On Constraining the Power of Lexical Phonology: Evidence from Tamil

ON CONSTRAINING THE POWER OF LEXICAL PHONOLOGY: EVIDENCE FROM TAMIL*

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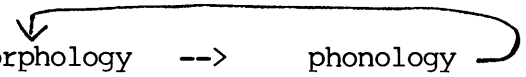
1. Lexical Phonology

The theory of Lexical Phonology incorporates the idea of level ordered morphology (Allen 1978) that was originally proposed to account for the different phonological properties of Level 1 and Level 2 affixation in English. In this account, all word-formation rules are grouped into a hierarchy of levels in the lexicon, each level being characterized by distinct morphological and phonological properties that are unique to that level. The difference between accounts such as Allen's and later models of Lexical Phonology such as Pesetsky (1979), Kiparsky (1982, 1983, 1985) and Mohanan (1982) is that in the latter, phonological rules apply in the lexicon following each morphological operation. The interaction between morphology and phonology is schematized in the figure below, (from Mohanan 1982:2).

(1)



As the model indicates, each morphological operation can feed into the phonology, the output of which can undergo further morphological processes.

Recent developments in Lexical Phonology show a divergence along two major lines. In one model, each word-formation component or stratum constitutes an independent module with its own set of phonological rules (Kiparsky 1982, 1983). In the second model, the phonological rules do not belong to discrete modules; instead each rule is specified for its domain of application with respect to one or more strata (Halle & Mohanan 1985, Kiparsky 1985). The discussion in this paper will be based on the second model, illustrated in Figure 1.

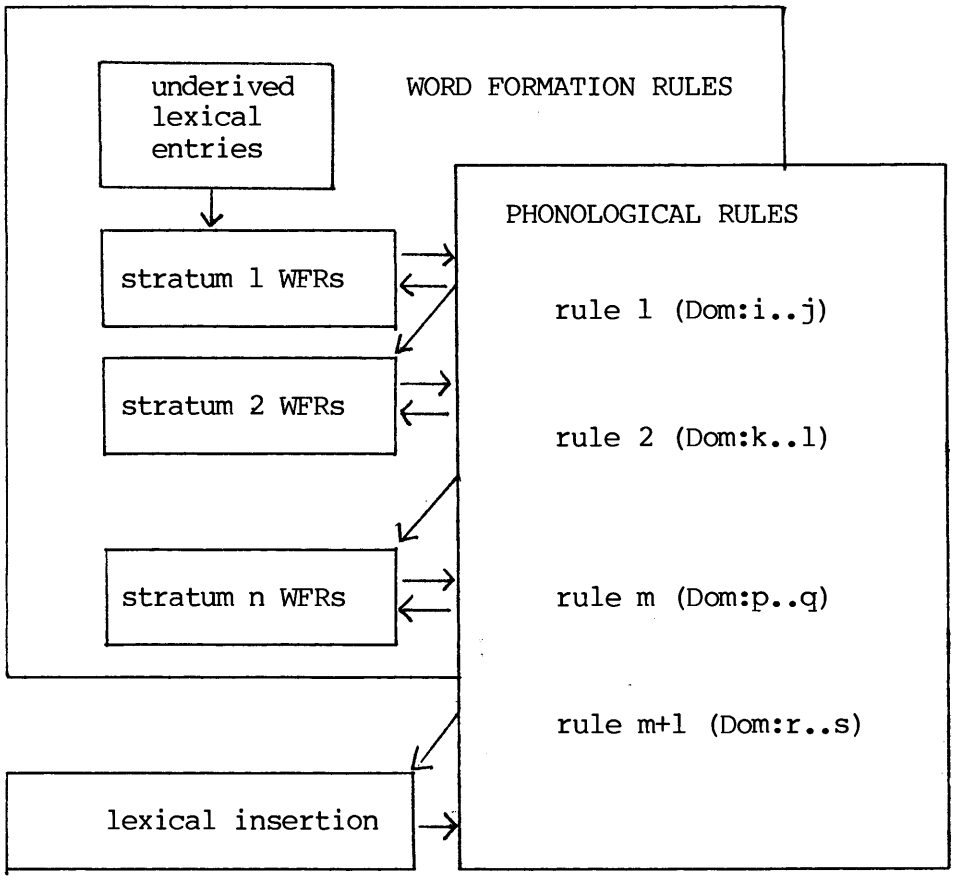


Figure 1: The organization of the lexicon

As the model indicates, phonological rules can also apply in the syntax, to the output of the word-formation component.

I will argue in this paper that the theory of Lexical Phonology is excessively powerful as it imposes no upper limit on the number of strata in the lexicon. I will show that increasing the number of strata to account for morphologically conditioned phonological rules is often unmotivated, and that apparent stratal ordering effects can be reduced to other principles that are independently required in the grammar. The device of the loop, moreover, weakens the theory as it allows in principle unconstrained recursion between adjacent strata. I propose that such power be constrained by imposing an upper limit on the number of strata and by eliminating the loop.

The organization of this paper is as follows. Section 2 presents the model of Lexical Phonology as proposed for Malayalam in Mohanan, 1982. Section 3 examines the phonology of compounding and inflection in a closely related language, Tamil, and section 4 proposes an alternative account of the phonology of the different types of compounds. Section 5 considers some of the consequences of the analysis proposed and section 6 presents a more constrained model of Lexical Phonology.

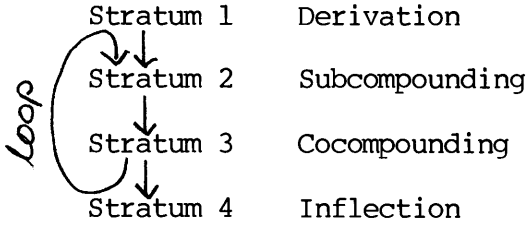
2. Stratal organization: evidence from Malayalam

Some of the basic assumptions of the model proposed in Mohanan (1982) that are relevant for the discussion that follows are

1. All wordformation rules are organized into one or more lexical strata.
2. Every phonological rule must be specified for its domain of application with respect to one or more strata.
3. The domain of rules that are assigned to more than one stratum must be a continuous sequence of strata.
4. Internal brackets are erased at the end of each stratum; thus the internal composition of an earlier stratum is not accessible to rules of a following stratum.
5. Recursion between adjacent strata is possible through the device of the loop.

An example of considerable power that follows from the assumptions above is seen in the analysis of Malayalam (Mohanan 1982). In the context of a theory that imposes no upper limit on the number of strata, four lexical strata are posited to account for the phonology and morphology of the language.

(2)



Some of the crucial evidence for stratal organization in Malayalam is seen in the phonology of compounds. Malayalam has two types of productive compounds, which are referred to as subcompounds

and cocompounds. The two rules that differentiate these compounds are Gemination, which applies in the domain of subcompounds (stratum 2), and Stress and Tone, which apply in the domain of cocompounding (stratum 3).

Gemination applies to stem-final[1] as well as stem-initial segments, as illustrated in (3a)[2] and (3b) respectively.

(3a) kaaṭəmaram --> kaaṭṭəmaram
forest tree forest tree

kayar kaṭṭil --> kayaṭṭəkaṭṭilə
rope cot cot made with rope

(3b) peṭṭi pattaayam kaḷ --> peṭṭippattaayaṇṇaḷə
box grainbin pl. grainbins used as boxes

aana kutira --> aanakkutira
elephant horse horse that is like an elephant

The domain of gemination being Stratum 2, the rule is blocked from applying on any other stratum. (4a) and (4b) show the non-application of stem-final and stem-initial gemination in cocompounds.

(4a) aaṭ maaṭ kaḷ --> aaṭəmaaṭəkaḷə
goat cow pl. cattle

kayar kampi caṇṇala wargam --> kayarəkampicaṇṇalawargam
rope wire chain category category of ropes, wires and chains

(4b) peṭṭi pattaayam kaḷ --> peṭṭipattaayaṇṇaḷə
box grainbins pl. boxes and grainbins

aana kutira kaḷ --> aanakutirakaḷə
elephant horse pl. elephants and horses

The second argument for a stratal distinction between subcompounds and cocompounds is based on the different stress patterns of the two compound types. A much simplified account of the stress and tone rules are as follows. If the first vowel of a stem is short and the second long, primary stress falls on the second (long) vowel. Otherwise, primary stress falls on the initial vowel. Secondary stress falls on all other long vowels. Primary stress is realized as a low tone; all secondary stresses are realized as high tones. A subcompound has only one low tone, corresponding to a primary stress, whereas each constituent of a cocompound has a low tone. The different stress patterns are illustrated in (5a) and (5b) respectively.

(5a) matam widweesam --> matawidweesam (SUB)
L H H
religion hatred hatred of religion

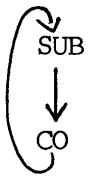
(5b) jaati matam --> jáatimátam (CO)
L H L H
caste religion caste and religion

This difference is attributed to the fact that stress and tone apply in stratum 3, before the stems are put together. Subcompounds, at this level, are already formed, and as the internal brackets have been erased by the Bracket Erasure Convention (BEC), a subcompound counts as a single constituent for the purpose of stress assignment. The ordering of the rules in this account is as shown below:

(6) { Stress
Compounding
Other phonological rules }

While the ordering above produces the desired results in the examples in (5), it contradicts Mohanan's claim that the morphology precedes the phonology in a given stratum (1982: 2, 10, 19, 38). (See also the derivation of compounds (1982: 19, 29,) where the morphological rule of compounding is ordered before any of the phonological rules.)

The different stress and tone patterns in the two compound types are proposed as evidence for the loop. The loop, in Malayalam, is motivated on the basis of morphological recursion. A cocompound, formed at stratum 3 can undergo subcompounding at stratum 2, an earlier stratum. Such recursion is possible by the device of the loop, as shown.

(7) 

Stratum 2
Stratum 3

Thus the output of stratum 3 can undergo further word-formation at stratum 2, and, in theory, undergo more morphological rules in the course of a second pass through stratum 3. The example that illustrates recursion and the application of the relevant phonological rules is the subcompound [jaatimatawidweesam] 'hatred of caste and religion', which contains the cocompound [jaatimatam] (5b). The derivation of this form, adapted from Mohanan[3], is shown below.

(8)	SUB	[jaati] [matam]	Stratum 2
			(no rules apply)
	CO	[jaati] [matam]	Stratum 3
		[já\à ti] [má\à m]	Stress rules
		[[já\à ti] [má\à m]]	Compounding
		[já\à timá\à m]	BEC
	SUB	[já\à timá\à m] [widweesam]	Stratum 2 (loop)
		[[já\à timá\à m] [widweesam]]	Compounding
		[[já\à timá\à] [widweesam]]	Nasal deletion
		[já\à timá\à widweesam]	BEC
	CO	[já\à timá\à widweesam]	Stratum 3
		[já\à timá\à widwéesàm]	Stress rules

According to Mohanan, stress rules apply to the subcompound in Stratum 3 to result in the surface stress pattern [já\à timá\à widwéesàm]. As Sproat (1985) points out, however, in its second pass through stratum 3, no stress rules should apply to the constituent [widweesam]. Recall that primary stress falls on stem-initial vowels; the vowel in [widweesam], however, is no longer in initial position, in Stratum 3, as the internal brackets have already been erased by virtue of the BEC at the end of the preceding stratum. However, the string surfaces with the stress pattern of a cocompound, suggesting that stress rules have applied in spite of the BEC. Notice that each constituent of the compound has a primary stress, and a corresponding low tone.

(9) já\à timá\à widwéesàm
L H L H L H

Evidence from stress is thus inconclusive for motivating a stratal distinction between the two compound types. The stress facts suggest, moreover, that there might be an alternative account of the rules of stress assignment that is independent of stratal organization.

3. The Phonology of nouns in Tamil

I will show in this section that it is possible in some cases to eliminate apparent stratal distinction between compounds and derive these differences from principles that are independently required in the grammar. The data I will be considering, however, comes from Tamil, a language that is closely related to Malayalam. More specifically, I will be presenting data from the Kanyakumari dialect of Tamil.

The relevant phonological facts of the language are summarized here. The underlying stops are /p t t̲ ṭ c k/, which can also occur as geminate sequences. The non-geminate stops are realized as

1. [v d r̲ ḍ s x] respectively in unaccented (non-initial) syllables.
2. [b d d̲ ḍ j g] respectively following a nasal stop.

A static constraint rules out the occurrence of the two apical stops /t̲ ṭ/ morpheme-initially. The underlying vowels are /i e a o u/. The non-geminate vowels /i,a/ are realized as unrounded [ɨ] and centralized [A] respectively in non-initial syllables. A subscripted dot indicates retroflex articulation; t is dental, t̲, n̲, are alveolar; r and r̲ are front and retracted rhotics respectively; v is a labiodental glide. N indicates a nasal stop unspecified for place of articulation features.

3.1. The phonology of compounds

Let us now consider the phonology of compounds in Tamil. Tamil has three types of compounds that I will refer to as Type I, Type II and Type III. The first two are endocentric in structure, with the first stem modifying the second stem. Type III compounds are exocentric in structure. Types I and III correspond to the subcompounds and cocompounds respectively of Malayalam. The rules that apply in compounds are listed below.

1. Apical Gemination (AG) geminates the stem-final apical stop /t̲ ṭ/ of the first constituent.
2. m-deletion (m-del) deletes the stem-final labial nasal of the first constituent.
3. Initial Gemination (IG) geminates the stem-initial obstruent of the second constituent.

All three rules apply in Type I compounds as illustrated in the following examples:

(10) vayat valiy --> vayAtti+vali
stomach pain stomach ache

aat kuttiy --> aatti+kkutti
goat calf kid

naay kuttiy --> naaykkutti
dog calf pup

maram katap --> marAkkAdAv+
wood door wooden door

kaal paNt --> kaalppand+
leg ball football

katalay parupp --> kaḍAlAppar+pp+
lentil kernel split lentils

Notice that IG applies even if the final stem does not undergo any phonological changes as in the third, fifth and sixth examples in (10).

Type II compounds are composed of two stems, the first of which has attached to it the suffix /am/. AG and m-del apply to the stem-final segments of the first constituent as seen below:

(11) payat-am parupp --> payAttAmPar+pp+
lentil kernel split lentils

aat-am karay --> aattAŋKarA
river edge river bank

root-am karay --> roottAŋKarA
road edge roadside

koḷam-am karay --> koḷAttAŋKarA
pond edge pondside

Notice however, that the /m/ of the suffix does not delete, nor does the initial obstruent of the second stem undergo gemination. The uppercase consonant symbols denote that the obstruents in question are partially voiced; such voicing is the result of a phonetic implementation rule, and is optional. Notice also the insertion of a geminate /t/ in the last example following m-del. I will return to the rule responsible for this in section 4.1.

None of the three rules apply in Type III compounds, as the examples in (12) indicate:

(12) aat maat --> aadimaadi
goat cow cattle

kooyil kolam --> kooyilKolã
temple pond places of pilgrimage

maram cetiy --> marAñCedi
tree plant vegetation

maram kottiy --> marAnKotti
tree peck woodpecker

kolam tooNtiy --> kolAnToondi
pond dig an implement for dredging ponds

Needless to say, in a theory that attributes such phonological difference to stratal distinctions, we would have to posit three strata to handle the phonology of compounding in Tamil. This, however, cannot be the right solution, as the three rules we have been discussing are not restricted to compounds, and would have to apply in non-adjacent strata, as we will see in the following section.

3. 2. The phonology of inflection

Let us consider some data from inflectional morphology, where we find that all three rules apply. Nouns are inflected for number and case. The order of affixation is shown in (13).

(13) N --> stem (plural) (case) (clitic)

The suffixes are optional; the nominative form has no overt case suffix, and can be considered to be uninflected or caseless. The table below shows the phonology of case and plural suffixation. The second column gives the underlying representations of the stem, and the last three columns give surface representations.

GLOSS	STEM (UR)	NOM Ø	ACC /ay/	PLUR /kal/
'ear'	kaat	kaadi	kaadA	kaadixA
'river'	aat	aari	aattA	aarixA
'rope'	kayat	kayAri	kayAttA	kayArixA
'goat'	aat	aadi	aattA	aadixA
'house'	viit	viidi	viittA	viidixA
'tree'	maram	marã	marAttA	marAngA
'pond'	kolam	kolã	kolAttA	kolAngA
'boy'	payyan	payyẽ	payyAnA	payyAngA
'field'	vayal	vayAl	vayAlA	vayAlixA

Figure 2: Case and Plural Affixation

The final vowel in the nominative forms is the result of a rule of epenthesis that inserts a V-slot[4] following obstruent-final stems. Some of the relevant phonological rules are listed below.

1. Stem-initial syllables are accented; accent is a diacritic feature of prominence that has no phonetic manifestation, but around which numerous phonological rules converge.
2. Epenthesis 1: a V-slot is inserted following obstruent-final stems.
3. Lenition: non-geminate voiceless stops /p t ṯ ṭ c k/ are lenited to [v d ṟ ḍ s x] respectively in non-accented syllables.
4. Nasal Deletion: final nasals are deleted (following nasalization of the preceding vowel) in non-accented syllables.
5. Glide Deletion: final glides in non-accented syllables are deleted; this rules accounts for the deletion of the final /y/ in the accusative forms in Figure 2.
6. Post-nasal Voicing: stops are voiced following nasals in non-accented syllables.
7. Lateral Deletion: syllable-final laterals of affixes are deleted. Stem-final laterals do not delete; compare the nominative and plural forms of 'field' in Figure 2.
8. Vowel Reduction: /u, a/ are realized as [ɨ, A] in non-accented syllables.

A comparison of the nominative and plural with the accusative (case) forms shows that AG and m-del apply in the latter, but not in the former. The difference between the case and non-case forms is thus parallel to the difference between Type I and II compounds on the one hand and Type III on the other. Notice from the examples in Figure 2 that, as expected, non-apicals do not undergo AG (the first example), and that non-labial nasals do not delete in the case forms (see the paradigm for 'boy'). Notice also that a geminate /t/ is inserted following m-del in the last two examples.

Consider next the phonology of cliticization. Clitics can be attached to the inflected as well as uninflected form of nouns (as well as verbs). Once clitics are attached, however, no further suffixes can be added. The clitic in the examples below is the emphatic /taaṉ/. When obstruent-initial clitics are attached to either the nominative or plural forms of nouns, the initial obstruent undergoes Lenition or Post-nasal voicing as shown:

(14) aaṯ taaṉ --> aaṟɨdãã 'river', emphatic
maram taaṉ --> marAndãã 'tree', emphatic

The same clitic, when it is attached to a case form, undergoes IG as the following examples show:

(15a) stem + ACC + clitic

aaṯ ay taaṉ --> aaṯṯAttãã
maram ay taaṉ --> marAttAttãã

(15b) stem + PLURAL + ACC + clitic

aat kaḷ ay taan --> aarɨxAḷAttãã
maram kaḷ ay taan --> marAṇgAḷAttãã

Case forms of nouns that do not undergo AG or m-del also trigger IG on a following clitic. Thus all the accusative forms in Figure 2 trigger IG on the clitic /taan/.

Figure 3 summarizes the distribution of the rules we have considered so far. I have included in the table a column for derivational morphology (DER), which is a cover term that includes diverse morphological processes such as several category changing derivational processes, prefixation, a limited amount of inflection, as well as some compounding. Among the phonological rules is included Palatalization (PAL). DER and PAL are included in the table of rules so as to give a better understanding of the phonology and morphology of the language. It must be pointed out that the rules in Figure 3 are only a fraction of the lexical phonological rules of Tamil. Not included are some other rules of gemination, all of which fall under a purely phonological analysis, as they depend only on segmental or skeletal information.

Derivation	Compounding			Inflection		
	DER	III	II	I	PL	CA	CLI
AG	-	-	+	+	-	+	-
m-del	-	-	+	+	-	+	-
Ø-->tt	-	-	+	-	-	+	-
IG	+	-	-	+	-	-	(+)
Pal	+	-	-	-	-	+	-

Figure 3: Morphological domain of the rules

The order of word-formation is from left to right, as shown in the table above. Derivational morphology precedes compounding, which precedes inflection. Within compounding, Types II and III precede

Type I. There does not seem to be any crucial ordering between Types II and III. I have, however, chosen to order Type II in between III and I mainly because II shares properties with III (non-application of IG) as well as with I (AG and m-del).

In a theory that assigns word formation rules to different strata on the basis of the different sets of phonological rules that apply to them, we would need at least seven strata to account for the phonology and morphology of Tamil. In the table above (Figure 3) no two word-formation processes share the same set of phonological rules. The three compound types differ from each other as well as from derivational and inflectional morphology. In spite of the apparent similarity between Type III compounds and Plural formation (none of the five rules apply in these two morphological processes), they cannot be assigned to a single stratum, as there are rules that apply in compounding but not in the plural, and vice versa. These rules are peripheral to the discussion and are treated in more detail in the account of Tamil in Christdas (in prep).

Several problems are immediately apparent from the distribution of the rules in the table above. The most obvious problem is the numerous strata that are needed to account for the rules associated with word-formation processes. A related problem is the numerous violations of the Continuous Stratum Hypothesis (Mohanan, 1982), which states that the domain of a rule must be a continuous sequence of strata. In Figure 3, which lists only a small subset of the lexical phonological rules of Tamil, we see at least five violations of the CSH. As the table indicates, AG applies in Type I and II compounds, in case inflection, but not in Type III compounds or in plural affixation. These violations and the consequent loss of generalization about the rules of gemination and m-deletion leads us to conclude that a stratal account of these rules is not necessarily the best account of the facts.

Yet another problem is the statement of the rule of IG in cliticization, illustrated in (15). Notice that a stratal account is by itself inadequate to properly restrict this rule; a condition is necessary in addition to the stipulation on the domain of application of the rule so that the rule applies only if the host noun is inflected for case[5].

4. The morphological feature [oblique]

In this section I will present an alternative account of the rules of AG, IG and m-deletion which is superior to a stratal account in several respects. In this account, all three rules are triggered by the morphological feature [oblique]. This feature, along with the notion of head and percolation (Williams 1981) that are independently required in universal grammar, accounts for all instances of the application of the three rules, as well as the non-application of these rules in some environments, as we will see.

Before presenting the solution, I will digress in order to introduce the notion of head. Williams, in his discussion of the notion of head, argues that in the unmarked case the head of a morphologically complex word is the righthand member. It follows that suffixes determine the category of the word they belong to. Williams goes on to propose that a head can also be an abstract feature such as tense or case, or a diacritic feature such as latinate. Only the features of the head can percolate upwards and thus be visible at subsequent levels of derivation.

In Tamil, the morphosyntactic feature case is visible at the phonological as well as the syntactic levels. However, as nominatives are uninflected for case and behave for all purposes differently from case-marked nouns, I will assume that the feature that plays a role in the phonology of compounding and inflection is the feature oblique which includes all the overt case forms, but excludes the nominative. A non-oblique case, therefore, is the nominative, which can be considered to be caseless for morphological and phonological purposes.

Recall that the three rules that apply in compounds apply in two different environments: AG and m-del apply to the first constituent of the compound, and IG applies to the second constituent. I propose that these rules are sensitive to the morphological feature [oblique]. Let us consider the implications of this proposal with respect to the three rules under consideration. In (16) is shown the structure of inflected nouns -- i.e. nouns that have a plural and case suffix respectively.

(16)

	Stem + plural	Stem + case
UR	[[aat] kal]	[[aat] ay]
	1) N / \ N af	2) N / \ N af [ob] [ob]
PR	aarxA	aattA

In the first example -- plural -- the stem is in the nominative and has no feature assigned to it. Suffixing of the plural /kal/ therefore, does not trigger any of the rules. In the second example -- case -- both stem and suffix are characterized for the feature [oblique]. The presence of this feature on the affix follows from the fact that case affixes can only attach to noun stems that have the feature [oblique]. Similar combinatorial restrictions on morphemes are well-attested in many languages (see Williams for examples from English). Other affixes such as the plural and the clitics have no such restrictions and therefore may attach to stems that are not marked for the feature [oblique]. The presence of the feature [oblique] on the stem in (16) above triggers AG and m-del as these rules are restricted to oblique stems (see (10, 11) for other examples).

One might raise the valid question that if [oblique] triggers stem-internal as well as stem-external changes, why does IG fail to apply to case formatives? The answer is obvious when we examine the phonology of these suffixes: they are either vowel-initial or have an initial geminate obstruent[6].

Consider next the effects of cliticization, the structure of which is shown in the examples below.

(17)

	Stem + plural + clitic	Stem + case + clitic
UR	[[aat kal] taan]	[[[aat kal] ay] taan]
	1) N: [N [N af] af]	2) N: [N [N af] af], [ob] [ob]
PR	aarixAdãã	aarixAlAttãã

In the first example, none of the rules apply as the plural suffix is not characterized for the relevant feature -- oblique. In the second example, however, the clitic is adjacent to the feature [oblique] which has percolated to the top of the inflected noun (see arrow). In the first stage of the derivation, the case suffix is affixed to the stem; [oblique] is in head position as it is on the right hand side of the derived word and percolates upwards by the head percolation mechanism of Williams, which allows features in head position to float to the top of the derived word. This feature is now visible and therefore relevant at the next stage of derivation -- cliticization. The clitic in this example is adjacent to the feature [oblique] and thus undergoes IG as expected.

Compounding is straightforward in the account proposed here; the feature [oblique] and the notion of head correctly predict the application of the three rules. In the structure of compounds shown below, the roman numerals refer to the three compound types.

(18)

	I stem + stem	II stem + af + stem	III stem + stem
UR	[aat kuttiy]	[[aat am] karay]	[aat maat]
	1) N: [N N], [ob]	2) N: [N N], [N am], [ob]	3) N: [N N]
PR	aattikkutti	aattaNkarA	aadimaadi

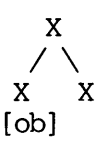
Recall that Type I and Type II compounds are endocentric in structure and that the first stem modifies the second stem, which is the head of the compound. The first stem, in these two compound types is a non-head, and is characterized for the feature [oblique], which triggers AG and m-del on the stem it is attached to, as well as IG on a following stem. The first example in (18) illustrates the structure of a Type I compound.

The second example in (18) shows the structure of Type II compounds. Recall that these compounds are composed of a stem and the suffix /am/, which is followed by another stem. The first stem, like that of Type I compounds, has the feature [oblique], which ensures the application of AG and m-del on that stem. Notice however, that [oblique] occurs inside the lowest (or first) derived constituent, and is therefore not in head position. As such, it is visible only at that level of word-formation; it cannot trigger IG, however, as the following constituent is the vowel-initial suffix /am/. As [oblique] is not visible at subsequent levels, it does not trigger any further rules. This correctly accounts for the failure of m-del to apply to the /m/ of the suffix as well as the failure of IG on the second stem in the examples in (11).

Type III compounds are composed of two stems, neither of which functions as a head. Consequently, the first stem is not assigned any feature other than the usual category features such as N, V, etc., which do not trigger any phonological rules.

We have, by introducing the morphological feature oblique and by exploiting the notions of head and percolation, accounted for the phonology of compounding, inflection and cliticization in an elegant manner. We have, moreover, eliminated the need for stratal distinctions to account for the different types of compounds as well as the difference between plural and case affixation. The structural condition on the three rules can be generalized to apply in the configuration below:

(19)



Notice that the statement of the rule does not require categorial information; all that is required is the tree structure and the feature [oblique].

4.1. A note on the tt-insertion rule

Recall from the table in Figure 3 that m-del is sometimes followed by a rule that inserts a geminate /tt/. The environment of the two rules is shown below:

(20)

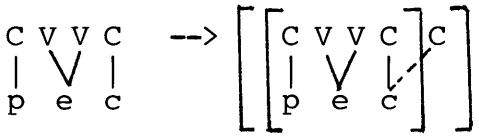
	Type I	Type II	Case
m --> Ø	+	+	+
Ø --> tt	-	+	+

tt-insertion applies in Type II compounds and in case affixation; the common environment in both processes is the presence of an affix immediately following the oblique stem. I will not go into the details of the rule as it is tangential to the issues discussed in this paper. The ordering of the two rules is

(21)
m --> Ø/_[ob]
Ø --> tt/V_[af]

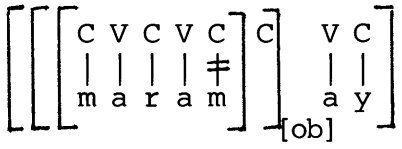
The condition on the tt-insertion rule is not ad hoc, as several rules in Tamil are sensitive to the distinction between a stem and an affix.

It has been suggested by M. Kenstowicz (p.c.) that [oblique] might be a morpheme consisting of an empty C slot unspecified for features. The implications of such a morpheme are interesting both for the morphology and the phonology. Evidence for empty skeletal morphemes is seen in the derivational morphology of Tamil. Other morphemes that consist of a single C slot derive nominals from verb stems, adjectives from noun stems and transitive verbs from intransitive verb stems (Christdas (in prep). An example is the noun [peecci], 'speech', derived from the verb [peesi], 'speak', by the suffixation of a C-slot to the stem /peec/. The derivation of the noun is shown below:

(22)


Association between the C-slot and the stem final obstruent results in the geminate sequence [cc] in the noun. The final vowels in both words are epenthetic. The [s] in the verb [peesi] is the result of Lenition applying to the stem-final /c/. I will briefly consider one of the phonological consequences of this proposal.

Consider the phonology of m-del in a theory of tiered phonology and the assumption that [oblique] is a skeletal slot. The example below is the accusative form of 'tree':

(23)


Notice that m-del results in a sequence of two empty C slots. The t-insertion rule can now be modified as in (24a) below:

(24a) $\emptyset \rightarrow t / V\ C\ C \left[\underline{\ \ V} \right]_{af}$

(24b)

```
C V C V C C V C
| | | |  \ /  | |
m a r a   t   a y
```

The inserted /t/ now links to the two empty C slots, as in (24b), and surfaces as a geminate stop.

5. Consequences

5.1 Predictions

The feature [oblique], besides accounting for the phonology of compounding and inflection in a principled manner, also has significant consequences some of which are discussed in this section.

First, it makes a number of predictions about the morphological environments where the three rules apply. [Oblique] being a feature associated with the morphology of nominals, it follows that only nominals can be characterized for this feature. Consequently the constituent on the left of the derived word must be a noun. This correctly rules out gemination in Adjective-Noun (AN) compounds as the following examples illustrate.

(25)

malay paaNp -->	malAppaambɨ
mountain snake	boa constrictor
caaray paaNp -->	caarAppaambɨ
	a kind of snake
nalla paaNp -->	nallAPaambɨ
good snake	cobra

In the first two examples in (25), the first stem is a noun; note IG on the second stem. In the third example, the first constituent is an adjective; adjectives cannot bear the feature [oblique], which correctly accounts for the non-application of IG in this and similar examples. Under an alterative analysis, such as a stratal account, AN compounds must be listed as exceptions to the rule of IG.

A second prediction that follows from the analysis proposed here is that there should be no categorial restriction on the second constituent -- i.e. the constituent to the right of the feature [oblique]. This is indeed the case, as we have seen. These constituents can range over nouns, as in Type I compounds, verbs, as in NV compounds (see Christdas (in prep)), or suffixes as in Type II compounds, case suffixes and clitics.

Yet another advantage is the statement of the rule of IG in cliticization. Recall that clitics undergo the rule only if the host noun is inflected for case (15). Under the analysis proposed here, no

conditions on the statement of the rule are required. The feature [oblique] correctly accounts for the gemination of the initial obstruent of the clitic only when it is attached to case-marked nouns.

5.2 Gemination in the syntax

Gemination is not restricted to the lexicon. The statement of the rule in (19) correctly accounts for several instances of the rule in the syntax as well.

Postpositions behave just like clitics with respect to the rule of IG: case-inflected nouns trigger IG on a following postposition, as the example below indicates:

(26) maram-ay poolay --> marAttAppoolA
tree ACC like like a tree

IG does not apply if the noun is uninflected for case:

(27) maram poolay --> marAmPoolA

IG applies across a verb and its objects. Tamil being a SOV language, verbs are usually in final position, and may be preceded by one or more object NPs. NPs that are case marked trigger gemination on a following verb as the example below shows:

(28) paaNp-ay paar-tt-een --> paambAppaattẽẽ
snake-ACC see-PST-1sg I saw the snake

A case marked NP also induces gemination on a following NP:

(29) paaNp-kk paṛam-ay koṭuv-tt-een --> paambɨkkɨppaṛAttAkkoḍɨttẽẽ
snake-DAT fruit-ACC give-PST-1sg I gave the fruit to the snake

Switching objects makes no difference as long as the case suffix is present:

(30) paṛam-ay paaNp-kk koṭuv-tt-een --> paṛAttAppaambɨkkɨkkoḍɨttẽẽ

Caseless nouns, whether subject NPs or a noun in object position that is not inflected for case[7], do not trigger IG. Gemination thus does not apply across a subject and verb. Nominatives, as we saw, are uninflected for case and do not bear the feature [oblique].

(31) paaNp paar-tt-atu --> paambɨ paattɨdɨ *paambɨppaattɨdɨ
snake see-PST-NEUT the snake saw (something)

Not all case-inflected nouns trigger IG as the examples below indicate. In (32), below, we see the failure of IG across a locative NP and a following verb:

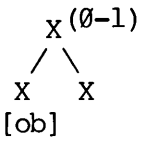
(32) caNtay-ilay paar-tt-een --> candAyilA paattẽẽ
market-ACC see-PST-1sg I saw in the market
*candAyilAppaattẽẽ (someone/something)

A possible explanation is that locatives are dominated by V" unlike object NPs, which are dominated by V', as they are immediate sisters of the verb. Gemination applies only within a V', which rules out IG across locative NPs and a following verb.

Dative subjects too do not trigger IG on a following verb. Recall from (29,30) that dative objects cause a following obstruent to geminate.

(33) paaNp-kk paciy-kk-atu --> paamb̪ikk̪ pasik'k'̪id̪
snake-DAT hunger-PRES-NEUT the snake is hungry
*paamb̪ikk̪ippasik'k'̪id̪

Again, the explanation is similar to that for locatives: dative subjects are not immediate sisters of a verb and therefore are not in the correct environment for gemination. Gemination thus applies within a configuration where the dominating node is no higher than X'. The structure of the rule environment in (19) is reformulated as shown below in order to account for all instances of gemination.

(34)


6. Conclusions and discussion

In the preceding discussion I have shown that the complex phonology and morphology of Tamil can be handled in a straightforward manner without increasing the number of strata to more than two. As there is no further motivation for stratal distinctions between the three types of compounds or between compounds and inflection (this is discussed at length in Christdas (in prep)) there is no evidence for more than two lexical strata for Tamil, as follows:

1. a stratum for the morphology discussed in this paper (compounding and inflection)
2. an earlier stratum for derivational morphology

As the feature [oblique] is crucial in eliminating numerous stratal distinctions we might ask whether the analysis proposed here can be extended to Malayalam, so as to dispense with the stratal analysis originally proposed by Mohanan.

The Malayalam data given in Mohanan (1982) and Mohanan & Mohanan (1984) are all consistent with an interpretation following the analysis proposed for Tamil. Recall that one of the two arguments in favour of a stratal distinction between subcompounds and cocompounds is the rule of gemination, which includes stem initial and stem final gemination. An interesting aspect of gemination is that its application is restricted to Dravidian stems (1982:16).

An examination of the Malayalam data reveals the following facts. m-deletion applies in the case forms, but not in the nominative or the plural forms, as the examples below indicate. The

case forms are from page 120 of Mohanan (1982), and the nominative and plural forms are from pages 120 and 20 respectively of the same work.

(35)

NOM	ACC	DAT	PLU /kal̤/
maram	marattine	marattinə	marangal̤

Likewise, stem-final gemination (corresponding to AG of Tamil) applies in the case forms such as the locative, but not in the nominative. The examples are taken from Mohanan & Mohanan (1984:582)

(36)

GLOSS	NOM	LOC
forest	kaaṭə	kaaṭṭil
river	aaṟə	aaṯṯil

The facts of Malayalam, from the data presented in Mohanan (1982) and Mohanan & Mohanan (1984) are[8]

(37)

	SUB	CO	PL	CASE
m-del	+	?	-	+
final gem	+	-	-	+
init. gem	+	-	-	N/A

Initial gemination also applies in clitics, postpositions and verbs in environments that are identical to those of Tamil.

The data presented above indicates that several aspects of compounding and inflection are similar in the two languages. However, the available evidence is insufficient to decide conclusively whether or not the analysis proposed for Tamil can be extended to Malayalam.

The stress facts of Malayalam have interesting consequences for the loop. Recall from section 2 (see Sproat 1985 for a detailed discussion) that the stress patterns of compounds do not support the loop: a subcompound that contains a cocompound has the stress pattern of a cocompound. There is thus no phonological evidence that the output of morphological recursion undergoes phonological rules. Further, the analysis presented here might eliminate the relevant stratal distinction altogether. Since there is no stratal difference among compounds in this account, then there can be no loop. Thus, in addition to Sproat's valid objections to Mohanan's analysis of the Malayalam data, we have an independent argument against the loop on principled grounds.

A loop has also been motivated to account for morphological recursion in English (Mohanan 1982, Halle & Mohanan 1985). However, whether the morphology requires four strata as proposed by Halle & Mohanan (1985), three as proposed in Kiparsky (1982), or two as proposed in Kiparsky (1983, 1985) is still a matter of dispute. Moreover, the four-stratal analysis of the English data in Halle & Mohanan (1985) has been reexamined by Borowsky (1986), Clements (1985)

and Rubach (1986), who arrive at the same conclusion: there is no evidence for more than two strata, and consequently there is no motivation for the loop.

The only two proposed instances of the loop[9], as we have seen, have not been well-motivated as they are based on insufficient data. I conclude therefore that there is no motivation for the loop, and that it can be eliminated from phonological theory. The elimination of the loop, and a constraint on the number of lexical strata to no more than two can strengthen the theory of Lexical Phonology by constraining the considerable power that went along with it.

The model of the lexicon proposed in this work, illustrated with some of the Tamil rules discussed here is shown below in Figure 4.

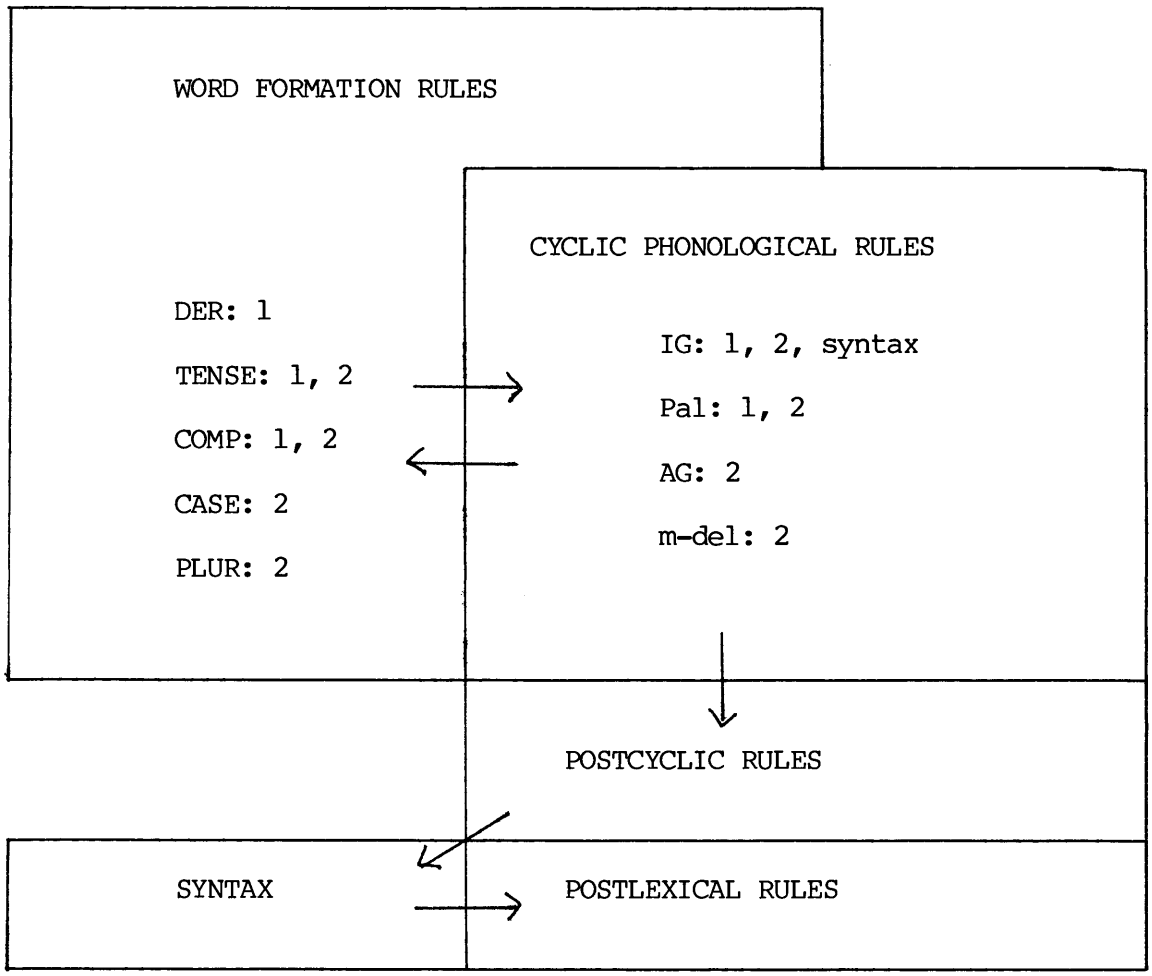


Figure 4: The model of the lexicon

I have adopted from Rubach (1986), Booij & Rubach (1987) the concept of post-cyclic rules. As Rubach notes, these rules apply in the lexicon, but are not sensitive to morphological information. As such, they apply following all the cyclic rules, but before the post-lexical rules.

In the model proposed above, the word-formation rules do not belong to separate "modules" (compare Figure 1). These rules are similar to the phonological rules in that they are specified with respect to their domain of application. The advantage of this model over earlier models lies in the fact that it can account for morphological processes such as compounding which in some languages are spread over two strata. Examples of such compounds are seen in Tamil and English, and are discussed in Christdas (in prep).

NOTES

*I am grateful to Nick Clements for many useful discussions of the issues in this paper and for his helpful comments and suggestions on an earlier draft.

[1]Stem-final and stem-initial gemination are stated as a single rule in Mohanan (1982). The data, however, indicates that stem-final gemination applies only to the apical stops /t̲ ṭ/, whereas stem-initial gemination applies to the class of voiceless stops.

[2]In Mohanan & Mohanan (1984) it is argued that the alveolar geminate stop t̲t̲ is derived from underlying /r̲r̲/; under this analysis, stem-final gemination must be stated as a rule that applies to the sonorant r̲ and the retroflex stop ṭ, which do not form a natural class. Under the alternative analysis proposed in Christdas (1985), the sonorant r̲ in words such as 'rope' in (3a) is derived from an underlying stop /t̲/. The rule that changes /t̲/ to [r̲] is part of a general rule of Lenition that applies to the class of non-geminate voiceless stops.

[3]According to Mohanan (personal communication), this analysis of the stress and tone rules has been revised in a recently published work. I have not been able to consult this work due to limitations of time.

[4]This is one of three different rules of epenthesis, all of which insert a V slot, which is realized as /u/. The vowel subsequently surfaces as [ɨ] by the rule of Vowel Reduction (Christdas (in prep)).

[5]Other problems that are not immediately apparent are the numerous rules that apply in Derivation, skip the intervening compounding domains, and apply in inflectional morphology. These rules are sensitive to the prosodic feature accent, and are discussed

in Christdas (in prep), which presents further arguments against a stratal distinction between compounds and inflection.

[6]The case formatives are Accusative /ay/, Dative /kk/, Genitive /kka/, Locative /ilay/, Instrumental /aalay/, and Comitative /ooṭay/.

[7]The traditional account of caseless NPs in object position is that non-human nouns can be optionally uninflected for case. Caseless objects, however, are not NPs (Christdas (1986)); the structure of these phrases is in fact

N V. I will not go into the question of whether this is the result of a morphological operation or a syntactic incorporation process.

[8]Gemination, in Mohanan's account, is a Stratum 2 rule. The Malayalam data, however, does not support this assumption. As the domain of locatives and other inflectional morphology is Stratum 4, there is no explanation in this account as to why gemination and m-deletion apply to some forms in Stratum 4, and not to others.

[9]Another instance of the loop is found in the analysis of Sekani (Hargus 1985). In this account, a loop has been motivated to account for recursion between stratum 4 and stratum 1. This analysis may be problematical, as the loop was originally introduced to handle recursion between adjacent strata.

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