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# Phonology

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vowels intervene: *kift* 'Open!, MASC.SG.', *kifč* 'FEM.SG.', but *qifif* 'cut the edges, MASC.SG.', *qʸifif* 'FEM.SG.'.

The third type of long-distance process, dissimilation at a distance, may involve aspiration, as in Grassman's Law in Indo-European; continuancy, as in Dahl's Law in Kikuyu; labialization, as in Labial Dissimilation in Chinese; or voicing, as in Lyman's Law in Japanese. In Japanese (Itô and Mester 1986), for example, a simple or compound native word may contain only one voiced obstruent. In compounds, the first consonant of the second constituent is usually changed to a voiced equivalent: *iro-kami* → *irogami* 'colored paper'. If the second word already contains a voiced obstruent anywhere, the voicing fails to apply: *onna-kotoba* → *onnakotoba*onna gotoba* 'woman + word, i.e. feminine speech'.

The fourth type of long-distance process, in which the patterns alternate, is extremely common in stress systems, where it is usually attributed to the construction of binary feet. The pattern may begin at either end of the word: the Australian language Maranungku and the Venezuelan language Warao both have strong-weak trochaic feet, but in Maranungku they start from the left (e.g. *lángkaràteti*) whereas in Warao they start from the right (*enàhoròahàkutái*). Length may also alternate, probably in response to pressure to achieve alternating stress, and also to avoid heavy unstressed syllables. For example, in the Australian language Gidabal, long vowels shorten after another long vowel, resulting in alternating length across the word: /gunu:m-ba:-da:n-be:/ → *gunu:m-ba-da:n-be*.

The study of long-distance processes has had significant implications for linguistic theory. The ability of a feature or features to surface at a distance from its point of origin, and the ability of the same or other features to be realized on more than one segment, led to theories like Autosegmental Phonology (Goldsmith 1976) that separate out at least some features onto separate tiers. The ability of sets of features to spread or move as a group at a distance, often because of their affinity with particular segment types, informed the theory of feature geometry (Sagey 1986, Clements and Hume 1995). Finally, the alternating patterns of some long-distance processes, particularly stress, motivated the postulation of binary metrical constituents (Hayes 1995).

[*See also* Generative Phonology; Phonological Features; Autosegmental Phonology; Lexical Phonology; Tone; *and* Optimality Theory.]

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**PHONOLOGY.** [*This entry includes the following subentries:*
Overview
American Structuralist Phonology
European Structuralist Phonology
Prosodic Phonology]

## Overview

Phonology is the study of the sound structure of language. Within linguistics as a whole, it has closest con-

nections with morphology and syntax on the one hand, and with phonetics on the other. (For general reference, see Sommerstein 1977, Kenstowicz and Kisseberth 1979, Dell 1980, Van der Hulst and Smith 1982, Lass 1984, and Anderson 1985.)

**1. Early history.** Although the emergence of phonology as a distinct discipline is relatively recent, its practice is actually quite ancient. The discovery of alphabetic writing in the ancient Near East required significant understanding of sound structure; the *segment* and the *phoneme*, two basic results of phonological analysis, are prerequisites to the alphabet.

A concern with the proper transmission of sacred texts led to very detailed study of the phonology of Sanskrit by the grammarian Pāṇini (5th c. BCE). Pāṇini is generally credited with constructing the first generative phonology, in which explicit rules relate an abstract representation of words to their actual pronunciation. This aspect of Pāṇini's work had a considerable impact on modern linguists, particularly Leonard Bloomfield.

**2. Structuralism.** During the first half of the 20th century, the most significant intellectual developments in the field were the emergence of American and European *structuralism* as the basis for nearly all phonological research. Particularly influential figures of this period were Bloomfield and Edward Sapir in the United States, and Roman Jakobson and Nikolai S. Trubetzkoy in Europe.

The greatest single contribution of structuralism to phonology was the recognition of the phoneme as the fundamental unit of the organization of sound systems. This unit is a contrastive element by which two words can be distinguished. The phoneme abstracts away from detailed rules of pronunciation to provide a representation of language from which the fully predictable aspects of phonological structure are absent. For example, the *p*'s of Eng. *pit* and *spit* differ in aspiration, the puff of air that immediately follows the release of the closure at the lips. If we transcribe aspirated *p* as [pʰ], then we can represent these two words phonetically as [pʰit] and [spit]. From a phonological standpoint, however, the phonetically distinct *p*'s of these two words are not in contrast: whether *p* is aspirated is entirely predictable by a rule of pronunciation, i.e. "Aspirate *p* when it begins a syllable." The phoneme written as /p/ is expressed as one of its two *allophones* [p] or [pʰ], by this rule of pronunciation.

The discovery of the phoneme led to a number of important results. Not only did it account for exceptionless aspects of pronunciation; it also provided a way of representing the lexicon of a language in terms of the units by which different lexical items are distinguished. The possibility was also opened of studying the phonemic systems of languages, which revealed the systematic patterning of phonological oppositions. Thus, for each of the Eng. voiceless stop phonemes /p t k/, there is a contrasting voiced stop phoneme /b d g/. The important paper of Sapir 1933 showed that phonemes are a part of speakers' mental representation of their language, rather than a mere analytic construct.

**3. Generative phonology.** Contemporary phonology begins with the watershed work of Chomsky and Halle 1968, *The sound pattern of English (SPE)*. The title alludes to a paper by Sapir; the analysis contains a subtle reference to Pāṇini. This book is both a synthesis of the results of earlier research and a source of major innovations. It describes a theory of sound structure that is known as *generative phonology* and applies it to a detailed analysis of English. The most influential themes of this work are as follows:

The theory is generative in the sense that it requires explicit formulation of the rules that relate the underlying representations of the lexicon to the surface representations of actual pronunciation. This permits exact evaluation of competing analyses of the same phenomenon.

The theory must be capable of describing all and only the sound systems and rules that actually occur in languages. This requirement follows from the psychological claims made: a generative phonology is a model of the mental representation by adult native speakers of the sound structure of a language. Phonological theory provides a limited set of possible models, among which a child must choose when learning a language.

The theory of phonological processes in *SPE* is a universal theory of how to express rules in terms of a metalanguage. The metalanguage (usually called the "notational system" or "abbreviatory conventions") makes claims about what sorts of phonological rules are possible in any natural language. For example, under certain conditions, stress in Hebrew falls on the final syllable of words ending in a C[onsonant]; however, it falls on the penultimate syllable of words ending in a V[owel]. Two rules are required: a penultimate stress rule, V → stress / ____CV#, and a final stress rule, V → stress /____C#. (The symbol # marks the end of a word.) The *SPE* theory requires that these two rules be collapsed or abbreviated as V → stress / ____(CV)#, with parentheses demarcating the elements not common to the two rules. The theory also claims that rules abbreviated in this way are subject to a principle of *disjunctive ordering*, such that the longer rule applies first, preempting the shorter one. Thus any

word that undergoes the longer (penultimate) stress rule will fail to undergo the shorter (final) stress rule. This is correct; CVCV words have penultimate stress without final stress.

Finally, *SPE* develops in considerable detail the idea that phonological rules and representations are characterized in phonetic terms. Every speech sound is composed of a set of two-valued *distinctive features*—phonetically defined entities that classify sounds and make claims about how they pattern in phonological rules. For example, the English stops /p t k/ are distinguished from /b d g/ by the feature value [−voice] in the former, and [+voice] in the latter. A rule like the voicing assimilation process responsible for *five+th* → *fifth* refers to the feature [voice]. An adequate theory of distinctive features expresses, for all possible human languages, the contrasts in their sound systems and the categories on which their phonological rules can operate.

Most of these points were generally accepted after 1968, but some aspects of the *SPE* program engendered considerable controversy in the years following its publication. The three most important ones involved abstractness of underlying representations, conspiracies among rules, and rule naturalness.

The *abstractness* controversy was initiated by Kiparsky 1968; he observed that the *SPE* theory places no limits on the remoteness of the relation between underlying and surface representation. Kiparsky pointed out that certain kinds of abstract analyses, although they account for patterning of data in the language itself, are not supported by external evidence, such as the progress of historical change. The efforts to grapple with this and related questions subsequently led to the development of the theory of *Lexical Phonology*.

A *conspiracy* consists of two or more rules that are functionally similar but formally distinct. This phenomenon was discovered by Kisseberth 1970; his premier example came from the phonology of Yawelmani Yokuts, which has several rules that actively eliminate or passively avoid creating sequences of three consonants. The problem with conspiracies, from the *SPE* perspective, is that formal and functional relatedness ought to go together. This is *SPE*'s central claim, following from its universal rule-writing metalanguage. In a conspiracy, rules that cannot be collapsed or abbreviated nonetheless function together in support of the same surface outcome, avoidance of a marked configuration (e.g. a triconsonant cluster).

Another area of debate which ultimately led to a greater understanding of phonological structure was the problem of *naturalness*. Within the *SPE* theory, the naturalness or likelihood of a system of rules was determined by maximally abbreviating the rules by use of the notational conventions, and then measuring the simplicity of the resulting grammar by counting the distinctive features using an *evaluation metric*.

In chap. 9 of *SPE*, Chomsky and Halle concede that this formalist approach to naturalness was not successful. In response, the theory of Natural Phonology proposed a repertoire of universal natural rules, called *processes*, in place of *SPE*'s rule-writing principles. A typical process is devoicing of final obstruents, as in German *Hund* [hunt] 'dog'. All learners start out with this process actively present, so the developing phonologies of young children are expected to show the effects of this process, as in fact they do. Children exposed to English hear final voiced obstruents in the ambient language, and this leads them to suppress the natural process. Children exposed to German simply retain the natural process unaltered from its original state. The phonology of a specific language, then, consists of all those natural processes that were not suppressed by learners in the course of acquiring that language.

From the mid-1970s through the 1990s, research on these and other issues moved away from *SPE*'s focus on rule-writing and toward a greater concern with aspects of phonological representation. This change of emphasis was initially driven by the desire to analyze phenomena, especially tone and stress, that had not been addressed satisfactorily in *SPE*, but the scope of this research program, sometimes known as "nonlinear phonology," quickly expanded, eventually having a transformative effect on phonological theory as a whole.

The study of stress led to the development of the theory of Metrical Phonology. Here stress is seen as a relation between syllables, rather than an intrinsic property of them. This syntagmatic view of stress has yielded a nearly comprehensive cross-linguistic typology of stress systems, as well as an excellent understanding of how rhythmic factors contribute to lexical and sentential stress. Relatedly, there has been significant progress in understanding other aspects of prosodic structure, particularly syllables.

Investigations of *tone* were the basis of the development of the theory of Autosegmental Phonology, in which the distinctive features that make up speech sounds are decomposed into separate levels of representation, called *tiers*. Principles of the theory provide a kind of orchestration of the gestures on the different tiers, with a single unit of one tier possibly corresponding to several units

of another. Autosegmental phonology has also been applied with success to non-concatenative morphology, to vowel and consonant harmony, and assimilatory phenomena in general.

Metrical and Autosegmental Phonology shift much of the burden of description and explanation in phonology from *SPE*'s rules to constraints on representations. The idea that all of phonology may be reducible to the interaction of constraints is pursued in Optimality Theory, which attributes linguistic generalizations to the interplay among ranked, violable constraints. Conspiracies, which had been so problematic in the rule-based model, emerge as the expected result of this interaction. Under the assumption that the constraints are universal and that languages differ only in their ranking, Optimality Theory also offers a solution to the naturalness problem. Language acquisition consists of learning a constraint ranking, with effects that hark back to process suppression in Natural Phonology.

Finally, we turn to the place of phonology in linguistics as a whole. Although the proper relation between phonology and syntax seems secure, the connections between phonology and the closely adjoining fields of morphology and phonetics are not. Work on Lexical Phonology and on non-concatenative morphology has established firm correlations between phonological and morphological structure; at the same time, it is unclear in the limiting case whether a particular phenomenon is to be analyzed phonologically or morphologically. The trade-off between phonetics and phonology is similarly unclear, although it continues to be a topic of lively debate.

[*See also* Acquisition of Language, *article on* Phonology; Autosegmental Phonology; Bloomfield, Leonard; Borrowing, *article on* Loanword Phonology; Generative Phonology; History of Linguistics, *articles on* American Structuralism, Ancient India, Prague School; Intonation; Jakobson, Roman; Language Change, *article on* Phonological Change; Learnability; Lexical Phonology; Markedness, *article on* Markedness in Phonology; Metrical Phonology; Morphology, *article on* Morphology and Phonology; Natural Phonology; Optimality Theory; Phoneme; Phonemic Systems; Phonetics; Phonological Derivations; Phonological Features; Phonological Processes; Sapir, Edward; Segments; Sentence Phonology; Syllables; *and* Tone.]

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## American Structuralist Phonology

American structuralist phonology was concerned primarily with formalizing the notion of the *phoneme*, and with elaborating a framework for the phonemic analysis of languages. By the early 20th century, phonetic science had revealed that languages often had more sounds in their phonetic inventories than had originally been suspected. For example, Eng. *p*[l̥]*ease* has the voiceless liquid also found in Welsh; the final sound in *ma*[tˀ] resembles the glottalized stop of many Amerindian languages. While phonetically accurate, these transcriptions are linguistically misleading: [l̥] and [tˀ] are of quite different status in English than in these other languages. Understanding the nature of this difference was taken to define the field of phonology.

In the 1920s, Edward Sapir and Leonard Bloomfield initiated two different approaches to the problem. For