

## SOME PRINCIPLES OF A NONSEGMENTAL PHONOLOGY

T D Griffen  
Wichita State University

The development of phonology has been dominated by the principle of the 'inner approach', as it is presented by Jakobson and Halle (1962). According to the inner approach, the categories and relationships of phonology are to be abstracted from the phonetic evidence. Of course, this does not mean that phonology should be phonetics. The phonologist is interested in the oppositions and the functional structures of sound systems, not in the acoustic and physiological data themselves. Nonetheless, these phonological oppositions and structures have their basis in phonetics.

The categories of phonology are basically the oppositions of phonetic and phonological pertinence (see Trubetzkoy 1969). Much effort has been expended by phoneticians to establish both acoustic and physiological features for these oppositions of phonology. Indeed, such phonetic investigations as those found in Fant 1973, Jakobson, Fant, and Halle 1952, Peterson and Shoup 1966, to name but a few, have established the basis for the opposition systems of phonology, such as we find in Chomsky and Halle 1968 for example.

These features and oppositions have traditionally been grouped into segments both by phoneticians and, through the inner approach, by phonologists. These segments, or bundles of distinctive features, are based upon the method of transcribing speech by the international phonetic alphabet. As these segments form the basic relationships between the phonetic features, we should expect that they have been investigated just as thoroughly as have been the features themselves. The fact is, however, that they have not been so thoroughly investigated.

The reason for our lack of investigation is quite simply that phoneticians have long recognized that the segment does not exist either acoustically or physiologically. Moreover, there have been no unambiguous experimental results to establish a psychological basis for the segment, though there has been a host of assumptions. In turn, phonologists, though using the segment as do phoneticians, recognize the segmental representation

tion (be it surface or underlying) as at best a 'convenient fiction', in the words of Twaddell (1935). In recent years, although Halle 1964, for example, de-emphasizes the segmental phoneme in phonology through the use of distinctive feature analysis, and all major schools do in fact base their phonologies upon oppositions, nevertheless, such important works as Chomsky and Halle 1968 and Anderson 1975 still maintain the feature [segmental] and in fact maintain the segmental phoneme itself.

Why would phoneticians work so hard at establishing the categories of phonetics while retaining a relationship between these categories which is known to be fictitious? Why, further, would phonologists abstract such a fictitious relationship? The reason is the lack of a viable alternative. Although the segment is fictitious, it is better than no relationship at all. And after all, it is quite convenient--phonologists have been able to abstract the phonetic segmental relationship and create nice, simple phonological structures using it.

However convenient the segment may be, though, and however systematic a phonological structure can be made using it, the fact remains, that the segment is tenuous, to say the least. Should an alternative present itself, an alternative which is based upon experimental evidence or at least is less tenuous than the segment, then phoneticians would presumably investigate the alternative and use it wherever applicable. Moreover, phonologists, recognizing a shift in phonetic theory, should follow suit in accordance with the tenets of the inner approach.

Such an alternative has presented itself. Two decades ago, Curtis (1954) suggested the development of a phonetic analysis not based upon the segment, but based upon a parameter of time. Such a notion was termed 'dynamic'. Especially in the past decade, investigations into dynamic phonetics have become increasingly frequent.

A milestone in dynamic phonetics is the articulatory model of Mermelstein (1973). With this model, phoneticians can predict with a remarkable degree of accuracy the physiological movements in speech. This is an essential function of any model in keeping with current linguistic theory, and it is something which had been suggested in segmental phonetics (for example, Liberman, Cooper, Shankweiler, and Studdert-Kennedy 1967, Liberman 1970), but which had never been approximated from the segmental basis.

Furthermore, the principles of Mermelstein's articulatory model corroborate to a high degree the findings of Ohman 1966 and 1967 in the area of acoustic phonetics

Central to Mermelstein's articulatory model and to Ohman's acoustic calculations is the notion of 'coarticulation', that vowels are produced with steady, precise movements of the tongue body, lips, and jaw, while 'consonants' are fast movements executed by other articulators which constrain the production of vowels. In such a model, then, consonants are not separate units occurring with the vowels, but are constraints acting upon the vowels. (Compare also Perkell 1969.)

The implications for phonology of a system of relationships between phonetic features that provides not only a viable alternative to the known fiction of the segment, but a workable alternative as well should be obvious. In accordance with the inner approach, phonologists should set about the task of abstracting the relationships between features supplied by this new phonetic evidence. Moreover, if phonologists are to maintain consistence with the theory (and this applies to all major, current models of structural and functional schools), then phonologists are indeed obligated either to alter the theory in order to ignore observed evidence or to incorporate these relationships into phonology.

In Griffen 1975, I suggest a phonological model termed 'hierarchical phonology' based upon the findings of dynamic phonetics. As the postulates and definitions of this model, as presented in the dissertation, are too lengthy to treat here, I shall briefly summarize the basic principles through which this model operates.

In its present stage of development, the hierarchical model is graphically represented in Figure 1 (next page). The vocalic pattern represents the vocalic oppositions abstracted from the phonetic features relating physiologically to tongue body, lip, and jaw position and acoustically to pertinent formant frequencies. This pattern is continuous, but it is divisible into syllables in the syllabic division of the model. The syllable is not bound by consonants, but it is an entity relating to (that is, abstracted from) a steady-state vowel approximation (with physiological and acoustic correlates) within the continuous vocalic pattern. This vocalic/syllabic pattern is constrained by

obstructions from the obstruction division of the model. These obstructions represent members of an opposition abstracted physiologically from position of articulation and acoustically from certain transition characteristics.

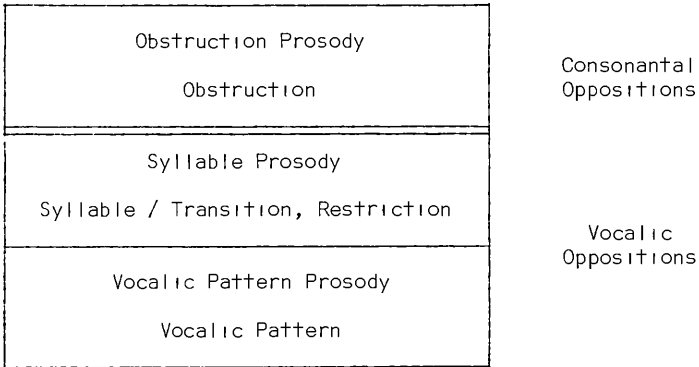


Figure 1

Each division of the model is further constrained by its own set of prosodies. The vocalic pattern prosodies include intonation, while the syllable prosodies include pitch, stress, tones, and tunes. The most complex set of prosodies is the set of obstruction prosodies. These constrain the obstructions and include such oppositions as nasality, tension, and aspiration (the inverse of voice, which is itself an integral part of the vocalic pattern).

As its name suggests, the basic relational principle of this phonological model is that of a hierarchy of constraints. The vocalic pattern is the basic realization which is constrained immediately by its own prosody, then by those of the syllable, finally by the obstructions and, usually indirectly, by the obstruction prosodies. The phonological opposition is still abstracted from the phonetic feature, maintaining the well-established principles of distinctive feature analysis and phonological (functional) pertinence. These abstracted oppositions may occur in sequence and in relationships one with another, but they

are not inherent in segments. Rather, all opposition relationships are in effect prosodic in nature.

To be sure, this system of relationships may not appear to be as simple as that afforded by segmental representation. On the other hand, theoretical consistence with the inner approach and accuracy of description ought to outweigh simplicity. That is to say that, while simplicity is an important criterion, it must be subordinate to theoretical and descriptive validity and applied only after such validity is established.

Although the relationships within the hierarchical framework may not be as simple as those of segmental phonology (at least in ease of conceptualization), they are far from being prohibitively complex and they afford significant insights not afforded by segmental phonology even with distinctive feature analysis. For a descriptive example of this phonology, I should like to describe the initial consonant gradation system of Modern Welsh, known as the 'mutation system'. I choose this system on account of its own inherent complexity of morphophonological relationships.

In the mutation system, a consonant in word-initial position may alternate with other consonants depending upon the grammatical environment (see T. J. Morgan 1952 for a complete explanation of the environments, at least in the Standard). For example, when the word ci /ki/ 'dog' is dominated by the third person singular masculine possessive pronoun, it is realized as /gi/ through 'soft mutation', when it is dominated by the third person singular feminine possessive pronoun, which has the same phonetic shape as the masculine, it is realized as /xi/ through 'spirant mutation', and when it is dominated by the first person singular possessive pronoun (present or implied), it is realized as /phi/ through 'nasal mutation'. In Table 1 (next page), I present the mutation system in its usual form. The 'radical' can be considered the morphophoneme in the generative usage of the term, and it is realized whenever a mutation form is not specified.

In the current phonological models, the nasal and spirant mutation could easily be handled by rules or other such relationships relating singular feature specifications (nasal and continuant). Soft mutation, however, involves voicing in some cases, continuance in others, deletion in another, continuance and denasalization with desonorization in another, and voicing

and vocalization with sonorization in yet others

| <u>radical</u> | <u>soft mutation</u> | <u>nasal mutation</u> | <u>spirant mutation</u> |
|----------------|----------------------|-----------------------|-------------------------|
| p              | b                    | mh                    | f                       |
| t              | d                    | nh                    | θ                       |
| k              | g                    | gh                    | x                       |
| b              | v                    | m                     |                         |
| d              | ð                    | n                     |                         |
| g              | deletes              | ŋ                     |                         |
| m              | v                    |                       |                         |
| ɬ              | l                    |                       |                         |
| ɸ              | r                    |                       |                         |

Table 1

ɬ is a voiceless lateral fricative    ɸ is a voiceless trill fricative (aspirated)

In the hierarchical phonology, this situation can be described through the interaction of obstructions with obstruction prosodies. There are three degrees of obstruction--1st degree (complete occlusion), 2nd degree (frication), and 3rd degree (sonorance). Welsh has all three degrees, but all 1st degree obstructions (occlusives) alternate prosodically with 2nd degree obstructions (fricatives) corresponding to their positions of articulation. The two remaining 2nd degree obstructions (fricatives), moreover, alternate with the two 3rd degree obstructions (sonorants) prosodically. (Welsh also has the sibilant and, in many dialects, the shibilant, but these do not enter into the mutation system of alternations.) Thus, each of the five positions of articulation (including point of articulation and tongue configuration) has only one phonological obstruction. The obstructions are designated as in Table 2 (next page)

|         |    |
|---------|----|
| labial  | b  |
| dental  | d  |
| velar   | g  |
| lateral | ʈ  |
| trill   | ʙ  |
| (slit   | s) |

Table 2

The prosodies which accompany these obstructions include aspirate-tension and nasality. The aspirate prosody is gradual and is justified both from a phonological and from an acoustic and physiological phonetic standpoint in Griffen (1975: Chapters 7 and 10). In the traditional notation, the sounds are arranged in accordance with the gradual opposition of tension and the opposition of nasality in Table 3.

|      |   |   |   |   |                |
|------|---|---|---|---|----------------|
| 1    | 2 | 3 | 4 | 2 | 3              |
| v    | b | p | f | m | m <sup>h</sup> |
| ʙ    | d | t | θ | n | n <sup>h</sup> |
| null | g | k | x | ŋ | ŋ <sup>h</sup> |
| l    | ʈ |   |   |   |                |
| r    | ʙ |   |   |   |                |

Table 3

Adding the appropriate prosodies to the obstructions in Table 2, with the symbol h representing the gradual opposition of aspiration and n representing nasality, we have the phonologically designated constraints as in Table 4 (next page).

|     |     |     |     |      |      |
|-----|-----|-----|-----|------|------|
| 1   | 2   | 3   | 4   | 2    | 3    |
| b1h | b2h | b3h | b4h | b2hn | b3hn |
| d1h | d2h | d3h | d4h | d2hn | d3hn |
| g1h | g2h | g3h | g4h | g2hn | g3hn |
| ʃ1h | ʃ2h |     |     |      |      |
| ɸ1h | ɸ2h |     |     |      |      |

Table 4

I present this linearly only for convenience in the absence of vowels. When vowels are designated, we might want to use a Firthian notation, reflecting the organization of the model as in Figure 1, though this, as all notation, would only be an aid to conceptualization devoid of meaning in and of itself. The organization of the Welsh consonant oppositions (the obstruction division of the model) can be designated as in Figure 2, dividing the obstructions into classes depending upon the degree to which they enter into relationships with the prosodies. A representation of these relationships can be found in Figure 3 (next page)

|           |     |                        |    |                           |
|-----------|-----|------------------------|----|---------------------------|
| n         |     |                        |    | Prosodic<br>Oppositions   |
| 1h        | 2h  | 3h                     | 4h |                           |
| b d g     | ʃ ɸ | s                      |    | Obstruction<br>Opposition |
| (Primary) |     | (Secondary) (Tertiary) |    |                           |

Figure 2



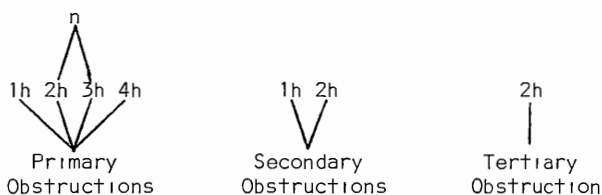


Figure 3

Examining the tables and figures, we can describe a system of relationships in which alternations occur for all mutations through a change or choice in one and only one prosody. The obstructions themselves are never affected (except, to be sure, in the case of the soft mutation of /g/, which I address below).

Moreover, important generalizations can be made in this system, due to its nonsegmental nature. For example, by defining the difference between /t/ and /l/ as prosodic, the two constraints can be seen to belong to the same general class, where current distinctive feature analysis would have one as a consonant segment and one as a liquid segment. By stating 'co-occurrence restrictions' on the prosodies, the denasalization of /m/ in soft mutation becomes a predictable development. In the case of the soft mutation of /g/, moreover, we can state that the subtraction from the lenis-most obstruction of one degree of aspiration (tension) results in the loss of all constraint, as some tension must be present for the articulation of an obstruction.

This 'systematic' description can also suffice for a 'taxonomic' description. The relationships that obtain between constraints are the same whether morphophonological or phonological. The difference between morphophonological and phonological relationships lies in the realm of function, as does the difference between phonological and phonetic pertinence (compare Trubetzkoy 1969).

In the final analysis, this approach is in some ways less complex in its operation than is the current segmental approach with distinctive feature analysis. Not only does this system

eliminate the need for a highly complex code for the generation of speech from phonology (compare Liberman 1970), a code which has yet to be made to work anyway, but it also, in effect, provides its own base for the phonological structure (compare Sampson 1970)

The most important consideration in the construction of an hierarchical model, however, is the maintenance of consistence with the principle of the inner approach, a basic tenet of phonology as it is known today. If in constructing our phonological structures, we choose to ignore the very basis of our own theories (be they functional or structural) in disregarding a system of relationships in phonetics which actually works, and if we choose rather to retain a system of relationships not justified in the observed phonetic data and which does not work, then our models cannot possibly generate the observations of speech or of language. Of course, by discrediting the traditional segmental representation in this way, I cannot prove that this particular hierarchical model is the answer to our problems (though this method of argument is not without recent precedent in the field of linguistics). I believe, however, that any model abstracted from a dynamic approach is much to be preferred over segmentation, for such an approach takes distinctive feature analysis through the inner approach to its logical (and by no means unreasonable) conclusion.

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