Chapter 4. Cophonologies and Level Ordering

This chapter focuses on the status of level ordering (Kiparsky 1982, Mohanan 1982, Mohanan 1986) in Sign-Based Morphology. In section 4.1, I present the basic claims of level ordering theory. In section 4.3, I investigate level ordering in the Turkish lexicon, motivating five lexical strata, and develop a set of stipulations which enable Sign-Based Morphology to handle "standard" level ordering phenomena. In section 4.7, I present challenges to level ordering, and show how these challenges can be handled by abandoning each of the level-ordering stipulations made in section 4.3. Level ordering is thus not an intrinsic part of Sign-Based Morphology, putting the theory in a position to handle the many phenomena motivating departures from level ordering. By contrast, any theory that incorporates level ordering as a fundamental assumption must resort to ad-hoc devices such as the "loop" of Mohanan 1982, Mohanan 1986, or level skipping or economy (Inkelas and Orgun 1995) to handle the phenomena which counterexemplify strict ordering.

4.1 Level ordering: the standard view

In Lexical Phonology (Kiparsky 1982, Mohanan 1982, 1986), the lexicon is assumed to be divided into a number of strata. Each morphological construction is assigned to a specific stratum. Words pass through these strata in sequence, potentially undergoing morphological (and phonological) operations at each of the strata. Each stratum is associated with a particular set of phonological rules. I illustrate this with a classic example from English affixation taken from Mohanan (1982). The English lexicon is assumed for purposes of this illustration to be divided into two strata. Essentially, Latinate morphology is assigned to stratum 1, while English morphology is assigned to stratum 2, although the generalization is not perfect. Examples of affixes belonging to these strata are shown in (176):

(176)

Stratum 1	Stratum 2
-ate	-ing
-al	-er
-ity	-ee
-ism	-ed

The expectation is that in forms containing both stratum 1 and stratum 2 affixes, stratum 1 affixes should appear inside stratum 2 affixes (as in *advoc-at*$_1$*-ing*$_2$).

Some of the phonological rules of the two strata are shown in (177):

(177)

Stratum 1	Stratum 2
velar softening (k → s)	no velar softening
stress shift	no stress shift
no consonant deletion	consonant deletion

Examples are given in (178):

(178)

Stratum 1	Stratum 2
electric/electricity (velar softening)	traffic/trafficking (no velar softening)
cátholic/cathólicism (stress shift)	ánalyze/ánalyzing (no stress shift)
damnation [dæmneɪʃɨn] (no deletion)	damning [dæmɪŋ] ([n] deletion)

A main claim in classical level-ordering theory (Kiparsky 1982, Mohanan 1982, 1986) is that every form, derived or underived, is subject to each level of the lexical phonology and morphology. Mohanan invokes a factory metaphor in which lexical levels correspond to rooms in which workers perform phonological and morphological operations to the words being built (Mohanan 1986:47):

(179) There is a conveyor belt that runs from the entry gate to the exit gate passing through each of these rooms. This means that every word that leaves the factory came in through the entry gate and passed through every one of these rooms.

$$\text{UR} \rightarrow [\text{ level 1 }] \rightarrow [\text{ level 2 }] \rightarrow [\text{ level 3 }] \rightarrow [\text{ level 4 }]$$

As Inkelas (1988) has shown, the hypothesis that every form undergoes every level is independent of the serial factory metaphor, however; if, following Selkirk 1982, Inkelas 1988, Cohn 1989, Inkelas 1993a, and Orgun 1994c, lexical levels are defined as hierarchically related constituent types, the same fundamental principle can be implemented. To this end Inkelas 1988 extends Selkirk's Strict Layer Hypothesis (Selkirk 1982:26), developed originally for postlexical prosodic constituents, to lexical structure:

(180) Selkirk's Strict Layer Hypothesis: "a category of level *i* in the hierarchy immediately dominates a (sequence of) categories of level *i*-1"

Applied to lexical constituent structure:

$$\begin{array}{l} [x]_{\text{level 4}} \\ \quad | \\ [x]_{\text{level 3}} \\ \quad | \\ [x]_{\text{level 2}} \\ \quad | \\ [x]_{\text{level 1}} \\ \quad | \\ /x/_{\text{level 0}} \end{array} \qquad \text{(UR)}$$

Languages with level ordering which have been analyzed following the basic assumption of level obligatoriness include Malayalam (4 levels) (Mohanan 1982, Mohanan 1986; English (between 2 and 4 levels) (Kiparsky 1982a,b, 1985; Mohanan 1982, 1986; Halle and Mohanan 1985); Tamil (2 levels) (Christdas 1988); Sekani (4-5 levels) (Hargus 1988); Kashaya (5 levels) (Buckley 1993); Turkish (4-5 levels) (Inkelas and Orgun 1994, 1995).

A summary of the basic claims of level ordering theory is in (181):

(181) a) Levels are ordered. A node of a particular level cannot dominate a node of a higher level.

b) Every form is represented at every level. Levels may not be skipped.
c) Morphemes that belong to the same level are associated with the same phonological system.

In addition to these basic claims, each level may be cyclic or noncyclic. Since I have already shown how Sign-Based Morphology deals with cyclic as well as noncyclic phonological effects, I will not dwell on the issue cyclic versus noncyclic levels in this chapter.

4.2 Introduction to cophonologies

In Sign-Based Morphology, most of the work of level ordering is taken over by cophonologies. In this section, I present the basic idea behind cophonologies.

In a morphological construction, the phonological constraints relating the daughter node to the mother node are represented by the function φ. In the simplest case, there would be only one such function that operated throughout the morphology of a given language. In reality, however, things are not that simple. Often, different morphological constructions are associated with different phonological alternations and constraints. In Sign-Based Morphology, this is handled by associating different morphological constructions with different phonological mapping functions. In such a language, each such phonological function is called a "cophonology", a term used in the Optimality Theory literature by Inkelas et al. 1994, Inkelas and Orgun 1995, and Orgun 1995c, among others. Cophonologies handle standard level stratification effects, in which different sets of morphemes subscribe to different cophonologies. Unlike phonological levels, however, cophonologies extend even to those phonological effects that are specific to individual morphemes or morphological constructions.[40] Handling such effects with cophonologies eliminates the need for diacritic reference to morphological features in individual phonological rules or constraints, as well as positive and negative exception features (see Zonneveld 1978 for review), required in classical level ordering theory.

I now offer an illustrative example of cophonologies. The well-known k~∅ alternation in Turkish deletes intervocalic velars at the end of polysyllabic roots (Lewis 1967, Underhill 1976, Zimmer and Abbott 1978, Sezer 1981a), as shown in (182):

(182)	gʲerekʲ	'necessity'	gʲere-i	'necessity-3sg.poss'
	ilʲikʲ	'marrow'	ilʲi-i	'marrow-3sg.poss'
	ɑjɑk	'foot'	ɑjɑ-ɯ	'foot-3sg.poss'

40 The contrast between level ordering and minor rules and other cases of morpheme-specific phonology in the earlier literature is argued to be spurious by proponents of cophonologies.

However, this alternation is not triggered by all vowel initial suffixes. For example, [k] never deletes before the future suffix *-edʒekʲ ~ -adʒak* (183):

(183)

gʲerekʲ	'be necessary'	gʲerekʲ-edʒekʲ	'be necessary-fut'
birikʲ	'accumulate'	birikʲ-edʒekʲ	'accumulate-fut'
bɯrɑk	'let go'	bɯrak-ɑdʒɑk	'let go-fut'

To handle this, we posit two separate phonological rule or constraint systems in Turkish, φ_1 and φ_2, such that φ_1 deletes intervocalic velars while φ_2 preserves them. The third person possessive construction (data in (182)) is shown in (184); it subscribes to φ_1, the velar deletion cophonology:

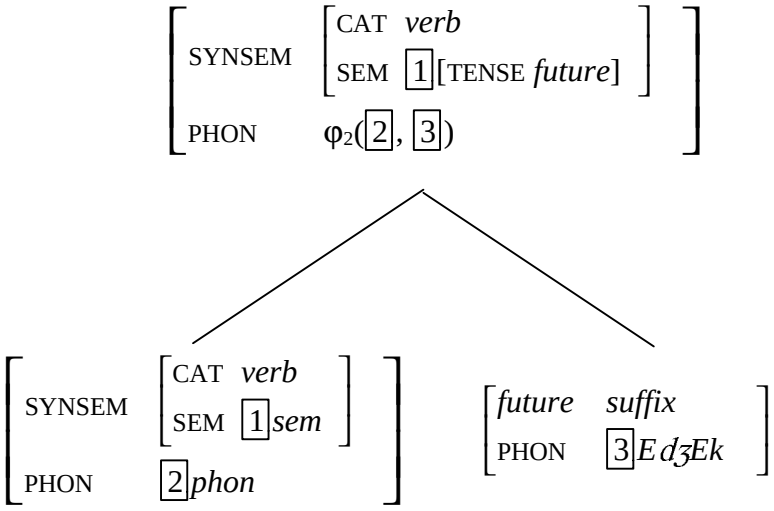
(184)

$$\begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{CAT} & \textit{noun} \\ \text{POSSESSOR} & \begin{bmatrix} \text{PERSON} & \textit{third} \\ \text{NUMBER} & \textit{singular} \end{bmatrix} \\ \text{SEM} & \boxed{1} \end{bmatrix} \\ \text{PHON} & \varphi_1(\boxed{2}, \boxed{3}) \end{bmatrix}$$

$$\begin{bmatrix} \text{SYNSEM} & \begin{bmatrix} \text{CAT} & \textit{noun} \\ \text{POSSESSOR} & \textit{none} \\ \text{SEM} & \boxed{1}\textit{sem} \end{bmatrix} \\ \text{PHON} & \boxed{2}\textit{phon} \end{bmatrix} \qquad \begin{bmatrix} \textit{possessive} & \textit{suffix} \\ \text{PHON} & \boxed{3}\textit{I} \end{bmatrix}$$

The future construction (data in (183)), on the other hand, subscribes to φ_2, the velar-preserving cophonology, as shown in (185).

(185)



Cophonologies are the only way in which morpheme-specific phonology is handled in Sign-Based Morphology. It does not matter whether a given phonological effect is exhibited by 1, 10, or all of the morphological constructions in the language; cophonologies are responsible for them all.

By contrast, in approaches such as Lexical Phonology, cophonologies are invoked only when it appears that many morphemes (or morphological constructions) require similar phonological treatment. Phonological effects specific to one, or only a few, morphological environments are handled by other means, such as negative and positive rule features (e.g. Halle and Mohanan's (1985) level 2 [i]-tensing rule of English, stipulated not to apply before the suffixes *-ly* and *-ful* (p. 67), vs. the rule of vowel shortening, stipulated to apply before the suffix *-ic* (p. 77)). Because it depends on the undefined, relative notion of "few" vs. "many", the decision as to when morpheme-specific phonology should be attributed to a lexical stratum and when it should be handled by some other mechanism is inevitably ad-hoc and arbitrary.

By streamlining its approach to morpheme-specific phonology, Sign-Based Morphology avoids the need for arbitrary choices of this kind.

4.3 Cophonologies and level ordering

The famous k~∅ alternation in Turkish (Zimmer and Abbott 1978, Sezer 1981a) was claimed by Inkelas and Orgun 1995 to provide evidence for level ordering in the Turkish lexicon. This alternation, which deletes intervocalic velars in morphologically derived environments, is, as we have already seen, triggered by some suffixes, but not others. Some examples are provided in (186) of suffixes that do not trigger velar deletion:

(186)	gʲedʒikʲ	gʲedʒikʲ-edʒekʲ	‘be late-(fut)’
		gʲedʒikʲ-ebilʲ-ir	‘be late-abil-imprf’
		gʲedʒikʲ-en	‘be-late-ppl’
		gʲedʒikʲ-indʒe	‘be late-adv’
		gʲedʒikʲ-ip	‘be late-sub’
		gʲedʒikʲ-idʒi	‘be late-agt’
		gʲedʒikʲ-iʃ	‘be late-noml’
		gʲedʒikʲ-erekʲ	‘be late-mnr’
		gʲedʒikʲ-ir	‘be late-imprf’
		gʲedʒikʲ-ilʲ-ir	‘be late-pass-imprf’
	aːfak	aːfaːkʲ-iː	‘horizon-(adj)’

Examples of suffixes that do trigger velar deletion are given in (187):

(187)	badʒak	badʒa-ɯ	‘leg-acc’
		badʒa-ɯ	‘leg-3poss’
		badʒa-ɯm	‘leg-1sg.poss’
		badʒa-ɯn	‘leg-2sg.poss’
		badʒa-a	‘leg-dat’
	salak	sala-ɯm	‘stupid-1sg.sbj’
		sala-ɯz	‘stupid-1pl.sbj’

One way to capture this phonological difference between these two sets of suffixes is to posit two lexical strata with different phonological systems, and assign the suffixes to the appropriate stratum, as Inkelas and Orgun 1995 propose.

To determine the ordering of these two levels, it is necessary to find forms that bear suffixes from both classes. This is indeed possible in a few cases, where tense/aspect suffixes in (186) may combine with agreement suffixes in (187). In such cases, the tense/aspect suffix is inside the agreement suffix (188):

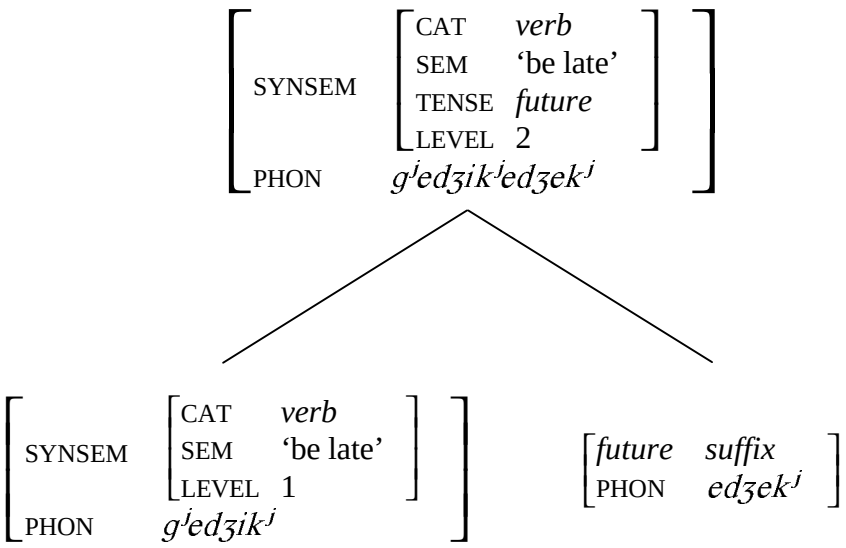
(188)	gʲedʒikʲ-edʒe-im	‘be late-fut-1sg.sbj’
	birikʲ-edʒe-i	‘accumulate-fut-3sg.sbj’
	bɯrak-adʒa-ɯn	‘let go-fut-2sg.sbj’
	gʲerekʲ-edʒe-imiz	‘be necessary-fut-1pl.sbj’
	adʒɯk-adʒa-ɯnɯz	‘become hungry-fut-2pl.sbj’

Thus, a level ordered account would assign the suffixes in (186) to an earlier level than those in (187); I will call these levels 2 and 3 here (reserving level 1 for unaffixed roots) (though Inkelas and Orgun 1995 have in fact proposed a further subdivision, for other reasons, among the suffixes I am calling "level 3".)

The effect of level ordering can be replicated in Sign-Based Morphology by using a diacritic level feature that morphological constructions refer to. This has been proposed for Turkish in Orgun 1994c (see also Selkirk 1982 and Inkelas 1989 for the claim that level is a type of category in constituent structure). I will now present this mechanism.

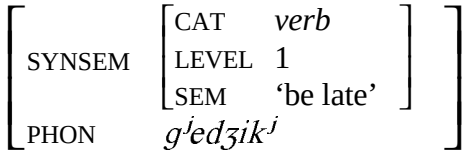
The main proposal is to include a diacritic level feature in signs. The structure of the form *gʲedʒikʲ-edʒekʲ* 'be late-fut' will then be as shown in (189). Note that the feature LEVEL is not appropriate for affixes, and is only borne by roots and morphologically complex stems (this would follow automatically if affixes were represented as arguments to the phonological function φ rather than constituents. LEVEL would then be a feature appropriate to all signs. Even though I have argued in section 3.2.2 that affixes should indeed be represented in this way, I will continue using the visually more perspicuous tree notation for the sake of easier readability).

(189)



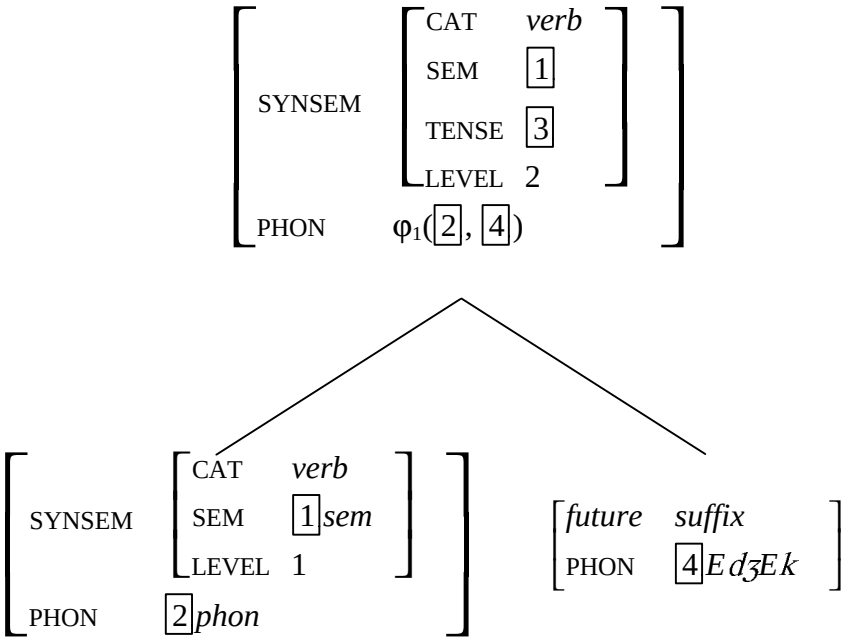
In order to complete a level ordered grammar, level specifications must be included in all morphological constructions. It is also necessary to indicate the appropriate cophonology in each construction. To this end, let φ_1 be the velar-preserving cophonology and φ_2 the velar-deleting cophonology. Recall that bare roots are assumed to be LEVEL 1, the future suffix is LEVEL 2, and the first person subject agreement suffix is LEVEL 3. The root *gʲedʒikʲ* 'be late' is shown in (190):

(190)



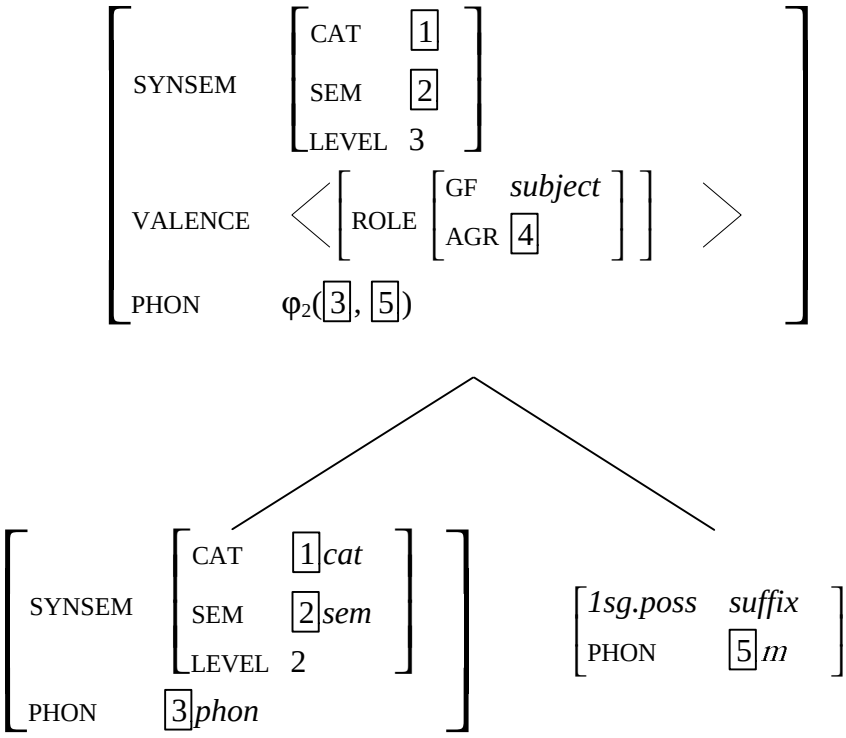
The representation of the future suffix -*edʒek*^{j} is shown in (191):

(191)



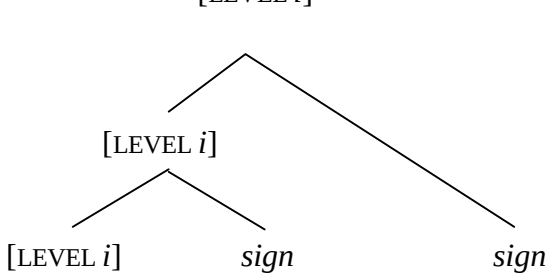
Finally, the representation of the 1st person subject agreement suffix is shown in (192):

(192)



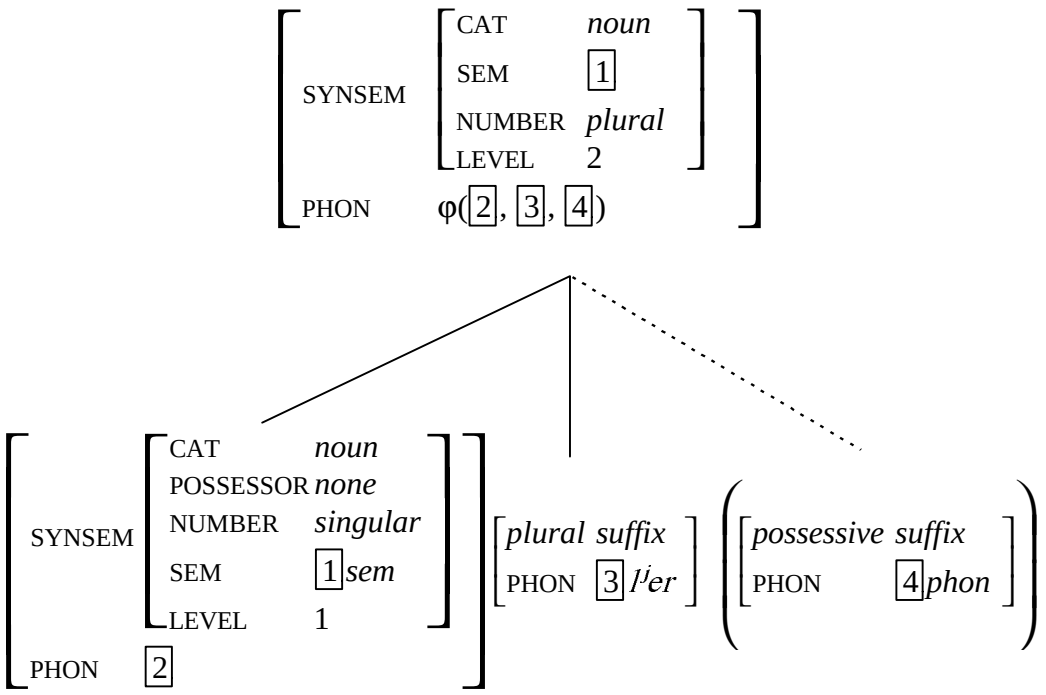
The reason that the LEVEL value of the mother node in these constructions is one higher than the LEVEL value of the daughter is that the "levels" in Turkish are all noncyclic (that is, no embedding of constituents is found within a level). The only apparent cyclic effects found result from adjunction of a higher level affix to a lower level stem. In other words, the configuration shown in (193) is, to my knowledge, not attested in Turkish:

(193)



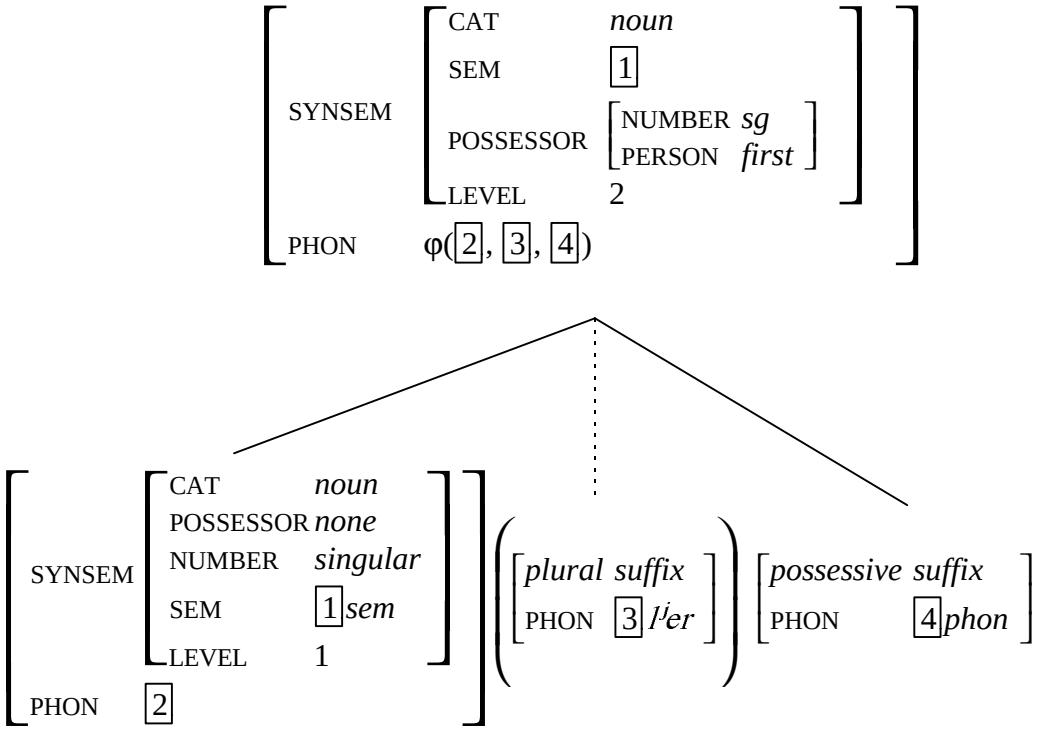
The constructions in (191) and (192) will not license the unwanted configuration in (193), since the mother node's LEVEL value is incompatible with the daughter node's, preventing recursion within the same LEVEL. At this point, we have successfully ruled out unwanted recursion, but we must still allow flat structures within a level, which are required to handle the apparent noncyclic application of the disyllabic minimal size condition in section 2.1. To do this, I use the Kleene star notation. An asterisk following a feature structure description means that there may be zero or more constituents of that description. The pluralization construction is shown in (194):

(194)



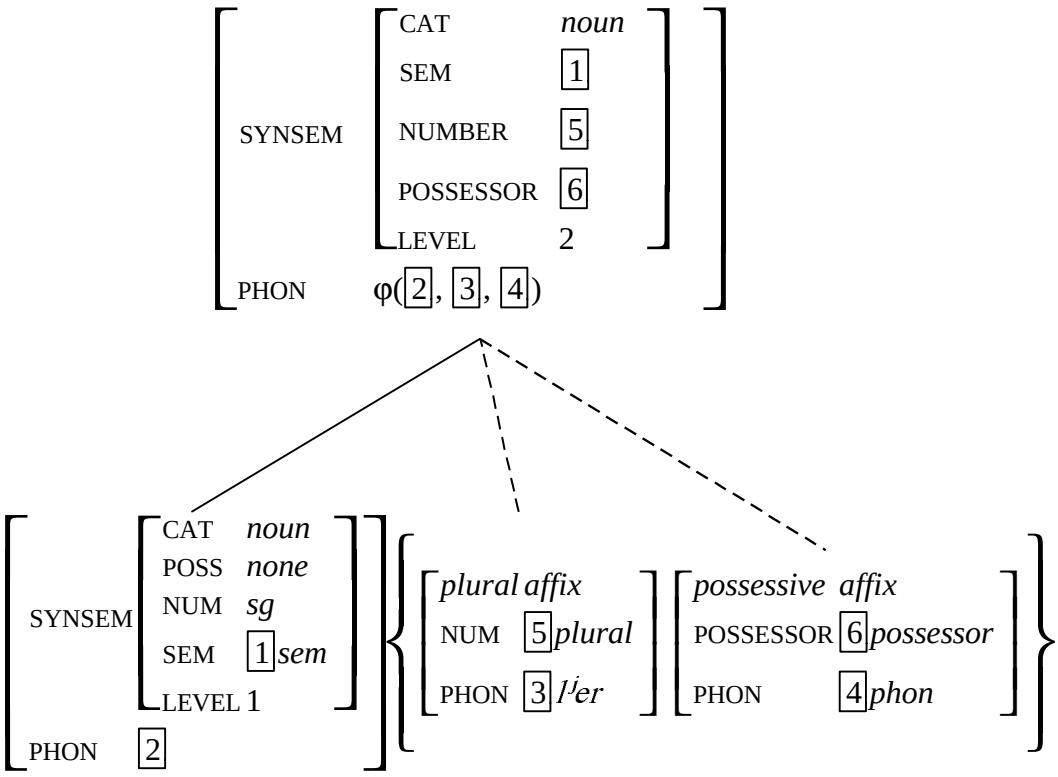
This construction attaches the plural suffix *-lʲer ~ -lar* to the root and allows the attachment of other suffixes to the right of the plural suffix. Of course, such attachment will only be possible if the other suffixes' constructions are compatible with the pluralization construction in (194). One (and, as far as I know, the only) compatible construction is the first person singular possessive construction, shown in (195):

(195)



We can combine these two constructions into a general construction that can attach either the plural suffix or a possessive suffix, or both to a noun stem, provided that we adopt a number of conventions (196):

(196)



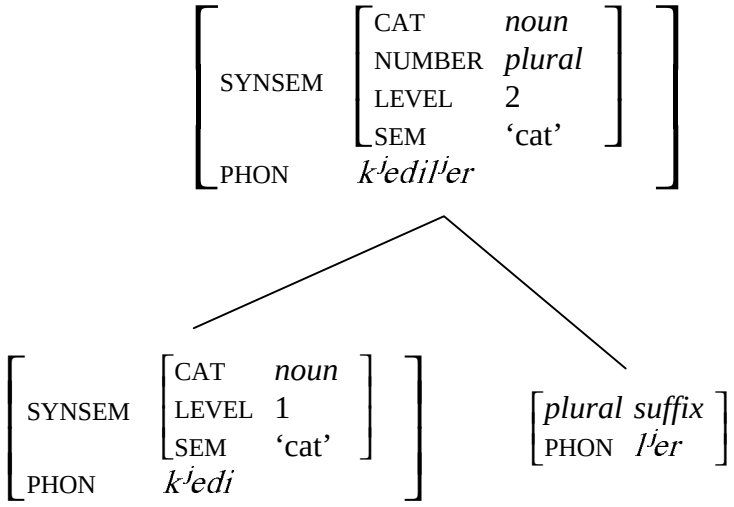
The (independently motivated) conventions that need to be invoked are the following:

i) Vacuous nonbranching dominance is prohibited. That is, the construction in (196) cannot license an affixless structure in which a bare (singular, nonpossessed) noun stem is dominated by a singular, nonpossessed mother node. This prohibition against vacuous structure is a standard feature of Construction Grammar (Fillmore and Kay 1996), and is necessary in Sign-Based Morphology in order to derive "Level Economy" effects (see section 4.7.2)

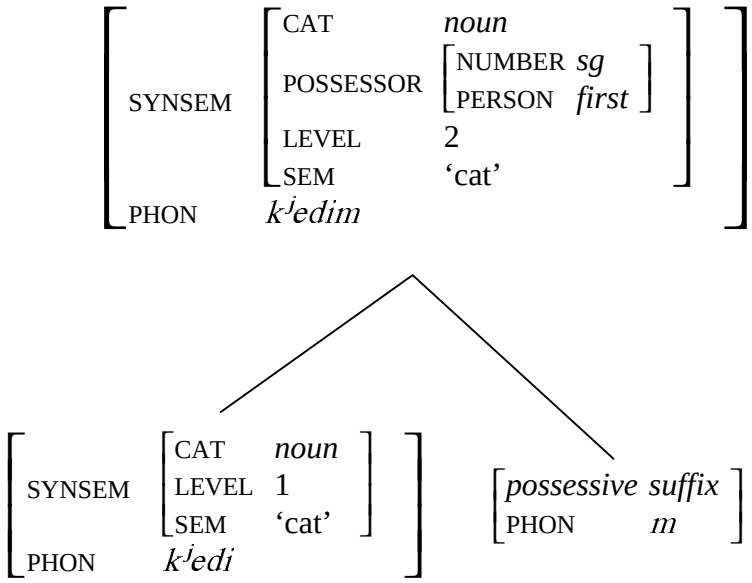
ii) In the absence of an affix, features of the mother node that are required by the construction to be identical to features contributed by affixes must instead be identical to corresponding features of the stem daughter. This convention is identical to the one proposed by Lieber (1980) to control feature percolation from affixes. Within a unification-based approach, it requires the use of default percolation: features percolate from the stem by default, but this default percolation may be overridden by specific requirements imposed by affixes.

Together, the plural and possessive constructions license all of the following forms:

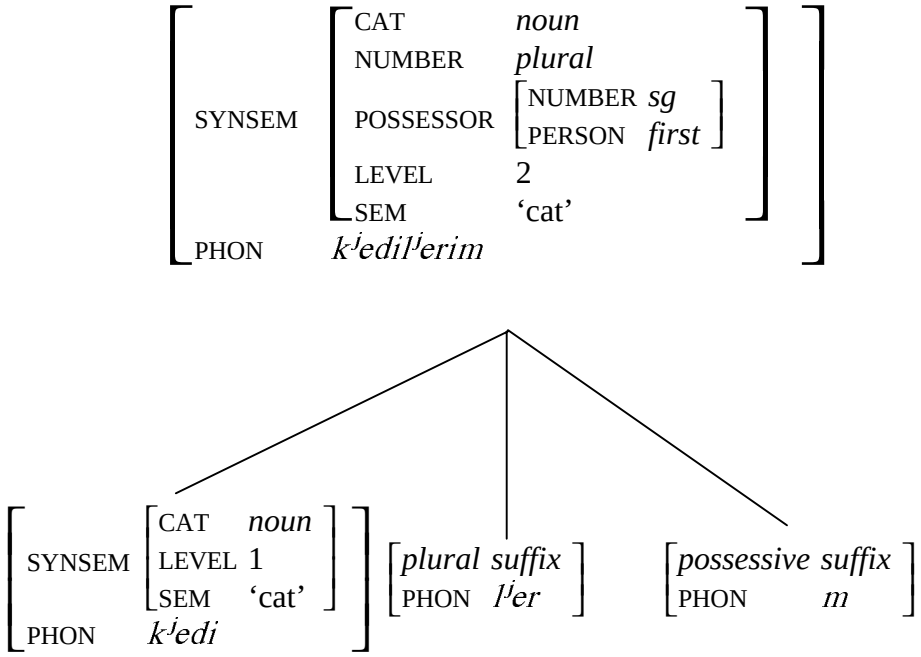
(197) a) Plural form



b) Possessive form

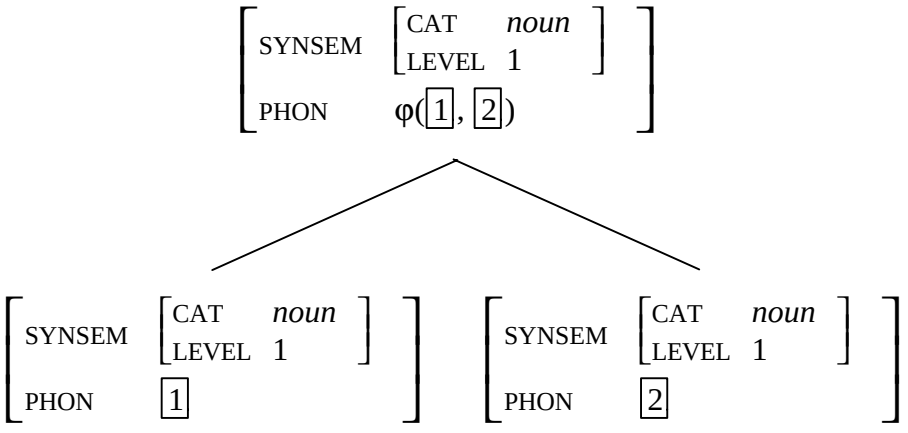


c) Plural possessive form



To sum up the discussion thus far, we have seen how the LEVEL feature can be used to handle level ordering phenomena (191)-(192), and also to force flat structures when appropriate (194)-(197). Of course, when recursion within a level is found (corresponding to "cyclic levels" in Lexical Phonology), the LEVEL value of the mother node of the construction in question will be the same as the LEVEL value of its daughter. An example of this would be Mandarin compounding (section 1.1). The construction that licenses Mandarin nominal compounds is shown in (198):

(198)



Since the daughter and mother nodes bear the same value for the LEVEL feature in this construction, the mother node of one instance can unify with one of the daughters of

another instance.[41] This allows embedding of compounds in compounds, which results in the observed cyclic phonological effects.

In conclusion, we have seen how level ordering phenomena can be handled in Sign-Based Morphology by using a diacritic LEVEL feature.

4.4 How different can cophonologies be from each other?

Any theory that allows different morphological processes to be associated with different morphophonological alternations, modeled as different phonological systems, needs to address the question of how much these different phonological systems can vary from each other. Within Lexical Phonology, two main proposals have addressed this issue: the Strong Domain Hypothesis (Kiparsky 1982), and the slightly weaker Stratum Domain Hypothesis (Mohanan 1982), also called the Uniform Domain Hypothesis (Halle and Mohanan 1985). In this section, I review these proposals and discuss the same issue from the perspective of Sign-Based Morphology, in which cophonologies are used to handle *all* morpheme-specific phonology, not just that judged somehow to be general. The question to be addressed is whether there are limits on the degree to which cophonologies in the same language can differ from one another.

4.4.1 Example of an unwanted language

In this section, I provide an example of an unattested phonological system that uncontrolled cophonology proliferation can describe. I will use this example in subsequent sections in comparing the restrictiveness of various attempted solutions to the cophonology proliferation problem.

Let this unwanted language (Hypothetical Language A) have two lexical strata, which we may term LEVEL 1 and LEVEL 2. Assume further that LEVEL 1 spreads underlying lexical tones rightward to toneless syllables, while LEVEL 2 assigns weight sensitive stress. As in Lexical Phonology, all forms undergo both levels. The LEVEL 1 tones are erased by the LEVEL 2 phonology, and stress is assigned to the leftmost heavy syllable. Some example derivations in this language are shown in (199):

(199) Hypothetical Language A:

UR	tàntáta
Level 1	tàntátá
Level 2	ˈtantata

In Hypothetical Language A, the first and second levels have radically different phonological systems. Since languages like this are not attested, it would seem that a satisfactory theory of the phonology-morphology interface must have a way of ruling them out. Any theory using cophonologies, whether for all phonological phenomena (Sign-Based Morphology) or only for some phenomena (Lexical Phonology) bears the burden of

41 This discussion presupposes that the feature level is needed in Mandarin to begin with, for which I have no evidence at this point.

restricting cophonology proliferation enough to rule out unattested language types like the one described in this section.

4.4.2 The Strong Domain Hypothesis and the Uniform Domain Hypothesis

One approach to the cophonology proliferation problem was proposed by Kiparsky (1984), who proposed the Strong Domain Hypothesis as a solution. According to this hypothesis, all rules are active on LEVEL 1. Some of the rules may cease to apply on LEVEL 2. These rules may not become active again at subsequent levels. In general, a number of rules may turn off at each level, but new rules may not be added. This way, the phonological systems of different levels are prevented from differing from each other in arbitrary ways.

The Strong Domain Hypothesis works quite well for case like English, where LEVEL 1 of the lexical phonology has rules like velar softening, trisyllabic shortening and nasal deletion, while LEVEL 2 has relatively few morphophonemic alternations. However, the Strong Domain Hypothesis turns out in general to be too strong. For example, some of the phonological constraints in Turkish that have already been discussed in this work counterexemplify the Strong Domain Hypothesis. The table in (200), taken from Inkelas and Orgun 1995, summarizes the constraints and the strata on which they are active.

(200)

	Level 1	Level 2	Level 3	Level 4
velar drop	no	no	yes	yes
[σσ]	no	yes	yes	
[μμ]	yes			

Two phenomena violate the Strong Domain Hypothesis: velar deletion is inactive within roots, as well as before LEVEL 1 and 2 suffixes, but active before LEVEL 3 and 4 suffixes. Disyllabic minimality is inactive within the root level, but active on LEVEL 2 and 3 (LEVEL 4 does not have any consonantal suffixes; it is therefore impossible to determine whether disyllabic minimality is active on this level or not).

Although these phenomena counterexemplify the Strong Domain Hypothesis, they are, however, consistent with the weaker Uniform (Stratum) Domain Hypothesis of Mohanan 1982 and Halle and Mohanan 1985. According to this hypothesis, rules (or constraints) must be active in a contiguous set of levels. Thus, we may specify the earliest and latest levels on which a rule applies; the rule must be active on all the intervening levels as well. For the Turkish case, we only need to specify the earliest level at which velar deletion and disyllabic minimality are active: LEVEL 3 for velar deletion and LEVEL 2 for disyllabic minimality.

4.4.3 How restrictive is the Uniform Domain Hypothesis?

The intent of the Uniform Domain Hypothesis is to keep the phonological systems of different levels (i.e. cophonologies) from differing from each other in arbitrary ways. In this section, I demonstrate, however, that the unwanted language type in section 4.4.1 is allowed by the Uniform Domain Hypothesis. The Uniform Domain Hypothesis is therefore not strong enough to rule out unattested types of cophonology proliferation.

In LEVEL 1 of Hypothetical Language A, the only rule to apply is tone spreading, which spreads underlying tone rightwards to all available syllables.

In accordance with the Uniform Domain Hypothesis, we posit two rules that turn on at LEVEL 2. The first of these is a tone deletion rule that deletes all tones. The second is a stress assignment rule that places word stress on the leftmost heavy syllable. The rules and their level assignments are summarized in (201):

(201)		
	LEVEL 1	Tone spread
	LEVEL 2	Tone deletion
		Stress assignment

These rules permit the derivation in (202), which corresponds to the unattested and undesired Hypothetical Language A:

(202)			
	UR		tàntátá
	Level 1	Tone spreading	tàntátá
	Level 2	Tone deletion	tantata
		Stress	ˈtantata

The insight behind the Uniform Domain Hypothesis is that the different phonological systems associated with the strata cannot differ from each other in arbitrary ways. However, the hypothesis is unable to curtail cophonology proliferation in a satisfactory way, since it fails to rule out the unattested Hypothetical Language A, whose different levels have completely unrelated prosodic structures.

In the following sections, I speculate on possible remedies to this problem.

4.4.4 An insight from Optimality Theory: focus on the output

A leitmotif in the Optimality Theory literature is the importance of focusing on the output rather than the rules/processes (alternations) that derive that output (Prince and Smolensky 1993; see also McCarthy 1996a for a particularly forceful argument in favor of this position). In rule-based theories, certain generalizations are inevitably lost due to the focus on rules rather than outputs. It is often the case that a number of different rules "conspire" to create wellformed outputs (Kisseberth 1970). An approach like Optimality Theory is better able to offer insightful analyses of this sort of phenomenon, since an Optimality Theory grammar consists largely of output wellformedness constraints.

This insight from Optimality Theory proves to be useful in allowing us to take one more step towards a genuine understanding of the relation between cophonologies in a language. Careful inspection of empirically motivated cophonologies reveals an important generalization: the similarities that we need to capture across cophonologies are mainly in the output strings that they license. Even when cophonologies differ in major ways in the alternations they enforce, their outputs are still quite similar as a set. The unwanted

Hypothetical Language A (section 4.4.1) has the opposite property: the outputs of the two cophonologies have radically different outputs.

A good demonstration of this point is provided by the Turkish cophonologies in section 4.3. Consider, for example, velar deletion. This alternation is active on levels 3 and 4, but not on levels 1 and 2. Thus, intervocalic velars are not deleted in level 1 or 2 morphology (203):

(203)				
	Level 1	Roots:	sokɑk	'street'
			sɑkɑl	'beard'
			ekʲip	'team'
			oku	'read'
		Acronyms:	ɑːkʲeːmeː	'AKM (Atatürk Cultural Center)
	Level 2	Future:	birikʲ-edʒekʲ	'accumulate-fut'
			bɯrɑk-ɑdʒɑk	'let go-fut'
			gʲedʒikʲ-edʒekʲ	'delay-fut'
			gʲerekʲ-edʒekʲ	'be necessary-fut'
		Imperfective:	birikʲ-ir	'accumulate-imprf'
			bɯrɑk-ɯr	'let go-imprf'
			gʲedʒikʲ-ir	'delay-imprf'
			gʲerekʲ-ir	'be necessary-imprf'

Intervocalic velars *are* deleted in level 3 and 4 morphology (204):

(204)					
	Level 3	Possessive:	sokɑk	sokɑ-ɯ	'street (-3sg.poss)'
			bɑdʒɑk	bɑdʒɑ-ɯm	'leg (-1sg.poss)
			eʃekʲ	eʃe-in	'donkey (-2sg.poss)'
			mekʲikʲ	mekʲi-imiz	'shuttle (-1pl.poss)'
			bɑrdɑk	bɑrdɑ-ɯnɯz	'glass (-2pl.poss)'
	Level 4	Case:	delʲikʲ	delʲi-i	'hole (-acc)'
			etekʲ	ete-e	'skirt (-dat)'
			bɑlɯk	bɑlɯ-ɯn	'fish (-gen)'

These cophonologies thus differ in the alternations they enforce. One of them deletes intervocalic velar across morpheme boundaries, while the other does not. However, when we consider the range of phonological strings that these cophonologies license as a set, we

notice that both sets of include strings with intervocalic velars as well as with vowel hiatus (205):

(205)

	Intervocalic velar		Vowel hiatus	
Level 1/2 output	ʃɑkɑ	'joke'	sɑɑt	'clock'
	gʲedʒikʲ-ip	'delay-sub'	tʃoɑl-ɯp	'increase-sub'
Level 3/4 output	tɑkɯm-ɯm	'team-1sg.poss'	ɑɑdʒ-ɯm	'tree-1sg.poss'
	hekʲim-im	'doctor-1sg.poss'	teti-im	'trigger-1sg.poss'

Thus, even though these two cophonologies differ in the alternations they enforce, they do not differ in the kinds of output strings they license (in terms of intervocalic velars and vowel hiatus). This suggests that attempts to restrict cophonology proliferation should focus on the output, not the alternations. This observation is in line with the major insight Optimality Theory has provided phonological theory with: important generalizations lost by focusing on rules or alternations may be gained by focusing on the output instead.

4.4.5 A Learnability Hypothesis: Hypothetical Language B

Focusing on the output immediately suggests a way to curtail cophonology proliferation without any extrinsic constraints on the theory. A striking property of Hypothetical Language A is that the tones from level 1 never surface—they are always deleted on level 2. Let us compare this language with another, minimally different language (Hypothetical Language B) which has no underlying tones (and thus no tone rules). Level 1 therefore has no rules of interest to us. Level 2, as before, has a stress rule, but no tone deletion rule. A typical derivation in this language is shown in (206):

(206) Hypothetical Language B

UR	tɑntɑtɑ
Level 1	tɑntɑtɑ
Level 2	ˈtɑntɑtɑ

Note that the ultimate surface outcome in Hypothetical Language B is the same as that in the undesirable Hypothetical Language A. Given this, no empirical evidence distinguishes these two languages. In the absence of positive evidence, a learner will certainly not posit an elaborate tonal system. Therefore, the unwanted Hypothetical Language A will never be learned. Instead, exposure to the same set of data will result in Hypothetical Language B being learned. Focusing on the output allows us to pinpoint the problem with the unwanted Hypothetical Language A: the problem is that the output of the inner level contains information that is not deducible from the surface form, and is therefore unlearnable based on positive evidence.

(207) Learnability Hypothesis: cophonologies must be learnable

Clearly, more research in this area is called for before any definitive claims can be made. Tentatively, however, I suggest that there should be no universal formal constraints on cophonological variation. Cophonologies are to be allowed to differ from each other in any way, as long as their outputs satisfy some minimal conditions that every surface phonological string in the language obeys.[42]

4.4.6 Some spurious cophonology proliferation problems

In this section, I discuss a few additional examples of cophonologies that seem to be too different from each other. I show, however, that these examples also do not point to the need for extrinsic constraints on cophonology proliferation.

The first example (Hypothetical Language C) is similar to Hypothetical Language A, except that the tones in Hypothetical Language C surface alongside stress. I argue that ruling out this situation is a problem for phonological theory proper, not a problem of cophonology proliferation. The second example involves a language (Hypothetical Language D) that has very restrictive syllable types on level 1, and allows a much wider variety of syllables on level 2. I argue that languages of this type do in fact exist. The conclusion of this section is that some apparent challenges of cophonology proliferation are better seen as challenges to phonological theory in general.

4.4.6.1 A variation on the tone/stress system: Hypothetical Language C

At first sight, the Learnability Hypothesis (207) does not seem to be sufficiently restrictive. For example, it allows a minor variation on the unwanted Hypothetical Language A. In particular, suppose we remove the level 2 tone deletion rule from the grammar, but leave everything else intact. We then license the derivation in (208):

(208) Hypothetical Language C:

UR		tàntátá
Level 1	Tone spreading	tàntátá
Level 2	Stress	ˈtàntátá

In Hypothetical Language C, as in Hypothetical Language A, the two cophonologies are radically different from each other. Level 1 has tones, and level 2 has quantity sensitive stress. The only difference is that the tones from level 1 are not deleted on level 2. Languages like this are not attested. Does this mean that the Learnability Hypothesis (207)

42 These conditions can perhaps be formally expressed in a construction that every word in the language must undergo, corresponding to the word level of Lexical Phonology (see especially Borowsky 1993 for discussion of the word level).

is not sufficiently restrictive, and must be supplemented by some stipulated formal universal constraint on cophonology proliferation?

Although the potential for describing Hypothetical Language C may seem to be a problem caused by cophonology proliferation, I claim that the problem is in fact more fundamental: the problem is within the level 2 cophonology itself, not in the difference between level 1 and level 2. The phonology of level 2 allows tones and stress to coexist in its output strings. It is this problem that phonological theory must address. Thus, what we need is a way to constrain a single phonological system, not formally restrict differences between phonological systems within a language.

Once again, more research is necessary before any conclusive claims can be made on the desired scope of restrictions on cophonology proliferation. However, the demonstration in this section shows that restricting phonological theory may sometimes be where the real challenge lies.

4.4.6.2 Different syllable inventories: Hypothetical Language D

In this section, I present a language (Hypothetical Language D) that is allowed by the Learnability Hypothesis. In this language, level 1 allows only CV syllables, while level 2 has a larger inventory of syllable types. It appears at first that such languages should be disallowed. However, I argue that they should in fact be allowed. This claim leads to the interesting issue of how much cophonologies should be allowed to differ in the output strings they license (assuming such differences are consistent with the Learnability Hypothesis to begin with).

Let us assume that level 1 only allows CV syllables. Level 2, on the other hand, allows complex coda clusters. Let us also assume that there are a number of level 2 consonantal suffixes that can create such clusters. A typical derivation in this language is shown in (209):

(209) Hypothetical Language D

UR	beke
Level 1	beke
Level 2	beke-l-k-t-s
Surface	bekelkts

The Learnability Hypothesis does not rule out Hypothetical Language D. It is in fact quite easy to learn the system: root internally, only CV syllables are found. Suffixes, however, may create coda clusters. Should such languages be ruled out? If so, this would mean that the Learnability Hypothesis is not sufficiently restrictive, and further formal universal constraints on cophonology proliferation are called for.

I claim that languages such as the one described in this section should not be ruled out. Though the particular example discussed here is rather extreme, systems of this general kind do exist. English is a case in point. Only relatively small consonant clusters are found within English morphemes. However, suffixed forms allow much larger clusters. None of the clusters in (210) can be found in monomorphemic English forms:

(210) English is Hypothetical Language D:

pact-s	[kts]
ten-th-s	[nθs]
six-th-s	[ksθs]
ask-s	[sks]

This demonstration has an important implication: cophonologies *may* differ considerably in their outputs as long as such differentiation is consistent with the Learnability Hypothesis.

4.4.7 Review of cophonology proliferation

At first sight, it may appear that Sign-Based Morphology's use of cophonologies results in a lack of restrictiveness, compared to, for example, a theory like Lexical Phonology, which embodies principles such as the Strong Domain Hypothesis or the Uniform Domain Hypothesis to control the content of cophonologies. However, I have contended that this apparent contrast between Sign-Based Morphology and Lexical Phonology is not a real one. The main points of this argument are summarized in (211):

(211) i) Approaches that do not use cophonologies (such as Lexical Phonology, which uses levels instead, or the approach of Benua 1995, which uses a single constraint ranking for all of morphology) are not necessarily more restrictive in empirical terms. Such approaches must allow additional tools like exceptions features or rules or constraints that make reference to specific morphemes. These tools can replicate everything that cophonologies can do. They are at least as powerful as cophonologies (section 4.4.3).

ii) Researchers in the Lexical Phonology framework (Mohanan 1982, Kiparsky 1983, Halle and Mohanan 1985) have had the valuable insight that cophonologies within a language do not seem to vary randomly. However, the rule-based phonological theory of the time prevented them from putting this insight into good use. The output focus of Optimality Theory has provided valuable insights into all aspects of phonological and morphological research. This same insight is important in cophonology proliferation as well: it is necessary to restrict the differences between the outputs of different cophonologies, not necessarily the alternations imposed by them (section 4.4.4).

iii) Learnability is a sufficient criterion to rule out many cases of unwanted cophonology proliferation. In particular, if there is a cophonology that every form must undergo (a word construction), then any phonological structure that this cophonology does not preserve will be prevented by the Learnability Hypothesis from occurring in cophonologies applying to

subconstituents (section 4.4.5).

iv) When learnable, considerable differences between cophonologies are possible, and are attested (section 4.4.6.2).

v) Certain problems that remain are better attacked from the perspective of restricting the flexibility of a single phonological system, not from the perspective of restricting differences between coexisting phonological systems within a language (section 4.4.6.2).

Tentatively, then, I claim that it is not necessary to impose any extrinsic universal constraints on cophonologies. Some apparent problems may disappear as phonological theory develops further. Other unwanted grammars are ruled out on the basis of learnability. Yet other seemingly extreme cases turn out to be attested. Further research will determine the validity of this claim.

Having addressed the issue of how much the phonology of one level can differ from the phonology of another level, I go back to the central topic of this chapter, the issue of level *ordering*.

4.5 Levels in the Turkish lexicon

In this section, I motivate some additional levels in the Turkish lexicon by using Suspended Affixation, prosodic minimality, cophonologies, and suffix ordering as tests. I also assign a number of suffixes to these levels. The purpose of this investigation is threefold. First, it illustrates how the mechanisms developed in section 4.3 for level ordering can handle a sizable fragment of Turkish morphology. Second, I refer to the levels motivated in this section in my discussion of departures from strict level ordering in section 4.7. Third, unlike the most familiar claim for level ordering, which is based on Latinate versus Anglo-Saxon morphology in English, all the morphological phenomena that motivate level ordering in the Turkish lexicon are fully productive. This lends the theory of level ordering more credibility by showing that claims that level ordering effects are restricted to cases where the inner level is unproductive (Bochner 1993), and that these are therefore of limited, if any, synchronic interest are incorrect.

Recall from the previous discussion of Turkish that we have assigned bare roots to level 1. The first productive suffix to be added to verb roots is the causative,[43] followed by the passive. We will not be concerned with the causative, since it does not interact with any of the phonological and morphological phenomena we are investigating. I will therefore assume that the passive suffix attaches to level 1 daughters, and that the mother node is level 2. Prosodic minimality tells us that tense and aspect suffixes form a flat structure with the passive. Observe the data in (212), where minimality violations can be repaired by adding further suffixes:

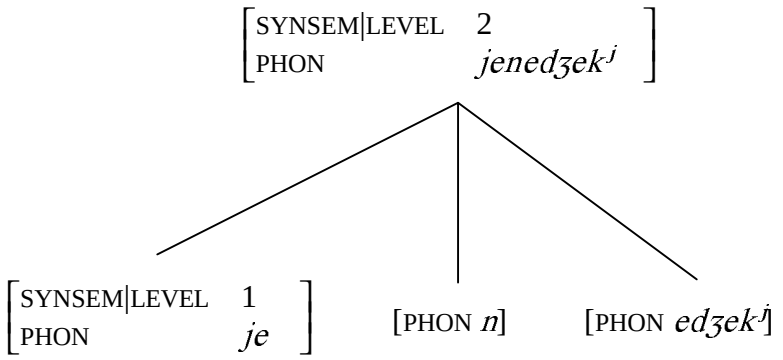
43 The reflexive and reciprocal suffixes precede the causative, but as they are only marginally productive, I will ignore them here, in accordance with my desire to lend more credibility to level ordering by basing it exclusively on productive morphology.

(212)

je	‘eat’
*je-n	‘eat-pass’
je-n-ir	‘eat-pass-imprf’
je-n-ijor	‘eat-pass-prog’
je-n-edʒek^{j}	‘eat-pass-fut’
je-n-di	‘eat-pass-past’
je-n-miʃ	‘eat-pass-evid’
je-n-mez	‘eat-pass-neg.imprf’

This apparent noncyclic application of the disyllabic minimal size condition is handled by positing a flat structure for the suffixes in question, as shown in section 2.1. The structure for *je-n-edʒek^{j}* ‘eat-pass-fut’ is shown in (213):

(213)



It follows from the fact that the passive and tense/aspect suffixes form a flat structure that they must all have the same level specification. Thus, tense/aspect suffixes belong to level 1 as well. Example (214) shows the level assignments we have so far. I will update this list each time I present evidence for a new level.

(214)

Level 1	Daughter: level 1, Mother: level 2
root	passive -*n*
	tense -*di*, etc.
	aspect -*ijor*, etc.

I now turn to the plural and possessive suffixes, which will turn out to belong to a different level. We know from Suspended Affixation that these suffixes belong to the same level: the fact that they cannot be suspended separately from each other shows that they form a flat structure (215):

(215) kʲedi ve kʲøpekʲ -lʲer -im
cat and dog -pl -1sg.poss

*kʲedi -lʲer ve kʲøpekʲ -lʲer-im
-pl -pl -1sg.poss

kʲedi-lʲer-im ve kʲøpekʲ -lʲer-im
-pl-1sg.poss -pl-1sg.poss

The first person possessive suffix can be added to verbs bearing the future suffix. This is made possible by a subordinate clause construction in which the subject is genitive and which expresses subject-predicate agreement by adding possessive suffixes to the predicate. An example of this construction is given in (216). See Lewis 1967, Underhill 1976 for more. The subordinate clause is enclosed in brackets.

(216) [ɑjʃe-nin gelʲ-edʒe-i] ʃyphe-lʲi
(name)-gen come-fut-3poss doubt-with
'It is doubtful that Ayşe will come'

The possessive suffixes belong to a level higher than that of the tense/aspect ones; that is, they adjoin to hosts containing tense/aspect suffixes rather than forming a flat structure with them. The main source of evidence for this claim is that aspect suffixes subscribe to the velar-preserving cophonology, while possessive suffixes belong to the velar-deleting cophonology, as the examples in (217) show:

(217) a) Tense-aspect: velar-preserving

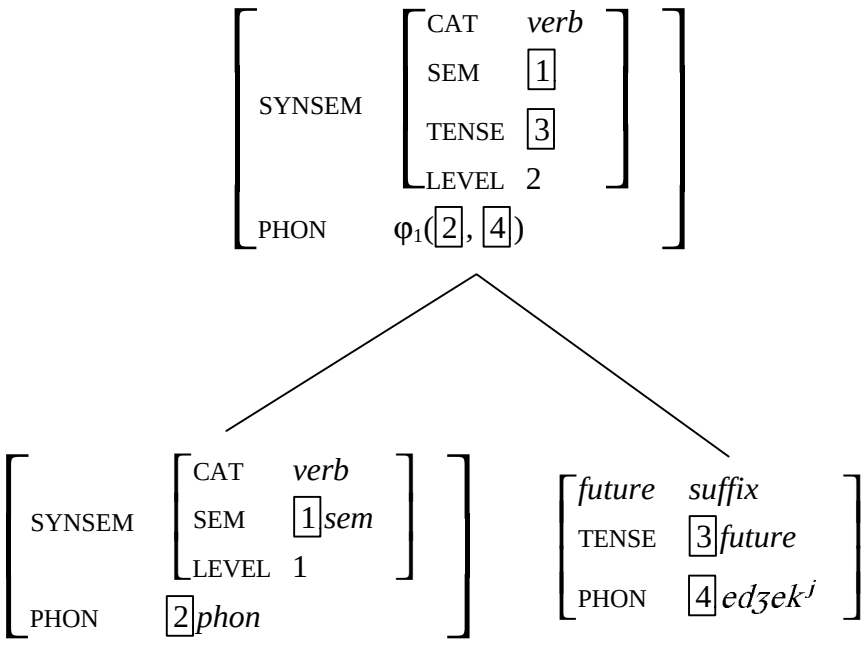
birikʲ	birikʲ-edʒekʲ	'accumulate-fut'
gʲedʒikʲ	gʲedʒikʲ-edʒekʲ	'be late-fut'
bɯrɑk	bɯrɑk-ɑdʒɑk	'let go-fut'
birikʲ	birikʲ-ijor	'accumulate-prog'
gʲedʒikʲ	gʲedʒikʲ-ijor	'be late-prog'
bɯrɑk	bɯrɑk-ɯjor	'let go-prog'
birikʲ	birikʲ-ir	'accumulate-imprf'
gʲedʒikʲ	gʲedʒikʲ-ir	'be late-imprf'
bɯrɑk	bɯrɑk-ɯr	'let go-imprf'

b) Possessive: velar-deleting

sokɑk	sokɑ-ɯ	‘street-2poss’
bil^{j}ek^{j}	bile-in	‘wrist-2sg.poss’
soluk	solu-um	‘breath-1sg.poss’
eʃek^{j}	eʃe-iniz	‘donkey-2pl.poss’
inek^{j}	ine-imiz	‘cow-1pl.poss’

Suffixes that subscribe to different cophonologies cannot form flat structures. This is because they impose incompatible requirements on the mother node’s phonology, and therefore the constructions introducing the suffixes cannot unify with each other.[44] Consider, for example, the construction for the future suffix (218):

(218)



The mother node’s phonology in (23) is related to the daughter nodes’ phonologies by a system of constraints identified as φ_1, which is the velar-preserving cophonology.

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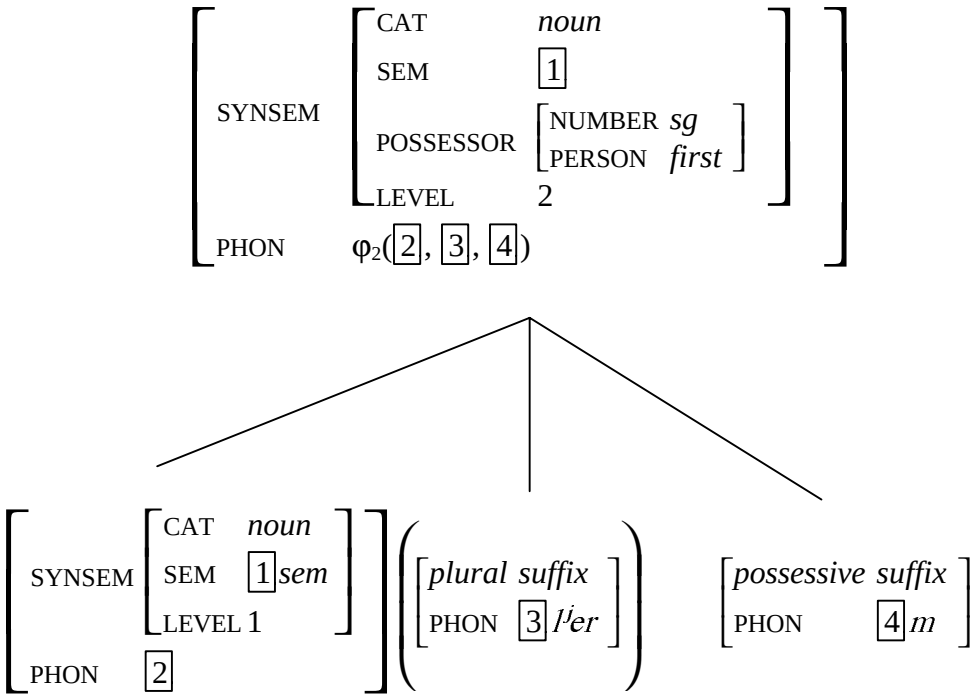
44 So far, we have seen three types of evidence for branching structures in Turkish. These are:

i) Cyclic enforcement of the disyllabic minimal size condition,
ii) Separability in Suspended Affixation,
iii) Incompatible cophonologies (level ordering).

The question of what conditions are necessary and sufficient for branching structures is an important one. In this study, I have identified sources of evidence from the phonology-morphology interface. A more comprehensive list of sufficient criteria for branching structures will have to await a thorough study of scope relations in morphology (assuming intuitively there is a relationship between scope and dominance).

Now consider the construction for the first person possessive suffix (219):

(219)



In this construction, the cophonology that relates the mother node phonology to the daughters' phonologies is φ_2, the velar-deleting cophonology. If we were to try to put these two suffixes in a flat structure, we would be imposing incompatible constraints on the mother node's phonology. It follows therefore that aspect and possessive suffixes do not form a flat structure. Rather, the possessive suffix adjoins to stems containing the future suffix. Since the mother node of the future construction is level 2, it follows that the daughter node of the possessive construction is likewise level 2. By Strict Layering, the mother node of the possessive construction is level 3. Since the plural suffix forms a flat structure with the possessive (as we know from Suspended Affixation (215)), it follows that the plural suffix also combines with a level 2 daughter, and that the mother node is level 3.

The updated chart showing level assignments for suffixes is shown in (220):

(220)

	Daughter: level 1,	Daughter: Level 2,
<u>Level 1</u>	<u>Mother: level 2</u>	<u>Mother: Level 3</u>
root	passive -*n*	possessive -*im*, etc.
	tense -*di*, etc.	plural -*l'er*
	aspect -*ijor*, etc.	

We now turn to case suffixes, which will turn out to belong to yet another lexical stratum. Suspended Affixation shows us that case suffixes adjoin to stems containing the plural or

possessive suffixes, rather than forming a flat structure with them. This is because case and plural or possessive suffixes can be suspended independently of each other (221):

(221) kʲedi ve kʲøpe -im -i
cat and dog -1sg.poss -acc

kʲedi -m ve kʲøpe -im -i
-1sg.poss -1sg.poss -acc

kʲedi -m -i ve kʲøpe -im -i
1sg.poss -acc -1sg.poss -acc

The daughter node of the case constructions is therefore level 3, and, by Strict Layering, the mother is level 4. The updated level chart is in (222):

(222)

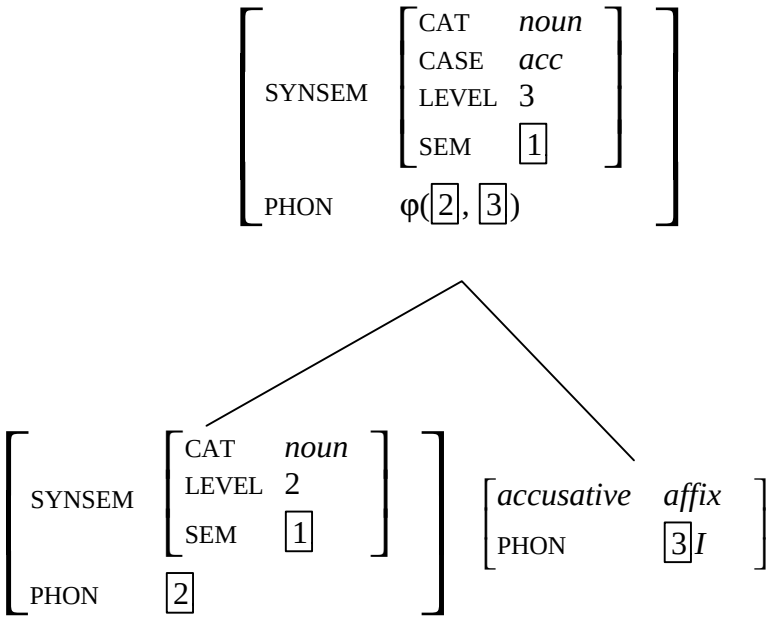
Level 1	Daughter: level 1, Mother: level 2	Daughter: Level 2, Mother: Level 3	Daughter: Level 3, Mother: Level 4
root	passive -*n* tense -*di*, etc. aspect -*ijor*, etc.	possessive -*im*, etc. plural -*lʲer*	case -*i*, etc.

This concludes my study of level ordering in the Turkish lexicon. We have seen that at least four strata are motivated. Sign-Based Morphology can handle this level stratification by using a diacritic level feature. The resulting morphological structures capture the level ordering and cophonology effects, as well as accounting for the cyclic versus noncyclic application of phonology, and restrictions on Suspended Affixation.

4.6 Modeling the Strict Layer Hypothesis

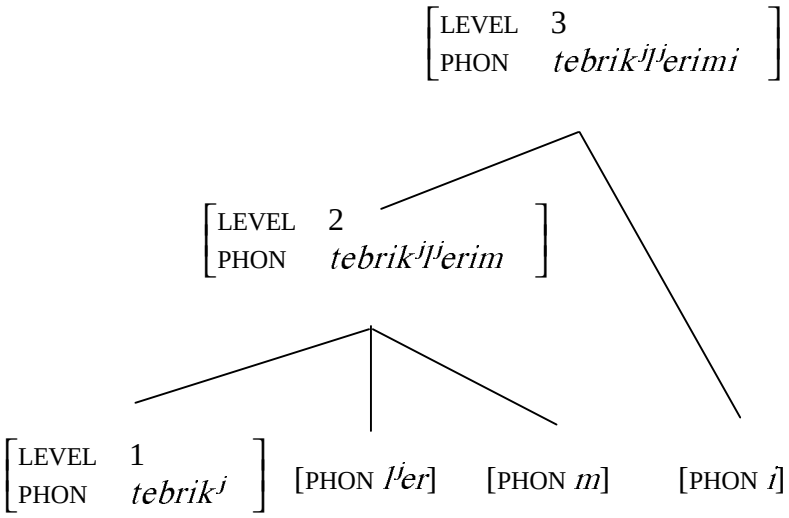
According to the Strict Layer Hypothesis, extended to lexical phonology by Inkelas 1988, 1993a, each node of level *i* dominates a node (or nodes) of level *i*-1 (recursion at the same level may still be allowed; what is not allowed is skipping a level, or domination of a higher level node by a lower level one). According to this proposal, nonderived forms are still represented at each level by means of unary branching structures (a direct translation of the Lexical Phonology position that all forms go through all lexical levels into structural, rather than temporal, terms). I illustrate this with the Turkish data we have seen in section 2.1. Recall that the case suffixes do not form a flat structure with possessed or plural forms. Rather, they are adjoined to the whole structure. This can be handled by specifying the daughter node of the case construction as LEVEL 2, and the mother as LEVEL 3. The accusative construction is shown in (223):

(223)



With this construction added to the grammar, we can now license the structure for *tebrik^{j}l^{j}erimi* 'my congratulations-acc' that was motivated by Suspended Affixation (section 2.2) and confirmed by prosodic minimality considerations (section 2.1). The structure is shown in (224) in highly abbreviated form:

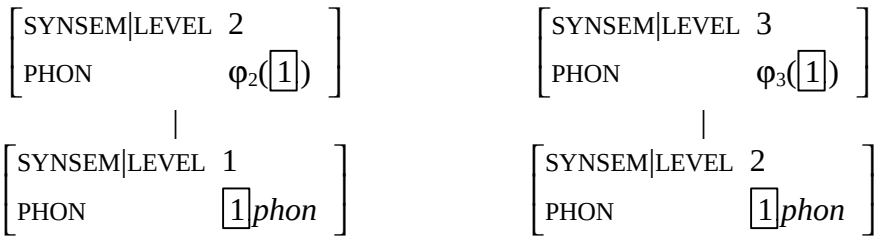
(224)



In order to complete the Strict Layer model, we need a family of nonbranching dominance constructions.[45] Some of these are shown in (225), where φ_2 and φ_3 are the cophonologies of level 2 and 3, respectively:

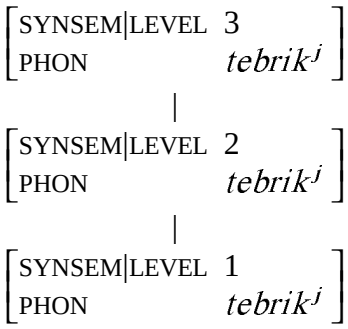
45 This is inconsistent with the convention, adopted earlier (196), against vacuous nonbranching dominance; however, we will shortly see that the earlier convention was in fact correct.

(225)



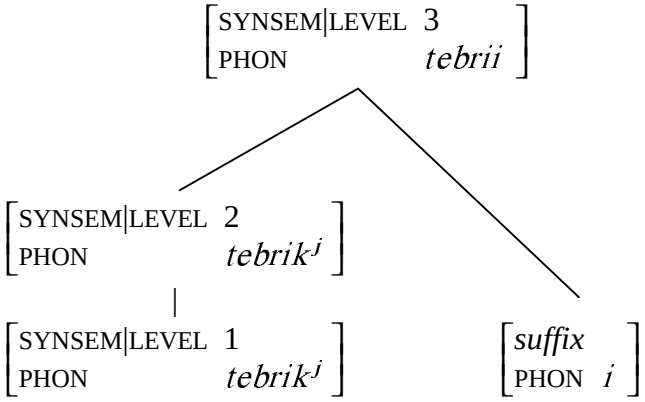
These constructions license the following structure for the nonderived word *tebrik*^{j} 'congratulation' (226):

(226)



Similarly, the form *tebrii* 'congratulation-acc' has the structure in (227). Notice that φ_3(*tebrik*^{j}, *i*) = *tebrii*.

(227)



Once again, the Strict Layer Hypothesis corresponds directly to the Lexical Phonology notion that all forms undergo the phonology of every level of the lexical phonology, even if they do not undergo morphology at every level.

4.7 Challenges to level ordering

Sign-Based Morphology handles level ordering effects by making a number of stipulations. These stipulations are listed in (228):

(228) a) No skipping: a node of level *i* may dominate a node of level *i*-1, but not a node of level *i-j*, where *j*≥2.

b) Ordering: a node of level *i* may not dominate a node of level *i+j*, where *j*≥1.

c) Cophonologies: each level is associated with a specific cophonology. A number of morphological constructions that share the same level specification must also share the same cophonology.

None of the conditions in (228), inherent in the Lexical Phonology view of level ordering (especially Kiparsky 1985), follow from the architecture of Sign-Based Morphology. They are all ad-hoc stipulations that need to be made in order to mirror level ordering theory within Sign-Based Morphology. In this section, I will demonstrate that there are phenomena that challenge level ordering. Each such phenomenon can be handled within Sign-Based Morphology by abandoning one of the conditions in (228). I will conclude that level ordering must not be adopted as a principle of morphological theory. These departures must be handled in Lexical Phonology by stipulating mechanisms to get around level ordering effects. In Sign-Based Morphology, on the other hand, violations of level ordering are expected. They do not require ad-hoc mechanisms.

4.7.1 Level jumping

In this and the following sections, I will discuss a number of departures from Strict Layering. Each departure will require relaxing one of the stipulations in (225). The first departure from the Strict Layer Hypothesis, to be discussed in this section, is the phenomenon of level jumping, where certain constructions cause a number of levels to be unrepresented in the constituent structure.

The data that motivate level jumping come from Nimboran, previously analyzed by Inkelas 1993b. In this section, I will provide just one example of level jumping, the durative suffix. Extensive motivation for the analysis and discussion of other cases of level jumping can be found in Inkelas 1993b.

Inkelas argues that the basic structure of the Nimboran verb is a compound. One member of this compound is the verb root, and the other member, which Inkelas calls the modifier, contains all of the suffixes. Similar proposals have been made for other languages (e.g., Halpern 1993 for Sekani, Myers 1992 for Bantu). We will be concerned with the internal structure of the modifier constituent here. Descriptively, there are eight suffix positions in the Nimboran verb such that each suffix occupies a fixed position. A partial list of morphemes and their positions is given in (229):

(229)

Root	Modifier							
0	1	2	3	4	5	6	7	8
root	pl.sbj	du.sbj pl.obj	m.obj dur part	inc.du.sbj	loc	iter	tense	sbj.pers

Only one morpheme may occur in each of these positions. Morphemes that are in the same column in (229) may never cooccur, even when semantically compatible. Some examples of verbs with suffixes from various positions are shown in (230). These examples illustrate the full range of subject marking available in Nimboran:

(230)	0	1	2	7	8	
	ŋgedúo			d	u	
	draw.sg			fut	1	‘I will draw (here)’
	ŋgedóu		k	d	u	
	draw		du.sbj	fut	1	‘We two will draw (here)’
	ŋgedói	i		d	u	
	draw.pl	pl.sbj		fut	1	‘We (many) will draw (here)’

When there is a plural object suffix present, the possibilities for subject marking are reduced. In particular, the dual subject suffix may not be added to forms that contain the plural object marker. The full range of possible subject marking patterns in the presence of the plural object suffix are shown in (231):

(231)	0	1	2	7	8	
	ŋgedóu		dár	d	u	
	draw		pl.obj	fut	1	‘I will draw them (here)’
	ŋgedói	i	dár	d	u	
	draw.pl	pl.sbj	pl.obj	fut	1	‘We (many/two) will draw (here)’

A similar case of blocking occurs between the durative and the masculine object marker, both of which occupy position 3. Example (232) shows the contrast between the presence and absence of the masculine object marker in verbs that are not durative:

(232)	0	3	6	7	8	
	príb	rár	be	d	u	
	throw	m.obj	loc	fut	1	‘I will throw him from here to above’
	príb		be	d	u	
	throw		loc	fut	1	‘I will throw ∅ from here to above’

As shown in (233), masculine object marking is impossible when the durative marker is present:

(233)	0	3	6	7	8	
	príb	tɑm	be	t	u	
	throw	dur	loc	pres	1	‘I am throwing him/∅ from here to above’

In general, only one suffix may occupy a given position. If more than one suffix competes for a given position, only one may be used, and the resulting form is ambiguous as to the feature normally expressed by the suffix that is excluded due to this position class restriction.

There are, however, more complicated types of position class blocking in Nimboran. The durative marker, already shown to block the position 3 masculine object marker in (233) turns out to block position 2 suffixes (dual subject and plural object) as well. The example in (234) illustrates the contrastive use of the dual subject suffix:

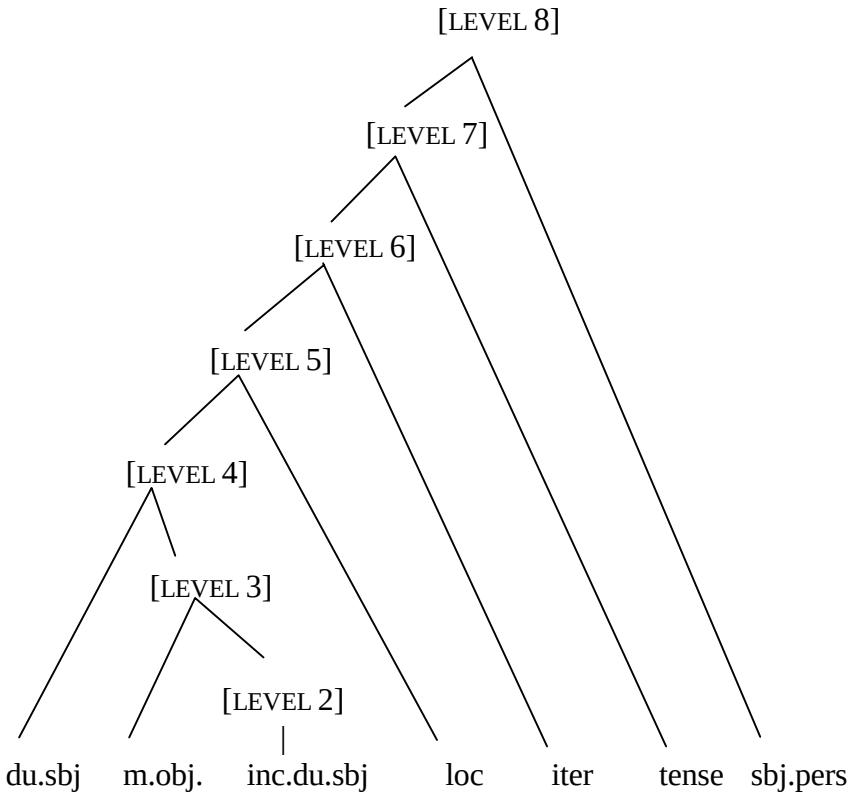
(234)	0	1	2	3	7	8	
	ŋgedóu		ke		t	u	
	draw		du.sbj		pres	1	‘we two draw (here)’
	ŋgedói	i			t	u	
	draw.pl	pl.sbj			pres	1	‘we (many) draw (here)’

When the durative suffix is present, dual subject marking is not possible. The plural subject suffix is then ambiguous between a dual and strict plural reading (235):

(235)	0	1	2	3	7	8	
	ŋgedói	i	tɑ́m		t	u	
	draw.pl	pl.sbj	dur		pres	1	‘we (many/two) are drawing (here)’

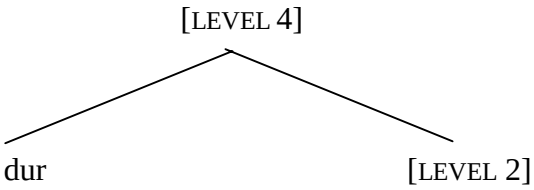
It is as if the durative suffix occupies both position 2 and position 3, as indicated by placing the suffix between the two columns corresponding to these positions in (235). The question is how to formalize this. As background information, I will take for granted the following constituent structure (236) for the modifier that Inkelas proposes. Motivation for this structure comes from complex blocking interactions that we do not need to be concerned with here (see Inkelas 1993b).

(236)



It is clear that the affixation constructions of Nimboran are like those of Turkish in that they take a daughter node of LEVEL *i* and yield a mother node of LEVEL *i*+1. The difference is that there are no flat structures in Nimboran, which results in the restriction that only one affix may occupy each level. Following Inkelas 1993b, we can handle the durative affix, which block level 2 and 3 affixes, quite simply in this model: the mother is LEVEL 4, rather than the expected LEVEL 3 (237):

(237)



This representation allows the durative to combine with the position 4 inclusive dual subject marker, as well as suffixes of position classes 5-8, but does not allow it to combine with suffixes of position classes 2 and 3, just as desired. Notice that this solution forces LEVEL 3 of the morphology to be skipped. This violates Strict Layering, as well as the equivalent Lexical Phonology principle that every form goes through every lexical stratum. Inkelas presents other examples that cause different levels to be skipped in Nimboran.

This completes our survey of level jumping, the first type of departure from Strict Layering.

4.7.2 Level economy

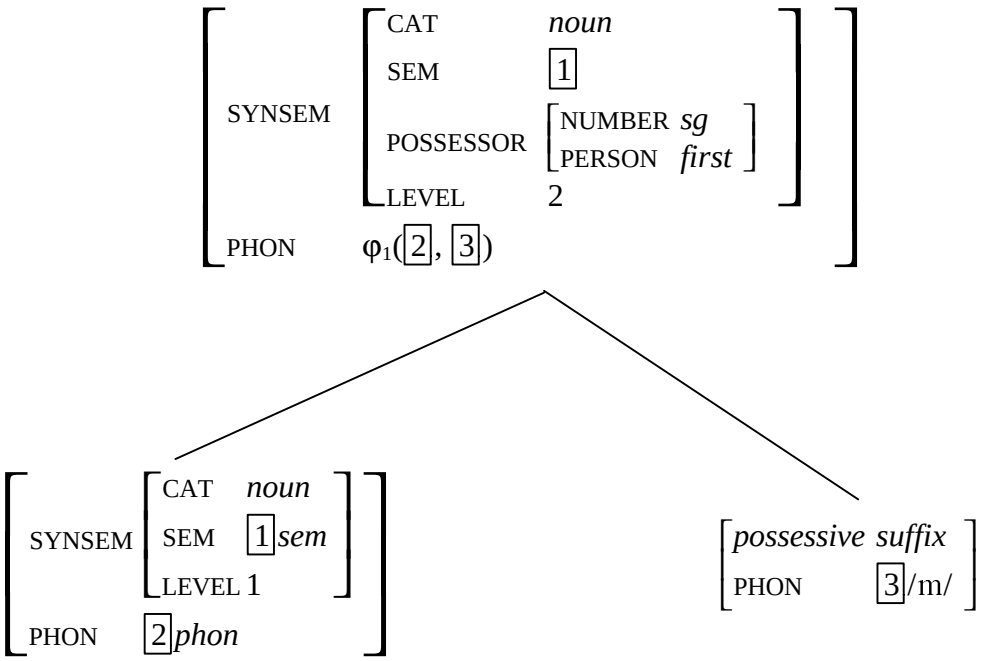
One of the major tenets of Lexical Phonology is that every form, derived or underived, is subject to the phonology of every level, as discussed in section 4.1. In section 4.7.1, I have shown that specific morphological constructions may cause lexical levels to be skipped. In this section, I present data that motivate a more general phenomenon of level skipping. The Turkish data I discuss in this section involves skipping of some lexical strata by forms that do not undergo morphology at those strata (Inkelas and Orgun 1995). Even though Inkelas and Orgun 1995 use level ordering in their analysis of Turkish, the data they present requires a significant departure from the standard model. In this section, I will briefly go over the relevant data and discuss its implications. The phenomenon we are interested in is the disyllabic minimal size condition that we have already seen. For some speakers of Istanbul Turkish, suffixed words are ungrammatical if they contain only one syllable (238):

(238)

*lʲɑː-m	'musical note A-1sg.poss'	solʲ-ym	'musical note G-1sg.poss'
*siː-m	'musical note B-1sg.poss'	siː-si	'musical note B-3sg.poss'
*doː-m	'musical note C-1sg.poss'	doː-muz	'musical note C-1pl.poss'
*re-n	'musical note D-2sg.poss'	reː-niz	'musical note D-2pl.poss'
*miː-n	'musical note E-2sg.poss'	miː-lʲer-i	'musical note E-3pl.poss'
*ɑː-m	'letter A-1sg.poss'	ɑː-mɯz	'letter A-1pl.poss'
*beːm	'letter B-1sg.poss'	beː-si	'letter A-3sg.poss'
*dʒeː-n	'letter C-2sg.poss'	dʒeː-niz	'letter C-2pl.poss'
*deː-n	'letter D-2sg.poss'	deː-lʲer-i	'letter D-3pl.poss'

According to our level ordering schema in section 4.4, the possessive suffixes belong to level 1. That is, they combine with a level 1 daughter, and their mother node is level 2. The cophonology associated with this level is φ_1, which enforces the disyllabic minimal size condition. The first person possessive construction is shown in (239) (the fact that this suffix forms a flat structure with the plural is ignored here. See (195) for a more accurate representation of this construction):

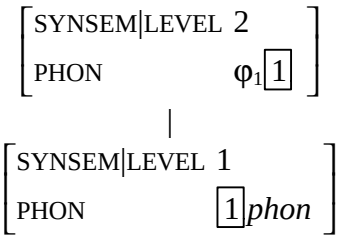
(239)



There are two ways to handle the disyllabic minimal size condition. The first way is to define φ_1 such that it will not have any output for a subminimal input. That is, φ_1(*do:*, *m*) (for example) would be undefined. The other way is to let φ_1 define an output in such cases, but declare that output ungrammatical by imposing the disyllabic minimal size condition on all level 2 constituents. These two ways of dealing with minimality are empirically equivalent, and I will therefore not dwell in the issue here, and will arbitrarily assume that the former option as to be used.

Now, for forms that do not bear the possessive suffix, the Strict Layer Hypothesis requires us to use the following construction (240):

(240)



According to this, the partial structure of the unsuffixed form *k-ʲedi* 'cat' is as follows (241):

(241)

$$\begin{bmatrix} \text{SYNSEM|LEVEL } 2 \\ \text{PHON } \textit{k}^{\textit{j}}\textit{edi} \end{bmatrix}$$
$$|$$
$$\begin{bmatrix} \text{SYNSEM|LEVEL } 1 \\ \text{PHON } \textit{k}^{\textit{j}}\textit{edi} \end{bmatrix}$$

However, there is a serious problem with this approach: it predicts that nonderived monosyllabic forms should be ungrammatical as well, since φ_1 will have no output for such inputs. In fact, there is a large number of nonderived monosyllabic forms in the Turkish lexicon, a small sample of which is given in (242):

(242)

ɑtʃ	'hungry'	ɑʃ	'food'
ɑt	'horse'	ɑk	'white'
ɑs	'hang'	ɑn	'commemorate'
bɑs	'press'	bɑt	'sink'
bɑk	'look'	bɑn	'dunk'
ben	'mole'	bez	'cloth'
bit	'louse'	bitʃ	'mow'
bin	'mount'	bil^{j}	'know'
dil^{j}	'tongue'	dip	'bottom'
gem	'bit'	gɑm	'sorrow'
k^{j}il^{j}	'clay'	kol	'arm'
sol	'left'	sɑp	'stem'
hɑp	'pill'	hɑm	'unripe'
tel^{j}	'wire'	tok	'full'

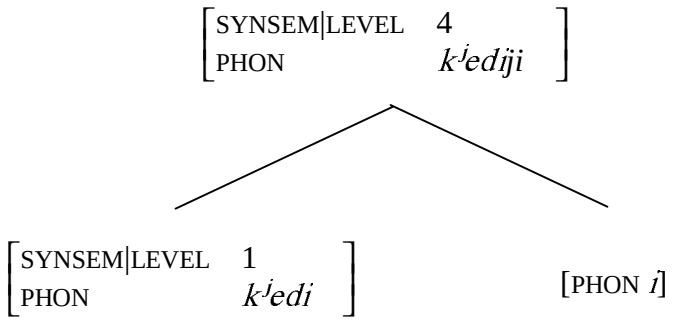
The structure for the form *at* 'horse' is shown in (243):

(243)

$$\begin{bmatrix} \text{SYNSEM|LEVEL } 2 \\ \text{PHON } \varphi_1(\textit{at}) = \top \end{bmatrix}$$
$$|$$
$$\begin{bmatrix} \text{SYNSEM|LEVEL } 1 \\ \text{PHON } \textit{at} \end{bmatrix}$$

The symbol $\top$ represents an inconsistent feature structure, that is, a description that is not satisfied by any entity. In other words, it is a notation for an illegal (ungrammatical) structure. The problem is that, monosyllabic nonderived forms are grammatical in Turkish. Inkelas and Orgun 1995 take this to motivate their proposal, level economy, according to which forms do not undergo phonology at the levels at which they do not undergo morphology. According to this proposal, the structure of the word *k^{j}edi-ji* 'cat-acc', which contains the level 3 accusative suffix would be as follows (244):

(244)



We still say that the accusative is a level 3 suffix, because it will not combine with a daughter of level higher than 3. It will, however, combine with a daughter of any level up to 3, according to level economy.

In this section, I have shown that one of the stipulations that give rise to level ordering effects must be abandoned. In particular, the stipulation that levels may not be skipped causes problem. It must be replaced by a convention that levels are always skipped unless a morphological construction of a particular level applies. Without going into formal details, it might be noticed that this is the expected state of affairs in a construction-based understanding of morphology. Application of phonology is handled by the function φ relating the mother node's phonology to its daughters' phonologies in each construction. When a morphological construction does not apply, there is no way to get the corresponding phonology to apply.

4.7.3 The loop

The first type of challenge we have seen to the Strict Layer Hypothesis, level jumping, had to do with morphological constructions that cause a stratum of the lexicon to be skipped. In those constructions, the level of the mother node was higher than expected. In the second type of challenge, the level of the mother node is lower than that of the daughter node. This is handled by "the loop" in Lexical Phonology, a mechanism that sends forms back to earlier levels of the stratum ordered derivation. Examples of the loop have been proposed by Mohanan 1982, Mohanan 1986, Hargus 1988, Hualde 1988, Szpyra 1989. In this section, I present an example from Turkish that has been discussed in Inkelas and Orgun 1996.

As Hankamer (1986) has observed, Turkish has a fair amount of recursive morphology in which certain suffixes may occur repeatedly in a word. One of the suffixes that causes such recursion is the relativizer -*kʲɨ*. Examples of recursion caused by this suffix are shown in (245):

(245) ev

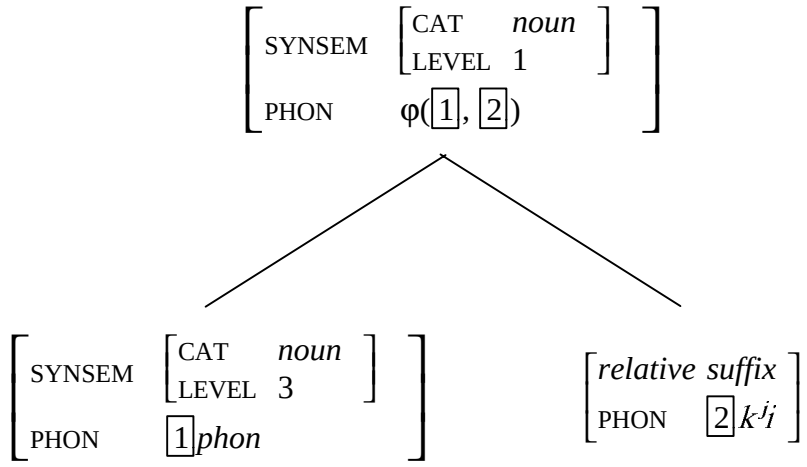
house	‘house’
ev-l^{j}er	
house-pl	‘houses’
ev-l^{j}er-de	
house-pl-loc	‘in the houses’
ev-l^{j}er-de-k^{j}i	
house-pl-loc-rel	‘the one in the houses’
ev-l^{j}er-de-k^{j}i-l^{j}er	
house-pl-loc-rel-pl	‘the ones in the houses’
ev-l^{j}er-de-k^{j}i-l^{j}er-in	
house-pl-loc-rel-pl-gen	‘of the ones in the houses’
ev-l^{j}er-de-k^{j}i-l^{j}er-in-k^{j}i	
house-pl-loc-rel-pl-gen-rel	‘the one that belongs to the ones in the houses’
ev-l^{j}er-de-k^{j}i-l^{j}er-in-k^{j}i-l^{j}er	
house-pl-loc-rel-pl-gen-rel-pl	‘the ones that belongs to the ones in the houses’

di:dem	(name)
di:dem-in	
Didem-gen	‘Didem’s’
di:dem-in-k^{j}i	
Didem-gen-rel	‘the one that is Didem’s’
di:dem-in-k^{j}i-l^{j}er	
Didem-gen-rel-pl	‘the ones that are Didem’s’
di:dem-in-k^{j}i-l^{j}er-in	
Didem-gen-rel-pl-rel	‘of the ones that are Didem’s’

There are no principled limits on how much recursion is allowed. The relativizer -*k^{j}i* attaches to nouns that have case suffixes, which makes it a level 3 suffix according to the schema in section 4.4. That is, the daughter node of the relativization construction is level

3. The question is, what level is the mother node? It has to be compatible with the requirements of the plural suffix, which can follow *-kʲi*. We have already established that the plural suffix attaches to level 1, and not higher, nouns. Thus the level of the mother node of the *-kʲi* construction must be is 1. The construction is shown in (246) (the semantics is omitted because of the complexity of its representation. The meaning of *-kʲi* is roughly equivalent to that of a relative clause):

(246)



This is an example of a looping construction. Like the Nimboran durative, Turkish *-kʲi* forces a violation of the Strict Layer Hypothesis, though in a different way.

Other examples of constructions in Turkish in which the level of the mother is lower than that of the daughter can be found in Inkelas and Orgun 1996. I present some of those examples here, as well as additional ones.

One of the constructions we are interested in forms place names out of any word. It is identified by the unique non-final stress it enforces (Sezer 1981b, Inkelas 1994, Inkelas and Orgun 1996). As illustrated in (247), the final syllable is ignored, and stress falls on the antepenultimate syllable if the penult is light and the antepenult is heavy. In all other cases, stress falls on the penultimate syllable. Following Inkelas and Orgun 1995, I call this stress pattern Sezer stress, after its discoverer.

(247) HŔσ is.tán.bul, an.tál.ja, hakʲ.kʲá:.ri, us.pár.ta
ŔLσ án.ka.ra, mér.dʒi.mekʲ, bólʲ.va.din, mén.te.ʃe
LŔσ e.dír.ne, ha.li.kár.nas, ma.láz.gʲirt, ta.ráb.ja
LĹσ a.dá.na, fa.sé.lʲis, symélʲa

Sezer stress is not just a static regularity in the Turkish lexicon. When existing words are used as place names, they revert from default final stress to the Sezer pattern (248):

(248)	Word		… used as place name
	(Final stress)		(Sezer stress)
	bebékʲ	‘baby’	bébekʲ
	ɑfjón	‘opium’	áfjon
	menteʃé	‘hinge’	ménteʃe

Even more interestingly, suffixed words can be used as place names, and when they do, they assume Sezer stress (249):

(249)		Suffixed word			... used as place name
					(Sezer stress)
a)	HHσ	kɑn.dilʲ.-lʲí	‘oil lamp-with’	→	kɑn.dílʲ.lʲi
		ɑj.rɑn-ʤɯ	‘yogurt drink-agt (=yogurt drink seller)’	→	ɑj.rán.ʤɯ
		kuz.gun-ʤúk	‘raven-Dim.’	→	kuz.gún.ʤuk
		økʲsyz-lʲy	‘orphan-with (=with orphans)’	→	økʲ.syz.lʲy
b)	HLσ	sir.kʲe-ʤí	‘vinegar-agt (=vinegar seller)’	→	sír.kʲe.ʤi
		tor.bɑ-lɯ́	‘bag-with’	→	tór.bɑ.lɯ
		kuʃ-tʃu-lú	‘bird-agt-with (=with bird keeper)’	→	kúʃ.tʃu.lu
		deʃ-ti-ín	‘make hole-rel-2sg (=the one you made a whole in)’	→	déʃ.ti.in
		kʲes.tɑː.ne-lʲíkʲ	‘chestnut-for’	→	kʲes.táː.ne.lʲikʲ

c)	LHσ	ka.vak-lɯ́	‘poplar-with’	→	ka.vák.lɯ
		ku.lak-sɯ́z	‘ear-without’	→	ku.lák.sɯz
		be.en-dík^{j}	‘like-past-1pl (=we liked)’	→	be.én.dik^{j}
		e.min-l^{j}ík^{j}	‘Emin-for’	→	e.mín.l^{j}ik^{j}
d)	LLσ	o.va-dʒɯ́k	‘valley-dim’	→	o.vá.dʒɯk
		bo.ja-dʒɯ́	‘paint-agt (=painter)’	→	bo.já.dʒɯ
		baʃar-án	‘succeed-rel (one who succeeds)’	→	ba.ʃá.ran
		ba.ka.dʒák	‘look-fut (=s/he will look)’	→	ba.ká.dʒak

I now present a summary of Inkelas’s (1994) analysis of the Sezer stress pattern. The main ingredients of the analysis are the following: a single trochaic foot is assigned at the right edge of a Sezer stem. A higher-ranking constraint against a heavy syllable followed by a stressed light syllable forces this foot to be placed one syllable to the left when the penult is light and the antepenult is heavy. The constraint that requires all feet to be trochaic is never violated, and will not be shown in the tableaux. Neither will LEX≈PR, the constraint requiring every stem to have a foot. The constraints that interest us are an alignment constraint that requires the foot to be at the right edge, and the higher-ranking CONTOUR constraint (*$\sigma_{\mu\mu}\acute{\sigma}_{\mu}$):

(250)

LEX≈PR	All Sezer stems must have a foot
TROCHEE	Feet are trochaic
ALIGN(Foot, R, Word, R)	All feet are at the right edge
*$\sigma_{\mu\mu}\acute{\sigma}_{\mu}$	A heavy syllable may not be followed by a stressed light syllable

Ranking: *$\sigma_{\mu\mu}\acute{\sigma}_{\mu}$ » ALIGN(Foot, R, Word, R)

The tableaux in (251) show how this ranking accounts for Sezer stress:

(251)

/kandilʲlʲi/	*σμμσ́μ	ALIGN-R
kándilʲlʲi		*!
☞ kandílʲlʲi		

/kʲestaːnelʲikʲ/	*σμμσ́μ	ALIGN-R
kʲéstaːnelʲikʲ		**!
☞ kʲestáːnelʲikʲ		*
kʲestaːnélʲikʲ	*!	

/ankara/	*σμμσ́μ	ALIGN-R
ankára	*!	
☞ ánkara		*

/baʃaran/	*σμμσ́μ	ALIGN-R
báʃaran		*!
☞ baʃáran		

I will refer to this cophonology as φ_S in constructions. The Sezer place name construction is depicted in (252):

(252)

$$\left[\begin{array}{ll} \textit{Sezer place name} & \\ \text{SYNSEM}|\text{CAT} & \textit{proper noun} \\ \text{PHON} & \varphi_S(\boxed{1}) \end{array}\right]$$

$$|$$

$$\left[\begin{array}{ll} \textit{stem} & \\ \text{SYNSEM} & \textit{synsem} \\ \text{PHON} & \boxed{1} \end{array}\right]$$

At this point, we must determine the level of the daughter and mother nodes of the Sezer place name construction. First, let us consider the level of the daughter. Examples are given in (253), where the level of the mother node of each word that is input to the Sezer place name construction is indicated:

(253)

Level	Word	Gloss	Place name
1	bebékʲ	'baby'	bébekʲ
2	baʃar-án	'succeed-rel'	baʃáran
3	deʃ-ti-ín	'puncture-past-2sg.poss'	déʃtiin

As we see, the Sezer construction can apply to forms that contain a level 3 suffix. Let us then assume that the level of the daughter is specified as 3 (we know that it cannot be lower than 3, or inputs such as (50) would be excluded). Now, let us look at the level of its mother. Sezer place names can themselves be input to considerable suffixation. Most obviously, they, like all other Turkish nouns, are inflected for case and number, and can be possessed. The lowest level that nominal suffixes attach at is level 2, represented by the plural and possessive suffixes. The plural suffix does not attach to place names for semantic reasons. The possessive suffix, however, may be attached; the resulting word is often used to express affection (254):

(254)	Place name	Place name-poss
	istɑ́nbul	istɑ́nbul-um
	bébekʲ	bébe-im

It appears therefore that the Sezer place name construction is another example of a loop, that is, a construction whose mother node is of a lower level than its daughter.

Compounding, another construction discussed by Inkelas and Orgun, also appears to be an example of "the loop". Some examples of compounds with suffixes inside are shown in (255)-(259):

(255) Past tense suffix -DI (level 2)

Compounds containing -DI 'past' suffix

[miːrás+je-di]$_N$	'inheritance+eat-past (= profligate)'
[ser-dén+gʲetʃ-ti]$_N$	'head-abl+pass-past (=suicide squad)'
[sinekʲ+kɑj-dɯ]$_{Adj}$	'fly+slip-past (= close-shaving face)'
[hynkʲɑr+been-dí]$_N$	'sultan+approve-past (= eggplant dish)'
[imɑm+bɑjɯl-dɯ]$_N$	'imam+faint-past (= eggplant dish)'
[vur-du-m+duj-máz]$_{Adj}$	'hit-past-1sg+feel-neg.imprf (= inattentive)'
[kɑp-tɯ+kɑtʃ-tɯ]$_N$	'grab-past+run off-past (= minibus)'

(256) Case endings (level 4)

Compounds containing case suffixes:

[gʲyn-é+bɑk-ɑn]$_N$	'sun-dat+look-rel (= sunflower)'
[jer-é+bɑt-ɑn]$_N$	'earth-dat+sink-rel (= place name)'
[ser-dén+gʲetʃ-ti]$_N$	'suicide squad'
[unút-mɑ+ben-i]$_N$	'forget-neg+I-acc (= forgetmenot)'

(257) Possessive suffixes (level 3)

Compounds containing possessive suffixes

[el^{j}-i̲+ɑtʃɯk]$_{Adj}$	‘hand-3sg.poss+open (= generous)’
[bɑʃ-ɯ+bozúk]$_{Adj}$	‘head-3sg.poss+spoiled (= civilian)’
[sɯrt-ɯ̲ɯ̲+pek^{j}]$_{Adj}$	‘back-3sg.poss+strong (= heavily clothed)’

(258) Professional -CI suffix

Compounds containing -CI suffix

[hɑstá+bɑk-ɯ-d̲ʒ̲ɯ]$_{N}$	‘patient+look-?-prof (= nurse)’

(259) Derivational suffix -lIk

Compounds containing -lIk

[søz+bir-l^{j}i̲ɯ̲-i]$_{N}$	‘word+one-ness-poss (= unity)’

Since compounding can apply to forms of level 4 (nouns with case suffixes), the daughter node of the compounding construction cannot be specified to be of a level lower than 4. Let us assume it is specified as level 4. Now, suffixes may be attached to compounds (240)-(244):

(260) Past tense suffix -DI (level 2)

-DI suffix outside compound

[orhán+bej]-d̲i̲	‘it was Mr. Orhan’
[báʃ+bɑk-ɑn]-d̲ɯ̲ɯ̲	‘head+look-rel-past (=it was the prime minister)’

(261) Case endings (level 4)

Case suffixes outside compounds:

[báʃ+ bɑk-ɑn]-ɯ	‘prime minister-acc
[[vɑní+k^{j}øj]+dʒɑdde-si]-n̲d̲e̲n̲	‘Vaniköy street-abl’
[ɔrtɑ+okul]-ɑ̲	‘middle school-dat’

(262) Possessive suffixes (level 3)

Possessive suffixes outside compounds

[ǿn+søz]-y̲	‘foreword-1sg.poss’
[ortá-okul]-u̲m̲	‘my middle school’

(263) Professional -CI suffix

-CI suffix outside compounds

[kuru+jemiʃ]-t̲ʃ̲i	‘dried fruit-agt (= dried fruit seller)’
[kuru+kɑhve]-d̲ʒ̲i	‘dried coffee seller’

(264) Derivational suffix -lIk

-lIk outside of compounds

[báʃ+ bɑk-ɑn]-l̲ɯk̲	‘prime minister-ness’
[bɑbɑ+ɑnne]-l̲ʲik̲ʲ	‘paternal grandmother-ness’

We can conclude from the data in (240)-(244) that the mother node of the compounding construction is level 1.

The last example of the loop has to do with a second set of tense suffixes. Inkelas and Orgun erroneously assigned all tense suffixes to the same level. However, there are in fact systematic differences between the tense/aspect suffixes I have assigned to level 1 (section 4.4) and the ones that cause my next piece of evidence for looping. Ultimately, I will argue that the two sets of tense suffixes are indeed the same, but a predicative suffix precedes the second set. It is this predicative suffix that causes the loop.

The difference between the two sets of tense suffixes are: i) the first set is stress-neutral (not perturbing default final word stress), while the second set is prestressing, and ii) the second set has an extra [j] following vowel-final stems. These differences are illustrated in (265) and (266), where the first set of tense suffixes attaches to verbal predicates (265) , and the second set to nominal and adjectival predicates (note that, in the last example in (265), the prestressing second person plural suffix causes stress to be placed on the evidential suffix. All tense/aspect suffixes take this allomorph of the agreement suffix, except for the past tense suffix, which takes the other, stress-neutral allomorph. See Lewis 1967, Underhill 1976 for details of the different agreement paradigms and their distribution):

(265) Verbal predicates: Set 1

gʲelʲ-dí	‘come-past’
gʲelʲ-di-níz	‘come-past-2pl’
gʲelʲ-míʃ	‘come-evid’
gʲelʲ-míʃ-iniz	‘come-evid-2pl’
dilʲe-dí	‘wish-past’
dilʲe-di-níz	‘wish-past-2pl’
dilʲe-míʃ	‘wish-evid’
dilʲe-míʃ-iniz	‘wish-evid-2pl’

(266) Nominal/adjectival predicates: Set 2

kʲélʲ-di	‘bald-past’
kʲélʲ-di-niz	‘bald-past-2pl’
kʲélʲ-miʃ	‘bald-evid’
kʲélʲ-miʃ-iniz	‘bald-evid-2pl’
ebé-jdi	‘midwife-past’
ebé-jdi-niz	‘midwife-past-2pl’
ebé-jmiʃ	‘midwife-evid’
ebé-jmiʃ-iniz	‘midwife-evid-2pl’

The two sets of tense/aspect suffixes can co-occur. On verbal predicates, Set 1 tense/aspect suffixes can cooccur with Set 2 tense suffixes, resulting in a perfect form (267):

(267)

gʲelʲ-edʒékʲ$_1$-ti$_2$	‘come-fut-past’
gʲelʲ-íjor$_1$-du$_2$	‘come-prog-past’[46]
gʲelʲ-dí$_1$-jdi$_2$	‘come-past-past’
gʲelʲ-míʃ$_1$-ti$_2$	‘come-evid-past’
gʲelʲ-edʒékʲ$_1$-miʃ$_2$	‘come-fut-evid’
gʲelʲ-íjor$_1$-muʃ$_2$	‘come-prog-evid’
gʲelʲ-míʃ$_1$-miʃ$_2$	‘come-evid-evid’

Nominal predicates do not combine with Set 1 tense/aspect suffixes at all. As a result, they may not be used with two tense suffixes.

46 The progressive suffix has a fixed stress on its first syllable.

Inspection of the data in (267) shows that at least two suffixes appear to be able to occur in either set. The past tense suffix *-di* and the evidential suffix *-miʃ* can occur in Set 1, where they are stress-neutral and attach directly to vowel-final roots, and also in Set 2, where they are prestressing and appear with an extra [j] after vowel-final stems. It turns out that this very same alternation is exhibited by the conditional suffix *-se* (268), as well:

(268) a) Conditional *-se* as group 1 suffix

gʲelʲ-sé	'come-cond'
gʲelʲ-se-níz	'come-cond-2pl'
gʲelʲ-sé-jdi	'come-cond-past'
gʲelʲ-sé-jmiʃ	'come-cond-evid'

b) Conditional *-se* as group 2 suffix

gʲelʲ-edʒékʲ-se	'come-fut-cond'
gʲelʲ-íjor-sɑ	'come-prog-cond'
gʲelʲ-dí-jse	'come-past-cond'
gʲelʲ-míʃ-se	'come-past-evid'

c) Conditional *-se* attaching to nominal/adjectival predicates

kʲélʲ-se	'bald-cond'
ebé-jse	'midwife-cond'

So far, we have the following list of group 1 and 2 suffixes (269):

(269)

Group 1		Group 2	
-di	'past'	-(j)di	'past'
-miʃ	'evid'	-(j)miʃ	'evid'
-se	'cond'	-(j)se	'cond'
-íjor	'prog'		
-edʒekʲ	'fut'		

It cannot be treated as an accidental fact that the semantic and phonological properties of corresponding group 1 and 2 suffixes are very similar, and where there is a phonological difference, this difference is found for all suffixes that belong to both groups. This strongly suggests that the extra [j] is a separate morpheme, a pre-stressing one, which appears as [j] after vowel-final stems but is segmentally null following a consonant. (For additional synchronic and diachronic evidence for this morpheme, see Orgun 1993, Orgun 1994a). This suffix, which I will refer to as *J*, attaches to stems bearing group 1 tense/aspect suffixes. The sister of *J* is therefore level 2, which is the level of the mother of tense/aspect

suffixes. Since tense suffixes may in turn attach to the mother node of this morpheme, we conclude that the mother is level 1, the level required for the daughter of the tense/aspect constructions. Thus, *J* presents another example of a suffix-driven loop. We have seen examples of suffix-driven loops as well as loops caused by nonaffixal constructions (namely, the Sezer place name construction and compounding).

4.7.4 Clustering

In this section, I will address the last remaining stipulation of level ordering theory. In the standard Lexical Phonology model, every morphological construction that belongs to a given level must be associated with the same phonological system. In Sign-Based Morphology, different phonological systems are modeled by different cophonologies, that is, different phonological mappings (φ) in different constructions. Given that, it follows that morphemes that form a flat structure must all share the same phonological system. However, there is no similar expectation for morphemes that form a hierarchical structure. In such a configuration, there is no principled reason why all constructions with a given level value must also subscribe to the same cophonology (φ).

In this section, I demonstrate the arbitrariness of the decision in Lexical Phonology to choose between two ways of handling morpheme specific phonology. One way to handle such phonology is to assign the morpheme in question to a particular lexical stratum, and associate the appropriate phonology with that stratum. Another way is to use minor rules or exception features.

For example, I have shown that some Turkish suffixes trigger intervocalic velar deletion, while others do not. I have used this contrast to motivate two separate lexical strata. Consider another case of morpheme-sensitive phonology. The diminutive suffix *-dʒikʲ ~ -dʒɯk* triggers deletion of a preceding [k] (270a). This is the only case of nonintervocalic velar deletion in Turkish. In (270b), we see that other consonants are not deleted before this suffix:

(270)	a)	bebekʲ	bebedʒikʲ	‘baby’
		kʲøpekʲ	kʲøpedʒikʲ	‘dog’
		eʃekʲ	eʃedʒikʲ	‘donkey’
		inekʲ	inedʒikʲ	‘cow’

b)	kʲedi	kʲedidʒikʲ	‘cat’
	ajɯ	ajɯdʒɯk	‘bear’
	kʲilʲit	kʲilʲittʃikʲ	‘lock’
	kʲitap	kʲitaptʃɯk	‘book’
	paspas	paspastʃɯk	‘mat’
	kʲiraz	kʲirazdʒɯk	‘cherry’
	hamam	hamamdʒɯk	‘bath’
	kazan	kazandʒɯk	‘cauldron’
	biber	biberdʒikʲ	‘pepper’
	kʲevgʲir	kʲevgʲirdʒikʲ	‘colander’
	subaj	subajdʒɯk	‘army officer’

By our methodology that each cophonology defines a level, this suffix would be assigned to a separate level. Note, however, that this is the only suffix that is associated with this preconsonantal k-deleting cophonology. The common practice in Lexical Phonology is not to assign such morphemes to separate levels. Rather, a morphologically conditioned phonological rule would be posited to apply within a level (271):

(271) $k \rightarrow \varnothing$ / ___+{diminutive suffix}

But of course, phenomena that are customarily handled by level ordering could also be handled by morphologically sensitive rules of this sort. For example, instead of positing two lexical strata associated with the intervocalic velar deleting and velar preserving cophonologies, we could have written a rule like the one in (272):

(272) $$k \rightarrow \varnothing \;/\; V\_\_\_+\begin{Bmatrix}\text{possessive suffixes}\\ \text{case suffixes}\\ \text{agreement suffixes}\end{Bmatrix}$$

Given that the minor rule mechanism, used in Lexical Phonology to deal with some morphologically sensitive phonology, has the power to deal with *all* morphologically sensitive phonology, the stipulation that each level has its own defining phonological system is devoid of empirical content. If two affixes belong to the same level but are associated with different phonological systems, all that one needs to do is formulate enough morphologically conditioned phonological rules.

In Sign-Based Morphology, cophonologies are the *only* way in which morphologically sensitive phonology can be handled. In this context, examples such as the Turkish diminutive suffix in (270) are sufficient to demonstrate that the expected (according to level ordering) clustering of levels and cophonologies does not hold. While this might at first seem to be a weakening of the predictive power of the theory with respect to Lexical Phonology, I have argued here that the empirical content of the Lexical Phonology claim is canceled by mechanisms such as minor rules and exception features.

The necessity for these mechanisms is enough to show that the strict clustering claim does not hold to begin with. Sign-Based Morphology is thus in a better position to handle attested phenomena without stipulating ad-hoc mechanisms. The cophonology that a morphological construction subscribes to does not depend on the level of the construction.

4.8 General evaluation of level ordering

Level ordering, and its structural equivalent, the Strict Layer Hypothesis both make the same claim about morphological structure: a node of level *i* may dominate a node of level *i* (as in the Mandarin compounding example), or a node of level *i*-1 (as in most of the Turkish examples). Any other relation between the level of a mother node and a daughter node is a violation of these principles. Example (273) shows the range of possibilities we have found in our survey of Mandarin, Turkish, and Nimboran:

(273)

[level *i*] | [level *i*]	Mandarin compounding
[level *i*] | [level *i*-1]	Turkish suffixation, Nimboran suffixation
[level *i*] | [level *i-j*]	Turkish level economy, Nimboran "level skipping" suffixes
[level *i*] | [level *i+j*]	Turkish "loop" suffixes, compounding, place name formation

Clearly, every type of relationship between daughter and mother nodes that is logically possible is attested. I conclude therefore that level ordering is not defensible, although the concept of "levels" is still useful for linking up morphological constructions with cophonologies.

I take this demonstration that level ordering does not hold to show Sign-Based Morphology to be superior to approaches such as Lexical Phonology. Given the basic structure of Sign-Based Morphology, level ordering is not the expected state of affairs. If we decide to use a diacritic feature, which I have called LEVEL since it captures traditional level ordering effects, there is no reason to expect for there to be universal restrictions on the relationship of this feature in a mother node and a daughter node. The fact that all logically possible configurations of mother and daughter node levels supports this view of levels over the temporal Lexical Phonology one. In that model, any departure from strict ordering calls for an additional mechanism such as level jumping or the loop. Allowing these mechanisms amounts to giving up level ordering. A theory that does not incorporate

level ordering to begin with is superior, because it does not need to postulate additional tools to handle violations of the now nonexistent principle of strict ordering.

I will continue the level feature as a convenient diacritic to keep track of attachment requirements of morphemes. However, strictly speaking, there is no need for this feature once we give up level ordering. Selectional requirements of individual affixes should be sufficient to handle all the combinatorial restrictions. As the focus of this study is the interaction of phonology with morphology, rather than morphology itself, I will not attempt such an analysis here, and will continue the feature LEVEL as a convenient, if not transparently named, diacritic to handle distributions of affixes.