

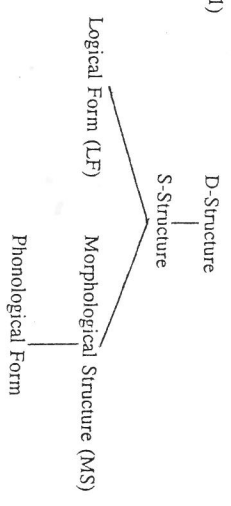
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The Morphology of Numeral Phrases

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The theoretical framework that underlies the following discussion is that of Halle and Marantz's 1993 "Distributed Morphology and the Pieces of Inflection". The fundamental conceptions of Distributed Morphology are in their essence quite traditional. The theory takes morphology to be primarily concerned with the formation of words, which are the pivotal units operated on by the phonology. The theory assumes the familiar organization of a "principles and parameters" grammar shown in (1), with the one important modification that a special level of representation Morphological Structure (=MS) is postulated between SS and PF. The main subject matter of the theory is the machinery that relates SS to MS and MS and PF. The label *Distributed Morphology* reflects the fact that this machinery is split up into a number of parts.

(1)



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Representations on all five levels are made up of nested constituents of terminal elements, which have traditionally been pictured in the form of the syntactic trees that are familiar to all. We use the term *morpheme* to designate the terminal elements of these syntactic trees. We assume further that morphemes are complexes of features of various kinds: semantic, syntactic, morphological, and phonological. While there are morphemes at all levels of representation, the feature content of a given morpheme does not characteristically remain invariant in the different representations of a given sentence. As we shall see, like the feature composition of a phoneme, the feature composition of a morpheme is not fixed once and for all, but can change to a limited extent in the course of the derivation. In addition, the operations of head movement and merger may rearrange the constituent structure of the sentence as well as alter the linear order of its morphemes. Finally, morphemes may be added to or be removed from the terminal string; a given morpheme may fuse into several distinct morphemes, or conversely several morphemes may fuse into a single morpheme. As a result the representations of a given sentence at the five levels in (1) may exhibit dramatic differences both in the organization of its morphemes into constituents as well as in the feature content of the individual morphemes. The extent of these differences, however, is mitigated by the limited power of the operations that are responsible for them and by the fact that a cost is associated with each operation.

To illustrate, Subject-Verb agreement in many languages is implemented by inserting an AGR node as an adjunct of the Tense node, and the so-called Phi-features of the Subject -- i.e., gender, person, number etc. -- are copied onto the AGR node. This is the situation in both Russian and English. There is, however, an obvious difference between English and Russian in their treatment

of the Tense and AGR morphemes. In both languages an AGR morpheme is adjoined to the Tense morpheme at MS. In Russian the two morphemes remain separate as shown in (2a), whereas in English they fuse into a single morpheme as shown in (2b).

(2) a.	stoj	-i	-m	nes	-i	-i
	stand	Pres.	1.Pl.	carry	Past	Pl.
b.	divide	-s		divide	-d	
	Pres.;	3.Sg		Past		

Although differences of the kind illustrated in (2) are of crucial importance for the morphology and phonology of the respective languages, they play no known role in DS, SS, or LF. This fact is reflected in the Distributed Morphology framework by consigning operations such as Tense-AGR fusion and the insertion of phonological features into these morphemes to the morphology, specifically to the part of the grammar that relates SS to MS. An immediate consequence of this decision is that inflectional morphemes such as Past, 1. Sg., Pl. obtain their phonological features only *after* the processes of Agr insertion and Tense-Agr fusion have applied.

Phonological features are supplied to different morphemes by means of Vocabulary Insertion.² As illustrated in (3) each

²The term *Vocabulary* is used here for the more traditional *Lexicon* or *Dictionary* to distinguish the DM conception of the list of morphological primitives from that of competing theories of morphology. For more details see Halle and Marantz 1993, 1994.

Vocabulary entry consists of a complex of semantic, syntactic and morphological features that is paired with a complex of phonological features, which includes, importantly, phonological zero. At the point of Vocabulary Insertion the features of an entry are copied onto the morpheme in the terminal string, subject to the condition that the features and contextual restrictions specified in the entry constitute a subset of the features in the node where it is inserted. As shown in (3a, b) insertion may in addition be subject to contextual restrictions. As a consequence of the "subset" requirement, insertion will not occur if a feature specified in the entry is not present in the target morpheme, nor will insertion occur if a feature specified in the entry conflicts with those of the target node. A further consequence of the subset requirement is that the syntactic and semantic features present in the terminal string serve as identifying indexes for the Vocabulary item to be inserted in the particular node.

I have given in (3) part of the English Vocabulary entries that are inserted in the fused Tense-AGR morpheme. The features serving as identifying indexes are given on the right hand of the double headed arrow, the (phonological) features supplied by Vocabulary insertion appears on the left.

- (3) a. zero <---> [+Past] in env. [+Strong] + _____
- b. /-v/ <---> [+Past] in env. [+Irregular] + _____
- c. /-d/ <---> [+Past]
- d. /-z/ <---> [3. Sg]
- e. zero <---> ... <elsewhere>

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The entry (3a) is inserted into the fused Tense-AGR morpheme having the feature [+Past] if it follows a verb stem belonging to the diacritic class of [+Strong] verbs in English. These are verbs such *hit*, *put*, *swim*, *freeze*, etc., which take the zero suffix in the Past tense. The entry (3b) is inserted after stems of the [+Irregular] class; i.e., stems such as *buy*, *mean*, *keep*, *teach*, etc., which take the /V/ suffix in the Past tense.

By hypothesis each morpheme in the terminal string is subject to Vocabulary Insertion. In cases where several Vocabulary entries can be inserted in a given terminal morpheme, the entry listed earliest is given preference over the rest. Thus, both /-V/ and /-d/ can be inserted into the Tense-AGR morpheme that is specified as [+Past], but being listed earlier, /-V/ insertion (3b) is given preference over /-d/ insertion (3d). The order of listing is determined by the well-known Panini-an principle that the most on insertion -- takes precedence over the rest. The entry /-V/ is therefore listed before /-d/ in (3) because /-V/ can be inserted only after a verb stem belonging to a special diacritic class, whereas /-d/ has no such restriction. Additional considerations are invoked to establish a unique order among all entries in the set. For some discussion of the "additional considerations", see Noyer 1991.

As already remarked, to be inserted in a terminal morpheme a Vocabulary entry need not contain all features that figure in the terminal morpheme; for insertion to take place it is sufficient that there be no conflicting feature in the entry. Thus, although in English all person and number features are copied onto the AGR node, it is only the 3. person sg. complex that is relevant for the insertion of the morphemes in (3).

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It is not necessary that the entries for functional heads such as Tense, AGR or Number should always be affixes. For example, Dryer 1989 has drawn attention to several languages -- e.g., Yapeese, Tongan, Kimaghana, Cayuvava -- where number is expressed by a word stem rather than by an affix, and in an unpublished paper Joyce McDonough has argued that in Navaho the INFL morpheme is a word stem rather than an affix. Admittedly, these are somewhat exceptional cases for which the precise reasons remain to be elucidated, but they illustrate clearly that functional heads do not figure as affixes everywhere.

While the distinction between stem and affix appears to play no role in DS, LF, and SS, the distinction is, of course, central to the operation of the morphology and the phonology. In Distributed Morphology this fact is reflected formally by postulating that Vocabulary Insertion is part of the operations relating SS to PF. This feature of the organization of a grammar immediately explains the well-known fact that phonological, as well as morphological properties of Vocabulary items are of no relevance to the syntax. They play no role at DS, SS, LF for the simple reason that they are not available at these levels.

The morphemes that figure as terminal nodes in DS, SS, LF are therefore not Vocabulary items, but complexes of syntactic, semantic and grammatical features into which Vocabulary entries are inserted at MS. These complexes are limited by UG, on the one hand, and by the speaker's imagination, knowledge of the world, etc. on the other. Speaking non-technically one might say that the morphemes at DS, SS, and LF are *concepts*, which are converted at MS into *words* by Vocabulary Insertion.

And so to some facts. The facts to be reviewed concern numerals in Hebrew and Russian: Hebrew first, because it is a bit simpler.

On Hebrew Numeral Phrases

In Hebrew, number is expressed by suffixation. The unmarked suffixation pattern is that given in (4), where the ending of the Singular Masculine represents a phonological zero.

(4)

	Singular	Plural
Feminine:	par-A ³	par-ot 'cow'
Masculine:	sus-Ø	sus-im 'horse'

A fundamental distinction between nouns and adjectives is that nouns have inherent Gender, whereas adjectives universally lack both inherent Gender and Number and obtain their gender and number from the noun that they modify. (For some discussion see Aronoff 1994.) I shall use the term Concord Rule to refer to the machinery that establishes Number-Gender-Case-Arimacy-etc. agreement among a noun and its determiners and adjectives. I unfortunately have little to say at this point about the precise manner in which Concord is established in Hebrew or in any other language beyond recording the fact that Gender (and in Russian also Arimacy) is copied by Concord from the stem of the head noun onto the stems of the determiners, numerals, and adjectives that modify this noun. In addition, the Number (and in Russian also the Case) of the entire NP (DP) is adjoined to the head noun and then copied by Concord as a suffix onto its modifiers.

³The capital letter A represents here the class of feminine singular suffixes. It would have been more correct to represent these as /l/, since this phoneme actually surfaces in the majority of contexts. In fact, the /l/ is deleted only after /a/ in the "absolute" state. Since none of these morphophonological matters has any bearing on the issues under discussion here, I have passed over them in the exposition by the typographical expedient of representing the feminine singular suffix by the capital letter A.

The rules of the Morphology fall into two major classes with regard to their effects. There are, on the one hand, *redundancy* rules; i.e., rules that add information to the representation, but cannot change the values of any of the features already present. The Concord rule is a typical redundancy rule, and as we shall see its inability to change previously specified information is crucial to its proper functioning.⁴ The second class of rules are the *readjustment* rules, which are not restricted to filling in absent information, but can and do modify the feature composition of the morphemes that make up the sequence. Examples of typical readjustment rules are the ablaut rules that change the stem vowel in different forms of the English verb, as in *begin-began-begun*, *write-wrote-writ-en*, *break-broke-brok-en*, *buy-bought*, *bought-t*, etc. The readjustment rules are not limited to changing phonological features, they can also change morphological features as I shall now illustrate.

As shown in (5), adjectives in Hebrew have the same number suffixes as the nouns.

(5)

	Singular	Plural
Fem:	par-A	par-ot
Masc:	Tov-A	Tov-ot
	Tov-Ø	Tov-im
		'good cow(s)'
		'good horse(s)'

⁴ In view of its inability to change features previously specified in the representation Concord can be implemented formally either by a well-formedness condition on terminal strings or -- as is done here -- by a set of special rules. I have opted for the latter treatment because I do not see at this point how to extend the former treatment to the characterization of the relationship between gender and inflection, which shares with Concord the crucial property of being unable to change previously specified features.

To reflect these facts formally we postulate that Concord copies the gender of the head noun on to the stem morpheme of the modifying adjective and also adjoins the number suffix to the noun and to the adjective. In (6) I have illustrated the effect of Concord in (6) on the phrase meaning 'good cows'.

(6)

[[[par] - [Tov]] - [+PI]] ---> [[[par] - [+PI]] - [[Tov] - [+PI]]]
 [+Fem] [+Fem] [+Fem]

The language has the four Vocabulary entries in (7) competing for insertion into the number suffix of both nouns and adjectives.⁵

(7) /oʔ/ <--> [+PI] in env. [+Fem] + ___
 A <--> ... in env. [+Fem] + ___
 /m/ <--> [+PI] in env. [+Fem] + ___
 zero <--> ... <elsewhere>

While there are no irregularities among adjectives in the realization of the number suffix, there are a fair number of irregularities among both feminine and masculine nouns. These are illustrated in (8).

⁵As noted above, like all other terminal morphemes, inflectional suffixes are subject to Vocabulary insertion. Phonological zero is included among the suffixes and functions on a par with the others as a reflex of the Hebrew number suffix.

(8)

	Singular	Plural	
Feminine:	kan-A	kan-im	'year'
	ʔerec-∅	ʔarec-ot	'land'
	ʔir-∅	ʔar-im	'city'
Masculine:	nahar-∅	nEhar-ot	'river'
	layl-A	leyl-ot	'night'

The irregularities in (8) are of a single kind, i.e., the noun in question has the number suffix that normally is assigned to nouns of the opposite gender. Thus, since *kan-A* 'year' is a feminine noun, we should have expected its plural to be *kan-ot*, instead we find it to be *kan-im*, which is the regular plural of masculine nouns. Given the Vocabulary entries in (7) the natural move to account for the aberrant forms in (8) is by postulating readjustment rules that switch gender in the noun either in the plural or in the singular or in both numbers. Specifically, we postulate the Gender Switch rule (9), consisting of a pair of readjustment rules, each of which applies to a list of stems.⁶

⁶The switch from [+Fem] to [-Fem] is much more common than its inverse. (In fact, *layl-A* 'night' is unique among masculine nouns in switching gender in the singular.) In view of this fact as well as of the important role played in the morphology by 'Improvement' rules -- i.e., rules deleting features (for more discussion see Halle and Marantz 1994) -- Gender Switch might be treated with the pair of rules (i) in place of (9).

(i) a. [-Fem] --> [+Fem] in env. [X, ___] + <[+PI]>
 where X = *nahar* ... <*layl*>
 b. [+Fem] --> 0 in env. [Y, ___] + [-PI]
 where Y = *ʔerec* ...
 in env. [Z, ___] + <[+PI]>
 where Z = *kan* ... <*ʔir* ... >

(9) [a fem] --> [-a fem] a. in env. [X,] + [-PI]
 where X = *ʔerec*, ... *layl*, *ʕir*, ...
 b. in env. [Y,] + [+PI]
 where Y = *nahar*, *ʕan*, ... *layl*, *ʕir*, ...

The proposed analysis is illustrated in (10).

(10) Masc	Fem	
sus/-im	par-A/-ot	regular
nahar/-ot	ʕan-A/ʕan-ot	(9a)
---	ʔerec/ʔarac-ot	(9b)
layl-a/lejl-ot	ʕir/ʕar-im	(9a/b)

As illustrated in (11) the gender of adjectives is unaffected by the effects of the Gender Switch rule (9) since no adjectives are listed in (9). This reflects the fact that the gender of an adjective is determined in all cases by the underlying gender of the noun that the adjective qualifies.

(11) Singular	Plural	
nahar-Ø Tov-Ø	nEharot Tov-im	'good river' -Fem
layl-A Tov-Ø	lejl-ot Tov-im	'good night' -Fem
ʕan-A Tov-A	ʕan-im Tov-ot	'good year' +Fem
ʔerec-Ø Tov-A	ʔarac-ot Tov-ot	'good land' +Fem
ʕir-Ø Tov-A	ʕar-im Tov-ot	'good city' +Fem

The sets of items enclosed in angled brackets switch Gender regardless of Number. Because (9) can be generalized more straightforwardly than (i) to include certain numeral phrases discussed below in (17), I have chosen (9) rather than (i) as the proper account of Hebrew Gender switch.

We capture this fact formally by postulating that Concord applies before the Gender Switch rule (9). In this way the inherent Gender of the noun is spread to the adjective. The Gender of the noun is then changed by rule (9).

This brings us -- finally -- to the point of this part of our story, the behavior of Hebrew numerals. Unlike adjectives, Hebrew numerals (other than *ʔeHad* 'one') precede the noun rather than follow it. In this respect the numerals behave like quantifier expressions such as *kama* 'several, how many', *harbe* 'many, much', *kol* 'all, every'. This is illustrated in (12) with phrases meaning '100, resp. 300, 30, 3 good z' where z = cows, years, horses, nights."

(12)

Fem:		
meʔ-A par-ot Tov-ot	meʔ-A ʕan-im Tov-ot	
ʕaloʕ me-ot par-ot Tov-ot	ʕaloʕ me-ot ʕanim Tov-ot	
ʕeloʕ-im par-ot Tov-ot	ʕeloʕ-im ʕan-im Tov-ot	
ʕaloʕ par-ot Tov-ot	ʕaloʕ ʕan-im Tov-ot	
Masc:		
meʔ-A sus-im Tov-im	meʔ-A lejl-ot Tov-im	
ʕaloʕ meʔ-ot sus-im Tov-im	ʕaloʕ meʔ-ot lejl-ot Tov-im	
ʕeloʕ-im sus-im Tov-im	ʕeloʕ-im lejl-ot Tov-im	
ʕeloʕ-A sus-im Tov-im	ʕeloʕ-A lejl-ot Tov-im	

We notice that the numeral *meʔ-A* 'hundred' behaves like an ordinary noun of feminine gender. It takes the suffix *-A* in the singular, and *-ot* in the plural. We can be sure that *meʔ-A* is not an adjective, since *meʔ-A* always precedes the noun, whereas adjectives always must follow it, as shown in (13) by the numeral *ʔeHad* 'one', the sole adjectival numeral of the language.

- (13) par-A Tov-A ?aHhat šan-A Tov-A ?aHhat
 sus-Ø Tov-Ø ?eHhad layl-A Tov-Ø ?eHhad

We now inquire as to how in the light of the preceding a numeral such as *šelošim* '30' is to be analyzed. The form looks quite familiar. The suffix *-im* indicates that this is a masculine plural noun, and, as shown by the second and fourth set of examples in (12), its base *šaloš* is also in the language and has the meaning 'three'. In fact, the numerals from 'three' to 'nine' appear in such double forms. As shown in (14) the singular has the meaning of the single digit, whereas the plural has the meaning of the corresponding decade. The numeral for 'ten' *gešer* also participates in this pattern, except that its plural *gešr-im* means not 'hundred', but 'twenty'.

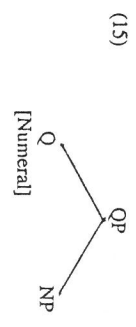
- (14) šaloš '3', šeloš-im '30', Gešer '10', Gešr-im '20'
 ?arbaš '4', ?arbaš-im '40'

The inference to be drawn from the facts just reviewed is that the Vocabulary entries for the decades are typical pluralia tantum, nouns like English *people, scissors, trousers*, etc. which can only figure in the plural, whereas their single digit counterparts are singularia tantum, i.e., nouns that can only figure in the singular.⁷

⁷The Hebrew counterparts of the last two English words cited above are also plurals (more accurately, duals, as shown by the special /-ay-/ suffix), i.e., *mitšeray-im* 'scissors', *mitšaray-im* 'trousers'. In addition, the language has several pluralia tantum of its own: e.g., *pan-im* 'face'.

Interestingly, Hebrew given names appear to be singularia tantum, as shown by the fact that they cannot be used in the plural ever. Thus, the word for word translation into Hebrew of the English question 'how many Davids are there in

I assume that the Hebrew numeral phrase is a special type of Quantifier phrase, where the NP is the complement of a (Quantifier)-morpheme, into which can be inserted either numerals or quantity expressions. I have illustrated this in (15). (See Franks (to appear) for a similar proposal about the structure of the quantity expressions.)



The Vocabulary entries competing for insertion in the Q-morpheme would then constitute a list like that in (16).

- (16) /šaloš/ + [-P] <--> [Q] '3'
 N_i, -Fem
- /šaloš/ + [+P] <--> [Q] '30' . . .
 N_i, -Fem
- /meʔ/ + [-P] <--> [Q] '100' . . .
 N_i, +Fem
- ?eHhad/ <--> [Q] 'one'
 Adj
- /kol/ <--> [Q] 'all, every' . . .

⁸your nursery school? receives several question marks, if not outright stars, from my informants.

Implicit in this proposal is the assumption stated above that the syntax proper does not deal with Vocabulary items such as those in (16), but rather with feature complexes containing all and only those syntactic, semantic and morphological features that are relevant for DS, SS, and LF. These clearly do not include such phonological information as that the Hebrew numeral meaning '3' begins and ends with the phoneme /s/, nor do they include such morphological information that '3' in Hebrew is a noun, rather than an adjective, or that it is of masculine, rather than feminine Gender. The obvious repository for this information, which must be memorized by the speaker for each morpheme in the language, is the Vocabulary. By postulating that Vocabulary Insertion takes place at MS rather than at DS or at any of the other syntactico-semantic levels, Distributed Morphology reflects the fact that phonological and morphological properties of morphemes play no role in either syntax or semantics.

To conclude this account of the Hebrew numerals, the manner in which Gender is reflected in a numeral phrase needs to be examined. Numerals normally undergo Concord. In Hebrew this is transparently so in the case of the numeral *ʔehad* 'one', which is an adjective. I have argued, however, that the other numerals in Hebrew are nouns, and since nouns have inherent Gender we do not expect the Gender of the head noun to be assigned to these numeral by the Concord rule since Concord is a redundancy rule and cannot change previously specified features. This expectation is fully borne out for all numerals that are plurals as well as for the numeral *meʔa* 'hundred' and *ʔelef* 'thousand'. As illustrated in (12), the singular numerals (*šalōš* '3', etc.) are an exception to this; they reflect the gender of the head noun; however, they do so in a manner that is the opposite of what would normally have been expected. The zero ending, which is the regular masculine suffix, appears only with feminine nouns, whereas the regular feminine

ending /-A/ appears with masculine nouns. Thus, we have

šalōš-∅ Par-ot Tov-ot šalōš-∅ kan-im Tov-ot
 šEloš-A sus-im Tov-im šEloš-A ley/-ot Tov-im

Since Gender assignment here cannot be attributed to Concord, the simplest explanation is that the numerals in these phrases are subject to the Gender Switch rule (9). Formally this is implemented by adding to (9a) the subrule (17)

(17) a'. in env. [[Z ___] + [-Pl]] + [[-Fem]]
 where Z = '3', '4' ...

Observe, that Gender Switch in the numeral must be ordered before Gender Switch in other nouns, because as indicated in (17) Gender Switch in numerals applies only if the noun heading the numeral phrase is masculine. Crucially, this refers to the Vocabulary gender of the noun, rather than to its gender as modified by Gender Switch. Since the context in which (17) applies is more complex than that of the two subrules in (9), the Paninian rule ordering principle will order (17) before the other two subrules. Thus, this somewhat subtle bit of rule interaction falls out automatically from principles and rules independently motivated.

I have illustrated the preceding with the derivations in (18).

(18)a.

<u>Input</u>	year	good
3	šan	Tov] [+P]]
[šaloš	šan	Tov] [+P]]
[-F]-[-P]]	[+F]	

Concord (spreads gender and number)
 šaloš šan Tov
 [-F]-[-P]] [+F]-[+P]] [+F]-[+P]]

Gender Switch (17) and (9) (applies to underlined morphemes)
 šaloš šan Tov
 [-F]-[-P]] [-E]-[+P]] [+F]-[+P]]

Vocabulary Insertion of Suffixes: (6)
 šaloš-Ø šan - im Tov - ot
 [-F]-[-P]] [-F]-[+P]] [+F] - [+P]]

(18)b.

<u>Input</u>	night	good
3	layl	Tov] [+P]]
[šaloš	layl	Tov] [+P]]
[-F]-[-P]]	[-F]	

Concord (spreads gender and number)
 šaloš layl Tov
 [-F]-[-P]] [-F]-[+P]] [-F]-[+P]]

Gender Switch (17) and (9)
 šaloš layl Tov
 [+E]-[-P]] [+E]-[+P]] [-F]-[+P]]

Vocabulary Insertion of Suffixes: (6)
 šaloš-A layl-of Tov - im
 [+F]-[-P]] [+F]-[+P]] [-F]-[+P]]

The derivations (18) begin at the point where Vocabulary items have been inserted into the stem morphemes, but not yet into the suffixes. This two-step Vocabulary Insertion is required by the following considerations. For Concord to operate properly information about both the Gender and Number of the head noun must be available, for it is these features that are spread by Concord. Since Gender is an inherent property of each individual noun, stem insertion must precede Concord. Moreover, the inherent Gender and Number of the Hebrew numerals is not affected by Concord. This follows immediately if stem insertion into the numeral node precedes Concord. Like all Readjustment rules, Gender-Switch (17, 9) is ordered after all Redundancy rules, including Concord. This ordering also explains the fact noted above that the Gender spread by Concord is the inherent Gender of the noun, not the surface Gender resulting from Gender Switch. As already remarked, although the outcome of the derivation crucially depends on the fact that the Hebrew numeral for '3' is a masculine singular noun, this fact is of no greater relevance for the computation of the logical form of the phrase than the fact that the Hebrew numeral begins with the phoneme /s/. Both of these facts are formally expressed in Distributed Morphology by including Vocabulary Insertion as part of the machinery that relates SS to PF. The facts of Russian numeral phrases, to which we now turn, lend further support to this proposition.

The Russian Declension

Every Russian noun belongs to one of two major Genders: [+Fem] and [-Fem]. [-Fem] nouns are further subdivided into [+Neut] and [-Neut]. Gender is conventional, except for nouns designating living beings, whose Gender is usually correlated with sex. In addition to Gender, Russian nouns are categorized with regard to animacy, which at least in some instances is conventional rather than natural. Thus, as noted by Garde 1980, the nouns *bakterija* 'bacteria', *usritca* 'oysters' are grammatical inanimates, whereas *pokojnik* 'deceased', *kukla* 'doll', *konek* 'knight' (chess piece), *uz* 'ace' (card) are grammatically animate.

Russian noun also belong to one of four declension classes. This is illustrated in (19), where Class IV is the class of indeclinables.⁸

(19):	I	II	III	IV
	[+Fem] [+Anim]	ženščin(a) 'woman'	lošad' 'horse'	Karmen 'Carmen'
	[+Fem] [-Anim]	knig(a) 'book'	ploščad' 'square'	saljami 'salami'
	[-Fem] [-Neut] [+Anim]	mužčin(a) 'man'	čar' 'sart'	kengurnu

⁸ A few marginal declension classes such as that of the numeral nouns *sorok*, *dyvanosio*, etc. are disregarded here.

[-Fem]	vopros	put'	kofe
[-Neut]	'question'	'way'	'coffee'
[-Anim]			
[-Fem]	okn(o)		pal'to
[+Neut]	'window'		'coat'
[-Anim]			
[-Fem]	čudovišč(e)		
[+Neut]	'monster'		
[+Anim]			

As shown in (19) Gender and Declension class correlate to a marked degree. Thus, with the single exception of *put'* 'way', Class III nouns are [+Fem]. The overwhelming majority of the remaining [+Fem] nouns belong to class I, whereas the [-Fem] nouns belong to class II. The correlation, however, is not total. In the present account the correlation will be expressed formally by means of a special set of redundancy rules given in (20).

- (20) a. [III] --> [+Fem]
- b. [+Fem] --> [I]
- c. [-Fem] --> [-Neut]
- d. [] --> [II]

It is an explicit assumption of Distributed Morphology that the features supplied by a redundancy rule such as (20) are omitted from Vocabulary entries. In the case of nouns, such as *put'* or *mužčina*, where the rules in (20) fail to predict the Gender or Declension class, the nouns are entered with the unpredictable information specified in the Vocabulary. Since redundancy rules like (20) cannot change any specified feature, these features will be unaffected by the rules (20). A few examples of Vocabulary

entries for nouns are given in (21).

- (21) [knig, +Fem] [ploščad', III]
- [vopros, -Fem] [put', -Fem, III]
- [okn, -Fem, +Neut] [mužčin, -Fem, I]
- [kofe, -Fem, IV] [pal'io, -Fem, +Neut, IV]

The rules (20) supply various redundant features to the items in (21) as shown in (22).

- (22) [knig, +Fem, I] [ploščad', +Fem, III]
- [vopros, -Fem, -Neut, II] [put', -Fem, -Neut, III]
- [okn, -Fem, +Neut, II] [mužčin, -Fem, -Neut, I]
- [kofe, -Fem, -Neut, IV] [pal'io, -Fem, +Neut, IV]

Like in some other Indo-European languages in Russian the word is composed of a stem followed by a Theme suffix, which in turn is followed by the Inflection. In nouns and adjectives the Inflection consists of the fused Number-Case morpheme. It is on the basis of the information contained in stems, i.e., nonphonological information of the type illustrated in (22), that Vocabulary entries are inserted into Inflection morphemes. We have already encountered the same order of precedence in our discussion of Hebrew numeral phrases. Specifically, Vocabulary Insertion of stems must precede the redundancy rules (20) and these in turn must precede the Vocabulary Insertion of Inflections.

As in most languages, adjectives and determiners in Russian have no inherent Gender but obtain it, as a result of the operation of the

Concord rule, from the noun that they modify.⁹ The Russian Concord rule copies in addition to Gender also Case and Number and, as will be seen below, also Animacy.¹⁰ The Concord rule - and I stress this especially -- does not copy Declension class. It has been suggested by Aronoff 1994 that it is a universal property of Concord in all languages to affect quasi-semantic features like Gender or Animacy, but not totally diacritic features such as Inflection class. Since Concord thus does not supply adjectives and determiners with Inflection class this information is obtained from the redundancy rules (20).

As noted above, the Concord rule is a redundancy rule and therefore can only fill in missing information, but is unable to over-write any information already present in the representation. This fact also determines the ordering of the Concord rule: it must follow redundancy rule (20a), but precede rules (20b-d), because the Concord rule spreads the noun's Gender to the determiner and adjectives that modify it, whereas Gender determines the Declension class of the determiner and the adjectives. This is shown in (23), where we also illustrate the fact that the rules (20b-d) apply after Concord. In the examples (23) the Declension class of the noun differs from that of the adjective (and determiner), because in the adjectives the Declension class is supplied by redundancy rules (20), whereas in the nouns the Declension class is an inherent property of the noun.

⁹Russian adjectives and determiners differ from the nouns in having only a single Declension class. Russian differs in this respect from Latin where, like the nouns, adjectives are distinguished as to their Declension class.

¹⁰The suggestion that animacy is spread to adjectives and numerals is due to Zaliznjak 1967, see Mel'čuk 1985, p. 419.

(23a) star [-P] mužčin [-P] star (23b) star [-P] lošad' [+P]
 [-F] [Acc] [-F] [Acc] [+An] [+An] [Acc]
 I [+An] I III

Redundancy rule (20a) star lošad' [+P]
 [+F] [+F] [Acc]
 III [+An] III

Concord star lošad' [+P]
 [+F] [+F] [Acc]
 III [+An] III

Redundancy rules (20b-d) star mužčin [-P] star [+P] lošad' [+P]
 [-F] [Acc] [-F] [Acc] [+F] [Acc] [+F] [Acc]
 [+An] [+An] [+An] [+An] III [+An] III

star [-P] mužčin [-P] star [-P] lošad' [+P]
 [-F] [Acc] [-F] [Acc] [+F] [Acc] [+F] [Acc]
 [+An] [+An] [+An] [+An] III [+An] III
 II I I III

Like in the derivation of the Hebrew numeral phrases in (18), a number of Readjustment rules are applied at this point. These in turn are followed by the insertion of Vocabulary entries into the

Case-Number suffixes.¹¹

A striking feature of the Russian declension is that it lacks a distinct Accusative Plural suffix. The Plural Accusative is identical with the Genitive, if the referent of the noun is animate, and it is identical with the Nominative, if the referent is inanimate. I propose to treat this instance of Case syncretism by means of a Readjustment rule that has the effect of switching the Accusative to Genitive or Nominative. The Case Switch rule given in (25) is an analog of the Gender Switch rule of Hebrew, and like its Hebrew counterpart, the Russian Case Switch rule is a Readjustment rule that must therefore apply before the insertion of Vocabulary entries into the suffix morphemes.

$$(25) \text{ Acc } \rightarrow \left\{ \begin{array}{l} \text{Gen in env. } [+Anim] \\ \text{Nom in env. } [-Anim] \end{array} \right\} + [+Pl, \text{---}]$$

Rule (25) will apply to (23b) and replace the Accusative feature by Genitive in the suffix of both the adjective and the noun.

It might be objected that these instances of case syncretism should be dealt with not by means of the readjustment rule (25), but rather by adding Vocabulary entries that can be inserted in the Accusative-Plural suffix. There are at least two reasons for rejecting this alternative. First, the Plural Nominative and Genitive suffixes in Russian are of considerable variety. As a consequence, the Vocabulary entries for these morphemes contain

¹¹The process of Vocabulary insertion has a number of technical complexities, but as these are not directly relevant to matters under discussion, I shall not discuss them here. I have treated this topic in Halle (to appear).

a considerable amount of specialized information. Under the proposed alternative this special information will have to be stated again for the Vocabulary entries for the Plural Accusative morpheme. This repetition is avoided by the Case Switch rule (25).

A further argument for the Case Switch rule (25) comes from the fact that in Class II masculine nouns the Accusative is replaced by the Genitive/Nominative also in the singular.¹² Russian thus is subject to a neat identical pair of rules which can be combined into a single formula by the standard devices for rule coalescence as illustrated in (26), where the // stands for 'in env.'

(26)

$$\begin{array}{l}
 \text{Acc} \rightarrow \left\{ \begin{array}{l} \text{Gen // [+Anim, <II, -F, -Neut>]} \\ \text{Nom // [-Anim, <II, -F, -Neut>]} \end{array} \right\} + [<+Pl>, _] \\
 \text{Condi: } <II, _ > \text{ or } <+Pl>
 \end{array}$$

Without a rule of Case Switch there would be no way to capture

¹²With the exception of *podmaster* 'apprentice', animate neuter nouns, all of which belong to class II, are not subject to Case Switch in the singular; these nouns are, however, subject to Case Switch in the plural. This is illustrated below:

- Geroj ubil morskoe čudoviče* (Acc Sg)
 - Geroj ubil *morskogo čudoviča* (Gen Sg)
 - Geroj ubil morskix čudovič* (Gen Pl)
 - Geroj ubil *morskix čudovič* (Nom Pl)
- *The hero killed the sea monster(s)*

the parallelism between the treatment of the Accusative in these two contexts. Further support for Case Switch is provided by the facts of the Russian numeral phrases to which we now turn.

The Numeral Phrase in Russian

I assume that like their Hebrew counterparts numeral phrases in Russian are special Quantifier Phrases having the structure shown in (15) above. As is well known Russian numeral phrases have a striking morphosyntactic property. When they are assigned oblique case, their internal case distribution is *homogeneous*, to use the convenient term introduced by Babby 1988; i.e., the numeral as well as the head noun of NP and its modifiers are in the same Case and Number. But when a numeral phrase is in the Nominative or Accusative, the Case is overtly marked only on the numeral, whereas the complement NP is in the Genitive. Complicating matters is the fact that with certain numerals the head noun is unexpectedly in the singular, rather than in the plural, and there are still further complications with the Case of adjective modifiers. When these matters are examined in detail it turns out that almost all of these apparent complexities are direct consequences of the machinery developed to this point.

The simplest situation is that in numeral phrases in oblique cases illustrated in (28). The phrases on the left have the numeral *pyat'* 'five', those on the right have the numeral *tri* 'three'. The translations of the different nouns are 'tsars, men, women, questions, books' respectively. Russian inflectional suffixes, those of nouns and adjectives as well as verbs are composed underlyingly of a theme vowel followed by a Case-Number suffix. The phonological rules of the language may, in certain cases, delete the theme vowel and/or the Case-Number suffix. This fact explains why some forms in (28) end in two suffixes, whereas

others in just one, and still others have no suffix.

(28)

<i>piat-i</i>	star-y-m	car-ja-m	tr-e-m	star-y-m	car-ja-m
D-Sg	D-Pl	D-Pl	D-Pl	D-Pl	D-Pl
<i>piat-i</i>	star-y-m	mužin-a-m	tr-e-m	star-y-m	mužin-a-m
D-Sg	D-Pl	D-Pl	D-Pl	D-Pl	D-Pl
<i>piat-i</i>	star-y-m	ženščin-a-m	tr-e-m	star-y-m	ženščin-a-m
D-Sg	D-Pl	D-Pl	D-Pl	D-Pl	D-Pl
<i>piat-i</i>	star-y-m	vopros-a-m	tr-e-m	star-y-m	vopros-a-m
D-Sg	D-Pl	D-Pl	D-Pl	D-Pl	D-Pl
<i>piat-i</i>	star-y-m	knig-a-m	tr-e-m	star-y-m	knig-a-m
D-Sg	D-Pl	D-Pl	D-Pl	D-Pl	D-Pl

We note that the two sets of phrases differ only in that in the set on the left the numeral is consistently in the singular, whereas in the set on the right the numeral is in the plural.¹³

¹³The inflections of certain Cases taken by adjectival numerals differ from those of ordinary adjectives. In particular, the Instrumental suffix is /m,a/ instead of /m,i/ and the Nominative suffix is /er/. In addition, in the Nominative numerals take different Themes than adjectives. These details are disregarded in the text above.

The inflections of the numeral nouns *sorok* '40', *devyatiosto* '90', *sto* '100' are highly deviant. Like the facts mentioned in the preceding paragraph, they are disregarded in the rest of the description.

This is correlated with the fact that in Russian the numerals from "1" to "4" are adjectives, whereas the numerals for "5" and above are Class III singular nouns. On the plausible assumption that both sets of examples are subject to the Concord rule, the difference follows directly from the fact that *piat'* is a singular noun of Class III, whereas *tri* is an adjective.

Being a redundancy rule the Concord rule can do nothing about the fact that *piat'* is singular, since this numeral is a Singular noun. (Recall the identical situation in Hebrew numeral phrases.) Nor can Concord affect this numeral's Declension class, Gender or Animacy: they are already specified at the point where the Concord rule applies and can therefore not be affected by Concord or any other redundancy rule.

The numeral *tri* does not exhibit this behavior, because it is an adjective rather than nouns. Since adjectives have no inherent Gender, Number, Animacy or Case, Concord assigns to the adjectival numeral *tri* not only the Case, but also Gender, Number and Animacy of the head noun. The same behavior as that exhibited in (28) is found in all other oblique cases: i.e., Locative/Prepositional, Genitive, and Instrumental, and this behavior is predicted by the account developed above.

Consider next the Nominative forms of phrases with the noun numerals "5" illustrated in (29).

(29)

<i>piat'</i>	star-y-x	car-ej
N/A-Sg	G-Pl	G-Pl
<i>piat'</i>	star-y-x	mužin
N/A-Sg	G-Pl	G-Pl

pat-'	star-y-x	ženščin
N/A-Sg	G-Pl	G-Pl
plal-'	star-y-x	vopros-ov
N/A-Sg	G-Pl	G-Pl
plal-'	star-y-x	knig
N/A-Sg	G-Pl	G-Pl

We recall that in the singular of Class III Nominative and Accusative have the same suffix. The numerals in (29) exhibit the Nominative/Accusative Singular syncretism. This is the result of the Concord rule and of the fact noted above that the numerals 5-20 are singular nouns of Class III. By contrast, the Genitive in the adjective and the head noun is unexpected by what has been discussed to this point. To account for this fact I propose --- following the spirit, if not exactly the letter of Babby 1988 -- that when the numeral phrase is in a direct Case, Concord cannot assign Case to the complement NP. The NP must, however, have a Case. The Genitive case that it obtains here is the default case assigned by the head to its complement NP.

The situation is somewhat different when the numeral is an adjective; e.g. *tri* as illustrated in (30). As noted, adjectives obtain Gender, Number and Animacy of by the operation of the Concord rule. Russian numerals prevent Concord from assigning direct Case to their NP complements. We therefore expect to find Genitive in place of Nominative in the adjectives and nouns that follow the numeral. As shown in (30) this expectation is borne out.

(30) Nominative Accusative

tr-i	star-y-x	car-ja	tr-e-x	star-y-x	car-ej
N-Pl	G-Pl	G-Sg	G-Pl	G-Pl	G-Pl
tr-i	star-y-x/e	mužin-y	tr-e-x	star-y-x	mužin
N-Pl	G-Pl	G-Sg	G-Pl	G-Pl	G-Pl
tr-i	star-y-x/e	ženščin-y	tr-e-x	star-y-x	ženščin
N-Pl	G/N-Pl	G-Sg	G-Pl	G-Pl	G-Pl
tr-i	star-y-x	vopros-a	tr-i	star-y-x	vopros-a
N-Pl	G-Pl	G-Sg	N-Pl	G-Pl	G-Sg
tr-i	star-y-x/e	knig-i	tr-i	star-y-x/e	knig-i
N-Pl	G/N-Pl	G-Sg	N-Pl	G/N-Pl	G-Sg

The grammatical Case of the adjective numeral is also expected. In particular, the Nominative in the left-hand column reflects the Case assigned by the syntax. In the right-hand column, the numeral does not exhibit the underlying Accusative Case, but this is as it should be, since Case Switch (26) applies here and switches the Accusative to Genitive where the head noun is animate, and to Nominative where the noun is inanimate.

Two things, however, are unexpected. We do not expect the head noun to switch number from Plural to Singular. Nor do we expect any of the adjectives to exhibit alternations between Genitive and Nominative. We can readily isolate the contexts in which the unexpected developments occur. Both appear only where the numeral head of the noun phrase is in the Nominative. I propose to account for the appearance of the Singular as the number of the head noun by means of the rule (31).

As a result, as illustrated by the fact in (29), the different cases assigned by the Concord rule are not distinguished in the numerals 5-20, all of which belong to class III. Thus Nominative/Accusative in (29).

(31) [+P] --> [-P]
in env. [[NUM] + [+Pl, NOM]]_R + nr[... [N] + []

The rule states that a Plural numeral -- i.e., 2-4 -- in the Nominative triggers a change in the number of the head noun from Plural to Singular. By ordering rule (31) after Case Switch (26) we account for the fact that (31) applies not only in Nominative phrases, but also in some Accusative phrases, namely those where Accusative is switched to Nominative (cf. (30b)).

The second irregularity involves the Case of the modifying adjective. Grammars of Russian teach that if the noun heading the numeral phrase is Feminine the modifying adjective may be either in the Genitive or in the Nominative, but if the head noun is Masculine or neuter, the adjective is always in the Genitive. It is noted that in the nineteenth century the Nominative was admissible also with masculine head nouns. Some examples cited in Vinogradov 1952 sec. 612 are given in (32).

(32) My s toboj dva raznyx <gen> čeloveka <masc>, i esi
xočeš', dve raznyx <gen> Amerki <fem>.
'You and I are two different people, if you will,
two different Americas' Simonov

... dve šturmovye <nom> gruppy <fem> ... dvinulis'
vpered
'... the two assault groups ... moved forward' Simonov
Začem eti dva russkie <nom> proletarija <masc>
xodit' k nemu?
'Why did these two Russian proletarians come to
him?' Goncharov

I propose to capture this fact with the help of the rule (33).

(33)
Gen --> Nom
in env. [[Num] + [+Pl, Nom]]_R + nr[... [AD]] + [+Pl, ---
[+F]]

While (31) is an obligatory rule, the fact that both the Genitive and the Nominative are acceptable with feminine adjectives implies that (33) is an optional rule.

Interesting light on the account presented here is shed by the facts of the conjoined numeral phrases in (34).¹⁴

- (34)
- a. on kupit dve-tri mašiny 'he'll buy 2 or 3 cars'
- b. on kupit dvux-trex korov 'he'll buy 2 or 3 cows'
- c. on kupit pjat'-šest' mašin 'he'll buy 5 or 6 cars'
- d. on kupit pjat'-šest' korov 'he'll buy 5 or 6 cows'
- e. on kupit četyre-pjat' mašin 'he'll buy 4 or 5 cars'
- f. *on kupit četyre-pjat' korov 'he'll buy 4 or 5 cows'

The point of these examples is that any two consecutive numerals can be conjoined in phrases of this type except for the numerals 4

¹⁴Examples of this type were discussed by Mel'čuk 1980. Mel'čuk did not assign a question mark to (34e). My informants, however, insisted that this phrase is not altogether felicitous.

and 5. As indicated by ? and * in (34e,f) the phrase "four or five X" is not altogether felicitous. The account presented above provides a straightforward explanation for this somewhat bizarre fact. Since the object noun phrases in (34) are all in the Accusative Plural, the adjective numerals, but not the noun numerals, will be subject to Case Switch by rule (26). As a consequence when the adjectival numeral *čtyry* '4' is conjoined with the noun numeral *čtyři* '5' the members of the conjunction will exhibit case conflict and it this case conflict that causes the phrases to be judged as less than fully felicitous.

Our account explains also the difference in unacceptability of the two phrases. When the head noun is animate as in (34f) the Case conflict involves the oblique Genitive and the direct Accusative; i.e., two Cases that differ in the feature most basic to the contrast between oblique and direct Cases. When the head noun is inanimate as in (34e) the conflict involves two direct Cases, Nominative and Accusative, i.e., two Cases that have the same value for the oblique/direct contrast. It therefore stands to reason that the conflict is more perceptible in (34f) than in (34e).¹⁵

¹⁵Mat'juk 1980, 1985 has drawn attention to such expressions as those in (1) where Case Switch appears to be blocked.

- (1) *stolj v tri medvedja* 'with the strength of three bears'
stolj tri belki 'to cost three squirrels'

The most direct way of dealing with these and similar examples where Case Switch is blocked is to postulate a rule that in the contexts in question marks the head noun [-Animate]. This special marking would account also for the surface case distribution in expressions with composite numerals such as those in (1i).

- (1i) a. *prokzamenovat' dvadcat' dva studenta* 'to test 22 students'
 b. *prokzamenovat' dvadcat' dvux studentov idem.*

Concluding Remarks.

~~I have outlined here how numeral phrases are treated in the theoretical framework of Distributed Morphology. The property of the framework that I have focussed on especially is that Vocabulary entries do not figure in the representations at DS, SS, and LF. In the representations at these levels morphemes are composed of bundles of syntactic and semantic features that contain all the information required for the operations of the principles and parameters of these levels, but they contain neither phonological features nor features assigning morphemes to particular inflection classes or labelling them as stem or affix. It is a well-known fact that neither of these two types of feature play a role in the operations that relate the representations at DS, SS, and LF. By postulating that Vocabulary items are inserted into the terminal string only at MS we provide an explanation for this important fact.~~

A major purpose of the above discussion of the numeral phrases of Hebrew and Russian was to provide further illustration of this proposition. In Russian the numerals 1 to 4 are adjectives, while the rest are singular nouns, whereas in Hebrew '1' is an adjective, while the rest are all nouns, some singular nouns, others plural. Significantly, these striking morphological differences have no effect on the way sentences are interpreted. In their lack of effect

- c. **prokzamenovat' dva studenta* 'to test 2 students'
 d. *prokzamenovat' dvux studentov idem.*

¹⁶Švedova 1980, sec. 1370 characterizes (1m) as 'normative', as against (1ii), which the Grammar terms *ustarelišče* 'obsolescent'. The exceptional marking does not apply in non-composite numerals as shown by the fact that (1i) is ungrammatical even in the most up-to-date idiolects.

DS

in this paper

on the interpretation of sentences these morphological features resemble the equally striking phonological differences among Vocabulary items. As far as the semantic interpretation of a Russian sentence is concerned the fact that the word for '5' begins with /p'/, whereas that for '3' begins with /l/ is as irrelevant as the fact that the former is a class III singular noun and the latter an adjective. Since all these are idiosyncratic properties of different Vocabulary items they are excluded from playing a role in the computation of the Logical Form of the sentence by the fact that Vocabulary entries are inserted into the representation at MS, and are absent at DS, SS and LF.

The account of the Russian numeral phrase was based crucially on the manner in which the redundancy rules, including both the rules in (20) and the Concord rule, interact with the Case Switch rule (26), which, unlike the redundancy rules, is capable of changing already specified features. These independently motivated rules of Russian were shown to account for almost all peculiarities of numeral phrases. The properties of numeral phrases not accounted for by the general rules required us to postulate the two readjustment rules (31) and (33), both of which deal with numeral phrases in the Nominative cases.

The examples (34e,f) were cited to illustrate an expression that is semantically well-formed yet results in an unacceptable surface string (Case Conflict) by virtue of the operation of Concord and Case Switch. This is the only way in which this ungrammaticality can be expressed within DM, and to the extent that this account accords with reality this treatment provides support for the theory.

As noted above, Vocabulary Insertion consists of finding in the list of Vocabulary items of the language we are using the entries that most closely correspond to the feature complexes of the

morphemes that make up the sentence being processed. In searching the Vocabulary for an appropriate entry we may discover that our Vocabulary has no entry that does justice to what we intend. Or we may find, as in the examples (34e,f) that the Vocabulary items that our language provides result in surface sequences that violate important output constraints. The inadequacy of language to express what we mean and feel has often been commented upon and lamented by writers and poets, perhaps no more eloquently than in the following lines of the Russian poet Tyučev:

Kak serden vyskazat' sebia?
Drugomu kak ponjat' tebya?
Pojmet-li on čem ty živeš'?
Mysl' izrečennaja jest' lož'.

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