

Introduction

In the pages that follow we set out some of the motivations for a view of phonological structure which is in certain respects somewhat novel, particularly in the context of major theoretical developments in the last two decades. Specifically, we shall outline a conception of phonological representation which involves an enrichment of, and a greater variety in, the structural relations that can hold between the atoms of a phonological structure. This enrichment, we shall argue, will enable us both to delimit more narrowly the class of possible phonological regularities and to characterise the relative ‘markedness’ (or potentiality for recurrence) of such regularities.

Our major concern, therefore, will be to pursue the consequences for phonological notation of the observed recurrence of certain groupings of elements and of certain relationships or rules in the phonologies of different languages – on the assumption that the existence of just such recurrences should be predictable from the character of the notation. These recurrences and the characterising notation are assumed to have a natural – i.e. phonetic – basis; thus, as well as optimising the expression of recurrent regularities, the structures allowed for by the phonological notation should, at the very least, not be incompatible with what can be established concerning the nature of the speaker/hearer’s production and perception. We hope that, as our understanding sharpens, the relationship between notation and production/perception will be made more determinate. At present we lack both adequate knowledge of the range of recurrent phonological regularities and sufficient criteria for selecting between competing phonetic frameworks. The elaboration of a well-defined phonological notation should stimulate progress in both these areas, and their eventual reconciliation.

It is our contention (following particularly Anderson & Jones 1974a, 1977) that conceptions of phonological structure which were prevalent until recently, e.g. those adopted by most varieties of ‘generative

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phonology', fail to incorporate structural properties crucial to the explication of a wide range of phonological phenomena. These deficiencies involve both the internal structure of segments and sequential structure, i.e. the relations holding between segments in sequence. In Part I of this book (chapters 1–3) we attempt to establish that this is indeed so, and we delineate a phonological notation which possesses the appropriate structural properties. The precise character of these representations, in particular those characterising the internal structure of segments, will be investigated in greater detail in Part II (chapters 4–6). In Part III (chapters 7–8) we explore some further consequences of the model developed in Parts I and II.

There is nowadays a widespread recognition of the need to introduce into phonological representation units larger than the segment, such as the syllable, foot, etc. There is an almost equally great diversity of views on how to represent these notions (e.g. Fudge 1969; Hooper 1972; Fujimura 1975; Kahn 1976), although two (partly related) systems of notation have become particularly influential in the last few years: those of METRICAL PHONOLOGY (e.g. Liberman & Prince 1977; Kiparsky 1981; Prince 1983; Hayes 1984; Giegerich 1985), and AUTOSEGMENTAL PHONOLOGY (Goldsmith 1976, 1979, 1985; Clements & Keyser 1983; Clements 1985) (for an outline of the two approaches see van der Hulst & Smith 1982b). In chapter 2 we offer our own conception of sequential structure, in the light of some of the available evidence. In chapter 3 we suggest a characterisation of the properties of phonological sequences in terms of dependency stemmata (formal objects perhaps more familiar from syntactic studies), and propose that this characterisation is more adequate than that embodied in metrical trees. There, too, we argue further that the notion of dependency is also crucial to the characterisation of the internal structure of segments (given the properties of segments that are observed in chapter 1); hence the title of this book.

However, the relationship between sequential and segmental structure is not limited to formal similarity. Rather, we suggest, there are intimate connections between the detailed properties of the internal structure of segments and their potential for occurrence in sequence. Part II explores in more detail not only the characteristics of segment structure but also their consequences for the formulation of sequential regularities. The two 'enrichments' of phonological structure are, then, not unrelated. Sequential representation is a projection of the internal properties of the segments

comprising the relevant sequence and the morpho-syntactic structure associated with it.

Rather than anticipate too much, however, let us focus in chapter 1 on the nature of the evidence for the internal structure of segments and the view of that structure which the evidence leads to, and, first of all, on the nature of what we hope are relatively uncontroversial assumptions – which, we claim, give our observations the status of evidence.

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PART I

PHONOLOGICAL STRUCTURE

1 *The structure of phonological segments*

1.1 Some basic assumptions

In this chapter we consider the nature of the segments whose distribution is the concern of phonological description. In particular, in common with most phonologists, we shall look at the groupings or classes of segments which must be invoked in the formulation of generalisations concerning their distribution and behaviour. In the course of this we shall explore the consequences of certain assumptions that are generally agreed on, but not, we think, fully exploited: that is, our proposals concerning phonological structure do not involve a reinterpretation of the domain of phonology. Phenomena and assumptions which have been the central concern of phonologists form the basis for the arguments which follow.

Let us illustrate these assumptions with a simple example from Old English. The distribution of the vowels in the first of the two syllables in the forms in (1.1) (here given in the traditional orthography) is rather typical of Old English; <æ> is generally considered to represent a low front vowel, and <a> the corresponding back vowel:

(1.1)	dæg	'day'	(nom./acc. sg.)	dagas	(nom./acc. pl.)
	dæges		(gen. sg.)	daga	(gen. pl.)
	dæge		(dat. sg.)	dagum	(dat. pl.)

We are not concerned here with the morphological correlations (singular *vs.* plural), but rather with the relation of the vowel in the first syllable with that in the following syllable, which is not limited to paradigms of this type. For example, a word like that in (1.2):

(1.2)	fæder	'father'	(nom./acc./gen./dat. sg.)
	fæderas		(nom./acc. pl.)

has a single vowel throughout the paradigm, i.e. <æ>, rather than <æ> and <a>, correlating with the universal presence of a following <e>, intervening before the inflectional vowel, if present.

Phonologists describing such situations generally make a two-part

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assumption, which (following Anderson 1980a) we shall label the NATURAL RECURRENCE ASSUMPTION, expressed informally as (1.3):

- (1.3) *Natural recurrence assumption*
- a. Classes of phonological segments are not random.
 - b. Phonological classes and the regularities into which they enter have a phonetic basis.

In the present case, it will be observed that the vowels before which the <a>-vowel appears belong to a class which is invoked by other rules in Old English and elsewhere – i.e. it is recurrent – and which can be labelled with the phonetically interpretable cover term ‘back’ – i.e. it is natural. Furthermore, the <a>-vowel involved in the paradigmatic alternation of (1.1) itself belongs to this class: there is a natural relation between it and the class which determines its occurrence rather than that of <æ>. Most phonologists adopt (1.3) as a unit; but it is appropriate to separate it into two sub-parts, the second of which presupposes the first, but is not presupposed by it, and, indeed, is not adopted by all (cf. Foley 1977, for example).

Most phonologists make a further assumption, that phonological regularities and the groupings established on this basis correlate with the ‘content’ of phonological segments. Segments belonging to a particular grouping share some component property, and it is these properties which can be associated with phonetically definable parameters. This assumption is crucial to the notion of FEATURE in standard generative phonologies and their antecedents, and to the associated proposal of a simplicity metric based on feature-counting, such that NATURAL CLASSES, i.e. groupings based on feature-sharing, can be formally more simply specified than individual segments or groupings of segments of disparate feature composition. The vowels which in (1.1) and (1.2) condition the appearance of <a> rather than <æ> share a property or property-value [*n* back], in these terms. A rule invoking such a grouping is in this respect easier to formulate than one involving a grouping of, say, /i/, /p/ and /h/, which cannot be distinctively characterised by a particular feature-value or by a (non-disjunctive) set of values.

This view of segment composition can be said to embody the COMPONENTIALITY ASSUMPTION, which may be formulated as (1.4):

- (1.4) *Componentiality assumption*
- The representation of the internal structure of segments optimises the expression of phonological relationships (‘classes’, ‘regularities’) that are (a) recurrent and (b) natural.

This requires that a theory of segment structure should permit recurrent regularities to be expressed more simply than non-natural, irregular and sporadic groupings and relationships, i.e. ones which do not show natural recurrence. Given this assumption, we can evaluate theories of segment structure with respect to two kinds of evidence: first, on the basis of their degree of correlation with independently established phonetic parameters, and second, in terms of their adequacy for expressing recurrent relationships.

In what immediately follows we examine the adequacy of some theories of segment structure with reference to the second kind of evidence. However, as far as we are aware, ‘phonetic’ evidence would not lead us to conclusions contrary to those we shall arrive at on phonological grounds concerning the relative appropriateness of the various theories of the segment which we shall consider. We return below to the relationship between the two kinds of evidence (e.g. §1.6.2).

In the following discussion we shall be looking at various putative phonological ‘processes’, or, more precisely (and less tendentiously), ‘substitution relationships’—since only in diachronic terms are we necessarily dealing with genuine ‘processes’ (see Lass 1984a:ch. 8). It is not germane to our purpose to establish the precise status of these relationships with respect to particular phonologies: for example, whether, in relation to the phonology of a particular dialect, we have to do with a phonological or phonetic rule, a lexical or postlexical rule, or whatever. Rather, we are simply concerned with the phonological content of recurrent processes (in this loose sense) and the evidence this provides for the character of the internal structure of segments, given the componentiality assumption.

1.2 Non-componentiality

The null hypothesis concerning the internal structure of segments would consist in a denial of (1.4); i.e. phonologically, segments have no internal structure—segment labels are atomic. Let us refer to this as a NON-COMPONENTIAL THEORY. Some of the descriptions offered by American phonemicians come close to adopting such a position.

In Hockett’s ‘Peiping morphophonemics’ (1950), for example, segment alternations are expressed in terms of atomic segment labels. It is only in determining the distinctive *phonetic* properties of individual phonemes, as in his ‘Peiping phonology’ (1947), that the content of segments is

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considered. Even then, the distinctive (or, in Hockett's terms, 'determining') features are simply listed and exemplified: the phoneme /p/, for example, is represented as (1.5):

$$(1.5) \quad /p/ = \begin{matrix} p \\ S \end{matrix}$$

i.e. it is defined as a simultaneous bundle of the two features 'bilabial position' (p) and 'unaspirated complete closure without nasalisation' (S) (1947:§7). The occurrence of non-distinctive (i.e. 'determined') features is also described (§9): only here is the internal structure of segments relevant to the expression of some regularity, such as the distribution of voice in syllables. But even this is not provided for by Bloomfield (1926:§16), for whom a phoneme is a 'minimum same of vocal feature', so that no proposal beyond this concerning internal structure is appropriate at all. Later descriptions in this tradition, such as Hockett's, do introduce some suggestions concerning componentiality; but even then the choice of features is language-specific, and there is no attempt to state the conditions governing feature combination (whether some are mutually exclusive, etc.). Thus the fact that componentiality is little invoked in the expression of phonological regularities is reflected in the absence of any explicit statement of principles specifying the composition of segments.

The Jakobsonian framework, whose notion of segment structure is generally adopted by generative phonology, is in marked contrast on both these counts. In the first place, a segment is comprised of a set of universally given properties or features, together with a specification of the value that each segment has with respect to that feature, where the number of values (as far as phonological regularities are concerned) is limited to two. On the second count, as we have already indicated, and as is again very familiar, the notions of feature and feature-value, and the natural classes they define, are crucial in this kind of phonological framework to the formulation and evaluation of phonological regularities, while the componentiality assumption is basic to the motivation of the individual features. These, and the assumption of componentiality, are supported to the extent that the Old English example which we started out with is typical, i.e. to the extent that recurrent regularities are indeed optimally expressible by the notation, and sporadic or non-occurring relationships are difficult (or 'expensive') to express.

We note in passing that Trubetzkoy (1969) in one respect occupies an intermediate position here, in that he systematically invokes components,

which are, however, not universal. On the other hand, Trubetzkoy's conception of the internal structure of segments is rather richer than Jakobson & Halle's (1956), as we shall see below.

1.3 Minimal componentiality

1.3.1 Binary features

Let us now look in some detail at the adequacy of binary feature proposals for segmental structure, particularly those of Chomsky & Halle (1968; henceforth *SPE*). In such a framework, recurrence of a grouping of segments is to be expected to the extent to which the grouping can be specified by a non-disjunctive set of feature-values. The appropriateness of many of the groupings predicted as recurrent by the feature-assignments of *SPE* is not in doubt. However, there are some characteristic failures to separate the recurrent from the non-recurrent – failures which result from the particular claims being made concerning the nature of segment structure. For although the internal structure of a segment is indeed conceived of in this framework as being crucial to an explanation of its phonological behaviour, the degree of structural complexity invoked is minimal: a segment is an unordered set of features (or at least a set whose ordering plays no systematic role in the phonology), each feature having one of two values. Phonologically, the *SPE* framework is MINIMALLY COMPONENTIAL: internal structure is minimal, and the only structural variable is the value of the individual features. Though certain features may informally be thought of as more 'basic', hierarchisation of the features is not structurally relevant, nor (despite informal labels like 'major class features') are specific sub-groupings of features; the features themselves (except for the accentual) are atomic and uniform, in that they are all binary, for example. We turn now to examples that illustrate a need for two different kinds of increase in the complexity which should be attributed to the internal structure of segments.

In the first place, and perhaps less drastically, there are phonological relationships which invoke certain subsets of features in a very specific way, where once more the subsets are recurrent, and therefore, on the componentiality assumption, should be reflected as distinctive in our representation.

Lass (1976:§6.4), for instance, discusses the very common cross-linguistic phenomenon of homorganic assimilation of nasals to a following consonant. In terms of the minimally componential theory embodied

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in the *SPE* framework, such processes or relationships require for their expression something like (1.6), at least:

$$(1.6) \quad \begin{bmatrix} C \\ +nasal \end{bmatrix} \rightarrow \begin{bmatrix} \alpha_{\text{anterior}} \\ \beta_{\text{coronal}} \end{bmatrix} / - \begin{bmatrix} C \\ \alpha_{\text{anterior}} \\ \beta_{\text{coronal}} \end{bmatrix}$$

How adequate or complete this is will depend on whether the agreement of other feature-values is guaranteed by other rules (and on the number of distinctive places of articulation for postnasal consonants in the language in question). Some uncertainty over this is revealed by formulations such as that of Hooper (1976: 194):

$$(1.7) \quad \begin{bmatrix} C \\ +nasal \end{bmatrix} \rightarrow \begin{bmatrix} \alpha_{\text{anterior}} \\ \beta_{\text{coronal}} \\ \vdots \end{bmatrix} / - \begin{bmatrix} C \\ \alpha_{\text{anterior}} \\ \beta_{\text{coronal}} \\ \vdots \end{bmatrix}$$

Such formulations are in one significant respect less adequate than traditional descriptions: they completely fail to capture the fact that what is involved in homorganicity is just the set of features that in articulatory terms specifies the place of the supralaryngeal stricture, and that what is crucial is agreement between *these as a whole* (rather than, say, some other fortuitous subset of features). Both Jakobson and Chomsky & Halle group their features into subsets, Jakobson on the basis of well-defined acoustic criteria. But these sub-groupings have no formal status, nor do they play a role in the formulation of phonological regularities. What homorganic assimilation involves is apparently the set of resonance features, in Jakobson's terminology, or the set of stricture and cavity features of *SPE*. The recurrence of phenomena such as nasal assimilation suggests that the relevant partitioning should be formally represented in phonological structure. Indeed, formulations like (1.6) and (1.7) clearly fail to satisfy the componentiality assumption.

It is in fact simpler to formulate, instead of (1.6), a rule in which, say, only two of the features assimilate, as in (1.8):

$$(1.8) \quad \begin{bmatrix} C \\ +nasal \end{bmatrix} \rightarrow \begin{bmatrix} \alpha_{\text{anterior}} \\ \beta_{\text{high}} \end{bmatrix} / - \begin{bmatrix} C \\ \alpha_{\text{anterior}} \\ \beta_{\text{high}} \end{bmatrix}$$

and equally simple to formulate agreement between the members of any