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IN DEFENSE OF THE NUMBER TWO*

THE SUBJECT of this essay is the Jakobsonian distinctive feature system, in particular its most controversial proposition concerning the binary structure of all features.[1] The distinctive feature system is a framework for the description of the phonetic facts of language. In the history of phonetics other such frameworks have been known: e.g. Alexander Melville Bell's Visible Speech and its direct descendant, the well-known phonetic alphabet of the International Phonetic Association, Jespersen's antalphabetic notation, or Pike's phonetic system.

Frameworks are fundamentally questionnaires. In using a particular phonetic system just as in using a particular questionnaire, certain information will be obtained and this information will have a certain structure. And as in the case of a questionnaire, the choice of one system over another is determined by the investigator's belief that the particular set of questions and the manner in which they are phrased are the most appropriate to the research he is interested in. Thus, for example, in the phonetic frameworks just mentioned the position of the epiglottis in the articulation of the different sounds is not considered, in sharp contrast to the position of the major tongue constriction which is of primary concern in all frameworks. The disregard of the epiglottis and the great attention paid to the position of the tongue constriction would normally be justified on the grounds that the former information does not seem to do much for our systematization of the facts of speech, whereas the latter does. If one wanted to force a change one would have to show that this change actually was

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[1] For a detailed presentation of the distinctive feature system see R. Jakobson, M. Halle, C. G. M. Fant, *Preliminaries to speech analysis, M.I.T. Acoustics Laboratory Technical Report 13* (1st printing: January 1952; 2nd printing with additions and corrections: May 1952; 3rd printing: June 1955), and R. Jakobson and M. Halle, *Fundamentals of language I. Phonology and phonetics* (The Hague, 1956).

(From Studies in Honor of [illegible] (S-gravenhage 1957) pp 65-72

helpful, in that it deepened our insight into the phenomena under investigation. One would thus justify this change exactly in the same manner as one would justify replacing one set of questions in a questionnaire by another, namely by showing that the new questions lead to a better understanding of the problem involved.

The questions that a scientist poses are, of course, always influenced by his hunches regarding the properties of the phenomenon he is studying. A physicist who believed that matter consists of atoms would ask different questions – i.e. perform different experiments – than one who believed that matter is infinitely subdivisible. The scientist cannot avoid posing questions that are 'loaded' in the sense that they reflect the scientist's picture of the phenomenon prior to the investigation. The scientist is under an obligation to show that these questions are fruitful, but he can show this only after performing his experiments, after asking his questions, not before.

In using the distinctive feature system one commits oneself to the view that all features are of a simple, binary type: i.e., one restricts oneself to asking about the phonetic features of a language only questions that can be answered by 'yes' or 'no.' It is impossible to know a priori whether this is a wise decision or not. But then it is also impossible to know before investigating a particular language whether the decision to represent all utterances as sequences of discrete segments, or any of the many other a priori decisions inherent in a particular phonetic system is wise or not.

If I understand the argument correctly, it is precisely this unsatisfiable condition which some would require the distinctive feature system to meet. In a recent book we read: "Pour avoir le droit d'affirmer que toutes les oppositions phonologiques sont binaires, il faudrait ou bien avoir constaté, après examen exhaustif, que tel était le cas, ou bien être arrivé à prouver que, l'homme étant ce qu'il est, il ne peut faire autrement qu'organiser ses unités distinctives selon le mode binaire. Mais qui pourrait se vanter d'avoir fait un examen exhaustif de toutes les langues existantes ou attestées? Et que dire des langues disparues sans laisser de traces et de celles qui apparaîtront demain sur la terre?"[2] Even if we omit from consideration the tendentious last question, which demands knowledge not ordinarily considered accessible to mere mortals, the author in effect limits the admissible statements of phonetics to those that have in fact been completely verified. In other words, he would allow us to pose questions only if we knew the answer, which seems somewhat pointless outside of an examination or quiz program. It is also to be noted that the condition given in the first sentence of the quoted passage would rule out not only scientific hypotheses – e.g. the binary nature of the features – but also statements containing the universal quantifier 'all', in other words, all generalizations. It is unlikely that any scientific description could be carried out under such severe restrictions. In the past no such restriction has ever been accepted by science, and I can find no justification for this move in the cited work or elsewhere.

[2] A. Martinet, *Economie des changements phonétiques* 73–74 (Berne, 1955).

While it is impossible to show that all features *are* binary, in advance of introducing this hypothesis into phonetics, the proposition can be confirmed in much the same manner as can other scientific hypotheses – i.e., by exhibiting its scope, its degree of factual confirmation, and the formal simplicity of the resultant description.[3] I shall attempt to show (1) that accepting the limitation of using only binary features in the description does not impair in any way the ability of the framework to handle data as compared with that of other frameworks not containing this limitation; (2) that in a number of instances it leads to a simplification both of the framework and of the description; and (3) that it admits certain developments in phonetic theory, in particular the formulation of an evaluation procedure for alternative descriptions, that could not be achieved with the more conventional frameworks. The discussion here will deal almost exclusively with the articulatory correlates of the distinctive features. The same arguments hold, of course, for the acoustical side of the problem since acoustic properties of speech are a consequence of the articulatory processes.

In the discussion concerning the binary feature system the fact seems to have been obscured that in many respects the distinctive feature system is substantially identical with such traditional frameworks as that of the IPA. Thus the distinctive features *voiced-unvoiced* and *nasal-nonnasal* are, of course, identical with the same features in all other frameworks. The distinctive features *sharp-plain* and *checked-unchecked* are identical except in name with the traditional distinctions palatalized-nonpalatalized and glottalized-nonglottalized.

In a number of instances the distinctive feature framework contains a single feature where the traditional systems have several binary features. This collapsing of the framework was done in cases where it could be demonstrated either that no single language possesses both features or that one of the traditional features applies to one class of phonemes – e.g. the vowels – and the other to a totally different class of phonemes – e.g. the consonants – and furthermore that these different traditional features possess common physical (i.e. articulatory and acoustical) properties. This unification under a single heading is thus only an extension of the well-known principle of complementary distribution.

The distinctive feature *flat-plain* includes the traditional features of pharyngalization, velarization, retroflection, labialization, and rounding. In the phonetic literature rounding and labialization are used to refer to the same articulatory process: the former term is restricted to the vowels and the latter is used only in reference to phonemes other than vowels.[4] There is thus no need for two separate terms.

The features of pharyngalization, velarization, retroflection, and labialization never

[3] Cf. C. G. Hempel, "Fundamentals of concept formation in empirical science," *International Encyclopedia of Unified Science* 2.7.39–50 (Chicago, 1952).

[4] Cf. R.-M. S. Heffner, *General phonetics* 98 and 133, (Madison, 1950). Earlier phoneticians like Sweet and Sievers used a single term; cf. E. Sievers, *Grundzüge der Phonetik* 75 and 144 (Leipzig, 1881).

function distinctively in the same phonemic context. We find either that one process – e.g. pharyngalization – is used in one language, while another process – e.g. labialization – is used in another language, or that one process is used only with certain classes of phonemes and another process is used with other classes of phonemes; facts that can be accounted for by the great similarity of the acoustical correlates of these articulatory processes.[5] Elementary considerations of economy dictate that these features be unified under a single heading.[6]

For essentially the same reasons the traditional features of tense–lax, aspirated–unaspirated and fortis–lenis are included in the single distinctive feature *tense–lax*.[7]

The above reduction in the number of features in no way affects the ability of the framework to describe the phonetic facts, since up to this point we have eliminated only features that never function independently. The reduction has the added advantage of requiring fewer independent variables in the framework. We therefore feel justified in claiming that a real gain in simplicity has been realized without any loss in scope.

More substantial differences between various traditional frameworks and the distinctive feature system are found in the treatment of the liquids and glides, of the affricates, and of the so-called point of articulation feature. Here the insistence upon a binary framework leads to a picture that is not simply related to that found in almost every textbook on phonetics.

In the treatment of the vowel-consonant distinction various traditional systems differ from one another. On the one hand, we have systems, like that of the IPA, where the glides and liquids are included among the 'consonants', which are sharply distinguished from the vowels. In these frameworks the 'vowel' – 'consonant' distinction is binary by definition. On the other hand, in a system like that of Pāṇini the liquids occupy an intermediate position between vowels and consonants. The distinction between the classes: vowel, consonant, liquid, and glide, must be maintained because of various grammatical and distributional statements which always have to be made in describing a language. The solution that is, therefore, adopted in the distinctive feature system is the following: Two binary features *vocalic-nonvocalic* and *consonantal-nonconsonantal* are defined: the first distinguishes the vowels and liquids from the consonants proper and from the glides; the second distinguishes the consonants and liquids from the vowels and glides.

In adopting this solution the descriptive scope of the framework is in no way affected. Whatever can be described in the traditional terms can be described in the distinctive feature framework. The binary framework gains in addition the

[5] For details see *Preliminaries*, secs. 2.4222 and 2.4236.

[6] This was evidently the reason why in the IPA system a single diacritic mark is used for both pharyngalized and velarized consonants.

[7] Cf. *Preliminaries*, secs. 2.43–2.434.

following advantages: (1) In separating the liquids and glides from the consonants it eliminates much unnecessary machinery which is represented on the IPA chart by the many empty boxes for the rows labelled 'Lateral Fricative', 'Lateral Non-fricative', 'Rolled', and 'Flapped'. The distinctive feature framework employs a smaller number of independent variables in the description, thereby realizing a definite economy. (2) Another kind of economy is realized by maintaining the same binary feature structure as in other parts of the description.

The standard phonetic frameworks treat the affricates as special sequences of stops and continuants. In some cases this treatment shows up gaps in the framework which are compensated for only at the price of abandoning the motivating principle of the entire scheme, the principle of phonetic realism. Thus, for example, the affricate represented in the IPA system by [p͡f] does not ordinarily have bilabial occlusion, as the presence of the symbol [p] would make it appear, but since the IPA does not possess a special symbol for a labiodental stop, the symbol for a bilabial stop is made to do double duty. In other cases the treatment of affricates as sequences reveals an excess of descriptive means. For instance, phonemes like */pφ/ and */tθ/, for which symbols are implicit in the IPA system, are not found in any language.

These disadvantages are avoided in the distinctive feature scheme by considering the affricates as special kinds of interrupted phonemes. The feature *continuant-interrupted*, which distinguishes between phonemes produced with a constriction and those produced with total occlusion, opposes all types of continuant to affricates and stops, which are classed together. The stops are distinguished from the affricates by means of the feature *strident-mellow*, which separates phonemes with strongly marked noisiness from phonemes where noisiness is slight or totally absent. Our confidence in this solution is further increased by the fact that the *strident-mellow* feature, which we set up to handle distinctions among interrupted phonemes – i.e., to separate affricates from stops – turns out to function distinctively also among the continuants. Thus, in Ewe in addition to the strident /p͡f/ and the mellow /p/, both of which are interrupted phonemes, there are also two kinds of continuants, a strident /f/ and a mellow /φ/.[8] Or in Gilyak there are four velar consonants, of which two are mellow, /k/ and /x/, and two strident, /q/ and /χ/.[9] Similarly in certain Slovene dialects

[8] D. Westermann, *A study of the Ewe language* (London, 1930).

[9] In speaking of the latter two phonemes, Zinder and Matusevič note: "It might not be superfluous to remark that these sounds cannot be called extreme post-linguals, for it is not a matter of the point of articulation being more or less far back, but of the active organ: /k/ is produced by contact between the back of the tongue with either the hard or the soft palate, depending on which, it will be either more or less front (without, however, being necessarily soft [palatized – M. H.]) or further or even very far back (without becoming /q/). On the other hand, sounds of the type of /q/, which are called velars or uvulars, are produced by contact between the edge of the soft palate (velum) and the back of the tongue either somewhat in front of or behind the former and consequently can themselves be 'back 'in varying degree. The /k/ series and the /q/ series thus represent two completely different series having essential qualitative differences." L. R. Zinder and M. T. Matusevič, "Èksperimental'noe

there are four dental consonants exhibiting the same paired structure: mellow /t/ and /θ/; strident /t͡s/ and /s/.[10] In Sutherlandshire Gaelic there are four palatal consonants, which are again paired in the same fashion: mellow /c/ and /ç/; strident /t͡ʃ/ and /ʃ/.[11] The differences in the points of articulation in all these cases are secondary effects of the primary differences between *strident* and *mellow* consonants, while the difference between affricates and fricatives is simply characterized by the feature *continuant-interrupted*.[12]

The introduction of the feature *strident-mellow* provides exactly the right amount of descriptive machinery, since it makes allowance neither for nonextant phonemes like */pφ/, nor forces upon us what are basically incorrect symbolizations like [p͡f]. It has the further advantage of providing a convenient description for the strident liquids like /ř/ in Czech and /ɔɬ/ in Zuñi. Finally it reduces to four the number of different points of articulation that need to be considered separately. This reduction is achieved without loss of descriptive power: all actually occurring phonemic patterns can be adequately described with the available machinery. It is also to be noted that the insistence on binary features does not impose any additional limitations on this framework as compared with those in general use.

The most marked deviations from the prevailing phonetic schemes will be found in the treatment of the so-called point of articulation parameter for the consonants and the dimensions of the so-called vowel triangle. It is a characteristic of many of the phonetic schemes now in use, and particularly of that of the IPA, that the vowels and consonants are described in terms that have nothing in common. It is evident that if one were concerned with descriptive economy one would inquire into the possibility of using the same set of dimensions for the vowels and for the consonants. The distinctive feature scheme obtains this in the following manner:

The distinction between open and close vowels is based on two fundamentally different vocal tract configurations. Open vowels are produced with a vocal tract that approximates a horn; in producing close vowels the vocal tract approximates a Helmholtz resonator, a large cavity with a small aperture to which a neck may be attached. This distinction, however, applies also to the configuration for the articulation of consonants. Thus, the velar [k] and palatal [c] stops have a horn-shaped vocal tract; while the labial and dental consonants have cavities that differ from those of the close vowels [u] and [i] only in that the aperture is greatly narrowed or totally occluded.

issledovanie fonem nivxskogo jazyka," in E. A. Krejnovič, *Fonetika nivxskogo (giljackogo) jazyka* 115 fn. 2 (Moscow-Leningrad, 1937).

[10] N. S. Troubetzkoy, *Principes de phonologie* 172 (Paris, 1949).

[11] Eric Hamp, "Unstressed and minimally stressed vowels in Sutherlandshire Gaelic" (Paper read at the Thirty-First Annual Meeting of the Linguistic Society of America, December, 1956).

[12] This point was first made by R. Jakobson in his "Observations sur le classement phonologique des consonnes," *Proceedings of the Third International Congress of Phonetic Sciences* 39–40 (Ghent, 1938).

These two extremes of vocal tract shape, the horn and the Helmholtz resonator, are taken as the defining characteristics of the features *compact-noncompact* (horn shape or not) and *diffuse-nondiffuse* (Helmholtz resonator shape or not). In terms of these features the close vowels are characterized as *diffuse* and *noncompact*; the open vowels like [a] and [æ] are classified as *compact* and *nondiffuse*; and vowels of intermediate degree of openness – e.g. [e] [ø] and [o] – are both *noncompact* and *nondiffuse*. Since all *compact* consonants are *nondiffuse* and all *diffuse* consonants, *noncompact*, only one of the two features functions distinctively in the consonants. We therefore describe labials and dentals as *noncompact*; and palatals, velars, gutturals, etc., as *compact*, and omit reference to feature *diffuse-nondiffuse*.

To complete the description we need a feature which would separate front from back vowels as well as labial and postpalatal consonants from dentals and palatals; i.e., [u] and [ɯ] from [y] and [i] as well as [p] and [k] from [t] and [c]. This is achieved by redefining the front-back distinction in vowels as a distinction between phonemes produced with a major constriction in a peripheral region of the oral cavity (i.e., at the lips or at the velum and further back) and those produced with a constriction in a central region (somewhere along the hard palate). This feature, which is known as *grave-acute*, permits us to characterize the distinctions mentioned at the beginning of this paragraph.

In the preceding section I have tried to show that the distinctive feature framework is capable of describing all facts that other phonetic systems can handle, but that by an extension of the principle of complementary distribution and the judicious redefinition of several features commonly used in phonetics, these results can be achieved with much less machinery than is usually employed.

Only in the case of the feature *diffuse-nondiffuse* has the insistence upon binary features led us to introduce a parameter which has an extremely restricted applicability and therefore may be said not to be optimal. It is for this reason that in previous formulations of the distinctive feature framework the feature *compact-noncompact* was defined as a ternary feature. In recent months we have been led to accept the more consistent solution of postulating two binary features in place of the ternary one, because, in connection with our work on evaluation procedures for alternative phonemic solutions, we found that the consistently binary system fitted our requirements better than the mixed system previously used.

Almost since the very beginning of modern phonology, linguists have realized that the criteria at their disposal admitted of several descriptions for the same set of facts.[13] As in other sciences the choice among alternative solutions was said to be decided by considerations of descriptive economy or simplicity. Attempts to characterize this

[13] Y. R. Chao, "The Non-uniqueness of phonemic solutions of phonetic systems," *Bulletin of the Institute of History and Philology, Academia Sinica*, 4, part 4, 363–397 (1934).

notion have been few and cannot be said to have been altogether successful. It seems intuitively correct that, all other things being equal, a reduction in the number of phonemes is a definite gain in economy. But how is one to decide between two descriptions having the same number of phonemes?

The difficulties experienced are no doubt due in part to the absence of a uniform system for presenting phonemic data. It is impossible to compare solutions in which prosodic features like accent and intonation are considered phonemes, with solutions in which they are considered features of vowels. But even if this difficulty could be overcome by an agreement to adopt a single system, it is unlikely that an answer could be suggested since, as we have seen, in the traditional frameworks considerations of economy play no rôle in the presentation of data. No attempt is made to minimize the number of features used, nor is there any obvious way in which equivalences can be set up among different features.

In the distinctive feature system a consistent attempt is made to minimize the number of features used in the description. An obvious extension of this would suggest that the simplicity of a description be measured by the average number of feature-questions per phoneme. We could then consider as best the description which on the average has the lowest number of feature-questions per phoneme. The presence of a ternary feature, however, again raises the problem of equivalence of features. Since there is no obvious way for setting an 'exchange rate' between binary and ternary features without simultaneously complicating the framework, postulating such an equivalence function would at best be an arbitrary step. If, however, we eliminated ternary features from our framework altogether – a move that is strongly suggested by the structure of the rest of the framework – the above difficulty would disappear. In our recent work on an evaluation procedure we have therefore replaced the ternary feature compact-diffuse by the two binary features *compact-noncompact* and *diffuse-nondiffuse*.[14]

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[14] The evaluation procedure is the joint work of N. Chomsky and myself. A preliminary report on this work was presented in our paper, "On the logic of phonemic descriptions," at the M.I.T. Conference on Problems of Speech Communications in June, 1956.