Reconsidering bracket erasure*

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1. INTRODUCTION

Whether there are limits on the amount of morphological information that the grammar can access has been the topic of much debate. In early cyclic approaches to phonology (Chomsky, Halle & Lukoff 1956, Chomsky & Halle 1968), the erasure of morphological boundaries at the end of cycles (Bracket Erasure) was simply a mechanism that drove the cyclic derivation. In The Sound Pattern of English (SPE), for example, Chomsky & Halle (1968) derived cyclic phonology in the following way

(1) i) Apply phonology to the most deeply embedded strings that have no morphological (or syntactic) boundary in them,
   ii) Erase the most deeply embedded boundary symbols,
   iii) Repeat the process until all boundary symbols have been erased

Restricting reference to internal structure received little attention at that time. The morphosyntactic constituent structure tree was kept intact throughout the derivation, making possible global reference to internal structure.

The discovery in the late 1970's that outer cycles do not access information from inner cycles (Siegel 1974, Allen 1978) formed one of the original motivations for the subsequent framework of Lexical Phonology (Pesetsky 1979; Kiparsky 1982; Mohanan 1986; Inkelas 1990; Booij 1997). Although the exact formulation of Bracket Erasure has been controversial, Pesetsky's (1979:44) statement is typical:

(2) Given the nested constituents
    \[ [n \ldots [n_{-1} \ldots n_{-1}] \ldots n] \]

    the last rule of the cycle n is: Erase brackets \( n - 1 \)

Pesetsky's Bracket Erasure convention allows phonology to refer to the boundaries introduced by the outermost morphological construction, but does not allow reference to more deeply embedded structure. In terms of constituent structure, Bracket Erasure makes the boundary between the immediate constituents visible, while disallowing reference to more deeply embedded constituents, as exemplified in (3):

---
mechanism for restricting reference to internal morphological structure) is excessively powerful.

2.1. The need for Bracket Erasure: Turkish stress

In the bulk of the Turkish lexicon, stress is word-final. Monomorphemic words with final stress are shown in (4):¹

(4) ka'dum 'woman' gani;met 'loot'
be'bek 'baby' hemjfire 'nurse'
dymbe'lek 'drum' j'lik 'marrow'
e'nik 'pup' a'dam 'man'

Most suffixes do not interfere with default word-final stress assignment:

(5) a) 'ev 'house'
ev-le' 'house-pl'
ev-le' -im 'house-pl-1sg.poss'
ev-le'r-im 'house-pl-1sg.poss-loc'
ev-le'r-im-de'ki 'house-pl-1sg.poss-loc-rel'
b) ge'dzik 'be late'
ge'dzik- 'tir 'be late-caus'
ge'dzik-ti' -il 'be late-caus-pass'
ge'dzik-ti'i' -ler 'be late-caus-pass-imprf'
ge'dzik-ti'il-ler 'be late-caus-pass-imprf-3pl.sbj'

Some suffixes, however, perturb the default final stress pattern. Most of these are pretesting, putting stress on the last syllable of the stem they attach to:

(6) a) Prestressing suffixes
-mE, 'negative'
ge'dzik-me 'be late-neg'
ge'dzik- 'tir-me 'be late-caus-neg'
ge'dzik-ti' -il-me 'be late-caus-pass-neg'
ge'dzik-ti'il-me-di 'be late-caus-pass-neg-past'
b) -(j)E, 'comitative'
kitap 'book'
kitap-la 'book-com'
ka'ta'b -um-la 'book-1sg.poss-com'
kitap-la'um-la 'book-pl-1sg.poss-com'

The Turkish pattern is consistent with any version of Bracket Erasure; stress
assignment is impervious to internal morphological structure, referring only to the stem that the prestressing suffix attaches to.

We now consider a minor variation of the Turkish stress pattern. Imagine a hypothetical language in which stress-perturbing suffixes place stress on the root-final syllable, regardless of the number of intervening suffixes (7):

(7) Hypothetical data
a. Word with all neutral suffixes:  
   gedlık-ti’r-il
b. Word with all neutral suffixes followed by stress-perturbing suffix -ir:
   gedlık-tir-il-ir

This pattern, in which a deeply embedded morpheme boundary is visible, is not attested in cyclic phonology. Yet a theory without Bracket Erasure can describe this pattern quite easily by, for example, using an alignment constraint (McCarty & Prince 1993) that refers to the root boundary. We sketch such an analysis in (8):

(8) Final:  
   ALIGN (6, R, Word, R)  (Final stress)  
   PERTURB: NO ALIGN (6, R, Perturbing-Suffix, R)  (Perturbed stress)  
   Root:  
   ALIGN (6, R, Root, R)  (Root stress)  
   Ranking: PERTURB >> FINAL >> ROOT

Tableaux (9) and (10) illustrate how the ranking in (8) derives word-final stress in the absence of perturbing suffixes, and root-final stress in their presence:

(9) No perturbing suffix

<table>
<thead>
<tr>
<th>/gedlık-ler-dí</th>
<th>PERTURB</th>
<th>FINAL</th>
<th>ROOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>gedlık-ler</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gedşık-ler-dí</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(10) -dí: stress perturbing

<table>
<thead>
<tr>
<th>/gedlık-ler-dí</th>
<th>PERTURB</th>
<th>FINAL</th>
<th>ROOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>gedlık-ler-dí</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In (10), the presence of a perturbing suffix means that high-ranking PERTURB must be satisfied at the expense of FINAL; this leaves the decision in the hands of lowest-ranking Root, resulting in root-final stress. If, as seems to be the case, phenomena like this are not found in natural languages, we must be suspicious of a theory without some mechanism to prevent us from formulating constraints such as the crucial Root, which makes reference to the deeply embedded root morpheme /gedlık/ in /gedlık-ler-dí/.

2.2. Apparent challenge for Bracket Erasure: potentiation

Despite thought experiments like the Turkish case study just discussed that lend support to a Bracket Erasure restriction, a number of examples in the literature pose descriptive problems for theories incorporating Bracket Erasure. Most such challenges are based on morphological rather than phonological facts. In the framework of Lexical Phonology, morpheme boundaries within phonological strings were thought not only to be delimiters of morphs but also to carry morphosyntactic featural information. Thus, evidence of morphological reference to internal structure was just as challenging to Bracket Erasure as evidence of phonological reference to deeply embedded morpheme boundaries.

One type of morphological challenge to Bracket Erasure involves POTENTIA- tion (see e.g. Fabb 1988, Hammond 1991, Bochner 1993), the situation where morpheme attachment is sensitive to the presence in the base of another, specific, morpheme. Such cases appear to require the internal structure of the stem to be visible to the outer morpheme. For example, Bochner (1993) observes that the suffix -ment is only marginally productive in the general English lexicon. However, it attaches quite freely to verbs containing the prefix en-. Thus, a proper description of the regular behavior of -ment seems to require reference to en:-

(11) 
entombment  
embalmment  
embarrassment  
embellishment  
embezzlement  
encirclement  
enforcement  
enfranchisement  
engagement  
encouragement  
genrossment  
encroachment  
enhancement  
edorsement

Making en- visible to -ment appears to entail that morphology can access the internal structure of the form en+STEM. How can a theory that adopts some version of Bracket Erasure deal with such data?

A crucial observation in such cases is that what the attaching suffix must know is only the fact that a given affix is present in a stem – not the location of that affix within the stem. We have found this generalization true of all the alleged challenges to Bracket Erasure that we have found in the literature as
well as in our own work on primary data. Abandoning Bracket Erasure altogether in order to describe the data in (11) is thus too drastic a move; it would fail to capture the generalization we have noticed, and it would fail to rule out the hypothetical language discussed in section 2.1.

In this paper we propose a version of Bracket Erasure, called RELATIVIZED OPAQITY, which can describe English while ruling out the hypothetical system in section 2.1. We show that RELATIVIZED OPAQITY need not be stipulated—as most past versions of Bracket Erasure have been—but follows from independent tenets of Sign-Based Morphology (Orgun 1996a), the framework we assume.

2.3. Overview of paper

Having established the need for some version of Bracket Erasure in section 1.1, we outline in section 3 the framework of Sign-Based Morphology, from which the desired formulation of Bracket Erasure follows naturally. Sign-Based Morphology has two components that are essential to the RELATIVIZED OPAQITY THEOREM, namely LEXICAL TYPES and Cophonologies. Section 3.2 discusses lexical types in detail, with case studies from English presented in sections 4 and 5. Section 6 offers a detailed discussion of cophonologies, including a case study from Japanese. Conclusions are offered in section 7.

3. OUTLINE OF SIGN-BASED MORPHOLOGY

The framework of Sign-Based Morphology has been introduced in Orgun (1996a, 1998). Here, we will take a few pages to summarize some of its basic tools before proceeding with data and analyses of Bracket Erasure effects. The basic mechanisms, Cophonologies and LEXICAL TYPES, are mainstays in previous literature. Cophonologies have independently been proposed to deal with morphe-specific phonological effects, lexical stratiﬁcation, and morphological dominance (see e.g. Itô & Mester 1995; Inkelas 1996, 1998; Orgun 1996a; Orgun & Zoll 1997; Inkelas & Zoll 2000; Yu 2000). Lexical Types are a central part of Head-Driven Phrase-Structure Grammar (HPSG; Pollard & Sag 1994, Sag & Wasow 1999) and Construction Grammar (Koenig 1994, 1999; Fillmore & Kay 1996, 1999), two inﬂuential sign-based theories of linguistics.

3.1. Sign-Based Morphology and cophonologies

Sign-Based Morphology is a constituent structure-based approach to the phonology–morphology interface. It shares with other sign-based theories the assumption that each node in a constituent structure is an attribute-value matrix containing morphosyntactic, semantic, and phonological information. (In some of these respects it resembles item-based theories of morphology that assume feature percolation, e.g. Lieber 1980.) Roots are represented as attribute-value matrices:

(12) The morpheme book:

\[
\begin{array}{l}
\text{SYNSEM} [\text{CAT noun}] \\
\text{PHON} \text{ bok}
\end{array}
\]

Grammatical constructions are represented as one or more daughter nodes (representing the input to an affixation or nonconcatenative morphological construction (“base”) or members of a compound, etc.) and a mother node dominating them (corresponding to the output of the affixation or other morphological operation). A typical constituent structure configuration, the noun-noun compound horsetail, is depicted in (13):

(13)

\[
\begin{array}{l}
\text{SYNSEM} [\text{CAT noun}] \\
\text{PHON} \text{ horsetail}
\end{array}
\]

\[
\begin{array}{l}
\text{SYNSEM} [\text{CAT noun}] \\
\text{PHON} \text{ horse}
\end{array}
\]

\[
\begin{array}{l}
\text{SYNSEM} [\text{CAT noun}] \\
\text{PHON} \text{ tail}
\end{array}
\]

Affixes are represented as constructions as well. Following Orgun (1996a), we represent affixes not as terminal constituents, but as arguments to the phonological function \( \phi \) that relates the mother node’s phonology to its daughter’s phonology. (Formally this is a realizational or item-and-process approach to affixation (see e.g. Anderson 1992, Stump 1988), as opposed to an item-based subcategorization approach (see e.g. Lieber 1980, Sellekirk 1982, Inkelas 1990).) Thus, affixation constructions exhibit nonbranching dominance—a mother node dominating a single daughter. A typical affixation construction is shown in (14):
be sufficient for the purposes of this paper. The interested reader can find an excellent exposition in Carpenter’s classic (1992) book. We follow Carpenter in assuming monotonic type inheritance (subtypes possess all the information in types they inherit from). For a discussion of inheritance with defaults and overrides, the reader is referred to Briscoe, Copestake & Paiva (1993).

One basic function of the type hierarchy is to capture generalizations across lexical items by extracting such generalizations into a supertype. For example, that *feed* in English means roughly ‘cause to ingest food’ is an idiosyncratic property of this lexical item, and is included in its lexical entry. However, the facts that *feed* occurs to the right of its subject and to the left of its direct object in an active declarative sentence, that it can be inflected for past tense or progressive aspect, that it can be passivized, etc., are shared with many other lexical items. The hierarchical lexicon captures this by grouping these lexical entries into a type that we may call *verb*. This type has several subtypes, including *transitive*, of which the verb *feed* is a subtype. Like all verbs, transitive verbs (including *feed*) are inflected for certain tenses and aspects. Like many transitive verbs, *feed* can be passivized (in a more precise account, these passivizable transitive verbs might be grouped into their own subtype).

The type hierarchy contains not only simple lexical entries (such as *feed*) but also grammatical constructions, including the compounding and affixation constructions just seen. For example, we may notice that English verbs precede their internal arguments. Likewise, prepositions precede their complements. Furthermore, nouns and adjective complements follow their heads. We can express these generalizations by positing a general grammatical construction called *head-first* from which a number of syntactic constructions (such as *verb phrase, preposition phrase*, etc.) inherit information.

This use of type hierarchies underlies Sign-Based Morphology’s reference to lexical types. Each morphological construction is defined as a lexical type. Every form licensed by a given construction is a subtype of that construction. For example, English affixation constructions may carry type designations that may be mnemonically named *re-verb* (which would include the verbs *reheat*, *redo*, *rethink*), *un-adjective* (which would include *unhappy*, *untalented*), etc. These constructions themselves may be subtypes of a general type, *prefixation construction*, which in turn would be a subtype of a general, possibly universal, *affixation construction*. We can refer to the types of individual forms licensed by these constructions. For example, *reheat* is a subtype of *re-verb*. We show in subsequent sections that reference to such lexical types provides us with the means to deal with apparent challenges to Bracket Erasure.

Flickinger (1987), Ackerman & LeSourd (1993), Koening & Jurafsky (1994) and Riehemann (1994) have applied type hierarchies to morphology. As an example, we present part of the type hierarchy Koening & Jurafsky (1994) propose for English (much detail is omitted to make the hierarchy simpler):

\[
\begin{align*}
\text{SYNSEM} & \quad \text{CAT} \quad \text{noun} \\
\text{PHON} & \quad \varphi(1, z) \\
\end{align*}
\]

The \text{PHON} value for the mother node is a phonological string, the output of applying the phonological function \varphi (which could be an Optimality Theoretic mapping) to the input \(1, z\). While the input in this particular example is morphologically complex, the output of \varphi is a simple phonological string with no morph boundaries. (The absence of morph boundaries in output will turn out to be an important component of our Bracket Erasure analysis.)

The phonological alternations we discuss are all morphologically conditioned to some degree. We must thus discuss the way in which Sign-Based Morphology handles such conditioning. In Sign-Based Morphology, morpheme- and construction-specific phonology in general – such as alternations triggered by a particular suffix, or applying only within compounds, etc. – is handled by allowing different morphological constructions to be associated with different phonological functions \varphi that coexist in the same language.\footnote{Each such phonological function is called a cophonology. For example, we may assume that English -ize suffixation subscribes to a stress-preserving cophonology (\textit{céntral}, \textit{céntral-ize}), while -ity suffixation subscribes to a stress-shifting cophonology (\textit{céntral}, \textit{céntral-ity}). More details of cophonologies may be found in Orgun (1996a, 1998), Inkelas (1998), Inkelas & Orgun (1998), Inkelas & Zoll (2000). We will present an application of the cophonology device in section 6.}

3.2. Types

The other main tool in Sign-Based Morphology that plays a role in our analysis of Bracket Erasure effects is \textsc{type hierarchies}. Type hierarchies form a central part of sign-based theories such as HPSG, independently of Sign-Based Morphology’s use of them to deal with challenges to Bracket Erasure. In such theories, grammatical constructions are organized into a hierarchy of types such that specific types inherit information from more general ones (Carpenter 1992).

The mathematical background and the details of the theory of type hierarchies are highly technical and involved. We give a rough introduction that will
Example (15) illustrates a number of notational conveniences. The boxed labels `LEXEMES` and `VALENCE` describe two (conjunctive) dimensions in the type hierarchy. Any subtype of the type `lexical constructions` must inherit from a type under `LEXEMES` as well as a type under `VALENCE`. Under `LEXEMES` are the (disjunctive) types `nouns` and `verbs`. Each subtype must inherit from exactly one of these types. The subtypes of `nouns` identified as `-er nouns` and `-ee nouns` include information such as the kind of verb these suffixes attach to and the syntactic, semantic, and phonological properties of the resulting nouns.

A simplified representation of the `-ee noun` construction is shown in (16). Type labels are shown in Italics in the upper left-hand corner of each feature structure, above the feature specifications:

```
(16) [-ee noun
SYNSEM [CAT noun
SEM “that which is pulled”]
PHON φ(ε(2), i)
]

[verb
SYNSEM [CAT verb
SEM [1]]
PHON [1]
]
```

This construction is a generalization over deverbal nouns that contain the suffix. It contains all the information that such nouns share, leaving the noun stem unspecified. Subtypes of `-ee noun` are specific nouns (such as `payee`). The noun stem supplies the missing semantic and phonological features, giving rise to a fully specified constituent structure, an actual word of English.

The `non-noun` construction can be developed in a similar fashion. A constituent structure representation of the noun `nonpayee` is shown in (17). Note that the phon values of the intermediate and top nodes are simply `/peji/` and `/nanpeji/`, respectively. The notation $\varphi(nan, peji) = nanpeji$, which elucidates the licensing of the phon value by the phonological mapping $\varphi$, is shown for the reader’s convenience but is not part of the actual linguistic representation.

```
(17) [non-noun
SYNSEM [CAT noun
SEM “nonpayee”]
PHON $\varphi(nan, peji) = nanpeji$]

[-ee noun
SYNSEM [CAT noun
SEM “payee”]
PHON $\varphi(\text{per, i}) = peji$]

[verb
SYNSEM [CAT verb
SEM “pay”]
PHON \text{per}]
```

The top node of this constituent structure bears the type label `non-noun`, by virtue of being licensed by the `non-noun` construction. The intermediate node, licensed by the `-ee noun` construction, bears the type label `-ee noun`.

It is of crucial importance to recognize the difference between features and type designations in order to follow our arguments concerning Relativized Opacity. Type designations are no more than arbitrary labels identifying individual morphological constructions. By definition, they (unlike features) cannot percolate from daughter node to mother node. For example, in `nonpayee`, the daughter node `pay` has the type label `verb`. The intermediate node has the type label `-ee noun`; this is simply the class of nouns licensed by `-ee` suffixation. A morphological construction applying to `payee` can identify it as an `-ee noun`, but cannot refer to the type label of the verb root. The type label of the root (whatever it may be) belongs to the granddaughters, a node that is too deeply embedded to be visible to a morphological construction, which consists of a mother node and its daughters. For example, reference to types does not allow representing a morphological construction that applies to `-ee nouns` formed out of transitive verbs (such as `payee`) but not to those that are formed out of intransitive verbs (such as `escapee`). Thus, assuming that `non-` prefixation is fully
productive and not subject to semantic restrictions, nonpayee and nonescapee are predicted to be equally acceptable (or equally unacceptable).\(^8\)

3.3. Relativized Opacity

The possibility of referring to types gives Sign-Based Morphology a crucial advantage over Pesetsky's Bracket Erasure convention (2). Pesetsky's condition forbids any reference to the internal structure of daughter nodes. Yet we saw that the English *-ment* construction needs to know that its base contains the prefix *en*-. This problem disappears in Sign-Based Morphology. True, the local tree model makes it impossible for the grammar to be sensitive to the location of morphological boundaries within the daughter nodes. However, reference to types does allow identification of the outermost affix (or, more accurately, outermost morphological construction; see section 6 for a case where a compounding construction is referred to) in each daughter node. The presence of an affix in a given form is thus accessible to the grammar, provided that it is the outermost affix within the daughter node. We call this consequence of the basic architecture of Sign-Based Morphology the RELATIVIZED OPAQUITY THEOREM.

(18) RELATIVIZED OPAQUITY THEOREM
a) The grammar can access information regarding the presence of an affix or construction in a daughter node, as long as that construction is the top node in the daughter node's constituent structure.

b) The grammar cannot access any morpheme boundary information within a daughter node – not even boundaries associated with constructions whose presence is known from clause (a).

The Relativized Opacity Theorem permits the English facts to be described: *en*-prefixation creates a stem of the type that *-ment* selects for. The theorem still, like the otherwise overly restrictive Bracket Erasure convention in (2), predicts that phonology applying to stems formed with cannot be sensitive to the boundary following *en*-. It should be noted that any cyclic theory of the phonology–morphology interface could stipulate the equivalent of the Relativized Opacity Theorem, and thus achieve a level of empirical adequacy equivalent to that of Sign-Based Morphology. However, Sign-Based Morphology would still have a theoretical advantage in that it derives the Relativized Opacity Theorem from basic architectural assumptions that it shares with standard sign-based theories of linguistics. The crucial aspects of Sign-Based Morphology from which the Relativized Opacity Theorem follows are:

i) Its sign-based architecture, in particular the fact that each node has a phon attribute (shared with GPSG (Gazdar et al. 1985); HPSG (Pollard & Sag 1987, 1994; Sag & Wasow 1999); Construction Grammar (Fillmore, Kay & O'Connor 1988, Fillmore & Kay 1996); and Lexical Functional Grammar (Kaplan & Bresnan 1982)).

ii) The fact that no morphological affiliation information – including morpheme boundaries – is represented within phonological strings. Such information is not needed because the sign-based structure is sufficient to deal with morphological effects on phonology. Furthermore, according to realizational morphologists such as Anderson (1992), Aronoff (1976, 1994), Stump (1988), and Zwicky (1994), it is not even possible to parsimoniously represent such information within phonological strings.


In previous theories, allowing reference to the presence of a morpheme in a form entailed making the associated morphological boundaries available – that is, abandoning Bracket Erasure. However, this move makes too much information available and is therefore not desirable. Sign-Based Morphology makes available just the right amount of information.

3.4. Restricting Types

Reference to Lexical Types crucially depends on the precise articulation of the type hierarchy. It is thus important to establish restrictions on the amount of detail allowed in the hierarchy. Particularly needed is a restriction on unprincipled type proliferation. Without one it would be possible to identify any arbitrary set of items by declaring an *ad hoc* type of which all those items are subtypes. For example, one could posit two separate types of pluralization constructions in English, say, *plurals of animate nouns* and *plurals of inanimate nouns.*
(19) Pseudo-English animate noun pluralization construction
\[
\text{SYNSEM} \begin{bmatrix}
\text{CAT} & \text{noun} \\
\text{NUMBER} & \text{plural}
\end{bmatrix}
\]
\[
\text{PHON} \begin{bmatrix}
\varphi(1, 2)
\end{bmatrix}
\]
\[
\begin{bmatrix}
\text{animate noun} \\
\text{SYNSEM|CAT} & \text{noun} \\
\text{PHON} & \text{1}
\end{bmatrix}
\]

(20) Pseudo-English inanimate noun pluralization construction
\[
\text{SYNSEM} \begin{bmatrix}
\text{CAT} & \text{noun} \\
\text{NUMBER} & \text{plural}
\end{bmatrix}
\]
\[
\text{PHON} \begin{bmatrix}
\varphi(1, 2)
\end{bmatrix}
\]
\[
\begin{bmatrix}
\text{inanimate noun} \\
\text{SYNSEM|CAT} & \text{noun} \\
\text{PHON} & \text{1}
\end{bmatrix}
\]

The types \textit{animate} and \textit{inanimate noun} characterizing the daughter nodes in (19) and (20) are valid semantic types that the lexicon of any language would presumably contain. But what is at issue here is the type labeling of the mother nodes of these constructions, namely \textit{animate noun plural} and \textit{inanimate noun plural}. (Recall that these are arbitrary labels identifying specific morphological constructions. Thus, these labels might as well have read \textit{construction 42} and \textit{construction 47}.) Given this type distinction, it would be possible to, for example, posit separate plural noun determination constructions (assuming for the purposes of this demonstration that the definite article is a clitic handled by the morphology) such that one allomorph \((\theta)\) attaches to plurals of animate nouns, and another \((\delta)\) to plurals of inanimate nouns – even though plurals of animate and inanimate nouns are formed by the same morphological process of adding the suffix \(-z\) or \(-z\) to.

(21) Pseudo-English animate plural noun determination construction
\[
\text{SYNSEM} \begin{bmatrix}
\text{CAT} & \text{noun} \\
\text{NUMBER} & \text{plural}
\end{bmatrix}
\]
\[
\text{PHON} \begin{bmatrix}
\varphi(\theta, 1)
\end{bmatrix}
\]
\[
\begin{bmatrix}
\text{animate noun plural} \\
\text{SYNSEM|CAT} & \text{noun} \\
\text{PHON} & \text{1}
\end{bmatrix}
\]

(22) Pseudo-English inanimate plural noun determination construction
\[
\text{SYNSEM} \begin{bmatrix}
\text{CAT} & \text{noun} \\
\text{NUMBER} & \text{plural}
\end{bmatrix}
\]
\[
\text{PHON} \begin{bmatrix}
\varphi(\delta, 1)
\end{bmatrix}
\]
\[
\begin{bmatrix}
\text{inanimate noun plural} \\
\text{SYNSEM|CAT} & \text{noun} \\
\text{PHON} & \text{1}
\end{bmatrix}
\]

What is wrong with this pseudo-language is the following: the plural construction does not differ in form between animate and inanimate nouns – it adds \(-z\) to both. Yet by arbitrarily splitting the plural construction into two subtypes, we created a situation in which the two different determination constructions could make reference to these two artificial subtypes. The effect of this is that the determination constructions are able to access information concerning the \textit{granddaughter} noun roots – namely, their animacy – without directly referring to them. Clearly, such type proliferation will allow unlimited access to the entire morphological structure of a form (though still not to the locations of the morpheme boundaries – thus reference to types will still be more restrictive than approaches that abandon Bracket Erasure altogether, even in this degenerate case!). Thus, if reference to lexical types is to be a restrictive mechanism, there must be constraints on type proliferation.
Examination of the ad hoc split of noun plurals into animate and inanimate subtypes provides an insight. The problem arose when the plural construction was split into two subtypes without a corresponding difference in form or function of the construction: both subtypes have exactly the same form, namely addition of the suffix -z with the appropriate phonological modifications, and both create plural nouns. Because neither makes a unique contribution, combining the two subtypes into one would give rise to exactly the same outcome in terms of the plural nouns licensed and the phonological form that they assume.

We must prohibit the splitting of a type into multiple, coextensive subtypes unless there is a corresponding difference in form. Somewhat more formally, we can impose the following restriction on type hierarchies:

(23) Subtype licensing condition:
If two subtypes of a construction can be consolidated such that the range of items the new type licenses coincides with the range of items the original subtypes license, then the subtypes must be so consolidated.

Under (23), no arbitrary splitting of a type into subtypes is allowed. The exact formulation and implications of this restriction deserve to be worked out further. For our immediate purposes, however, it is clear that this commonsense restriction will prevent unlimited access to the morphological structure of a form.

4. REFERENCE TO LEXICAL TYPES IN ENGLISH NOMINALIZATION

This section presents the first of several examples similar to the -ment example discussed in section 2.2. These examples pose descriptive challenges to standard statements of Bracket Erasure, but are consistent with the Relativized Opacity Theorem. In each case, an apparent need to refer to internal morphological structure turns out simply to be a case of sensitivity to the presence of an affix within a daughter node. Crucially, the location of that affix is never relevant.

We begin with data concerning English zero nominalization (see Raffelsiefen 1992, Orgun 1996a, Orgun & Sprouse 1999). Raffelsiefen (1992) shows that zero nominalization is sensitive to the presence of the verbal prefix re-. Such sensitivity is in apparent conflict with Bracket Erasure (2).

The construction of interest is stress-shifting zero nominalization, which converts a disyllabic verb into a noun by placing primary stress on the first syllable and secondary stress on the second syllable. This construction is unproductive, as the data in (24) show. The verbs in (a) have stress-shifted nominals while those in (b) do not.

(24) a. Verb Noun b. Verb Noun
accént accént account *account
adress addréss arrés* *arrés*
alloy allure *allure
abstráct abstréct advanc* *advanc*
conflict consént *consént
contést concérn *concérn
contruct contrôl *contrôl
décéase déféat *défèat

Although stress-shifting nominalization is unproductive in general, Raffelsiefen (1992) notes that it has a "niche of productivity". Verbs containing the prefix re- freely undergo stress-shifting nominalization in the terminology of section 2.2, re-prefixation potentiates stress-shifting nominalization:

(25) Verb re-Verb Noun
fill refill reflill
do redo rédo
make remåke remåke
load reload rëload
paint repaint rëpaint
play replay rëplay
count recount rëchunt
print reprint rëprint

It is important to establish that the nouns in (25) are indeed formed by nominalizing the re- verb, rather than by adding re- to the nominalized verb stem, e.g. fillv → filln → refilln. Stress draws the relevant distinction. Nouns like recapüre, rebroadcast have primary stress on the root-initial syllable, while nominalized re-verbs have primary stress on re- and secondary stress on the root. Further, nouns like recapüre can occur only when the verb stem has an independent zero nominalization (here, capture). Thus, nouns such as recapüre are arguably derived by re- prefixation from deverbal nouns such as capture. By contrast, nominalized re-verbs (25) may be derived from verb stems that lack zero nominals, e.g., makev, *makev (in the intended sense). Finally, in contrast to the general zero nominalization examples in (24), re-verbs (25) are not ambiguous semantically as to the direction of derivation (noun → verb or verb → noun): the nominal is clearly zero-derived from the verb, with corresponding stress shift.

To confirm the productivity of stress-shifted re-verb nominalization, we collected additional data from three native English speakers (one being the second author). We found that some speakers find certain stress-shifted re-verb nominals to be only marginally acceptable. The sets of acceptable and
marginal stress-shifted nouns vary from speaker to speaker. This variability does not mean, on our view, that the stress-shifted re-verb construction is unproductive; rather, it is due to the phenomenon in derivational morphology that forms are acceptable to speakers to the extent that they know what meaning to assign to them. Modulo these remarks, all the verbs in (26) have stress-shifted nominalizations.\(^{11}\)

\[
\begin{array}{llllllll}
(26) & \text{re-bore} & \text{recross} & \text{rehash} & \text{re-cede} & \text{re-pass} & \text{re-tread} & \\
& \text{rebound} & \text{refit} & \text{rejoin} & \text{recast} & \text{replant} & \text{retrim} & \\
& \text{recap} & \text{refloat} & \text{relay} & \text{recount} & \text{replay} & \text{revamp} & \\
& \text{recharge} & \text{re-fund} & \text{retool} & \text{reheat} & \text{retool} & \text{rewire} & \\
\end{array}
\]

To account for this phenomenon, we require a mechanism that will let a morphological construction recognize that the stem it applies to contains a specific morpheme (here, the prefix re-). Hammond (1991) handles potentiation of this kind with (criterial) Morphemic Circumscription, a device that directly refers to stem-internal constituent structure. In (27) we illustrate Morphemic Circumscription with the English suffix -ation, which attaches freely to stems ending in the suffix -ize (among certain others). Here the stem is modernize:

\[
(27) \begin{array}{ll}
\text{UR} & \text{modern} \\
\text{Suffixation} & \text{modernize} \\
\text{Circumscription} & \text{modern} <\text{ize}> & \text{(criterion satisfied: -ize present)} \\
& \text{-ation suffixation} & \text{modernization} \\
\end{array}
\]

A stem not ending in -ize cannot (productively) combine with -ation:

\[
(28) \begin{array}{ll}
\text{UR} & \text{damp} \\
\text{Suffixation} & \text{dampen} \\
\text{Circumscription} & \text{damp} <\text{en}> & \text{(criterion not satisfied)} \\
& \text{-ation suffixation} & \\
\end{array}
\]

In order to recognize that the potential base of affixation ends in the appropriate suffix, Morphemic Circumscription detaches the final morph of the base, identifies it, and only then attaches the potentiated affix (if allowed). Example (29) illustrates how criterial morphemic circumscription would handle re- verb nominalization:

\[
(29) \begin{array}{ll}
\text{UR} & \text{fill} \\
\text{Prefixation} & \text{refill} \\
\text{Morphemic circumscription} & <\text{re}> \text{fill} & \text{(criterion satisfied: stress-shifting nominalization}} \\
\text{Stress-shifting nominalization} & \text{réfill} & \text{re- present}} \\
\end{array}
\]

The stem refill is scanned for the presence of re-; having identified re-, stress-shifting nominalization can apply.

The apparent success of morphemic circumscription might seem to justify abandoning Bracket Erasure, with which it is strongly incompatible. However, the theory behind Morphemic Circumscription is subject to an interesting problem.

Inasmuch as it resembles criterial prosodic circumscriptio (McCarthy & Prince 1986, 1990, 1999), criterial morphemic circumscriptio should be expected to target material at the edge where the affix in question is attached. A suffix circumscribes material at the end of the stem, while a prefix circumscribes material at the beginning. Although not much has been said in the literature about this point, it is clear that such a restriction holds on criterial prosodic circumscription. Numerous cases exist of prex allomorphy sensitive to the base-initial segment, and of suffix allomorphy sensitive to the base-final segment. A useful example is the Turkish passive suffix: the allomorph -(1)n/ occurs with vowel- and [I]-final roots, while -(1)i/ is used elsewhere.\(^{12}\)

\[
(30) \begin{array}{ll}
\text{tekmele-n} & \text{'kick-passive'} \\
\text{buda-n} & \text{'prune-passive'} \\
\text{yjxkel-in} & \text{'raise-passive'} \\
\text{kal-um} & \text{'stay-passive'} \\
\text{dn-yl} & \text{'turn-passive'} \\
\text{bak-ul} & \text{'look-passive'} \\
\text{dolaj-ul} & \text{'wander-passive'} \\
\text{bedjer-il} & \text{'manage-passive'} \\
\end{array}
\]

Prosodic circumscription can account for this common type of allomorphy: the passive suffix circumscribes the base-final segment and decides on that basis which allomorph to use; if the proper conditions are met, it attaches to the whole stem. If not restricted to the edge of attachment, however, criterial prosodic circumscription will generate cases of prefixal allomorphy sensitive to the final segment of the base, and of suffixal allomorphy sensitive to the initial segment of the base. Since such flagrant violations of locality are not found in human languages, criterial circumscription must be restricted to the edge of attachment.

This argument is even more forceful in the light of McCarthy & Prince's (1994a) Generalized Alignment framework. Using alignment constraints instead of prosodic circumscription guarantees that affixes will be sensitive to phonological material at their edge of attachment, but not at the opposite edge.\(^{13}\) Similarly, if morphemic circumscription effects were to be handled by alignment, they too would be guaranteed to exhibit exclusive same-edge sensitivity.

Thus, if morphemic circumscription (or, even better, alignment) is the right way to deal with potentiation, we should not find cases where a suffix potentiates a prefix or vice versa. Unfortunately, there are convincing cases of suffixes potentiating prefixes in English. We have already discussed one: the case of -ment potentiating en-. These two affixes are not linearly adjacent.
But potentiation is not completely unconstrained: note that the layers in structure corresponding to en- and -ment are hierarchically adjacent.\textsuperscript{14} We conclude that while phonologically conditioned allomorphy (whether handled by prosodic circumscript or alignment) is subject to a same-edge (but not necessarily hierarchically local) restriction, morphologically conditioned effects (on phonology, on suppletion, or on morphological productivity) are subject to a hierarchical, not linear, locality principle. Morphologically conditioned effects may be sensitive to the outermost morpheme (construction) in a form, even when the phonological contribution of that morpheme is at the opposite edge. In sum, since morphological and phonological effects exhibit different kinds of behavior, they need not be handled by the same mechanism (circumscript or alignment).

The conclusion that “Morphemic Circumscript” effects are a matter not of linear order but of hierarchical constituent structure is in line with the contention of realizational morphologists (e.g. Anderson 1992; Aronoff 1976, 1994) that affixational morphology involves not morphemes but “morphological rules”, which correspond to Sign-Based Morphology’s constructions.

To see how reference to lexical types can deal with the potentiation of stress-shifting nominalization by the prefix re- in English, recall from section 3.2 that each morphological construction is a particular type in the lexical type hierarchy. Affixation constructions are of course also part of the type hierarchy. In (31), the type hierarchy of Koenig & Jurafsky (1994) is extended to include the type re-verb (with some irrelevant information omitted):

$$$(31)\quad \text{LEXEMES}$$$

- nouns
- verbs
  - agentic -er nouns
  - -ee nouns
  - re- verbs
    - absentee
    - payee
    - music
    - refill

A simplified constituent structure for the verb refill is given in (32):

$$$(32)\quad \text{re-verb}$$$

$$$
\text{SYNSEM} [\cat verb]$$$

$$$
\text{PHON} \text{ refill}$$$

$$$
\text{verb}$$$

$$$
\text{SYNSEM} [\cat verb]$$$

$$$
\text{PHON} \text{ fill}$$$

The productive stress-shifting nominalization construction specifies its daughter to be a re-verb, rather than the more general type verb:

$$$(33)\quad \text{stress-shifted noun}$$$

$$$
\text{SYNSEM} [\cat noun]$$$

$$$
\text{PHON} \phi(\overline{1})$$$

$$$
\text{re-verb}$$$

$$$
\text{SYNSEM} [\cat verb]$$$

$$$
\text{PHON} \overline{1}$$$

Like all morphological constructions, stress-shifting nominalization refers to the type of its daughter. This type reference identifies the structurally outermost morphological construction that has applied to the daughter. As the daughter is an affixed stem, this reference effectively identifies the outermost affix.

A similar account is possible for the other cases of potentiation described in this section. The construction that adds un- to adjectives specifies its daughter to be an -able adjective; -ation specifies its daughter to be an -ize verb.

In sum, the potentiation data we have seen, while inconsistent with Pesetsky's Bracket Erasure, are fully consistent with the Relativized Opacity Theorem. The identity of the outermost morpheme is referenced via the stem’s lexical type. The location of that morpheme is not, however, available, since phonological strings do not carry morphological breakdown information.
5. MORE ON ENGLISH POTENTIATION

In this section we discuss several types of potentiation discussed by Fabb (1988) in an influential paper on English affixation. Fabb observes that a number of English suffixes attach only to unsuffixed stems. Some (e.g., -hood) turn out to be suffixes traditionally assigned to Level 2 in Lexical Phonology (Kiparsky 1982), posing a challenge for Bracket Erasure. Fabb remarks:

... if any suffixation at level 1 was rendered invisible by bracketing erasure, then one of these Level 2 suffixes would not be able to distinguish between a word containing no suffix and a word containing a level 1 suffix, and so would not be able to obey the selectional restriction which is descriptively true of it (p. 538).

In this section, we show that reference to lexical types can handle all types of potentiation discussed by Fabb, who describes three classes of suffixes:

(34)  
- Freely attaching suffixes  
- Suffixes that only attach to an unsuffixed stem  
- Suffixes that only attach outside (and adjacent to) one other suffix

The first class requires no special treatment. Freely attaching suffixes (e.g., -able, -ness) simply specify the syntactic category and semantic features of their stem.

Type reference is required to handle the second and third classes. Suffixes that attach only to unsuffixed stems simply require the daughter node to be of type root, a valid class in any theory of morphology. Suffixes that attach outside other specific suffix(es) are similarly straightforward to represent. The knowledge that a particular suffix is present in a stem is captured in Sign-Based Morphology via reference to the lexical type of the stem. The type label of the stem is that of the construction that licenses the stem, which in effect tells us what the outermost affix in the stem is. Fabb offers the example of noun-forming -ary, which attaches only to stems ending in the suffix -ion. In type terminology, the noun construction specifies its daughter as an -ion noun.

It is thus clear that reference to lexical types can handle the known types of potentiation in English morphology. Reference to lexical types also successfully handles cases of "wrong-end" potentiation discussed in section 4, where a prefix potentiates a suffix or vice-versa. Fabb’s (1988) proposal that potentiation be handled by attaching a suffix to another to form a compound suffix does not extend to those cases. Nor does it help with the potentiation of stress-shifting nominalization by the prefix re- (section 4), since stress-shifting nominalization must apply to the whole word, not just the prefix. Reference to lexical types is thus empirically more adequate than Fabb’s proposal.

6. COPHONOLOGICAL ALLOMORPHY IN JAPANESE DEVERBAL NOUN ACCENTUATION

The preceding section dealt with cases in which the morphology needs to refer to the lexical type of a daughter node. This section introduces a case from Japanese where the phonology appears to require more access to word-internal structure than Bracket Erasure (2) permits. We argue that, like those in sections 4 and 5, this case also requires reference to types. In addition, it introduces the need to invoke cophonologies, briefly introduced in section 3.1.

Poser (1984) claims that Japanese deverbal noun accentuation poses a counterexample to Bracket Erasure (2) because a phonological rule applying to the output of nominalization needs to know that the input to nominalization was a compound. Poser handles these data by exceptionally suppressing Bracket Erasure, so that phonological rules applying to the output of nominalization can detect a compound boundary within the input stem.

We begin with a description, based on Poser (1984), of the accentuation of deverbal nouns formed from transitive verbs. If the verb is unaccented, so is the deverbal noun, as shown in (35):

(35)  
- Accentless verb (infinitive)  
  deverbal noun (no accent)  
  kari-ru ‘borrow’  
  nagusam-u ‘be diverted by’  
  utaga-u ‘doubt’

If the verb is accented, the deverbal noun bears a final accent, regardless of the location of the verb’s accent:

(36)  
- Accented verb (infinitive)  
  deverbal noun (final accent)  
  haji-ru ‘be ashamed’  
  hirakoi ‘shame’  
  iri ‘parch’

Let us refer to the cophonology that enforces this final accent pattern (see Orgun 1996b for an Optimality Theoretic analysis) as $\Phi_i$.

In contrast with what we have just seen, deverbal nouns formed from compound verbs are never accented, even when the input verb itself bears accent:

(37)  
- Compound verb (infinitive)  
  deverbal noun (no accent)  
  hikige-ru ‘pull up’  
  ii-a-u ‘quarrel’  
  oki-kae-ru ‘replace’
Poser argues that the rule accenting deverbal nouns must mention the compound boundary in its environment. This requires the compound boundary to be visible to the phonology.

If the Relativized Opacity Theorem is to be preserved, it is necessary to develop an alternative analysis of Japanese. There is also other motivation to look for an alternative analysis. A rule that deletes an accent when there is a morpheme boundary anywhere in the form is highly unnatural and inconsistent with locality conditions on phonological rules (Poser 1982, Odden 1994).

The solution we propose to Poser’s problem involves reference to types. Any grammar with a compounding construction must have a node in its type hierarchy that describes this construction. For example, the partial type hierarchy that Riehmann (1994) proposes for German includes the types compound and derived, as shown in (39). The type derived includes forms derived by affixation as well as by nonconcatenative morphology such as zero derivation, reduplication, and truncation. There is a subtype for each of these kinds of derivation.

The lexical type hierarchy for Japanese would contain similar types. The type that we need to refer to is compound verb, shown in (39) to inherit from the types compound and verb:

The Japanese deverbal noun construction has two subtypes. The general type is called deverbal noun. It does not specify a cophony. Deverbal noun has two subtypes. One of these subtypes applies to noncompound verbs and subscribes to cophony \( \varphi_1 \). The other subtype, which applies to compound verbs, subscribes to a different cophony, \( \varphi_2 \), which deletes any input accent. Note that it is empirically necessary to posit these two subtypes of deverbal nominalization, as two distinct phonological mappings are associated with them.

A description of the type de-noncompound-verbal noun is shown in (41):

The structure of deverbal nouns from compound verbs is shown in (42):

On this analysis there is no Bracket Erasure problem in Japanese deverbal noun accentuation. Reference to the lexical type of the input verb is sufficient to make the relevant morphological distinction. Moreover, the relevant lexical
type is available and needed for constructing the type hierarchy independently of Bracket Erasure effects. No additional ad hoc tools or mechanisms are used.

7. CONCLUSIONS

We have argued in this paper that Sign-Based Morphology allows a stricter approach to Bracket Erasure effects than was previously possible. It follows from the architecture of Sign-Based Morphology that the grammar can refer to the identity of the outermost affix or morphological construction in the constituent structure of a daughter node. Crucially, however, the locations of any boundaries associated with this affix or construction are invisible to the grammar (the Relativized Opacity Theorem). To derive the Relativized Opacity Theorem, we have used two basic and independently motivated mechanisms of Sign-Based Morphology: reference to lexical types and cophonologies.

(43) Reference to lexical types: English potentiation (§§4, 5)

Japanese nominalization (§4)

In (44), we show a list of phenomena examined in this paper that require reference to various types of information made available by Relativized Opacity.17

(44)

<table>
<thead>
<tr>
<th></th>
<th>a) Requires reference to the presence of an affix</th>
<th>b) Requires reference to the presence of a morphological construction</th>
<th>c) Requires reference to the location of internal boundaries</th>
</tr>
</thead>
<tbody>
<tr>
<td>English SSN</td>
<td>Japanese nominalization</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>English un-</td>
<td>Japanese nominalization</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>English -ment</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The new generalization captured by the Relativized Opacity Theorem escaped detection in previous theories in which grammar must access morphological structure through labeled brackets, which also mark morph boundaries within phonological strings. Sign-Based Morphology, by contrast, marks no morphological breakdown information within phonological strings, this task being taken over completely by the constituent structure. This architecture allows an important generalization, previously overlooked, to emerge: the identity but not the location of the outermost morpheme or morphological construction (in terms of constituent structure) in a stem is accessible to the grammar.

NOTES

1 We are grateful to Larry Hyman, Paul Kiparsky, Steven Lapointe, Edward Flemming, Arto Anttila, Rich Rhodes, Charles Fillmore, Thomas Shannon, Paul Kay, David Perlmutter, Jaye Padgett, Andrew Dolbey, and Steven Bird for comments on this work.

2 All transcriptions in this paper are in IPA, except for English data presented in English orthography with stress marked by acute and grave accents, and Japanese accent, marked by an apostrophe. For Turkish underlying forms, following the tradition in Turkish linguistics, we use capital letters to represent vowels that undergo harmony and consonants that undergo voicing alternations.

3 There do exist cases of so-called dominant affixes which trigger stress deletion and allow default rules to place stress, usually on an initial or final syllable (see, for example, Kiparsky 1984; Halle & Vergnaud 1987a,b; Inkelas 1996; Alderete 1999). This situation differs, however, from the hypothetical example here in not requiring reference to internal morpheme boundaries.

4 Negative alignment constraints are equivalent to positive alignment constraints that refer to the complement category.

5 Note that the alignment constraints in this analysis must be violated categorically as in McCarthy & Prince’s (1994b) analysis of Makassarese, Prince & Smolensky’s (1993) Nornality and Orgun’s (1994) NoAlign. Zoll (1996), who presents an extensive discussion of categorical versus gradient alignment constraints, uses the term Coincide for the former and Align for the latter. We continue using the traditional term Align here. Thus the NoAlign constraint in (8) is violated just in case alignment holds.

6 We discuss a phonological challenge to Bracket Erasure in section 6.

7 The relevant apparatus in Optimality Theory would be morpheme-specific constraints or constraint rankings; see, e.g., Kirchner (1993), Alderete (1999). Inkelas, Orgun & Zoll (1997) critique such approaches as being descriptively inadequate.

8 Strictly speaking, the type label of this noun should be non-payer, since this word is a subtype of non-noun, and must have its own type label. Reference to lexical types still works, however, since a construction that requires a particular type will also accept all subtypes of that type. For example, a construction that specifies its daughter node as type verb will apply to all subtypes of verb, e.g., transitive, intransitive, ditransitive, etc.

9 One may wonder whether it is possible to sneak in deeply embedded category information by elaborating type labels. We propose in section 3.4 a criterion that prohibits such information smuggling.

10 Because this construction is unproductive, it is not always clear for the pairs in (24) whether the noun is derived from the verb or vice versa. It could be that some of the verbs in (24) are derived via a stress-deleting verbalization construction from the corresponding nouns; it is also possible, in the spirit of paradigmatic approaches to morphology (e.g., Bochner 1993), that the grammar allows for related noun-verb pairs without specifying the directionality of derivation.
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Morphological and syntactic paradigms: Arguments for a theory of paradigm linkage*

GREGORY T. STUMP

1. TWO PERSPECTIVES ON PARADIGMS

A paradigm is a set of cells; each such cell is the pairing of a word form with the set of morphosyntactic properties which that word form realizes. Thus, the paradigm of the Latin noun AMICUS "friend" is the set of cells in (1).

(1) Paradigm of Latin AMICUS 'friend'

\[
\begin{align*}
\langle \text{amicus}, \text{[masc nom sg]} \rangle & \rightarrow \langle \text{amicī}, \text{[masc nom pl]} \rangle \\
\langle \text{amicēs}, \text{[masc voc pl]} \rangle & \rightarrow \langle \text{amicūrī, [masc voc sg]} \rangle \\
\langle \text{amicīs, [masc gen sg]} \rangle & \rightarrow \langle \text{amicōrum, [masc gen pl]} \rangle \\
\langle \text{amicōs, [masc dat sg]} \rangle & \rightarrow \langle \text{amicōs, [masc dat pl]} \rangle \\
\langle \text{amicūs, [masc acc sg]} \rangle & \rightarrow \langle \text{amicūs, [masc acc pl]} \rangle \\
\langle \text{amicōs, [masc abl sg]} \rangle & \rightarrow \langle \text{amicōs, [masc abl pl]} \rangle
\end{align*}
\]

Paradigms can be seen as participating in the definition of two different grammatical domains. On the one hand, paradigms are objects defined by a grammar's morphological component: the paradigm of a root $R$ is the inventory of cells that can be projected from $R$ in inferential-realizational theories of inflection (such as that of Matthews (1972), Zwicky (1983), Anderson (1992), Aronoff (1994), Stump (2001), and others), the cells in $R$'s paradigm are deduced from $R$ by means of a set of realization rules. Thus, in the morphology of Latin, the paradigm in (1) is the inventory of cells projected from the second-declension root amīc by means of realization rules such as those in (2). Seen as the output of the morphology of Latin, (1) can be characterized as a MORPHOLOGICAL PARADIGM.

(2) Some Latin morphological rules

a. Stem-formation rule:

Where root $R$ is a second-declension nominal, $R$'s thematized stem is $R-u$

b. Realization rules: Where $X$ is the thematized stem of a second-declension root $R$ and $R$ is an adjective or masculine noun,

i. the [masc nom sg] cell in $R$'s paradigm is $\langle Xs,[masc nom sg]\rangle$

ii. the [masc voc sg] cell in $R$'s paradigm is $\langle Re,[masc voc sg]\rangle$

In the syntactic domain, paradigms enter into the definition of phrasal