

ON THE ROLE OF SIMPLICITY IN LINGUISTIC DESCRIPTIONS¹

BY

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Almost from the very beginning of abstract concern with language there have been proposals for schemes to classify the sounds of speech. This is hardly surprising since it is almost self-evident that speech sounds form various intersecting classes. Thus, for instance, the final sounds in the words *ram*, *ran*, *rang* share the property of *nasality*; i.e., the property of being produced with a lowered velum, which allows air to flow through the nose. In a similar fashion, the sound [m] shares with the sounds [p] and [b] the property of being produced with a closure at the lips, or, as phoneticians would say, of having a bilabial *point of articulation*. The individual speech sounds can then be characterized as complexes of nasality, particular points of articulation and other properties, which together make up the various classificatory frameworks.

The proposed frameworks differ, of course, from one another, and up to the present phoneticians have not agreed on any single framework that is to be used in all linguistic description. In the following I shall utilize the *distinctive feature* framework, which is due primarily to Roman Jakobson. This framework differs from others in that it consists exclusively of binary properties. If we adopt the distinctive features as our classificatory scheme, we commit ourselves to speaking about speech sounds exclusively in terms of two-valued attributes; i.e., of properties which a given sound may or may not possess.

The manner in which individual speech sounds are characterized in terms of distinctive features is illustrated in Figure 1. In this framework [s] is characterized as nonvocalic, consonantal, nongrave, noncompact, strident, non-nasal, continuant, voiceless; or [m] is characterized as nonvocalic, consonantal, grave, noncompact, nonstrident, nasal, noncontinuant, voiced. Consequently, the alphabetic symbols *s* and *m* by which we conventionally designate these sounds are nothing but abbreviations standing for the feature complexes just mentioned. It is as feature complexes, rather than as indivisible entities that speech sounds will be regarded hereinafter. It will be shown that this decision opens the way for further advances in the theory.

We note, moreover, that we can use the features to refer conveniently to classes of speech sounds. Thus, for instance, all sounds represented in Figure 1 belong to the class of consonants and as such they share the features non-vocalic and consonantal. We note furthermore that the consonants [s z č ž š ŝ] are the only ones that share the features nongrave and strident; or [p b f v m]

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| | p | b | m | f | v | k | g | t | d | θ | ð | n | s | z | č | ž | š | ž |
|-------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| vocalic | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| consonantal | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + | + |
| grave | + | + | + | + | + | + | + | - | - | - | - | - | - | - | - | - | - | - |
| compact | - | - | - | - | - | + | + | - | - | - | - | - | - | - | + | + | + | + |
| strident | - | - | - | + | + | - | - | - | - | - | - | - | + | + | + | + | + | + |
| nasal | - | - | + | - | - | - | - | - | - | - | - | + | - | - | - | - | - | - |
| continuant | - | - | - | + | + | - | - | - | - | + | + | - | + | + | - | - | + | + |
| voiced | - | + | + | - | + | - | + | - | + | - | + | + | - | + | - | + | - | + |

Figure 1. Distinctive feature representation of the consonants of English

alone share the features grave and noncompact. On the other hand, [m] and [s] share no features which would distinguish them from all other consonants. If we wanted to designate the class containing the sound [m] and [s] in distinctive feature terminology, we should have to give a long, cumbersome list of features. We shall say that a set of speech sounds forms a *natural class* if fewer features are required to designate the class than to designate any individual sound in the class. Hence the first three sets of sounds form natural classes, whereas the set containing [m] and [s] is not a natural class.

Jakobson has shown that in describing the most varied linguistic facts, we commonly encounter sets of sounds which form natural classes in the distinctive feature framework, and that only rarely does one meet classes of sounds that require long, cumbersome lists of distinctive features for their characterization. As a case in point, consider the formation of English noun plurals. As every English speaker knows in practice, if and only if a noun ends in [s z š ž č ž], the plural is formed by adding the extra syllable [ɪz]. But as we have already seen it is precisely this class of consonants that is exhaustively characterized by the features nongrave and strident. This coincidence is important, for the distinctive features were not postulated with the express purpose of affording a convenient description of the rules for forming the English plural.

The preceding remarks imply a special notion of descriptive economy. I should like to suggest that in the part of a linguistic description that deals with the phonic aspect of language, economy should be measured by the number of distinctive features utilized. The fewer features mentioned in a description, the greater its economy. It is not difficult to show that in simple cases the criterion does indeed perform as one would expect. Given two statements of which one applies to all consonants, whereas the other applies only to strident consonants, we should say without a doubt that the former is more general, more economical. This fact would also be reflected in the number of distinctive features that would have to be mentioned in the two

statements, for in order to speak of the class of all consonants we need to mention only the features nonvocalic and consonantal, whereas to designate the class of strident consonants we must mention the feature strident in addition to those which designate the class of all consonants. In an analogous fashion we should consider a rule that applies without restriction, more general and hence simpler than a rule that applies in specific contexts only. The second rule would also require mention of more features, for we would need to mention at least one distinctive feature in order to characterize the context in which the second rule applies.

The proposed criterion, however, has other interesting consequences. To see these we turn again to the formation of plurals of English nouns. The facts can be stated as follows:

To form the plural:

(a) [ɹz] is added if the stem ends in a sound which is nonvocalic, consonantal, nongrave, and strident.

(b) [s] is added if the stem ends in a sound which is nonvocalic, consonantal, voiceless, and nonstrident; or nonvocalic, consonantal, voiceless, strident, and grave.

(c) [z] is added if the stem ends in a sound which is vocalic; or nonvocalic, consonantal, voiced, and nonstrident; or nonvocalic, consonantal, voiced, strident, and grave.

It is to be noted that the above three statements are not ordered with respect to each other, and it is this which makes them so cumbersome. If we impose an order on the application of the statements, we can simplify them markedly as follows:

To form the plural:

(A) [ɹz] is added if the stem ends in a sound which is nonvocalic, consonantal, nongrave, and strident.

(B) [s] is added if the stem ends in a sound which is nonvocalic, consonantal, and voiceless.

(C) [z] is added.

The relative lengths of the two sets of statements graphically reflect their relative simplicity. Ordering, therefore, is mandatory in the present instance, if we want to satisfy our criterion of simplicity.

The proposal that an order be imposed on the application of the rules is not novel. Every description that makes use of phrases like "in all other cases" so as to eliminate the need for spelling out in detail what these "other cases" might be, makes use of an order among the descriptive statements. The only novelty here is that the reason for establishing an order is made explicit: it is a direct consequence of the proposed criterion of simplicity. Note, however, that the ordering established by the criterion may not be total, since in some instances it will not result in a simplification of the description.

Consider now a hypothetical dialect of English² which differs from the

² A dialect with almost exactly these features has been described by my colleague Dr. J. R. Applegate of M. I. T. In order to illustrate my point more clearly, I have modified the facts slightly. This modification, however, in no way affects the plausibility of the constructed example.

standard language in the following two respects:

Where the standard language has a continuant consonant in noninitial position, the dialect has the cognate noncontinuant (stop) consonant.

Where the standard language has several identical noncontinuant consonants in a word, the dialect replaces all but the first of these by a glottal stop.

EXAMPLES:

| I | | II | | III | |
|----------------|---------|-------|---------|--------|---------|
| cuff (cup) | [k'ʌp] | puff | [p'ʌp] | pup | [p'ʌʔ] |
| gave (Gabe) | [g'eb] | brave | [br'eb] | babe | [b'eʔ] |
| sauce (sought) | [s'ɔt] | toss | [t'ɔt] | taught | [t'ɔʔ] |
| lies (lied) | [l'ajd] | dies | [d'ajd] | died | [d'ajʔ] |

It is to be noted that the dialect admits words with several identical noncontinuant consonants, as can be seen in the examples in Column II, but in every one of these examples the second noncontinuant corresponds to a fricative in the standard language.

The phonetic peculiarities of this dialect are handled by the following two ordered rules, which do not function in the standard language:

1. If in a word there are several identical nonvocalic, consonantal noncontinuant, all but the first become nonvocalic, nonconsonantal noncontinuants (i.e., glottal stops in distinctive feature terminology). Examples in Column III.

2. In noninitial position, nonvocalic, consonantal continuants become noncontinuant.

I believe that this solution, proposed by Applegate, is preferable to the alternative of postulating a different phonological system for the dialect than for the standard language. It seems to me intuitively more satisfactory to say, as we have done here, that the dialect differs from the standard language only in the relatively minor fact of having two additional low-level rules, rather than to assert—as we should have to do, if we rejected the proposed solution—that the dialect deviates from the standard language in the much more crucial sense of having either a different phonemic repertoire than the standard language, or of having a strikingly different distribution of phonemes. It must be stressed that in the proposed solution the ordering of the rules is absolutely crucial, for if Rule (1) is allowed to operate after Rule (2) the noncontinuants produced by Rule (2) would be turned into glottal stops by Rule (1); i.e., the examples in Column II could not be accounted for. Without ordering of the rules we are forced to accept the unintuitive alternatives mentioned above.

If we regard the process of synthesizing an utterance as a sort of calculation whose final results are transmitted as instruction to the speech organs, which in turn produce the acoustical signal that strikes our ears, then the descriptive rules discussed above are simply steps in the calculation. We have found that by ordering these steps in a particular way the entire calculation becomes less laborious. We might now ask whether the order of the rules does not also reflect the chronology of their appearance in the language. Did, for example, the English dialect just discussed pass first through a stage where it was identical with the standard language, and then through another

stage where it differed from the standard language only in having glottal stops as required by Rule (1), but lacking the noncontinuants produced by Rule (2)?

If the order of the rules can be regarded in this light, then the proposed criterion of descriptive simplicity becomes an important tool for inferring the history of languages, for it allows us to reconstruct various stages of a language even in the absence of external evidence such as is provided by written records or by borrowing in or from other languages.

This way of looking at the phonological rules of a language is anything but novel. As a matter of fact, I should like to argue that the reconstruction of the history of the Indo-European languages, which is perhaps the most impressive achievement of nineteenth century linguistics, was possible only by making use of the proposed criterion of economy to establish an order among the descriptive statements; the order was then assumed to reflect their relative chronology. This can perhaps be illustrated most graphically by a discussion of the so-called Laws of Grimm and of Verner, which, with good reason, are considered among the most solid achievements of Indo-European studies. The Laws describe stages in the evolution of the Germanic languages from the Indo-European proto-language, stages which, it should be noted, are not attested by any external evidence.

The Indo-European proto-language is supposed to have had a single continuant consonant [s], which was voiceless; and a fairly complex system of noncontinuants, of which for present purposes we need consider only two, one voiced and the other voiceless. Grimm's and Verner's Laws describe what happened to these consonants in the course of the evolution of the Germanic languages.

The part of Grimm's Law that is of interest here consists of two rules which can be formulated as follows:

G-1. In certain contexts where condition C_1 (the precise nature of which need not concern us here) is satisfied, nonconvocalic, consonantal, voiceless noncontinuants become continuant. (It is by virtue of this Law that English *five* is said to be cognate with Greek *pentē*, Russian *pjat'*, and Sanskrit *pañca*.)

G-2. Nonvocalic, consonantal, voiced noncontinuants become voiceless. (G-2 establishes the correspondence between English *ten* and Greek *deka*, Russian *desjat'*, and Sanskrit *daça*.)

The handbooks tell us that these two rules came into the language in the order indicated, because—and this is particularly important here, for there is no other evidence—if G-2 had operated before G-1 the voiceless continuants produced by G-2 would have become noncontinuants as a consequence of rule G-1. This argumentation, however, is identical with the reasoning which we gave above in justifying the ordering of the rules in the example from the English dialect. The only new factor here is that the order of the rules, which in the English example had no chronological significance, is given such significance here.

At some later time Germanic underwent the effects of Verner's Law which can be formulated as follows:

V. In contexts where C_2 holds, nonvocalic, consonantal, voiceless con-

tinuants become voiced.

If we believe with the majority that Verner's Law was later than G-1, then we must assume that at this stage the language possessed voiceless continuants from two sources: the [s] which descended unchanged from the Indo-European proto-language, and the voiceless continuants produced by the operation of Grimm's Law (Rule G-1). The fact that Verner's Law applies without distinction to voiceless continuants from both sources is always cited as the crucial evidence in favor of regarding Verner's Law later than Grimm's Law. This evidence, however, carries weight only if we accept a criterion of descriptive economy much like the one that was stated above, for—as in the case of the plural of English nouns—the facts can also be accounted for fully by the following three unordered rules:

In contexts where both condition C_1 and C_2 are satisfied, nonvocalic, consonantal, voiceless noncontinuants become voiced and continuant.

In contexts where C_1 but not C_2 is satisfied, nonvocalic, consonantal, voiceless continuants become continuant.

In context C_2 , [s] (i.e., its total feature specification, which requires mentioning a fair number of features) becomes voiced.

By the proposed criterion of simplicity we must reject the unordered rules, for they require more features than the ordered alternatives G-1 and V. Since there is no external evidence that the language changed in the manner indicated by Grimm's and Verner's Laws, the acceptance of these Laws as historical fact is based wholly on considerations of simplicity. But these are very weighty considerations indeed, for as Professor Quine has remarked, we construct the picture of our world on the basis of "what *is* plus *the simplicity* of the laws whereby we describe and extrapolate what is."

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