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Distributed Morphology Impoverishment and Fission

Morris Halle

1. Introductory Remarks on Distributed Morphology

Morphology is concerned with the elements that compose words and with the organization of these elements into hierarchical constituents of different kinds. In syntactic discussions we often speak as though words were the elements that make up the terminal strings which are operated on by the syntax. It hardly needs saying that this is at best a crude approximation. It is well known, for example, that the Tense morpheme of verbs and the Number and Case morphemes of nouns have the status of independent syntactic elements that require separate nodes in the terminal string, yet none of these morphemes is a word. And a central purpose of morphology is to account for the vastly different ways in which different languages package these universal morphological entities into words.

As an example consider the finite verb forms of English in (1).

- (1) Mary play-**ed** there
Mary play-**s** there

The verb forms are composed of a stem and a suffix. A simple illustration of their bipartite character is given by the sentences in (2) where the tense morpheme appears at some distance from the verb stem.

- (2) Di-**d** Mary play there?
Mary doe-**s** not play there

The suffix /d/ is the exponent the Past tense, whereas the suffix /z/ is the exponent not only the Present tense, but also the fact that the subject of the sentence is 3Person and Singular. A more explicit representation of the verbs in (1) is given in (3), where the angled brackets enclose the grammatical — i.e., non-phonetic — information conveyed by the stem and the suffixes, and the phonetic information appears between slashes.



The terminal nodes in the syntactic trees in (3) are thus composed of two parts, a string of phonemes and a complex of grammatical features. I shall refer to terminal elements of syntactic trees as *morphemes*, and I shall use the term *phonological or phonetic exponent* to designate the phoneme sequence in a morpheme. Since morphemes are the terminal elements of syntactic trees, there are morphemes at every level of representation of a sentence. However, as will be seen below, not every morpheme need have a phonologic exponent.

It is well known that the relationship between the grammatical features of a morpheme and its phonetic exponent is many-to-many. That is, a given complex of grammatical features can have several phonological exponents, and a given phonological string can serve as exponent for several distinct grammatical feature complexes. For example, the phonological exponent of the English Past tense is /d/ in *played*, *decided*, but /t/ in *bought*, *left*. On the other hand, the suffix /z/ is the phonological exponent of the complex of the grammatical features [3Pl, Sg, Present] after verbs, but of [pl] after nouns. To add further complexity to this relationship, phonetic NULL can function as the exponent of certain morphemes. E.g., in English NULL is the exponent of Present tense morphemes other than the 3Sg, as well as of the Past Participle and finite Past tense morphemes for such verbs as *hit*, *put*, *strike*.¹

This manifestation of what has been termed *l'arbitraire du signe* has been the source of innumerable problems for designers of mechanical analyzers of speech as well as

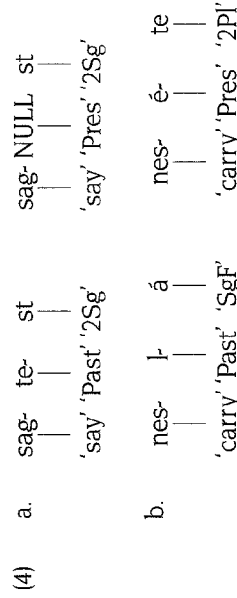
¹ NULL is also the phonological exponent for the singular of English nouns, as well as for the plural of such nouns as *deer*, *fish*, *moose* and *geese*, *mice*.

In Nimboran, a New Guinea language discussed by Inkelas 1993 and Anceaux 1965, a whole series of verbs have a phonetically NULL stem: be, become, bring, dream, extend, go hear, kiss, laugh, make a cat's cradle, say, sleep. These stems 'are disambiguated by the different particles for which each zero root selects ... the zero root-particle pair <0, -rār> 'brings' occurs only when the action of the verb is directional, while the pair <0, -tār> 'make cat's cradle' occurs only when the action is non-directional. These semantic restrictions are of exactly the same type that characterize overt roots ...' (Inkelas 1993, 610, 611)

for linguists. Though a major difficulty for engineers and speech scientists, the arbitrary relation between the exponent of a morpheme and its referent is apparently of little concern to speakers, for examples of this relation are readily found in every language.

The two parts of the morpheme — i.e., the phonological exponent and the set of grammatical and semantic features — play a radically different role in the syntax than they do in the phonology. The syntax is concerned only with the grammatical properties of the morphemes and the phonetic exponents are effectively invisible to the syntax. As far as syntax is concerned, it makes no difference whether the phonetic exponent of the Perfect Participle is /d/ or /t/ or NULL. Unlike the syntax, the phonology is not exclusionist: in the phonology both phonetic and grammatical features are of interest. The link between these two parts of a grammar — the syntax, on the one hand, and the phonology, on the other — is supplied by the morphology in a manner to be sketched below.

The English examples reviewed above have illustrated aspects of Subject-Verb agreement. Languages differ in the manner in which they implement Subject-Verb agreement. Thus, in English the so-called phi-features of the subject are fused into a single morpheme with the Tense features, but as illustrated in (4), both German and Russian keep Tense separate from Agr.



Russian and German differ with regard to the grammatical features that are signalled by the Agr morpheme. In German the exponent of the Agr morpheme is selected in both tenses by the Person and Number features of the Subject. In Russian, by contrast, the Person and Number features select the Agr exponent only in the Present tense, whereas in the Past tense the Agr exponent represents Gender or Plural.

It is assumed here that all phi-features of the subject NP — i.e., Person, Gender, Number, Animacy — are copied onto a special Agr node that is a sister of the Tense node. In Russian and German the Tense and Agr nodes remain distinct and are supplied with phonetic exponents in a manner to be described below. In English, an operation of the morphology fuses these two sets of features into a single morpheme; as a result there is only one morpheme into which the English Tense-Agr suffixes may be inserted.

In Distributed Morphology (Halle & Marantz 1993, 1994), the phonetic exponents of the different morphemes are listed in the Vocabulary. As illustrated in (5) and (6)

Crucial to the accounts above was the assumption that Vocabulary items are inserted into the morphemes of a sentence only after the rules of the morphology have had an opportunity to modify in various ways the feature complexes appearing in the morphemes. This insertion procedure has been termed *late insertion* in the literature, and in what follows I illustrate additional aspects of this procedure.

3. Fission

In addition to Impoverishment and Fusion, Morphology employs also the important device of Fission, discovered by Rolf Noyer (1992). In the examples discussed to this point Vocabulary Insertion came to an end as soon as the first Vocabulary item that satisfied the Subset Condition (7) was inserted into the morpheme. Noyer noticed that this procedure did not produce the correct results in all cases. In a number of examples from the Afro-Asiatic languages and in some Australian languages (Nungubuyu), Noyer discovered that the process did not come to an end with the insertion of an exponent into a morpheme; instead an additional terminal morpheme was generated into which was inserted the exponent of a less marked Vocabulary item from the same list. Noyer called this special insertion procedure *Fission*, and this term is used here although Noyer's formal proposal is somewhat modified.⁴

It is assumed here that certain morphemes are marked as being subject to Fission. At this time no principle determining this marking is known; if and when such a principle is discovered it will, of course, be incorporated into the formal account.

For morphemes marked for Fission, the initial step of the insertion procedure is identical with that sketched above, but this is not the end of the procedure. Simultaneously with insertion of the phonological exponent, a subsidiary terminal morpheme is generated into which are copied the features – if any such remain – that have not been required for (matched in) the first step. This subsidiary morpheme is then itself subject to Vocabulary insertion in the usual manner. Like Impoverishment, Fission extends the domain of unmarked exponents, for the subsidiary morpheme normally contains fewer features than the original morpheme.

Insertion may or may not stop after a single iteration. No further iterations takes place if among the items competing for insertion in the original morpheme there is an absolute default item, i.e., one that is inserted without having to match any features in the terminal morpheme. If there is such an item, Insertion stops after a single iteration; if not, iteration continues until the features copied into the subsidiary morpheme match no Vocabulary item.

4. The Latin Declension⁵

A simple example of Fission is provided by the PlG and PlD/Abl forms of the Latin noun, to which we now turn. The Latin noun has the tri-partite structure in (14).

⁴ The treatment of Fission given below differs in some respects from that offered by Noyer and makes use of ideas suggested to me by Alec Marantz and Benjamin Brunning.

⁵ For more details on the Latin declension, see Halle & Vaux (1997).

Distributed Morphology

(14) [Stem-Theme] - <Number-Case>

	di	e	m	

'day' Sg.ACC

Each noun stem belongs to one of the five traditional declension classes of the language. Class membership determines the vowel that is inserted into the Theme slot as shown by the entries in (15).

(15)	/a/	↔		in env. [I]	+	—
	/o/	↔		in env. [II]	+	—
	/i/	↔		in env. [III]	+	—
	/u/	↔		in env. [IV]	+	—
	/e/	↔		in env. [V]	+	—

Consider the forms of the Fifth declension noun *die:s* 'day' in (16).

(16)		Singular	Plural
	N	di-e-s	di-e-s
	Acc	di-e-m	di-e-s
	G	di-e-i	di-e-r-um
	D	di-e-i	di-e-bu-s
	Abl	di-e	di-e-bu-s

We notice that the /s/ suffix figures in both the Singular and the Plural and that its distribution is highly irregular. This irregularity indicates that the /s/ suffix cannot be the exponent of any natural category, but must rather be the default suffix. By contrast the suffix /um/ figures only in the PlGen. It is the exponent of the PlGen in all declensions, as shown below, and in the I,II,V Declensions triggers in addition insertion of /r/, a fact to which return below:

I	port-a-r-um	II	hort-o-r-um	III	urb-i-um
IV	fruct-u-um	V	di-e-r-um		

In the Singular, we find /m/ in the SgAcc, /i/ in the SgD/G, and NULL in the SgAbl. These simple observations suggest the Vocabulary entries in (18), where the Cases are treated as complexes of the features in (17).⁶

⁶ Because of our limited familiarity with the facts we are unable at present to motivate properly the case features in (17), and these must be regarded as provisional. [-oblique] is assigned to nominals that are arguments of the verb; [+oblique] is assigned to non-argument nominals. [-superior] is assigned to nominals in governed positions in the syntactic structure; [+superior] is assigned to nominals in non-governed positions. [-structural] is assigned to nominals on non-structural semantic grounds; [+structural] is assigned to nominals solely on the basis of their position in syntactic structure.

- (17) N Acc G D Abl

Oblique

Structural + - + + +

Superior + - - + +

- (18) /um/ ↔ [+Obl,+Struct,-Sup,+Pl] PlG
 /i:/ ↔ [+Obl,+Struct,-Pl] SgG/D
 /m/ ↔ [-Obl,-Pl] SgAc
 NULL ↔ [-Pl] Sg default
 /s/ ↔ [] default

As noted above the /s/ suffix appears in a variety of Cases in the Plural that lack a common denominator. This is reflected in (18) where /s/ is the default exponent and as a result is inserted without having to match even a single feature. The /s/ is the phonological exponent also of various Singular forms; e.g., SgN *korbt-u-s* 'garden' *urb-s* 'city' *fruct-u-s* 'fruit' and SgG *urb-i-s*, *fruct-u-s*. We have here another instance of the extension of the domain of the default exponent noted above in the discussion of the allomorphs of the English copular verb (8). Like in that case we capture the extension of the domain of the unmarked exponent by positing an Impoverishment rule, viz. (19a) which deletes the feature [-Pl] from Nom morphemes of non-neuter nouns.⁷ The morpheme so impoverished can host only the default suffix since all other entries in (18) include [+Pl] or [-Pl]. This is illustrated in (19b).

- (19) a. [-Pl] → ∅
 in env. [-Neut, I,II,III,IV,V] + [____-Obl,+Sup]
 b. /di/, -Fem,-Neut; V] + [-Obl,+Struct,+Sup,-Pl] →
 /di/, -Fem,-Neut; V] + [-Obl,+Struct,+Sup]

Still to be accounted for is the /r/ exponent in the PlG and the /bu/ exponent in the PlD/Abl. What differentiates these two from the rest of the endings in (16) is that the PlG and PlD/Abl endings are bi-partite. The obvious move to account for the bi-partite structure of these morphemes is to posit that the PlG and PlD/Abl morphemes of the V declension are subject to Fission. In the PlG, Fission results in a second morpheme that has no features since the Vocabulary entry for PlG in (18) matches all features of the #-Case node. The only Vocabulary item that can be inserted in such a "featureless" morpheme is the default /s/. The /s/ that is thus inserted is then turned into /r/ by the well-known "rhotacism" rule (20) of Latin phonology.

- (20) /s/ → /r/ in env. V ____ V

In addition to the appearance of /r/ in *di-e-r-um*, rule (20) is also responsible for such alternations as *ru:s* - *ru:r-i-s* 'country'; *corpus* - *corpore-i-s* 'body' and many others.

The PlD/Abl form *di-e-bu-s* also includes the default /s/ suffix. In order to account for the appearance of the *-bu-* it is necessary to assume that like the PlG, this PlD/Abl ending is subject to Fission, but here we must also add the entry (21) to the Vocabulary entries (17) that compete for insertion in the #-Case slot.

- (21) /bu/ ↔ [+Obl,+Sup,+Pl] in env. [III,IV,V] + ____

The PlDat/Abl morpheme of class III,IV,V nouns will then be derived as shown in (22).

- (22) [+Obl,+Sup, <±Struct> +Pl] →
 [/bu/, +Obl,+Sup,+Pl] + [<±Struct>] → /bu/ + /s/

A comparison of the derivation (22) with that of the PlGen above shows that the linear order of the inserted morphemes is not determined by the order of insertion of Vocabulary items. The Latin facts may be accounted for by some simple assumptions about the admissible syllable structure. Other evidence available to me (especially that of the Afro-Asiatic languages discussed below as well as that of Catalan (see Harris 1996) and of Chukchi (see Hale & Halle: in preparation) indicates that factors in addition to syllabification must be at play, as well. I leave this as a question for further study.

5. Fission in the Afro-Asiatic languages

As discussed in detail in Noyer (1992), Fission plays an important role in the morphology of the Semitic languages, as well as of many other Afro-Asiatic languages.

I begin with a few elementary facts of Biblical Hebrew. In Hebrew, like in many other Afro-Asiatic languages there are two patterns of verbal inflection: the so-called Perfect conjugation, which employs suffixation exclusively, and the Imperfect conjugation, where both prefixation and suffixation are employed. This is illustrated in (23) with forms of the verb /zrq/ 'to throw'.

- (23) a.

	Perfect		Imperfect	
	Singular	Plural	Singular	Plural
1	za:raq-ti	za:raq-nu:	?e-zroq	ni-zroq
2m	za:raq-ta:	zEraq-tem	ti-zroq	ti-zrEq-u:
2f	za:raq-t	zEraq-ten	ti-zrEq-i:	ti-zroq-na:
3m	za:raq	za:rq-u:	yi-zroq	yi-zrEq-u:
3f	za:rq-a:	za:rq-u:	ti-zroq	ti-zroq-na:

b.

Like in English, Tense and Agr are fused in Hebrew into a single morpheme. In the Perfect tense the fused Tense-Agr morpheme is subject to Vocabulary insertion of the

⁷ As stated, rule (19a) applies to non-neuter nouns in all but the I declension. It is shown in Halle & Vaux (1998) that the list of declension classes in (19a) can be dispensed with.

unmarked (non-Fission) kind. A list of the items competing for insertion in the Tense-Agr slot of the Perfect is given in (24). The person features are those of (9) above.

- (24)
- | | | | |
|-------|---|--------------------------|----------------------|
| /ten/ | ↔ | [+PSE, -Auth, +Fem, +Pl] | } in env. __, +Perfl |
| /tem/ | ↔ | [+PSE, -Auth, +Pl] | |
| /t/ | ↔ | [+PSE, -Auth, +Fem] | |
| /ta:/ | ↔ | [+PSE, -Auth] | |
| /nu:/ | ↔ | [+Auth, +Pl] | |
| /ti:/ | ↔ | [+Auth] | |
| /u:/ | ↔ | [+Pl] | |
| /a:/ | ↔ | [+Fem] | |
| NULL | ↔ | elsewhere | |

Since the Hebrew Perfect is not subject to Fission, the first Vocabulary item in (24) satisfying the Subset Condition (7) is inserted into a Perfect morpheme and no special account is taken of any unmatched features. For example, the 1Sg.Fem morpheme has the feature composition [+PSE, +Auth, +Fem, -Pl]. This morpheme will host the item /ti:/ in (24), which will leave the features [+PSE, +Fem, -Pl] unmatched. If Fission applied here these three features would be fissioned off into a subsidiary morpheme, which would host the item /a:/, generating an incorrect output. Since the Perfect is not subject to Fission no subsidiary morpheme is generated, and the derivation ends – correctly – with the insertion of /ti:/.

The situation is radically different in the Hebrew Imperfect, for here Vocabulary insertion is subject to Fission. The affixes of the Hebrew Imperfect are in part prefixes, in part suffixes of the stem. I assume this is an idiosyncratic property of a given item that is reflected directly in its Vocabulary entry as shown in (25).

- (25)
- | | | | | |
|-------|---|--------------------------|------|---------------------|
| /i:/ | ↔ | [+PSE, -Auth, +Fem, -Pl] | Suff | } in env. __, Impfl |
| /na:/ | ↔ | [+Auth, +Fem, +Pl] | Suff | |
| /n/ | ↔ | [+Auth, +Pl] | Pref | |
| /u:/ | ↔ | [+Auth, +Pl] | Suff | |
| /y/ | ↔ | [+PSE, -Fem] | Pref | |
| /ʔ/ | ↔ | [+Auth] | Pref | |
| /t/ | ↔ | elsewhere | Pref | |

The examples in (26) illustrate the insertion of these items into the fissioned Imperfect morphemes.

- (26)
- a. [-PSE, -Auth, -Fem, +Pl] →
 [-Auth, -Fem] + [/u:/, -Auth, +Pl] →
 [/y:/, -Auth, -Fem] + [/u:/, -PSE, +Pl]
- b. [+PSE, -Auth, +Fem, -Pl] →
 [] + [/i:/, +PSE, -Auth, +Fem, -Pl] →
 [/t/;] + [/i:/, +PSE, -Auth, +Fem, -Pl]
- yi-zrEa-u: 3PlMasc
 ti-zrEa-i: 2SgFem

- c. [+PSE, -Auth, -Fem, -Pl] →
 [/t/;] + [+PSE, -Auth, -Fem, -Pl]
- d. [+PSE, +Auth, +Fem, +Pl] →
 [/n/; +Auth, +Pl] + [+PSE, +Fem]
- [ti-zroq 2SgMasc
 ni-zroq 1PlFem/Masc]

As explained above, Fission involves the generation of a subsidiary morpheme into which are copied the features remaining unmatched in earlier steps. Thus, as illustrated in (26a) with the morpheme of the 3PlMasc – i.e., [-PSE, -Auth, -Fem, +Pl] – the first item to be chosen from (25) is the suffix /u:/, Insertion of this item copies the unmatched features [-Auth, -Fem] onto the subsidiary morpheme. The prefix /y/ is inserted into the subsidiary morpheme and since only a single iteration of Fission is admitted, the derivation comes to an end.⁸

Consider next the 2SgFem morpheme in (26b). Since all four phi features of the Hebrew verb figure in the first Vocabulary item /i:/ in (25), no feature remains to be copied onto the subsidiary morpheme. The featureless node however can – and therefore must – host the default prefix /t/, thus yielding the correct output.

The 2SgMasc morpheme in (26c) can host only the default /t/ prefix. As shown in (26c) this will generate a subsidiary morpheme containing all the features of the original morpheme into which the default prefix can be inserted, generating the plainly incorrect output /ti-ti-zroq/. To prevent this from happening I posit the language-specific prohibition (27).

- (27) Imperfect forms may include only one Prefix

Prohibition (27), which holds also in other Afro-Asiatic languages, prevents the generation of prefix sequences in all other suffix-less forms of the Imperfect paradigm, including the 1Pl form, which is illustrated in (26d).

As Noyer points out (1992, 105) the Imperfect conjugation is very ancient; it is attested in the earliest records of Akkadian, which date from 2500 BC. It is moreover found in numerous other Afro-Asiatic languages and therefore constitutes one of the main bits of evidence for the existence of this language family. Below I review some of this evidence in an attempt to show that the machinery introduced to this point readily handles the additional data.

(28)

Egyptian Arabic	Singular	Plural
1	ʔa-ktib	na-ktib
2m	ti-ktib	ti-ktib-u
2f	ti-ktib-i	ti-ktib-u
3m	yi-ktib	yi-ktib-u
3f	ti-ktib	yi-ktib-u

⁸ Here and in other examples in this section I have omitted the post-prefixal vowel which is inserted by phonological rules that differ somewhat in the different languages.

I begin with the Egyptian Arabic paradigm in (28). As a comparison with (23b) shows there are two main differences between Egyptian and Hebrew. First, Egyptian lacks the /na/ suffix in the Plural Feminine forms. Formally this is captured by the simple expedient of not listing this item in the Egyptian analog of (25). Second, in Egyptian the /y/ prefix is not limited to 3Masc forms, but occurs also in 3PlFem forms. We express this formally by generalizing the /y/ entry to all 3Person forms. (Cf. 22a) We prevent insertion of /y/ in the 3SgFem by positing the Impoverishment rule (29b).⁹

- (29) a. /i/ ↔ [+PSE, -Auth, +Fem, -Pl] Suff
 /n/ ↔ [+Auth, +Pl] Pref
 /u/ ↔ [+Pl] Suff
 /y/ ↔ [-PSE] Pref
 /ʔ/ ↔ [+Auth] Pref
 /t/ ↔ elsewhere Pref
 b. Delete [-PSE] in env. [____ +Fem, -Pl]

It is worth noting that like Hebrew, Egyptian Arabic is subject to condition (27). In fact, as will be seen below, the prohibition against multiple prefixes in the Imperfect is common to all Afro-Asiatic languages reviewed here.

The Imperfect conjugation of Beja, a Northern Cushitic language spoken in the Sudan and Northern Ethiopia, is given in (30).

(30)	Beja	liw 'burn'	Singular	Plural
		1	a-liw	ni-liw
		2m	tɪ-liw-a	tɪ-liw-na
		2f	tɪ-liw-i	tɪ-liw-na
		3m	ʔi-liw	ʔi-liw-na
		3f	tɪ-liw	ʔi-liw-na

Except for the special /a/ suffix in the 2SgMasc the Beja paradigm is structurally all but identical with that of Egyptian Arabic illustrated in (28). This near identity is also reflected in the Vocabulary items of the two languages <cf. (31) and (29)> and the fact that the two languages have the same Impoverishment rule.

⁹ In view of (29b) it may be asked whether the distribution of the 3Pers prefix in Hebrew (see (23) above) should also be captured by means of an Impoverishment rule. This would allow us to eliminate the specification [-Fem] in the Vocabulary entry for /y/ in (25). This saving would, however, be counterbalanced by the cost of the Impoverishment rule "Delete [-PSE] in env. [____ +Fem]" where two features must be specified. While in the synchronic grammar of Hebrew there would thus be no motivation for Impoverishment, the Impoverishment rule is likely to have been part of the language at an earlier stage.

- (31) a. /i/ ↔ [+PSE, -Auth, +Fem, -Pl] Suff
 /a/ ↔ [+PSE, -Auth, -Pl] Suff
 /n/ ↔ [+Auth, +Pl] Pref
 /na/ ↔ [+Pl] Suff
 /y/ ↔ [-PSE] Pref
 /a/ ↔ [+Auth] Pref
 /t/ ↔ elsewhere Pref
 b. Delete [-PSE] in env. [____ +Fem, -Pl]

The Imperfect paradigm of MeHri, a language spoken by small populations in Yemen and Oman, is shown in (32), where /E/ stands for schewa and the /i/ in angled brackets indicates that it appears only in some forms.

(32)	MeHri	Singular	Dual	Plural
	rɛz 'straighten'	1 ɛ-ru:kɛz	ɛ-rɛkz-o:	nɛ-ru:kɛz
		2m tɛ-ru:kɛz	tɛ-rɛkz-o:	tɛ-rɛkz-əm
		2f tɛ-rɛ:kɛz<i>	tɛ-rɛkz-o:	tɛ-rɛkz-ən
		3m yɛ-ru:kɛz	yɛ-rɛkz-o:	yɛ-rɛkz-əm
		3f tɛ-ru:kɛz	tɛ-rɛkz-o:	tɛ-rɛkz-ən

Since Mehri distinguishes three numbers, the [±Plural] feature is supplemented here by the feature [±Singular] as shown in (33).

(33)	Singular	Sg	Du	Pl
	Plural	+	-	-
		-	-	+

The Vocabulary items of the Imperfect paradigm in MeHri are shown in (34), where schewa is represented by E, and a rule of the phonology is assumed to replace word initial /a/ by E.

(34)	/i/	↔	[+PSE, -Auth, +Sg, -Fem] in env. XYZ	Suff
	/n/	↔	[+Auth, +Pl]	Pref
	/o:/	↔	[-Sg, -Pl]	Suff
	/En/	↔	[+Pl, +Fem]	Suff
	/y/	↔	[-PSE, -F]	Pref
	/a/	↔	[+Auth]	Pref
	/En/	↔	[+Pl]	Suff
	/t/	↔	elsewhere	Pref

The similarities between (34) and the lists of the other languages presented above is readily apparent. Like Hebrew, MeHri has no Impoverishment rule for 3Pers affixes. I have illustrated in (35) the derivation of the three 1Pers forms of Mehri.

- (35) a. [+PSE,+Auth,-Sg,+Pl,±Fem] →
/n/; +Auth,+Pl] + [+Pse,-Sg,±Fem] nE-ru.kEz 1Pl
- b. [+PSE,+Auth,+Sg,-Pl,±Fem] →
/a/; +Auth] + [+Pse,+Sg,-Pl,±Fem] E-ru.kEz 1Sg
- c. [+PSE,+Auth,-Sg,-Pl,±Fem] →
[+PSE,+Auth,±Fem] + /o/; -Sg,-Pl] →
/a/; +Auth] + /o/; -Sg,-Pl] + [+PSE,±Fem] E-ʔE.kEz-o: 1Du

The 1Pl morpheme in (35a) is host to the prefix /n/, which matches the features [+Auth,+Pl]. The subsidiary morpheme contains the features [+PSE,-Sg,±Fem] into which none of the items in (34) can be inserted; Insertion of /t/ is blocked by (27).

The derivation of the 1Sg morpheme in (35b) is quite similar. The morpheme hosts only the NULL prefix and (27) prevents the insertion of the Elsewhere prefix in the subsidiary morpheme.

The derivation of the 1Du in (35c) begins with the insertion of the [-Sg,-Pl] suffix /o:/ and the fissioning off into the subsidiary morpheme of the features [+PSE,+Auth,±Fem]. This morpheme can host the [+Auth] prefix, which is inserted next and blocks insertion of the elsewhere prefix /t/.

I have illustrated in (36a) one of the three prefixal paradigms of Classical Arabic. I have chosen the Jussive here since it is the simplest of the three and reveals most readily similarities to the other paradigms discussed above. The Vocabulary entries for Classical Arabic and its Impoverishment rule are given in (36b).

(36)	a.	Singular	Dual	Plural
	1	ʔ-aktub	n-aktub	n-aktub
	2m	t-aktub	t-aktub-aa	t-aktub-uu
	2f	t-aktub-ii	t-aktub-aa	t-aktub-na
	3m	y-aktub	y-aktub-aa	y-aktub-uu
	3f	t-aktub	t-aktub-aa	y-aktub-na
	b.	/ii/ ↔ [+Pse,-Auth,+Sg,-Fem]	Suff	
	/n/	↔ [+Auth,-Sg]	Pref	
	/aa/	↔ [-Sg,-Pl]	Suff	
	/na/	↔ [-Sg,+Fem]	Suff	
	/y/	↔ [-Pse]	Pref	
	/ʔ/	↔ [+Auth]	Pref	
	/uu/	↔ [-Sg]	Suff	
	/t/	↔ elsewhere	Pref	
	c.	Delete [-Pse] in env. [____,+Fem,-Sg]		

This concludes our survey of the Imperfect conjugation in the Afro-Asiatic languages. A comparison of the Vocabulary entries for the five languages reveals striking similarities. All five languages are subject to the prohibition (27) against multiple prefixes. In all five languages there are four Vocabulary items competing for insertion

in the prefix position. These are /n/ 1Pl; /ʔ/ <or its direct phonetic reflex> 1Sg; /t/ is the default prefix, and only /y/ is the exponent of somewhat differing grammatical feature complexes in the different languages: in Classical Arabic, Beja and Egyptian Arabic the /y/ prefix is the exponent of the 3Pers with certain exceptions that are formally expressed by an Impoverishment rule, whereas in Hebrew and Mehri /y/ is the exponent of 3PersMasc and there is no Impoverishment.

The similarities in the suffixes are only slightly less striking. All five languages have the /i/ suffix in the 2SgFem; they also share the fact that there is no suffix in the 1Pl, but in all other Plural forms there is a suffix. There is also no suffix in the 1Sg and the 3Sg, but languages differ with regard to suffixation in the 2SgMasc.

Most important from the theoretical perspective of this paper is the important role that Fission plays in the Imperfect conjugation of all the languages surveyed here. The fact that the same principles govern the data of languages widely separated both in time and space must be counted as strong evidence for the reality of these principles.

6. Walbiri

A different test for the principles of Distributed Morphology is provided by the Australian language Walbiri, which has become relatively well-known due to the extensive investigations of K. Hale. The information that is basic to this discussion is that in Hale (1973); it has been supplemented with data and suggestions provided by Hale (pc). Hale's (1973) paper is remarkable not only for its data, but also for its theoretical foresight: Hale's treatment of the data anticipates in many ways the theoretical positions of Distributed Morphology.

The Walbiri verb has a bi-partite structure consisting of an auxiliary and a main verb. The main verb is composed of a stem followed by a Tense-Aspect suffix. According to Hale the auxiliary, which is the topic of main interest here, is "enclitic to the first nonauxiliary constituent of the sentence. The auxiliary is unstressed and, particularly, where the base is monosyllabic or empty, it forms a prosodic unit with the preceding word." Hale notes that "<t>his refers not only to the behavior ... with respect to stress and intonation ... but also to the phenomenon of vowel assimilation." (p. 313) Hale observes that where the base of the auxiliary is disyllabic or longer, it may optionally appear in sentence-initial position. He concludes therefore that "the auxiliary is basically initial in Walbiri and that it is moved into second position by ... rule." (p. 312) Except for this restriction on the positioning of the auxiliary, word order in Walbiri is essentially free.

The auxiliary is composed of a Tense morpheme followed by one or more Agr morphemes. The Vocabulary items competing for insertion in the Tense morpheme of the auxiliary are given in (37) (cf. p. 310)

- (37) kapi ↔ Future
 ka ↔ Present
 lpa ↔ Past
 NULL ↔ elsewhere

As shown in (38) the pronominal system of Walbiri is based on the same two features as those of more familiar languages. The Walbiri system differs from that illustrated in (9) above in that it makes full use of its two features to define four distinct persons. As noted in sec. 2 the fourth person refers to a set of individuals that includes both the author of the speech event *and* one or more nonparticipants; i.e., "I and he/they, but not you." Hale terms these "IPers Exclusive" pronouns, I shall call them here simply 4Pers.

- (38)
- | | | | | |
|-----------------------------|-----|---|---|---|
| | 1 | 2 | 3 | 4 |
| Participant in Speech Event | PSE | + | + | - |
| Author | | + | - | + |

The Walbiri verb expresses three grammatical numbers: singular, dual and plural. The feature composition of the three numbers is identical with that given in (33) for the Afro-Asiatic languages. As there are four pronominal categories and three numbers we would expect Walbiri to have 12 personal pronouns. However, as remarked in sec. 2, since no single individual can be both Author of a Speech Event as well as a Nonparticipant, a Singular 4Pers pronoun designates a logical impossibility. There are, therefore, only 11 distinct pronouns in Walbiri.

As noted above, in addition to a Tense morpheme the auxiliary includes one or more Agr morphemes. In normal intransitive clauses there is only a single Agr morpheme reflecting the features of the subject. In transitive sentences the auxiliary normally has two Agr morphemes: one for the subject and one for the object. Finally in certain transitive sentences with a benefactive, such as "I'm looking for a boomerang for you" (Hale 1973, p. 335), the auxiliary includes three Agr morphemes. The structure of the auxiliary is given in (39), where elements enclosed in angled brackets are optional.

- (39)
- ```

 Aux
 / \
 T Agr
 / \
 AgrS <AgrO> <AgrB>

```

In a sentence each Agr slot is composed of different combinations of the features [PSE, Auth, Sg, Pl]. As already noted there are 11 such combinations. The crucial fact for an understanding of the distribution of the different Agr exponents is that in Walbiri *Agr morphemes are subject to Fission*; i.e. to the mandatory generation of a subsidiary

morpheme onto which features unmatched in the first step of Vocabulary Insertion are copied.

The Vocabulary items competing for insertion in the AgrS morpheme are given in (40). (Cf. Hale, p. 315) Capital N, L, represent retroflex consonants.

- (40)
- |         |   |                         |           |
|---------|---|-------------------------|-----------|
| Lipa    | ↔ | [−PSE, +Auth, −Sg, +Pl] | 4Pl       |
| Li      | ↔ | [−PSE, +Auth, −Sgl]     | 4Du       |
| Litjara | ↔ | [+Auth, −Sg, −Pl]       | 1Du       |
| nku     | ↔ | [+PSE, −Auth, +Pl]      | 2Pl       |
| npa     | ↔ | [+PSE, −Auth]           | 2Sg/Du    |
| pala    | ↔ | [−Sg, −Pl]              | Du        |
| Na      | ↔ | [+Auth]                 | 1Pers     |
| lu      | ↔ | [−Sgl]                  | Pl        |
| NULL    | ↔ | [ ]                     | Elsewhere |

Each of the 11 combinations of Person and Number features can appear in the AgrS slot of an auxiliary. The derivation of a few AgrS strings is illustrated in (41).

- (41)
- |    |                           |                                            |                 |
|----|---------------------------|--------------------------------------------|-----------------|
| a. | [+PSE, −Auth, −Sg, +Pl] → | [nku/; +PSE, −Auth, +Pl] + [lu/; −Sg]      | [nku-lu] 2Pl    |
| b. | [+Pse, −Auth, −Sg, −Pl] → | [npa/; +PSE, −Auth] + [pala/; −Sg, −Pl]    | [n<pa>pala] 2Du |
| c. | [+PSE, +Auth, −Sg, −Pl] → | [Litjara/; +Auth, −Sg, −Pl] + [NULL; +PSE] | [Litjara] 1Du   |
| d. | [−Pse, −Auth, +Sg, −Pl] → | [NULL; −PSE, Auth, +Sg, −Pl] + [NULL; ]    | [ ] 3Sg         |

Like in the Hebrew examples in (23) and in those of MeHri in (32), it can be seen in (41), that features remaining unmatched in the initial insertion are transferred to the subsidiary morpheme into which other items are inserted. The main difference between Walbiri and the Afro-Asiatic languages is that the Vocabulary items of Walbiri are not affixes of the verb stem.

In (41a) the insertion of the 2[+Pl] exponent /nku/ matches all but the [−Sg] feature. This feature is transferred to the subsidiary morpheme into which the item /lu/ is inserted. In (41b) the features in the terminal are similarly split into two parts, each of which finds its own entry in the list (40). A rule of the phonology deletes the parenthesized (<pa>) before a following *pa*. In (41c) the unmatched feature is [+PSE]. Since the default item in (40) is NULL, the output is [Litjara]. In (41d) the default NULL is inserted in both steps of the derivation.

In Walbiri transitive sentences the AgrS clitic is normally followed by an AgrO clitic. The list of Vocabulary items to be inserted in the AgrO morpheme is given in (42).

|      |          |   |                      |           |
|------|----------|---|----------------------|-----------|
| (42) | tjaraõku | ↔ | [+Pse,+Auth,-Sg,-Pl] | 1Du       |
|      | õaliõki  | ↔ | [+Auth,-Sg,-Pl]      | 4Du       |
|      | palaõu   | ↔ | [-Pse,-Sg,-Pl]       | 3Du       |
|      | njara    | ↔ | [+Pse,-Auth,+Pl]     | 2Pl       |
|      | õanpa    | ↔ | [+Pse,-Sg]           | 1Pl       |
|      | õalpa    | ↔ | [+Auth,-Sg]          | 4Pl       |
|      | tjana    | ↔ | [-Pse,-sg]           | 3Pl       |
|      | õku      | ↔ | [+Pse,+Auth]         | 2Sg/Du    |
|      | pala     | ↔ | [-Sg,-Pl]            | Du        |
|      | tju      | ↔ | [+Auth]              | 1Sg       |
|      | lu       | ↔ | [+Pl]                | Pl        |
|      | NULL     | ↔ |                      | Elsewhere |

Like that of the AgrS morpheme, Vocabulary Insertion of AgrO morphemes is subject to Fission. Because the list of items for the AgrO is larger than that for AgrS there are fewer instances where two non-NULL morphemes will appear in output forms. In fact, the only AgrO where Fission is completely transparent is that shown in (43a). I have given in (43b) an actual sentence with this AgrO.

- (43) a. [+PSE,-Auth,-Sg,-Pl] → [/ŋku/;+PSE,-Auth,]/+[/pala/;-Sg,-Pl]  
 b. *najulu-Lu ka-Na-NULL-ŋku-pala nja-nji*  
 I-ERG PRES-1PERS-Sg-2PERS-DU see-NONPAST  
 'I see you two.'

As shown in (44) when the dual marker is that of the AgrS it appears to the left of the AgrO marker /tjana/. As noted above, the parenthesized string *pa* is deleted before *pa*.

- (44) *njum-pala-Lu ka-n(pa)-pala-tjana wawiri-patu nja-nji*  
 2-DU-ERG PRES-2-DU-3PL kangaroo-PAUC see-NONPAST  
 'You two see the several kangaroos.'

This straightforward behavior is, however, obscured in a number of instances. Hale observes that "whenever a subject clitic which is analyzable into a person marker followed by one of the number markers ... precedes one of the object clitic /tju/ 'I' or /ŋku/ 'you' the number marker follows rather than precedes the object clitic" (p. 328). This is illustrated in (45), where the Subject Plural exponent /lu/ appears not next to the subject marker, but is metathesized to the right of the object marker.

- (45) *njurula-Lu ka-ŋku-tju-lu natju nja-nji*  
 2PL-ERG PRES-2-1-PL 1SG see-NONPAST  
 'you (pl) see me'

Following Hale, we account for this fact with the help of a rule of Metathesis, which permutes the Number morpheme with a following /tju/ >I= or /ŋku/ >you=. It is to be

noted that the Metathesis rule must be ordered after Vocabulary insertion. Metathesis differs in this respect from the Impoverishment rules above, all of which must apply before Vocabulary insertion.

As Hale remarks (p. 328) the Metathesis rule provides important justification for Fission, for without prior fissioning there would be no Number morpheme to be moved by the Metathesis rule.

This example is of special importance because it provides motivation for Fission as a special device available to the morphology. Since the theory allows us to add items to the Vocabulary, the different cases in which Fission has been invoked have an alternative account. E.g., instead of analyzing the Latin PlG morpheme in *die-rum* as an instance of fission, as was done in sec. 4 above, it is possible to add to the list in (18) the item:

- (46) /rum/ ↔ [+Obl,+Struct,-Sup,+Pl] in env. [I,II,V] + \_\_\_\_

A reason needs to be given why recourse to Fission is to be preferred to the addition of item (46). Our first answer is basically to re-iterate Noyer's observation that in the cases where Fission is invoked the morpheme to be added is invariably composed of sequences of existing Vocabulary items. The addition of a new item would therefore fail to take explicit account of the fact that the new item literally contains items already in the list. Implicit in this answer is the further proposition that language acquisition in humans is constrained so as to force the learner to utilize maximally already existing Vocabulary items and therefore always choose Fission over the addition of a new Vocabulary item. One might think of this as a generalization of the injunction (11) to minimize the features in the Vocabulary.

The Walbiri evidence tells us that this is the right move, for in example (45), the addition of another Vocabulary item over recourse to Fission would have led to the wrong result. Specifically, by eliminating Fission and adding to the AgrS items in (42) the item

$$\eta k u l u \leftrightarrow [+PSE,-Auth,-Sg,-Pl]$$

we would be making it impossible to account for the facts in (45), for in the absence of a morpheme /lu/ the Metathesis rule would have nothing to move. There are other facts in Walbiri, in addition to Metathesis, that argue in favor of the same conclusion.

Hale writes: "It is not the case that clitic sequences correspond exactly to the possible co-occurrences of subject and object noun phrases. Thus, while it is possible of course to have a dual subject and dual object in a given sentence, it is not possible, in the auxiliary, to have subject and object clitics which are both of dual form ..." (p. 329) In the Eastern Walbiri dialect this is the result of the Impoverishment rule (47), which deletes the feature [-Pl] in auxiliaries with multiple Agr morphemes wherever both morphemes are [-Sg].



Much attention was focused on the conventions that govern Vocabulary insertion in morphemes specially marked as undergoing Fission. As illustrated above, a morpheme subject to Fission, in addition to being subject to normal insertion, generates a subsidiary morpheme into which are copied the features not matched for insertion in the first step. An exponent is then inserted into the subsidiary morpheme in the normal manner. Like Impoverishment, Fission extends the domain of the exponent of the less marked Vocabulary items at the expense of the more marked items.

In view of the intricacy of the conventions governing insertion in these cases, the limited amount of data that was presented above in support of them here cannot be dismissed as coincidental. As noted, a puzzling aspect of the process is that the linear order of the two affixes inserted into a morpheme subject to Fission is not fixed, but rather varies in accordance with principles that are yet to be understood. Additional facts and discussion bearing on this question are to be found in Harris (1996) and Hale and Halle (1997).

Last but not least, as illustrated by many of the examples discussed above, for Vocabulary insertion to yield the correct changes resulting from the application of Impoverishment, Fusion and Fission must be in place. This is an instance of *late insertion*, one of the most striking features of Distributed Morphology.

# Acknowledgments

I thank S. Bromberger, B. Bruening, K. Hale, W. Idsardi, M. McGinnis, R. Noyer, D. Pesetsky, and B. Vaux as well as audiences at Sophia Antipolis, MIT, University College London, the University of Essex, Colchester and UCLA for comments and other help on this paper.

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