

ON THE STATUS OF *STEMS* IN MORPHOLOGICAL THEORY*

DAVID EMBICK AND MORRIS HALLE

University of Pennsylvania and MIT

1 Introduction

To a first approximation, languages show two different types of morphological alternation, with ‘alternation’ construed in a broad sense. One type is concatenative, involving what looks like the affixation of one piece to another; e.g. *kick/kick-ed*. Another type of alternation involves morphophonological alternations of the type seen in *sing/sang*. One of the primary tasks of morphological theory is to provide an analysis of such alternations, and to situate them with respect to other parts of the grammar, especially syntax and phonology. Here we examine alternations that have been used in arguments that grammar must contain the ‘stem’ as a privileged object. We argue that the move to stems is both unmotivated and problematic, points that we illustrate in a number of case studies, including a discussion of the verbal morphology of Classical Latin.

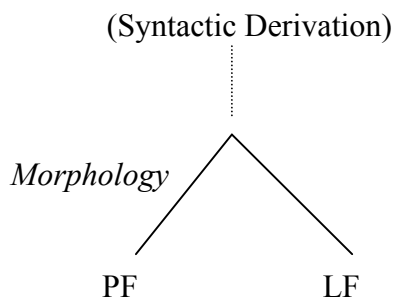
The theory of Distributed Morphology (Halle and Marantz 1993, Harley and Noyer 1999, Embick and Halle (forthcoming)) advances a piece-based view of word formation, in which the syntax/morphology interface is as transparent as possible. Distributed Morphology posits that there are two types of primitive elements in the grammar that serve as the terminals of the syntactic derivation, and, accordingly, as the primitives of word formation. These two types of terminals correspond to the standard distinction between *functional* and *lexical* categories (for more details on the view adopted here see Embick and Halle (forthcoming)):

* Aspects of our analysis of the Latin conjugation were presented at Going Romance 2003, and we would like to thank both the organizers of the conference and the conference participants. For comments on a draft version of the material presented here we are indebted to Alec Marantz, Rolf Noyer, Marjorie Pak, and Don Ringe.

- (1) a. **Abstract Morphemes:** These are composed exclusively of non-phonetic features, such as [past] or [pl], or features that make up the determiner node D of the English definite article *the*.
- b. **Roots:** These make up the open-class vocabulary. They include items such as $\sqrt{\text{CAT}}$, $\sqrt{\text{OX}}$, or $\sqrt{\text{SIT}}$, which are sequences of complexes of phonetic features, along with abstract indices (to distinguish homophones) and other diacritics (e.g. class features).

Distributed Morphology conceives of the architecture of the grammar as sketched in (2), in which *morphology* refers to a sequence of operations that apply during the PF derivation, operations that apply to the output of the syntactic derivation. This theory is in its essence a syntactic theory of morphology, where the basic building blocks of both syntax and morphology are the primitives in (1). There is no *Lexicon* distinct from the syntax where word formation takes place; rather, the default case is one in which morphological structure simply is syntactic structure.¹

(2) The Grammar



The derivation of all forms takes place in accordance with the architecture in (2). Roots and abstract morphemes are combined into larger syntactic objects, which are moved when necessary (Merge, Move). In the simplest case, PF rules linearize the hierarchical structure generated by the syntax, and add phonological material to the abstract morphemes in a process called *Vocabulary Insertion*. During Vocabulary Insertion, individual *Vocabulary Items*—rules that pair a phonological *exponent* with a morphosyntactic context—are consulted, and the most specific

¹ For explicit discussion of the non-Lexicalist aspect of this theory, see Marantz (1997) and Embick and Halle (forthcoming).

rule that can apply to an abstract morpheme applies. Abstract morphemes are thus said to be *spelled out* during Vocabulary Insertion.² To take a specific example of Vocabulary Insertion, the Vocabulary Item inserting the phonological form of the English regular past tense is as follows:

(3) T[past] \square -d

The effect of this rule is to add the exponent /d/ to a T(ense) node containing the feature [past]. Some Vocabulary Items make reference to items in the environment in the head being spelled out in this way. So, for instance, the exponents $-t$ and $-\emptyset$ also appear in the English past tense; the Vocabulary Items that insert these exponents make reference to specific lists of verbs, as illustrated in (4):

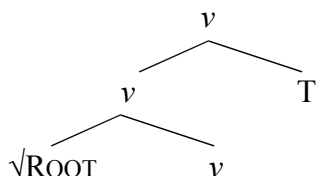
(4) T[past] \square $-t/\{\text{LEAVE, BEND, BUY...}\}$ + _____ (List 1)
 T[past] \square $-\emptyset/\{\text{HIT, SING, SIT...}\}$ + _____ (List 2)

These rules, which are more specific than the rule in (3), apply whenever a Root from List1 or List2 is in the same complex head as T[past]. Since in Vocabulary Insertion a more specific rule takes precedence over a rule that is less specific, the rules in (4) apply before (3), which has no contextual condition on its application and therefore functions as default for T[past].

Vocabulary Items like those in (3) and (4) are rules that apply to abstract morphemes and supply phonetic features to them. The abstract morphemes are terminal nodes that appear in syntactic structures. In the case of the English past tense, the standard analysis is that the syntax generates a structure in which the verb (*v*-Root complex) is separate from Tense (i.e. there is no ‘verb raising’ to Tense in English). At PF, a *Lowering* operation combines Tense and *v*-Root into a single complex head (for a discussion of this operation see Embick and Noyer 2001):

² In special cases, PF rules manipulate the syntactic structure in sharply constrained ways. Crucially, these processes are triggered by language-specific well-formedness conditions, and do not constitute a generative system. Rather, the only generative system in the grammar is the syntax.

(5) Complex head



The Lowering process that derives the complex head in (5) applies prior to Vocabulary Insertion. When Vocabulary Insertion applies at T, all of the information that is required for the spell-out of this abstract morpheme is localized in (5).

A common occurrence in morphology is *syncretism*, a situation where several abstract morphemes have the same phonetic exponent. A typical example IS the Person/Number prefixes for subject and object in the Athabaskan language Hupa (Golla 1970):

(6) Hupa Subject/Object Markers

	Subject	Object
1SG	W-	Wi-
2SG	n-	ni-
1PL	di-	noh-
2PL	oh-	noh -

As shown in (6) in Hupa there are distinct exponents for 1PL and 2PL Subject, but only a single exponent for 1PL and 2PL Object.

An important reason for the separation of morphology from syntax and semantics in Distributed Morphology (and realizational theories of morphology in general) is that this provides a means for capturing syncretisms in a systematic fashion. In particular, it is assumed that in the syntax of Hupa these prefixes are supplied with their entire complement of grammatical features as illustrated in (7) (in addition to 1, 2 and PL, we assume features for SUBJ and OBJ):

- (7) a. 1, +PL, SUBJ
 b. 2, +PL, SUBJ

- c. 1, +PL, OBJ
- d. 2, +PL, OBJ
- etc.

As noted above, these four morphologically distinct forms correspond to only three phonetically distinct strings. We account for this fact by positing the three Vocabulary Items in (8).

- | | | | |
|--------|--------------|---|-----|
| (8) a. | 1, +PL, SUBJ | □ | di |
| b. | 2, +PL, SUBJ | □ | oh |
| c. | +PL, OBJ | □ | noh |

While in (8a,b) all three features on the left of the Vocabulary Item match features in the morpheme into which they are inserted, this is not the case for Vocabulary Item (8c): the exponent *noh-* is inserted into the morphemes (7c,d) even though the Vocabulary Item (8c) matches only two of the three features specified in (7c,d), and it is this fact that gives rise to the syncretism of these two morphemes. The converse, however, does not hold; an exponent is not inserted into a morpheme in cases where the Vocabulary Item includes features that are absent in the morpheme. We express these facts formally by positing that Vocabulary Insertion is subject to the Subset Principle (9) (Halle 1997):

- (9) The phonological exponent of a Vocabulary Item is inserted into a morpheme of the terminal string if the item matches all or only a subset of the grammatical features specified in the terminal morpheme. Insertion does not take place if the Vocabulary Item contains features not present in the morpheme. Where several Vocabulary Items meet the conditions for insertion, the item matching the greatest number of features in the terminal morpheme must apply.

It is by virtue of the Subset Principle (9) that (8c) is inserted into both (7c) and (7d). The fact that 1PL OBJ and 2PL OBJ are non-distinct is systematic on this account, with the syncretism being captured via the single underspecified Vocabulary Item (8c).

We note that Vocabulary Insertion only applies to abstract morphemes; Roots are not subject to insertion. A consequence of this view is that it is not

possible for Roots to show *suppletion*. Contextual allomorphy of abstract heads of the type found with the *-ed*, *-t*, \emptyset realizations of T[past] in English is, effectively, suppletion: the same abstract morpheme is expressed by phonologically unrelated exponents. The formal means by which these patterns are stated is Vocabulary Insertion. Since Roots are not subject to insertion in the first place, they cannot supplete. We assume that apparent cases of Root suppletion involve members of the functional vocabulary (e.g. *go/went*, is a light-verb; see Marantz (1995) and Embick and Halle (forthcoming) for discussion), although other treatments are possible as well.

The rules in (3-4) specify how the abstract morpheme T[past] is instantiated phonologically in structures like (5) in English. However, these rules specify only a subpart of the morphological alternations seen in the English past tense. In addition to the Vocabulary Items required for T[past], the English past tense requires a number of further rules that alter the phonology of the Root, as in the case of the past tense form *sang- \emptyset* . Such rules are called *Readjustment Rules*. Readjustment Rules are phonological rules that effect changes in a given morphosyntactic context and that typically include lists of Roots that undergo or trigger these changes. In the case of *sang- \emptyset* , the rule in question is one that makes reference to the morphosyntactic feature [past] and the Root list X:

- (10) /I/ \square /æ/ /X_____Y [past],
 X= SING, RING, SINK, BEGIN, SIT, ...

Readjustment Rules like (10) do not block Vocabulary Insertion rules (or vice versa) in the way that the insertion of e.g. *-t* at T[past] blocks the insertion of *-ed*. This fact is clear from the existence of such ‘doubly-marked’ forms as *tol-d* or *froz-en*; in cases of this type, Vocabulary Insertion inserts overt exponents into abstract morphemes, while Readjustment Rules apply as well to alter the phonology of the Root.³ Of course, in some forms there is no Readjustment, e.g. *beat/beat-en* etc..

A further point is that Readjustment Rules like (10) may be limited in scope, in some cases only applying to a handful of listed Roots. However, the very nature of the readjustments is such that no generalizations are lost in this treatment.

³ In the English cases in question it is the phonology of the Root (and not the form of the exponent inserted by Vocabulary Insertion) that is affected by the Readjustment Rule. In principle, nothing prevents such rules from applying to exponents.

It is simply a fact that certain morphemes undergo phonological changes in certain environments, and all approaches must list which forms are subject to these rules in particular environments, and state what the rules are. Our treatment, which relies on Roots with underlying phonological forms and the operation of Readjustment Rules, treats these patterns in a way that allows for strong syntax/morphology connections to be maintained. That is, stem changing is analyzed in a way that accounts for the facts, and that does the least damage to the general claim that sound/meaning correspondences should be predictable in derivationally related forms. The same cannot be said of treatments that appeal to the storage of stems to account for such patterns, a point we revisit in §3.⁴

Readjustment Rules are phonological rules; their distinguishing property is that they are conditioned by both morphosyntactic and Root-specific information. For instance, the rule that changes the nucleus of *sing* to /æ/ makes reference both to the presence of the feature [past] and to the identity of the Root (e.g. √SING and not √HIT; also *bit/bit*, *sit/sat*, and so on). In this way, Readjustment Rules differ from other rules of the phonology that require no reference to morphosyntactic environments, and are not accompanied by lists of Roots that undergo or trigger the rules. For example, the rule of regressive devoicing that applies in past tense forms when the exponent *-t* appears— e.g. *leave/lef-t*, or *lose/los-t*— is a ‘normal’ phonological rule, and not a Readjustment Rule.

Like Vocabulary Items, Readjustment Rules are underspecified with respect to the syntactico-semantic environment in which they apply. It appears to be the case that they are even broader in their distribution; Readjustment Rules are unlike Vocabulary Items in that they allow heterogeneous sets of environments to condition their application.⁵ One clear example of this type of underspecification is found in the phenomenon of *Umlaut* in German (see e.g. Wiese 1996). The Umlaut process, which is represented orthographically in the familiar way, relates the following pairs of vowels:

⁴ The fact that irregular forms behave differently from regular forms for the purposes of some psycho- and neurolinguistic tests is sometimes taken to indicate that irregular forms must be stored as a whole, an interpretation which our approach rejects; see Embick and Marantz (2000) for some comments.

⁵ This observation follows in some ways proposals made by Lieber (1981); see below.

(11)	Umlaut		
	Vowels		Examples
	/u:/	/y:/	Huhn, Hühn-er
	/ʊ/	/ʏ/	dumm, dümm-lich
	/o:/	/ø:/	hoch, höch-st
	/ɔ/	/œ/	Holz, hölz-ern
	/a:/	/ɛ:/	Europa, europä-isch
	/a/	/ɛ/	Stand, ständ-ig
	/aʊ/	/ɔʏ/	sauf, Säuf-er

As discussed by Wiese (1996), the process of umlaut is a fronting process, with some additional complications that we disregard here.

We take it that Umlauting is accomplished via a Readjustment Rule. The important point for our purposes concerns the environments in which this Readjustment Rule is triggered. The rule makes reference both to morphosyntactic features and to the identity of particular Roots. Moreover, the morphosyntactic environments in which Umlaut applies are not a natural class; rather, they must be listed (see Wurzel 1970). A subset of these environments is given in (12):

- (12) Umlaut: Morphosyntactic Environments (Not Exhaustive)
- a. Verb forms: fahr-en ‘drive’ Inf, fährt 3s Pres.
 - b. Noun Plurals: Huhn ‘hen’, Hühn-er ‘hens’
 - c. Diminutives: Vater ‘father’; Väter-chen ‘father-DIM’
 - d. Adjective Formation: Europa ‘Europe’, europä-isch ‘European’
 - e. Comparatives: lang ‘long’, läng-er ‘longer’

In addition, it is also the case that a Root that undergoes Umlaut in one of these environments may or may not be subject to this process in another environment. This fact must evidently be listed; some examples are given in (13) (cf. Wiese (1996:188)):

- (13) back(-en), Bäck-er; fahr(-en), Fahr-er; fahr-en, fährt
Maus, Mäus-e, maus-en; Luft, lüft-en

These examples show that while *FAHR* undergoes Umlaut in the verbal environment, this rule does not apply in the agentive nominalization for that particular Root, although it does for other Roots like *BACK*; the situation is similar for *MAUS*.

In terms of the process responsible for this type of readjustment, the grammar contains a single phonological rule:⁶

(14) **Umlaut Rule:** V □ [-back]

The important fact about this rule is that in addition to the phonological conditions on its application, it requires reference both to a host of morphosyntactic environments, and to a list of the particular Roots subject to the rule in each environment.

As is clear from the discussion above, a Readjustment Rule like Umlaut may be triggered in a number of distinct syntactico-semantic environments, while at the same time being a single rule of the grammar. In this way Readjustment Rules can potentially show distributions that are much broader than those found with exponents inserted by Vocabulary Insertion. This difference between Readjustment and Vocabulary Insertion parallels proposals made by Lieber (1980:311sq). In the context of an architecture that differs significantly from that assumed here, Lieber argues for the conclusion that Readjustments like Umlaut (for her, ‘string dependent’ rules) differ fundamentally from ‘lexical’ morphological processes, i.e. those involving discrete pieces. As Lieber notes, the relevant distinctions are difficult to make in ‘pieceless’ theories of morphology, a point to which we return below.

In the discussion above, we have made reference to (i) the underlying forms of Roots; (ii) the Vocabulary Items, rules that add phonological material to abstract morphemes; and (iii) the Readjustment Rules, morphosyntactically conditioned phonological rules. Both types of rules in (ii) and (iii) may be underspecified with respect to the syntactico-semantic context in which they apply. Beyond this, there are no *stems* listed as phonological instantiations of a Root.⁷ Rather, any particular phonological form of a Root, such as *broke* for *BREAK*, exists only as the output of a derivation of the type above; forms like *broke* do not

⁶ Something in addition must be said about *a/ä*.

⁷ As discussed below, the absence of stems is one of the essential features that distinguishes our approach from others.

appear on any list. Roots appear in syntactic structures with abstract morphemes. The latter receive phonological form through the process of Vocabulary Insertion, in which (potentially underspecified) Vocabulary Items pair phonological exponents with conditions on insertion. Readjustment Rules apply in specific contexts to alter phonological forms in a way that is distinct from Vocabulary Insertion. Such rules are specified in the grammar to apply only in certain environments; apparently these environments may be simply listed. These mechanisms constitute a departure from the ideal type of syntax/morphology interaction, by introducing a distinction between morphophonology and syntax/semantics. Accepting this type of distinction amounts to accepting a version of the *Separation Hypothesis* (cf. Beard 1995). While our approach acknowledges the need for Separation, it seeks to constrain syntax/morphology mismatches to the fullest possible extent.

2. *The Verbal Inflection of Latin*

In traditional accounts of Latin grammar (of the kind commonly presented in introductory classes of Latin) students are required to memorize the so-called principal parts of each verb illustrated in (15).⁸

(15)

	‘Present’	‘Perfect’	‘Supine’	Trans.
a.	laud-ā-mus	laud-ā-v-i-mus	laud-ā-t-um	‘praise’
b.	scrib-i-mus	scrip-s-i-mus	scrip-t-um	‘write’
c.	tang-i-mus	tetig-i-mus	tāc-t-um	‘touch’
d.	ag-i-mus	ēg-i-mus	āc-t-um	‘act’
e.	fer-i-mus	tul-i-mus	lā-t-um	‘bear’

It is obvious that the forms (15e) differ fundamentally from those in (15a-d), in that in (15e) the portions of the word to the left of the first hyphen in the three principal parts are phonetically unrelated. There is no set of phonological rules that

⁸ Traditionally students are taught to commit to memory the first person singular forms of the present and perfect. We have replaced these here with the first person plural forms, because this allows us to side-step a number of phonological issues (e.g., vowel deletion) that have no bearing on the matters under discussion here.

can plausibly relate the stems in (15e) to one another. By contrast, the stems in (15a-d) are readily related by phonological rules.

In traditional grammars this fact is noted only terminologically, i.e., by referring to verbs of the type (15e) as *suppletive*. It has been observed that suppletive verbs (as well as adjectives and nouns) constitute but a vanishingly small portion of the total vocabulary of the language, and that semantically these verbs express very elementary notions. Suppletive verbs in the languages of the world have meanings such as ‘be’, ‘go’, ‘bear’, etc., but not ‘grind’, ‘withstand’, ‘animadvert’. We take it that these cases involve light-verbs, i.e. members of the functional vocabulary. Like other abstract morphemes, these morphemes obtain their phonetic features by Vocabulary Insertion. In particular, for (15e) there are three distinct Vocabulary Items, each of which applies in a different morphological environment: *tul-* in finite forms of the perfect; *lā-* in (certain) participial forms, and *fer-* elsewhere.

The majority of Latin verb forms have the structure shown in (16) where the Root is followed by a theme vowel (at least in the present tenses). We take it that theme vowels are exponents inserted into Theme positions, henceforth TH, and that the TH positions are added to the syntactic structure at PF in particular structural configurations. The addition of TH nodes is in accordance with well-formedness requirements of Latin.

TH nodes are *dissociated* nodes that are not present in the syntactic part of the derivation (see Embick 1997 for discussion of nodes of this type). Rather, they are added to *v* (and other functional heads) at PF (for related proposals concerning themes, see Oltra 1999 and Arregi 1999). For example, in an Imperfect like *laudā-bā-mus* ‘we were praising’, the Root combines with the syntactic heads *v* and T[Past] via head-movement to form a complex head (16a). At PF, a TH node is added to *v*:⁹

⁹ The *-ā-* component following the Tense exponent *-b-* in Imperfects like *laudābāmus* is also a theme, so that the full morphological structure for this example is

- (i) Morphological Structure: [[[Root [v TH]] [T[past] TH]]]

See also Oltra (1999) and Arregi (1999) for this type of approach; similar proposals appear in Aronoff (1994) as well as Williams (1981).

- (16) a. Syntactic Structure: [[Root v] T[past]]
 b. Morphological Structure: [[Root [v TH]] [T[past]]]

Membership in one of the conjugation classes is an arbitrary property of the Roots that appear in the Latin verbal system. The simplest implementation of this fact involves specifying each Root for a diacritic feature that encodes membership in a specific class:¹⁰

$$(17) \quad \sqrt{\text{AUD}}_{[\text{IV}]}$$

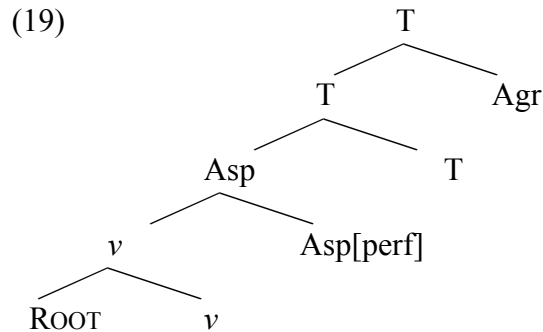
The TH node acquires the Conjugation Class feature of the Root via a Concord process (18a); the TH node is subsequently spelled out with one of the theme vowels by the Vocabulary Items in (18b):

- (18) a. TH \square TH[X]/ $\sqrt{\text{ROOT}}_{[\text{X}]}$ _____
- b.
- | | | |
|------------|-----------|-----|
| TH[I] | \square | -ā- |
| TH[II] | \square | -ē- |
| TH[III] | \square | -i- |
| TH[III(i)] | \square | -i- |
| TH[IV] | \square | -ī- |

We take it that the small number of ‘athematic’ verbs like *esse* possess a diacritic that triggers deletion of the TH node (see below).

The Latin Perfect tenses are of particular interest here because they exhibit more allomorphy than the non-Perfect tenses. Moreover, the theme vowel found in the non-Perfect tenses does not always appear in the Perfect tense. We assume that that Perfect forms have the syntactic structure (19), where the head Asp[perf] is the locus of the aspectual semantics of the perfect ‘tenses’:

¹⁰ We use the label III(i) to refer to verbs like *capiō* which are treated in traditional accounts as being somewhere in between Conjugations III and IV. For the treatment of the theme in Conjugation III as *-i-* see Embick and Halle (forthcoming).



With respect to form, the most regular is the behavior of verbs of Conjugation I and IV, which typically show the theme vowel (\bar{a}/\bar{i} respectively) and a $-v-$ exponent of Asp[perfect] (cf. (20a)). But even these conjugations include a number of exceptional cases. As illustrated in (20b,c), there are verbs of Conjugation I and IV that have no theme in the Perfect (we follow the traditional practice of representing the Root-attached $-v-$ exponent of Asp[perf] as $-u-$ orthographically):

(20)

	Present	Perfect	Trans.
a.	laud- \bar{a} -mus aud- \bar{i} -mus	laud- \bar{a} -v-i-mus aud- \bar{i} -v-i-mus	‘praise’ ‘hear’
b.	crep- \bar{a} -mus cub- \bar{a} -mus sec- \bar{a} -mus	crep-u-i-mus cub-u-i-mus sec-u-i-mus	‘rattle’ ‘lie’ ‘cut’
c.	aper-i-mus oper- \bar{i} -mus sal- \bar{i} -mus	aper-u-i-mus oper-u-i-mus sal-u-i-mus	‘open’ ‘cover’ ‘leap’

The Perfect exponent in all these forms is v (followed by i), and as shown in (20a) the Perfect exponent commonly appears directly after the Theme following the verb Root. By contrast in the Perfect forms in (20b,c) the Theme is absent and the suffix $-v-$ appears directly after the verb Root. We shall account for the Perfect

forms in (20b,c) by positing an Impoverishment rule which deletes the TH position on the head v with these verbs in the Perfect:¹¹

(21) TH \square \emptyset /LIST v ____Asp[perf]

LIST = { CREP, CUB, SEC,...}

The effect of this rule is to make these verbs athematic in the Perfect; they have no TH position.

The verbs without a TH position in the Perfect are unusual in Conjugations I and IV, but they are the standard case in Conjugations II and III (as well as for III(i) verbs like *capiō*). In fact, in Conjugation II except for the six listed in (22a), where the /ē/ Theme appears in the Perfect, none of the other verbs has a theme vowel in the Perfect as illustrated in (22b-e).

(22) Perfect forms: Conjugation II

- a. dē-l-ē-v-i-mus ‘destroy’
ol-ē-v-i-mus ‘grow’
fl-ē-v-i-mus ‘weep’
pl-ē-v-i-mus ‘fill’
n-ē-v-imus ‘spin’
vi-ē-v-i-mus ‘plait’
- b. mon-u-i-mus ‘remind’
sorb-u-i-mus ‘suck up’
- c. aug-s-i-mus ‘grow’ (trans)
fulg-s-i-mus ‘glow’
- d. prand-i-mus ‘breakfast’
strid-i-mus ‘screech’
- e. to-tond-i-mus ‘shear’ (pres. tond-ē-mus)
mo-mord-i-mus ‘bite’ (pres. mord-ē-mus)

Regarding the forms in (22a), it has been argued that these Roots share a common property— they would all fail to be minimally CV without the -ē-. For this reason,

¹¹ It would also be possible to hold that the TH position simply is not assigned under the relevant conditions.

it has been argued that these verbs are not exceptions to the pattern according to which Conjugation II verbs are athematic in the Perfect; rather, the *-ē-* is part of the phonology of the Root, not a theme vowel (cf. Ernout 1952/1989:143sq; also Aronoff 1994:48). Thus it can be concluded that Conjugation II verbs are always athematic in the Perfect. Similarly, the *-i-* and *-i-* theme vowels of Conjugations III and III(i) are never found in Perfect forms; these conjugations can be treated as uniformly athematic as well. This requires a simple extension of the LIST in the rule in (21) above:

(23) TH □ Ø/LIST v ____Asp[perf]

LIST = {[II],[III],[III(i)], CREP, CUB, SEC,...}

The environment for this rule is a list that includes both individual Roots and diacritic conjugation features. This is necessary since the conjugations II, III, and III(i) do not form a natural class in terms of e.g. the phonology of their theme vowel; listing is the only option.

The examples (22b-e) illustrate not only the absence of Theme vowel /*ē*/ in the Perfect tense, but also the fact that not all Conjugation II verbs form the Perfect with the suffix *-v-*. In fact, this is true only of the verbs in (22a,b). The verbs in (22c) form the Perfect with the suffix *-s-*, whereas those in (22d,e) take the suffix *-Ø*. Each of these Asp[perf] exponents is followed by the vowel *-i-*, which we take to be the realization of a TH position attached to Asp[perf]. A complete account of the Latin conjugation must, of course, deal properly with all five types of Perfect forms illustrated in (22). (See Embick and Halle (forthcoming)).

The Perfect exponents are dependents of the ASP head, and, as we have just seen, it has the exponents *-v-*, *-s-*, and *-Ø-*. Moreover, (i) all three exponents of the Perfect are followed by the suffix *-i-*, (ii) the exponent *-v-* appears in the overwhelming majority of verbs, and (iii) in certain cases the phonology of the Root undergoes changes of various kinds. We discuss each of these three facts in turn.

As noted above, in Latin verb forms, Themes are inserted not only after Roots (i.e. after *v*); but also after Tense nodes and after the Asp[perf] node. The Perfect theme is *-i-*, i.e., identical with that of Conjugation III Roots. The three exponents of the Perfect have now the shapes shown in (24), which brings together these observations:

- (24) Asp[perf] □ -s- in env. List1 _____ T
 List 1 = { AUG, FULG, DĪC, SCRĪB ... }
- Ø- in env. List2 _____ T
 List2 = { PRAND, STRĪD, TOND, MORD, ... }
- v- elsewhere

Of the three Perfect exponents, -v- is by far the most common, and it also occurs in both thematic and athematic perfects. We therefore assume that it is the elsewhere case, whereas each of the other two exponents appears after its own list of Roots.

In (22e) the forms of the Roots in the Perfect differ from those of the Present (and other non-Perfect tenses). We propose to account for these differences by means of Readjustment rules, which apply to listed items in the Perfect; in this particular case, the Readjustment rule effects reduplication. The Readjustment rules here function exactly like those responsible for English Root ablaut as in *sing/sang-Ø*, *buy/bough-t*, and *tell/tol-d*. (For details of Root ablaut in English, see Halle and Mohanan 1985, and in Latin, Embick and Halle (forthcoming)).¹²

3. *Stems*

The Distributed Morphology approach sketched above makes a fundamental distinction between abstract morphemes, which, as noted, lack phonetic exponents, and Roots (concrete morphemes), which have an underlying phonological form. The distinction between abstract morphemes and Roots is further marked by the important fact that the phonetic exponents of morphemes may be subject to phonological Readjustment Rules. These rules have the limited expressive power of phonological rules. (They differ from the rules of the phonology in being ordered in a block separate from the latter.) Readjustment Rules can therefore not be employed to relate phonetic exponents of radically

¹² In (24) and other cases, we have simply listed the Roots referred to by Vocabulary Items, or Readjustment Rules. It should be noted that there might very well be internal structure to such lists, structure that is relevant for learnability or acquisition (e.g. “neighborhood effects”; see Albright and Hayes (2002) and Yang (2002) for perspectives on this question). Our point is that this structure is irrelevant to the working of the grammar per se; see Embick and Marantz (forthcoming) for some comments.

different shapes. The only way of dealing with suppletive morphemes is by Vocabulary Insertion (recall our discussion of contextual allomorphy above).

A significant difference between Distributed Morphology and other approaches is the answer that the respective theories offer to the question as to whether a particular morpheme such as Past Tense or Plural, that has to be recognized as a head in the syntax, can be expressed phonologically by nothing more than a phonetic modification of the Root to which it attaches in the syntax. An affirmative answer runs into immediate difficulties with forms such *tol-d* and *sol-d*, on the one hand, where the Past tense suffix /d/ is accompanied by Root alternations, and, on the other hand, by Past forms such *put* or *hit*, where the Past tense is signaled by neither Root alternation, nor by the presence of a distinct suffix. This point is especially relevant in view of Anderson's (1992) 'amorphous' approach, in which no distinction is made between affixation and readjustment; rather, all morphological alternations are the result of rules that rewrite the phonology of the stem.

A further important difference between Distributed Morphology and other approaches concerns *stems*, which have no place in Distributed Morphology. Theories that posit multiple stems for a single underlying item (typically referred to as the *lexeme* in such approaches) are faced with the questions of how a set of such stems is represented, and how a particular stem is selected in a particular context.¹³ Recognizing this issue, Anderson (1992) attempts to answer these questions with reference to the notion of *lexical stem set*.¹⁴

A lexical stem set S is a group of phonologically distinct stems {S1, S2, ...} with the same syntactic requirements and semantic interpretation, each associated with its own (partial) set of morphosyntactic properties. (1992:133)

Thus with SING, for example, the lexeme contains a stem set that lists particular phonological stems, along with the contexts in which they appear:

¹³ There are also further questions for such approaches, such as the question of whether or not a particular stem is derived from an underlying form, or from another stem. These questions need not concern us here, although they are touched on to some extent in our discussion of the Latin 'third stem' below.

¹⁴ Anderson's approach to stems is also discussed in Halle and Marantz (1993) and Embick and Halle (forthcoming).

(25) Stems of SING

sing	+V
sang	+V +Past
sung	+V +Participle

Anderson's treatment of stem-changing in these terms leads to problems with blocking effects in his amorphous theory, a point which has been detailed elsewhere (Halle and Marantz 1993, Embick and Halle forthcoming). We wish to emphasize here that nothing about the representation in (25) ensures that there should be any phonological similarity between the different stems of SING. As far as (25) is concerned, the relationship between *sing* and *sang* is equivalent to that between e.g. *go* and *went*. Storing stems in this fashion thus amounts to generalizing the phenomena of suppletion, in such a way that stem-changing with phonologically-related forms is non-distinct from outright suppletion of the *go/went* type. Suppletion is very rare in natural language, and constitutes a sort of 'worst case scenario'—a maximally opaque phonological relationship between two syntactico-semantic objects that are taken to have a common derivational source. As such, it is clearly undesirable to generalize suppletion to cover all morphological alternations that involve some change in the phonology of a Root.

For these reasons, it is important that sharp distinctions be made between non-suppletive morphological relationships and cases of suppletion. In an approach with stem-storage, this is not possible without explicit stipulation; in principle, any phonological forms could be linked in a representation like (25). This point can be made with respect to other approaches endorsing 'stems' as well. The idea that the relationship between different stems of the same lexeme can be essentially arbitrary is asserted quite clearly in Zwicky's (1990) conception of the stem:

...several stems might be available for particular lexemes... . . .how are the different stems related to one another phonologically? Apparently, in just the same ways that an input stem can be related to its output form—in every way from suppletion, at one extreme, to complete predictability by rule, at the other. (1990:225)

Our objection is not that apparent instances of suppletion should simply be ignored. Rather, the point is that the theory must sharply distinguish between the extremes of predictability and suppletion if it is to be explanatory in any

meaningful sense. Introducing stems into the theory makes this distinction impossible to draw, or requires a host of additional stipulations. An approach that generalizes suppletion makes the weakest possible predictions concerning sound/meaning relationships: it makes no predictions.

Theories with stem storage are subject to this argument in one form or another. It might always be possible to stipulate conditions that have the desired effect. But given the additional complexities caused by such stipulations, what must really be asked is if there is any reason to store stems in the first place. Given the severe problems confronting treatments with stem storage, and general concerns of theoretical parsimony, it is clear that morphological theory should not admit the ‘stem’ into its inventory of basic objects.

4. *Stems in Latin?*

Aronoff’s (1994) discussion of Latin verbs is in part an attempt to argue that morphology must contain ‘stems’ as a special sort of object. According to this view, the grammar must contain more than Roots and their underlying forms, along with rules that operate on such forms. Rather, the grammar must also make reference to and in some cases list ‘stems’. The view of the stem advanced by Aronoff is that it is a particular form that a Root (in Aronoff’s terminology, a *lexeme*) takes:

A stem, in my use of this term, is a sound form. In particular, it is the phonological domain of a realization rule: that sound form to which a given affix is attached or upon which a given nonaffixal realization rule operates. ...however...we cannot simply equate the two notions ‘stem’ and ‘sound form of a lexeme’. ...a lexeme may have more than one stem, not all of them necessarily listed.(1994:39)

Aronoff’s discussion is centered on identifying stems of this type—phonological forms that have a broad syntactico-semantic distribution. To the extent that Aronoff’s arguments point to the conclusion that phonological forms are underspecified with respect to the syntactico-semantic environments in which they appear, we are in full agreement. The additional point— that these patterns require the introduction of stems as objects in the theory of morphology— is, however, not correct. The mechanisms we have motivated already, Vocabulary Insertion and Readjustment Rules, are capable of stating the relevant generalizations in a way that does not interfere with the general idea that sound/meaning connections are

systematic. The further move that introduces stems is problematic, and ultimately unnecessary.

4.1 *The Perfect*

Recall from our discussion of the Perfect above that verbs of Conjugations II and III show *-ē-/i-* themes in the present tenses, but these theme vowels do not surface in the Perfect tenses at all. The fact that the thematic vowels *-ē-* and *-i-* do not surface in any Perfect forms, in conjunction with the fact that the Perfect shows a great deal of allomorphy, leads some researchers to the conclusion that the Perfect involves stored stems.¹⁵ Aronoff, for instance, concludes from patterns like those discussed above that it is individual stems that belong to conjugation classes, not Roots (for him, *lexemes*):

A less subtle type of evidence for the direct relation between conjugation or theme vowel and stems, rather than lexemes, lies in the fact that there are many verbs whose individual stems “belong to different conjugations”. These are almost all verbs of the first or fourth conjugation that lack theme vowels in the perfect or third stem....In these cases, it is simply impossible to say that a lexeme belongs to a conjugation or selects a theme vowel. Rather, we must say that an individual *stem* of a lexeme belongs to a particular conjugation.... This only reinforces my earlier remark that theme vowels are associated directly with stems of lexemes rather than with entire lexemes. (1994:49)

Such cases constitute an apparent ‘change of conjugation’ because in Aronoff’s terms, the categories ‘Conjugation I’ and ‘Conjugation IV’ clearly exist in the Perfect— that is, there are numerous verbs that show *-ā-* and *-ī-* theme vowels in the Perfect. This is unlike Conjugation II, because there are no verbs that have an *-ē-* Theme in the Perfect. On these points, Aronoff’s position reflects in part the traditional view that the division of the Latin verbal system into conjugation

¹⁵ It has also led to the conclusion that the Perfect is outside the system of conjugation classes in Latin, a conclusion that is unwarranted. Justifying his decision to examine only the non-perfect tenses of Latin verbs, Carstairs-McCarthy (1994:752) makes an assertion of this type:

As has often been pointed out, these conjugations really apply only to the imperfective forms of Latin verbs, because perfective forms make use of perfective ‘stems’ formed in various ways which do not correlate closely with the imperfective forms.(1994: 752)

This type of comment recapitulates the observation that there is more allomorphy in the Perfect than there is in the non-perfect tenses.

classes is really only justified in the present system (cf. Sommer 1914:487). Concerning the details of the Perfect, Aronoff argues that the appearance of *-ā-* and *-ī-* theme vowels for verbs that are conjugations I and IV in the present system is derivative:

...the theme vowel occurs basically in the present stem for all Latin verbs...it occurs in other stems only when they are built on the present stems.(1994:52)

In terms of what this means for the representation of Conjugation Class information, the idea is that the theme vowel, or Conjugation Class feature, is not a property of a Root. Rather, it is a property of a stem of a Root. In some cases, the form of a stem is predictable by rule. For instance, the default for forming the Perfect Stem of a verb in Conjugations I or IV, and for the system in general, is to derive this stem from the Present stem. In other cases, i.e. in those cases in which the Perfect Stem does not show the theme vowel of the Present stem, the stem must be listed. This is illustrated for the verb *crepāre* in (26); recall that while this verb appears with the *-ā-* theme in the present system, its Perfect is athematic *crep-u-i-mus*, not **crep-ā-v-i-mus*:

- (26) Root CREP
- a. Present Stem: *crepā*
 - b. Perfect Stem: *crepu*

Note that in this type of case, Aronoff is driven to the position that the sound form found in the Perfect— for him, *crepu*— must be listed in the lexicon as a stem of the lexeme CREP. Aronoff takes care in his discussion of stems to argue against the idea proposed in Lieber (1980) that all stems of a lexeme must be listed.¹⁶ Thus for verbs that are ‘regular within their conjugation’, there is no need for stem

¹⁶ In particular:

Contrary to what Lieber claims, the majority of verb stems are regular and hence most likely are nonlexical (in the idiosyncratic sense of the term). Being listed is therefore not a necessary criterion for being a stem. ... I conclude that a given lexeme may have more than one stem and that these stems are not necessarily arbitrary and hence listed in the permanent lexicon (though they may be). (1994:44)

storage of the Perfect stem, since it is derived from the Present Stem. But for Aronoff this is not the case with verbs like *crepāre*; the stem *crepu* must be stored as an (unanalyzed) whole.

This is clearly a stem-storage solution, the problems with which were discussed in section 3 above. The analysis in (26) does not distinguish the behavior of *crepāre* from the behavior of truly suppletive verbs, and this is undesirable with CREP and other Roots of this type. While some information must be listed concerning such Roots—namely, the fact that they are athematic in the perfect—this is very different from saying that *crepu* is a suppletive stem form.

A further problem with the treatment in (26) is that it allows for any unrestricted ‘conjugation changing’ behavior. With stem storage, and the idea that the theme vowel is a property of the stem, any possible combination of conjugation changes can be represented; for instance, analogous to (26), one could have a lexeme that has a stem of Conjugation IV in the Imperfect tenses, but a stem of Conjugation I in the Perfect:

- (27) Hypothetical Lexeme
- a. Present Stem: STEMē
 - b. Perfect Stem: STEMāv
 - c. Third Stem: STEMīt

As long as stem storage is an option, and as long as thematic vowels are properties of stems, any combination of different theme vowels throughout the tense system is possible. In other words, the representation allows for any possible ‘feature changing’ behavior among the different conjugations; this is clearly a weak position given the facts of Latin. Our approach, in which Roots are specified for Conjugation Class features that determine Vocabulary Insertion at TH nodes, is not subject to this objection. In the default case, a Root will show a uniform conjugational/thematic behavior across tenses.¹⁷

¹⁷ Something further must be said about a handful of ‘special’ cases like *pet-i-mus/pet-ī-vi-mus*, where an *-i-* theme in the present system is paired with an *-ī-* theme in the perfect tenses. These are the only instances of ‘conjugation changing’ verbs in the language. See Embick and Halle (forthcoming) for a proposal.

4.2 ‘Past’/‘Passive’ and ‘Future Active’ Participles

Aronoff’s principal argument for stems is derived from what Matthews (1972) and Aronoff call *priscianic* or *parasitic* formations. These are cases in which some derived form is apparently derived not from the underlying form of the Root, but instead from a form with a different distribution. The example of this that Matthews and Aronoff focus on is in the formation of the so-called *Future Active* participle in Latin. This participle has an interpretation that is roughly futurate, i.e. ‘about to’: *laudāre* ‘praise’, Fut. Act. *laudātūrus* ‘about to praise’. In terms of its form, the Future Active participle looks like the result of simply adding *-ūr-* to the so-called ‘Passive Participle’ (what Aronoff calls the ‘third stem’):¹⁸

(28)	Infinitive	Pass.Part.	Fut. Active	Trans.
	<i>laudāre</i>	<i>laudātus</i>	<i>laudātūrus</i>	‘praise’
	<i>monēre</i>	<i>monitus</i>	<i>monitūrus</i>	‘warn’
	<i>premere</i>	<i>pressus</i>	<i>pressūrus</i>	‘press’
	<i>iubere</i>	<i>iussus</i>	<i>iussūrus</i>	‘order’

While the ‘Passive Participle’ is typically past and passive,¹⁹ the Future Active participle shares neither of these properties. For Matthews and Aronoff, such a case constitutes a clear instance of the separation of sound form from syntax/semantics. In particular, Aronoff’s argument is that both the Future Active and Passive participles must be derived from a sound form—in this case the ‘Third Stem’—that exists independently of any particular syntactico-semantic context.

Within the context of our assumptions, there is no need to assume that the Future Active participle is derived from the ‘Past Passive’ participle in any sense, whether syntactico-semantic or morphophonological. In this way, we are in agreement with Aronoff. This point is especially obvious when we take into consideration the rest of the grammar, and the role that morphosyntactic derivations play in the construction of phonological forms. Syntactico-semantically, there is a clear sense in which one object can be said to be ‘derived from’ another: if structure S contains structure S' as a subcomponent—i.e. is built

¹⁸ There are some exceptions to this general pattern, such as *secō* ‘cut’, with Past *sectus* and Future Active *secātūrus*.

¹⁹ The form appears in active syntax with deponent verbs; see Embick (2000) for discussion. In addition, there are some complications to the aspectual interpretation of this form, many of which are documented in Brugmann (1895).

additively on S'—then S is derived from S'. In the present case, while there might be some parts in common to the two types of participle— i.e. common syntactic structure in the form of *v* and Asp(ect) syntactic heads— there is no obvious syntactic sense in which one must be directly derived from the other simply because of the similarity in form (although it would be desirable for the connection in form to be as syntactico-semantically motivated as possible).

The criteria for one form being derived from the other are, of course, purely phonological. But phonological criteria may not always be very informative. One property that Aronoff's approach shares with Distributed Morphology is the idea that phonological forms may be underspecified with respect to the syntactico-semantic contexts in which they appear. Consider the relationships between the English forms in (29), recalling the discussion of §2 above:

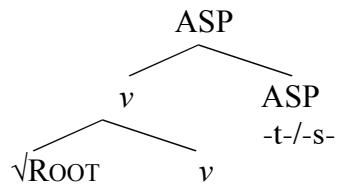
- (29) break, broke, broken
 drive, drove, driven
 take, took, taken

It happens to be a fact about English that the same Readjustment Rule applies to BREAK in both the Past Tense and the Participle forms, since each of these forms shows the same vowel. This is not the case for DRIVE and TAKE. But this in no way implies that the participle *broken* is derived from the Past form (or vice versa) in the case of BREAK, but not in the case of the other Roots. The syntactic structures are what they are, and Vocabulary Insertion and Readjustment Rules apply to the different Roots and contexts in a distinct way. Taken together, these two types of rules generate the correct forms; as far as the grammar is concerned, there is nothing further to be said about relationships between the stem forms found in the Past and Participle environments.

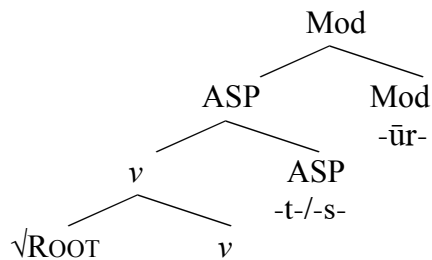
Returning to the 'Past Passive' and 'Future Active' participles, the strongest hypothesis is that the apparent 'priscianic' formation is a result of the two participles having some common syntactico-semantic properties, however abstract this common structure may be. This is the strongest hypothesis because it grounds the similarities in the forms of the two participles in the syntactico-semantic structure. In particular, this would be an analysis in which the participles contain similar heads/features, with the underspecification of Vocabulary Items and Readjustment Rules accounting for the similarities in form.

An analysis of Latin participles in terms of the underspecification of piece-based Vocabulary Items is sketched in Embick (2000). This analysis treats the Past Passive and Future Active participles as forms involving both verbalizing structure (*v*) and Asp(ectual) structure; this is shown in (30-31):

(30) Past Passive



(31) Future Active



The basis for this analysis is that while there are differences with respect to voice and mood, each of these structures involves the creation of a participle from a verbalized object (Root and *v*). Thus there is an ASP head present in each, and the default realization of the ASP head is *-t-/-s-*. In the Future Active participle, which has additional modal (future) properties, there is an additional head Mod (for Modal), which is realized as *-ūr-*; syntactico-semantically this head is the locus for the modal/futurate interpretation of this participle.²⁰

Moving beyond the participles to other derivations that show the ‘Third Stem’, the type of analysis sketched above can be extended quite naturally. For instance, different types of nominalizations show the exponents *-t-/-s-*:

²⁰ The word-final desinences *-us* are the realization of an AGR node, which we have not included in these structures.

(32) Nominalizations

- a. *Agentive Nominalizations:*
 amāmus ‘love’ amā-t-or ‘lover’
 canimus ‘sing’ can-t-or ‘singer’
- b. *Other Nominalizations:*
 cogitāre ‘think’ cogitā-t-io ‘thought’
 dēpellimus ‘defend’ dēpul-s-io ‘defense’

In all of these cases, the *-t/-s-* exponents appear when additional material—Aspectual or perhaps verbal (i.e. *v*-like)—appears in the structure (cf. the discussion of nominalizations in Marantz 1997, Alexiadou 2001, and related work). While this covers a wide range of semantic features, the pattern can be accounted for directly if the Vocabulary Items that insert *-t/-s-* are highly underspecified with respect to the contexts in which they apply.

An additional factor is that there are Readjustment Rules that alter the phonology of the stem in the contexts associated with the ‘Third Stem’ (e.g. *ag-i-mus*, *āc-t-um* and other readjustments). One alternative would be to treat these effects along the lines of German Umlaut—that is, by enumerating the environments in which these Readjustment Rules apply:

(33) ‘Third Stem’ Readjustments apply in environments $X_1\dots X_n$

There is, however, an apparent problem with this solution. This rule lists exactly the environments $X_1\dots X_n$ in which the exponents *-t/-s-* are inserted, a kind of ‘elsewhere’ environment where more Vocabulary Items for Asp do not apply. The fact that the contexts for (33) are identical with the contexts in which *-t/-s-* are inserted are identical is an accident.

This problem is avoided if the phonological effects of stem readjustment are analyzed as resulting from Readjustment Rules triggered by the exponents *-t/-s-* themselves, rather than by abstract feature content:²¹

(34) Readjustment Rules are triggered by the ASP exponents *-t/-s-*

²¹ This assumes that these exponents are uniquely indexed; that is, they are distinct from e.g. the *-t-* of 3S Agr and the *-s-* of 2S Agr respectively.

Because the rules that insert *-t-/-s-* are highly underspecified, and because the Readjustment Rules are linked to the presence of these exponents, in the default case the Readjustments will accompany the presence of *-t-/-s-*. Moreover, the Readjustment Rules will have the same wide distribution as the exponents that trigger them. The effects of the ‘Third Stem’ can thus be stated directly with Vocabulary Insertion and Readjustment Rules.²²

4.3 *Stems and ‘Morphology by Itself’*

The questions raised by the ‘Third Stem’ effect have a very particular status in the context of our theory of syntax/morphology interactions. However, at the level of detail that Aronoff argues it is impossible to conclude anything other than that the ‘third stem’ has a relatively broad distribution. The reason for this comes ultimately from the fact that Aronoff’s project is *sui generis*—‘morphology by itself’. In the case at hand, the problem is that the exact mechanics of how stems relate to syntactic contexts is not specified by Aronoff (unlike Anderson (1992), who makes the proposal criticized above). This is important, since the stems clearly must relate to syntactico-semantic features in some fashion. In any case, Aronoff derives three primary conclusions:

...these stems, whether or not they are listed in the permanent lexicon, have three important properties. First, they are not meaningful. Second, the abstract elements present stem, perfect stem, and third stem enjoy a special status in Latin grammar as independent parts of the morphological system of the language. Realization rules of the language operate on these abstract elements, and not on specific forms, when selecting forms on which to operate. Finally, they are functions whose output may vary considerably according to the verb to which they apply. (1994:58)

While these observations might in some cases be in agreement with positions we have taken, there remain innumerable questions of representation and derivation. It is difficult to see how these questions could be answered, because Aronoff’s approach isolates morphophonology from other components of the grammar. Absent a theory of morphosyntax, and in particular absent an explicit theory of how phonological forms relate to the environments in which they appear, little can

²² Some questions remain concerning the formation of some verbal derivatives like *ag-i-t-ō* (cp. *āc-t-us*, where the Readjustment is not found. It is unclear how systematic formations of the latter type are. We leave this matter for further research.

be concluded from Aronoff's observations, beyond the fact that these are problems for lexicalist approaches to grammar in which syntax-semantics must be deterministically projected from phonological forms. In a sense Aronoff's arguments constitute the statement of a problem to be solved, and not a concrete proposal.

There is in addition a related problem concerning how to determine what counts as a 'stem'. Aronoff tries to define this notion in terms of the removal of affixes: "I will adopt the traditional definition of stem as the part of complete word form that remains when an affix is removed" (1994:31). On what basis is the distinction between being part of the stem and being an affix determined? The dividing line between what has to be part of a 'stem' and what has to be added by realization rules is apparently arbitrary. Given the fact that the imperfect tense has a syntax involving a node like T[past], and given that the Latin imperfect invariably shows *-bā-* (e.g. *laud-ā-bā-mus* 'we were praising'), why treat the object containing *-bā-* as a stem? The general conclusion is that treating form as completely divorced from structure is in principle unsystematic, a conclusion which is stated in (35):

- (35) In a non-piece-based view of morphology, distinctions between stem alternants and by-products of morphophonological rules (i.e. word-formation rules) is arbitrary.

The reason for this is that the notion of 'stem' is defined as a sound form, i.e. in the absence of any notion of piece-based internal structure. Since there is no principled structural basis on which some subpart of a phonological string could be treated as a 'stem', anything could be a stem, reducing the notion to an ad hoc device subject to no principled constraints.

To summarize, notwithstanding the theoretical interest of the facts considered by Aronoff, there is no reason to augment our inventory of morphological objects by reifying the 'stem'. The cases studied above raise a number of analytical issues centering on the relationship between piece-based affixation and Readjustment Rules, and the question of how morphophonological forms are underspecified with respect to the context in which they appear. But these questions can only be addressed concretely in the context of a theory that provides explicit connections between syntax/semantics and morphological form, something which Aronoff's approach fails to do.

5. *Conclusions and Further Directions*

There is no need for the ‘stem’ in morphological theory. In the context of the analysis that we have sketched above, some further questions remain about the relationship between Vocabulary Insertion and Readjustment Rules, since both of these rule types are required in the grammar. Given that word formation is grounded in syntactic structure, a guiding hypothesis concerning these two rule types is that the default assumption should be that morphological alternations involve pieces:

- (36) **Piece Assumption:** All other things being equal, a piece-based analysis is preferred to a Readjustment Rule analysis when the morpho-syntactic decomposition justifies a piece-based treatment.

Exactly what is contained in the ‘all other things being equal’ clause is a matter of great interest. There are a number of different factors that could be implicated in the analysis of a particular alternation as being piece-based as opposed to being the result of a Readjustment Rule.²³ Questions of this type are, to a large extent, open. The fact that they can be posed meaningfully derives from the fact that there is a sharply defined theoretical framework which makes it possible to discuss the grey areas between piece-based and non-piece based morphological alternations. In alternative approaches to morphology, questions about sound/meaning connections are either not articulated in detail (e.g. Aronoff 1994), so that it is difficult to situate any particular morphological analysis with respect to other parts of the grammar (as discussed above). Or, sound/meaning connections at the word level are treated as essentially arbitrary, so that there is no morphological ‘theory’ per se, surely the most pessimistic option (this seems to be the case with Stump 2001). Questions of this type are of great interest; but they can be appreciated only in a framework that analyzes word formation along with syntax and other parts of the grammar, in the way that we have done here.

²³ A case of interest is the formation of verbs in *-en*. Consider: *wide, width, widen*; *long, length, lengthen*; *high, height, heighten*. The fact that the ‘deadjectival’ verb is formed with the phonological form associated with the nominalization has potential implications for the analysis of nominalizations in *-th*. In particular, if *length* is treated as the output of a Readjustment Rule in *length-en*, then this same analysis should apply to the nominal *length*, which would be *length-Ø*. Similar considerations might extend to *growth*, etc..

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