PHONOLOGICAL THEORIES

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Abstract: *This is a critical review of two major phonological theories: linear natural phonology and the nonlinear optimality theory. Natural phonological theory asserts that phonological processes are phonetically based. Phonological error patterns help organize treatment targets and assess generalization. However, the natural phonology's explanation of speech sound learning in children does not attain the status of a scientific theory.*

Key words: *phonology, constraints, speech sounds, linear string of segments, mentalistic approach, natural phonology, phonological patterns.*

This is a critical review of two major phonological theories: linear natural phonology and the nonlinear optimality theory. Natural phonological theory asserts that phonological processes are phonetically based. Phonological error patterns help organize treatment targets and assess generalization. However, the natural phonology's explanation of speech sound learning in children does not attain the status of a scientific theory. Process proliferation and poor definitions are other limitations. Optimality theory proposes that speech sounds may be marked (complex, more difficulty to produce, etc.) or unmarked (simple, easier to produce, etc.). Optimality replaces rules with markedness and faithfulness constraints. Constraints are common to all languages, but their ranking are unique to each language. Speakers can violate constraints ranked lower, but not those ranked higher in their language. When speech is imminent, GEN the generator generates a variety of output (response) options and EVAL the evaluator selects an optimal output that is faithful to the higher-ranked constraints. There is no independent evidence for the existence of universal and innate constraints, specific language-based rankings, and the operation of GEN or EVAL. Assumptions of universality of phonological rules and even the existence of such rules are speculative. That children have innate phonological knowledge is an untenable assumption. Most generative phonological theories have little or no empirical validity. Investigations of child-directed speech, statistical learning, implicit learning, sociolinguistics, usage- and exemplar-based phonology and behavior analysis have all supported the view

that children master their speech sounds (and language structures) through social interactions.

Phonology is a study of speech sounds and the rules that dictate the formation of sound sequences in forming syllables and words. The root of phonology goes back to Panini, the Indian Sanskrit grammarian of the 5th century (Cardona, 1998; Shukla, 2006). Phonology as the study of a mental and innate sound system and the rules that govern that system is a product of the 20th century.

Phonology is linked with phonetics, which is the science of speech sound production and classification. Speech articulation is a phonetic event. Both phonology and phonetics study certain common factors of speech sounds. For instance, both are concerned with the description of speech sounds, sound sequences, and sound patterns that result when speech is produced. A major distinction is that phonology is concerned with abstract rules and knowledge that govern the production of speech sounds. Phonetic rules are grounded in speech physiology and acoustics; hence they are empirically observable and measurable. Phonological rules are a part of mental and unconscious knowledge; hence they are abstract and not directly observed. Phonetics is descriptive and experimental, whereas phonology is theoretical.

In speech-language pathology (SLP), the value of phonetic study of speech sounds is well-established and devoid of controversy. Speech-language pathologists (SLPs) appreciate the need to understand the physiological mechanism of speech sound production as well as the physical (acoustic) properties of speech sounds produced and modified in the human vocal tract. The value of phonological theories that entered SLP in more recent times, however, is debatable. Therefore, this paper offers a critical review of two major phonological theories and their relevance to an understanding of speech sound disorders in children.

A prototype of an innate mentalistic approach to language that began to influence SLP in the 1960s was Chomsky's (1957) theory of universal grammar. Subsequently, Chomsky and Halle's (1968) distinctive feature theory influenced the analysis of speech sounds and speech sound disorders. However, since the advent of newer phonological theories, the distinctive feature analysis has tapered off in SLP. Therefore, this review will be limited to currently influential phonological theories.

In a linear phonological theory, phonemic segments are independent of each other, not hierarchically organized, and form a *linear string of segments*. A segment

may be a sound, a combination of sounds, or a unit that is more abstract than a sound (e.g., the sonorant quality of a sound). Examples of phonemic segments include such properties as *vocalic, sonorant, low, nasal, voiced*, and so forth. Chomsky and Halle's (1968) distinctive feature theory is a classic and standard linear theory in which phonemic segments are a bundle of independent features that may combine with any other segment. Children have an inner level of mental representation of speech sounds from which they derive the outer level of surface productions. To translate mental representations to speech production, children apply the rules sequentially (i.e., linearly), one at a time, not simultaneously.

Phonological Processes

In their **Natural phonology** or **natural phonological theory** (NPT), Stampe (1979) and Donegan and Stampe (1979) proposed that to learn their speech sound productions, children simplify adult productions. Such simplifications are *phonological processes* that may affect an entire class of sounds sharing a common articulatory difficulty. Simplifications result in speech sound errors in the context of adult models, but those errors are unlearned because they stem from phonetic-physiological limitations. Learned speech sound errors cannot be attributed to a natural process (Donegan and Stampe, 1979). In SLP, the currently preferred term is **phonological patterns,** but I shall continue to use the term *phonological processes* because that is the term in the theory.

The theory is called *natural* because the children's simplifications of adult sound productions are due to their phonetic (speech production) limitations. Because children learning different languages simplify the adult production in similar ways, Stampe proposed that phonological processes are both universal and natural. NPT retains the Chomskyan assumption (Chomsky, 1995) of innately given adult phonological system that children are supposed to possess. However, in contrast to the Chomskyan theorists, natural phonologists believe that children do not follow some kind of rules in learning to produce their speech sounds. Processes are not abstract cognitive or mental rules, but they are a product of phonetic or physiological limitations of young children trying to master speech sounds. Children's speech improves as their speech production mechanism becomes more competent and their productions better match the adult models. Consequently, the simplification processes fade.

Phonological Processes vs. Rules

Phonological processes are unlearned, innate, involuntary, and natural and work at an unconscious level. Children cannot verbalize the process they exhibit. Rules, on the other hand, are not natural because they are not based on

physiological (phonetic) limitations. Most language rules are characteristics of dialects of a verbal community, and hence are learned. Learned rules may be verbalized. Americans pronounce the word *pentagon* as [pɛntagɑn] and the British pronounce it is [pɛntəgən]. Both are instances of dialectal learning, not a matter of phonetic limitations of the speakers, and hence not phonological processes. Most speakers in either dialect (American or British) may be able to describe the rule of how *pentagon* is pronounced in their dialect. However, a child who says [top] for *stop* is not following a rule. Given the child's phonetic limitations, it is a natural phonological process of cluster simplification, not a learned response. The child cannot verbalize the process of cluster reduction (Donegan and Stampe, 1979).

Having rejected phonological rules, the NPT proposes phonological **constraints**, which are restrictions a language imposes on a phonological process. Constraints force children to overcome phonological processes. For example, many typically learning English speaking children may delete the final consonants. Natural simplification as it is, the final consonant deletion process has a constraint on it: *there shall be final word consonants in English*. (It may be noted that such constraints are not universal; words in Spanish, Vietnamese, and many other languages have few or no final word consonants.) Because of this constraint, typically developing children have to master the production of final consonants and thus eliminate that process.

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