| | | | | |
|---|---|---|---|---|
| lab$^h$ 'profit' | + | kɔra 'making' | → | lapkɔra |
| šat 'seven' | + | b$^h$ali 'brothers' | → | šadb$^h$ali |
| lob$^h$ 'greed' | + | t$^h$aka 'remaining' | → | lopt$^h$aka |
| mɔd 'alcohol' | + | k$^h$aoa 'drinking' | → | mɔtk$^h$aoa |

### *4.7 Lyman's Law in Japanese*

Review the analysis of Lyman's Law in Japanese compounds in section 4.3.3. Provide derivations for the following two compounds, explaining the difference in voicing. Briefly discuss the role that the notion of tier plays in accounting for this difference.

| | | | | | | |
|---|---|---|---|---|---|---|
| (1) | ko 'child' | + | tanuki 'raccoon' | → | kodanuki 'baby raccoon' |
| (2) | taikutsu 'boredom' | + | šinogi 'avoiding' | → | taikutsušinogi 'time-killer' |

### *4.8 Acoustic Phonetics*

A. Calculate the first three resonance frequencies of a tube closed at one end that is 10 cm long. What is the wavelength of the lowest resonance?

B. The speed of sound in water is 1,520 meters per second. Calculate the first three frequencies at which a tube closed at one end whose length is 17 cm will resonate in water.

C. Using the Chiba-Kajiyama rule, label the cells in the following table as higher or lower with respect to the values for the neutral vowel schwa. Hint: Rely on the diagrams in figure 4.19 and assume that [u] is produced with a constriction at the lips, [i] with a constriction about 5 cm in from the lips, and [a] with a constriction about 11 cm in from the lips. Verify your results by referring to figure (47).

(1)

| | | | | |
|---|---|---|---|---|
| $F_1$ | 500 Hz | ___ | ___ | ___ |
| $F_2$ | 1500 Hz | ___ | ___ | ___ |
| | [ə] | [u] | [i] | [a] |

# 5 Lexical Phonology

In this chapter we will look at generative research into the relation between phonology and morphology. We will begin with evidence that phonological rules fall into two broad classes: one sensitive to the morphological and lexical environment and the other not. We will then note another criterion of lexical rules – sensitivity to derived contexts – and examine attempts to subsume this property under the notion of strict cyclicity. After a review of early work in generative morphology, we will see how phonology and morphology are integrated in Kiparsky's (1982a) Lexical Phonology model – the received generative interpretation of the relation between phonology and morphology. We will examine the model's basic concepts and claims and in the final sections turn to current issues and problems that confront the model.

## 5.1 Introduction

Since the inception of the scientific study of phonology, linguists have noted that phonological alternations and the rules that underlie them tend to fall into two broad classes. These classes are distinguished by several properties, which are listed in (1).

(1) a. relevance of lexical information
b. distinctive nature of alternating sounds
c. phonetic motivation for alternation

As illustration, let us compare two rules of English phonology: the flapping rule that converts intervocalic dental stops to a sonorant [D] (IPA [ɾ]) and the so-called trisyllabic laxing rule (TSL) that shortens a vowel when followed by two syllables. These rules differ with respect to each of the features listed in (1). First, the context in which the flapping rule applies can be stated in purely phonological terms as V́___V. The rule converts an intervocalic dental stop to a sonorant essentially without exception. It applies both morpheme-internally (2a) and when the V́___V context is interrupted by a morpheme boundary (2b). Flapping also applies at the phrasal level, where the following vowel is contributed by another word (2c).

| | | | |
|---|---|---|---|
| (2) | a. | a[D]om | cf. atom-ic |
| | b. | mee[D]-ing | cf. meet |
| | c. | wha[D] is wrong? | cf. what |

The flapping rule exhibits the two other features of (1) that often accompany such purely phonologically conditioned rules. The [D] that is the output of the rule is not a member of the underlying inventory of contrasting phonological segments in English. This sound arises only as a product of the flapping rule. For this reason English speakers are typically unaware of the sound substitution introduced by this rule. It takes phonetic training to realize that the [t]'s in *atom* and *atomic* are in fact different sounds. Finally, the sonorization of an intervocalic stop is a natural phonological process that is widely distributed through the languages of the world and can be viewed as an assimilation of the sonority of the adjacent vowels.

The TSL rule differs in each of these respects. Before developing this point, we need to assemble some background on this rule, which has played a prominent role in generative phonology. TSL is responsible for many of the vocalic alternations running through the phonology of English. Its precise statement is still a matter of some controversy. For purposes of discussion here, we will accept the formulation given by Kiparsky (1982a), listed in (3a); see section 10.9 for further discussion. This rule shortens a long vowel when followed by two syllables, the first of which is unaccented. (The latter restriction prevents application of the rule in *tītán-ic, Hēbrá-ic, Plātón-ic,* etc.) After TSL has applied, another rule known as Vowel Shift transforms the vowels that have escaped shortening in the manner indicated in (3b).

(3) a. $\bar{V} \rightarrow \check{V}/$ ____ C $V_1$ C $V_2$
(where $V_1$ is not stressed)

b. ī → aj
ē → ij
ǣ → ej

The rules in (3a,b) jointly account for the vowel alternations exemplified in (4a). (In dialects where long vowels are not diphthongized, the alternations take the form [ē] → [ī] and [ǣ] → [ē]; also, short [i] and [e] are realized as [−ATR] lax vowels [ɪ] and [ɛ].)

(4) a.

| | | | |
|---|---|---|---|
| divīne | [aj] | divĭn-ity | [i] |
| serēne | [ij] | serĕn-ity | [e] |
| profǣne | [ej] | profæ̆n-ity | [æ] |

b.

| | | |
|---|---|---|
| div[ī]ne | div[ī]n + ity | UR |
| inappl. | [i] | TSL |
| [aj] | inappl. | Vowel Shift |

We will follow the analysis of these alternations developed in *SPE,* which assumes the underlying long vowels reflected in the orthography. The pair *divine-divinity* receives the derivations in (4b).

Additional suffixes whose attachment to a stem invokes TSL are listed in (5).



(5)

| | | |
|---|---|---|
| [-ify] | vīle | vĭl-ify |
| | clēar | clăr-ify |
| [-ual] | rīte | rĭt-ual |
| | grāde | grăd-ual |
| [-ize] | tȳrant | tȳrann-ize |
| | pēnal | pĕnal-ize |
| [-ous] | tȳrant | tȳrann-ous |
| | fāble | făbul-ous |

With this background, let us now consider the ways in which the TSL rule differs from the flapping rule. First, specification of the context in purely phonological terms as ____CVCV is not sufficient to characterize the precise range of application of the rule. There are a significant number of stems with a long tense vowel followed by two syllables. These V̄CVCV strings show no tendency to shorten the initial vowel (6a). Consequently, the rule is only conditioned by the addition of a suffix. Second, not all suffixes activate the rule. While [-ity] and [-ify] regularly initiate shortening, the suffixes in (6b) systematically fail to do so.

(6) a. nīghtingale, stēvedore, īvory
b. brāv-ery, mīght-ily, pīrat-ing

Finally, within the class of suffixes that trigger TSL, there are still idiosyncratic lexical exceptions: *obēsity* fails to undergo the rule and be pronounced as **obĕsity*. Consequently, precise delimitation of the extension of TSL requires information about the lexical and morphological environment in which the V̄CVCV string is located. By contrast, the domain of the flapping rule can be specified in purely phonological terms.

In addition, TSL differs from flapping in that it relates segments that occur as independent phonemes in English. The [ij]≈[ɛ] alternation of *serēne-serenity* relates phonological segments that contrast in such minimal pairs as *beat* vs. *bet*. English speakers have no difficulty in perceiving the sound substitutions effected by TSL in such pairs as *serene-serenity* even if they are not reflected in the orthography. This [ij] vs. [ɛ] difference is one to which proponents of orthographic reform are likely to appeal in order to justify a change in English spelling. It is noteworthy that the *t*'s in *atom-atomic* differ by just as many features as the *e*'s in *serene-serenity*. But few would argue that *atom* and *atomic* should be distinguished orthographically – precisely because this sound difference is below the threshold of consciousness for most speakers. Finally, given the formulation of TSL as in (3a), the environment of the rule is not a particularly natural one for vowel shortening (closed syllable, unstressed syllable, etc.).

The flapping and TSL rules thus contrast with respect to each of the properties of (1). Other rules often fail to display all three features. But this does not invalidate the classification. Rather, the features of (1) should be thought of as relations that constrain the range of properties any given phonological rule is likely to display. If a rule introduces allophones, then it typically lacks lexical conditioning and tends to be phonetically motivated. If a rule substitutes sounds in a

phonetically irrational way, then the terms of the alternation are usually elements of the underlying phonemic inventory, and the rule will quite likely display or develop lexical restrictions.

Let us consider another example in which the distinction between these two kinds of phonological rules is evident. Recall from section 2.7 the rule of Polish that raises [o] to [u] when followed by a word-final voiced nonnasal consonant (7b). This rule accounts for the alternations in (7a).

(7) a.

| | | |
|---|---|---|
| bup | bob-u | 'bean' |
| xut | xod-u | 'pace' |
| kot | kot-a | 'cat' |
| vus | voz-u | 'cart' |
| dzvon | dzvon-u | 'bell' |

b. [o] → [+high] / ___ [+cons, −nasal, +voiced] #

Polish raising displays many of the characteristics of English TSL. First, it has lexical exceptions: for example, *skrop* 'scratch' imper. from underlying [skrob] (cf. 1sg. *skrob'-e*). It also has some morphological conditioning. According to Bethin (1978), the rule applies much more often in feminine and neuter nouns than in masculines. The latter point is shown also by extension of the rule to loanwords: the feminines *doz-a* 'dose', *pagod-a* 'pagoda', *mod-a* 'fashion' show raising in the suffixless genitive plural: [dus], [pagut], [mut]. Bethin reports that there is no tendency to extend the rule to such masculines as [mop] 'mob', [snop] 'snob'. In contrast, the final devoicing rule is completely regular. Its context and extent of application do not require access to any lexical or morphological information. Second, Polish speakers are aware of the sound substitution effected by the raising rule since [o] and [u] are contrastive segments. In fact, this sound change is reflected in the orthography: the [u] derived from raising is spelled *ó*. The voicing change is essentially below the level of consciousness; it is not reflected in the orthography. It happens to be the case that each voiced obstruent phoneme in Polish is matched by a corresponding voiceless one. Consequently, the final devoicing rule has no opportunity to introduce allophones. It should be noted that the discussion here abstracts away from the effects of the phrasal context. When the following word begins with a voiced obstruent, the final obstruent of the preceding word will assimilate in voicing. This process may introduce allophones. For example, the voiceless fricative [x] lacks a voiced counterpart as an independent phoneme. But this gap fails to constrain the change of [x] to [ɣ]: for example, *Lech Wałęsa* is phonetically [. . .ɣ # v. . .]. Thus, when the proper conditions obtain, the rule(s) responsible for the voicing of word-final obstruents in Polish display the range of features predicted by the classification in (1). Finally, while final devoicing is one of the most common kinds of phonological rule, the raising of [o] to [u] before a voiced nonnasal consonant is an arbitrary and phonetically unmotivated sound substitution.

Thus, the Polish raising and devoicing rules classify with respect to the properties in (1) in essentially the same way as the English TSL and flapping rules do. However, the Polish data bring out an additional point. Recall that the raising rule must precede the devoicing rule. This ordering reflects the generalization



that lexically restricted rules typically precede rules of the second type. This is another important difference between the two rule classes that must be explained. Anticipating later discussion, we will refer to rules whose application is sensitive to the morphological or lexical context of the phonological string as *lexical* rules. The second class of rules is termed *postlexical*.

Let us continue developing the distinction between lexical and postlexical rules by looking at another example from Polish. Here we will rely on the discussion of Rubach (1984). Polish has a general rule palatalizing dental consonants such as [t,d,s,n,] to [ć,ʒ́,ś,ń] before suffixes beginning with front vowels, such as the loc.sg. [-e]. The data in (8a) illustrate.

(8) a.

| nom.sg. | loc.sg. | |
|---|---|---|
| brat | bra[ć]e | 'brother' |
| cud | cu[ʒ́]e | 'miracle' |
| pas | pa[ś]e | 'belt' |
| dzwon | dzwo[ń]e | 'bell' |

b. wtedy 'then', deptać 'tread', sejm 'parliament'

c. [ć]eń 'shade', [ʒ́]eń 'day', [ś]eń 'hallway', [ń]e 'no'

Polish also has a significant number of root morphemes containing substrings composed of a dental plus front vowel (8b). Rubach reports that there is no tendency to generalize the palatalization rule to these morpheme-internal strings. However, Polish also has a significantly larger number of stems containing a palatal plus front vowel sequence (8c).

The data in (8) pose a significant theoretical problem. Two analyses are possible. The morphemes in (8c) can be assigned underlying representations composed of a dental plus front vowel: [ten], [sen], and so on. If the palatalization rule is permitted to apply morpheme-internally as well as across a morpheme boundary, then these morphemes will be assigned surface representations with a palatal. On this analysis, the items in (8b) are treated as idiosyncratic exceptions to the palatalization rule. Alternatively, an analysis might be proposed in which the palatalization rule is restricted to *heteromorphemic* contexts: the focus of the rule (the dental consonants) is contributed by one morpheme, while the triggering context (front vowel) is contributed by a different morpheme. On this alternative analysis, the items in (8b) are not idiosyncratic exceptions. They are systematically excluded by virtue of the fact that their dental+front vowel substrings do not span a morpheme boundary. An important corollary of this alternative analysis is that the palatal consonants in (8c) must be part of the underlying representations. They cannot be derived by the palatalization rule, which is restricted to apply at the morpheme boundary.

The table in (9) summarizes the opposing analyses.

(9) analysis A
- a. domain of palatalization rule is unrestricted
- b. [ć]*eń* derives from underlying [t]*eń*
- c. *wtedy* is an idiosyncratic exception to the palatalization rule

analysis B
a. domain of palatalization is restricted to heteromorphemic contexts
b. [ć]*eń* derives from underlying [ć]*eń*
c. *wtedy* is not an idiosyncratic exception to the palatalization rule

English TSL poses a similar analytic indeterminancy. If the rule is allowed to apply morpheme-internally, then words such as *elephant* and *pyramid* could be derived from underlying representations with a long vowel: [ēlephant], [pȳramid]. Forms such as *īvory* and *stēvedore* would have to be marked as lexical exceptions. But if TSL is restricted to heteromorphemic environments, then *elephant* must be derived from an underlying short vowel and *īvory* is not a lexical exception. In general, any lexical phonological rule allows these alternative analyses. An adequate theory of phonology will resolve the indeterminacy by imposing a consistent choice between the alternatives.

Rubach (1984) shows that the adaptation of loanwords in Polish strongly supports the second analysis, which restricts the rule to heteromorphemic contexts. In etymologically foreign words, a stem-final dental consonant regularly palatalizes before a front vowel suffix. The data in (10) are representative.

| (10) | | | | |
|---|---|---|---|---|
| | Fiat | 'Fiat' | Fia[ć]-ik | dimin. |
| | Ford | 'Ford' | For[ʒ́]-e | loc.sg. |
| | ras-a | 'race' | ra[ś]-ista | 'racist' |
| | dżentelmen | 'gentleman' | dżentelme[ń]-i | pl. |
| | serwis | 'auto service' | serwi[ś]-e | loc.sg. |
| | tez-a | 'thesis' | te[ź]-e | loc.sg. |

The important point is that the palatalization rule just as systematically fails to affect morpheme-internal dental+front vowel sequences. Note the unpalatalized dentals in *dżentelmen, serwis, teza*. This is a striking contrast. Why should the initial [s] in *serwis* fail to palatalize while the final one undergoes the rule? The contrast is exactly what we expect under analysis B of (9), which restricts palatalization to heteromorphemic dental+front vowel strings. It remains unexplained under analysis A, in which the rule applies in unrestricted, across-the-board fashion.

The Polish data suggest that the class of lexical rules is systematically restricted from applying to morpheme-internal strings. This is an additional criterion to distinguish lexical from postlexical rules: the latter apply without regard to the morphemic constituency of the phonological string. In the next section we will see that delimiting the domain of application of the lexical rules is actually a more complex matter than the tautomorphemic/heteromorphemic distinction found in Polish.

## 5.2 Derived Environment Rules

Kiparsky (1973a) discovered a class of lexical phonological rules whose application is sometimes extended to tautomorphemic strings and sometimes not. Let



us begin with an example from Finnish, which has a rule converting [t] to [s] before suffixal [i] (11a). This rule accounts for the alternation in (11b) but must be prevented from affecting the morpheme-internal [ti] strings in such lexical items as those in (11c).

(11) a. [t] → [s] / ___ [i]
b. halut-a 'to want', halus-i 'wanted'
c. tila 'room', äiti 'mother'

So far this is exactly the behavior we expect of lexical rules. What makes the Finnish example noteworthy is the existence of a class of morpheme-internal [ti] strings that, unlike those in (11c), do undergo the rule – and systematically so. These [ti] strings derive from underlying [te] sequences through another rule of Finnish that raises word-final [e]. This raising rule, which is stated in (12a), accounts for the alternations in (12b). (12c) cites stems that end in [te]. Observe that in the latter case both rules apply.

(12) a. [e] → [i] / ___ #

| | | | | |
|---|---|---|---|---|
| b. | joki | 'river' | joke-na | essive sg. |
| | äiti | 'mother' | äiti-nä | essive sg. |
| c. | vesi | 'water' | vete-nä | essive sg. |
| | käsi | 'hand' | käte-nä | essive sg. |

*Vesi* must therefore be derived as shown in (13a).

| (13) | a. | | b. | | |
|---|---|---|---|---|---|
| | [vete] | | [äiti] | | UR |
| | veti | | inappl. | | raising |
| | vesi | | block | | $t \rightarrow s$ |

But now there is a serious problem – namely, how to permit the $t \rightarrow s$ rule to apply to the [ti] sequence in (12c) but at the same time prevent it from affecting the morpheme-internal [ti] strings of the items in (11c). There is of course a systematic difference in the two classes of tautomorphemic [ti] strings: the ones in *tila* and *äiti* are present in the underlying representation, while the one in [veti] arises from the application of the raising rule to [vete]. The $t \rightarrow s$ rule blocks on underlying [ti] sequences but applies to derived ones.

In earlier chapters we have seen that rule ordering may sometimes be used to distinguish between underlying and derived strings. More specifically, ordering of rules is relevant to situations in which a given rule A applies to an underlying string [x] but fails to apply to an identical string [x] derived from another rule B. We simply order A before B. But in the present case rule ordering is of no avail. The $t \rightarrow s$ rule must apply to the output of raising and therefore is ordered later. Yet somehow the grammar must be constructed so that this rule applies to derived [ti] strings but blocks on underlying [ti] strings.

After the publication of Kiparsky 1973a, phonologists discovered a number of other cases of rules whose application is restricted to such "derived contexts."

The *ruki* rule of Sanskrit furnishes an additional example. This rule turns [s] to the retroflex [ṣ] after [r], velars, and high vowels. Following Kiparsky's discussion of the phenomenon, we will assume that the feature [+high] adequately characterizes the environment for this rule. The retroflexion rule applies quite regularly across morpheme boundaries. Suffixes beginning with [s] appear with an [ṣ] in the [r,u,k,i] environment.

(14)

| [-si] 2sg. | | [-sya] future | |
|---|---|---|---|
| da-dā-si | 'you give' | kram-sya-ti | 'he will go' |
| bi-bhar-ṣi | 'you carry' | vak-ṣya-ti | 'he will say' |
| **[-s] aorist** | | **[-su] loc.pl.** | |
| a-yā-s-am | 'I wanted' | senā-su | 'armies' |
| a-bhār-ṣ-am | 'I carried' | agni-ṣu | 'fires' |

There are a substantial number of lexical items with unretroflexed [s] appearing tautomorphemically in the ruki environment: *bisa* 'lotus', *busa* 'mist', *barsa* 'tip'. However, the retroflexion rule cannot be restricted to apply just across morpheme boundaries. When rules of ablaut modify the root vowel so as to create a ruki context morpheme-internally, the rule regularly applies. For example, the root *sās* 'instruct' ablauts to [i] in the participle, triggering retroflexion: *śiṣ-ṭa* 'taught'. Also, *ghas* 'eat' loses its vowel in the reduplicated [ga+ghas+anti], resulting in a [velar+s] cluster that undergoes retroflexion: *ja-kṣ-ati* 3pl. Thus, just as in Finnish, underlying [s] in a tautomorphemic ruki environment must be prevented from undergoing the rule, while derived tautomorphemic strings do undergo it.

Rules that block on underlying tautomorphemic strings but apply either (i) to strings that span a morpheme boundary or (ii) to tautomorphemic strings derived by a previous rule have become known as *derived environment rules*. They pose a serious theoretical problem. Somehow, the underlying [ti] string in Finnish *tila* 'room' and underlying [is] in Sanskrit *bisa* must be prevented from being inputs to the $t \rightarrow s$ and retroflexion rules. But at the same time, the [ti] string derived from Finnish raising and the [is] string derived from Sanskrit ablaut must be inputs to these same rules.

One possible solution to the problem is to allow the application of individual rules to be determined not only by the immediately preceding step in the derivation, but also by information contained in the underlying representation. For example, the Finnish $t \rightarrow s$ rule might be formulated so as to apply to a representation just in case it contains a [ti] string that does not derive from an underlying [ti] string. This *global* condition will block application to *äiti* 'mother' in (13b), since its [ti] string is underlying. But the rule will apply in the derivation of *vesi* 'water' in (13a), because the [ti] string that is input to the rule does not derive from an underlying [ti] string. While this proposal generates the correct outputs, it is theoretically undesirable. If the theory grants any individual rule the power to look back to the underlying representation, then the class of possible grammars is increased significantly. It would be preferable to impose a general condition that predicts when any given rule will block on tautomorphemic underlying strings (i.e., in nonderived contexts). If such a condition can be formulated, then the



class of grammars is not increased at all. In fact, it becomes internally more articulated.

At the time of Kiparsky's discovery and formulation of the problem (1973), many linguists were skeptical about whether such a general condition could be found (see discussion in Kenstowicz and Kisseberth 1977). For there are a significant number of situations in which phonological rules quite clearly do apply in nonderived contexts. Four types are listed in (15).

(15)
a. allophonic rules (e.g., English aspiration [$t^h$]*eam*)
b. cyclic stress (e.g., English *América*)
c. context-free "absolute" neutralization (e.g., Yokuts lowering)
d. contextual neutralization (e.g., Chukchee [ŋ] assimilation)

In view of the fact that the rule types in (15) freely apply in nonderived contexts, the problem reduces to the following two questions. How do the Finnish $t \rightarrow s$ and the Sanskrit retroflexion rules differ from the rules in (15)? Does the purported difference provide a natural explanation for why the former rules block in nonderived contexts, while the latter do not (rather than the other way around, for example)?

Answering these two questions has turned out to be a very difficult problem. An early answer, given by Kiparsky (1973a), noted that the Finnish and Sanskrit rules are neutralization rules. Both [t] and [s] contrast before [i] as well as in many other contexts in Finnish; and both [s] and [ṣ] contrast after [i] as well as in other contexts in Sanskrit. Application of Finnish $t \rightarrow s$ to [tila] would produce **sila*. But since the [ti] string is morpheme-internal, no alternation will be produced and *sila* would naturally tend to be reanalyzed as [sila]. Thus, one might plausibly argue that the $t \rightarrow s$ rule blocks on underlying tautomorphemic [ti] strings, so that a greater range of underlying lexical contrasts surface phonetically. However, while this may be true, the rules in (15c,d) also neutralize underlying contrasts. Why isn't their application blocked morpheme-internally as well? Kiparsky noted that the rules in (15c,d) tend to be automatic rules with no lexical exceptions. Apparently, the Finnish $t \rightarrow s$ and Sanskrit retroflexion rules have exceptions. Thus, the existence of lexical exceptions might permit the two classes of neutralization rules to be distinguished. However, it is hard to see how this purported difference explains why neutralization rules with exceptions block in nonderived contexts while automatic rules do not. Why couldn't the two classes be reversed, so that it is the automatic rules that are restricted to nonderived contexts? As we will see, an answer to this question only emerged much later.

## 5.3 Strict Cyclicity

The next significant advance on the problem of derived environment rules was made by Mascaró (1976), who discovered reasons to believe that the restriction to derived contexts is a property of *cyclic* rules. Cyclic application refers to a situation in which the derivation proceeds in stages, through the repeated application of the same set of ordered rules to successively larger, more inclusive

strings. The derivation of a big string VWXYZ thus works in successive cycles, from the inside out, rather than in one single run through the rules. Given a string VWXYZ, first an inner substring X is submitted to the cyclic rules. They apply to derive VWX′YZ. The derivation then moves out to a more inclusive substring WX′Y. This substring WX′Y is submitted to the same set of cyclic rules. Their application yields a string X″. The resultant VX″Z is then cycled through the rules again until the outermost cycle comprehending the entire string has been processed. Of course, one assumes that the delimitation of the cyclic domains has some motivation independent of the phonology. A natural proposal is that the cyclic domains mirror the morphological structure of the word, such that each successive level of affixation defines a separate cycle. For example, for the word [origin+al+ity], the stem [origin] would constitute the first cyclic domain, [[origin]al] the second, and the entire word [[[origin]al]ity] the third.

Before considering how cyclic application is connected to the derived environment problem, we might ask if it makes any material difference whether or not phonological rules are applied cyclically. Often the result is the same as under noncyclic application. But there are situations in which the cyclic mode has empirical consequences. Sometimes application of a rule on an earlier cycle supplies information that is crucial to the proper application of another rule on a later cycle. The *SPE* analysis of English provides a classic example. According to *SPE*, some English dialects assign different stress contours to the words *compensation* and *condensation*. The second syllable of *comp*[ə]*nsation* bears no stress and so its vowel is reduced to schwa. But in these dialects, for some reason, vowel reduction blocks on the second syllable of *cond*[ɛ]*nsation*. The pronunciation **cond*[ə]*nsation* with a schwa is unacceptable. If the derivations start with [compensat+ion] and [condens+ation], it will be impossible to explain the contrast in the second syllables, since the words are virtually equivalent. However, the contrast finds a natural explanation in the observation that *cond*[ɛ]*nsation* derives from *condénse* while *comp*[ə]*nsation* derives from *cómpensàte*. If the stress rule is applied cyclically, as in (16), then *condensation* has a stress placed on its second syllable in an earlier cycle. This stress will then block vowel reduction. Since *compensate* assigns no stress to the medial syllable, vowel reduction may apply in this word. Later rules of stress neutralization may leave the medial vowel distinction as the only contrastive feature.

(16)

| [condens]ation | [compensat]ion | |
|---|---|---|
| | | first cycle |
| [condense] | [compensate] | |
| condénse | cómpensàte | stress |
| | | second cycle |
| [condéns]ation | [cómpensàt]ion | |
| condènsátion | còmpensátion | stress |
| | | later rules |
| ——— | còmpənsátion | vowel reduction |
| còndɛnsátion | ——— | stress neutralization |



In sum, cyclic application of stress provides a natural basis for distinguishing the otherwise equivalent *compensation* and *condensation*.

Cyclic application also solves certain ordering paradoxes in which application of a given rule A must both precede and follow application of another rule B. Such a situation can arise when the rules apply in the order [A,B] on one cycle and then rule A applies over again on a subsequent cycle. To take a simple example, the paradigm for [bɛn] in (17) illustrates two rules of Catalan phonology.

(17)

| | | | |
|---|---|---|---|
| a. | mol | bɛn | 3sg. |
| | mol-s | bɛn-s | 2sg. |
| | mol-k̲ | bɛŋ | 1sg. |
| | mul-íə | bən-íə | 3sg. past |
| | 'grind' | 'sell' | |

| | | |
|---|---|---|
| b. | bint-ɛ́ | 'twentieth' |
| | bin | 'twenty' |
| | bim pans | 'twenty breads' |
| | biŋ kaps | 'twenty heads' |

The first rule assimilates the point of articulation of the dental nasal to that of a following consonant. The second deletes a word-final stop after a nasal. In the derivation of [bɛŋ] from [bɛn+k], nasal assimilation clearly must precede cluster simplification. But the phrases *bim pans* and *biŋ kaps* show that nasal assimilation follows cluster simplification as well; for it is only by deletion of the final stop in [bint] 'twenty' that the dental nasal comes to immediately precede the initial stops of the following words.

Thus, nasal assimilation both precedes and follows cluster simplification. Such a state of affairs poses a significant problem for a theory in which the underlying representation is passed through the rules just once. But the paradox is solved if the nasal assimilation process applies on two separation cycles in Catalan: once on the word level and a second time on the phrasal level. The derivations in (18) illustrate the proposed solution.

(18)

| [bɛn+k] | [bint] | [kap+s] | |
|---|---|---|---|
| | | | first cycle |
| bɛŋ+k | bint | ——— | nasal assimilation |
| bɛŋ | bin | ——— | cluster simplification |
| | [bin] | [kaps] | |
| | | | second cycle |
| | biŋ kaps | | nasal assimilation |

Having seen that cyclic application can sometimes be empirically detected, let us now return to the derived environment problem. Mascaró (1976) demonstrated that certain rules of Catalan are subject to an opacity constraint that can be explained if it is assumed (i) that the rules apply in a cycle and (ii) that they display the property of *strict cyclicity* (Chomsky 1973). He then showed that the derived

environment restriction could be subsumed under the independently needed strict cycle constraint. The rest of this section recapitulates his important result.

Three rules of Catalan phonology are relevant to the discussion. First, although stress falls on one of the last three syllables of the word in Catalan, which particular syllable bears the accent is, in general, unpredictable. Mascaró assumes that the stress is located in the underlying representation. Given this assumption, then a rule destressing a vowel before another stressed vowel is required, since any stem loses its stress whenever it is followed by a stressed affix. In general, only the rightmost underlying accent surfaces phonetically. A rule that removes a stress when followed by another stress accounts for this accentual limitation: $\acute{V} \rightarrow V$ / ____ . . . $\acute{V}$. Second, Catalan contrasts the seven vowels [i,u,e,o,ɛ,ɔ,a] in stressed syllables. However, in unstressed syllables [e,ɛ,a] reduce to schwa and [o,ɔ] reduce to [u]. As the forms in (19) show, the stress deletion rule feeds the reduction process. An underlying representation such as [nɔ́bl+ɛ́z+ə] first loses its initial stress to become [nɔbl+ɛ́z+ə], and then reduces to [nubl+ɛ́z+ə].

(19) nɔ́bl-ə 'noble'
nubl-ɛ́z-ə 'nobility'

The final rule relevant to the discussion devocalizes unstressed high vowels after a vowel. This rule is stated informally in (20a). Its application is illustrated in (20b), where the conjunction [i] 'and', the inflectional suffix [-u], and the adjectival suffix [-ik] devocalize postvocalically.

(20) a. [i,u] → [y,w] / V ____ (in unstressed syllable)

| | | | | |
|---|---|---|---|---|
| b. | sál i pá | 'salt and bread' | pá y sál | 'bread and salt' |
| | fɛ́r-u | 'iron' | dé-w | 'God' |
| | fɛ́r-ik | 'ferrous' | əlžəbrá-yk | 'algebraic' |

Devocalization must precede destressing, because a postvocalic high vowel does not turn to a glide when it loses its stress. This is clear from the examples *rəim-ét* and *ruin-ós* in (21a).

(21) a.

| | | | |
|---|---|---|---|
| rəím | 'grape' | rəim-ɛ́t | dimin. |
| ruín-ə | 'ruin' | ruin-ós | 'ruinous' |

b. [[ruín] ós]

| | |
|---|---|
| | second cycle |
| inappl. | devocalization |
| ruin ós | destressing |
| inappl. | vowel reduction |

The derivation of *ruin-ós* must be as shown in (21b). On the first cycle [ruín], no rules are applicable and so we pick up the derivation on the second cycle. If devocalization is ordered first, it (correctly) fails to apply since the postvocalic [i] is stressed. Subsequently, the stress on the stem is deleted by the destressing rule. Vowel reduction is inapplicable, and *ruinós* is derived. If devocalization applied to the output of destressing, then [ruin]*ós* would incorrectly become disyllabic **ruynós*. We prevent this derivation by ordering devocalization first.



There are, however, some additional cases in Catalan where devocalization does apply to a vowel that has been destressed. The paradigms in (22a) illustrate this situation.

(22) a.

| | |
|---|---|
| óbr-ə | 'opens' |
| ínst-ə | 'instates' |

b.

| | |
|---|---|
| ubr-ír | 'to open' |
| inst-ár | 'to instate' |

c.

| | |
|---|---|
| à wbrír | 'in order to open' |
| nò ystár | 'not to instate' |

The roots, shown in (22a), are [óbr] and [ínst]. In (22b) the stressed infinitival suffixes trigger loss of stem stress and vowel reduction. In (22c) the infinitives are preceded by *a* 'in order to' and the negative *no*, which devocalize the following vowel. (The vowels in these particles apparently retain some degree of prominence and thus fail to reduce. This is informally recorded with a grave accent: *à, nò*.) The derivations appear in (23).

(23)

| [[óbr] ír] | [[ínst] ár] | |
|---|---|---|
| | | second cycle |
| inappl. | inappl. | devocalization |
| obr ír | inst ár | destressing |
| ubr ír | inappl. | reduction |
| à [ubrír] | nò [instár] | |
| | | third cycle |
| à wbrír | nò ystár | devocalization |
| inappl. | inappl. | destressing |
| inappl. | inappl. | reduction |

The important point that emerges from the discussion so far is that devocalization applies to the output of destressing in (23). But this rule interaction fails to obtain in the derivation of *ruinós* in (21b). Here the [i] does not turn to [y] in spite of the fact that it has been destressed and is preceded by a vowel. Mascaró observed that this mysterious contrast finds a natural explanation if the rules are applied cyclically. In *nò* [ynstár], *nò* devocalizes a vowel [i] that has been destressed on a previous cycle. The third cycle thus starts with an unstressed [i]. But in *ruinós* of (21b), the [i] is still stressed at the point when the devocalization rule is reached on the next cycle. Consequently, devocalization cannot apply.

In order to maintain this attractive explanation, however, we must ask what happens to *ruinós* when another affix is added, forcing the [ui] string to go through the rules again. Will devocalization apply to the unstressed [i] at the start of the next cycle? The answer is evident from the superlative form *ruinuz-ízim* 'very

ruinous'. Devocalization does not apply. The disyllabic [ui] string established on the earlier cycle by ordering devocalization before destressing is carried through the subsequent cycles. Thus, devocalization must somehow be prohibited from returning to affect the material of an earlier cycle. Note, however, that the superlative suffix does trigger destressing and vowel reduction on the preceding stem. The derivation consequently must be as shown in (24).

(24) [ruinós] ísim

| | |
|---|---|
| block | devocalization |
| ruinosísim | destressing |
| ruinusísim | reduction |
| ruinuzízim | other rules |

The problem then is that we must block devocalization in (24) but still permit it to apply in derivation (23) of *nò ystár* from *nò* [instár]. Mascaró pinpointed the relevant difference between the two cases. In the former, the [ui] string is completely contained within the bounds of an earlier cycle. But in the latter, the [òi] string straddles a cyclic boundary. The Catalan data indicate that information drawn exclusively from an earlier cycle constitutes an opaque domain to which rules applying on a later cycle are blind. This, in essence, is the strict cyclicity requirement that Chomsky (1973) argued to hold of the transformational cycle in syntax. The phonological version of the constraint can be formulated as shown in (25). (This formulation departs slightly from that of Mascaró 1976 and follows more closely the statement of the condition in Halle 1978.)

(25) Strict Cycle Condition (SCC)
A cyclic rule may apply to a string $x$ just in case either of the following holds:

a. The rule makes crucial reference to information in the representation that spans the boundary between the current cycle and the preceding one.

b. The rule applies solely within the domain of the previous cycle but crucially refers to information supplied by a rule operating on the current cycle.

In essence, the SCC requires a cyclic rule to refer to a mixture of information – one portion drawn from the earlier cycle and the other contributed by the current cycle.

The SCC succeeds in explaining the intricate pattern of application and blocking of the Catalan devocalization and stress reduction rules. Some important theoretical consequences follow from the assumption that cyclic rules are subject to this condition. To begin with, the first rule to apply on any cycle must apply by case (a), since a rule can apply by case (b) only if some preceding rule has applied on the current cycle. But if the first application on any cycle goes by case (a), then it also follows that no cyclic rule may apply on the innermost cycle of a derivation – for lack of a cyclic boundary. This in turn implies that the underlying



representation of the root morpheme is an opaque domain. No cyclic rule may enter this domain directly, without the assistance of an affix.

It should now be apparent how the SCC draws precisely the same distinction between derived and nonderived contexts that is needed to block improper application of the Finnish $t \rightarrow s$ rule. If we suppose that $t \rightarrow s$ (and thus by implication the raising rule) is cyclic, then just the right patterns of application take place for *halus-i, vesi,* and *tila*. This point is illustrated in (26).

(26)

| [halut] i | [vete] | [tila] | |
|---|---|---|---|
| | | | first cycle |
| | | | raising |
| | | | $t \rightarrow s$ |
| | | | second cycle |
| | veti | | raising |
| halus i | vesi | | $t \rightarrow s$ |

By the SCC, no cyclic rules may apply on the innermost root-level cycle. On the second cycle raising applies to [vete] since, we assume, the triggering word boundary lies outside the root [# [vete] #] and thus becomes visible only on the final word-level cycle. This application takes place in virtue of condition (a). The [+high] introduced by raising will trigger application of $t \rightarrow s$ by condition (b). *halus-i* is derived by condition (a) since it combines information that spans the boundary between the stem and the suffix. But the rule blocks on [tila], which satisfies neither condition of the SCC.

To summarize, Mascaró 1976 is an important contribution – for several reasons. The first is theoretical economy. The derived context restriction can be reduced to a condition on rule application (the SCC) that is independently needed for cyclic rules. The theory now admits two classes of rules: cyclic and noncyclic. On the conceptual level, it is natural to try to identify the cyclic-noncyclic classification with the lexical-postlexical distinction developed earlier. In this way, cyclicity becomes another trait of the lexical class of rules. Construing the derived context limitation in terms of strict cyclicity also endows the theory with sharper empirical consequences. We have seen that the cyclicity of a rule is sometimes independently detectable. The implication is that if a rule must be restricted to derived contexts, then it should also display cyclic characteristics; similarly, any cyclic rule will have to apply in derived contexts. In addition, if cyclicity is a function of the lexical-postlexical distinction, then a further prediction is made. The lexical-postlexical distinction traces a line through a language's set of phonological rules. Consequently, any rule A ordered before another rule B that is restricted to derived contexts must also be cyclic. And any rule ordered after a rule that does not respect strict cyclicity will have to be a postcyclic rule.

Tying the derived context problem to strict cyclicity in this way should thus make the validity of the overall theory easier to assess. However, some nagging problems still remain. Most striking is the fact that the English stress rule does not fall into place properly. *SPE* – and later Kiparsky (1979) – showed it to be a paradigm example of a cyclic rule; yet it apparently applies on the root cycle in *América*.

## 5.4 Morphological Preliminaries

Besides work on the derived environment problem, the other important line of research of the 1970s leading to the development of the Lexical Phonology model took place in morphology. In this section we will review some of the highlights of this research. In its initial stages, generative grammar did not develop a distinct theory of morphology and instead tended to adopt, essentially by default, the assumptions underlying the morphological theory and analysis of the earlier structuralist period – in particular, the conception of the morpheme as a minimal meaningful element.

Aronoff 1976 represents the first serious generative attempt to deal with morphology on its own terms. Two of Aronoff's most significant results relate to the nature of morphemes and to constraints on morpheme concatenation. First, he shows that while the *morpheme* is the minimal unit in word structure, it need not have any constant meaning or indeed any meaning at all. For example, morphological analysis of paradigms such as [permit, remit, commit], [perceive, receive, conceive] isolates the prefixes [per-, re-, con-] and the roots [mit] and [ceive]. Even though no constant semantic value can be assigned to these elements, the grammar nevertheless analyzes them as distinct units. This is evident from various allomorphy rules. For example, the morpheme [mit] has the alternant [mis] before the suffix [-ive]: *permissive, remissive,* and so on. This rule does not apply to just any [mit] string – in fact, it applies only to those that comprise the root [mit] (cf. *vomit, *vomissive*). Consequently, [mit] must be a linguistic unit even if it has no consistent semantic value independent of the particular word in which it occurs.

Aronoff also discusses the notion of *morphological blocking*. In general, lexical items can be located in an abstract morphological space or grid. The same sector is often occupied by items that are the product of distinct *word formation rules* (WFRs). The term "blocking" refers to the fact that the output of a more idiosyncratic, less productive WFR often preempts or blocks application of a more general and productive rule. For example, the regular rule for forming the English past tense suffixes [-ed]: *compute, computed*. The past tense is also formed by less productive rules of ablaut (*sing, sang*) or by suppletion (*be, was*). These less productive formations block the creation of **sing-ed* and **be-ed*. To cite one more example, the productive rule for constructing agentive nouns suffixes [-er]: *compute, computer*. Less productive are the WFRs that add [-ant] (*inhabit, inhabitant*) or that form the agentive directly from the verb by so-called zero derivation (*to guide, a guide*). The less productive rules occupy the lexical building site first, blocking the construction of **inhabiter, *a guider*. (*Guider* is a possible word; but like *cooker,* it is restricted to inanimate denotees.)

Another finding of the early generative morphologists was that the *SPE* distinction between primary and secondary affixes crucial for the proper operation of several phonological rules in English is also crucial to the morphology. English affixes fall into two classes with respect to their effect on stress placement and vowel length. The syllables comprising such primary affixes as [-al] and [-ous] are counted in the computation of antepenultimate position (27a). But secondary affixes such as [-ship, -less] have no effect on the location of the accent (27b). The same distinction also applies to the rule of trisyllabic laxing. Affixes drawn from the former class may trigger a shortening of the root vowel, but those from the latter class never do (27c,d).



(27)

| | | |
|---|---|---|
| a. | pýramid | [pyrámid]al |
| | hómonym | [homónym]ous |
| b. | pártisan | [pártisan]ship |
| | | *[partísan]ship |
| c. | nātion | [nătion]al |
| | ōmen | [ŏmin]ous |
| d. | sēaman | [sēaman]ship |
| | | *[sĕaman]ship |
| e. | in[potent] | im[potent] |
| | un[popular] | *um[popular] |
| | in[legal] | il[legal] |
| | un[lawful] | *ul[lawful] |

A similar distinction shows up among prefixes (27e). The negative [in-] may, at least sometimes, count for stress while the negative [un-] never does. Correlated with this contrast is the fact that the nasal of [in-] assimilates to a following consonant while that of [un-] does not.

Three generalizations emerging from the study of English word structure also distinguish between primary and secondary affixes. First, primary affixes may be added to bound morphs such as [ept], [ert], [leg]: *in*[ept], *in*[ert], [leg]*al,* [curi]*ous*. But secondary ones may not: **un*[ept], *[leg]*ness,* *[curi]*less*. (There are a few isolated exceptions such as *unkempt*.) Second, as the terms primary and secondary suggest, there appears to be an ordering among the affixes. A secondary affix such as [-ness] can, in general, be added to a base with a primary affix such as [-al]. From [parent]*al* we may form [parental]*ness*. But a primary affix may not be attached to a base that contains a secondary affix. This explains why *[[happy]ness]*al* sounds much worse than [parental]*ness*. Similarly, the secondary prefix [un-] may be added to *ir*[regular] (from *in*[regular]) to form *un*[ir[regular]]. But addition of primary [in-] to a base with a secondary affix yields ungrammatical results – the word *in*[un[regular]] is impossible. Finally, secondary affixes tend to have more coherent semantics. The meaning of *un*[credible] is more or less adequately described as "not capable of being believed." But *in*[credible] means much more, having an added, unpredictable dimension of "amazement."

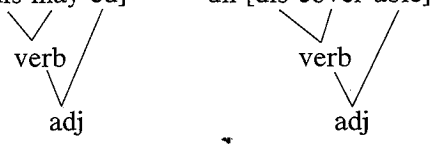
One more result is due to Siegel (1978), who observes that WFRs exhibit an *opacity* property similar to the subjacency property of syntactic transformational rules. Aronoff (1976) had noted that some WFRs are sensitive to lexical properties of the base such as whether or not it is drawn from the Latinate sector of the vocabulary. To take a simple example, [-ity] attaches to Latinate bases. This explains why *[weird]*ity* is odd while [equal]*ity* is not. The word [drink]able is composed of a Latinate affix and a non-Latinate root. Since [-ity] successfully attaches to this base ([drinkabil]*ity*), it appears that when the base contains conflicting [±Latinate] specifications, it is the one added on the preceding cycle that

determines the outcome. In other words, the [−Latinate] feature of the base [drink] is no longer visible when the [-ity] affixation rule applies. To take another example, the prefix [un-] does not in general attach to bases containing the prefix [dis-]; this restriction must be built into the *un*-prefixation rule.

(28) *un[dis[sonant]] *un[dis[tinct]]
*un[dis[loyal]] *un[dis[honest]]

However, it then is mysterious why such words as *undismayed* and *undiscoverable* are completely well formed. As Siegel points out, the mystery vanishes once the internal structure of the bases [dismayed] and [discoverable] is taken into account. They derive from [dismay]*ed* and [discover]*able*. The [dis-] prefix is added on a cycle prior to the one that immediately precedes attachment of [un-].

(29) un[dis may ed] un [dis cover able]




The information that the bases [dis[may]]*ed* and [dis[cover]]*able* contain the prefix [dis-] thus appears to be inaccessible to the *un*-prefixation rule. This result follows if information only from the immediately preceding cycle is available to the WFRs. Then, when the *un*-prefixation rule becomes applicable, it will be able to analyze the adjectives *dismayed* and *discoverable* into just the two immediate constituents [dismay]*ed* and [discover]*able*.

One mechanical way to implement the opacity restriction is to suppress the internal bracketing at the end of a given cycle. To illustrate, *undiscovered* and **undisloyal* would be derived as in (30).

(30) cover → dis[cover] loyal → dis[loyal]
dis[cover] → [dis[cover]]ed dis[loyal] → *un[dis[loyal]]
[discover]ed → un[[discover]ed]

In the transition from the second to the third step, the internal bracketing showing that *discovered* is composed of a complex stem containing a prefix [dis-] and a root [cover] is erased. Consequently, at the point where *un*-prefixation applies, the string [dis] of *discovered* has the same status as the three-phoneme sequence beginning *discotheque*. By contrast, the information that *disloyal* is composed of the prefix [dis-] and the root [loyal] is still accessible to the *un*-prefixation rule because these two morphemes have been concatenated on the immediately preceding cycle.

Pesetsky (1979) noted a serious problem with this *bracket erasure* proposal. The WFRs apply in the lexicon. Nevertheless, a record of the internal bracketing is crucial for the phonology, because it delimits the domains for the cyclic application of the phonological rules. Pesetsky proposed the following bold solution



to the problem: assume that the cyclic phonological rules apply inside the lexicon, after the application of each WFR, as depicted in (31).

(31) WFRs ⇄ cyclic phonology

Several noteworthy consequences ensue from this proposal. First, the cyclicity of the phonological rules no longer has to be stipulated. It now follows from the decision to organize the grammar as depicted in (31). More importantly, we now have a partitioning of the phonological rules into two classes that follows from their location in the overall model of grammar. Kiparsky (1982a) showed that many of the differences between the two classes of rules begin to make sense when the grammar is organized in this fashion. In the next section we turn to this influential work.

## 5.5 Lexical Phonology

The research on the derived environment problem and the role of morphology in phonology was synthesized by Paul Kiparsky into the theory of Lexical Phonology. In two highly influential papers, Kiparsky (1982a, 1985) developed and articulated Pesetsky's proposal that phonological rules appear at two distinct points in the grammar: in the lexicon and in the postsyntactic, phonological component. Given these two locations, many of the long-noted differences between the two classes of phonological rules begin to make sense. If the lexical phonological rules apply after each WFR, then this class of rules is inherently cyclic. Their cyclic application does not have to be stipulated; it follows from the organization of the grammar. From the work of Mascaró (1976), we know that limitation to derived contexts follows, in turn, from strict cyclicity. Finally, since the lexical rules are interleaved with the WFRs, it is natural for them to have access to the lexical properties of a given word's immediate constituent morphemes. Postlexical rules, on the other hand, apply outside the lexicon to the output of the syntactic component. By virtue of their different location, they can be expected to display different properties. First, since they are postsyntactic, their application may take a word's phrasal environment into account. Lexical rules of course may never do so, since they appear in the presyntactic component. Second, the postlexical rules have no direct access to the lexical properties of the constituent morphemes composing a word. This information is closed off by the bracket erasure convention. This explains why the paradigm postlexical rules – phrasal and allophonic rules – typically are automatic and have no lexical exceptions. Finally, if cyclicity is a function of interleaving with the WFRs, then there is no reason to suppose that the postlexical rules are cyclic. They are consequently free to apply in across-the-board (ATB) fashion and hence are not restricted to derived contexts by strict cyclicity.

Kiparsky's proposal to draw the lexical-postlexical distinction in this way is theoretically very attractive – for several reasons. First, it comes to terms with the intuition, dating back to the beginning of the study of phonological structure,

that there are two different kinds of phonological rules – a distinction that was essentially denied by the earlier generative models. Second, it makes this distinction not by stipulation but rather by a specific proposal about the internal architecture of the grammar; furthermore, this proposal explains, at least in gross terms, why the two classes of rules display the specific properties they do. Third, the lexical-postlexical distinction helps to articulate and individuate the grammar; it thus accords with the modularity thesis that has become a methodological cornerstone of generative grammar. Finally, the Lexical Phonology model makes concrete predictions about how individual languages will have to look under this conception of the grammar. For these reasons, this model has become the focus for most generative research, both of a descriptive and of a theoretical nature, concerned with the relation of phonology to word structure.

In the following sections we will examine the basic concepts and principles of Lexical Phonology. We will also try to distinguish areas where there is basic agreement from those that are more unsettled.

### 5.5.1 *The Model*

Lexical Phonology develops the distinction between primary and secondary affixes noted by the early generative morphologists into a level-ordered morphology. The basic proposal is that the word formation rules (WFRs) and the lexical phonological rules can be partitioned into a series of *levels* or *strata*. Figure 5.1 illustrates Kiparsky's (1982a) conception of how the English lexicon is organized. Primary inflection includes the umlaut of *tooth-teeth,* the ablaut of *sing-sang,* and the past tense [-t] of *sleep*-[slep]*t* in addition to the primary derivational affixes in such items as [pyrámid]*al,* [ṓmen]*ous,* [dĕp]*th, im*[potent]. Secondary derivation is illustrated by the affixes in *un*[happy], [loneli]*ness,* [labor]*er*. The remaining inflection includes the regular plural in [cat]*s* and [brush]*es* and the past tense of [leap]*ed* and [pleat]*ed*. In this model, each level has the lexical phonological rules distinctive of that level. The morphological structure of a word is characterized by tracing its development through the paths indicated by the arrows. For example, the structure of *codifiers* is analyzed as follows. The word is composed of the base [cōde], which has been submitted to the lexical phonological rules of level 1 (stress being the only relevant rule to apply). Then the verbalizing WFR affixing *-ify* applies to yield the representation [cōd]*ify*. This representation is submitted to the phonological rules of level 1, where TSL applies to derive [cŏd]*ify*. The latter representation then enters level 2. No phonological rules are applicable, and the agentive suffix is added to give [cŏdifi]*er*. Finally, at level 3 the plural suffix is added to yield [codifier]*s*. It is apparent that this model defines a set of lexical items by a hierarchy of WFRs.

Two additional points should be noted about figure 5.1. First, any derivation proceeds through all the levels even if no relevant morphology applies at that level. Thus, the word *cat* is derived by submitting it to the lexical phonological rules of each of the three levels. Second, the output of each level is a *lexical item*. This is a technical term for Kiparsky; and as we will see, it plays a central role in the theory.

It should be clear that the model straightforwardly accounts for several generalizations about English word structure noted earlier. For example, the contrast



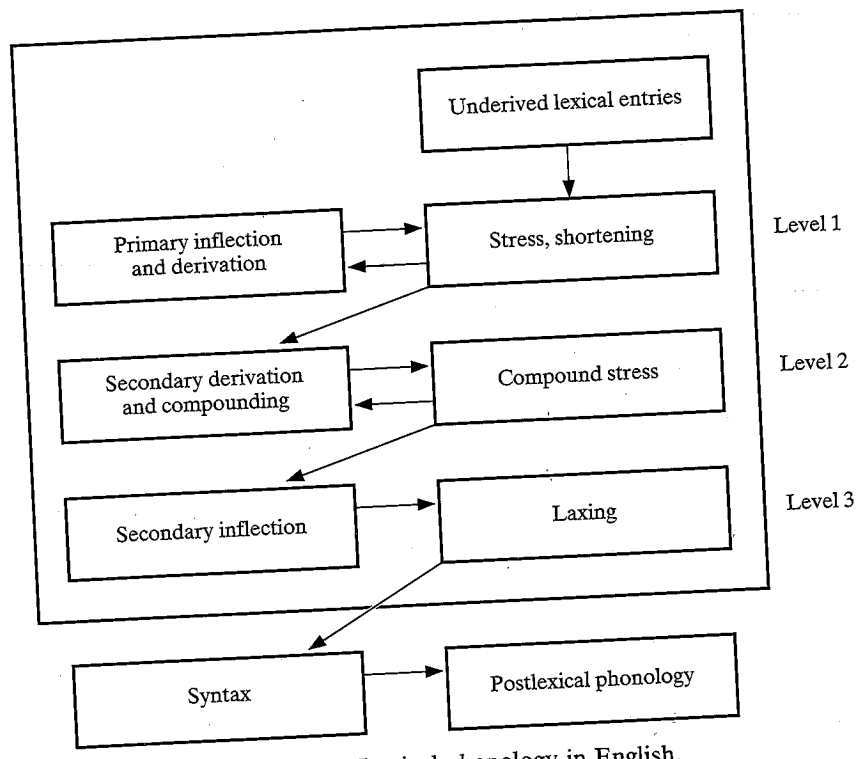



**Figure 5.1** Lexical phonology in English.

between the relative well-formedness of *parentalness* and the marked deviance of **inunregular* can now be explained as follows. In the Lexical Phonology model, words are formed by the successive application of the WFRs. Prefixation and suffixation rules thus create successive layers of affixation. *Parentalness* arises from suffixation of *-al* to the base [parent] at level 1, followed by suffixation of *-ness* at level 2. **Inunregular* would have to arise from prefixation of *in-* to the base [unregular]. But the WFR prefixing *in-* applies at level 1, while the base [unregular] only arises at level 2. Since there is no provision to return to an earlier level in the model of figure 5.1, once [unregular] has been formed, the prefix *in-* cannot be attached. In this way, the generalization that primary affixes may not appear outside secondary affixes is captured.

Kiparsky also assumes that the output of each level is a full-fledged lexical item. If this assumption is granted, then we can explain why bound roots such as [ept] only appear with level 1 affixes: compare *in*[ept] with **un*[ept]. The latter can only be constructed by prefixing *un-* at level 2. Because the morphological levels are ordered, the bound morph [ept] must traverse level 1. But this will be impossible if the output of each level must be a full-fledged lexical item.

Another noteworthy feature of the model is that an underived base is passed through the level 1 phonological rules before any WFRs are applied. In many cases this step will be vacuous if application is blocked by the SCC. But recall that at least some rules such as stress assignment must be permitted to operate on the initial cycle. Since, in general, phonological rules may precede the appli-