is actually the head of the word. Lieber (1992) shows that Tagalog word formation is largely left-headed; the majority of Tagalog prefixes are category-changing. In the case outlined above as well, it is very likely that it is the outermost prefix rather than the stem which is the head. Specifically, according to Schachter and Otnes (1972), *pang-* attaches to noun or verb stems to form adjectives. Although Aronoff's glosses, taken from Bloomfield (1933), suggest that the *pang-* forms are nouns, a native speaker of Tagalog confirms that they are adjectives instead with the glosses 'for roofing' and 'for cutting', in conformity to Schachter and Otnes (1972).⁸ Reduplication then changes the *pang-* adjective to a noun. And if the reduplicative affix changes category, it must be the head. The stem therefore cannot be the head, and the operation cannot be a head operation.

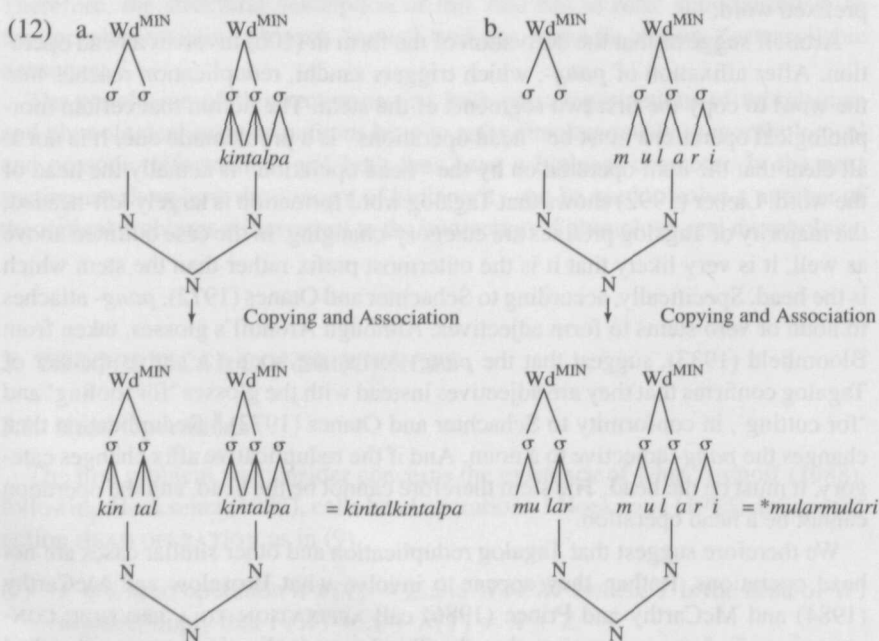
We therefore suggest that Tagalog reduplication and other similar cases are not head operations. Rather, they appear to involve what Broselow and McCarthy (1984) and McCarthy and Prince (1986) call AFFIXATION TO A PROSODIC CONSTITUENT. In fact, we propose that the Tagalog reduplication process sketched above is one in which the reduplicative morpheme is subcategorized for both morphological and prosodic constituents, and that this simultaneous biplanar subcategorization gives rise to nonisomorphic prosodic and morphological structures in this case.

Let us first illustrate the notion of biplanar subcategorization with a somewhat simpler case. McCarthy and Prince (1986: 12) show that it is sometimes necessary to subcategorize affixes to attach to prosodic constituents (e.g., Wd , Wd^{MIN} , etc.), rather than to purely morphological constituents (that is, an X^0 of some sort).⁹ They argue, for example, that the reduplicative affix in the Australian language Yidiny (Dixon, 1977) must attach to Wd^{MIN} , rather than simply to N^0 . Consider the examples in (11).

(11) YIDINY NOMINAL REDUPLICATION:¹⁰

<i>mulari</i>	'initiated man'	<i>mulamulari</i>	'initiated men'
<i>kintalpa</i>	'lizard sp.'	<i>kintalkintalpa</i>	'lizards'

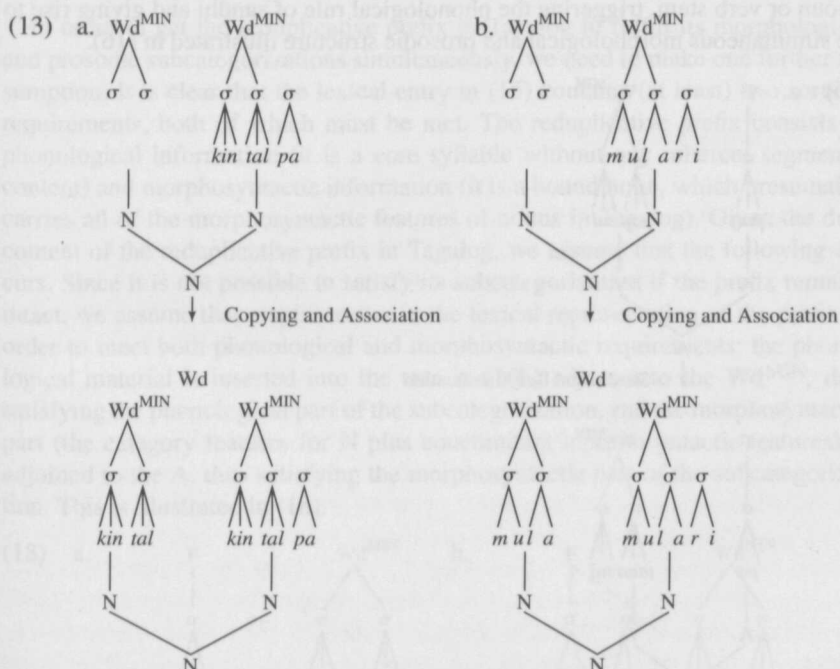
The Yidiny reduplicative prefix is, according to McCarthy and Prince (1986), the prosodic constituent Wd^{MIN} (which is to say a foot—two syllables in Yidiny). If the Wd^{MIN} prefix were to attach to the morphological constituent N^0 , with concomitant copying of the phonemic melody of this constituent, we would expect the derivations illustrated in (12). Note that in (12) prosodic structure is illustrated above the phonemic melody, morphological structure below.



The derivations in (12) are presumed to go as follows. In both (12a) and (12b) the reduplicative prefix Wd^{MIN} is attached to the noun, and morphological structure is built. The phonemic melody of the verb stem is copied and the prosodic affix incorporates as much of the phonemic melody as can be fitted into its two syllables. The result is correct for the case in (12a); *kintalpa* reduplicates as *kintalkintalpa*. But (12b) is not; reduplication based on the whole noun stem yields **mularmulari*.

larmulari, rather than the correct *mulamulari*. The question raised is thus how to get the *l* of *kintalpa* to reduplicate without also getting the *r* of *mulari* showing up in the reduplicative prefix.

McCarthy and Prince argue that this pattern of facts follows if the reduplicative prefix Wd^{MIN} attaches to the prosodic constituent Wd^{MIN} rather than simply to N^0 , and if we make the following crucial assumption: ONLY THE PHONEMIC MELODY OF THE PROSODIC CONSTITUENT TO WHICH THE REDUPlicative AFFIX ATTACHES IS AVAILABLE FOR COPYING. For the example in (12a), the prosodic constituent Wd^{MIN} which is copied is *kintal*, since the *l* forms the coda of the second syllable of the Wd^{MIN} . But for (12b) the constituent which is copied is *mula*, the *r* being the onset of the third stem syllable, and therefore not part of the Wd^{MIN} . This is illustrated in the derivations in (13), where the plane of morphological structure is again beneath the melody and that of prosodic structure above the melody.



The pattern of reduplication illustrated in Yidiny can thus be accounted for if we assume that a reduplicative affix can sometimes be subcategorized for a prosodic constituent alongside a morphosyntactic constituent. In the theory of Lieber (1992), the Yidiny reduplicative prefix will therefore have the biplanar subcategorization in (14).

- (14) YIDINY REDUPLICATION:
 $Wd^{MIN} / [N \text{ — } [N/Wd^{MIN}]$

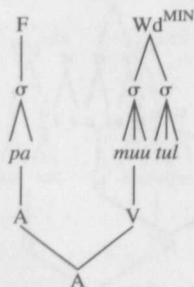
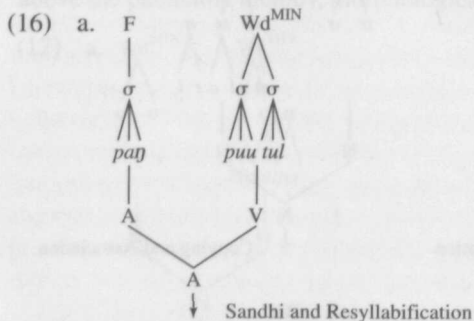
The notation in (14) should be interpreted as follows. The reduplicative prefix is a Wd^{MIN} which attaches to a Wd^{MIN} in prosodic structure and to a N^0 in morphological structure. Both morphological structure and prosodic structure must obviously be present simultaneously for such a subcategorization to be met.

The notion of biplanar subcategorization may now be used to account for the Tagalog case in (10). We assume that the particular reduplicative prefix in question is a core syllable (that is, CV), σ_c in the notation of McCarthy and Prince (1986), and that it has the subcategorization in (15).

(15) TAGALOG REDUPLICATION:

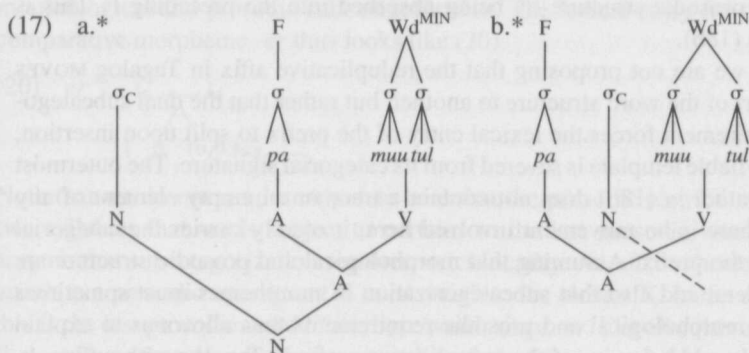
$$\sigma_c / [N \text{ — } [A/Wd^{MIN}]$$

(15) says that the reduplicative prefix σ_c attaches morphologically to an A^0 and prosodically to the Wd^{MIN} (= a foot in Tagalog). Let us see what happens when this prefix is attached. We assume, first of all, that the prefix *pang-* is attached to a noun or verb stem, triggering the phonological rule of sandhi and giving rise to the simultaneous morphological and prosodic structure illustrated in (16).

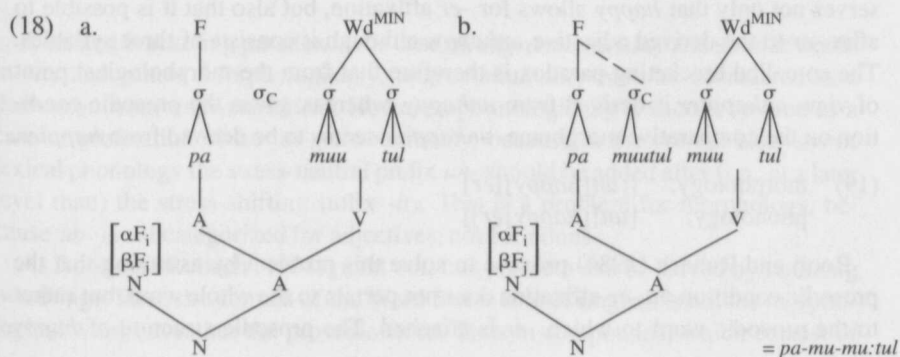


When we try to insert the reduplicative prefix, however, we find that we cannot fulfill the morphological and prosodic subcategorizations simultaneously. If we insert the σ_c to the left of *pa-*, in (16b), the σ_c will not be adjacent to the Wd^{MIN} , as illustrated in (17a). But if we try to insert the reduplicative prefix so that it is adjacent to the Wd^{MIN} , it will not be adjacent to the A, as shown in (17b); indeed,

it is unclear how morphological structure could be projected at all in this structure, since to do so would involve creation of morphological structure on top of already existing morphological structure.



In order to get the reduplicative prefix in Tagalog to fulfill its morphological and prosodic subcategorizations simultaneously, we need to make one further assumption. It is clear that the lexical entry in (15) contains (at least) two sorts of requirements, both of which must be met. The reduplicative prefix consists of phonological information (it is a core syllable without any inherent segmental content) and morphosyntactic information (it is a bound noun, which presumably carries all of the morphosyntactic features of nouns in Tagalog). Given the dual content of the reduplicative prefix in Tagalog, we assume that the following occurs. Since it is not possible to satisfy its subcategorization if the prefix remains intact, we assume that a split occurs in the lexical representation of the prefix in order to meet both phonological and morphosyntactic requirements: the phonological material is inserted into the tree in (16b) adjacent to the Wd^{MIN} , thus satisfying the phonological part of the subcategorization, and the morphosyntactic part (the category features for N plus concomitant morphosyntactic features) is adjoined to the A, thus satisfying the morphosyntactic part of the subcategorization. This is illustrated in (18).



(18a) shows the splitting of the phonological and morphosyntactic parts of the entry. This is then followed by the copying of the phonemic melody of the Wd^{MIN} and association to the σ_c . We assume that the σ_c prefix is then incorporated into the existing prosodic structure by being absorbed into the preceding F. This is illustrated in (18b).

Note that we are not proposing that the reduplicative affix in Tagalog MOVES from one part of the word structure to another, but rather that the dual subcategorization requirement forces the lexical entry of the prefix to split upon insertion, so that the syllable template is severed from its categorial signature. The outermost layer of structure in (18b) does not contain a trace or an empty element of any sort, since there is no movement involved here; it merely carries the categorial signature of the prefix. Assuming that morphological and prosodic structure are built in tandem, and also that subcategorization of morphemes must sometimes satisfy both morphological and prosodic requirements thus allows us to explain the apparently odd behavior of the reduplicative prefix in Tagalog without invoking the special device of head operations. We will see in the next section that other theoretical benefits follow from these assumptions as well.

3.2. Bracketing Paradoxes

In this section we argue that a number of well-known bracketing paradoxes can be made to disappear if the simultaneity of morphological and prosodic structure is taken into account, and specifically if affixes are permitted to have both morphological and prosodic subcategorizations, as previously argued. We begin with a discussion of the well-known bracketing paradox of the English comparative form *unhappier* (see also Booij and Rubach, 1984, and Cohn, 1989, for discussion of similar paradoxes in Indonesian).

The problem presented by *unhappier* is as follows: the English comparative suffix *-er* can normally only be attached to adjectival bases consisting of one syllable, or consisting of two syllables of which the second one is light, a characteristic example of a prosodic condition on word formation. Pesetsky (1985) observes not only that *happy* allows for *-er* affixation, but also that it is possible to affix *-er* to the derived adjective *unhappy*, although it consists of three syllables. The so-called bracketing paradox is therefore that from the morphological point of view *unhappier* is derived from *unhappy*, whereas, given the prosodic condition on the comparative morpheme, *unhappier* seems to be derived from *happier*.

- (19) morphology: [[un[happy]]er]
 phonology: [un[[happy]er]]

Booij and Rubach (1984) propose to solve this problem by assuming that the prosodic condition on *-er*-affixation does not pertain to the whole word, but rather to the prosodic word to which *-er* is attached. The prosodic structure of *happy*

consists of two syllables that together form one prosodic word. *Unhappy*, on the other hand, consists of two prosodic words, *un* and *happy*.

We propose to treat the comparative affix *-er* as an affix which has simultaneous morphological and prosodic subcategorization. The lexical entry for the English comparative morpheme *-er* thus looks like (20).

- (20) *er* $\begin{array}{c} \text{I}_A \text{ --- } \text{I}_A \\ \wedge \\ [\sigma \text{ (}\sigma_C\text{)}]_{\text{wd}} \text{ ---} \end{array}$

Note that we do not need to stipulate here that the prosodic restriction to one or two syllables that *-er* is subject to pertains to the last prosodic word only. We assume that subcategorization requires strict locality. An affix subcategorized to attach to a prosodic constituent X must attach to the closest X. In the case of *-er*, this is the last prosodic word of the base word, since *-er*, like all cohering suffixes (i.e., suffixes that do not form a prosodic word of their own) fuses prosodically with the last prosodic word of the word to which it is attached, with concomitant resyllabification. In other words, prosodic subcategorizations of morphemes can only see the prosodically adjacent material.

- (21)
-
- ```
graph TD; Wd1[Wd] --- F1[F]; Wd1 --- S1[σ]; Wd1 --- S2[σ]; F1 --- un[un]; S1 --- hap[hap]; S1 --- py[py]; S2 --- er[er]; un --- A1[A]; hap --- A2[A]; py --- A2; er --- A3[A]; A1 --- A4[A]; A2 --- A4; A3 --- A4;
```

A related bracketing paradox is the case of *ungrammaticality* and similar words in *-ity* and *-ation*. Morphologically, *ungrammaticality* is to be considered as a derivation from *ungrammatical*. However, phonologically it should be seen as a case of prefixation of *un-* to *grammaticality*, because in the current analyses of lexical phonology the stress-neutral prefix *un-* should be added after (i.e., at a later level than) the stress-shifting suffix *-ity*. This is a problem for morphology, because *un-* is subcategorized for adjectives, not for nouns.

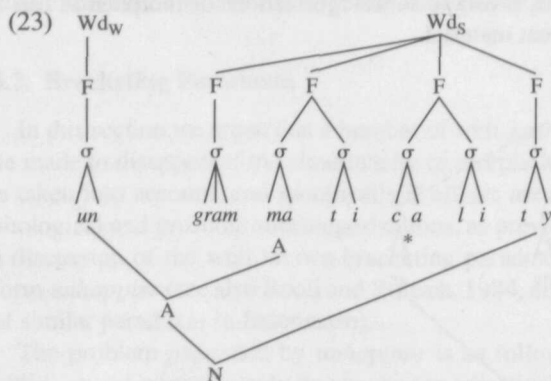
As Booij and Rubach (1984) point out, this problem can be solved by realizing two things. First, the domain of the Word Stress rule of English is not the morphological word but rather the prosodic word. Thus in compounds, which consist of

at least two prosodic words, the Word Stress rule applies in at least two domains. Note also that the Word Stress rule is a rule that specifies prominence relations between syllables within a prosodic word. Secondly, as pointed out above, the prefix *un-* can be assumed to form a prosodic word of its own. This implies that there is no phonological problem created anymore by the correct morphological structure  $[[un[grammatical]]ity]$ . The relevant domains for the assignment of word stress are (*un*) and (*grammaticality*). In other words, although morphologically *-ity* attaches to the whole base word *ungrammatical*, prosodically it is only attached to the last prosodic word, with which it fuses: (*grammatical*). The lexical entry for *-ity* will therefore be as follows.

- (22) *-ity*      ]<sub>A</sub> — ]<sub>N</sub>

Note that it is not necessary to subcategorize *-ity* for a preceding prosodic word, because normally suffixes become part of the preceding prosodic word.

The representation of *ungrammaticality* will thus be as follows (the asterisk indicates the designated terminal element of the prosodic word *grammaticality*).



The same analysis can be applied to similar cases such as *underestimation* and *extrametricality*, since *under-* and *extra-* can also be considered to be prosodic words of their own. Note, by the way, that we also have to specify prominence relations within so-called stress-neutral prefixes; both in *under-* and *extra-* the first syllable is strong, in conformity with the word stress rule. That is, it is impossible to account for the so-called stress-neutral character of English prefixes even by ordering prefixation after the word stress rules, since polysyllabic prefixes conform to the patterns of metrical structure assignment that we find for words, and therefore they have to undergo the rule for (prosodic!) word stress.

It should be observed that the solution to this particular bracketing paradox, although it shows the necessity for an analysis in which the two sorts of structuring are available, does not necessarily require these two structures to be present simultaneously. Nevertheless, we deal with these phenomena here for two reasons.

First, the hypothesis of biplanarity provides us with a natural solution for this kind of bracketing paradox. Secondly, this analysis does imply that rules may have to refer to both planes: whereas in English compounds consisting of two prosodic words the Compound Stress rule correctly predicts the first to be strong, the situation is just the opposite in prefixed structures where the second prosodic word is the strongest one. That is, the metrical rules that assign prominence relations above the level of the prosodic word are sensitive to morphological information, namely the difference between nominal compounds and prefixed complex nouns. Thus, this case is parallel to the Dutch one discussed above concerning the stress differences between nominal and adjectival compounds in Dutch.

We therefore conclude that by making use of the biplanar nature of the structuring of words, there are no bracketing paradoxes that have to do with a conflict between phonology and morphology, and we do not need to introduce multiple levels of representation and rules relating these levels in morphology, as proposed by Pesetsky (1985) and Sproat (1985, 1988).<sup>11</sup>

### 3.3. Clitics

Clitics form classical examples of the nonisomorphy between morphosyntactic and prosodic structure. This can be seen most clearly in the case of so-called simple clitics (Zwicky, 1977) that have the same syntactic distribution as their nonclitic counterparts but are prosodically dependent on either the following prosodic word (proclisis) or the preceding prosodic word (enclisis). In this section we argue that simple clitics are elements that have only prosodic subcategorization but no morphological subcategorization and that they are distinct from affixes, which do have morphological subcategorization. The present framework therefore makes available a convenient typology in which clitics can be distinguished from other bound morphemes.

We illustrate this with the Dutch third person singular clitic pronoun *ie* [i] that is syntactically equivalent to its strong counterpart *hij* 'he'.<sup>12</sup> *ie* is an enclitic because it always fuses prosodically with the preceding prosodic word, which functions as its host. This host provides the necessary prosodic support. The following sentences illustrate the syntactic equivalence of *hij* and *ie*.

- (24) a. *Komt hij?* / *Komt ie?*  
lit. 'Comes he? Does he come?'  
b. *dat hij komt* / *dat ie komt*  
'that he comes'  
c. *wat hij doet* / *wat ie doet*  
'what he does'

That *ie* forms one prosodic word with the preceding word is clear from the syllabification patterns  $(kom)_\sigma (tie)_\sigma$ ,  $(da)_\sigma (tie)_\sigma$ , and  $(wa)_\sigma (tie)_\sigma$ , which show that

the syntactic boundary before *ie* does not create a prosodic word boundary [compare *komt aan* 'comes at (i.e., arrives)' with the syllabification pattern (*komt*)<sub>σ</sub> (*aan*)<sub>σ</sub>]. Note also that *ie* is a typical clitic in that it combines with words of completely different syntactic categories, namely verbs, complementizers, and relative (or interrogative) pronouns. We can express this prosodic property of the clitic *ie* by assigning the following prosodic subcategorization to its lexical entry.

- (25) *ie*      N, 3rd pers. sing.      ]<sub>wd</sub> —

This lexical entry for *-ie* states that *ie* can only be inserted after a prosodic word. This clearly requires that at the level of lexical insertion the prosodic structuring of words up to the word level is already available, and this is exactly what is predicted by our view of the role of prosodic structure in the lexical phonology: since morphological and prosodic structure are derived simultaneously, both kinds of information are available at the level of lexical insertion. We also assume that, like affixes, such clitics become part of the prosodic category for which they are subcategorized. But, unlike affixes, they do not have a syntactic subcategorization, and hence they cooccur with words of different syntactic categories.

This prosodic subcategorization of *ie* also correctly predicts that *ie* cannot occur at the beginning of a sentence, because in that case there is no host available.

- (26) *Hij komt. / \*Ie komt*  
'He comes.'

That is, the exclusion of *ie* from the sentence-initial position does not need to be accounted for by a special stipulation in the syntax, but simply follows from its prosodic subcategorization.<sup>13</sup> Similarly, *ie* cannot be used as a one-word sentence (for instance as an answer to a question) because in that case it would also lack a prosodic host. From this we may conclude that the concept of "prosodic subcategorization" is not only necessary for expressing prosodic conditions in morphology, but also to account for the behavior and distributional restrictions of simple clitics. Moreover, this analysis supports our view that prosodic and morphosyntactic properties of morphemes and words must be simultaneously available.

The concept of prosodic subcategorization can also be used in accounting for the observations concerning clitics made by Klavans (1985). The main theme of this interesting article is the independence of syntax and phonology in cliticization. For instance, the following situation obtains in Nganhcara, an Australian language: the clitics *ngku* 'you' and *nhcara* 'us' occur either before or after the verb, which is always sentence-final (otherwise, word order is free in this language). Therefore, Klavans considers the verb as the syntactic host of these clitics. However, phonologically, these clitics are always attached to the preceding word. This is a phonotactic necessity, because Nganhcara does not allow for the consonant clusters *ngk* and *nhc* in word-initial position. Therefore, the first consonant

of the cluster has to form a syllable with the final vowel of the preceding word. This is illustrated by the following sentence taken from Klavans (1985: 104).

- (27) *nhila pama-ng nhingku kuʔa=ngku wa:*  
 he.NOM man.ERG 2sg.DAT child.DAT=2sg.DAT give=DAT  
 'The man gave a dog to you.'

The enclitic nature of *ngku* is indicated by '='. Klavans (1985:98) remarks that the direction of phonological attachment is a property of the clitic itself. In our analysis, this can be expressed by providing the lexical entry for such clitic pronouns with the prosodic subcategorization ]<sub>wd</sub> \_\_\_\_\_. We also assume that, just as in the case of the English comparative suffix dealt with above, clitics that are subcategorized for a prosodic word become part of that prosodic word by convention.

Although Klavans's observations about the behavior of clitics appear to be correct, her own formalization of the enclitic property of such pronouns is inadequate. She proposes to consider clitics as "phrasal affixes," that is, as words that are subcategorized (in the sense of Lieber, 1980) for a phrasal host. For instance, the general form of the subcategorization frame of clitics that she proposes (p. 117) is as follows.

- (28)  $X' [ \text{---} ]_{X'}$  = enclitic  
 proclitic =  $X' [ \text{---} ]_{X'}$

Note, however, that such a subcategorization frame is impossible in those cases where an enclitic is subcategorized for a syntactic host on its right side, unless we also allow for subcategorization frames of the following type, with the boundary symbol "=" nonadjacent to the category for which the clitic is subcategorized.

- (29) = enclitic  $X' [ \text{---} ]_{X'}$   
 $X' [ \text{---} ]_{X'}$  proclitic =

This amounts to using the symbol "=" as a diacritic for the prosodic requirement "follows/precedes a prosodic host." That is, subcategorization frames of the form proposed by Klavans do not make it possible to account for the difference between the prosodic host and the syntactic host of a clitic, which are not necessarily identical, as Klavans has argued convincingly [cf. (27)]. This is only possible by making use of a separate prosodic subcategorization.

In fact, it is unlikely that we need syntactic subcategorization at all for clitics. In cases such as the Dutch clitic discussed above, the pronominal clitic shows up only in places where the independently needed phrase structure principles of Dutch would allow pronouns. Similarly, in the cases of the Greek definite article *ho* and the Kwakwala determiner particles that Klavans discusses, the clitics show up only where the phrase structure principles of these languages would independently allow articles and determiner particles. Since the syntactic positions of

these clitics follow from the phrase structure rules of the languages in question, it would be superfluous (and incorrect) to subcategorize them for syntactic phrasal hosts, as Klavans proposes to do. Clitics are prosodically, not syntactically, dependent, and we propose to express this prosodic dependence through prosodic subcategorization.

Note that there are, however, items which we would consider to be bona fide phrasal affixes, that is, bound morphemes which subcategorize for a phrasal host. Lieber (1992) gives a number of examples of phrasal affixes, including the English possessive marker *-s* which Klavans assumes to be a clitic. Whereas clitics can have words of different syntactic categories as prosodic hosts, a real phrasal affix such as the possessive suffix *-s* occurs only with phrases of a specified type, in this case NP; prosodically it is absorbed into the closest phonological word to its left, as most suffixes without special prosodic subcategorization are.

We consider then that it is correct to characterize simple clitics as items which are syntactically independent, but prosodically dependent, and therefore that a theory that allows simultaneous reference to prosodic and morphological structure is superior to one that does not.

#### 4. CONCLUSION

We have argued in this article that there are a number of reasons to believe that prosodic structure and morphological structure must be built in tandem. There are phonological rules that must refer to both sorts of structure simultaneously and affixes whose subcategorizations must be biplanar as well. Assuming simultaneity of prosodic and morphological structure allows us to eliminate the notion of "head operation" from morphology, to account simply for several sorts of bracketing paradoxes, and to characterize simple clitics in an appropriate way. Finally, by using the notions of morphological and prosodic subcategorization we can arrive at a typology of morphemes that allows us to distinguish clitics from both free morphemes and affixes.

#### ACKNOWLEDGMENT

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## NOTES

<sup>1</sup> Cf. Anderson (1975), Booij (1988), Booij and Rubach (1984), and Cohn (1989). Similar ideas have been developed in an unpublished dissertation by Inkelas (1989).

<sup>2</sup> See Jackendoff (1987), Levin and Rappaport (1986), and Rappaport and Levin (1988) for discussion of LCS, PAS, and the relationship between them.

<sup>3</sup> Note that even the grid-only theory of word stress requires that information about the syllabification of words be available.

<sup>4</sup> It is probably useful at this point to discuss some conceivable alternatives to the analysis proposed here. First, note that the difference in stress pattern between, e.g., *sociologie* and *preventie* cannot be predicted on the basis of the segmental composition of these words. All present analyses of Dutch stress (e.g., Van der Hulst, 1984; Kager, 1989) assume that in the normal case main stress falls on the penultimate syllable of words ending in *-ie*, and therefore words in *-ie* with final stress have to be marked diacritically with a feature, say [+F], that takes care of this. Note, however, that we cannot make use of this feature [+F] instead of stress to select the proper suffix, since it is the distributionally more restricted suffix *-ief* that requires that its class of base words be characterized, whereas the words in *-ie* that are marked by the feature [+F] are those that cooccur with the more general suffix *-isch* (note that there is no evidence in Dutch that the distribution of *-ief* is determined by a diacritic feature [latinate]).

Observe, furthermore, that we cannot derive the adjectives from nominal stems without *-ie* such as *sociolog-* and *prevent-*, because in that case the property that distinguishes the bases of *-ief* and *-isch* would not be available, since it is located on the final syllable with [i]. That is, this is a typical case of word-based morphology.

Another conceivable analysis is based on the idea expressed in Chomsky and Halle (1968) that morphology precedes phonology, as suggested more recently by Halle and Vergnaud (1987). The facts discussed here might be analyzed within such a theory as follows. The morphology attaches both *-ief* and *-isch* to nouns in *-ie*. Prosodic structure is created cyclically on the basis of the morphological structure of the complex words, and there is a filter that states that words in which the suffix *-ief* is preceded by a syllable with main stress are ill-formed. Note, however, that the final [i] of the base noun that bears main stress before the suffix is added is deleted by rule before suffixes beginning with [i]. Therefore the filter could only do its work if it applied before the application of the [i]-deletion rule. Similarly, the filter would also have to apply before the application of the stress rules that derive the stress pattern of the adjectives, because otherwise the crucial information would get lost. That is, the filter cannot function as a prosodic well-formedness condition on the surface form of these adjectives, as one would expect from filters. One could of course envision a theory in which filters could be cyclic checking mechanisms, but such a theory would be far less restrictive than the theory of lexical phonology we assume here; it would, for example, leave the way open for the ordering of filters after particular rules in a cycle. Thus, the filter approach that one is forced to accept here, if one rejects the basic tenet of lexical phonology, seems to be completely ad hoc.

A final alternative analysis of the *-iefl-isch* facts might seem to be the following. We might assume a surface filter at the end of the lexicon for checking the stress patterns of

words with these suffixes, with a postlexical rule deleting [i] before [i]. This alternative is not correct either, however; such a postlexical filter would incorrectly apply to words ending in [i] followed by the clitic *ie* [i], for example, *wie-ie is* 'who he is' (note that *-ie* forms one prosodic word with the preceding word).

<sup>5</sup>Alternatively, one might assume a phonological rule that inserts *ej* in this context. Note, however, that this cannot be a general rule of epenthesis, because *ej* is only inserted in comparatives. It is therefore more natural to analyze these facts in terms of two competing suffixes. If one preferred to assume a phonological insertion rule here, this would still make the point that lexical phonological rules have to refer to both morphological and prosodic structure.

Parallel to the discussion above with respect to Dutch, one might consider an alternative analysis in which a filter forbids the long allomorph to occur after a syllabified consonant. Again, such a filter could not be a condition on the surface form of these words, because at the surface all consonants will be syllabified due to the recursive application of syllabification procedures.

<sup>6</sup>Note that the examples which we discuss below provide direct evidence against the claim in Cohn (1989: 197) that, in languages which have prosodic structure not isomorphic with morphological structure, the phonology will not refer to morphological structure.

<sup>7</sup>This section is adapted from Lieber, *Deconstructing Morphology. Word Formation in Syntactic Theory*, with permission from the publisher, the University of Chicago Press. Copyright © 1992 by the University of Chicago.

<sup>8</sup>Thanks to Patrocinio Schweikart for the Tagalog data. Further evidence that *pang*-forms are adjectives is that they can occur in the position of modifiers of nouns, as in *papel pang-sulat* 'paper for writing'.

<sup>9</sup>McCarthy and Prince (1986) do not state the facts below in terms of morphological subcategorization, so here we are taking the liberty of translating their basic idea into the morphological framework we have adopted.

<sup>10</sup>McCarthy and Prince (1986) label this reduplication "Verbal Reduplication," but in Dixon (1977) these examples are given as examples of Nominal Reduplication.

<sup>11</sup>See also Hoeksema (1987) for a critical appraisal of Pesetsky's (1985) proposal.

<sup>12</sup>See also Booij and Rubach (1987) and the references cited there for data concerning Dutch clitics.

<sup>13</sup>The general distribution of *ie*, as with other pronouns, is accounted for by syntactic principles such as X-bar theory,  $\theta$ -theory, case theory, and so on.

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