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Linear Phonology

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Linear phonology is a method of studying the structure of the phonological components of language. Phonology is the branch of linguistics that explores how speech sounds are spoken and systematically organized within languages. Phonologists inventory the phonemes (i.e., the speech sounds) of a language and examine the features of these sounds and propose rules to describe how sounds are linked and patterned to form words. This entry discusses the differences between linear and nonlinear phonology; uses of linear phonology, for example, with children who have phonological delays; and the contributions of researchers, such as Noam Chomsky and Morris Halle.

Phonology entails several branches of study. Classical phonemics explores phonemes and phoneme combinations. Generative phonology is the study of the features of phonemes. Analysis within generative phonology focuses upon each segment of the linear sequence of sounds used to produce a stream of speech. Linear phonology provides the mechanism for this type of analysis of individual, discrete phonemes. In **nonlinear phonology,** a stream of speech is represented as multidimensional; it is an assembly that includes the overlapping features of phonemes along with linguistic units, such as syllables and morphemes, and suprasegmental features (such as sound, syllable, or word stress; changes in vocal pitch, loudness, and tone; and duration of sound production). Nonlinear models of phonology include the following:

1. autosegmental phonology, which explores speech sounds along with other independent features of speech, such as the tone and harmony that accompany speech sounds and that influence the production of groups or sequences of sounds;
2. metrical phonology, which describes how speech sounds are organized into syllables, how syllables become metrical feet, how feet become words, and how words are grouped in phrases and sentences; and
3. lexical phonology, which explores how sounds and morphemes are used to build words.

Speech–language pathologists are concerned with the diagnosis and treatment of speech sound production disturbances. Children who are acquiring speech and language may experience delayed or disordered development of the phonological system. These conditions characteristically have their onset in the preschool age range, result in systematic speech sound production errors, and are independent of physical or cognitive impairment, or of dialects, accentedness, cultural practices, or the influences of learning multiple languages. Children with phonological delays attain slower progress in acquiring the typical sequence of phonological development. Children with phonological disorders produce unusual speech sound errors and have a restricted phoneme repertoire. *Phonological impairment* and *speech sound disorder* are the umbrella diagnostic terms that describe phonological delay and phonological disorder. The term speech sound disorder globally encompasses the speech sound production difficulties that are due to motor origins (such as apraxia, dysarthria, and articulation delays or articulation disorders that are uncomplicated by language deficits), as well as speech production difficulties that are due to phonological impairment, that is, that have linguistic origins within the phonological system. In cases of phonological impairment, children appear to have difficulty producing speech sounds, but the cause of this difficulty is a language impairment within the phonological system. In this condition, children do not mentally represent speech sounds correctly; this difficulty perceiving, classifying, remembering, and activating speech sounds causes them to speak these sounds incorrectly.

Speech–language pathologists carefully analyze children's speech sound productions to determine the phonological patterns of error, known as *phonological processes*. Linear phonology and nonlinear phonology, as fields of linguistic study, historically informed the clinical research in the field of speech–language pathology. Linear phonology contributed to establishing the theoretical basis for how speech–language pathologists formally describe the linguistic features that underlie phonological impairments, and it influenced how speech–language pathologists diagnose the phonological behaviors of children who experience phonological delays or disorders.

A Historical Perspective on Linear Phonology

Linear phonology provided the theoretical basis for clinical study of speech sound production disorders throughout the middle decades of the 20th century. During the last two decades of the 20th century, nonlinear phonology supplanted linear phonology as the prevailing theory for the study of children's phonological development and as an explanation for the linguistic features that contribute to phonological processes and the phonological behaviors of children who experience phonological delays or disorders.

Although the study of the structure of language predates the 20th century by hundreds of years, a new scientific study of language emerged in Europe in the 1920s. Roman Jakobson, a philosopher of language, influenced the linguistic conceptualizations promoted by the scholars of the Prague school and drew attention to the emerging study of phonology as a system of language. Jakobson and other linguists advanced a theory of phonology and devised scientific methodologies to demonstrate the merits of this theory. The goal was to understand the function of the phonological system, but to make this discovery it was also necessary to explain the structural organization of the phonological system. Ensuing linguists explored paradigms for practical and complete analyses of the sound structure of language, with emphases on the functional or structural perspectives.

Chomsky and Halle: *The Sound Pattern of English*

Structuralism, as one theoretical framework and its empirical explanations came to be known, provided the preeminent approach to the study of linguistics through the 1970s. The accomplishments of the linguists in Europe and the United States who advanced the rigorous scientific study of language were situated within the structuralist approach. Generative phonology, which is the study of the features of phonemes, was devised by Noam Chomsky and Morris Halle, academicians at the Massachusetts Institute of Technology. Notable among their many publications was their 1968 book, *The Sound Pattern of English*. In the preface to the book, Chomsky and Halle stated that their intention was to provide a detailed investigation into English sound patterns and their underlying structure and to expose the rules of English phonology. Their methods established that a stream of speech is composed of sequences of discrete segments and that segments are composed of sets of phonetic features (speech sounds). The simultaneous and sequential combinations of these phonetic features and segments are subject to specific constraints that are predicated upon the multitude of ways that the sounds and segments can be spoken. They devised a "grammar" for phonology, that is, a linear sequence of rules for usage. The grammar represents the organization of the possible conditions under which the phonetic features of English could be used, one after the other, in a stream of speech.

Chomsky and Halle diagrammed phonetic representations within a two-dimensional matrix in which the rows lay out the sequences of phonetic features and the columns demarcate the consecutive segments of the utterance. The segments contextualize how the phonetic representations are being used and how they should be interpreted by a listener. A diagram might, for example, indicate the degree of intensity with which a given phonetic feature is present in a segment; for example, a "strident" feature might be indicated along a differentiated scale of degrees of stridency. The language context assigns to each phonetic representation a structural description that indicates how it is to be interpreted by a listener. This language context may govern the need for specific ways to produce a sound, for example, with intensity.

Chomsky and Halle acknowledged that the schematic of linear phonology is vast. The number of possible sequential phonetic representations is infinite, as is the number of possible sentences that can be constructed in each human language. However, the rules of a language must be finite, and the grammar must be attainable by the speakers of the language. Therefore, the system of grammar must be recursive, meaning that it must be constructed of rules that can be reapplied indefinitely and as needed, in new arrangements and combinations. As such, the grammar must be generative of the structural descriptions it needs. The rules must give rise to circumstances for applications of the rules. There is no limit to the number of applications of the processes, so the rules must be able to offer a structural explanation for any utterance.

In addition, Chomsky and Halle remarked on how every utterance is the externalized representation of the thoughts of a speaker. Each utterance is one possible manifestation of the ideas or concepts that the speaker is trying to convey. Chomsky and Halle described the spoken message, including its phonetic representations, as the surface structure of the message, and they labeled the speaker's thoughts or intentions as the deep structure. The surface structure is a transformation of the deep structure, meaning that the ideas are somehow transformed when they are put into language. The surface (i.e., overt) phonological properties of the utterance are determined by the mental representations of speech sounds that are inherent within the covert deep structure. The deep structure is transformed by the way that these properties are combined and exhibited as a surface structure. Chomsky and Halle described a "transformational cycle" that involves the rules that assign phonetic representations to each surface structure. Thus, the grammar of the phonological system must be transformational, in the sense that the rules allow for the transformation of thoughts into speech.

In sum, Chomsky and Halle accounted for certain "formal universals" that determine the structure of grammars and the form and organization of rules. They also accounted for "substantive universals" that define the sets of elements that figure into individual grammars, as within certain languages or dialects that have unique properties. They stated, "The theory of transformational generative grammar proposes certain formal universals regarding the kinds of rules that can appear in a grammar, the kinds of structures on which they may operate, and the ordering conditions under which these rules may apply" (Chomsky & Halle, 1968, p. 4). They proposed that there is a phonological component to generative grammar and observed it to occur in the linear patterning of the components of a fixed set of phonetic features. Their theory of universal phonetics specified the possible phonetic representations by determining the universal set of phonetic features and the conditions for their possible combinations within utterances. The phonetic form of each sentence in each language is drawn from this class of possible phonetic representations.

Linear phonology maintains that humans can innately and intuitively use patterns of sounds in rule-governed ways to generate words. The patterns and rules are the generative grammar of a given language, that is, the components that speakers use to generate language. There is a finite set of rules for stringing together phonological elements that allows for linguistic predictability. A speaker's phonological competence involves following the patterns and rules for effectively employing the elements of phonology to construct complex words.

The Utility and Applicability of Linear Phonology

Linear phonology provides an algorithmic description of the surface forms of the phonological properties of a language. It accounts for a multitude of phonological rules, and it allows for generating new forms by applying this set of phonological rules. The phonological representations within a language are explained as linear sequences and are diagrammed as matrices of features. As a structural system, linear phonology reveals the phonological contrasts that exist in a language and the conditions within a stream of speech under which these occur. However, linear phonology only marginally accounts for any other linguistic structures that occur outside of the linear structure of phonetic features and segments that are depicted in the matrices. For example, the morphology of syllables is not emphasized as a factor within the stream of speech that necessitates contrasts in pronunciation and inflection. This omission was addressed by the theory of lexical phonology, which emphasized the variations of sounds and structures that are operative within the inventory of the lexicon of a language, and which characterized how phonological rules could be governed by morphemic usage. Similar shortcomings of the linear model of phonological representations were identified by the theory of natural generative phonology, which adhered to the syllable as the unit of analysis and which saw the syllable as more suited to identifying the phonotactics of a language (i.e., the possible combinations of sounds within a language) as well as for distinguishing variations in how sounds are produced in words (e.g., as in the allophony and sonority of phoneme production).

Recent Perspectives: The Transition to Nonlinear Phonology

Nonlinear phonology accounts for spoken language as the assembly of phonemes, suprasegmentals, syllables, and morphemes. The phonetic features of language are one component within the multidimensional interactions of these linguistic constituents. A linear, left-to-right horizontal sequence of adjacent sounds has been supplanted by models that depict a speaker's dynamic coordination of many linguistic features, which may be adjacent or nonadjacent in an utterance. Nonlinear phonology provided the theoretical basis for the identification of the phonological processes produced by children with phonological impairments. Clinical assessment of children's phonological skills documents how children produce phonemes in the context of syllables, words, and phrases. Interventions for phonological impairments address developing children's mental representations of phonemic contrasts and the production of speech sound contrasts within these linguistic units.

See also Linguistics; Nonlinear Phonology; Phonological Processes; Phonology; Speech Sound Disorders

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Further Readings

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