

A Review of
Chomsky and Halle's
The Sound Pattern of English
A Milestone in Phonology

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Introduction

***The Sound Pattern of English* (SPE) and Generative Grammar**

Chomsky and Halle's SPE, the founding work of generative phonology, must be seen as a part of the entire theory of transformational generative grammar. Chomsky revolutionized the field of linguistics in the 1950's by describing the human capacity for language as an innate ability rather than a set of learned habits, as was claimed by behaviourists. His theories formalized the description of the human language faculty by stating rules which applied universally to any language. Chomsky's phrase structure grammar describes sentences as consisting of noun phrases and verb phrases with recursive properties. Phrase structure syntax can be expressed by the formula below:

$$\bar{X} \dots \rightarrow \{ZP^*, X\}$$

The formula means that an X-bar (a phrase) is composed of a head X and any number of role players, in any order (Pinker 1994 : 111).

The purpose of this paper is not to explain this aspect of generative grammar, so one need not understand all the details of Chomskyan linguistics in order to appreciate the aim of Chomsky and Halle's work in SPE. The formula above is shown simply to demonstrate its similarity to those used in generative phonology. As can be seen in the following pages (see part three), their work in generative phonology made use of

similar formulas to explain English phonology with as much efficiency and mathematical elegance as possible, and to situate it firmly within the theory of transformational generative grammar.

One of the aims of this theory of generative grammar is to demonstrate that such abstract rules could not possibly be learned as habits. Indeed Chomsky was the first to make these rules explicit. Revealing them was such an impressive intellectual effort that it would be difficult to claim that a native speaker of a language consciously learns them or is even aware of them. Thus, SPE was an addition to Chomsky's earlier theories, demonstrating that at both the syntactic and phonological level, language is rule governed and learnable because of innate language learning faculties in the human brain.

This paper is divided into five parts. Part one summarizes the method of phonemic description which Chomsky and Halle rejected in SPE. Part two explains why they and other generative phonologists find phonemic analysis more problematic than helpful. Part three attempts to give an overview of the original theories presented in SPE, explaining its principles, system of notation and brief examples of the phonological rules it proposes for English. Part four examines whether SPE has any practical application to language pedagogy or suggests any questions for which answers could be sought by language teachers. Part five serves as a conclusion by discussing SPE's significance in the history of phonology.

Part One

Phonemic Description in Phonology

SPE rejected the prevailing use of phonemes in phonology. This section contains a brief account of the ideas underlying phonemic description.

Durand (1990 : 7) describes what he calls classical tests for the identification of phonemes as tests for *opposition*, *free variation*, *complementary distribution* and *phonetic similarity*.

Opposition is determined by doing simple minimal pair tests. One allophone is substituted for another in a word, and if the switch pro-

duces no change in meaning, then they are considered *free variants* of the same phoneme. If the switch produces a change in meaning, they can be considered, tentatively, as different phonemes.

Complementary distribution means that two allophones are always found in mutually exclusive environments. Durand (1990 : 5) gives the example of phonetic transcriptions of *train*[trejn] and *rain*[rejn]. The two allophones [r] and [r̥] can be considered, still tentatively, as representations of the same phoneme /r/ because they occur in complementary environments.

Many other allophones also occur in complementary environments, yet no one would say they are representations of the same phoneme. A test for *phonetic similarity* often appeals to a common sense notion of what makes two allophones similar, or it must resort to a description of features of articulation. Defining phonetic similarity obviously becomes arbitrary, and this became one of the criticisms of phonemic description.

Durand (1990 : 9) stresses that American linguists of the 1940's and 50's, known as post-Bloomfieldians, relied on these tests as discovery procedures. Languages were investigated inductively from sounds to grammatical structure, with no reference to the latter. This was the target of much of Chomsky and Harris' criticism in the 1960's.

Chapter four of Clark and Yallop (1990) describes the same tests of phonemic description, and throughout the chapter they hint at the shortcomings of this method which led to refinements of the concept of the phoneme or its abandonment altogether. They note "there are certain indeterminacies about phonemic analysis" (Clark and Yallop 1990 : 99). In spite of the criticisms which are described below, it is important to keep in mind that the phoneme remains a useful concept in language pedagogy and linguistic analysis.

Part Two

The Need to Abandon Phonemic Description

SPE itself contains little criticism of phonemic description or explanation of why the writers abandoned reference to the phoneme. For

this they refer the reader to their earlier books and articles. Otherwise, their reasons are well cited and explained in the texts which are cited in this section.

Chomsky felt the need to be quite scathing in his criticisms of contemporary phonology in *Current Issues in Linguistic Theory* (Chomsky 1964 : 25), referring to current methods as a hundred years out of fashion. He describes "a curious and rather extreme contemporary view to the effect that true linguistic science must necessarily be a kind of pre-Darwinian taxonomy concerned solely with the collection and classification of countless specimens." He contended that phonological description should be based on constructing the rules that make up the phonological component of a grammar (Clark and Yallop 1990 : 131). Other phonologies offer descriptive adequacy, but generative phonology offers explanatory adequacy (Clark and Yallop 1990 : 141). A useful analogy refers to biology again. At a certain point biologists lost interest in cataloguing the morphological differences between species and focused their attention on cracking the genetic code which governed these differences. Chomsky and Halle were interested in finding the minimal set of formal rules which governed the phonology of a language, and the use of phonemes seemed to complicate rather than simplify matters.

Pinker (1994 : 158-191), provides a simple outline of the faults with phonemic description. He points out that variations in accent and idiosyncratic speech patterns still allow listeners to identify morphemes (Pinker 1994 : 163). Words which we believe to contain the same phonemes can actually be quite different because they are altered by the environment in which they appear. There must be an underlying form, not necessarily the same as the surface sound, stored in memory which the listener compares to the phonetic input. The [i] in *rider* and *writer* are not the same, and this difference can be noticed in other pairs of words such as *prize-price*, *five-fife*, *jibe-hype*, *geiger-biker*. Phonemic description would have to create five rules for these pairs, but generative phonology looks beyond the phonemes to what features of articulation they have in common. In this case, the sound of [i] changes depending on whether it is followed by

a voiced consonant (Pinker 1994 : 176-178).

Pinker claims that "a word boundary with no one to hear it has no sound" (Pinker 1994 : 159). Boundaries do not exist in spoken output because it is a continuous stream of sound. The boundaries are created in the mind of the listener because he knows the language which is being spoken. While listening to an unknown foreign language, even a trained phonetician cannot discern morpheme boundaries.

Finally, Pinker states that by describing the features of articulation of speech sounds, language is seen to consist of two distinct "discrete combinatorial systems" (Pinker 1994 : 179), one phonological and one syntactical, thus both fit neatly into Chomsky's concept of transformational generative grammar.

Durand makes many of the same points as Pinker, but goes into more detail, using the same example with *rider* and *writer*:

If... we made the notion of surface phonetic contrast central, and postulated a phonemic opposition /aj/-/a:j/, we would have to restrict this opposition to one environment (before a flap). At the same time we would leave unexpressed the relation of *writer* to *write* and *rider* to *ride*, and we would fail to resort to two general and independently motivated rules of the phonology (Durand 1990 : 11).

He adds that some accents of English have the same underlying forms for *rider* and *writer* but they differ in rule application as to how they are pronounced. Durand states that "the observable differences between modern accents of English conceal striking similarities at the underlying level and in the set of core rules of the language" (Durand 1990 : 11). Thus the phonemic, or structuralist ideal of a description of a one to one correspondence between surface realizations and underlying forms breaks down.

Durand also criticizes structuralists for making reference to features only on an *ad hoc* basis when it is convenient to use them to refer to a group of phonemes (Durand 1990 : 14). He claims that this is fine as long

as the metalanguage of phonology is everyday language, but it is insufficient for formal description.

He argues for the use of features by highlighting their usefulness in phonotactic statements, using the rules for three-consonant clusters in English as an example. The rules state that the first consonant must be /s/, the second one of /p, t, k/ and the third one of /l, r, j, w/. The /p, t, k/ group occurs repeatedly in English phonotactic statements, but listing them this way does not make it clear what they have in common—the fact that they are voiceless plosives. Another such rule is the simple statement that in English initial CC clusters cannot both be labial (Durand 1990 : 16–18). Such statements are not only valuable because they simplify long lists, but also because they have predictive value and demonstrate that native speakers of a language apply complex phonological rules that they are usually unaware of.

Clark and Yallop's work (1990 : 128–160) makes comments similar to what has been stated above. They add to the argument against phonemic description by saying that it seems vague and relativistic in many ways. They describe a phoneme as “a point in a system of oppositions rather than an item in an inventory” (Clark and Yallop 1990 : 120). Speakers with different accents may disagree about the number of phonemes in their language, as with American and British English. One powerful example that they give refers to arbitrary analytical decisions about the number of phonemes in a language. If a language has twelve obstruent phonemes, all of which can be labialized, there are twenty-four obstruent phonemes. However, if /w/, the labializing feature of articulation, is considered to be a distinct phoneme following the twelve obstruent phonemes, the phoneme count is now arbitrarily reduced by twelve (Clark and Yallop 1990 : 124).

Like other writers, Clark and Yallop emphasize the need to refer to grammar in phonological analysis. Citing Chomsky (1964) they notice that “Harris and others' efforts to define ‘objective’ analytical procedures constantly presuppose access to native speakers' intuitions into their own language” (Clark and Yallop 1990 : 104). In other words, structuralist

made reference to grammar even though they did not acknowledge it. Clark and Yallop refer to Javanese where the appearance of /k/ or /ʔ/ depends on whether it occurs at the end of a morpheme.

Clark and Yallop (1990 : 130) also make reference to the oft-cited example of voicing assimilation in Russian which was one of Halle's strongest arguments against phonemic description. In the Russian phonemic inventory there is no distinction between the voiced and voiceless fricatives [dʃ] and [dʒ], but there is a distinction between the voiced and voiceless plosives [b] and [p]. Halle pointed out that in Russian these obstruents become voiced in front of a voiced obstruent, yet a phonemic description must account for the assimilation of [dʃ] and [dʒ] as allophonic conditioning, and the assimilation of [t] and [d] as phonemic substitution. Halle claimed that this is a very awkward way to express one rule, and similar examples were found in other languages which provided a strong argument for abandoning reference to phonemes (Clark and Yallop 1990 : 130).

Part Three

An Overview of SPE

The main principles underlying SPE can now be summarized to include the following:

1. The features of articulation, rather than phonemes or even allophones, are the primary concern of phonological analysis. See Appendix A for Chomsky and Halle's set of universal phonetic features.
2. Phonological rules are applied in a particular order in a language.
3. Phonological rules follow a transformational cycle, applied first to morphemes, then to words, then to phrases, then to sentences, upward through tree diagrams or outward through bracketed expressions. See Appendix B for examples of these devices.
4. There is reference to consonants and vowels, but not to syllables.
5. Rules should be expressed as simply as possible, and only the fea-

tures relevant to the rule need to be noted.

6. The ability to acquire complex phonological rules is innate. The application of the transformational cycle is an innate function, but it is used to acquire and apply different rules depending on the language spoken.
7. Phonological rules are influenced by the syntactic level of language, and generative phonology is a component of universal grammar.
8. The minimal elements of the surface structure are called formatives, and each formative has phonological, syntactic and semantic features that define it.
9. Proper bracketing indicates how a string of formatives in the surface structure is subdivided into phrases. Phrases can overlap only if one is contained in the other. This bracketing can be expressed in bracketed expressions or in tree diagrams.

Some of these principles obviously need further elaboration, and this follows below.

Rule order is demonstrated in the simple example given by Pinker cited above (Pinker 1994 : 176) using *write* and *ride*. One rule states that the [i] sound is altered depending on whether it comes before a voiced consonant. In *writing* and *riding* another rule, in some dialects of English, states that according to the flapping rule, the [t] should become voiced. One might assume that the two [i] sounds should be identical because they are now, because of flapping, both before a voiced consonant, but this is not so. The rules are applied in a fixed order. The vowel change rule is applied first with reference to the underlying forms of these words held in memory (note that the memory of an orthographic form is not to be confused with the underlying form which is a more abstract concept) then the second flapping rule is applied.

Chomsky and Halle's explanations of such rules are not easy to follow, and one might wonder, at first glance, about their claim to be presenting simplified phonological rules. Simplified in this sense should be taken to mean formalized. The abstractness of the rules they postulate

demonstrates their claim of innateness. They state "...it would be reasonable to state that the Compound and Nuclear Stress Rules are learned, while the principle of the transformational cycle, being well beyond the bounds of any conceivable method of learning, is one of the conditions, intrinsic in the language acquisition system, that determines the form of the language acquired" (Chomsky and Halle 1968 : 24) . Thus one can appreciate the aims and principles of generative grammar without having followed the development and complex notation of every rule postulated. Nonetheless, what follows in an attempt to briefly present an example of these rules as a general illustration of Chomsky and Halle's work in SPE.

In part one, chapter two of SPE, Chomsky and Halle give an overview of their work by presenting a limited sample of the rules of English phonology which they postulate. They stress that in generative grammar there is a transformational cycle in which "the application of cyclical rules depends not only upon the formatives in the surface structure but also upon the way they are categorized. For example, the specification of N (noun), A (adjective), or V (verb) is necessary for determining the applicability of the Compound Rule" (Chomsky and Halle 1968 : 20).

Using the example of *blackboard eraser*, they point out that the stress pattern of this string depends on how its parts are interpreted. If it is a board eraser which is black, the string will have one stress pattern. If it is an eraser for blackboards, it will have a different stress pattern. In their notation, stress is indicated by numbered superscript above vowels, with 1 indicating the strongest stress in the string, 2 the second strongest, and so on.

This change in stress patterns is due to the cyclical rule or the transformational cycle. Rules are first applied to the innermost bracketed expression, then the brackets are erased and reapplied to the next bracketed expression. In the example above a *blackboard* and a *black board* differ in their categorization, the former being a noun and the latter being a noun phrase. They can be expressed in the following bracketed expressions (examples from Chomsky and Halle 1968 : 15-18).

- (1) $[N\# [A\# \text{black}\#]_A [N\# \text{board}\#]_{N\#}]_N$ *blackboard*
- (2) $[NP\# [A\# \text{black}\#]_A [N\# \text{board}\#]_{N\#}]_{NP}$ *black board*

In the first cycle, in which rules are applied to the innermost brackets, *black* and *board* are always monosyllables and the stress pattern is simply:

- (3) $[N\# [A\# \text{black}\#]_A [N\# \text{board}\#]_{N\#}]_N$ *blackboard*
- (4) $[NP\# [A\# \text{black}\#]_A [N\# \text{board}\#]_{N\#}]_{NP}$ *black board*

The stress contour changes when the four inner brackets of each string are removed and rules which Chomsky and Halle observed are applied as follows:

- (5) $\text{---} \dots \overset{1}{V} \dots]_N$
- (6) $\overset{1}{V} \dots \text{---} \dots]_{NP}$

where (5) means: assign primary stress to a primary-stressed vowel which is followed by another primary stressed vowel *in a noun*, and (6) means: assign primary stress to a primary stressed vowel which is preceded by another primary stressed vowel *in a noun phrase*. To derive the final stress pattern for *blackboard*, yet another rule applies:

- (7) $\text{---} \dots \# \# \overset{2}{C_0VC_0\#}]_N$

which means that primary stress is assigned to a vowel which is followed by a word containing zero or any number of consonants, followed by a secondary stressed vowel followed by zero or any number of consonants, followed by a morpheme boundary, in a noun.

Rule 5 above is the Compound Stress Rule, and rule 6 is the Nuclear

Stress Rule. They are formal descriptions which have great descriptive power in the English language, and similar rules have been noted for other languages. (5) can be applied to any compound noun, compound adjective or compound verb, and (6) can be applied to any phrase which is not a lexical category, even sentences such as *Jack smokes*. With this wider description the formal rules can be expressed thus:

$$(8) \left[\begin{array}{c} \text{1 stress} \\ V \end{array} \right] \rightarrow [\text{1 stress}] \left\{ \begin{array}{l} \text{---.....}^1\text{V...}]_{\text{NAV}} \text{ a) Compound Rule} \\ ^1\text{V.....} \text{---.....}] \text{ b) Nuclear Stress Rule} \end{array} \right.$$

Using the same principles, Chomsky and Halle demonstrate that these rules can be applied repeatedly to the final level of the sentence, which of course can be quite complex.

In all, Chomsky and Halle present forty-three rules of English phonology, summarized in Part Two, Chapter Five of SPE (Chomsky and Halle 1968 : 238-245). In addition to stress patterns, these rules concern contexts in which changes such as velar softening, diphthongization, palatalization and so on occur.

Part Four

Considerations of SPE in Language Teaching

It is hard to imagine any practical application of generative phonology in the teaching of English to speakers of other languages. It would be difficult to contend that a learner of English would improve his language skills by learning about Chomsky and Halle's theory. However, their work does at least give a teacher interesting questions to ponder or investigate further.

Chomsky and Halle (1968 : 50) state that there are many interesting questions regarding the development of systems of underlying representations. They suggest the need for empirical research of this question because it is important to the practical problem of the teaching of reading. However, this problem was not a concern of SPE itself. A foreign

language teacher could speculate about the extent of an interface between formal instruction and acquisition of phonological rules. SPE seems to suggest that acquisition of grammar is a great asset in the acquisition of phonological rules, so one must wonder what the differences are in L 1 and L 2 acquisition in this regard. The theory also suggests that listeners can comprehend extremely varied input, for example foreign accents, as long as both speaker and listener have a good competence with syntax and lexicon. Phonology both before and after SPE has also recognized the questions raised by phonotactic rules. One might assume, for example, that rules of assimilation exist because of the biomechanical design of the speech organs and thus do not need to be taught. However, this is not always true. The phonological rules of languages often force the speech articulators *not* to take the path of least resistance in their movement (Clark and Yallop 1990 : 129).

Unfortunately, little data seem to be available to provide answers to these questions, thus they remain speculative considerations worthy of research. Obviously, it would be a great challenge to conduct empirical research and provide definitive answers to them in a theory of language pedagogy.

Part Five

The Place of SPE in Phonology

In the preface to the 1991 edition of SPE, Chomsky and Halle declare that "few of the matters treated in this 1968 book have remained unaffected by the developments in phonology that have taken place in the last twenty years" (Chomsky and Halle 1968 : v). Other writers speak of a revolution in phonology in the 1970's with a proliferation of theories of non-linear generative phonology as opposed to the linear theory of SPE (Durand 1990 : 2). Jackendoff (1994 : 27) summarizes current views as "a consensus that phonological rules cannot refer directly to syntactic categories." Current theories take account of syllables and intonational phrases, for example, and these sometimes occur across morpheme boundaries, presenting a problem when trying to display a strict one to

one correspondence between the phonological and syntactic components of a language. Nonetheless, SPE is still considered to be one of the cornerstones of phonology which no student in the field can ignore. Chomsky and Halle present the 1991 edition as "a book that students of phonology should find worth reading and pondering and arguing with" (Chomsky and Halle 1968 : v). It is also worth noting that the ideas presented by SPE may not seem radical now; however, when it appeared it was quite an extreme departure. The sharpness of their attack on phonemic description can be appreciated as a loud wake-up call in a field of study that had been staring down the wrong path for too long. The development of formal description was similar to trends in other sciences occurring in the same era, such as in artificial intelligence and genetics, and this gave phonology and linguistics a new respect as a true science.

Appendix A

Chomsky and Halle's universal set of phonetic features (Clark and Yallop 1990 : 430-31).

The features are described principally in articulatory terms, although Chomsky and Halle also refer (occasionally) to acoustic and perceptual correlates. Each feature is a 'physical' scale defined by two points, e. g. sonorant-nonsonorant. The features are binary for linguistic description—e. g. all sounds are functionally either [+voiced] or [–voiced]—but may have several values when taken as physical or phonetic scales. Where only one of the two functional values is given below, the other is a simple negative—e. g. nonvocalic, nonconsonantal.

<i>Feature</i>	<i>Articulatory description</i>
<i>Major class features</i>	
1 Sonorant (Nonsonorant = obstruent)	Produced with vocal tract cavity configuration in which spontaneous voicing is possible
2 Vocalic (Syllabic)	Constriction does not exceed that of high vowels, and position of vocal cords allows spontaneous voicing (Proposed renaming of vocalic)
3 Consonantal	Radical obstruction in mid-sagittal region of vocal tract
<i>Feature</i>	<i>Articulatory description</i>

Cavity features

- | | |
|-------------------------|---|
| 4 Coronal | Produced with blade of tongue raised from neutral position |
| 5 Anterior | Produced with obstruction in front of palato-alveolar region |
| 6 High | Tongue body above neutral position |
| 7 Low | Tongue body below neutral position |
| 8 Back | Tongue body retracted from neutral position |
| 9 Round (ed) | Narrowing of lip orifice |
| 10 Distributed | Constriction extends for some distance along direction of airflow |
| 11 Covered | Pharynx walls narrowed and tensed and larynx raised (in vowel production) |
| 12 Glottal constriction | Constriction of vocal cords |
| 13 Nasal | Lowered velum |
| 14 Lateral | Lowered side(s) of mid-section of tongue |

Manner of articulation features

- | | |
|---------------|---|
| 15 Continuant | Primary constriction in vocal tract does not block air flow |
|---------------|---|

(Noncontinuant = stop)

- | | |
|--------------------------|----------------------------------|
| 16 Instantaneous release | Instantaneous release (of stops) |
|--------------------------|----------------------------------|

(Chomsky and Halle's discussion, 1968, pp. 318-22, suggests two release features:

- | | |
|-----|--|
| 16a | Instantaneous versus delayed release of primary closures |
|-----|--|

- | | |
|-----|---|
| 16b | Instantaneous versus delayed release of secondary closures) |
|-----|---|

- | | |
|------------------------|---|
| 17 Velar (ic) suction | Velar closure producing suction (clicks) |
| 18 Implosion | Glottal closure producing suction (implosives) |
| 19 Velar (ic) pressure | (Velar closure producing pressure—no evidence of use in language) |
| 20 Ejection | Glottal closure producing pressure (ejectives) |
| 21 Tense | Deliberate, accurate, maximally distinct articulation (of supraglottal musculature) |

(Nontense = lax)

Source features

- | | |
|-----------------------------------|---|
| 22 Heightened subglottal pressure | Tenseness in subglottal musculature producing greater subglottal pressure |
| 23 Voiced | Vocal cord vibration (induced by appropriate glottal opening and airflow) |

(Nonvoiced = voiceless)

- | | |
|-------------|--|
| 24 Strident | Turbulence (in fricatives and affricates) caused by nature of surface, rate of airflow and angle of incidence at point of articulation |
|-------------|--|

Prosodic features

(listed but not discussed in Chomsky and Halle 1968)

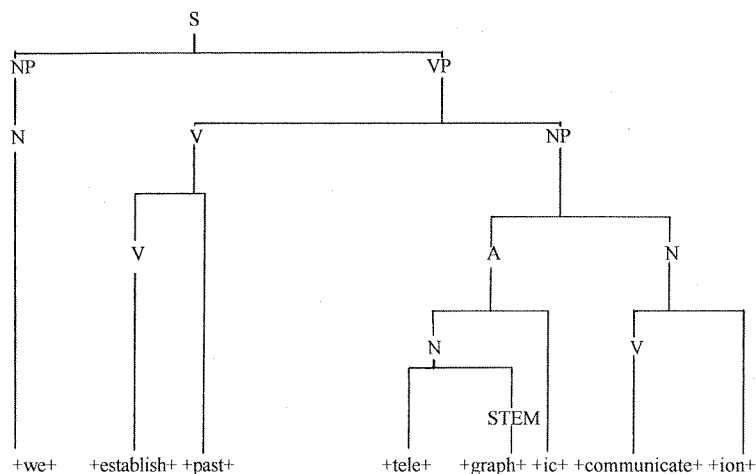
25 Stress

26 Pitch (high, low, elevated, rising, falling, concave)

27 length

Appendix B

Tree Diagram:



Bracketed Expression:

[S [NP [N + we +] N] NP [VP [V [V + establish +] V + past +] V [NP [A [N + tele + [STEM + graph +] STEM] N + ic +] A [N [V + communicate +] V + ion +] N] NP] VP] S

(examples from: Chomsky and Halle 1968 : 8)

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