Linguistics 201

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STILL RELEVANT AFTER ALL THESE YEARS

The Legacy of Lexical Phonology

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Contents

1. Introduction

What makes a word, a 'word?' What is the process by which a stream of sounds in one instantiation has a [k] that is replaced by an [s] in another (for example, in the formation of 'criticism' from 'critic')? Where does morphology end, and phonology begin, and how do these two 'systems' work together in speech? These are some of the types of questions that Lexical Phonology specifically focuses on addressing, by extending the role played by the 'lexicon' and in particular, the role of morphology in the process of word building and its relationship to phonology insofar as rule application.

This review paper looks at some of the insights brought to light by lexical phonology. Of particular interest is how aspects of the theory have influenced our understanding of phonological data; as noted in the literature "the theory of lexical phonology finally allows us to see the intimate relations between cyclicity, alternation, and neutralization." (Kaisse & Shaw 1985: 2) These relations are the crux of the matter to be explored in this paper.

2. Theoretical Background: Origins in Generative Phonology

Lexical phonology first emerged during the 1970s and '80s, an offshoot of generative phonology developed in the late 1960s in *The sound pattern of English* by Noam Chomsky and Morris Halle (Chomsky & Halle 1968). One of the key concepts proposed in *The sound pattern of English* (henceforth, SPE) was the introduction of the transformation cycle (Hyman: 198). This concept of the cycle is at the core of SPE's "system of rules that relates surface structures to phonetic representations" (Chomsky & Halle: 14). Briefly, the idea is that phonological rules are applied to 'strings' that 'surface' in a particular order. Chomsky & Halle describe the process as follows:

"...The syntactic component generates a string with a *surface structure* that is represented by *labeled bracketing*. The sequence of phonological rules is first applied to all innermost constituents of this string. Innermost brackets are then deleted, and

the sequence applies to the new innermost constituents. This cyclical application is repeated until the maximal domain of phonological process is reached." (Chomsky & Halle: 60; emphasis mine.)

The 'labeled bracketing' mentioned above refers to the notational convention defined in SPE to identify lexical items and their attributes or properties. Basically, a bracketed and labeled rendering of a lexical item (the various lexical items are called *formatives* in the terminology of the SPE) represents "surface structure in the presentation of phonological rules" (Chomsky & Halle 1968: 14). For example, the word that would be spoken in American English as [sæŋ] would emerge from the transformational cycle in a labeled bracketed string represented in the SPE theory as follows:

$[_v[_v sing]_v past]_v$ (Chomsky & Halle: 11)

The phonological surface structure is the "underlying representation" (UR) that enters the phonological component of the grammar (Chomsky & Halle: 18). The formatives, the rules, and all other elements that go into the word-building are provided by the lexicon (Chomsky & Halle: 10). *Formatives* have an associated *boundary* whose type influences how the formative can integrate with other formatives during the word building (word formation) process.

The boundary notations used in SPE to designate boundary type affect a formative's ability to combine with other units, and how the stress pattern of the emergent English word ultimately derives from the rules applied during the cycle. The concept of boundaries and how they affect or are influenced by phonological rules is a major point of departure for Lexical Phonology—it does away with them—but to understand what supplants them, here's a brief summary of some of the key points from SPE. To begin, these symbols characterize sets of associated features—they are cover symbols for characteristics along the lines of the [feature] bundles, but in these the set of features include only three:

[∓FB]	Formative boundary feature present or absent
[∓WB]	Word boundary feature present or absent
[-segment]	Segment feature absent

Table 1. Summary of boundary symbols from SPE (Chomsky & Halle: 13, 67-68, 94-95)

Boundary	Feature definition	Where it appears
+	[+FB] [-segment] [-WB]	Formative boundary. Final segment of one formative and the initial segment of the one that follows it.
#	[-FB] [-segment] [+WB]	Word boundary. Sentence initial, sentence final, and before and after each word. Readjustment rules can replace this boundary with a + as needed.
=	[-FB] [-segment] [-WB]	Unit boundary. This boundary applied to prefixes that affect the stress pattern of words, such as in complex verbs.

Table 1 is an attempt to coalesce some of the key points about boundaries and the role they play in SPE with respect to stress patterns and rule application in the word building process. The key points are that the "presence of the formative boundary + can be marked in a rule, but the absence of this boundary cannot" (Chomsky & Halle: 13), which means that this boundary can block rule application.

According to SPE, "certain of the phonological rules will apply only to words; others will apply freely to strings of formatives which may be words or subparts of words, or phrases that include words" (Chomsky & Halle: 13). These boundaries basically 'mark up' a string to which rules are applied, and in some cases, the boundary type itself may undergo a change—specifically, the # boundary can be replaced by a formative boundary, as in #tele+graph#ic" (Chomsky & Halle: 13), in which #tele# becomes #tele+ and in so doing, allows the re-adjustment rules to apply to the string with the result being a properly stressed word in English. The "readjustment rules" of SPE are applied to the surface structure to produce a phonological and ultimately phonetic utterance (Chomsky & Halle: 10).

As an example of this concept in action: SPE explains the seeming contradiction between applying the same rule for forming the past tense of regular and irregular verbs (mend→ mended vs. sing→sang) by positing that the readjustment rule "would replace *past* by *d*, as a general rule; but in the case of *sang,* would delete the item *past* with the

associated labeled brackets, and would add to the *i* of *sing* a feature specification indicating that it is subject to a later phonological rule which, among other things, happens to convert *i* to *æ.* Designating this new column as *, the readjustment rule would therefore give the forms [$_v$s*ng]$_v$ and [$_v$[$_v$mend[$_v$ d]$_v$, respectively." (Chomsky & Halle: 11). The result of applying all readjustment rules is "the phonological representation" (Chomsky & Halle: 11).

Accounting for the stress patterns in English word formation is a major theme of SPE. However, SPE discounts the concept of morphophonemic. Katamba describes the readjustment rules as being "rules with unbridled power" and notes that they are really "morphological rules in disguise" (Katamba: 11-12). With this background, we turn to some of the theoretical work that focused more closely on some of the rules from a morphological perspective, which ultimately helped set the stage for the theory of lexical phonology.

3. Morphologists' Perspectives on Generative Phonology

One thing that's missing from the SPE is discussion of 'morphology' and its relationship to phonology in the word-formation process. That's because at that time in the field of linguistics, the generative theory of transformational grammar was focused on syntax and theory of syntax had to be fully elucidated before the relationship between syntax and morphology could be clearly delineated (Siegel: 22). Mohanan characterizes this time period during lexical phonology's development as being an 'intellectual movement' that was searching for more answers from the lexicon than as the 'catch-all for exceptions' proposed in SPE (Mohanan: 5). Theorists working in lexical phonology all credit several sources—including Siegel, Allen, Mascaró, and Pesetsky—for various insights that ultimately led to re-thinking of the relationship between phonology and morphology, as viewed in the context of the cycle, the rules applied during the cycle, and the organization of the lexicon—in other words, the theory of lexical phonology. This section summarizes some of these contributions to the theory.

SIEGEL'S CONTRIBUTION: TWO CLASSES OF AFFIXES

Siegel (1974) provides an in-depth reframing of the nature of inflectional and derivational morphology, and how they differ in function. Specifically, inflectional morphology falls under the purview of syntax, while derivational morphology occurs in the lexicon. This difference is the basis of the difference in the application of stress rules during word formation. For example, during the word-building process, once a word has obtained an inflectional suffix, only phonological processes that can apply at word boundary (#) can apply (Siegel: 15-16). According to Siegel, all "inflectional affixes are stress-neutral" and cyclic rules that assign primary stress to words occur prior to rule

Siegel identifies the key constructs of the lexicon as being either a *stem*, *suffix*, *prefix*, *underived word*, or *derived word*. These are the formatives of English. The stress pattern of English words and the changes that these words undergo as they change morphophonemic shape is central to Siegel's discussion. It was this fact of the difference in stress patterns between the + (morpheme) and # (word) boundaries that

Thus, Siegel re-casts the three different kinds of boundary from SPE (#, +, and =) into a set of two boundaries (# and +) that apply based on the type of affix –its membership as a class of affix specified Class I or Class II. The details proposed by Siegel are summarized in Table 2.

Table 2. Classes of Affixes in English (Siegel: 102-105)

	Class 1	**Class 2**
Boundary notation	+	#
Description	Class I affixes can attach to either words or stems.	Class II affixes can attach only to words.
Prefix examples	in-, con-, circum-	anti-, pro-, electro-, circum-
Suffix examples	-en, -ate	-ness, -less, -ly
	Class I suffixes form adjectives.	Class 2 suffixes form nouns.

Suffixes generally derive words belonging to a specific syntactic category, while prefixes generally do not (Siegel: 107). pre-fixation onto a stem cannot predict word categories, but suffixation generally "derives words which belong to specific syntactic categories, specifically, -*ation* for nouns, -*en* for verbs, and –*less* for adjectives…"(Siegel 1974: 106-107)

ALLEN'S CONTRIBUTION: REFINING THE ADJACENCY CONDITION

Allen (1978) also focused on morphology in the context of English. She picks up a theme touched upon in Siegel (1974), that of the *adjacency condition*, and notes that she agrees with Siegel vis-à-vis the inclusion of the adjacency condition as necessary component of morphological theory (Allen: 50). The adjacency condition basically imposes an overarching constraint that word-formation rules (aka, WFR) can only be applied to items in adjacent cycles. According to Allen, "adjacent to refers not to linear adjacency, but to structural adjacency with respect to depth of bracketing," meaning that a prefix may be structurally adjacent to another prefix, an underived word, or to a suffix (Allen: 45). Allen suggests that intuitive evidence for the Adjacency Condition can be found in "negative prefixes, by verbal-based and non-verbal-based compounds, and by deverbal and denominal -ed adjectives" (Allen 1978: 2).

One important impact of the adjacency condition is that it "limits the number of conceivable types of rules and conditions on rules" (Allen: 50). It makes it "impossible for a WFR to refer to any conceivable property of the base at any possible cyclic depth." In terms of Lexical Phonology, I think this means that it imposes structural integrity, and precludes subsequent rules from 'dipping into' the context of previous cycles or previous rules. For example, once a suffix has been added, the nature of the phonological data is sufficiently changed, and the relevance of previous formatives that might have existed prior to this instantiation are not 'adjacent' for purposes of subsequent rule application.

It's Allen's reframing of the Adjacency Condition that Kiparsky adapted into his view of the cyclic nature of rule ordering at each level within the lexicon (perhaps also the Strong Boundary Condition). Allen drops Siegel's requirement in the statement of this

condition (in which Siegel stipulated that X must be an affix", and "generalizes" the adjacency condition as in the following rule statement:

> **(57) The Adjacency condition (generalized)**
>
> No WFR can involve X and Y, unless Y is uniquely contained in the cycle adjacent to X.

(Allen 1978: 49)

MASCARÓ'S CONTRIBUTION: CYCLIC RULES APPLY TO DERIVATIONS

Mascaró re-formulates "a more general idea of the Strict Cycle Condition" attributed to "Chomsky (1973) for syntax and Kean (1974) for phonology" (Mascaró 1976: 8), identifying the item 1B in the excerpt below as the point he takes from the SCC and will use in terms of Catalan phonology.

> **(1) Given a bracketed expression $[_n \ldots [_{n-1} \ldots, [_1 \ldots]_1, \ldots]_{n-1} \ldots]_n$, and a partially ordered set of cyclic rules C,**
>
> A.   C applies to the domain $[_j \ldots]_j$ after having applied to the domain $[_{j-1} \ldots]_{j-1}$, each rule in C applying in the given order whenever it applies properly in j.
>
> B.   Proper application of cyclic rules. For a cyclic rule to apply properly in any given cycle j, it must make specific use of information proper (i.e. introduced by virtue of) cycle j."

(Mascaró 1976: 7)

It is this idea that Kiparsky and Mohanan adapted and further developed as a working theory of the cyclic application of phonological rules to morphophonemic constructs. In Kiparsky's hands, this initially becomes the following:

> **(47) Strict Cycle Condition (SSC):**
>
> a.   Cyclic rules apply only to derived representations.
>
> b.   Def.: A representation ϕ is derived w.r.t rule R in cycle j iff ϕ meets the structural analysis of R by virtue of a combination of morphemes introduced in cycle j or the application of a phonological rule in cycle j.

(Kiparsky 1982: 154)

However, Kiparsky further refines this initial proposal and is the subject of his later work, as we'll see subsequently.

Kaisse & Shaw tell us that "…Lexical phonology adopts Pesetsky's (1979) extension of level-ordering: phonological rules apply in the lexicon after *every* morphological operation, including operations with the same stratum. Their output can then undergo further morphological derivation. The internal organization of the lexical phonology model thus automatically encodes the cycle" (Kaisse & Shaw 1985: 19). Thus, the notion of level-ordering which first emerged in Siegel (1974), that "in English, Class I affixation precedes class II affixation, and that application of cyclic stress assignment rules apply after Class I before Class II in the process (Seigel: 152)—was further refined by Pesetsky and lays another brick in the foundation of lexical phonology, and with some of these innovations on SPE re-framed in the context of morphology, the theory of lexical phonology takes shape.

4. Kiparsky's Theory of Lexical Phonology

Kiparsky (1982) incorporates various aspects of the notions identified in the previous section and elucidates his conception of lexical phonology. He extends the notion of the lexicon conceived of in SPE as a place for "exceptions" to rules as a conceptually layered structure that interleaved morphological rules with phonological rules, by incorporating notions of morphology. Thus, "the rules of Lexical Phonology are sandwiched between successive morphological operations," which means that "they are intrinsically 'cyclic.'" (Kiparsky 1985: 87) Unlike SPE, which viewed the lexicon as being limited to 'irregularities,' lexical phonology views the lexicon as embodying regularities as well. Some of the those regularities are the very constraints and conditions discussed in the previous section This are variously called 'levels' or 'layers' or 'strata,' with 'strata' being Mohanan's terminology and Kiparsky using 'level.'

Phonological processing should thus occur in two major components, one of which is the lexical component in which rules apply to words only, the other being a postlexical component that applies to larger

As conceived by Kiparsky, the lexicon comprises multiple levels for handling the word-building process. Certain affixes can be added at level 1; others can be added at level 2. The rules associated with the addition of these affixes apply on that level. Primary affixes are bound to the root morpheme at level 1, and the phonological rules associated with word stress and tri-syllabic shortening apply to the output at that level.

The strata (layers, levels) of the lexicon might be considered analogous to 'sub-systems' or 'modules' of computer software, each sub-system dedicated to its tasks and outputting a 'unit-of-work' that gets submitted to the next sub-system. The 'tasks' comprise the processing rules for building words out of sets of morphemes, the affixes, stems, and the phonological rules that apply to them.

Kiparsky does away with the brackets entirely and embeds the notion of affix type within the levels (strata) of the lexicon itself. He also takes the lessons of the Adjacency Condition and the Strict Cycle Condition and reformulates the SCC such that in the end, it seems that the adjacency condition is embedded within the notion of the lexicon itself, insofar as rule application. That is, an overarching constraint applies in the word-formation process which requires completion of processing between morphology and phonology the end of which a complete well-formed word emerges and either moves on the next layer (for further processing, say, the addition of a suffix –ness, or simply spoken, in which case the post-lexical rules apply (eg., flapping)

With lexical phonology, the need for boundary symbols is obviated by the Strong Cycle Condition. This followed from the Adjacency Condition—the Adjacency condition led to the strong cycle condition, and then obviated the need for an adjacency condition. "Lexical phonology directly predicts the correlation between 'boundary' strength and affix order" (Kiparsky 1985: 139)

In lexical phonology, rules are applied at specific levels only. The end result of processing within any single level or strata is a complete word (derivation) whose morphological boundaries have been eliminated and thus are not available to subsequent layers. As each word is built up from its constituent affixes, the next level (or even the same

level, if the word must iterate on that level to obtain another affix), the lexicon processes the composite as complete word. From an overarching perspective, this means that rules can be simplified. The bracket erasure convention obliterates "any information concerning bracketing and any morphological, phonological, or other properties ***internal*** to the word" (Katamba 1993)

Table 3. Summary of some of the differences between lexical and post-lexical rules

	Lexical rules	Postlexical rules
Application	Word-bounded	not word-bounded
Access	Apply to formatives	Phrase-structure
Cyclic	Cyclic (morphophonemic)	Not cyclic (syntactic)
Environment	Derived	Everywhere
Structure	Preserving	Non-preserving
Example	Tri-syllabic shortening	The flapping rule

Because only certain rules apply at each level, and because the morphological boundaries are eliminated, leaving a complete word once processing on a given layer (strata, level) completes, the rules can be made simpler and don't need to impose restrictions. In other words, adjacency conditions impose additional overhead on processing that is in effect, unnecessary.

Figure 1: Lexicon as conceived by Kiparsky (Kiparsky 1982: 5)
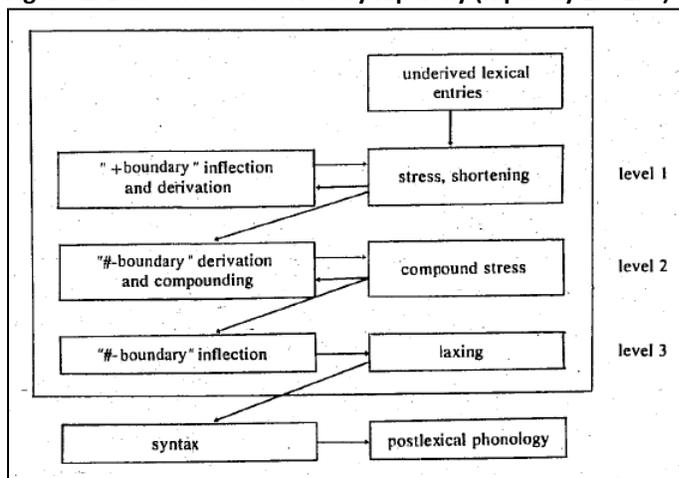
Mohanan's view on lexical phonology differs from Kiparsky's (Figure 1) in a few significant ways. According to Mohanan, the strata in the Lexical strata can be either cyclic

or non-cyclic and the strata 'knows' which it is and works accordingly. Mohanan also conceives of a lexicon with four strata, and a rule scheme that involves a loop—so his cycle is not confined to each individual layer, but the final layer can return to a previous layer if necessary to complete the word building process (Mohanan 1985: 139). As with using "Goto" statements in a programming language, this sounds like an accommodation that shouldn't have to be made in a theory. Both Katamba (1993) and Kaisse & Shaw (1985) find Kiparsky's approach to the lexicon as two levels "preferable to Halle & Mohanan's use of the loop and a fourth layer" (Katamba 1993: 150).

5. Conclusion

This paper has examined the theory of lexical phonology starting from its origins in generative phonology. In addition, I've reviewed some of the original sources that contributed to the development of the theory, specifically dissertations by Allen, Siegel, and Mascaró. We've seen how some of these sources informed the theory. The paper has also shown that, at the core of the theory is the conceptualization of a multi-tiered lexicon that plays a pivotal role in applying various phonological rules of a given language so that ultimately, words that conform to the language can be spoken. In the context of a word that is part of an utterance, we've also seen that post-lexical rules can also apply. These post-lexical rules are not cyclical, and they operate under the control of the syntax rather than the lexicon. Many of the arguments presented as evidence of the validity of this theory are in themselves valuable as guides for 'how to analyze linguistic data.' The importance of rule-ordering and the idea that morphology has an important role to play in any phonological analysis is made abundantly clear by theorists working in lexical phonology.

The theory helps explain, without relying on abstract underlying representations, the many examples of English patterns of stress in a coherent, logical analysis. For example, the case of 'nightingale' which seems to defy the rule of tri-syllabic shortening and requires an accounting in SPE that claims an underlying velar continuant ('niXtingale') . In an analysis based on lexical phonology, 'nightingale' is simply a complete word (not derived) in the lexicon, so it need not be processed using the morphological rules within the various

strata of the lexicon, hence it does not ever undergo processing by the layer where TSS occurs. The example of "nightingale" seems to defy the rule, but it is an un-derived word: "nightingale" enters the lexicon as a fully-formed underived word.

There are far too many aspects of this theory to be covered in a single term paper. For example, the relationship of this theory to (and interdependence on) other theories such as metrical stress theory and developments in Autosegmental Phonology and Optimality Theory show the interrelationships among various theoretical pursuits. From the most basic perspective, the important lessons from Lexical Phonology for any phonologist might well simply be mindfulness about rule-ordering and the necessity to follow a coherent and consistent approach in a phonological analysis.

REFERENCES

ALLEN, MARGARET. 1978. *Morphological Investigations.* Storrs, CT: University of Connecticut dissertation.

CHOMSKY, NOAM & MORRIS HALLE. 1968. *The Sound Pattern of English*. New York: Harper and Row.

KAISSE, ELLEN & PATRICIA SHAW. 1985. On the theory of Lexical Phonology. In Ewen, Colin & John Anderson (Editors) *Phonology Yearbook* 2.1-30.

HYMAN, LARRY. 1975. *Phonology theory and analysis.* New York, NY: Holt, Rhinehart and Winston.

KATAMBA, FRANCIS. 1993. *Morphology*. New York, NY: St. Martin's Press.

KIPARSKY, PAUL. 1982. From cyclic phonology to lexical phonology. In Harry van der Hulst & Norval Smith (Editors) *The structure of phonological representations: part I.* Dordrecht, The Netherlands: Foris Publications Holland.

KIPARSKY, PAUL. 1985. Some consequences of lexical phonology. In Ewen, Colin & John Anderson (Editors) *Phonology Yearbook* 2.85-138.

MASCARÓ, JOAN. 1976. *Catalan phonology and the phonological cycle*. Cambridge, MA: MIT dissertation.

MASCARÓ, JOAN. 1976. *Catalan phonology and the phonological cycle*. Cambridge, MA: MIT dissertation.

MOHANON, K.P. 1986. *The Theory of Lexical Phonology*. Boston, MA: D. Reidel Publishing Company.

SIEGEL, DOROTHY. 1974. *Topics in English morphology*. Cambridge, MA: MIT dissertation.