7. *Diacritic features*

Many grammatical rules apply only to certain lexical items. For example, in a language with a rich inflectional system, such as Latin or Russian, it is necessary to divide all noun stems into several declensional classes to account for the phonetic realization of the gender, number, and case features. These classes may play no other role in the grammar; in particular, they generally have no syntactic function. We shall represent this rather peripheral classification with special "diacritic features" in lexical entries. Thus, in the grammar of Russian there will be, for example, a diacritic feature associated with all feminine nouns which will differentiate the "third declension" stem /dal,/, "distance," from the "second declension" stem /dol,/, "portion."

In the phonology proper, we also find quite commonly that rules apply in a selective fashion and thus impose an idiosyncratic classification on the lexicon. Often there is a historical explanation for this idiosyncratic behavior, but this is obviously irrelevant as far as the linguistic competence of the native speaker is concerned. What the speaker knows is, simply, that a given item or set of items is treated differently from others by the phonological component of the grammar.

In English, for example, we have noted that it is necessary to classify many lexical items in terms of a feature that, roughly, distinguishes items of Germanic origin from other items; and for certain rules, such as Velar Softening, we need a further classification of the non-Germanic part of the vocabulary into items of Greek and Romance origin, roughly. This classification is functional in the language and must be presumed to be represented in the internalized grammar. It is justified not by the historical development of the language but by the applicability of phonological and morphological rules.

Parallel instances may be cited from a great variety of languages. For example, in his study of Turkish phonology, Lees (1961) makes use of a classification that corresponds closely to Turkic or Arabic origin. Similarly, Lightner (1965a) has shown that the phonological component of Modern Russian requires at least the following three classes of lexical formatives: [−Slavic], $\begin{bmatrix} +\text{Slavic} \\ +\text{Russian} \end{bmatrix}$, $\begin{bmatrix} +\text{Slavic} \\ -\text{Russian} \end{bmatrix}$ (= Church Slavonic).[22] Thus, for instance, Russian has the "second conjugation" verbs [vərəčú], "I turn," and [vəz # vraščú], "I return." These two verbs are derived from an underlying root /uərt/, which figures both in the "Russian" and in the "Church Slavonic" components of the Russian lexicon. All [+Slavic] forms undergo "liquid metathesis" in the environment ——C_1. The [+Russian] forms, however, are first subject to vowel doubling (i.e., /ər/ → [əər], whereas the [−Russian] forms are first subject to tensing (i.e., /ər/ → [ər̃]). Since tense vowels are unrounded, and ultimately laxed, we find in the Church Slavonic forms the derivation /ər/ → [ər̃] → [rə̃] (and ultimately) → [ra]; whereas in the Russian forms we derive /ər/ → [əər] → [ərə]. In addition, in the Russian forms stem-final /t/ alternates with [č] in the first person singular present tense of this class of verbs, whereas in the Church Slavonic forms the stem-final /t/ alternates with [šč].

In these instances the categories to which lexical items are assigned account not only for their phonological peculiarities but also for their behavior with respect to various

[22] The names we give to the categories designate their major historical source, but, of course, are not etymologically justified in detail.

morphological processes such as the choice of derivational affix and freedom of compounding.

Lexical items may also belong to categories that are much less general than those just illustrated. In fact, not infrequently an individual lexical item is exceptional in that it alone fails to undergo a given phonological rule or, alternatively, in that it is subject to some phonological rule. The copula is an example of such a highly deviant item in many languages.

The natural way to reflect such exceptional behavior in the grammar is to associate with such lexical items diacritic features referring to particular rules, that is, features of the form [αrule *n*], where α is, as before, a variable ranging over the values + and − and *n* is the number of the rule in question in the linear ordering. We must then establish precise conventions that will have the effect of excluding an item specified as [−rule *n*] from the domain of rule *n*. This can be done in various slightly different ways.

A reasonable approach within our framework seems to be the following. Suppose that rule *n* is (125):

$$(125) \qquad A \rightarrow B \;/\; X\text{——}Y$$

By convention, one of the features contained in *A* will be [+rule *n*], thus requiring that any segment to which the rule applies be specified as [+rule *n*]. Secondly, we assume that for each rule *m* of the phonology, the feature specification [+rule *m*] is automatically assigned to each unit of each lexical matrix.[23] After this obligatory assignment of [+rule *m*], for each *m*, to each unit in the lexicon, we apply convention (126):

(126) All nonphonological features of a given lexical item are distributed to every unit of this item.

In particular, if a given lexical item is a human noun in the k^{th} declensional class which is an exception to rule *n*, then the feature specifications [+noun], [+human], [+k^{th} declensional class], [−rule *n*], now reinterpreted as on a par with phonological features, are assigned to each unit in this lexical item. The assignment of [−rule *m*], for any *m*, modifies the specification [+rule *m*] determined by the preceding convention.[24] The ordinary conventions of rule application will now prevent the application of rule *n* to any of the phonological units of an item marked in the lexicon as an exception to rule *n*.

A few comments are necessary about this particular way of handling exceptions. First, we assume that the readjustment rules that convert a syntactically generated structure to an appropriate input to the phonology may modify or introduce diacritic features. In particular, then, they may affect specifications of the type [αrule *m*]. One might also raise the question whether the rules of the phonology themselves may modify these features; for example, should we permit rules of the form (127):

$$(127) \qquad A \rightarrow [-\text{rule } n] \;/\; Z\text{——}W$$

Such rules add greatly to the power of the phonology. Suppose, for example, that rule (125)

[23] In terms of the system developed in Chapter Nine, we assume, simply, that [+rule *m*] is the "unmarked" value for the feature [rule *m*], for each *m*.

[24] Convention (126) makes it possible for phonological rules to refer to any syntactic or semantic property and is thus, no doubt, far too strong. Various modifications might be proposed, but we will not go into this matter.

applies as indicated except in the context Z—— W. By ordering rule (127) before rule (125), we achieve exactly this effect. Therefore rules of the form (127) permit us to formalize the notion "except"; in other words, they permit us to refer to contexts in which a rule does *not* apply, as well as to those in which it does apply. This is true even if we permit a rule such as (127) only when it is rule $n-1$ in the ordering, so that it can be reformulated as (128):

$$(128) \qquad A \rightarrow [-\text{next rule}] \ / \ Z \text{——} W$$

If we permit rules such as (127) to appear more freely, we add still greater power to the phonology. At various stages of our work we have experimented with rules of the form (128) and of the more powerful type (127), but we have not found any convincing example to demonstrate the need for such rules. Therefore we propose, tentatively, that rules such as (127), (128), with the great increase in descriptive power that they provide, not be permitted in the phonology: the feature [−rule n] must either be introduced by readjustment rules or appear as a diacritic feature in the lexical representation of an item.

Furthermore, observe that our first convention assigned the feature [+rule n] only to the unit A in (125), and not to the units of X and Y. Suppose, then, that we have a string $\ldots X'A'Y' \ldots$ such that A' is nondistinct from A, and X', Y' are nondistinct from X, Y except with respect to the feature [rule n]. Suppose further that X' and Y' contain units which are specified as [−rule n] but that A' is specified [+rule n]. The convention we have suggested would permit rule n to apply to $\ldots X'A'Y' \ldots$ under these circumstances; but the application of rule n to this string would be prevented if we were to adopt an alternative convention which assigned the feature [+rule n] to each unit of A, X, and Y in rule (125), thus requiring not only that any segment to which the rule applies be specified as [+rule n] but that the contextual segments be so specified as well. In brief, the issue is whether the context in which a segment appears should be permitted to block the application of a rule to this segment, even if the segment itself is not specified as an exception to this rule. It is easy to invent examples that militate against this assumption, but we have no clear cases in a real language. Considerations of plausibility, admittedly weak, have led us to adopt the convention proposed above which blocks application of a rule only when the segment to which the rule applies is itself identified as an exception to this rule. There is, in fact, one sort of example that suggests that our convention is inexact. Suppose that we have a rule of epenthesis such as (129):

$$(129) \qquad \phi \rightarrow B \ / \ X \text{——} Y$$

Suppose further that a lexical item $W = XY$ is an exception to this rule and is lexically marked as such. Our convention does not permit us to express this fact, but the alternative that we have rejected would allow it to be expressed readily. Such examples suggest that we reformulate the convention slightly, so that rule (125) is inapplicable to a string $\ldots X'A'Y' \ldots$ (where X, A, Y are nondistinct from X', A', Y', respectively, except with regard to the feature [rule n]) if A' is specified [−rule n], as in the earlier convention, or if the formative containing A' is specified [−rule n]. This modification, which we will not take the trouble to make precise here, would account for examples such as the exceptions to epenthesis without permitting the full range of difficulties that appear to be possible consequences of the convention we have rejected, which assigns [−rule n] to each unit of A, X, and Y in (125). Obviously, additional empirical material is needed before this matter can be settled.

Finally, notice that our conventions imply that in a given lexical item either all segments that otherwise satisfy the condition for application of some rule will be subject to the rule or no such segments will be subject to the rule; for it is the lexical item rather than an individual segment that constitutes an exception, at least insofar as exceptions are indicated in the lexicon. For example, if a language has a rule voicing intervocalic stops and a given lexical item containing several intervocalic stops[25] is marked as exempt from this rule, then, in general, all intervocalic stops in the lexical item will be exempt from voicing. We shall not exclude the possibility that in the situation just presented an item is doubly exceptional in that one of its intervocalic stops *is* subject to the voicing rule; however, this will be quite costly, for a special readjustment rule will be required to supply the intervocalic stop in question with the feature [+Intervocalic Voicing Rule]. The diacritic features, as noted earlier, will thus have two sources, the lexicon and the readjustment rules. An example illustrating the way in which readjustment rules operate in such cases is discussed at the end of this section.

With the help of diacritic features, we can deal with many phenomena involving prosodic features—for example, the behavior of stress in languages such as Russian or Bulgarian, and pitch in languages such as Japanese or Serbo-Croatian. The salient property that distinguishes stress in Russian or Bulgarian from other phonological features is that once it is determined which vowel in the word receives the main stress, the stress contour of the word is also determined. The fact that stress must be indicated for only one vowel of a word suggests that this vowel be designated by means of a diacritic feature associated with the root of the word. There appears to be a fair amount of evidence—although a definitive demonstration is still lacking—that the location of this vowel in Russian words can be determined by quite simple rules, given the structure of the word and some idiosyncratic information about the stress behavior of the root (in particular, whether or not the root takes stress; if not, whether main stresses must be placed on the suffix following the root or on the case ending; etc.) Once these facts are known, the location of the main-stressed vowel is directly determined. In terms of the framework that has been developed here, this means that the root will have to be provided in the lexicon with a few (perhaps two or three) diacritic features which will then provide enough information for the rules to locate the main stress on some vowel in the word. Subsequent rules then determine the stress contour of the word.

The situation is rather similar in Serbo-Croatian and Japanese. As has been shown by Browne and McCawley (1965) for Serbo-Croatian and by McCawley (1965) for Japanese, the tonal contour of the word can be determined by simple rules, once the location of the vowel with high pitch is determined. As in the case of Russian stress, these facts suggest that we utilize a diacritic feature associated with the lexical formative rather than phonological features associated with a given vowel in a word. Similar mechanisms have been shown by Heeschen (1967) to account for the very intricate prosodic features of Lithuanian words.

The situation in these languages thus differs from that obtaining in true tone languages, such as Chinese or Mixtecan, where, as observed by McCawley (1965), "the number of possible pitch shapes [our 'tone contours'—NC/MH] increases geometrically as the length of the morpheme increases, rather than arithmetically as is the case in Japanese."

[25] These segments may not be intervocalic stops in the lexicon but only at the point where the rule in question is reached in derivations; correspondingly, we are not concerned here with intervocalic stops of the lexicon if they do not have this property at the point in derivations where the rule in question applies.

In languages such as Japanese or Russian, one need at most determine the location of a single vowel in the word in order to determine the tonal contour of the word, whereas in languages such as Mixtecan or Chinese, each vowel in the word may have its own distinctive prosodic features. Only in the latter case might it be proper to mark the prosodic features for each vowel in the lexicon rather than associating a few diacritic features with the lexical item as a whole.

Another type of phenomenon that is appropriately handled with diacritic features is vowel harmony, which is found in languages in all parts of the world. A particularly instructive example occurs in Nez Perce, an American Indian language. According to Aoki (1966), on whose study the following remarks are based, Nez Perce has, phonetically, the five vowels [i u o a æ]. The [o] is always round, but in the high back vowel [u] rounding appears to vary a great deal. The words of Nez Perce fall into two classes with regard to their utilization of vowels; in the words of the first class the vowels are selected from the set [i a o]; in the words of the second class the vowels are chosen from the set [i æ u]. Nez Perce words are composed of strings of morphemes. The morphemes themselves constitute two mutually exclusive categories: morphemes of the first category, to which we shall attribute the diacritic feature [+H], appear in words of the first class only, whereas morphemes of the second category, which we shall designate as [−H], appear in words of both classes. Hence [+H] morphemes show no vowel alternations and select their vowels from the set [i a o], whereas [−H] morphemes exhibit the vowel alternations *a–æ* and *o–u*, depending on whether the morpheme appears in a word of the first or the second class. For example, the first person possessive pronoun morpheme [na ʔ]–[næ ʔ] is [−H]; we therefore have [na ʔ + tó·t], "my father," but [næ ʔ + mǽx], "my paternal uncle." On the other hand, the morpheme for *father* appears everywhere with the vowel [o], and must therefore belong to the category [+H]. Since morphemes containing the vowel [i] may be either [+H] or [−H], this property must be indicated with the help of a diacritic feature rather than derived from the phonetic features of the vowels. Moreover, the sets of vowels in the two classes of words—[i a o] and [i æ u]—are not natural classes in any reasonable phonetic framework. This represents further evidence that the categorization should not be based on phonetic features.

In order to account for the facts just sketched, it is necessary to postulate a readjustment rule that distributes the feature [+H] to all segments of a *word* containing a single [+H] segment. (As noted above, a universal convention distributes all diacritic features to all segments of a given *lexical item*.) This readjustment rule might have the following form:

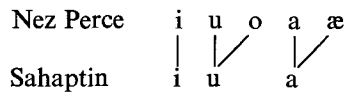
$$(130) \qquad [+\text{seg}] \rightarrow [+\text{H}] \; / \; \begin{Bmatrix} \#X[+\text{H}]Y\text{——} \\ \text{——}Z[+\text{H}]W\# \end{Bmatrix}$$

As a consequence of (130), words containing a [+H] morpheme will have all their segments marked [+H]; all other words will contain only segments marked [−H]. We now need to postulate in the lexicon only the three vowels /i u a/. The phonological rules (131) will then supply the correct output:

$$(131) \qquad \text{V} \rightarrow \left\{ \begin{array}{l} [-\text{back}] \; / \; \left[\begin{array}{l} \overline{\quad\quad} \\ +\text{low} \\ -\text{H} \end{array} \right] \\ [-\text{high}] \; / \; \left[\begin{array}{l} \overline{\quad\quad} \\ +\text{back} \\ +\text{H} \end{array} \right] \end{array} \right\}$$

A certain amount of support for this analysis may be derived from comparing Nez Perce with Sahaptin, which is closely related to Nez Perce genetically. Sahaptin has the three-vowel system /i u a/, which corresponds to the Nez Perce system as illustrated in (132):

(132)



It is obvious that the relationship between the two vowel systems corresponds to the effects of the vowel harmony rule (131). Since Sahaptin lacks vowel harmony, this correspondence is precisely what one would expect.

A rule similar to (131) would account for the vowel harmony in such African languages as Igbo (Carnochan, 1960), Twi (Fromkin, 1965), and Fanti (Welmers, 1946). There are, however, a number of differences between the vowel harmony in these West African languages and that in Nez Perce. In the first place, in Nez Perce the diacritic feature is distributed to the entire word only if it has the coefficient +; in the West African languages the diacritic feature is distributed to the word if it has either + or −. This can readily be effected by use of the variable notation. In the West African languages, moreover, the diacritic feature is distributed from stems alone (but see below), whereas in Nez Perce the source of the [+H] feature may be any element in the word; if a word contains a single [+H] morpheme, the entire word is marked [+H]. Finally, in the West African languages the diacritic feature in question is fully correlated with the phonological feature "covered." (See Chapter Seven, Section 4.5, for a discussion of the phonetic correlates of this feature.) As a result, instead of (131), we have the much simpler rule (133) (where H represents the diacritic feature governing harmony):

(133)

$$\begin{bmatrix} +\text{voc} \\ -\text{cons} \\ \alpha\text{H} \end{bmatrix} \rightarrow [\alpha\text{covered}]$$

Rule (133), incidentally, fails to account for a curious assimilation phenomenon which has been observed in the West African languages mentioned above. According to Carnochan (1960, pp. 161–62), if a noun ending with a high vowel immediately precedes a verb that is [−H], the high vowel is [−covered], even if the noun is [+H] and the vowel should therefore have been [+covered]. This can readily be accounted for by a special readjustment rule which assigns the feature [−H] to high vowels in the position stated above, or by a phonological rule that makes the vowel [−covered].

It would appear that vowel harmony in the Ural-Altaic languages can be characterized by structurally similar rules. In a language such as Turkish there are four classes of harmonizing words, rather than two as in Nez Perce or Igbo. This fact requires that we supply each lexical item with two diacritic features instead of the single feature that was required in Nez Perce and in Igbo. Ural-Altaic vowel harmony appears to be a process that propagates from left to right, from the first vowel of the word to the last, rather than being a nondirectional property inherent in each word by virtue of its containing a particular type of morpheme. This seems to us to be only a superficial phenomenon, however,

resulting from the fact that in these languages prefixation is not utilized and words are formed by suffixation alone. The evidence brought forward by Zimmer (1967) with regard to Lightner's analysis (1965b) of vowel harmony in Mongolian, which proceeded along the lines sketched here, shows that there are certain cases where the evaluation measures that have been developed up to this point would fail to decide the issue clearly one way or the other. As Zimmer notes, in order to resolve the matter in favor of the approach advocated here, one would have to enrich the descriptive machinery in some way so as to make readjustment rules such as (130) formally less complex, that is, more economical, than the phonological rules having the equivalent effect. This seems to us the proper solution; since vowel harmony is a process available to languages, this fact should be formally recognized by incorporating into the theory a device especially designed to reflect it. At the present time we are unable to make specific suggestions as to the nature of this device. The problem, however, is not one of principle but rather one of a scarcity of data for choosing among the many alternatives that readily come to mind.

It was observed above that diacritic features may be assigned to particular segments by readjustment rules. This possibility may be illustrated by the following example from the Russian conjugation.

It has been shown by Lightner (1965a) that in the underlying representations of Russian there are two parallel sets of vowels, tense and nontense. The nontense high vowels never appear in the output; they are either deleted by rule (134), or they are lowered by rule (135) and thus appear phonetically as [e] or [o]:

(134)
$$\begin{bmatrix} +\text{voc} \\ -\text{cons} \\ -\text{tense} \\ +\text{high} \end{bmatrix} \rightarrow \phi \; / \; \text{---} \left\{ \begin{matrix} \# \\ C_1 \begin{bmatrix} +\text{voc} \\ -\text{cons} \\ \{-\text{high} \\ +\text{tense}\} \end{bmatrix} \end{matrix} \right\}$$

(135)
$$\begin{bmatrix} +\text{voc} \\ -\text{cons} \\ -\text{tense} \end{bmatrix} \rightarrow [-\text{high}]$$

Thus, high nontense vowels are deleted at the end of a word or if followed in the next syllable by a vowel which is tense or nonhigh; elsewhere, they become nonhigh. These two rules account for alternations such as the following, in the nominative and genitive singular:

(136)

/rut+u/	→	[rot]	/rut+a/	→	[rta]	(mouth)
/lid+u/	→	[l,ed]	/lid+a/	→	[l,da]	(ice)
	(→	[l,od])				

Among the exceptions to rule (134) is the suffix /isk/. The vowel of this suffix is not deleted by the rule if the stem to which the suffix is attached ends with a velar or palatal consonant, that is, a consonant which is [−anterior, −coronal]. In the output, velars in this position are usually actualized as strident palato-alveolars because velars before front

vowels undergo the so-called "first palatalization" (see Chapter Nine). Thus we have [s,ib,írskəy], "Siberian," [r,ímskəy], "Roman," [uč,ít,il,skəy], "teacher" (adj.), but [gr,éč,iskəy], "Greek," [manášiskəy], "monkish," [múžiskəy], "masculine" (gram.) In addition there is a further layer of exceptions to the exceptions just cited, namely, forms in which the suffix /isk/ follows a nonanterior consonant but in which the vowel of the suffix is deleted: e.g., [mušskóy], "manly," [vólšskəy], "Volga" (adj.), [čéšskəy], "Czech" (adj.)

To account for the above facts, we may postulate a readjustment rule with the effects of (137):

$$(137) \quad \begin{bmatrix} +\text{voc} \\ -\text{cons} \\ +\text{high} \\ -\text{back} \\ -\text{tense} \end{bmatrix} \rightarrow [-\text{rule (134)}] \; / \; \begin{bmatrix} +\text{cons} \\ -\text{ant} \\ -\text{D} \end{bmatrix} + \text{——sk} +$$

This rule exempts the vowel of the suffix /isk/ from deletion by rule (134) if the stem to which the suffix is attached ends with a velar or palatal consonant, unless the stem is marked with the special diacritic feature [+D] which indicates that it is an exception to the readjustment rule (137).

8. Lexical representation

A language contains a stock of items which, under various modifications, constitute the words of the language. Associated with each such item is whatever information is needed to determine its sound, meaning, and syntactic behavior, given the system of grammatical rules. Hence this information ultimately determines the sound and meaning of particular words in specific linguistic contexts. Evidently, this knowledge constitutes part of the knowledge of the speaker of the language. He makes use of it not only in his normal linguistic behavior, but also in explaining the meaning of a word, in distinguishing rhyming from nonrhyming pairs of words, in determining whether verse is properly constructed (given certain canons), in seeking a word with a particular meaning, and so on. To represent this aspect of linguistic competence, the grammar must contain a lexicon listing the items which ultimately make up the words of the language. Clearly, the lexicon may contain different items for different individuals, and a given speaker may revise and expand his lexicon throughout his life.

As noted above, knowledge of lexical structure goes beyond familiarity with a list of lexical items. For example, speakers can distinguish in various ways among items that are not in their lexicon. Certain "nonsense" forms are so close to English that they might be taken by the speaker to be accidental gaps in his knowledge of the language: e.g., *brillig*, *karulize*, *thode*. Other forms, such as *gnip*, *rtut*, or *psik*, will almost certainly be ruled out as "not English." To account for these and other facts, we must assume that there is more structure to the internalized lexicon than merely the list of known items. An examination of the additional structure that must be presupposed is the subject of the present section.

In order for a lexical item to be used in a well-formed sentence, two types of information are required. First, we must have information about the syntactic and morpho-