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THE PHONOLOGY OF KARAO, THE PHILIPPINES

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To the people of Karao

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION	1
CHAPTER 2: DESCRIPTION OF PHONETIC SEGMENTS AND THEIR DISTRIBUTION PATTERNS	3
2.1 Description of phonetic segments	3
2.2 Distribution constraints on phonetic segments	5
2.3 Phonemic status of phonetic segments	8
2.4 Phonological stress	8
2.5 Verb morphology	10
CHAPTER 3: THEORETICAL FRAMEWORK	12
CHAPTER 4: SURFACE SYLLABLES AND UNDERLYING BIMORAIC STRUCTURE	18
4.1 Roots and surface syllables	18
4.2 Bimoraic structure	19
4.3 Association of phonetic material with the bimoraic structure	20
4.4 The surface vowel [a]	46
4.5 The epenthetic complex vowel	50
4.6 The glottal stop	62
4.7 Well-formedness conditions	73
4.8 Alternations involving [-labial] and [+labial] segments	81
4.9 Summary of underlying segments and association rules	83
CHAPTER 5: MORPHOLOGICAL SURFACE ALTERNATIONS	90
5.1 Root types	90
5.2 Alternations occurring with verb affixation	91
5.3 Summary of morphological surface alternations	100
CHAPTER 6: AN AUTOSEGMENTAL ANALYSIS	101
6.1 Alternations affecting all root types	101
6.2 Alternations affecting CVCVC and C _i C _i C _i VC root types	129
6.3 Alternations affecting glottal-initial root types	144
6.4 Summary of alternations affecting root types	155
6.5 Prefixes and suffixes that trigger alternations	162
CHAPTER 7: MORPHOLOGY OF INFIXATION	180
7.1 Infixation in roots	180
7.2 Infixation in prefixes and vowel decomposition	197
7.3 Summary of perfective infixation and vowel decomposition	209
CHAPTER 8: REDUPLICATION	213
8.1 Reduplication signalling continuous, intensive, or repeated action	213
8.2 Reduplication signalling comparison between two items	224
APPENDIX	228
REFERENCES	259



CHAPTER 1

INTRODUCTION

This study is an analysis of the moraic structure and phonological alternations of Karao.¹ I attempt to show that the mora is the primary organising unit of phonological segments at the word level, and that in the underlying representation there is a single structure consisting of two moras, resulting in a drive towards a preferred closed (CVC) syllable in the surface representation. I argue that the function of phonological alternations is to provide phonetic material for underlying moras thereby allowing the underlying structure to surface. I also attempt to account for phonological alternations characteristic of the language.

The claim that Karao has a single underlying structure consisting of two moras, which results in a drive towards a closed surface syllable, may be considered controversial since a proposed universal of phonology is that all languages have (C)V syllables. In fact, Karao does have such syllables in surface representations. However, I argue that CV surface syllables are actually bimoraic units that have failed to acquire sufficient phonetic material to allow them to surface as closed syllables; they are, in this sense, defective units.

Karao, it seems, does not lack the unusual. In order to account for various phonological alternations, I make several additional claims which may also be regarded as controversial. Firstly, I propose that the surface vowel [ɨ] is a complex vowel that is epenthetic in all occurrences. That is, [ɨ] is never associated with a position in the underlying unit, but is always supplied automatically for a nucleus that lacks phonetic material in the underlying unit. This claim may be considered unusual in that languages do not usually have segments that are epenthetic in all occurrences.

Secondly, I argue that [ɨ] is a complex segment that can undergo decomposition. I propose that [ɨ] is composed of two underlying segments: the feature [high] (or surface [i]) and a fully underspecified segment (or surface [a]). In certain environments, [ɨ] appears to undergo decomposition in which the feature [high] and a fully underspecified segment separate. I argue that the decomposition hypothesis accounts for the fact that three surface vowels appear to insert epenthetically: [ɨ], [a] and [i]. I provide evidence that these surface forms can all be derived from a single underlying structure. I also argue that the decomposition hypothesis accounts for surface alternations between [ɨ] and the vowels [i] and [a] in certain prefixes and one root type.

Thirdly, I propose that Karao has a single fully underspecified segment that surfaces as [a] when it is associated with a vowel position, and as [ʔ] when it is associated with a consonant position. This hypothesis accounts for certain asymmetries in the behaviour of surface [a] and [ʔ].

¹ I would like to thank Austin Hale for his comments and suggestions on an earlier version of this work, and Scott DeLancey for his comments and suggestions on this version. I would also like to thank all the people of Karao who graciously helped me gather and check the data upon which this study is based.

In order to distinguish between underlying segments and their surface forms in this study, segments associated with the underlying structure occur in bold type, as in **m**, and surface forms are placed in square brackets, as in [m]. Orthographic representations are italicised, as in *biybiy* (for [biybiy]).

Data supporting this study is taken mainly from forms involving verb affixation and reduplication and represents the major phonological operations of Karao. The analysis is presented within an autosegmental framework following Goldsmith (1990) and uses a version of moraic theory (Hyman 1985) proposed by Hayes (1989).

Karao belongs to the Southern Cordilleran subgroup of Northern Philippine (Western Austronesian) languages.² It is spoken by approximately 1,300 people who live in villages in the Karao and Ekip 'barangays' (political subdivisions) in the municipality of Bokod in eastern Benguet. Bokod is about fifty-six kilometres east of Baguio, in central Luzon in the Philippines. Karao is most closely related to Ibaloi and Pangasinan.

² This study is based on data gathered between March 1988 and March 1990, while the author was living in the village of Karao, under the auspices of the Summer Institute of Linguistics. The data include approximately 3,000 roots and represent Karao as spoken by speakers both under and over the age of forty, since there are variations in the way these two age-groups pronounce Karao. Elicited data have been compared with data noted in casual oral conversation, and with data noted in oral texts that have been tape-recorded and transcribed.

Karao is a complex language situation. The villages of Karao are nestled in the midst of an area containing 90,000 to 100,000 Ibaloi speakers. (Ibaloi is also classified as a Southern Cordilleran language.) Karao folk history claims that the Karao people originally came from a village called Palingaw in Bontoc, a Central Cordilleran area. They left Bontoc, travelling through the lowlands of Nueva Vizcaya, and eventually settled in their current location in Benguet.

Whatever the origin of the Karao people and their language, their language today is about eighty-five per cent cognate with Ibaloi. Most Karao people are at least functionally, and in some cases fluently, bilingual in Ibaloi. After the sixth grade, students attend school outside Karao. Most continue their education in Bokod or Baguio, both Ibaloi-speaking areas. Marriage between Karaos and Ibalois is not uncommon.

With such influence from Ibaloi, it is notable that Karao has not been completely replaced by Ibaloi, despite the fact that it seems to be becoming more and more like Ibaloi. It is interesting to note which language features have been most subject to change. For example, lexical items are readily replaced with Ibaloi equivalents. In fact one of the persistent concerns for a linguist studying Karao is the problem of sorting out which Karao words common to Ibaloi are borrowed terms, and which are simply terms indigenous to both languages. Karao speakers themselves are not always sure of the origin of certain words. Other features, such as nominal markers and pronunciation features peculiar to Karao, have not been replaced.

Another significant factor in the analysis of Karao is the fact that there is a fair amount of variation in the surface forms of Karao words. As this study shows, there can be as many as three surface variations for a given form, all of which are perfectly acceptable to Karao speakers.

CHAPTER 2

DESCRIPTION OF PHONETIC SEGMENTS AND THEIR DISTRIBUTION PATTERNS

In this chapter, I briefly describe the articulatory features of Karao segments and the distribution patterns of those segments. There are twenty-two consonants and four vowels in Karao, as shown in (1).

(1)		PHONETIC SEGMENTS						
		CONSONANTS						
		bilabial	inter- dental	alveolar	alveo- palatal	velar	back velar	glottal
voiceless stops		<i>p</i>		<i>t</i>		<i>k</i>	<i>ḱ</i>	ʔ
voiced stops		<i>b</i>		<i>d</i>		<i>g</i>		
labial stops						<i>g^w</i>		
fricatives		<i>ɸ</i>	<i>θ</i>	<i>s</i>			<i>x</i>	
voiceless affricates					<i>č</i>			
voiced affricates					<i>ǰ</i>			
nasals		<i>m</i>		<i>n</i>		<i>ŋ</i>		
lateral				<i>l</i>				
flap				<i>ɾ</i>				
semi-vowels					<i>y</i>	<i>w</i>		
		VOWELS						
		front		central	back			
non-low		<i>i</i>		<i>ɨ</i>	<i>o</i>			
low				<i>a</i>				

2.1 DESCRIPTION OF PHONETIC SEGMENTS

The following is a description of the articulatory features of Karao consonants.

- /p/ is a voiceless bilabial stop which has three allophones: [p], [P] and [p^h].
- /b/ is a voiced bilabial stop which has three allophones: [b], [b^h] and [b^h].
- /t/ is a voiceless alveolar stop which is pronounced in a dental position further forward than the usual voiceless alveolar stop; it has three allophones: [t], [t^l] and [t^h].
- /d/ is a voiced alveolar stop which has three allophones: [d], [d^h] and [d^h].
- /k/ is a voiceless velar stop which has two allophones: [k] and [k^h].

/g/ is a voiced velar stop which has three allophones: [g], [g̚] and [gʰ].

/gʷ/ is a voiced labialised velar stop.

/k/ is a voiceless back velar stop which is pronounced further back in the mouth than the usual voiceless velar stop; it has three allophones: [k̠], [k̟] and [kʰ].

/ʔ/ is a glottal stop.

The stops /p, b, t, d, g/ and /k/ each have an unaspirated allophone, an unreleased allophone, and a slightly aspirated allophone. The unaspirated allophone occurs only in a syllable onset. The unreleased allophone occurs in a syllable coda, and in a word-final position following /i/. The aspirated allophone occurs only in a word-final position where it varies freely with the unreleased allophone. The stop /k/ has only an unaspirated and an unreleased allophone: the unaspirated allophone occurs only in a syllable onset; the unreleased allophone occurs in a syllable coda when it geminates following /i/.

/p/ [p] is a voiceless bilabial fricative.

/θ/ [θ] is a voiceless interdental fricative.

/s/ [s] is a voiceless alveolar fricative.

/x/ [x] is a voiceless back velar fricative; like /k/, it is pronounced further back in the mouth than the usual voiceless velar fricative.

/č/ [č] is a voiceless alveo-palatal affricate.

/j/ [j] is a voiced alveo-palatal affricate.

/m/ [m] is a bilabial nasal.

/n/ [n] is an alveolar nasal.

/ŋ/ [ŋ] is a velar nasal.

/l/ [l] is an alveolar lateral.

/ɾ/ [ɾ] is an alveolar flap.

/w/ [w] is a rounded velar semi-vowel.

/y/ [y] is an unrounded alveo-palatal semi-vowel.

The following is a description of the articulatory features of Karao vowels.

/i/ is a non-low front unrounded vowel which has three allophones: [e], [ɛ] and [i].
[e] is a mid front unrounded vowel which occurs in an open syllable contiguous to /k/ or /x/.

[saʔk̠e]	/saʔk̠i/	one
[sexo]	/sixo/	elbow

[ɛ] is a lower-mid front unrounded vowel which occurs in a closed syllable contiguous to /k/ or /x/.

[tuPdek̠ʰ]	/topdik̠/	second harrowing
[saxet]	/saxit/	sickness

[i] is a high front unrounded vowel which occurs elsewhere.

[ʔinum]	/ʔinom/	drink
---------	---------	-------

Although this is the most common distribution of the allophones of /i/, the allophones can vary freely in these positions; however, free variation occurs less often when /i/ is contiguous to /k/. For example, in an open syllable, the allophone [e] usually occurs contiguous to /k/; however, the allophones [e], [ɛ] Also, in a closed syllable, while the allophone [ɛ] allophones [ɛ]

/i/ is a non-low central unrounded vowel which has two allophones: [ʌ] and [i].
[ʌ] is a mid central unrounded vowel.
[i] is a high central unrounded vowel.

The allophones [ʌ] and [i] vary freely; however, [ʌ] typically occurs in fast speech whereas [i] occurs more often in slower speech.

/o/ is a non-low back rounded vowel which has two allophones: [u] and [o].
[u] is a high back rounded vowel.
[o] is a mid back rounded vowel.

The general distribution pattern is that [u] usually occurs in word-initial syllables and [o] in word-final syllables; however, the allophones can vary freely. Also, the actual sound of /o/ can range anywhere between [u] and [o].

[čuntog ^h]	/čontog/	mountain
[bulow]	/bolow/	to bark

Following velar stops and fricatives, the allophones of /o/ follow a distribution pattern which is of interest because of its similarity to the pattern followed by the allophones of /i/. The allophone [u] normally occurs following /k/ or /g/; however, [u] varies freely with [o] when /o/ follows /k/ or /g/ in a closed syllable in a word-final position.

[kulid]	/kolid/	scab
[čakus] ~ [čakos]	/čakos/	immediately

The allophone [o] normally occurs following /k/ or /x/; however, [o] varies freely with [u] when /o/ follows /k/ or /x/ in a closed syllable in a word-final position.

[koxo]	/koxo/	fingernail
[ʔoxow] ~ [ʔuxuw]	/ʔoxow/	to cease to rain

/a/ is a low central unrounded vowel which has two allophones: [ʌ] and [a].
[ʌ] is a mid central unrounded vowel which occurs in two limited sets of words. In one set, it occurs in closed syllables when followed by a stop; in the other set, it occurs in a word-final position.

[ʔʌpʔʌp ^h]	/ʔapʔap/	to distribute
[niyanʌ]	/niyana/	why

[a] is a low central unrounded vowel and occurs elsewhere.
[ʔaʔʔa] /ʔaʔʔa/ child

2.2 DISTRIBUTION CONSTRAINTS ON PHONETIC SEGMENTS

Segments in Karao are affected by three systems. The first is a consonant distribution system based upon syllable position; the second is a consonant alternation system based

upon the feature of sonority; and the third is a system of co-occurrence restrictions on sequences of consonants and vowels.

2.2.1 CONSONANT DISTRIBUTION BASED ON SYLLABLE POSITION

The distribution of consonants according to syllable position is given in (2).

(2)	Syllable or word initial	Word intervocalic	Syllable or word final
<i>p</i>	<i>p</i>	<i>p</i>	<i>p</i>
<i>ɸ</i>	---	<i>ɸ</i>	---
<i>t</i>	<i>t</i>	<i>t</i>	<i>t</i>
<i>θ</i>	---	<i>θ</i>	---
<i>k</i>	<i>k</i>	<i>k</i>	<i>k</i>
<i>x</i>	---	<i>x</i>	---
<i>g</i>	<i>g</i>	<i>g</i>	---
<i>g^w</i>	<i>g^w</i>	<i>g^w</i>	<i>g</i>
<i>w</i>	---	<i>w</i>	<i>w</i>
<i>ʃ</i>	<i>ʃ</i>	<i>ʃ</i>	---
<i>y</i>	---	<i>y</i>	<i>y</i>
<i>d</i>	<i>d</i>	<i>d</i>	---
<i>l</i>	---	<i>l</i>	<i>l</i>
<i>č</i>	<i>č</i>	<i>č</i>	---
<i>ř</i>	---	<i>ř</i>	---
<i>d</i>	---	---	<i>d</i>

The distribution patterns in (2) are somewhat misleading. While it is true that all consonants can occur in the intervocalic position, in actual fact the less sonorant member of each set rarely does so. For example, for the set /p/ and /ɸ/, /p/ rarely occurs intervocalically while /ɸ/ commonly does; for the set /ʃ/ and /y/, /ʃ/ rarely occurs intervocalically while /y/ frequently does. The consonants /b, m, n, ŋ/ and /s/ have no distribution constraints and can occur syllable and word initially, intervocalically, and syllable and word finally. The glottal stop can occur in all of these positions except word finally.

2.2.2 CONSONANT ALTERNATION BASED ON THE FEATURE OF SONORITY

The distribution patterns in (2) show that all consonants can occur in an intervocalic position; however, in an unaffixed root, it is usually the most sonorant member of a set that does so. With certain types of affixation, consonant alternation takes place in intervocalic positions. The general alternation pattern is that a more sonorant consonant is replaced by a less sonorant consonant. Those consonants that alternate with each other under such conditions are identical to those that are in complementary distribution with each other in (2). For example, the bilabials /p/ and /ɸ/ form a distribution set with /ɸ/ occurring intervocalically more often than /p/ in an unaffixed root. With appropriate affixation, however, the more sonorant fricative /ɸ/ is replaced by the less sonorant stop /p/ in an intervocalic position. The consonants /k/ and /g/ interact in the same way: /k/ and /g/ form a distribution set with /g/ occurring intervocalically more often than /k/ in an unaffixed root. With certain affixation, the

more sonorant voiced stop /g/ is replaced by the less sonorant voiceless stop /k/. Not all consonants, however, alternate in an intervocalic position. In general, those consonants that do not participate in complementary distribution also do not alternate intervocalically; however, in a limited set of words, the consonant pairs /g^w/ and /b/, and /w/ and /m/ also alternate.

The chart in (3) gives the sets of consonants that commonly alternate in an intervocalic position.

(3)	Set 1	Set 2
Alternating consonants	<i>p</i>	<i>ɸ</i>
	<i>t</i>	<i>θ</i>
	<i>k</i>	<i>g</i>
	<i>k̤</i>	<i>x</i>
	<i>d</i>	<i>l</i>
	<i>č</i>	<i>ř</i>
	<i>g^w</i>	<i>w</i>
	<i>ʃ</i>	<i>y</i>
Non-alternating consonants	<i>b</i>	----
	<i>ʔ</i>	----
	<i>m</i>	----
	<i>n</i>	----
	<i>ŋ</i>	----
	<i>s</i>	----

2.2.3 CO-OCCURRENCE RESTRICTIONS ON SEQUENCES OF CONSONANTS AND VOWELS

There are two categories of consonant-vowel co-occurrence restrictions: those that apply in an intervocalic position; and those that apply in other positions. Let us consider the intervocalic position first.

Although all consonants may occur in an intervocalic position, not all consonants may occur in that position following all vowels. The consonants affected by this restriction fall into sets similar to the alternation sets above. That is, nearly all the set 1 consonants in (3) may occur in an intervocalic position following any vowel. Specifically, all consonants can follow /a/; however, /g^w/ cannot follow /o/, /ʃ/ cannot follow /i/, and /ʔ/ cannot follow /ɨ/. All set 2 consonants may occur following any vowel except /ɨ/. The notable features of this pattern are that, in an intervocalic position, all consonants can follow /a/; and set 1 consonants (except /ʔ/) can follow /ɨ/, but set 2 consonants cannot.

The co-occurrence restrictions on the consonant-vowel sequences /o/ and /g^w/, /i/ and /ʃ/, and /ɨ/ and /ʔ/ apply to positions other than the intervocalic position. Typically, the vowel /o/ does not occur adjacent to /g^w/, nor /i/ to /ʃ/, in any position in a word. Also, the sequences /ɨy/, /ɨw/, and /ɨʔ/ never occur in any position in a word. In the case of /ɨʔ/, however, the reverse sequence /ʔɨ/ is permitted.

Later on I argue that only set 1 consonants occur in the underlying representations of words. I propose that set 2 consonants are surface variations of set 1 consonants which are determined by syllable position and manner of association in the underlying representation. I also discuss the one exception to this pattern which involves the surface consonants /g^w/ and

/w/, and /j/ and /y/ which may be surface variations of the underlying non-low vowels /o/ and /i/, as well as surface variations of the underlying set 1 consonants /g^w/ and /j/. I will provide an explanation for the constraint prohibiting sequences of /j/ and /i/, and /g^w/ and /o/, as well as the sequences /ɪy/, /ɪw/, and /ɪʔ/.

2.3 PHONEMIC STATUS OF PHONETIC SEGMENTS

The phonemic status of the phonetic segments listed in the chart in (1) is debatable. The distribution patterns of consonants in (2) suggest that the segments might better be analysed as sets of allophones that are in complementary distribution with each other, especially since contrast can be established for these phonetically similar segments only in an intervocalic position (and for some pairs, only in that position following /a/). An allophone hypothesis is further supported by the fact that for each set the less sonorant segment rarely occurs intervocalically, suggesting that its occurrence in that position is exceptional rather than normal. This hypothesis would give us a pattern in which the less sonorant segment of a set would occur in the stronger syllable and word positions, while the more sonorant segment would occur in the weaker positions. Such a hypothesis would also agree with a claim which I present later in which I state that only the least sonorant segment of a set occurs in the underlying representation. What conflicts with this hypothesis is Karao speakers' reactions to different proposed orthographies for the language.

Although a phonemic analysis suggests that the sets of segments in (2) are best analysed as sets of allophones, these segments appear to have phonemic reality for Karao speakers. This conclusion is based on tests of various orthographies for Karao which reveal that Karao speakers prefer that each segment in (2) be represented by a separate written symbol. For example, for the set /p/ and /p̄/, speakers prefer that /p/ be written as *p* and /p̄/ as *f*; they object to having only one symbol, such as *p*, to represent both segments. One might argue that this orthographic preference is due to Karao speakers' familiarity with English orthography, since many speakers are at least functional if not fluent speakers and readers of English, and English is taught in the public school system. Evidence that the orthographic preference is not simply a consequence of exposure to English can be seen in the way Karao speakers prefer to write the allophones of /i/.

The vowel /i/ has the allophones [e], [ɛ] and [i]. Contrary to what we find for the sets of consonants in (2), Karao speakers insist that all the allophones of /i/ be written with one symbol, namely *i*. If preference in orthography were simply a consequence of influence from English, we might expect Karao speakers to want [i] written as *i* and [e] and [ɛ] as *e*, but they don't. This suggests that the preference for using separate symbols for certain sounds reflects Karao speakers' intuitions about the phonemic status of those segments: while sets of phonetically similar segments, such as the allophones of /i/, clearly do not have phonemic status for Karao speakers, the sets of consonants in (2) apparently do, regardless of what we might expect from a phonemic analysis. Although the issue is not resolved, for these reasons, I have chosen to represent the twenty-two consonants shown in (1) as phonemes.

2.4 PHONOLOGICAL STRESS

One syllable in a phonological word is acoustically more prominent than all other syllables in the word, signalling that it carries primary stress. This syllable is pronounced with greater volume, a slight rise in pitch, and a lengthening of the vowel in the syllable nucleus.

Phonological stress in Karao has not been fully analysed; however, there are two important facts to be noted about the stress system. Firstly, a phonological word is not necessarily a grammatical word. Karao has a number of grammatical clitics that occur with high frequency in conversation and written text; these clitics (which include preclitics and enclitics) attach to free-standing morphemes, such as verbs and nouns, to form phonological words.

Secondly, there is evidence that stress is not contrastive, but predictable in Karao, although the exact rules for assigning stress appear to be complex. There are a number of empirical facts that point to this hypothesis:

(a) There are no minimal pairs or near minimal pairs of words that contrast in stress only.

(b) When a freestanding morpheme is pronounced in isolation, phonological stress can occur freely on either the ultimate or penultimate syllable; for example, the freestanding noun [ɲaʁan] 'name' may be pronounced [ˈɲaʁan] or [ɲaʁˈan]. If stress occurs on the penultimate syllable of a word, it can be maintained in that position by shifting one syllable to the right when one-syllable suffixes and enclitics are added to the word. Examples of stress shift are given below.

(4)	[ˈɲaʁan]	name
	[ɲaʁˈanto]	his/her name
	[ˈʔiʔkan]	to give
	[ʔiʔkanan]	to give something to someone
	[ˈʔiʔkaˈnanto]	s/he will give something to someone

(Phonological words composed of four or more syllables also have secondary stress (ˈ). Secondary stress usually occurs on the second syllable to the left of the one carrying primary stress (ˈ), as seen in (4).)

(c) Further evidence that stress is not contrastive is that phonological stress in a given freestanding morpheme will alternate between the ultimate or penultimate syllable depending on the presence and identity of grammatical clitics with which it occurs in a phonological word; for example, the verb [mančiddan] (*man-+čalan*) 'to follow a route' can have penultimate stress, as in [mančiddan], or ultimate stress, as in [mančidˈdan], depending on the grammatical clitics with which it occurs.

A complete analysis of stress in Karao has yet to be undertaken; however, what is of importance for this study is that the phonological alternations described here occur in a syllable whether or not the syllable is stressed, as indicated by the example in which *man-+čalan* may become [mančiddan] or [mančidˈdan]. In this example, alternations affecting [a] and [l] in *čalan* can take place whether or not the first syllable of the root is stressed.

2.5 VERB MORPHOLOGY

Karao has a Philippine-type voice system in which one argument of the verb is morphologically marked as the absolutive argument. Verb affixes indicate the semantic case role of the absolutive argument. Examples are given in (5).³

- (5) a. *ʔoŋkowan ʔi nowaŋ ča kolos.*
ʔon-kowan ʔi nowaŋ ča kolos
 PAT-go ABS water.buffalo OBL river
 The water buffalo will go/goes to the river.
- b. *Kakanin*
CV-kan-in na nowaŋ ʔi doʔbit
 eat-PAT ERG water.buffalo ABS weed
 The water buffalo will eat/eats the weeds.

In (5a), *kowan* ‘go’ is an intransitive verb; *nowaŋ* ‘water buffalo’ is marked by *ʔi* as the absolutive argument; the verb prefix *ʔon-* indicates that the absolutive argument is a patient. (The marker *ča* signals that the noun phrase is an oblique argument.) In (5b), *kan* ‘eat’ is a transitive verb; *doʔbit* ‘weed’ is marked by *ʔi* as the absolutive argument; the verb suffix *-in* indicates that the absolutive argument is a patient; *nowaŋ*, the agent, is marked by *na* as the ergative argument.

Transitive clauses may undergo passivisation; passivisation is signalled by passive morphology on the verb, the absence of an agent, and the presence of a non-agent as the absolutive argument. Taking the transitive clause in (5b), we can form the passive clause in (6).

- (6) *Mikan ʔi doʔbit.*
mi-kan ʔi doʔbit
 PASS/PAT-eat ABS weed
 The weeds will be eaten.

In (6), the prefix *mi-* indicates that the clause is a passive construction and that a patient is the absolutive argument; the agent of the action is absent.

Verb affixes also indicate aspect, the basic contrast being perfective and imperfective. That is, the affixes indicate a contrast between action that has been completed and action that has not been initiated or, having been initiated, has not yet been completed, as shown in examples (7) and (8).

- (7) a. *ʔoŋkowan ʔi nowaŋ ča kolos.*
ʔon-kowan ʔi nowaŋ ča kolos
 IMPF-go ABS water.buffalo OBL river
 The water buffalo will go/goes to the river.
- b. *Kimowan ʔi nowaŋ ča kolos.*
kowan-im- ʔi nowaŋ ča kolos
 go-PERF ABS water.buffalo OBL river
 The water buffalo went to the river.

³ Abbreviations used in (5) - (9) are as follows: A – actor/agent, ABS – absolutive, ERG – ergative, IMPF – imperfective, OBL – oblique, PASS – passive, PAT – patient, PERF – perfective, PROG – progressive.

In (7a), the prefix *ʔon-* signals the imperfective aspect; in (7b), the infix *-im-* signals the perfective.

- (8) a. *Kakanin na nowaŋ ʔi doʔbit.*
 CV-*kan-in* na nowaŋ ʔi doʔbit
 eat-IMPF ERG water.buffalo ABS weed
 The water buffalo will eat/eats the weeds.
- b. *Kiyakan na nowaŋ ʔi doʔbit.*
 CV-*kan-iy-* na nowaŋ ʔi doʔbit
 eat-PERF ERG water.buffalo ABS weed
 The water buffalo ate the weeds.

In (8a), the suffix *-in* indicates the imperfective aspect; in (8b), the infix *-iy-* indicates the perfective.

The basic verb affixes in Karao are listed in (9). As typical of verb morphology in Philippine languages, verb affixes form sets that may be identified according to the semantic case role that they signal. The semantic roles in (9) are cover terms for a range of roles that are signalled by a given affix; for example, ‘agent/actor’ includes experiencers as well as agents; agents may or may not be volitional; ‘location’ includes recipients, that is, human locations, as well as geographical sites; ‘associate’ includes instruments, conveyed items, and concomitant participants. Some affixes also have allomorphs which are not included here, but which will be discussed in the study.

(9) BASIC VERB AFFIXES IN KARAO

	Active		Passive
	patient	location	location
IMPF	<i>ʔon-</i>	<i>-an</i>	<i>mɨ--an</i>
PERF	<i>-im-</i>	<i>-iy--an</i>	<i>ʔɨ--an</i>
PROG	<i>man-+CV(C)</i>	<i>-i</i>	<i>ʔɨmanɣkɨ--i</i>
	agent/actor		
IMPF	<i>man-</i>		
PERF	<i>ʔiyan-</i>		
PROG	<i>man-+CV(C)</i>		
	agent/actor	patient	patient
IMPF	<i>mɨN-</i>	<i>-ɨn</i>	<i>mɨ-</i>
PERF	<i>ʔɨN-</i>	<i>-iy-</i>	<i>ʔɨ-</i>
PROG	<i>man-+CV(C)</i>	<i>-a</i>	<i>ʔɨmanɣkɨ--a</i>
	actor/agent	associate	associate
IMPF	<i>mɨŋi-</i>	<i>ʔi-</i>	<i>may-</i>
PERF	<i>ʔɨŋi-</i>	<i>ʔin-</i>	<i>ʔiyay-</i>
PROG	<i>man-+CV(C)</i>	<i>ʔi-</i>	<i>ʔɨmanɣkaʔi-</i>
	actor/agent	location	location
IMPF	<i>mɨŋi-</i>	<i>ʔi--an</i>	<i>may--an</i>
PERF	<i>ʔɨŋi-</i>	<i>ʔin--an</i>	<i>ʔiyay--an</i>
PROG	<i>man-+CV(C)</i>	<i>ʔi--i</i>	<i>ʔɨmanɣkaʔi--i</i>

CHAPTER 3

THEORETICAL FRAMEWORK

This study employs insights from various theories within non-linear phonology, specifically autosegmental phonology, moraic theory, feature geometry, particle phonology, and underspecification theory. I will briefly describe aspects of the theories which are significant for this study, beginning with autosegmental phonology as presented by Goldsmith (1990).

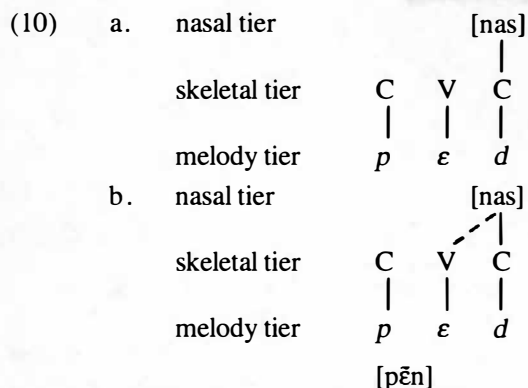
Autosegmental phonology differs from earlier phonological theories in that it posits a phonological representation in which a gestural (or acoustic) feature of a phonetic unit can function independently from other features associated with that unit. These autonomous features are placed on separate tiers, or planes, and may associate with autonomous features on other tiers. This non-linear representation contrasts with other theories that posit phonological representations in which a phonetic unit is a bundle of indivisible features, and units are strung together in a linear fashion on a single plane.

Goldsmith defines a 'segment' as a minimal unit of phonological representation, equating the term 'segment' with a single phonetic feature, such as [high] or [nasal]. Each segment, or feature, that has a phonological role in the language appears on one and only one tier; each tier is defined by the kind of features found on it. For example, the feature [nasal] can be separated from vowel and consonant segments and placed on a tier consisting only of nasal segments; the tier is a nasal tier. The terms 'segment' and 'feature' are used interchangeably here.

An autosegmental representation consists of two or more parallel tiers of phonological segments, one of which is the skeletal tier (also known as the CV tier or the timing tier). The skeletal tier consists of timing units that represent points on a time line where all the features of a unit occur simultaneously. The timing units function as anchor points to which features on different tiers are associated, enabling us to know which features occur with individual vowels and consonants. Features on different tiers are connected to the skeletal tier by association lines; the association lines represent simultaneity in time. It is this information that enables us to move from an autosegmental representation to a natural phonetic realisation of the unit.

Features not on the skeletal tier are typically placed on the melody tier (also referred to as the phonemic tier or the segmental tier). This, however, is a representational convenience since the theory states that features associated with the same timing unit on the skeletal tier can exist on separate tiers, functioning independently of each other.

The example of English vowel nasalisation in (10) illustrates how segments on the melody tier are associated with the skeletal tier.

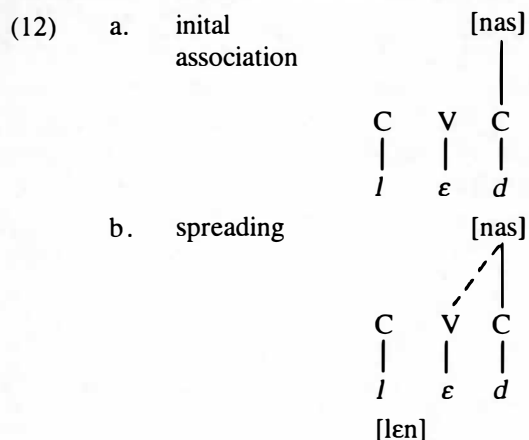


The elements C and V represent timing units on the skeletal tier. In (10a), the segments *p*, *ε*, and *d* are placed on the melody tier and connected to the elements of the skeletal tier by association lines. The feature [nasal] is placed on a separate tier and connected to the same timing unit as *d* by another association line, and the segment surfaces as [n]. In English, when a vowel precedes a nasal consonant, the feature [nasal] associated with the consonant spreads leftwards to the vowel, resulting in vowel nasalisation. The spreading of the feature [nasal] to the preceding vowel is indicated in (10b) by a broken association line. Thus, the process of assimilation can be characterised as the spreading of the single feature [nasal] from one element to another on the skeletal tier; that is, from a consonant and to a preceding vowel. So the format for writing rules is as shown in (11).

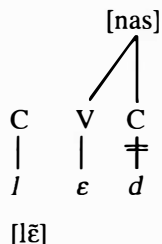


The solid line is part of the input to the rule, and the dotted line represents the structural change.

There are several conventions concerning the representation of association lines. A solid line represents a previously established association; a broken line indicates a structural change (that is, a change in association between segments on different tiers), as in (10b); and double bars through an association line indicate that the line has been deleted, or 'delinked' (that is, the association between segments on different tiers has been discontinued). An example is the French word *lin* 'flax' in (12).

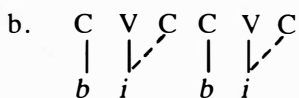
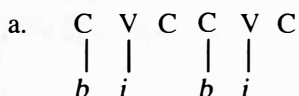


c. delinking



The segments *l*, *ε* and *d* on the melody tier are associated with timing units on the skeletal tier. The feature [nasal] is on another tier and associates initially with *d* in (12a), then spreads to the preceding vowel *ε* in (12b), resulting in the surface segments [ɛ̃] and [n]. The segment *d* is deleted in (12c), but the feature [nasal] remains associated with the vowel *ε*, and *ε* surfaces as a nasalised vowel even though it is no longer followed by a nasal consonant.

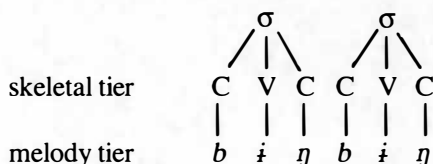
Association lines are established by rule. An initial association rule identifies which segments on two separate tiers are connected first. Subsequent associations may follow an association convention stating that segments on separate tiers are associated in a one-to-one fashion. Language-specific rules may add or delete association lines; they can also indicate that a segment on one tier may be associated with more than one segment on another tier, allowing one-to-many and many-to-one associations, as shown in (12) and (13) respectively. Unassociated segments are not phonetically realised; however, they are not necessarily deleted. This resistance to deletion is known as the stability effect. For example, the feature [nasal] may not be deleted even though the segment it is associated with is phonologically deleted, as in (12c). In the same way, a segment may not be deleted even though its corresponding feature [nasal] undergoes deletion. The primary constraint governing association lines is that association lines may not cross. In (13a), the segments *b* and *i* are associated in a one-to-one fashion; in (13b), *i* is multiply associated to indicate spreading.

(13) *biybiy* 'to show'

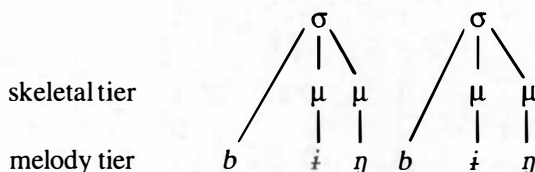
[biybiy]

Moraic theory as proposed by Hayes (1989) posits moras, or timing units, as the basic unit organising phonetic segments on the melody tier. The theory states that the skeletal, or prosodic, tier consists of moras rather than units such as C's or V's. In (14), the word *bɪŋbɪŋ* [bɪŋbɪŋ] 'door' is given in CV representation (14a), and in moraic representation (14b). (The symbol σ represents a syllable node.)

(14) a. CV representation



b. Moraic representation



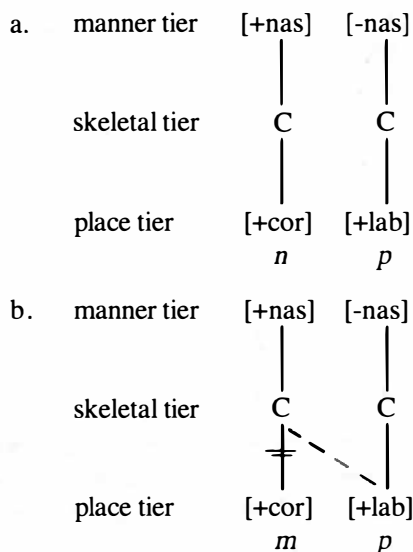
Moraic structure provides a frame that guides various phonological processes operating in the language. An assumed principle is that segments receive the same number of moras in the underlying representation as they bear on the surface unless otherwise specified by rule. Typically, onset consonants bear no mora; short vowels bear one mora; and coda consonants may or may not bear a mora. Long segments, such as lengthened vowels or geminate consonants, may bear one or two moras, depending on the specific language.

Feature geometry proposes that phonological features, not phonological segments, are the smallest unit of phonological analysis. ('Segment' in feature geometry refers to the notion of a phonetic unit as a bundle of indivisible features.) Having made this claim, the theory offers a model for the organisation of features associated with a phonological unit (Clements 1985; McCarthy 1988). Specifically, features at the phonological level are not a bundle of randomly organised elements; rather, they are organised into a hierarchical structure. This organisation reflects two facts: one is that certain gestural features appear to function independently of other features; the second is that some features appear to function as a unit.

Certain features, such as degree of nasal cavity stricture (open or closed) and degree of oral cavity stricture, typically function independently of each other. We can see this by comparing oral and nasal vowels. The vowel [a] is pronounced with a minimum degree of oral cavity stricture. Nasal cavity stricture can be varied independently while maintaining the same degree of oral cavity stricture. If the nasal cavity is closed, [a] is an oral vowel; if the nasal cavity is open, [ã] is a nasal vowel. The same degree of independence occurs if nasal cavity stricture is held stable and oral cavity stricture is varied. If the nasal cavity is open, a minimum degree of oral cavity stricture produces a low nasalised vowel, such as [ã̃]; a greater degree of oral cavity stricture produces a non-low nasalised vowel, such as [ĩ̃]. Although the stricture of the oral cavity changes, the stricture of the nasal cavity does not change, and the vowels remain nasalised.

While some sets of features function independently of each other, other sets, such as place features, typically behave as a unit with respect to certain types of phonological processes, such as assimilation. Nasal assimilation as it applies in the prefix *in-* (as in *improbable*) provides a typical example of such feature dependency.

(15) Nasal assimilation



In (15a), *n* is identified on the manner tier as [+nasal], and *p* as [-nasal]. Feature geometry states that within the category of place, features cannot function independently of each other. Nasal assimilation then must be represented as a process in which the place feature of the non-nasal consonant spreads to the preceding nasal; that is, the feature [+labial] of *p* in (15b) spreads to the preceding nasal, replacing the feature [+coronal]. This behaviour supports the claim that place features form a subset that functions as a unit.

Particle phonology, as proposed by Shane (1984), offers an explanation for the internal structure of vowels and their interrelationships. Specifically, vowels may be characterised by three elementary particles, or privatives, which in isolation correspond to the vowels [i], [u] and [a]. The particle *i* is associated with palatality, or frontness; the particle *u* with labiality, or rounding; and the particle *a* with aperture, or openness. All other vowels are combinations of these particles.

Example (16) gives the particle structure of some short vowels. (Traditional phonetic symbols are placed in square brackets; representations of particle structures are unbracketed.)

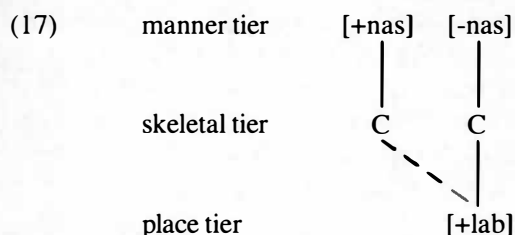
(16)	[i]	<i>i</i>	[u]	<i>u</i>	[ü]	<i>iu</i>	
	[e]	<i>ai</i>	[o]	<i>au</i>	[ø]	<i>aiu</i>	
	[ɛ]	<i>aai</i>	[ɔ]	<i>aau</i>	[œ]	<i>aaiu</i>	[a] <i>a</i>
	or [æ]						

The structures in (16) show how complexes of elementary particles define different vowels. Front vowels have the particle *i*; rounded vowels have the particle *u*; low vowels have the particle *a*. Vowel height is indicated by the number of aperture, or *a*, particles: a greater number of aperture particles indicates a greater degree of openness in the vowel.

An important property of these particles is that they can perform different functions. The particles *i* and *u* correspond to the high vowels [i] and [u] when syllabic and uncombined; on the other hand, they correspond to frontness (or palatalisation) and rounding (or labialisation) when non-syllabic and combined with a consonant.

Underspecification theory addresses the issue of whether all types of redundant information are included in the underlying representation. Certain patterns in phonological processes suggest that some phonological units are not fully specified for all features at all points of a derivation. An example is the pattern of dependency in nasal assimilation in which the place, or point of articulation, feature for the nasal appears to be systematically unspecified.

When nasal assimilation occurs, a nasal always agrees in point of articulation with the following consonant; that is, a nasal preceding a labial will be labial while a nasal preceding a velar will be velar. This suggests that the nasal itself is not specified for a point of articulation, but simply acquires this feature from the following consonant, as shown in (17).



In (17), a nasal is followed by a non-nasal consonant. On the place tier, the nasal has no point of articulation feature; that is, its point of articulation is unspecified. In order to surface, the process of nasal assimilation spreads the following consonant's place feature, [+labial], leftwards onto the nasal, and the nasal and the consonant surface with the same point of articulation. Such evidence supports the claim that not all redundant features are specified in the underlying representation.

CHAPTER 4

SURFACE SYLLABLES AND UNDERLYING BIMORAIC STRUCTURE

The root is the centre of the system of morphological alternations; different canonical roots undergo different surface alternations. For this reason, we begin the analysis by looking at a taxonomy of root types and the syllables of which they are composed. Following a survey of these surface forms, I present an argument for positing a single underlying bimoraic structure for all surface syllables and discuss the association of phonetic material with that structure. I propose that this single structure and the rules governing the association of phonetic material with the structure will allow us to account for all of the variations in unaffixed surface forms. (Some of the following examples include phonological rules that are described in Chapter 6; the reader may refer to that chapter for details of a given rule.)

4.1 ROOTS AND SURFACE SYLLABLES

Karao abounds in disyllabic roots of which there are four canonical forms: (1) $CV_1C_1C_2V(C)$, (2) $CV_1CV(C)$, (3) $CaCV(C)$, and (4) $CiC_1C_1V(C)$. In a $CV_1C_1C_2V(C)$ root, V_1 is any vowel, and in a $CV_1CV(C)$ root, V_1 is either [o] or [i]. In a $CiC_1C_1V(C)$ root, the intervocalic consonant following [i] geminates. Notice that [i] occurs only in closed syllables, and that only [i] occurs before geminate consonants. The taxonomy is organised according to the canonical shape of the initial syllable and the phonetic material occurring in that syllable, since these factors are central to phonological alternations triggered by affixation. Examples of each root type are given in (18).

(18)	Root type			
	$CV_1C_1C_2V(C)$	<i>soŋbat</i>	[suŋbat]	to answer
		<i>diŋdiŋ</i>	[diŋdiŋ]	to forget
		<i>baʔjɨs</i>	[baʔjɨs]	to borrow
		<i>kɨlʃaw</i>	[kɨlʃaw]	to shout
		<i>ʔosʔos</i>	[ʔosʔos]	to use an ʔosʔos tool ⁴
		<i>ʔikdit</i>	[ʔɛkdit]	to crush lice
		<i>ʔakdo</i>	[ʔakdo]	to serve rice
		<i>ʔigči</i>	[ʔigči]	to hold in the hand
	$CV_1CV(C)$	<i>doθo</i>	[doθo]	to cook
		<i>bilin</i>	[bilin]	to give advice
		<i>ʔolop</i>	[ʔulup]	to take someone along
		<i>ʔiris</i>	[ʔiris]	to crush hot peppers

⁴ An ʔosʔos is a block of wood in which holes have been drilled. It is used in the process of rope-making: strands of rope are threaded through the holes of the ʔosʔos in order to keep them from tangling as they are twisted together.

CaCV(C)	<i>saxit</i> ʔala	[saxet] [ʔala]	to get sick to get
CiC ₁ C ₁ V(C)	<i>dipik</i> ʔičom	[dɪppɪk] [ʔičom]	to get wet to add

The roots in (18) show that Karao has two surface syllable types: CV and CVC. Both syllables occur root initially and root finally. I propose, however, that these syllables are surface realisations of a single underlying structure.

4.2 BIMORAIC STRUCTURE

Following Hayes (1989), syllable structure is not represented in the underlying representation; rather, underlying structures are grouped into syllables by a syllabification algorithm. The forms of surface syllables in Karao and the alternations occurring in those forms with verb affixation may be best understood if we assume that both CV and CVC surface syllables have a single underlying structure consisting of two moras, as illustrated in (19).

(19)

Underlying Bimoraic Structure

μ μ

The use of moraic notation represents the claim that the mora, rather than CV segments, is the central motivating phonological unit in Karao.

For Karao, the syllabification algorithm is as follows: the first mora, being the most sonorous, is dominated by a syllable node and forms the nucleus, a vowel; the second mora joins to the syllable node and forms the coda, a consonant; and the onset consonant has no mora and joins directly to the syllable node. Once the syllabification algorithm is applied, the structure takes the form shown in (20).

(20)

Syllabified Structure

Syllable tier

Moraic tier

Melody tier

σ

μ μ

x y z

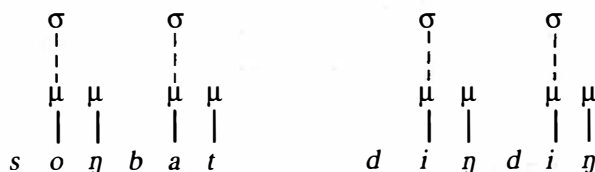
In (20), the structure has three tiers, or levels: the melody tier, consisting of phonetic material; the moraic tier, consisting of moras, or timing units; and the syllable tier. The segments on each tier function autonomously with respect to segments on other tiers; segments on separate tiers are linked by means of association lines. A segment on one tier may be singly or multiply associated with segments on another tier; however, association lines may not cross. These conventions follow those presented by Goldsmith (1990). In order to identify onsets in derivations, I include syllable structure in the representations, although syllable structure is not part of the underlying representation. The moraic structure and the application of the syllabification algorithm for two Karao roots are given in (21).

(21) *soŋbat* 'to answer'; *diŋdiŋ* 'to forget'

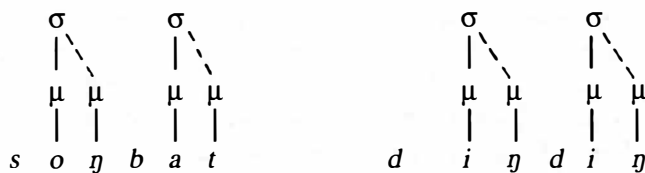
Underlying form



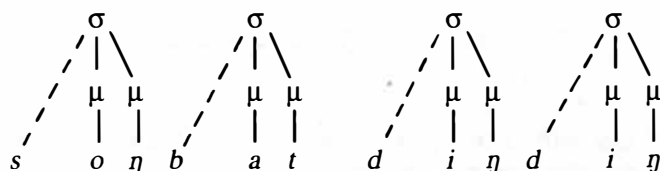
Association of first mora



Association of second mora



Association of onset consonant



Surface form

[soŋbat]

[diŋdiŋ]

Note in (21) that phonetic material is singly associated with every position in an underlying bimoraic unit and that the unit surfaces as a closed syllable. Later on I will argue that a surface CV syllable is an underlying bimoraic unit that lacks enough phonetic material to achieve single association of material for every position in the unit and so cannot surface as a CVC syllable. In such cases, a number of strategies are employed to acquire enough phonetic material so that the underlying bimoraic unit can achieve a minimal level of well-formedness, although on the surface it can still have the form CV.

4.3 ASSOCIATION OF PHONETIC MATERIAL WITH THE BIMORAIC STRUCTURE

In describing the association of phonetic material with bimoraic units, we want to posit underlying segments and associations which will allow us to do two things. Firstly, we want to be able to derive all the surface forms occurring in Karao; secondly, we want to be able to capture in a revealing way apparent relationships between specific surface segments, such as the distribution patterns of various sets of consonants (section 2.2). In order to do this, I begin by positing a set of segments that associate with the underlying bimoraic unit. These segments include the following: the vowels *i* and *o*, and the consonants *p*, *t*, *k*, *ʔ*, *d*, *gʷ*, *ɕ*, *ʃ*, *b*, *m*, *n*, *ŋ* and *s*. Note that the underlying consonants are all set 1 consonants. Although I have initially posited *i*, *o*, *ʃ* and *gʷ* as separate segments, I argue that we may better account for certain distribution constraints by analysing *i* and *ʃ* as the single feature [high], and *o* and *gʷ* as the single feature [labial]. One fully underspecified segment also occurs in the underlying bimoraic unit; it surfaces as [a] when associated with a nucleus position, or [ʔ] when associated with an onset or coda position. I attempt to show that all surface segments are derived from this set of underlying segments. In doing so, I also argue

that [ɨ] never occurs in an underlying representation but is inserted epenthetically in all occurrences. Also, although I begin by placing all underlying segments on a single melody tier, I present arguments to suggest that there are three melody tiers: one for fully specified segments; a second for partially specified segments; and a third for the fully underspecified segment.

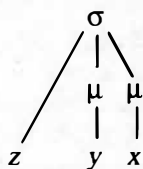
Surface variations of underlying segments appear to be the result of three factors: the manner in which segments are associated with the underlying bimoraic unit; position in the unit; and the sonority hierarchy. Let us consider the association of phonetic material with the bimoraic unit and describe the effect of position within that unit and the effect of the sonority hierarchy as they bear on the discussion.

Phonetic material can be associated either singly or multiply with positions in a bimoraic unit. There are two kinds of multiple association: one involves the multiple association of a consonant with the coda of one unit and the onset of a following unit; the second involves the spreading of a vowel from the nucleus to the following coda, or from the nucleus to the following coda and the adjacent onset. Let us consider each of these patterns of association. In this discussion, the association of phonetic material with unaffixed forms is the primary concern.

4.3.1 SINGLE ASSOCIATION OF SEGMENTS

Single association is simply a one-to-one association of phonetic material with a position in the bimoraic unit; that is, one phonetic segment associates with only one position, as in (22).

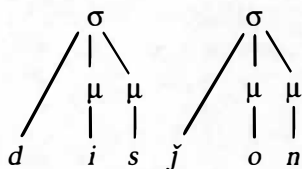
(22) Single Association



Under ideal conditions, there is one segment for each position in the underlying representation, in which case the underlying unit surfaces as a closed syllable, as in (23).

(23) *disʃon* 'to despise'

Underlying form



Surface form

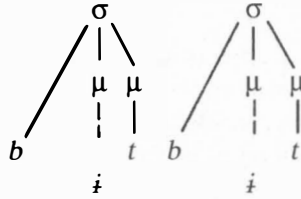
[disʃun]

If an underlying representation lacks phonetic material for a position, material can be supplied in different ways. One way is to insert an epenthetic segment. Specifically, if the nucleus lacks material, [ɨ] is inserted (24a); if the onset or coda lacks material, [ʔ] may be inserted (24b). The segment [ʔ] is always inserted epenthetically in an empty onset; however,

[ʔ] must be inserted by rule in an empty coda. The issue of epenthetic segments will be considered in detail later.

(24) a. Vowel epenthesis

Underlying form



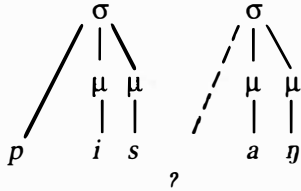
Vowel epenthesis

Surface form

[bitbit] 'to cut with a *bolo*'

b. Glottal epenthesis

Underlying form



Glottal epenthesis

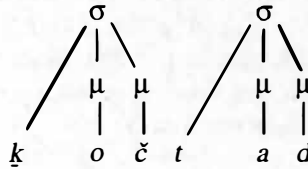
Surface form

[pisʔaŋ] 'to break apart'

At this point, we can consider the factor of position. The consonant distribution patterns given in the chart in (2) (section 2.2.1) motivate a claim that consonant positions in the underlying bimoraic unit are ranked according to a strength hierarchy: the onset being the stronger position and the coda being the weaker position. The onset is the stronger position and requires the stronger, or less sonorant, set 1 form of a consonant. Furthermore, consonant alternation never occurs in the onset as long as the consonant remains singly associated with that position. In contrast, the coda is the weaker position, and certain consonants even though singly associated with this position surface as their weaker, or more sonorant, set 2 forms; these consonants are *d*, *k*, *g^w*, *j* and *ɕ*. Although the stops *p*, *t* and *k* have more sonorant surface forms, these consonants are apparently sufficiently obstruent-like to resist the weakening effect of the coda position. The consonants *b* and *m* also have more sonorant surface forms that surface in limited environments (see section 4.3.4); however, in the coda position, *b* and *m* pattern like *p*, *t* and *k* in that they do not weaken, but surface as [b] and [m] in that position. The remaining consonants *n*, *ŋ*, *s* and glottal stop have only one surface form and so are not subject to weakening. The pattern for coda consonants never varies as long the consonants remain singly associated. Examples are given in (25) and (26).

(25) *kɔdɪl* 'to kick'

Underlying form



Surface form

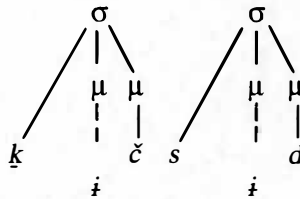
[kɔdɪl]

In (25), *k* and *t* in the onset positions of their syllables surface as their less sonorant forms; on the other hand, *ɔ* and *d* in the coda positions surface as their more sonorant forms: *ɔ* as [ɔ], and *d* as [ɪ].

In the underlying representation in (25), a vowel precedes the coda consonant; however, in (26) below, no vowel precedes the coda consonant, yet weakening still occurs in the coda consonants.

(26) *kɪdsɪl* 'to behave badly'

Underlying form



Vowel epenthesis

Surface form

[kɪdsɪl]

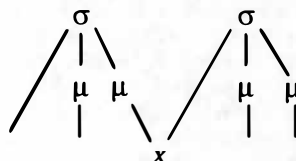
In (26), *k* in the first onset surfaces as its less sonorant form; *s* in the second onset has only one surface form and so surfaces as [s]. The consonant *ɪ* in the first coda surfaces as [d], its more sonorant form; *d* in the second coda surfaces as [ɪ], its more sonorant form. Since no vowel occurs in the nucleus of either unit, we must conclude that the weakening effect on *ɪ* and *d* is due to position and not to the presence of a preceding vowel.

To summarise, for underlying consonants which have more than one surface form, a singly associated consonant always surfaces as its stronger, or less sonorant, form in an onset position and as its weaker, or more sonorant, form in a coda position, unless the consonant is *p*, *t*, *k*, *b* or *m* in which case the consonant surfaces as its less sonorant form in both positions.

4.3.2 MULTIPLE ASSOCIATION OF CONSONANTS

Multiple association of a consonant involves the association of a single consonant with the coda of one bimoraic unit and the onset of the following unit, as represented in (27).

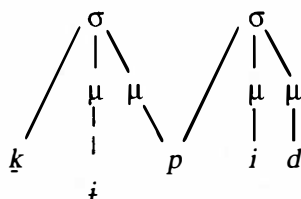
(27) Multiple Association of Consonant



The surface realisation of a multiply associated consonant varies depending on whether or not a vowel is associated with the preceding nucleus in the underlying representation. For example, we have seen in section 2.2 that [p] and [p̥] are in complementary distribution and that both forms can occur in a surface intervocalic position. Since I have claimed that only *p* occurs in the underlying representation, we need to account for the variation in surface forms. Examples (28) and (29) suggest how this may be done.

(28) *k̥ipil* 'to roast on coals'

Underlying form

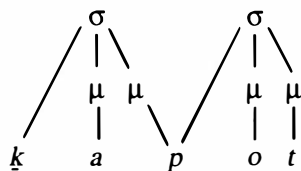


Vowel epenthesis

Surface form [k̥ippil]

(29) *k̥aput* 'thin rope'

Underlying form



Surface form [k̥aput]

In both examples, *p* is multiply associated with the coda of one bimoraic unit and the onset of the following unit. In (28), no vowel precedes *p* in the underlying representation, and *p* surfaces as [p], its less sonorant form; furthermore, *p* surfaces as a geminate consonant, that is [pp]. This agrees with the claim of autosegmental theory that a geminate cluster is the surface realisation of a single segment which is multiply associated in the underlying representation. In (29), *p* is also multiply associated; however, this time it is preceded by a vowel, *a*, in the underlying form and *p* surfaces as [p̥], its more sonorant form.

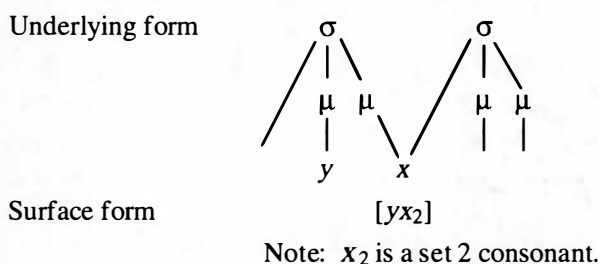
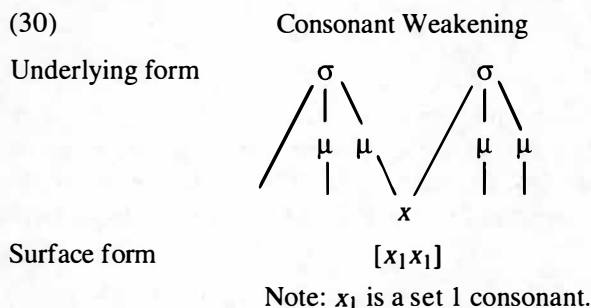
The claim that surface forms [pp] and [p̥] both derive from an underlying multiply associated *p* is supported by the fact that Karao speakers cannot pronounce either root as separate syllables. That is, when pronouncing [k̥ippil], speakers are unable to pause either before, after, or between the two stops [pp], and when pronouncing [k̥aput], they are unable to pause either before or after [p̥].⁵

If we accept the claim that [i̯] is inserted epenthetically and indicates a lack of phonetic material for a nucleus of the underlying representation, but that [a] in an unaffixed surface

⁵ There are two points to be made here. Firstly, in the case of [p̥], one could argue that Karao speakers are unable to pause before or after a fricative because fricatives never occur word initially or syllable initially following a closed syllable in Karao words; however, syllable breaks for intervocalic consonants were checked with speakers who were at least functional, and in some cases fluent, speakers of English and who showed no difficulty pronouncing word-initial fricatives in English words. Consequently, we may assume that failure to pause before or after fricatives in Karao words is not due to Karao speakers' inability to articulate such sounds syllable initially.

Secondly, the only [continuant] set 2 consonant that does not follow this syllabification pattern is surface [l]. Some Karao speakers can pause before an intervocalic [l].

root does occur in the underlying representation (as a fully underspecified segment), then the surface alternation of [pp] and [p̥] motivates the claim that when a multiply associated consonant is preceded by a vowel in the underlying representation, it undergoes a weakening process, surfacing as its more sonorant form. A rule representing this weakening process is given in (30).

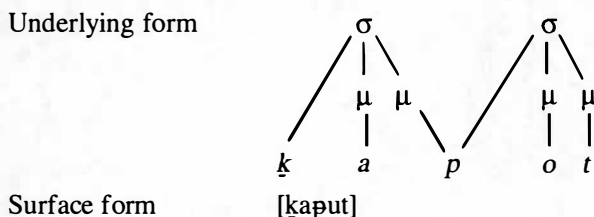


In the surface form, this alternation looks similar to the weakening process that affects intervocalic consonants in many languages. The formalisation of intervocalic weakening in Karao might appear unusual, but I do not know what a moraic analysis of surface intervocalic weakening might look like in other languages.

The claim then is that if an underlying medial consonant has two surface forms, a more sonorant form and a less sonorant form, the consonant will surface as the more sonorant form if two conditions apply in the underlying representation: if the consonant is multiply associated; and if the consonant is preceded by a vowel.

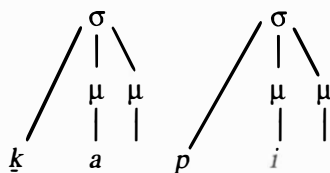
The multiple association condition is verified by comparing [k̥aput] with [k̥api] in (31). The root [k̥api] differs from [k̥aput] in that speakers can syllabify [k̥api] (by pausing before [p]), suggesting that [p] is not multiply associated, but is singly associated with the onset of the second underlying unit. Thus, the surface form has the strong consonant [p].

(31) a. *k̥aput* 'thin rope'



b. *kapi* 'coffee'

Underlying form



Surface form

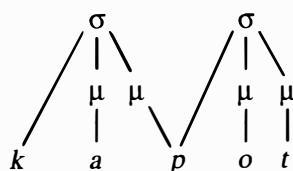
[kapi]

In both (31a) and (31b), the medial consonant *p* is preceded by the vowel *a*. In (31a), *p* is multiply associated (demonstrated by the fact that Karao speakers cannot pause before or after [p]), and *p* weakens, surfacing as [p̥]. In contrast, in (31b), *p* is not multiply associated, and *p* surfaces as [p], its less sonorant form, unaffected by the preceding vowel *a*.

The preceding vowel condition is verified by comparing [kippil] and [kaput] with [kapis] in (32).

(32) a. *kapot* 'thin rope'

Underlying form

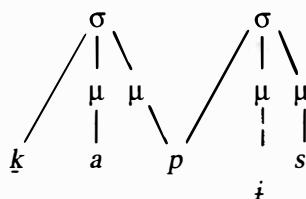


Surface form

[kaput]

b. *kapis* 'yarn'

Underlying form



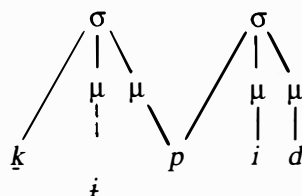
Vowel epenthesis

Surface form

[kapis]

c. *kīpil* 'to roast on coals'

Underlying form



Vowel epenthesis

Surface form

[kīpil]

Thinking of typical instances of weakening in surface intervocalic consonants, we might expect that a multiply associated consonant would need to be both preceded and followed by vowels in the underlying representation in order for weakening to occur, as in [kaput] in (32a); however, (32b) and (32c) show that this is not the case. Example (32b) demonstrates

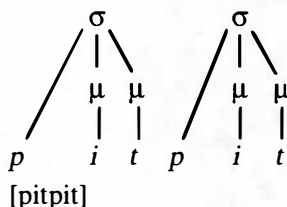
that only one vowel is required in order to trigger weakening. That is, in [kəpɪs], multiply associated **p** is preceded by the vowel **a**, but no vowel follows **p** in the underlying unit (shown by the fact that [ɪ] follows [p] in the surface form); however, **p** still undergoes weakening, surfacing as [p̥]. Furthermore, example (32c) verifies that it is the preceding vowel, not the following one, that is required. In [kɪppɪl], although the vowel **i** follows the multiply associated **p**, no vowel precedes **p** in the underlying form, and so **p** does not weaken, but surfaces as [pp]. From these examples, we must conclude that only a preceding vowel is required in order to trigger weakening in a multiply associated consonant.⁶

The fact that the set 1 consonants **n**, **ŋ** and **s** have only one surface form provides further evidence that set 1 and set 2 consonants have the same source in an underlying representation. When these consonants occur in an intervocalic position following a vowel in the underlying representation, they are always singly associated with the onset following the vowel. This is indicated by the fact that Karao speakers can pause before these consonants when they occur in an intervocalic position following any vowel except [ɪ]. On the other hand, when these segments occur in an intervocalic position following a nucleus lacking phonetic material, they are always multiply associated with a coda and the following onset, and surface as a set 1 geminate cluster. This demonstrates that the segments can multiply associate with two consonant positions in the underlying form; however, they do so only when no vowel precedes them in the underlying representation. I propose that these segments exhibit this alternation pattern because alternating set 1 and 2 surface consonants have the same source in the underlying representation, and that phonetically there are no set 2 surface counterparts available in the language for **n**, **ŋ** and **s**; consequently, they cannot multiply associate with two consonant positions following a vowel in the underlying representation since they lack an appropriate surface form for that environment.

It appears then that two environments have a weakening effect on consonants: the coda position, if a consonant is singly associated with that position; and the medial position, if a consonant is multiply associated and preceded by a vowel. Of the two environments, the medial position (when all the phonological conditions are met) has the greater weakening effect. This is verified in two ways.

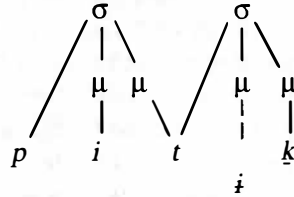
Firstly, the stops **p**, **t** and **k** never surface as their more sonorant forms in the coda position (if they are singly associated), since these consonants are apparently strong enough to resist the weakening effect of the coda position. In contrast, all consonants which have more than one surface form, including **p**, **t** and **k**, always surface as their more sonorant form in a medial position (if they are multiply associated and preceded by a vowel), as in (33). (The two exceptions **b** and **m** are discussed later.)

(33) a. **t** in coda position: *pitpit* 'to flatten'



⁶ Weakening is blocked only when required by affixation. In an unaffixed root, multiply associated **p**, **t** and **k** always undergo weakening when preceded by a vowel in the underlying representation.

- b. *t* in medial position: *piθ~~k~~* 'soil'



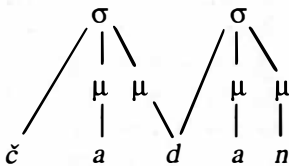
Vowel epenthesis

[piθ~~k~~]

In (33a), *t* occurs in a coda position in both underlying bimoraic units and is singly associated; it surfaces as its less sonorant form [t]. In (33b), *t* occurs in a medial position and is multiply associated and preceded by the vowel *i*; it surfaces as its more sonorant form [θ].

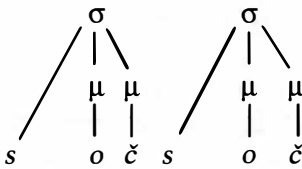
Secondly, the consonant *č* has three surface forms: [č], the least sonorant form; [d], a more sonorant form; and [ř], the most sonorant form. The form [d] always surfaces in a coda position (if it is singly associated), but the form [ř], never [d], surfaces in the medial position (if it is multiply associated and preceded by a vowel), as shown in (34).

- (34) a. *č* in onset position: *čalan* 'path'



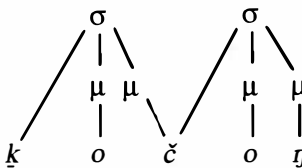
[čalan]

- b. *č* in coda position: *sodsod* 'to explain'



[sudsud]

- c. *č* in medial position: *kōřoŋ* 'to crawl'



[kōřoŋ]

In (34a), \check{c} occurs in an onset position and is singly associated; it surfaces as its least sonorant form [č]. In (34b) \check{c} occurs in a coda position in both bimoraic units and is singly associated; it surfaces as the more sonorant form [d]. In (34c), \check{c} occurs in a medial position and is multiply associated and preceded by the vowel σ ; it surfaces as its most sonorant form [ř]. From the alternation patterns of p , t , k and \check{c} in coda and medial positions, we may conclude that the medial position has potentially the greatest weakening effect.

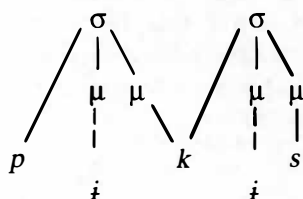
4.3.3 VOICING OF CONSONANTS

Normally, sets of alternating consonants have the same value for the feature [voice]; that is, if the strong set 1 consonant is voiceless, its weaker set 2 counterpart will also be voiceless, as in the set [p] and [p̥]. In the same way, if the strong consonant is voiced, its weaker counterpart will also be voiced, as in the set [d] and [l]. There are two sets of alternating consonants that do not follow this voicing pattern: [k] and [g]; and [č], [d] and [ř]. Let us begin with the simpler set: [k] and [g].

If we assume that surface consonants which alternate with each other have the same underlying source, then we would posit k as the underlying segment for the surface forms [k] and [g], since voiceless [k] is less sonorant than its voiced counterpart [g]. The consonants [k] and [g] differ, however, from most sets of alternating consonants in that when [g] occurs in an intervocalic position, it does not appear to be multiply associated in the underlying representation. This claim is based on the fact that Karao speakers can pause before an intervocalic [g] in words such as [ni\$gay] 'to gather vegetables for a viand'.⁷ On the other hand, we know that k can multiply associate with a coda and an adjacent onset because k surfaces as the geminate cluster [kk] following [i], as shown in (35).

(35) $pikis$ 'to be strong in force'

Underlying form



Vowel epenthesis

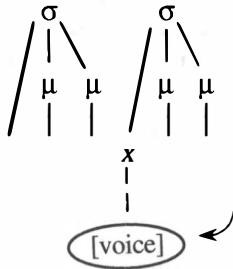
Surface form

[pikkis]

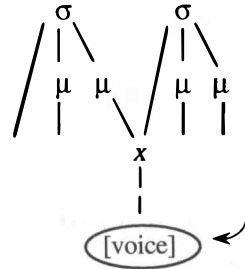
From (35), we conclude that when k is preceded by a vowel, it cannot multiply associate with a coda and an adjacent onset. Since k cannot multiply associate when it is preceded by a vowel, the feature [voice] is added to a singly associated k in a medial root position in order to provide the segment with a weaker surface form for that position, and k surfaces as [g]. The rule for voicing is represented in (36). Following Goldsmith (1990), the feature [voice] is circled to show that it is the inserted element; the arrow indicates that the addition of the feature is part of the structural change.

(36)

Voicing



or



Note: *x* is *k*.

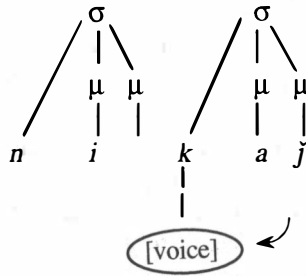
Note: *x* is *č*.

Thus, the root *nigay* would have the following underlying representation.

(37) *nigay* 'to gather vegetables for a viand'

Underlying form

Voicing



Surface form

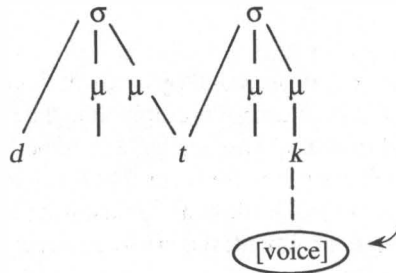
[nigay]

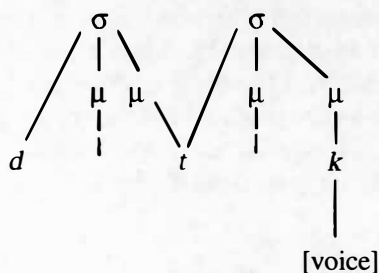
I have represented voicing as an insertion rule, rather than an assimilation rule; that is, I have represented the feature [voice] as inserting into the structural description to create a structural change, and not as spreading, or assimilating, from a preceding vowel. I suggest that the feature [voice] does not spread from a preceding vowel to the underlying consonant because we find roots in which *k* surfaces as [g] even though it is not preceded by a vowel in the underlying representation, as shown in (38).

(38) *ditiḡ* 'to become straight'

Underlying form

Voicing





Vowel epenthesis

i

i

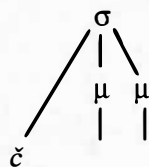
Surface form

[dittig]

In (38), **k** is associated with the coda position, but is not preceded by a vowel in the underlying representation. The feature [voice] is added to **k**, and **k** surfaces as [g]; vowel epenthesis follows.

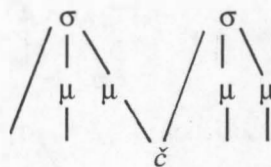
The weakening effect of voicing combines with the weakening effect of vowels preceding multiply associated consonants in medial positions to produce the three-way contrast in the surface forms of the underlying segment **č**: [č], [d] and [ř]. A schema for each surface form is given in (39).

(39) a. surface form [č]



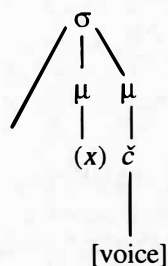
[č]

or



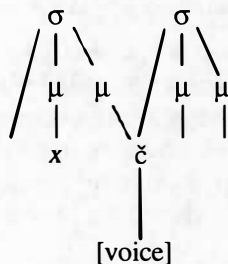
[tč]

b. surface form [d]



[voice]

c. surface form [ř]



[voice]

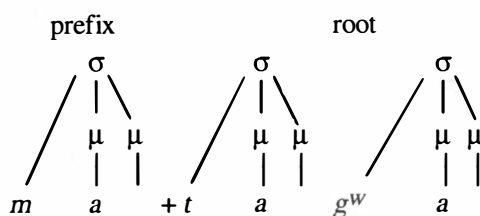
In (39a), \mathcal{C} surfaces as the strong consonant [č] when it is singly associated with an onset position; it surfaces as the strong geminate cluster [tč] when it is multiply associated with two consonant positions and not preceded by a vowel. In (39b), \mathcal{C} surfaces as the weaker form [d] when it is singly associated with a coda position, and the feature [voice] is added to it. In (39c), \mathcal{C} surfaces as its weakest form [ɾ] when it is multiply associated in the medial position and preceded by a vowel, and the feature [voice] is added to it.

4.3.4 ALTERNATION BETWEEN [b], [m], [w] AND [g^w]

We will now look at a unique alternation pattern involving the surface segments [b], [m], [w] and [g^w]. Normally, [b] and [m] do not alternate; consequently, we may assume that the underlying and surface forms of the segments are the same, that is, **b** for [b] and **m** for [m]. In a few roots, however, surface alternation occurs between [b] and [g^w], and between [w] and [m] following affixation or reduplication; specifically, [g^w] is replaced by [b], and [w] by [m]. Examples are given in (40) and (41).

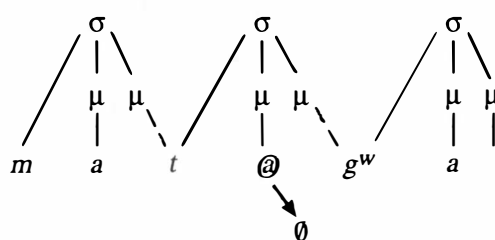
(40) *tag^wa* ‘fat’ (noun)

Affixation



Multiple association

Vowel deletion



Vowel epenthesis

Surface form

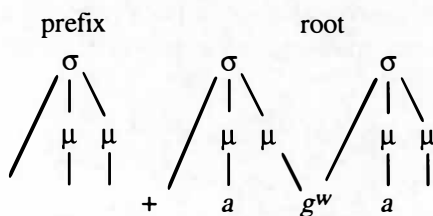
[maθⁱbba] ‘fat’ (adjective)

According to the analysis presented so far, for [g^w] in *tag^wa* [tag^wa] ‘fat’, the underlying form should be a singly associated **g^w**. In (40), the prefix *ma-* (an adjectiviser) is added to the root *tag^wa*. Affixation triggers a series of typical alternations (these will be discussed in detail later). Specifically, in the root, the underlying segments **t** and **g^w** multiply associate with the coda of one bimoraic unit and the onset of the following unit; **a** in the V₁ root position is deleted, and epenthetic [i] is inserted in its place.

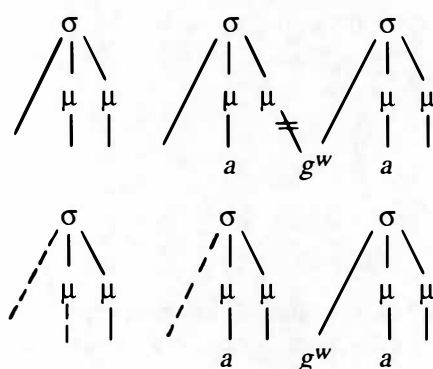
What is unusual about this alternation is the surface form of **g^w** after affixation. Normally, when **g^w** is multiply associated and preceded by a vowel, it surfaces as [w], its more sonorant form; however, when the prefix *ma-* is added to the root *tag^wa*, **g^w** surfaces as [b] instead. On the other hand, if we posit **b** as the underlying form, it would normally surface as [b] if singly associated, rather than as [g^w], resulting in the root *[taba], an unattested form in Karao. Now consider the alternation between [w] and [m] in (41).

(41) ?awa 'father'

Affixation



Delinking



Vowel epenthesis

Glottal epenthesis

? ?

Surface form

[ʔaʔamʌ] 'old man'

For [w] in ?awa [ʔawʌ] 'father', the underlying form should be a multiply associated g^w . In (41), the prefix ?i- is added to the root ?awa to produce the noun ?aʔama 'old man'. Affixation triggers typical alternations: in the root, the consonant g^w delinks from the coda of the initial unit; vowel epenthesis occurs, supplying the allomorph [a] for the nucleus of the prefix; glottal epenthesis follows, supplying material for all empty onsets. Again, the unusual aspect of the alternation is the surface form for g^w : normally when g^w is singly associated, it surfaces as [g^w]; however, in (41), it surfaces as [m] instead. (Compare this with the singly associated g^w in the root tag^wa in (40) which surfaces as [g^w].)

The source of this alternation pattern appears to lie in the fact that the Karaos are supposed to have originated in the province of Bontoc, north of their current location. Bontoc is a Central Cordilleran language, and the Bontoc cognate for tag^wa is *taba*, and for ?awa, it is ?ama (Reid 1971:79). This suggests that for surface [g^w] in tag^wa, the original source is [b], and for surface [w] in ?awa, it is [m]. Positing *m* as the underlying segment for alternations between surface [m] and [w] presents no problems since one could argue that surface [w] has two sources: an underlying g^w and *m*. If this analysis is followed, g^w and *m* would both surface as [w]; consequently, single association of the underlying segment would be required in order to identify the correct source of a surface [w]. Alternation between surface [g^w] and [b] is problematic however. While [g^w] may have two sources, g^w and *b*, [g^w] is not the surface variation of a multiply associated underlying segment, but a singly associated segment (demonstrated by the fact that Karao speakers can pause before [g^w] in [tag^wa]). This suggests that g^w is the underlying form of [g^w] in [tag^wa].

Regardless of how we resolve this problem, what is of interest for a synchronic study is that the alternation between [b], [m], [w] and [g^w] is not arbitrary. These consonants all share the feature [labial], and it is this feature that appears to be the basis for the alternation

between the consonants. Furthermore, I will suggest later that the alternation between these consonants is a counterpart to another alternation that occurs between vowels. With respect to this point, notice that no similar alternation pattern occurs involving [j] and [y] and other consonants.

4.3.5 VOWEL SPREADING

Vowel spreading involves the spreading of a non-low vowel from the nucleus mora to the coda mora of the same underlying bimoraic unit, as in (42).

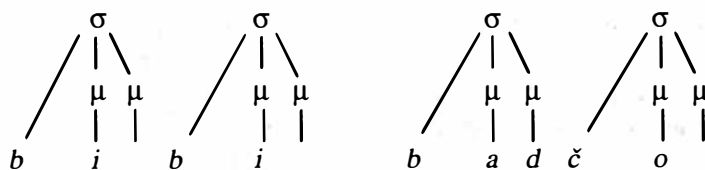
(42) Vowel Spreading



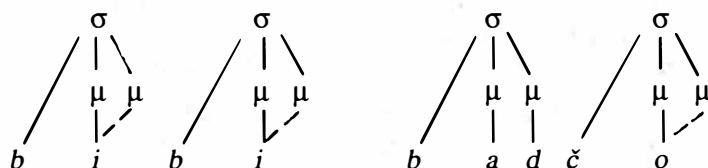
Vowel spreading occurs when no phonetic material is associated with a coda mora in the underlying representation. In such cases, a non-low vowel, either *i* or *o*, in the preceding nucleus can spread to the empty coda, supplying a surface glide for the coda, as shown in example (43).

(43) *biybiy* 'to show'; *balčow* 'fishnet'

Underlying form



Vowel spreading



Surface form

[biybiy]

[balčuw]

In (43), the vowel *i* spreads from the nucleus to the coda in both bimoraic units in *biybiy* [biybiy] 'to show', and the vowel *o* spreads from the nucleus to the coda of its unit in *balčow* [balčuw] 'fishnet'.

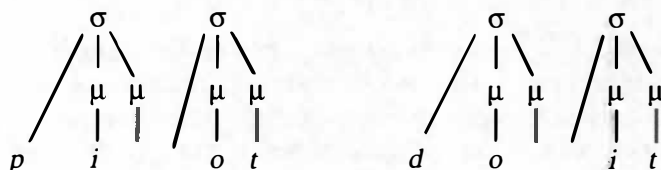
The spreading of a non-low vowel from a nucleus to a coda (and an onset, as we shall see) is the one exception to the claim that set 2 consonants are surface variations of underlying set 1 consonants. Although the glide [w] can be the surface variation of an underlying *g^w*, it can also be the surface variation of an underlying *o* that has spread to a coda position. The same is true for the glide [y]: it can be the surface variation of an underlying *j* or of an underlying *i* that has spread to a coda position. (There are also the derived affixes *may-* and *?iyay-* in which the final surface [y] is underlyingly a singly

associated *i*.⁸) The claim that surface glides have two different sources, namely, a set 1 consonant or a non-low vowel, is supported by the fact that surface glides have different alternation patterns. This evidence will be discussed shortly.

One of the features of vowel spreading is that a non-low vowel can spread not only to the coda of its own bimoraic unit but also to the onset of the following unit if both the coda and the adjacent onset lack phonetic material, as in (44).

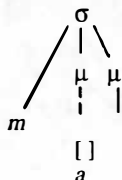
(44) *piyot* 'to become thin'; *dowit* 'strip of banana fibre'

Underlying form



- 8 The prefix *may-* is a derived affix: the passive prefix *mi-* is added to the associative prefix *?i-*. In order to account for the presence of the variant [a] of the epenthetic vowel in the nucleus, and the sequence in which phonetic material is associated with positions in the surface form, we must assume that vowel epenthesis occurred in the prefix *mi-* before it attached to the associative prefix *?i-*, as shown below.

Underlying form

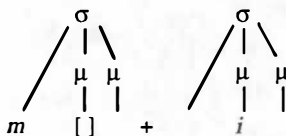


Vowel epenthesis
Redundant feature
assignment

Surface form

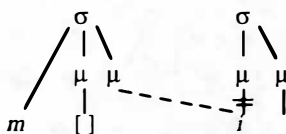
[ma-]

Underlying form

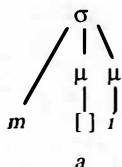


Delinking

Reassociation



Resyllabification



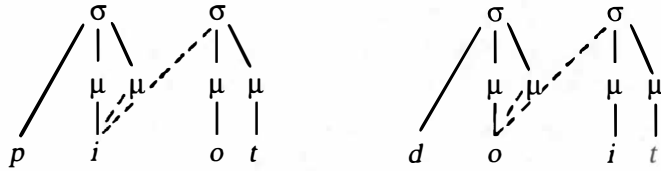
Redundant feature
assignment

Surface form

[may-]

In the derivation above, the surface form [ma-] attaches to the form [i-]; *i* delinks and reassociates with the coda of the first bimoraic unit; resyllabification takes place; and redundant feature assignment occurs last.

Vowel spreading



Surface form

[piyot]

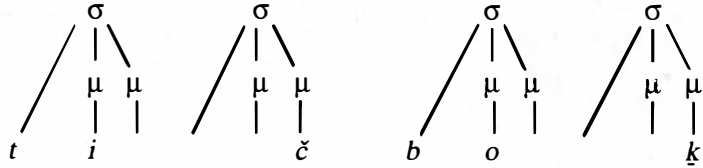
[duwit]

Here again the glides [y] and [w] are surface variations of the underlying vowels *i* and *o*, rather than the set 1 consonants *j* and *g^w*.

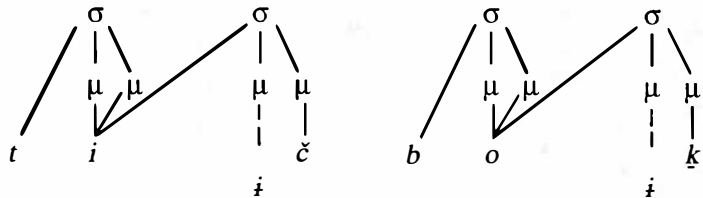
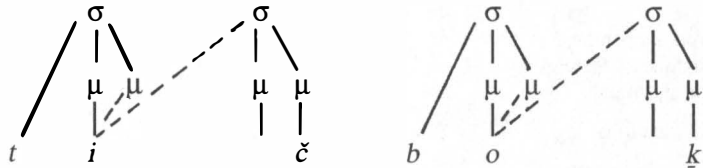
Vowel spreading appears to have limits: a non-low vowel can multiply associate with only three adjacent positions – a nucleus, the following coda, and the adjacent onset. If a nucleus in the fourth adjacent position also lacks phonetic material, the non-low vowel cannot spread to that position; instead, an epenthetic vowel is added to the empty nucleus, as shown in example (45).

(45) *tiyid* ‘to go uphill’; *bowik* ‘hair’

Underlying form



Vowel spreading



Vowel epenthesis

Surface form

[tiyid]

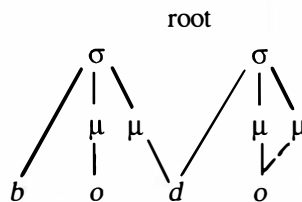
[buwɨk]

An interesting variation to this alternation, shown in (46) and (47), occurs when a suffix is added to a root, and vowel spreading takes place in the final bimoraic unit of the root.

(46) *bolow* ‘to bark’

Vowel spreading

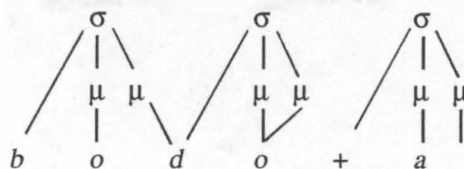
in root



Surface form

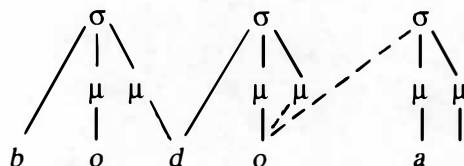
[buluw]

Suffixation



Variation 1

Vowel spreading in suffixed root

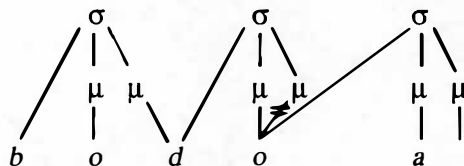


Surface form

[buluwa]

Variation 2

Vowel spreading in suffixed root



Delinking

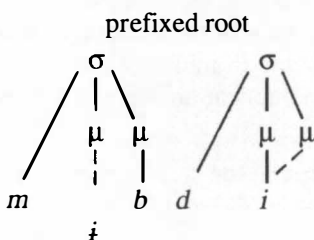
Surface form

[bulug^wa]

Example (46) presents two variations of vowel spreading that occur when *-a*, a suffix signalling present progressive aspect, is added to the root *below* [bulow] 'to bark'. In variation 1, following suffixation, vowel spreading takes place as described above: *o* in the nucleus of the root final unit spreads to the coda of its unit and to the onset of the suffix, and the form surfaces as [buluwa]. In variation 2, the same alternations take place plus one more: after *o* spreads to the coda of its unit and the onset of the suffix, it delinks from the final coda of the root, and the form surfaces as [bulug^wa]. The same variations occur when the vowel *i* spreads in a root final unit, as the next example shows.

(47) *mɪbdiy* 'to be tired'

Vowel spreading in prefixed root

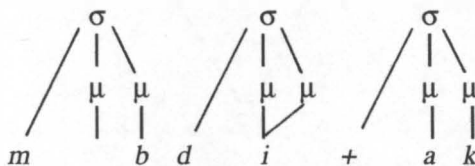


Vowel epenthesis

Surface form

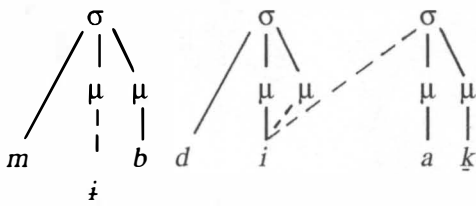
[mɪbdiy] 'to be tired'

Suffixation



Variation 1

Vowel spreading
in suffixed root



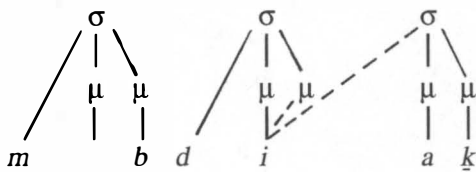
Vowel epenthesis

Surface form

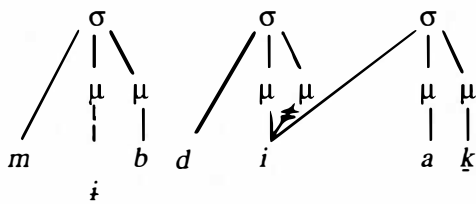
[mɪbdiyək] ‘I will be tired’

Variation 2

Vowel spreading
in suffixed root



Delinking



Vowel epenthesis

Surface form

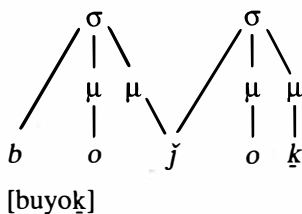
[mɪbdiʃək] ‘I will be tired’

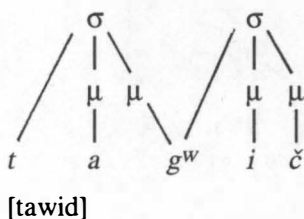
Example (47) presents two variations of vowel spreading that occur when the suffix *-ək* ‘I’ is added to the affixed root *mɪbdiy* (*mɪ*+*bidiy* [biddiy]) ‘to be tired’. In variation 1, following suffixation, vowel spreading takes place as usual: *i* in the nucleus of the root final unit spreads to the coda of its unit and to the onset of the suffix; the form surfaces as [mɪbdiyək]. In variation 2, after *i* spreads to the coda of its unit and the onset of the suffix, it delinks from the coda; the form surfaces as [mɪbdiʃək].

Examples (46) and (47) demonstrate that the set 1 consonant *gʷ* may be a surface variation of the vowel *o*, as well as the underlying consonant *gʷ*, and that the set 1 consonant *ʃ* may be a surface variation of the vowel *i*, as well as the underlying consonant *ʃ*. In (46) and (47), the partial delinking of multiply associated *i* or *o* occurs across morpheme boundaries. In the discussion of reduplication, we will see that this alternation can also occur within a morpheme (see section 8.2).

The forms [y] and [w] may also be the surface representations of the multiply associated underlying segments *ʃ* and *gʷ*, as in (48) and (49).

(48) *boyək* ‘to rot’



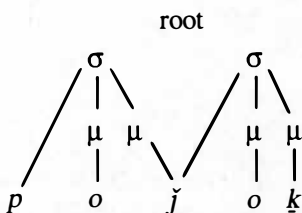
(49) *tawid* 'to inherit'

In (48) and (49), \check{j} and g^w are multiply associated with the coda of the first bimoraic unit and the onset of the second. The result is that \check{j} surfaces as its more sonorant counterpart [y], and g^w as its more sonorant counterpart [w].

Alternation patterns triggered by affixation verify the different underlying sources for surface glides. Specifically, affixation triggers alternation in intervocalic glides that result from the multiple association of \check{j} and g^w ; however, it does not trigger alternation in intervocalic surface glides that result from vowel spreading. The alternation pattern for multiply associated \check{j} is shown in (50); the pattern for the spreading of i is shown in (51).

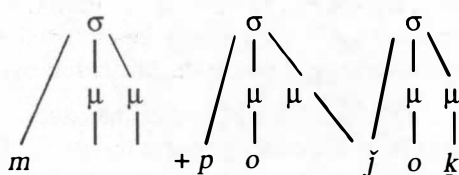
(50) *poyok* 'to rub'

Underlying form



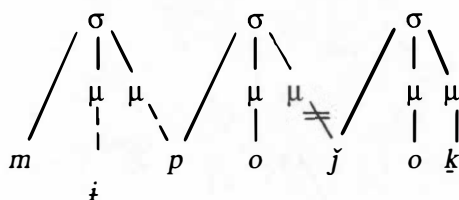
Surface form

Affixation



Multiple association

Delinking



Vowel epenthesis

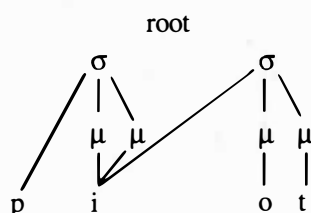
Surface form

[mippuyok]

In (50), the prefix *mi-* is added to the root *poyok* [puyok] 'to rub'. In the root, the surface consonant [y] is underlyingly a multiply associated \check{j} . With affixation, p in the initial onset of the root multiply associates with the coda of the prefix; \check{j} delinks from the first coda of the root and surfaces as [j]. Vowel epenthesis in the prefix follows.

(51) *piyot* 'to become thin'

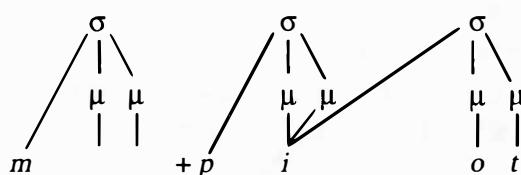
Underlying form



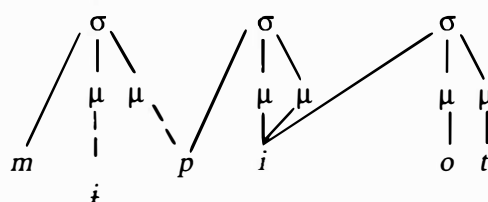
Surface form

[piyot]

Affixation



Multiple association



Vowel epenthesis

Surface form

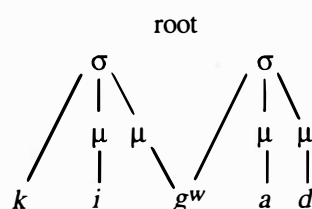
[mɪpiyot]

In (51), the prefix *mi-* is added to the root *piyot* [piyot] 'to become thin'. In the root, the surface glide [y] is the result of the underlying vowel *i* in the first nucleus spreading to the coda of its bimoraic unit and the onset of the following one. With affixation, *p* in the initial onset of the root multiply associates with the coda of the prefix; however, no alternation occurs in the medial root position. That is, the vowel *i* does not delink, but remains multiply associated and surfaces as [y]. Vowel epenthesis in the prefix follows.

These alternation patterns are the same for *g^w* and *o*: the pattern for multiply associated *g^w* is shown in (52); the pattern for the spreading of *o* is shown in (53).

(52) *kiwal* 'to stir'

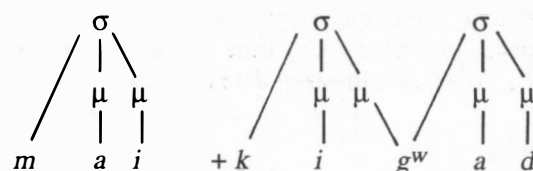
Underlying form



Surface form

[kewal]

Affixation



Delinking



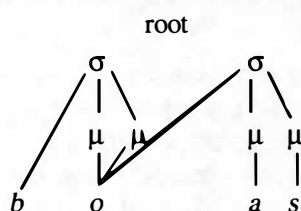
Surface form

[maykɛg^wal]

In (52), the prefix *may-* (underlyingly *mai-*) is added to the root *kiwal* [kɛwal] ‘to stir’. In the root, the surface consonant [w] is underlyingly a multiply associated g^w . With affixation, g^w delinks from the coda of the first bimoraic unit of the root and surfaces as [g^w]. (Recall that *i* surfaces as [ɛ] following [k].) Notice that the final [y] in the prefix *may-* is underlyingly the segment *i* (see footnote 8).

(53) *bowas* ‘to do something early in the morning’

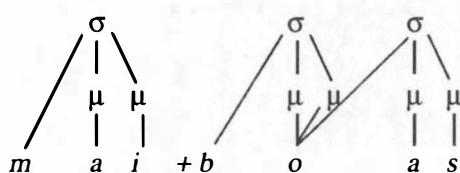
Underlying form



Surface form

[buwas]

Affixation



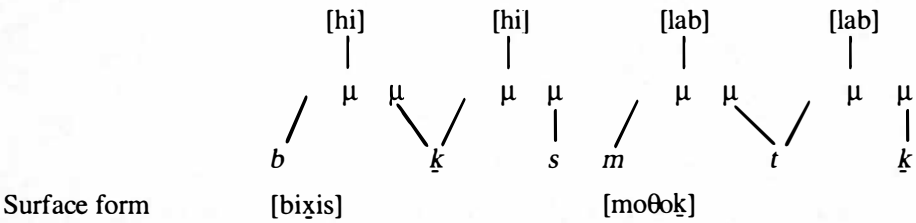
Surface form

[maybuwas]

In (53), the prefix *may-* is added to the root *bowas* [buwas] ‘to do something early in the morning’. In the root, the surface glide [w] is the result of the underlying vowel *o* in the first nucleus spreading to the coda of its unit and the onset of the following one. With affixation, no alternation occurs in the medial root position: the vowel *o* does not delink, but remains multiply associated and surfaces as [w].

There are three distribution constraints affecting the segments [j], [y] and [i], and the segments [g^w], [w] and [o]: firstly, the sequences [ji] and [g^wo] never occur within a syllable (although they may occur across morpheme boundaries as shown in (46) and (47)); secondly, the sequences [iyi] and [owo] never occur across syllable boundaries; thirdly, the sequences [iyj] and [owg^w] never occur across syllable boundaries. These constraints are explained by the fact that the surface segments [j], [y] and [i], and segments [g^w], [w] and [o] (or [u]) appear to have just two sources: the feature [high] for [j], [y] and [i], and the feature [labial] for [g^w], [w] and [o] (or [u]). I have suggested, for reasons to be presented later, that the partially specified segments [high] and [labial] exist on a tier separate from other segments. As (54) shows, this analysis results in contiguous [high] segments and contiguous [labial] segments occurring on the same tier (i.e. the partially specified tier). (In the following examples, [hi] represents [high], and [lab] represents [labial].)

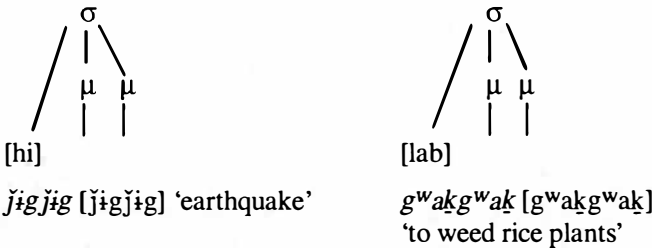
(54) *bixis* ‘inchworm’; *moθok* ‘to arrive’



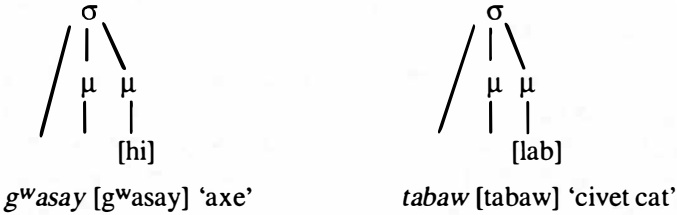
Example (54) shows that [high] segments may occur adjacent to each other as may [labial] segments; however, surface distribution patterns clearly indicate that there are constraints affecting sequences of these segments. If we look closely at these surface restrictions and consider how the segments would be associated with the moraic tier in the underlying representation, it appears that the constraint operates not on the partially specified melody tier, but on the moraic tier; specifically, [high] and [labial] cannot be associated with adjacent positions on the moraic tier.

On the basis of surface alternations and distribution constraints, I propose that [j], [y] and [i] derive from the feature [high], and [g^w], [w] and [o] (or [u]) from the feature [labial], and that the exact surface forms are determined by the specific feature, its position within a bimoraic unit, and its manner of association with those positions. This claim is demonstrated in (55) in which a schema is given for each attested surface variation of [high] and [labial]; examples are also included.

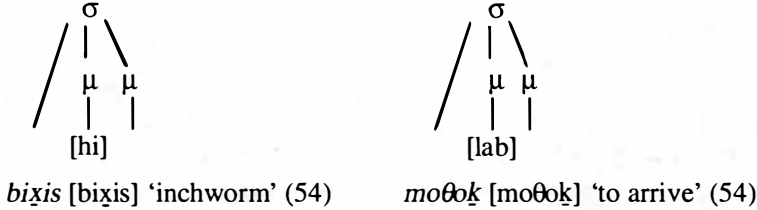
(55) a. Single association of feature - onset position



b. Single association of feature – coda position



c. Single association of feature – nucleus position



d. Multiple association of feature – consonant positions

*boyok* [buyok] 'to rot' (48)*tawid* [tawid] 'to inherit' (49)

e. Multiple association of feature – nucleus and coda positions

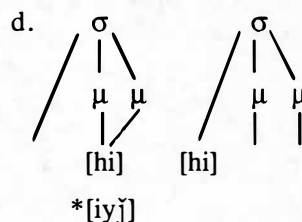
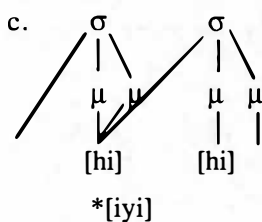
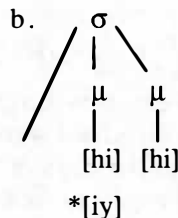
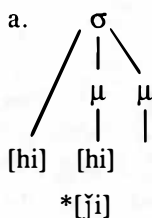
*biybiy* [biybiy] 'to show' (43)*balčow* [balčuw] 'fishnet' (43)

f. Multiple association of feature – nucleus, coda, and onset positions

*piyot* [piyot]
'to become thin' (44)*dowit* [duwit]
'strip of banana fibre' (44)

Surface distribution constraints predict that the following associations of the features [high] and [labial] are not permitted, since they result in separate [high] or [labial] features being associated with adjacent positions on the moraic tier. (Schemata for [high] only will be given since [labial] follows the same pattern.)

(56) Prohibited associations



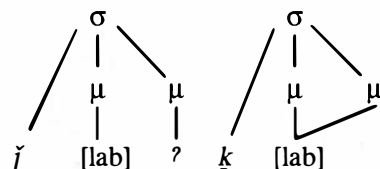
In (56b), [y] in the sequence *[iy] is derived from an underlying \check{y} , not from vowel spreading.

The schemata in (55) account for all attested surface variations of [high] and [labial] except for the alternation patterns exhibited by [b], [m], [w] and [g^w]. For alternation between these surface segments, another feature besides [labial] must be posited in the underlying representation in order to predict the correct surface form. For example, [labial] and [-continuant] would predict an alternation between [b] and [g^w] whereas [labial] and [+continuant] would predict an alternation between [m] and [w]. Later on I will argue that for the alternation pattern involving [b], [m], [w] and [g^w], [labial] is a redundant feature and that the crucial features for predicting the correct surface forms are [high] and [back] (see section 4.8).

Further evidence that [labial] is the single underlying segment for the surface forms [o] (or [u]), [g^w] and [w] are the surface variations of the root for 'sleep': [j^oḵow] and [j^og^wḵ]. The alternation between these two forms is one of metathesis, as illustrated in (57). (For convenience, all phonetic segments will be shown on one tier, since the issue of separate melody tiers is not relevant for this discussion.)

(57) a. j^oḵow 'to sleep'

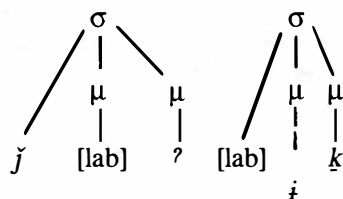
Underlying form



Surface form [j^oḵow]

b. j^og^wḵ 'to sleep'

Underlying form



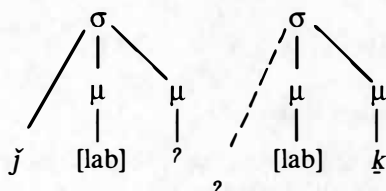
Vowel epenthesis

Surface form [j^og^wḵ]

In (57), metathesis occurs between the segments [labial] and ḵ in the second bimoraic unit of the root. In (57a), ḵ associates with the onset of the unit, and [labial] associates with the nucleus, spreading to the coda of the same unit. In (57b), ḵ and [labial] metathesise. Normally, we would expect the feature [labial] to remain associated with the nucleus mora since [labial] is the more sonorant segment; ḵ would then associate with the coda. Such a sequence of association, however, would result in the unattested forms in (58).

(58) a.

Underlying form



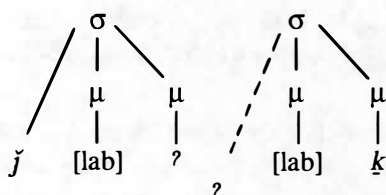
Glottal epenthesis

Surface form

*[jɔʔʔok]

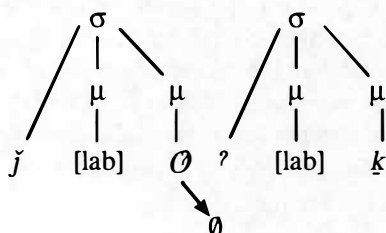
b.

Underlying form



Glottal epenthesis

Consonant deletion



Surface form

*[jɔʔok]

The unattested form *[jɔʔʔok] in (58a) is ill-formed because the surface sequence [ʔʔ] is not permitted. The unattested form *[jɔʔʔok] in (58b) is also ill-formed in that the association of segments in the underlying representation fails to produce two closed syllables in the surface form.

If the claim that only bimoraic units occur in the underlying representation is true, and if the claim that the central function of the phonological system is to produce closed surface syllables is also true, we have motivation for the specific order of association demonstrated by the attested surface forms [jɔʔkɔw] and [jɔʔgʷɪk] in (57). Notice first that in (57a) and (57b) each position in the first bimoraic unit is singly associated with a segment in the underlying representation, and so the unit will surface as a preferred closed syllable. In (57a), the association of *k* to the onset and [labial] to the nucleus and coda moras permits material to be associated with all positions in the second bimoraic unit, and the unit surfaces as a closed syllable. In the same way, in (57b), the association of [labial] with the onset and *k* with the coda permits material to be associated with the consonant positions of the second unit, and the vowel [i] is supplied for the nucleus by epenthesis, thus allowing the second unit to surface as a closed unit. Any other arrangement of the phonetic material in the second unit would fail to produce two closed surface syllables.

The alternation in (57) is also of interest because it suggests there is an association hierarchy for phonetic material in the underlying representation. The association hierarchy

predicts the order of association of phonetic material with underlying positions shown in (59).

(59) Association Hierarchy

onset > nucleus > coda

Specifically, the association hierarchy states that phonetic material in an underlying representation will be associated first with the onset, then with the nucleus, and finally with the coda. What is unusual about this hierarchy is that it predicts that, at least in certain environments, an onset will be assigned phonetic material before the nucleus, and this is what happens in [ʃoʔgʷɪk] in (57b). Such a hierarchy appears to be possible because Karao is able to provide epenthetic material for both onset and nucleus positions, and because the features [high] and [labial] are versatile and can associate with both consonant and nucleus positions.

The association hierarchy applies only to phonetic material occurring in the underlying representations; it does not include epenthetic material. If we were to include epenthetic material, then a nucleus would outrank an onset, and the association hierarchy would be: nucleus > onset > coda. That is, an epenthetic [ɪ] would be assigned to a nucleus lacking phonetic material and an epenthetic glottal stop to an onset lacking such material. Normally, if only one sonorous segment is available in the underlying representation and both the onset and nucleus lack material, the sonorous segment is associated with the nucleus and a glottal stop inserted for the onset; however, alternations such as those occurring between [ʃoʔkɔw] and [ʃoʔgʷɪk] demonstrate that, under certain conditions, an onset outranks a nucleus in eligibility for association with phonetic material.

4.4 THE SURFACE VOWEL [a]

I have suggested that the surface vowel [a] is underlyingly a fully underspecified segment. This claim needs to be refined slightly. Although surface [a] is always a fully underspecified segment, it has two sources: it may be the surface form of a fully underspecified segment that is associated with a vowel position in the underlying representation; or it may be a fully underspecified segment that is an allomorph of the epenthetic complex vowel. (I will show that the complex vowel is composed of two segments: the feature [high] and a fully underspecified segment.) In unaffixed roots, or in affixes which have only one surface form, the source of surface [a] is always a fully underspecified segment associated with a vowel position in the underlying representation; this is the segment that we will be concerned with in this section. (Surface [a] which is an allomorph of the epenthetic vowel will be discussed in section 4.5.)

There are different kinds of evidence for the claim that surface [a] is a fully underspecified segment. The most direct evidence is found in unaffixed roots: in such roots, [a] is the only vowel that permits all consonants to occur in the intervocalic position following it. All other vowels have distribution constraints limiting the consonants that may follow it in this position; for example, [o] (or [u]) does not permit [gʷ], and [i] does not permit [ʃ]. (The vowel [ɪ] occurs only in closed syllables.) The fact that only surface [a] allows all consonants to follow it in an intervocalic position motivates the claim that, in the underlying representation, [a] is a fully underspecified segment. In other words, the fact that [a] imposes no distribution constraints on consonants that follow it in an intervocalic position suggests

that [a] has no specified features, and thus permits any consonant to occur in that position. The surface form [a], then, is the result of a redundancy rule that supplies a default feature, namely [back], allowing the fully underspecified segment to surface as [a] when it is associated with a vowel position. (In section 4.6, I argue that the fully underspecified segment can also associate with a consonant position, in which case, it surfaces as [ʔ].) One might suppose that the default feature would be [low] for surface [a]; however, I later show why [back] is the preferred choice (see section 4.8). The [back] Redundant Feature Assignment rule is given in (60). (The symbol [] represents a fully underspecified segment.)

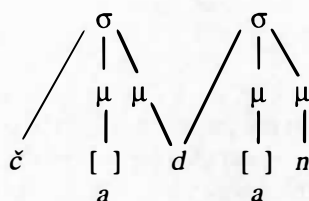
(60) [back] Redundant Feature Assignment

[] --> [back]

The underlying representation of the root *čalan* [čalan] 'path' is as shown in (61). (The symbol 'a' represents the redundant feature [back] when it is assigned to a fully underspecified segment in a vowel position.)

(61) *čalan* 'path'

Underlying form



Redundant feature
assignment

Surface form

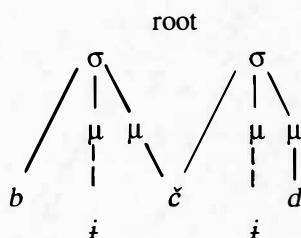
[čalan]

Observe that the fully underspecified segment has a weakening effect on multiply associated *d* which follows it. The fact that the segment weakens a multiply associated consonant indicates that it is present in the underlying representation and is not an epenthetic vowel.

Less direct evidence that surface [a] is a fully underspecified segment is found in alternations triggered by verb affixation. When appropriate affixes are added to CaCVC roots, [a] in the V₁ root position undergoes alternations that suggest it is present in the underlying representation, but that it has no specified features. We will first consider evidence that surface [a] is a segment present in the underlying representation. To do this, we will compare alternations occurring in a CiC₁C₁VC root (62) with those occurring in a CaCVC root (63) when the prefix *mi-* is added.

(62) *bičil* 'to be pregnant'

Underlying form

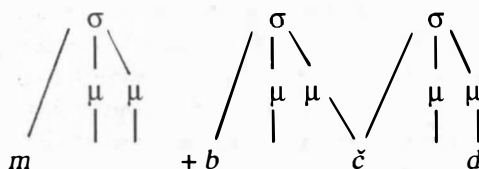


Vowel epenthesis

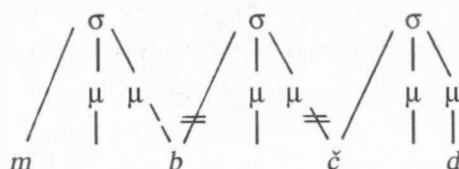
Surface form

[bičil]

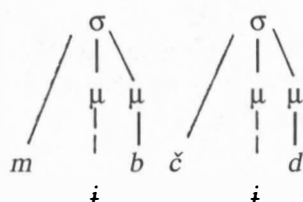
Affixation



Delinking



Resyllabification



Vowel epenthesis

Surface form

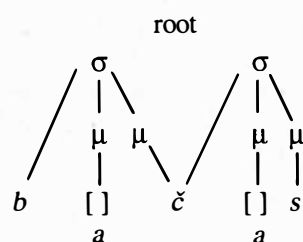
[mɪbčɪl]

In (62), the prefix $mɪ-$ is added to the $C_iC_1C_1VC$ root $b\check{c}l$ [bɪčɪl] 'to be pregnant'. Following affixation, b delinks from the initial onset of the root and reassociates with the prefix coda; \check{c} delinks from the first coda of the root, but remains associated with the second onset; the first bimoriac unit of the root is deleted; and resyllabification occurs. After these alternations, vowel epenthesis provides phonetic material for nuclei lacking material.

In (62) we see that when a prefix allowing resyllabification is added to a $C_iC_1C_1VC$ root, the entire first syllable of the root including the V_1 position is deleted. This alternation appears to be possible because no phonetic material is associated with the underlying V_1 root position. Now consider alternations occurring in a $CaCVC$ root when the same prefix is added.

(63) *bařas* 'to whip'

Underlying form

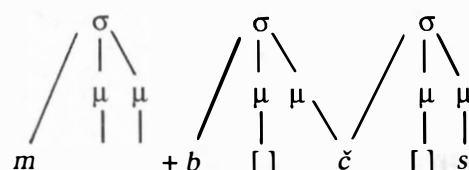


Redundant feature assignment

Surface form

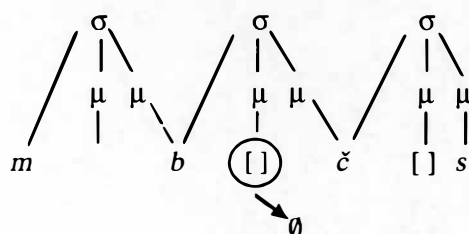
[bařas]

Affixation

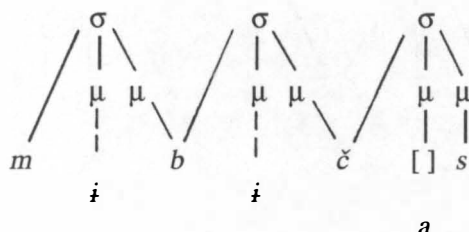


Multiple association

Vowel deletion



Vowel epenthesis

Redundant feature
assignment

Surface form

[mɪbbitčas]

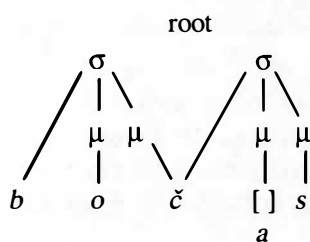
In (63), the prefix *mɪ-* is added to the CaCVC root *bařas* [bařas] 'to whip'. Following affixation, *b* in the initial onset of the root multiply associates with the coda of the prefix, and the fully underspecified segment in the V_1 root position is deleted. After these alternations, vowel epenthesis provides phonetic material for empty nuclei; and redundant feature assignment takes place.

What is important to note in (63) is that although the fully underspecified segment in the V_1 root position is deleted, the V_1 position itself is retained (as well as the rest of the first bimoraic unit of the root), and the V_1 root position surfaces with an epenthetic [ɪ]. This contrasts with the deletion of the first bimoraic unit in the $C_iC_1C_1VC$ root in (62) in which the V_1 position is not retained. These differences in alternation patterns provide support for the claim that surface [a] in an unaffixed root is a segment present in the underlying representation.

Now compare the alternations occurring in the CaCVC root in (63) with those occurring when the same prefix is added to the CV_1CVC root in (64) (representing roots in which V_1 is [o] or [ɪ]). A comparison of alternations occurring in these two root types provides evidence that although [a] is a segment present in the underlying representation, the segment has no specified features.

(64) *bořas* 'to pick'

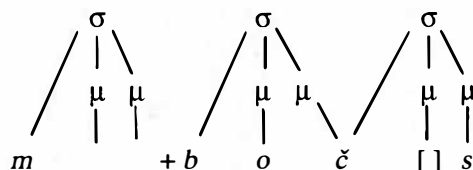
Underlying form

Redundant feature
assignment

Surface form

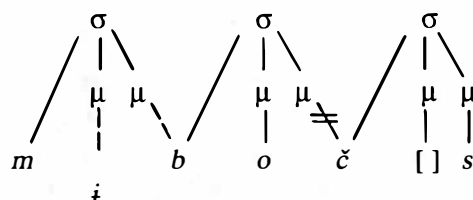
[buřas]

Affixation



Multiple association

Delinking



Vowel epenthesis

Redundant feature assignment

Surface form

[mɨbbučas]

In (64), the prefix *mi-* is added to the CV₁CVC root *bořas* [buřas] 'to pick' in which V₁ is *o*. Following affixation, *b* in the initial onset of the root multiply associates with the coda of the prefix; *č* delinks from the first coda of the root, but remains associated with the second onset; vowel epenthesis provides phonetic material for the nucleus of the prefix; and redundant feature assignment takes place.

What is of importance for our discussion is that *o* in the V₁ root position is not deleted with the addition of *mi-*; specifically, neither the position nor the segment associated with the position is deleted. The same holds true when the prefix *mi-* is added to CV₁CVC roots in which V₁ is *i*. Having established previously that [o] is present as the feature [labial] in the underlying form, and [i] as the feature [high], we can conclude that underlying segments specified for features occurring in the V₁ position of a CV₁CVC root will not be deleted following affixation. Thus, if [a] were a segment specified for a feature in the underlying representation, we would expect it to surface as [a] in a CaCVC root following affixation, but it doesn't; instead, [a] is replaced by epenthetic [ɨ]. The fact that [a] fails to surface as [a] in a CaCVC root following affixation is evidence that although [a] is a segment present in the underlying representation, it has no specified features.

4.5 THE EPENTHETIC COMPLEX VOWEL

I have made two claims about the epenthetic vowel in Karao: firstly, it is a complex vowel composed of two segments; and secondly, it is epenthetic in all occurrences. First let us consider evidence for the claim that the epenthetic vowel is a complex vowel.

For an underlying nucleus lacking phonetic material, a vowel may be inserted epenthetically in order to allow the bimoraic unit to surface. In surface representations, three vowels appear to insert epenthetically: [ɨ], [a] and [i]. I propose, however, that when [ɨ], [a] and [i] appear epenthetically, they do not originate from three separate sources, but from a single epenthetic vowel which surfaces as either [ɨ], or [a], or, more rarely, [i], depending on the environment.

The fact that surface [ɨ], [a], and [i] may alternate with each other in certain environments motivates the claim that [ɨ] is a complex vowel composed of two segments: the feature [high]

and a fully underspecified segment. Each segment occurs on a separate tier, but associates with the same timing unit on the moraic tier, thus representing the fact that [ɨ] is a single articulation, not a sequence of articulations, as seen in (65).

(65) Epenthetic Complex Vowel

Underlying form	[high]
	μ
	[]
Redundant feature assignment	a
Surface form	[ɨ]

If we accept the proposal that [ɨ] is a complex vowel, then the fully underspecified segment cannot occur on the same tier as the partially specified segment [high], since these segments must associate simultaneously with the same timing unit on the moraic tier. On the other hand, the feature [high] and the fully underspecified segment must occur on tiers separate from fully specified segments (i.e. consonants other than those derived from [high] and [labial]) in order to avoid crossing association lines when a consonant in the first onset of a $C_iC_1C_1VC$ root spreads to the coda of the same bimoraic unit (see section 6.2.5)). This then gives us three melody tiers in the underlying representation.

Before going farther, we need to distinguish between the surface vowels [ɨ], [a] and [i] that occur in unaffixed roots and those that occur in affixed forms. I propose that in unaffixed roots, only surface [ɨ] is an epenthetic vowel; that is, in a root, surface [ɨ] is evidence that no material is associated with the corresponding nucleus in the underlying representation. On the other hand, in unaffixed roots, surface [a] and [i] are never variants of the epenthetic vowel; instead, surface [a] represents an underlying fully underspecified segment, and surface [i] represents an underlying [high] feature. With the addition of certain affixes, however, an epenthetic vowel may be inserted in an affix or a root, in which case the epenthetic vowel may surface as [a], [i] or [ɨ]. It is only in affixed forms, then, that [a] and [i], as well as [ɨ], may occur as surface variants of the epenthetic vowel. This analysis implies that [ɨ], and its surface variants [a] and [i], never occur in the underlying representation of any form, and that is precisely the claim I wish to make: I propose that [ɨ] in any one of its surface forms is epenthetic in all occurrences and will provide support for this claim shortly.

The schema in (65) above provides us with an underlying representation for the epenthetic vowel that allows us to derive any one of its three surface forms: [ɨ], [a] or [i]. We now need to determine how to predict which variant of the epenthetic vowel will surface in a given environment, and the means by which a particular variant is derived from the underlying representation.

The general rule for vowel epenthesis is that if a nucleus lacks phonetic material in the underlying representation, an epenthetic complex vowel will be added to the nucleus. The rule is represented in (66).

(66)

Vowel Epenthesis

Underlying form



Vowel epenthesis



Redundant feature assignment

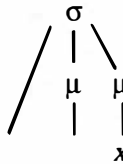
[back]

The epenthetic vowel surfaces as [ɨ] if the vowel is inserted in an underlying bimoraic unit in which a fully or partially specified segment is associated with the coda, as shown in (67). In this environment, both the feature [high] and the fully underspecified segment remain associated with the nucleus mora. A schema for the variant [ɨ] is given in (67), and an example follows in (68).

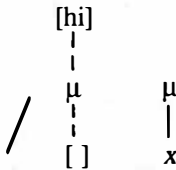
(67)

Vowel Epenthesis: Variant [ɨ]

Underlying form



Vowel epenthesis



Redundant feature assignment

[back]

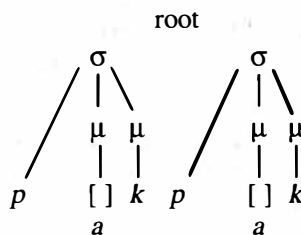
Surface form

[ɨx]

Note: *x* is a specified segment.

(68) *pagpag* 'to pat'

Underlying form

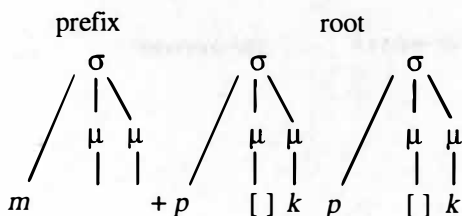


Redundant feature assignment

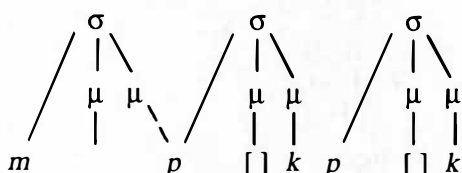
Surface form

[pʌgpʌg]

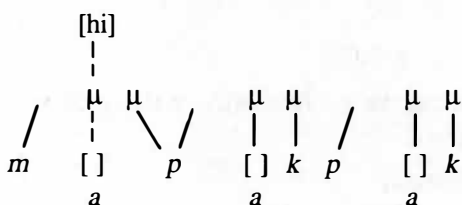
Affixation



Multiple association



Vowel epenthesis



Redundant feature assignment

Surface form

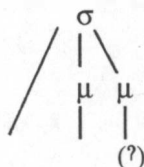
[mɪppʌgpʌg]

In (68), the prefix *mi-* is added to the root *pagpag* [pʌgpʌg] 'to pat'. Following affixation, the consonant *p* in the initial onset of the root multiply associates with the coda of the prefix. The nucleus of the prefix lacks phonetic material, and so an epenthetic vowel must be supplied in order for the underlying bimoraic unit to surface. Since the prefix coda is multiply associated with a fully specified segment, namely *p*, both segments of the epenthetic vowel remain associated with the nucleus mora; redundant feature assignment occurs last; and the epenthetic vowel surfaces as [ɪ].

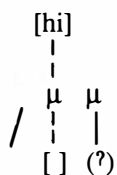
The epenthetic vowel surfaces as [a] if the vowel is inserted in a bimoraic unit: in which no phonetic material is associated with the coda; or in which a glottal stop is associated by rule with the coda, as shown in (69). I will argue later that [ʔ] is a fully underspecified segment that is associated with a consonant position. As a fully underspecified segment, [ʔ] has no specified features, and so the same allomorph of the epenthetic vowel surfaces preceding a coda with a glottal stop as does preceding a coda with no phonetic material. (More will be said about the glottal stop in section 4.6.) In these environments, the feature [high] and the fully underspecified segment are inserted in the empty nucleus; however, the feature [high] delinks, since [ɪ] never occurs in an open surface syllable or immediately preceding [ʔ]. This leaves only the fully underspecified segment associated with the mora of the nucleus. A schema for the variant [a] is given in (69); examples follow in (70) and (71).

(69) Vowel Epenthesis: Variant [a]

Underlying form



Vowel epenthesis



[high] delinking



Redundant feature assignment

[back]

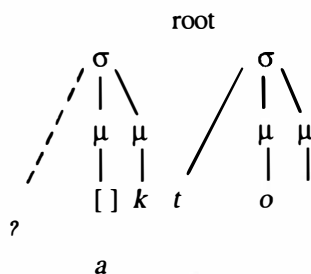
Surface form

[a(?)]

In example (70), an epenthetic vowel is inserted in the nucleus of the prefix; the coda of the prefix lacks phonetic material.

(70) ?agto 'to carry on the head'

Underlying form



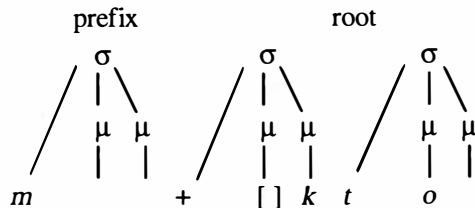
Glottal epenthesis

Redundant feature assignment

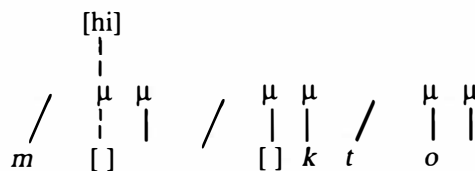
Surface form

[ʔʌgtu]

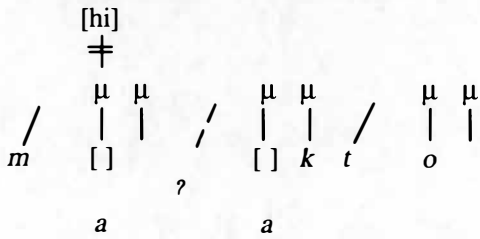
Affixation



Vowel epenthesis



[high] delinking



Glottal epenthesis
Redundant feature
assignment

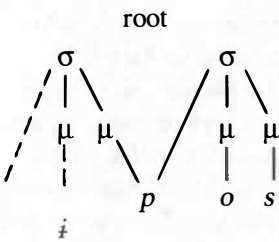
Surface form [maʔagtu]

In (70), the prefix *mi-* is added to the root *ʔagtu* [ʔagtu] ‘to carry on the head’. The nucleus of the prefix lacks phonetic material, and so an epenthetic vowel is inserted. Since the prefix coda is empty and cannot acquire phonetic material from the adjacent onset which is also empty, the epenthetic vowel cannot surface as [i]; instead, the feature [high] delinks, leaving only the fully underspecified segment associated with the prefix nucleus. Glottal epenthesis and redundant feature assignment occur last, and the epenthetic vowel surfaces as [a].

In example (71), an epenthetic vowel is inserted in the nucleus of the prefix; a glottal stop is inserted by rule in the coda of the prefix.

(71) *ʔipos* ‘to consume’

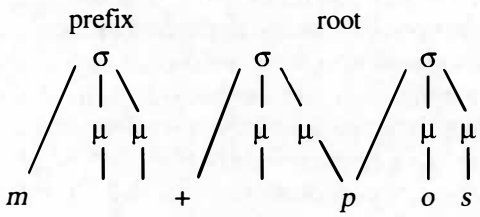
Underlying form



Vowel epenthesis
Glottal epenthesis

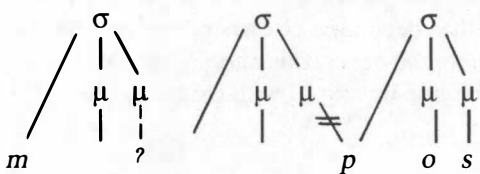
Surface form [ʔippos]

Affixation

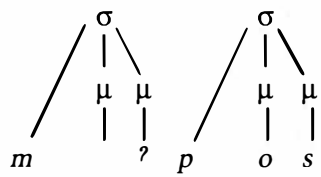


Prefix coda

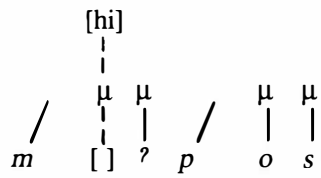
Consonant delinking



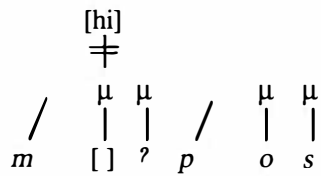
Resyllabification



Vowel epenthesis



[high] delinking



Redundant feature assignment



Surface form

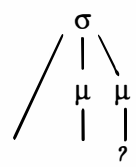
[maʔpos]

In (71), the prefix *mi-* is added to the root *ʔipos* [ʔippos] ‘to consume’. Following affixation, a glottal stop is added by rule to the prefix coda; multiply associated *p* in the medial root position delinks; the first bimoraic unit of the root is deleted; and resyllabification takes place. The nucleus of the prefix lacks phonetic material, and so an epenthetic vowel is inserted. Since the prefix coda is associated with a glottal stop, the epenthetic vowel cannot surface as [i]; instead, the feature [high] delinks, leaving only the fully underspecified segment associated with the prefix nucleus. Redundant feature assignment occurs last, and the epenthetic vowel surfaces as [a].

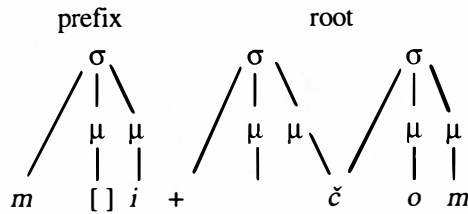
When the prefix *may-* attaches to a *ʔiC₁C₁VC* or *ʔaCVC* root, affixation triggers alternations in both roots with the result that a glottal stop is supplied by rule for the first coda, and an epenthetic vowel is inserted in the first nucleus of the root. Since the epenthetic vowel is followed by a glottal stop, it cannot surface as [i]. Instead, either the feature [high] delinks, and the epenthetic vowel surfaces as [a], as shown in (72a), or the fully underspecified segment is deleted, and the epenthetic vowel surfaces as [i], as shown in (72b). This is the only environment in which the allomorph [i] occurs. (Following Goldsmith (1990), a segment is circled to indicate that it is the deleted element, and an arrow pointing to a null sign signals that the deletion is part of the structural change. Since the circle and arrow formalism has been used elsewhere to represent the deletion (or delinking) of [a], it has been retained here; however, this alternation could also be represented by double bars through the association line linking [] with the moraic tier.)

(72) a.

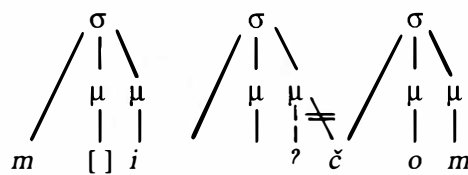
Underlying form



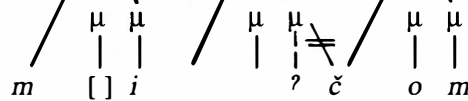
Affixation



Consonant delinking

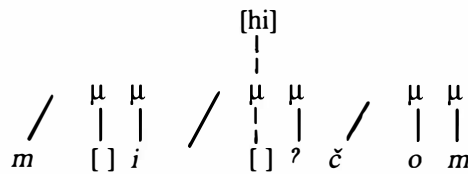


Root coda

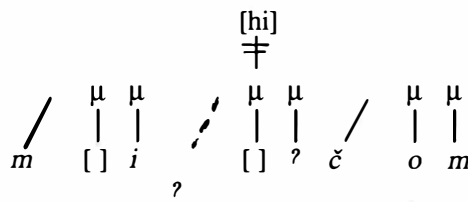


Variation 1

Vowel epenthesis



[high] delinking



Glottal epenthesis

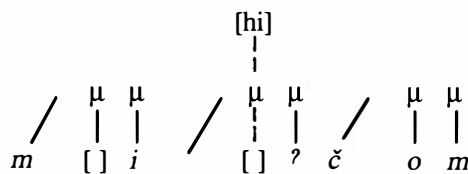
Redundant feature assignment

Surface form

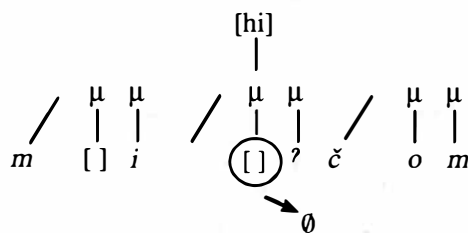
[may[?]a[?]čom]

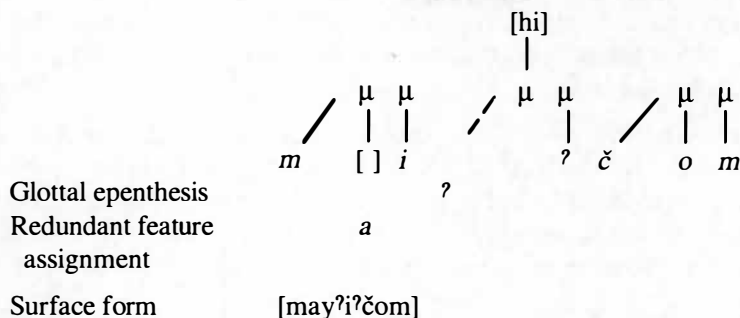
Variation 2

Vowel epenthesis



Vowel deletion





In (73), the prefix *may-* (underlying *mai-*) is added to the root *ʔičom* [*ʔičom*] ‘to add to something’. Following affixation, the multiply associated consonant *č* in the medial root position delinks from the first coda of the root, and a glottal stop is added to the first coda by rule. Since the nucleus of the root lacks phonetic material, an epenthetic vowel is inserted; however, both segments of the epenthetic vowel cannot remain associated with the nucleus, because the following coda is associated with a glottal stop. In variation 1, the feature [high] delinks, leaving the fully underspecified segment associated with the first nucleus of the root, and the epenthetic vowel surfaces as [a]. In variation 2, the fully underspecified segment is deleted, leaving the feature [high] associated with the nucleus, and the epenthetic vowel surfaces as [i]. This accounts for the surface allomorphs of the epenthetic vowel. Let us now consider the claim that the epenthetic vowel (represented as [ɨ] here) is epenthetic in all occurrences.

I have proposed that [ɨ] (in any one of its surface forms) is epenthetic in all occurrences. Evidence for this claim is found in both unaffixed roots and in alternations triggered by affixation. The occurrence of [ɨ] in unaffixed roots is considered first. (Recall that in unaffixed roots, the epenthetic vowel always surfaces as [ɨ].)

Unaffixed roots provide three kinds of evidence that [ɨ] is always epenthetic: firstly, phonemic contrast; secondly, distribution constraints; and thirdly, behaviour patterns. We will start with phonemic contrast.

In unambiguous closed syllables (unambiguous in the sense that the medial consonants are not identical; that is, the medial consonants are not a geminate cluster), the vowel [ɨ] contrasts with all other vowels (that is, [i], [o] (or [u]) and [a]), as shown in (74).

(74)	[bɨtɨt]	<i>bɨtɨt</i>	to cut with a <i>bolo</i>
	[batbat]	<i>batbat</i>	type of ritual
	[butbut]	<i>botbot</i>	to curse
	[kɨlkɨl]	<i>kɨlkɨl</i>	to wrinkle
	[kelkel]	<i>kɨlkɨl</i>	to ache

In open syllables, however, it is impossible to demonstrate contrast between [ɨ] and any other vowel since an intervocalic consonant always geminates following [ɨ] and only [ɨ]. Thus, the phonemic status of [ɨ] can be established only in unambiguous closed syllables. The fact that phonemic contrast for [ɨ] can be established only in closed syllables leads us to wonder about the exact nature of [ɨ]. If [ɨ] were present in the underlying representation, then we would expect to be able to establish contrast for [ɨ] in both open and closed syllables, just as we can for all other vowels. On the other hand, if [ɨ] is an epenthetic vowel, as I suggest, a closed syllable is precisely the environment in which we predict it will occur.

Thus, contrast of [ɨ] with other vowels in unambiguous closed syllables is not proof that [ɨ] is present in the underlying representation. What such contrast does show us is that [ɨ] is not a surface variant of another underlying vowel.

Another kind of evidence that the vowel [ɨ] is always epenthetic is provided by distribution constraints. The vowel [ɨ] is subject to two constraints that do not affect other vowels: [ɨ] cannot occur in the sequence *[ɨʔ]; and [ɨ] cannot occur in an open syllable. (The open syllable constraint is demonstrated unambiguously by the fact that [ɨ] never occurs word finally.) All other vowels, however, may occur in both environments, as shown in (75).

(75) a. [Vʔ] sequence

[daʔbaɿ]	daʔbaɿ	width
[diʔbit]	diʔbit	to carry in hand
[duʔbɨt]	doʔbɨt	wild grass

b. [V#] sequence

[daɿa]	daɿa	cheap
[daɿe]	daɿi	man/boy
[daɿo]	daɿo	goods for sale

Another distribution constraint unique to [ɨ] is the prohibition of the sequences *[ɨy] and *[ɨw]. A survey shows that all other vowels can occur in a [Vy] or [Vw] sequence, as illustrated in (76).

(76)	[ɨ]			[i]		
	*[ɨy]			[paɿey]	paɿiy	unhusked rice
	*[ɨw]			[baʔdiw]	baʔdiw	men's chant
	[o]			[a]		
	[ʔaɿuy]	ʔaɿoy	fire	[buʔday]	boʔday	yard
	[paɿow]	paɿow	chest	[tayaw]	tayaw	men's dance

An explanation for this constraint is the association hierarchy presented in (59) which predicts that if sonorous material is available in the underlying representation, it will be associated with the nucleus first and then with the coda. We may assume that a segment that can only function as a vowel is more sonorous than a segment that can function as either a vowel or a consonant. So then, if the vowel [ɨ] were present in the underlying representation, we would expect to find the sequences [ɨy] and [ɨw], since [ɨ] would associate with the nucleus, allowing the features [high] and [labial] (underlying forms of [y] and [w]) to associate with the coda, as they do in combination with all other vowels in the underlying representation. Since the sequences *[ɨy] and *[ɨw] are not permitted, this is support for the claim that [ɨ] does not occur in the underlying representation.

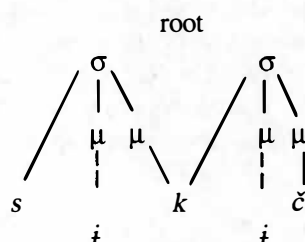
A third kind of evidence that [ɨ] is always epenthetic is found in the behaviour patterns exhibited by [ɨ]. The first pattern is the effect of [ɨ] on intervocalic consonants: in surface forms, intervocalic consonants geminate following [ɨ] and only [ɨ]. I have proposed that surface gemination is the result of multiple association of a single segment with a coda and an adjacent onset in the underlying form. I have also suggested that set 2 consonants in an intervocalic surface position are the result of the same type of multiple association. In order to account for the surface variations in multiply associated consonants, I have argued that the

difference between a geminate set 1 consonant and a corresponding single set 2 consonant in an intervocalic surface position is due to the presence or absence of a vowel preceding the multiply associated consonant in the underlying representation: if a vowel precedes a multiply associated consonant in the underlying form, it weakens the consonant, and the consonant surfaces as its set 2 form; on the other hand, if no vowel precedes the consonant, the consonant does not weaken and surfaces as a geminate set 1 consonant. On the basis of this argument, if [i] were present in the underlying representation, we would expect it to have the same weakening effect on multiply associated consonants as do all other vowels. The fact that it does not is evidence that [i] is not present in the underlying representation, but rather is supplied epenthetically in order to permit an underlying bimoraic unit to surface.

The second behaviour pattern involving [i] has to do with alternations triggered by affixation. (Alternations triggered by affixation are treated in detail later; consequently, only those points that are relevant for the present discussion are described here.) Following the addition of a prefix, the vowel [i] in the surface root $C_iC_1C_1VC$ is always deleted, as shown in (77).

(77) *sikid* 'to wait'

Underlying form

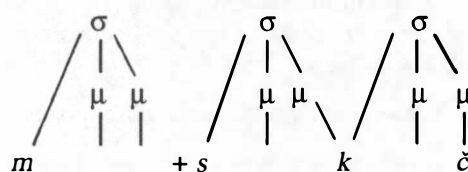


Vowel epenthesis

Surface form

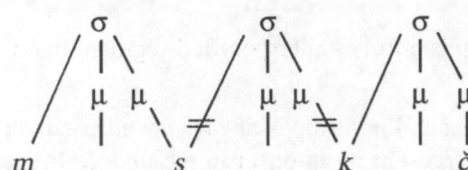
[sikkid]

Affixation

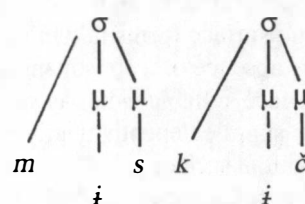


Multiple association

Delinking



Resyllabification



Vowel epenthesis

Surface form

[miskid]

In (77), the prefix *mi-* is added to the $C_iC_1C_1VC$ root *sikid* [sikkid] 'to wait'. Following affixation, *s* delinks from the first onset of the root and reassociates with the prefix coda; *k* delinks from the first coda of the root, but remains associated with the second onset; the first moraic unit of the root is deleted; and resyllabification takes place. Vowel epenthesis occurs last. Note that the affixed form surfaces as two unambiguous closed syllables.

The alternation pattern for [ɨ] is unique in that the V_1 position of a $C_iC_1C_1VC$ root is always deleted, resulting in resyllabification that produces unambiguous closed surface syllables. For C_iCVC and $CoCVC$ roots, the V_1 position is never deleted following the addition of any prefix; for a $CaCVC$ root, [a] in the V_1 position is deleted with the addition of certain prefixes, but normally the position itself is not lost; instead [a] is replaced by [ɨ]. (The only exception to this pattern is when the initial onset of a $CaCVC$ root is a glottal stop, that is ?aCVC; in such roots, both [a] and the V_1 position of the root are deleted.)

The pattern for [ɨ] is also unique in that the V_1 position in a $C_iC_1C_1VC$ root is deleted with the addition of any prefix that permits resyllabification. For all other root types, alternation is triggered only by prefixes beginning with consonants other than a glottal stop; that is, prefixes in which phonetic material is associated with the underlying initial onset (see section 6.5). I suggest that the susceptibility of $C_iC_1C_1VC$ roots to resyllabification is due in part to the drive towards closed surface syllables and in part to the lack of phonetic material associated with the V_1 position of the root. The fact that the initial syllable of a $C_iC_1C_1VC$ root is relatively unstable, and so more susceptible to resyllabification compared to $CVCVC$ roots provides support for the claim that [ɨ] is not present in the underlying representation.

4.6 THE GLOTTAL STOP

The glottal stop is a problematic segment in Karao.⁹ In describing this segment, I make several claims which may seem unusual; however, I provide evidence to show that each claim is necessary if we are to account for all occurrences of the glottal stop and its behaviour. The claims are as follows:

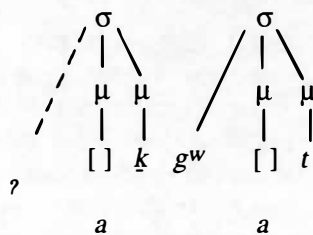
- (1) The glottal stop is always epenthetic in the onset position.
- (2) The glottal stop is never epenthetic in the coda position; rather, a coda glottal stop may be present in the underlying representation, or it may be added by rule.
- (3) The glottal stop is a fully underspecified segment that is associated with a consonant position.

The first claim is that a glottal stop is always epenthetic in an onset position. Specifically, a glottal stop is never present in an onset in the underlying representation, but is inserted epenthetically whenever an underlying onset lacks phonetic material. This claim is based on the following observation: there are no surface forms in which the presence of a glottal stop in an onset position contrasts with the absence of a consonant in that position. This suggests that a glottal stop in the onset of a surface syllable is not associated with that position in the underlying representation; rather, it is supplied epenthetically whenever an underlying onset lacks phonetic material. Since vowel-initial surface syllables are not permitted, the addition of a glottal stop in the onset is required in order for the underlying bimoraic unit to surface, as shown in (78).

9 For convenience, I refer to the segment as 'glottal stop' until I present evidence that surface [ʔ] is underlyingly a fully underspecified segment.

(78) ?ak^gwat 'to stand'

Underlying form



Glottal epenthesis
Redundant feature
assignment

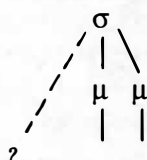
Surface form

[ʔak^gwat]

A rule for glottal epenthesis is represented in the following schema.

(79) Glottal Epenthesis

Underlying form

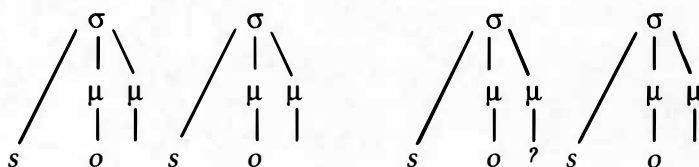


Glottal epenthesis

The second claim is that a glottal stop is never epenthetic in a coda position; a glottal stop in a surface coda position represents either a glottal stop that is present in the corresponding coda position in the underlying representation, or a glottal stop that has been added to the coda position by rule at some point in the derivation. The claim that a glottal stop can be present in the underlying representation is based on the following observation: there are surface forms of unaffixed roots in which the presence of a glottal stop in a coda position contrasts with the absence of a consonant in that position, as shown in (80).

(80) soso 'breast'; soʔso 'to feed someone'

Underlying form



Surface form

[susu]

[suʔsu]

In (80), [susu] 'breast' and [suʔsu] 'to feed someone' contrast in that the first syllable of [susu] lacks a coda while the first syllable of [suʔsu] has a coda which is a glottal stop. (Since word-final glottal stops are prohibited, contrast can be confirmed only in non-final codas.) From this example, we conclude that the presence of a glottal stop in the coda of an unaffixed surface root indicates the presence of a glottal stop in the corresponding position in the underlying unit.

Additional evidence that a coda glottal stop is present in the underlying representation is the fact that when an affix triggering morphological alternations is added to a CVC₁C₂VC root in which C₁ is a glottal stop, such as *kʌʔkʌ* [kʌʔkʌ] 'to scoop', the root patterns like CVC₁C₂VC roots in which C₁ is any consonant other than [ʔ], such as *kʌlkʌ* [kʌlkʌ] 'to disarrange'. If a glottal stop were not present in the C₁ root position in the underlying

representation, we would expect the CV[?]C₂VC root to pattern like one of the CVCVC root types when such an affix is added, but it doesn't.

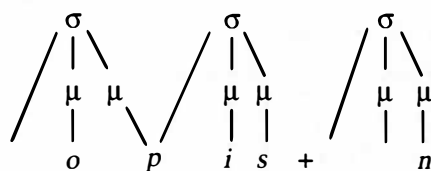
These facts tell us only that a glottal stop can be present in a coda position in the underlying representation; they do not show us that a glottal stop can never be added epenthetically to a coda position. In order to demonstrate that a glottal stop is not inserted epenthetically in a coda, we must consider phonological alternations in which a segment delinks from a coda, leaving it unassociated. If the addition of a glottal stop in a coda were an epenthetic rule, as it is for an onset, then we would expect a glottal stop to be automatically supplied for any empty coda position; however, as we will see this does not happen. (The following examples include phonological rules that are presented formally in Chapter 6. The reader may refer to that chapter for details about any rule.)

First, the contrastive pair *soso* [susu] 'breast' and *soʔso* [suʔsu] 'to feed someone' in (80) demonstrate that epenthetic material is not supplied for codas in unaffixed roots. If a coda does not acquire phonetic material by multiple association of a consonant, or by spreading of a vowel, the coda remains empty and does not surface, as in the root *kapi* [kapi] 'coffee' or *ʔotik* [ʔotək] 'small'. If glottal epenthesis occurred in all consonant positions, that is, codas as well as onsets, then we would expect a glottal stop to be inserted in all empty codas, producing *[kəʔpi] and *[ʔotək], but these are unattested forms.

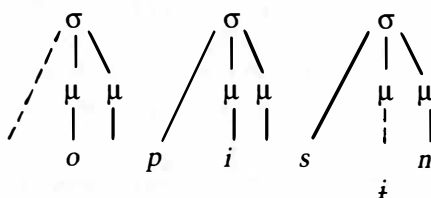
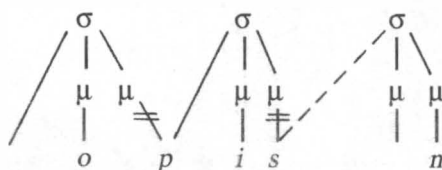
One could argue that an empty coda in an unaffixed root might be lexically specified and so is prohibited from associating with a segment; thus, lexical specification would explain empty codas in unaffixed roots. Let us, then, consider phonological alternations in which a segment associated with the coda of a root delinks, leaving the coda empty, as shown in example (81).

(81) *ʔopis* 'to massage'

Underlying form



Delinking



Vowel epenthesis

Glottal epenthesis

Surface form

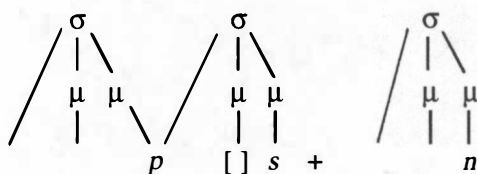
?
[ʔu\$pi\$sin]

In (81), the suffix *-in* attaches to the root *?opis* [*?upis*] ‘to massage’. Following affixation, *p* delinks from the first coda of the root; *s* delinks from the final coda of the root and reassociates with the suffix onset; and vowel and glottal epenthesis follow. No segment is provided for the empty codas of the root and the codas fail to surface. Since both codas of the root are associated with phonetic material before affixation, we cannot assume that the lexical specification of the root blocks glottal epenthesis in either coda.

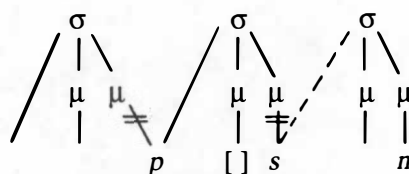
One might argue that there is a language specific constraint that prohibits a coda from reassociating with a segment once the coda has undergone delinking. This would explain the failure of a segment to associate with the empty codas in (81). If we compare the first coda of the root in (81) with that in (82), however, we see that a coda can reassociate following delinking.

(82) *?ipas* ‘to take down’

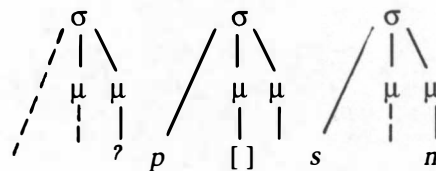
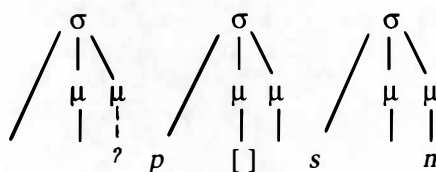
Underlying form



Delinking



Root coda



Vowel epenthesis

Glottal epenthesis

Redundant feature assignment



Surface form

[*?a?pa\$sin*]

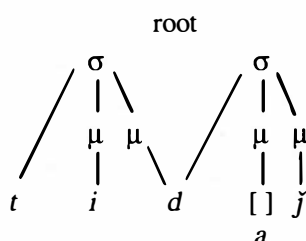
In (82), the suffix *-in* attaches to the root *?ipas* [*?ippas*] ‘to take down’. Following affixation, *p* delinks from the first coda of the root and a glottal stop is added to the first coda by rule; *s* delinks from the final coda of the root and reassociates with the suffix onset. Vowel and glottal epenthesis follow, and redundant feature assignment occurs last. The fact that a glottal stop is added to the first coda of the root after the coda has delinked from *p* is evidence that a coda can reassociate with a segment following delinking. Furthermore, the

fact that a glottal stop is not added to the final coda of the root, even though it also lacks phonetic material, is evidence that the addition of a glottal stop in a coda position is accomplished by a lexical rule and not by epenthesis. (The specific rule for the addition of a glottal stop in a root coda is given in Chapter 6.)

Final evidence that an onset glottal stop and a coda glottal stop are added by different types of rules comes from its ability to trigger morphological alternations. When morphological alternations, such as consonant delinking or vowel deletion, are triggered by the presence of a segment in certain onset positions in the underlying representation (either the first onset of a prefix (see section 6.5), or the second onset of a CVCVC root (see section 6.2.3)), these alternations fail to occur when the corresponding surface onset is a glottal stop. An example from consonant delinking is given in (83).

(83) *tilay* 'to writhe in pain'

Underlying form

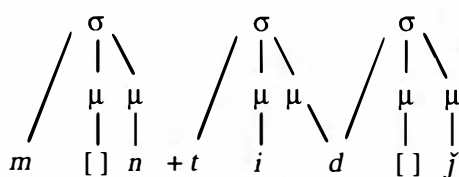


Redundant feature assignment

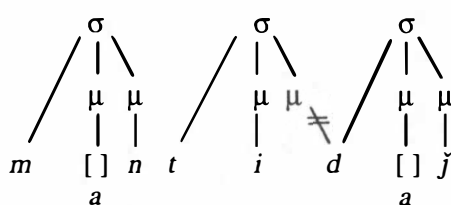
Surface form

[tilay]

Affixation



Delinking



Redundant feature assignment

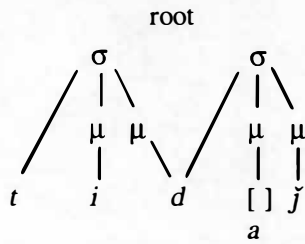
Surface form

[mantiday]

In (83), the prefix *man-* is added to the root *tilay* [tilay] 'to writhe in pain'. Following affixation, multiply associated *d* in the medial root position delinks from the first coda of the root, but remains associated with the second onset, surfacing as [d]. Redundant feature assignment occurs last. Compare (83) with (84) below in which the prefix *ʔiyan-* is added to the same root. Notice that the first onset of the prefix is [ʔ].

(84) *tilay* ‘to writhe in pain’

Underlying form

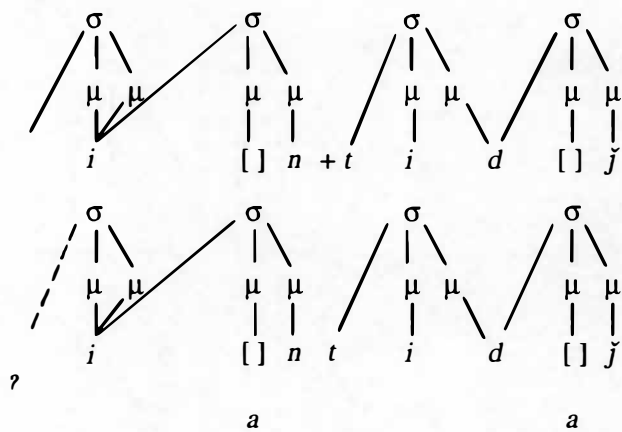


Redundant feature assignment

Surface form

[tilay]

Affixation



Glottal epenthesis
Redundant feature assignment

Surface form

[ʔiyanṭilay]

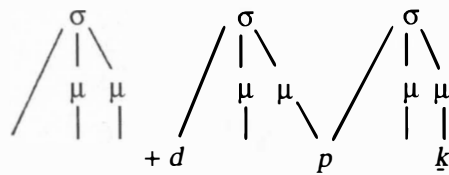
In (84), the prefix *ʔiyan-* is added to the root *tilay* [tilay] ‘to writhe in pain’. Following affixation, no alternations occur other than glottal epenthesis and redundant feature assignment. I suggest that the prefix fails to trigger consonant delinking in (84) because no segment is present in the first onset of the prefix when the delinking rule applies in the derivation; consequently, delinking is not triggered.

In contrast, when morphological alternations, such as the addition of an infixation template in a prefix followed by vowel decomposition, are triggered by the presence of a segment in a coda position in the underlying representation, the morphological alternations are triggered even when the corresponding surface coda is a glottal stop, as shown in (85)-(87). (These morphological alternations are complex so I will give only those details that are relevant to the discussion of the glottal stop. The reader may refer to section 7.2 for details about infixation and vowel decomposition.)

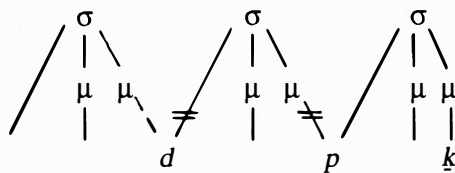
In a prefix, a bimoraic perfective template is added only if the final coda of the prefix is associated with a segment at that point in the derivation, as shown in (85).

(85) *dipik* 'to get wet'

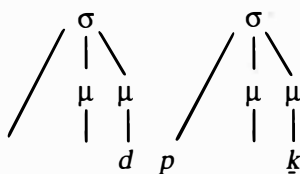
Affixation



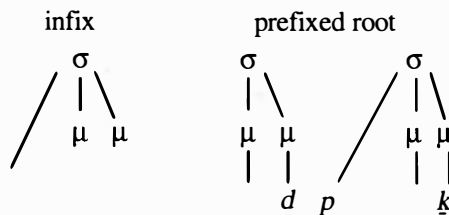
Delinking



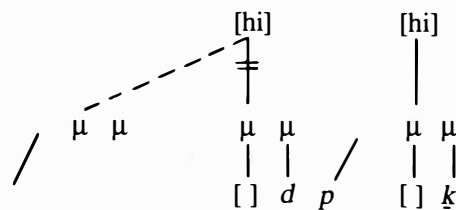
Resyllabification



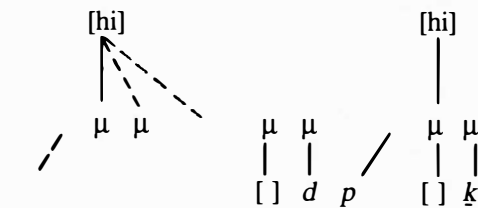
Inflection



Vowel epenthesis and decomposition



Vowel spreading



Glottal epenthesis
Redundant feature
assignment



Surface form

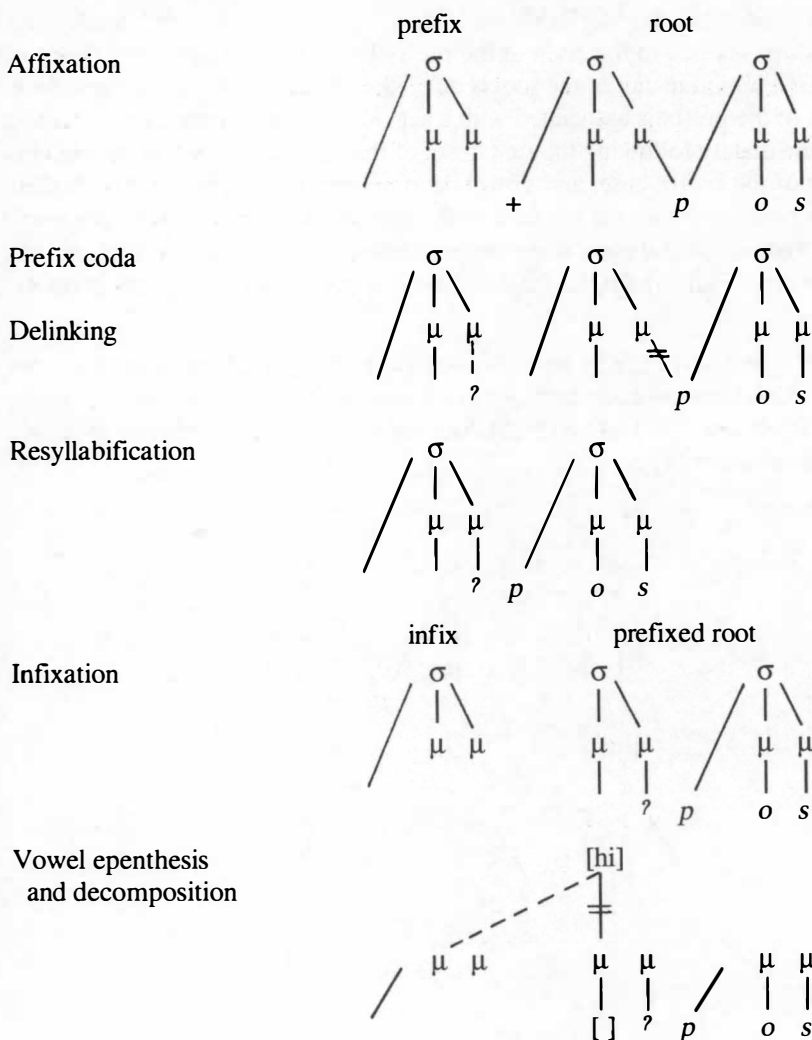
[[?]iyalpik]

In (85), the prefix [?]i- is added to the C_iC₁C₁VC root *dipik* [dippik] 'to get wet'. Following affixation, *d* in the first onset of the root delinks and reassociates with the coda of the prefix; *p* in the second onset delinks from the first coda of the root, but remains associated with the second onset; the first bimoraic unit of the root is deleted; and resyllabification takes place.

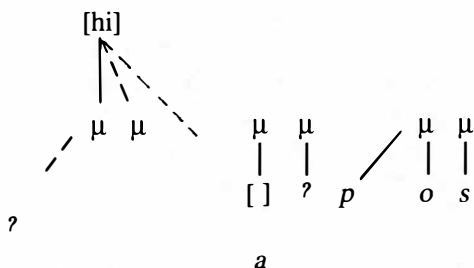
Since the final coda of the prefix is associated with a segment, a bimoraic perfective template is added immediately following the first onset of the prefix. An epenthetic vowel is added to the nucleus of the prefix base, and vowel decomposition is triggered. The feature [high] of the epenthetic vowel delinks and reassociates with the nucleus of the perfective template (thereby functioning as the perfective segment [high], or *i*). The feature [high] then spreads to the adjacent coda and onset. Glottal epenthesis and redundant feature assignment occur last.

This same process is triggered when a glottal stop is added to the final coda of a prefix, as shown in (86).

(86) *ʔipos* 'to consume'



Vowel spreading



Glottal epenthesis

Redundant feature
assignment

Surface form

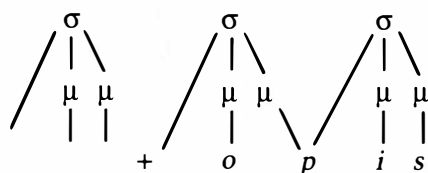
[ʔiyaʔpos]

In (86), the prefix ʔi- is added to the ʔiC₁C₁VC root ʔipos [ʔippos] 'to consume'. Following affixation, a glottal stop is added to the coda of the prefix by rule; *p* in the second onset of the root delinks; the first bimoraic unit of the root is deleted; and resyllabification takes place. Again, the final coda of the prefix is associated with a segment, and so a bimoraic perfective template is added immediately following the first onset of the prefix. An epenthetic vowel is added to the nucleus of the prefix base, and vowel decomposition is triggered. The feature [high] delinks and reassociates with the nucleus of the perfective template, then spreads to the adjacent coda and onset. Glottal epenthesis and redundant feature assignment occur last. Now compare (86) with (87) in which the final coda of the prefix never acquires phonetic material.

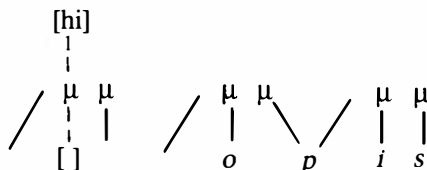
If the final coda of a perfective prefix remains unassociated, a perfective template is not added to the prefix. Although the epenthetic vowel decomposes when the feature [high] delinks from the prefix nucleus, the feature [high] does not surface since there is no available mora in the prefix, as shown in (87).

(87) ʔopis 'to massage'

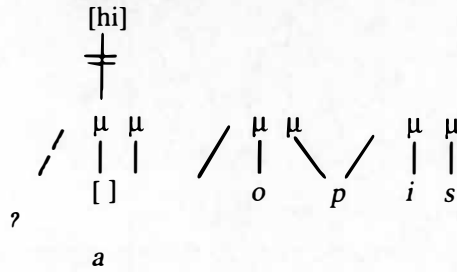
Affixation



Vowel epenthesis



[high] delinking



Glottal epenthesis
Redundant feature
assignment

Surface form

[ʔaʔupis]

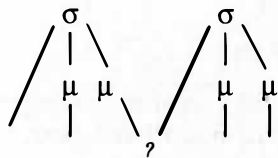
In (87), the prefix ʔ- is added to the ʔVCVC root ʔopis [ʔupis] 'to massage'. A perfective template is not added, since the prefix coda also lacks phonetic material. Consequently, only vowel epenthesis can occur; however, the feature [high] of the epenthetic vowel delinks because the adjacent coda is empty, and surface [i] cannot occur in an open syllable. Glottal epenthesis and redundant feature assignment take place last.

Comparing these examples, we see that if a glottal stop is added to a coda, it triggers the same alternations as any other consonant; however, if a glottal stop is added to an onset, it fails to trigger alternations as other consonants do. I suggest that these asymmetries may be explained by the claim that onset glottal stops and coda glottal stops are added to a derivation at different stages. In other words, an onset glottal stop is supplied epenthetically and so is not added to a derivation until all lexical rules have applied; thus, a surface glottal stop in the onset position cannot trigger alternations controlled by that position because the glottal stop is not present at the stage in the derivation when lexical rules apply. On the other hand, a coda glottal stop is supplied by lexical rule and so is able to interact with other lexical rules; thus, a surface glottal stop in the coda position triggers alternations controlled by that position because the glottal stop is present in the coda at that point in the derivation. From these facts, we may conclude that a glottal stop is supplied epenthetically for any empty onset, but that a glottal stop is supplied for an empty coda only by lexical rule.

The third claim is that a surface glottal stop is underlyingly a fully underspecified segment. There are two distribution constraints which suggest that a glottal stop is, at least, different from other consonants. The first constraint states that a glottal stop cannot geminate, that is, the sequence *[ʔʔ] is prohibited, as shown in (88).

(88) Prohibition on surface sequence *[ʔʔ]

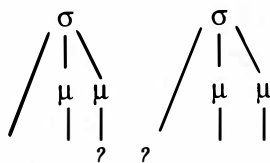
a. Underlying form



Surface form

*[ʔʔ]

b. Underlying form



Surface form

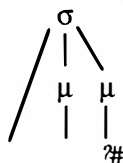
*[??]

The prohibition on the sequence *[??] implies that a glottal cannot multiply associate with two consonant positions in the underlying representation, whereas all others underlying consonants can.

The second constraint states that a glottal stop never occurs word-finally, as shown in (89). All other underlying segments, however, can occur in this position.

(89) Prohibition on word-final glottal stop

Underlying form



Surface form

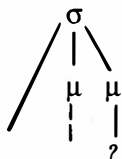
*[?#]

Although these two distribution constraints indicate that a glottal stop is different from other consonants, they do not show that a glottal stop is a fully underspecified segment. A third distribution constraint, however, offers evidence for the claim that a surface glottal stop is underlyingly a fully underspecified segment.

The third distribution constraint states that a glottal stop cannot follow a surface [ɨ], that is, the sequence *[ɨʔ] is prohibited, as shown in (90).

(90) Prohibition on the surface sequence *[ɨʔ]

Underlying form



Vowel epenthesis

ɨ

Surface form

*[ɨʔ]

In unfixed roots, a glottal stop may occur in a coda position following [a], [i] and [o]. On the other hand, I have argued that, in unfixed roots, [ɨ] only occurs in closed surface syllables. So the question is: why can [ɨ] occur in a closed syllable preceding any consonant except [ʔ]? The answer appears to be that [ʔ] has a different feature specification from other consonants. Specifically, other consonants are either fully specified, or in the case of the features [high] and [labial], partially specified. If we assume that a glottal stop is a fully underspecified segment, we can account for the prohibition on the sequence *[ɨʔ] in unfixed roots by stating that, in unfixed roots, the epenthetic vowel is inserted in a bimoraic unit only if the coda is associated with a specified segment. This claim not only

takes care of the *[ɨʔ] prohibition, it also allows us to account for the fact that the epenthetic vowel surfaces as the variant [a] in two environments: firstly, when it precedes a coda that lacks phonetic material; and secondly, when it precedes a coda that is associated with a glottal stop (by rule). If a glottal stop is a fully underspecified segment, then it has no features and is, in effect, invisible to the vowel epenthesis rule; thus, the vowel epenthesis rule treats a coda with a glottal stop as though it were an empty position, and surfaces as the variant [a].

Archangeli (1988) proposes that a language will have only one fully underspecified segment. If we accept that a surface glottal stop is a fully underspecified segment, then we are proposing that a fully underspecified segment has two surface forms: [a] when the segment is associated with a vowel; and [ʔ] when the segment is associated with a consonant position. This claim is not as unusual as it may seem at first since we have already established that the partially specified segments [high] and [labial] may associate with either a vowel or a consonant position, surfacing as different phonetic forms depending on the position. It follows then that the fully underspecified segment may also associate with either a vowel or a consonant position with the redundant feature [back] being assigned in either case. Based on the evidence and arguments presented here, I assume [a] and [ʔ] are surface forms of a single fully underspecified segment. The segment will be represented in derivations by the symbol []; for convenience, the redundant feature [back] will be represented by 'a' when the segment is associated with a vowel position and by '?' when it is associated with a consonant position.

4.7 WELL-FORMEDNESS CONDITIONS

There are four well-formedness conditions affecting surface syllables: three concern the syllable itself; the fourth concerns the contact position between two adjacent syllables.

4.7.1 SYLLABLE CONDITIONS

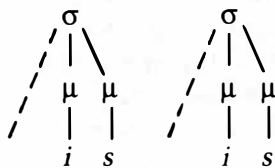
The three well-formedness conditions for a surface syllable are: a syllable must have an onset; it must have a nucleus; and a preferred syllable has a coda. I have argued that there is a single underlying bimoraic unit for all surface syllables that results in a drive towards closed surface syllables. I have also proposed that the main problem in achieving closed surface syllables appears to be a chronic shortage of phonetic material for units in the underlying representation. To remedy the problem, various strategies are employed to acquire sufficient material for the underlying unit, thereby satisfying the well-formedness conditions and allowing the unit to surface. In this section, we will consider those strategies that are employed in unaffixed roots; later, we will consider strategies that are employed in affixed roots.

4.7.1.1 ONSET

If an onset lacks phonetic material, a fully underspecified segment, which surfaces as [ʔ], is supplied, as shown in (91).

(91) *ʔisʔis* 'to leak'

Underlying form



Glottal epenthesis

[]
ʔ[]
ʔRedundant feature
assignment

Surface form

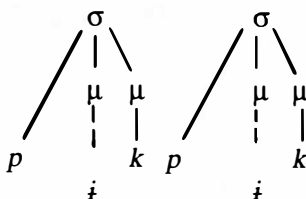
[ʔisʔis]

4.7.1.2 NUCLEUS

If a nucleus lacks phonetic material, an epenthetic vowel is supplied, surfacing as [ɨ] in an unfixed root, as shown in (92).

(92) *pɨgpɨg* 'heartbeat'

Underlying form



Vowel epenthesis

Surface form

[pɨgpɨg]

4.7.1.3 CODA

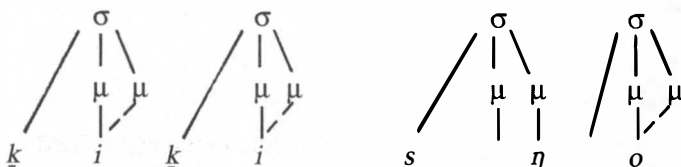
If a coda lacks phonetic material, it may acquire material in two ways: vowel spreading, and multiple association of a consonant.

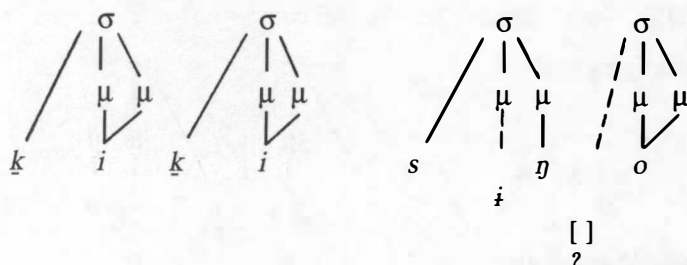
If a coda lacks material and the preceding nucleus is associated with the feature [high] (represented by *i*) or the feature [labial] (represented by *o*), then the feature may spread to the coda position, surfacing as a glide in the coda, as shown in (93).

(93) *kɨy̥kɨy̥* 'to move back and forth'; *sɨŋʔow* 'to smell good'

Underlying form

Vowel spreading





Vowel epenthesis
Glottal epenthesis
Redundant feature
assignment

Surface form

[keykey]

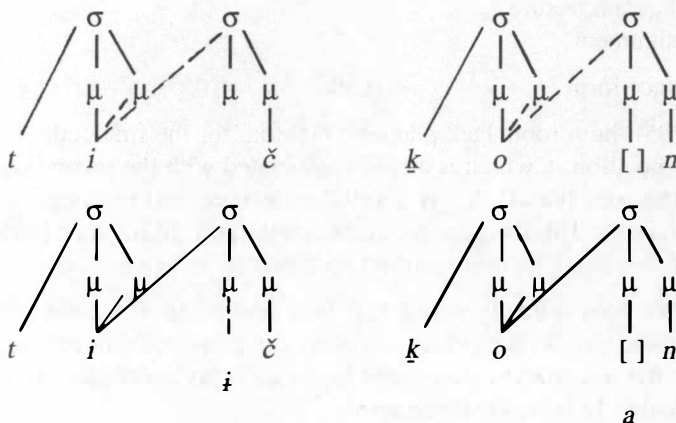
[siŋ'ow]

In *kɪyɪy* [keykey] in (93), the feature [high] (or i) spreads to the coda position in both bimoraic units; in *siŋ'ow* [siŋ'ow], the feature [labial] (or o) spreads to the coda of its unit, and vowel and glottal epenthesis take place followed by redundant feature assignment. (Recall that following k , i surfaces as [e].)

If a coda and an adjacent onset lack material, the feature [high] or [labial] may spread to both consonant positions, surfacing as an intervocalic surface glide, as shown in (94).

(94) *tiyid* 'to go uphill'; *kowan* 'to come/go'

Underlying form



Vowel spreading

Vowel epenthesis
Redundant feature
assignment

Surface form

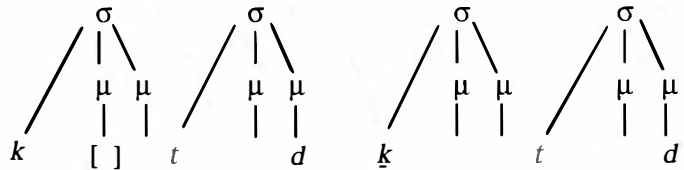
[tiyid]

[kowan]

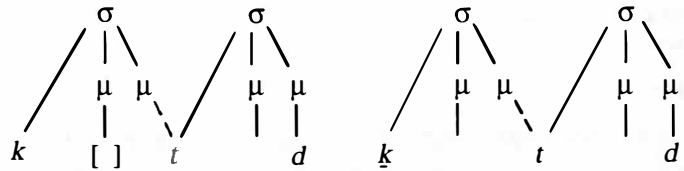
The second way a coda may acquire phonetic material is by multiple association of a consonant. Since surface syllables must have onsets, we can assume that if only one segment is available in the underlying form for two consonant positions, then it must associate with the onset position. Once the segment associates with the onset, it may spread to the preceding coda. If the preceding nucleus is associated with a vowel, that is i , o or a fully underspecified segment, the multiply associated consonant will surface as its more sonorant set 2 counterpart. If the nucleus is not associated with a vowel, indicating that the nucleus will surface as an epenthetic $[i]$, the multiply associated consonant will surface as its less sonorant set 1 counterpart. Examples follow.

(95) *kaθi:l* ‘to itch’; *kɪti:l* ‘to feel cold’

Underlying form



Multiple association



Vowel epenthesis

Redundant feature assignment

Surface form

[kaθi:l]

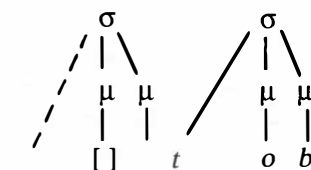
[kɪti:l]

In (95), both roots lack phonetic material for the first coda. In order to supply material for this position, *t*, which is already associated with the second onset, spreads to the first coda. In the root [kaθi:l], *V*₁ is a fully underspecified segment, and so multiply associated *t* surfaces as [θ], its more sonorant counterpart. In the root [kɪti:l], *V*₁ is unassociated, and *t* surfaces as [t], its less sonorant counterpart, and geminates.

We have already noted that in a few roots, the coda of an underlying unit remains unassociated. In such cases, speakers can pronounce the root as separate syllables, indicating that the intervocalic consonant is not multiply associated, as in (96). Empty codas in roots appear to be lexically determined.

(96) *ʔatob* ‘women’s chant’

Underlying form



Glottal epenthesis

Redundant feature assignment

Surface form

[ʔatob]

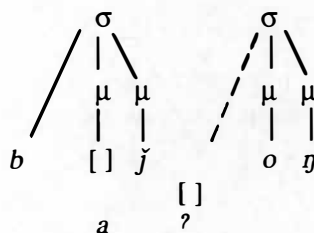
In (96), *t* is singly associated with the second onset; an epenthetic glottal stop is added to the initial onset, and redundant feature assignment takes place. Evidence that *t* is not multiply

associated is that Karao speakers can pronounce the surface form as separate syllables, pausing before *t*, that is [ʔa\$to**b**].

Since some codas are left empty, one may question whether a coda is actually present. In unaffixed roots, we can verify the presence of a underlying word-final coda in vowel-final surface forms by adding certain enclitic morphemes. Several enclitic possessive pronouns have two allomorphs: one that follows consonant-final surface forms, and another that follows vowel-final surface forms. For example, the pronoun 'my' has two allomorphs: *k*o and *k*. The allomorph *k*o follows consonant-final surface forms, as in (97) and (98); *k* follows vowel-final surface forms, associating with the word-final coda position, as in (99).

(97) *bayʔoŋ* 'market basket'

Underlying form

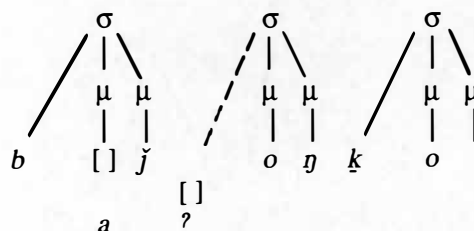


Glottal epenthesis
Redundant feature
assignment

Surface form

[bayʔuŋ]

Addition of
enclitic pronoun



Glottal epenthesis
Redundant feature
assignment

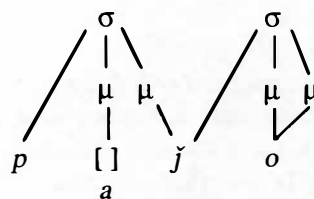
Surface form

[bayʔuŋko] 'my market basket'

In (97), the root ends with the consonant [ŋ] which is singly associated with the final coda, and the allomorph *k*o follows.

(98) *payow* 'rice field'

Underlying form

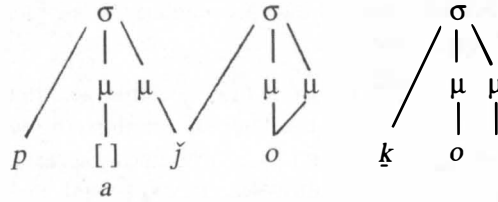


Redundant feature
assignment

Surface form

[payuw]

Addition of
enclitic pronoun



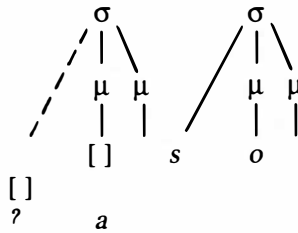
Redundant feature
assignment

Surface form [payuwko] 'my rice field'

In (98), the surface form of the root ends with the glide [w], and the allomorph $\underline{k}o$ follows.

(99) ?aso 'dog'

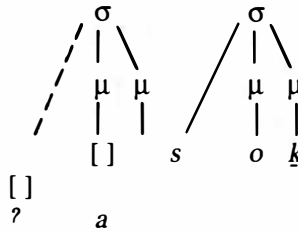
Underlying form



Glottal epenthesis
Redundant feature
assignment

Surface form [ʔasu]

Addition of
enclitic pronoun



Glottal epenthesis
Redundant feature
assignment

Surface form [ʔasuk] 'my dog'

In (99), the surface form of the root ends with the vowel [u], and the allomorph \underline{k} is associated with the final coda position.

4.7.2 SYLLABLE CONTACT

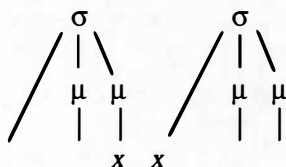
Finally, there is a preferred syllable contact (as defined by Vennemann 1988:40) between adjacent syllables: two non-identical consonants. Although a single specified segment can be multiply associated with two adjacent consonant positions on the moraic tier in the underlying representation, resulting in a surface geminate cluster, two identical specified segments cannot be singly associated with adjacent positions on the moraic tier, resulting in a surface cluster of identical consonants. This is an expression of the same constraint affecting the partially specified segments [high] and [labial]. Recall that although one [high] segment can occur adjacent to another [high] segment on the partially specified tier, two [high] segments cannot be associated with adjacent positions on the moraic tier. (The same is also true of [labial] segments.) The fact that two fully specified segments cannot be associated

with adjacent positions on the moraic tier, suggests that the adjacent mora constraint is a general prohibition that applies to specified segments on all tiers. The prohibition may be stated as follows: identical specified segments on the same melody tier cannot be associated with adjacent positions on the moraic tier. The prohibition is represented in the schema in (100): (100a) represents segments on the fully specified tier; (100b) represents segments on the partially specified tier.

(100) Adjacent Mora Prohibition

a.

Underlying form



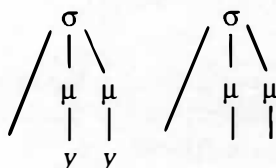
Surface form

*[xx]

Note: x is a fully specified segment.

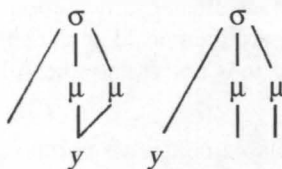
b.

Underlying form



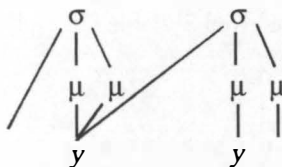
or

Underlying form



or

Underlying form



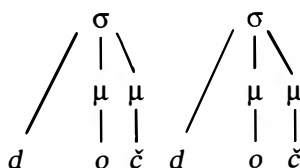
Note: y is a partially specified segment, and so has different surface forms depending on whether it is associated with a vowel or consonant position.

Segments on the fully underspecified tier are not affected by the Adjacent Mora Prohibition; that is, two fully underspecified segments can associate with adjacent positions on the moraic tier, as confirmed by the attested surface sequence [a?ʔ] occurring in words such as [paʔdoŋ] 'stream'. We may assume that fully underspecified segments are exempt from the Adjacent Mora Prohibition precisely because they lack feature specifications in the underlying representation.

An interesting example of the Adjacent Mora Prohibition applied to syllable contact occurs in the root *doddod* [duddud] 'to weed dykes'. The surface form suggests that the medial consonant cluster [dd] is a sequence of identical consonants, not a geminate consonant, since geminate clusters typically follow only [i]. The following derivation shows the underlying form of the root.

(101) *doddod* 'to weed dykes'

Underlying form



Surface form

[duddud]

As indicated in (101), the source for the surface [d] in the first coda is not the same as the source for the surface [d] in the second onset: the source for the coda [d] is č, but the source for the onset [d] is *d*. This claim is based upon the distribution patterns for [d] and [l], and for [č], [ř] and [d] (see section 2.2.1). For the segments [d] and [l], [d] occurs in onsets, but [l] occurs in codas; for the segments [č], [ř] and [d], [č] occurs in onsets, but [d] occurs in codas.

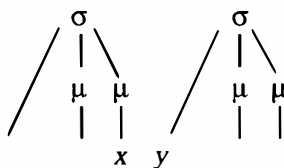
Further evidence that the source for the coda [d] is an underlying č is had by adding the suffix *-an* to the root; following suffixation, the final [d] of [duddud] changes to an intervocalic position. For the set [d] and [l], either [d] or [l] may occur intervocalically; for the set [č], [ř] and [d], either [č] or [ř] may occur intervocalically (but not [d]). When *-an* is added to *doddod*, we get [dudduřan], demonstrating that the underlying form of root-final [d] is č. Despite the fact that the surface cluster [dd] is composed of two identical segments, the language apparently does not regard them as identical since each segment has a different source; thus, the underlying cluster does not violate the Adjacent Mora Prohibition and is allowed to surface.

To summarise, the preferred syllable contact is composed of non-identical consonants associated with adjacent positions on the moraic tier in the underlying representation, as represented in (102). (The symbols *x* and *y* represent non-identical consonants.)

(102)

Preferred Syllable Contact

Underlying form



Surface form

[xy]

Taking all the syllable well-formedness conditions and the strategies employed in unaffixed roots to meet these conditions, we can make certain predictions about how phonetic material will be associated with positions in the underlying representation, particularly when there is a lack of phonetic material. I have suggested that underlying every surface syllable is a single bimoraic unit. Most roots in Karao are disyllabic; therefore, we may assume that the preferred root has an underlying template composed of two bimoraic

units. Among disyllabic roots in Karao, there is a large number in which the two syllables are identical; for example, [diŋdiŋ] 'to forget', [biŋbiŋ] 'to cut with a *bolo*', [ʔokʔok] 'to cough', and even [ŋaʔŋa] 'child' and [siʔsi] 'grass broom' in which the final glottal stop appears to be blocked by the prohibition on word-final glottal stops in surface forms.

These roots suggest that when there is insufficient phonetic material in the underlying representation, the material is associated in a one-to-one manner with the positions of the first bimoraic unit and then the first unit is copied as a whole to form the second unit of the root template. Thus, if only two consonants and a vowel are available in the underlying representation, a well-formed root, such as [diŋdiŋ], can be produced. Since epenthetic material is always supplied for an empty onset and nucleus, if only two consonants are available, an epenthetic vowel can be added and a well-formed root, such as [biŋbiŋ], can still be produced. Or if only a vowel and a consonant are available, then an epenthetic glottal stop (i.e. a fully underspecified segment) can be added to the onset and a well-formed root, such as [ʔokʔok], is possible. If only one consonant is available, a well-formed root can still be formed, but in this case, the consonant must be associated with the coda, since epenthetic material is never supplied for a coda. This is exactly what we find in the root [ʔibʔib] 'to suffocate'. Since onset [ʔ] and [i] are epenthetic material, we must conclude that only the single segment *b* is present in the underlying representation. The surface root is produced by associating *b* with the first coda of the root template; epenthetic segments are supplied for the first onset and the first nucleus; then the entire first bimoraic unit is copied in order to form the second unit of the disyllabic template; and the template surfaces as [ʔibʔib], a well-formed root composed of two closed syllables with a preferred syllable contact. The fact that *b* is associated with the coda position, rather than the onset position provides further support for the claim that underlying all surface syllables is a single bimoraic unit. It also provides support for the claim that the central problem in the phonological system is the acquisition of sufficient phonetic material for positions in the bimoraic unit, particularly the coda position, since epenthetic material is not supplied for this position.

4.8 ALTERNATIONS INVOLVING [-LABIAL] AND [+LABIAL] SEGMENTS

The segments [-labial] and [+labial] each participate in separate alternation patterns: [-labial] occurs in alternations affecting the surface vowels [i], [a] and [ɨ]; [+labial] occurs in alternations affecting the surface consonants [b], [m], [w] and [gʷ] (see section 4.3.4).

4.8.1 ALTERNATIONS INVOLVING [-LABIAL]

I have proposed that Karao has only three underlying vowel segments that can function as vowels: [high], [labial], and a fully underspecified segment. Because of the interaction between the segments [i], [j], and [y], and the segments [o], [gʷ] and [w], I have argued that [i] is best represented as the feature [high], and [o] (or [u]) as the feature [labial] in the underlying representation. I suggest that the default surface feature for the fully underspecified segment is best represented as [back] (rather than [low]), since [back] produces the correct surface form for the three segments that require a default feature specification; namely, the fully underspecified segment when it functions as a vowel (surface [a]), the fully underspecified segment when it functions as a consonant (surface [ʔ]), and the feature [nasal] in certain prefixes (surface [ŋ]). In addition, it will be seen that [back] is also needed to account for feature specification for the underlying segment *gʷ*.

Within the vowel system, the feature [high] and the fully underspecified segment interact with each other; however, [labial] never interacts with any other vowel. These facts can be explained by means of feature specification following Clements (1985) and Archangeli (1988). The following chart gives each surface vowel and the features representing that vowel.

(103)

[i]	[ɨ]	[o]
[high]	[high back]	[labial]
	[a]	
	[back]	

In (103), each surface vowel except [ɨ] is represented by a single privative feature: the vowel [i] is represented by [high]; the vowel [o] (and [u]) by [labial]; the vowel [a] (or the fully underspecified segment) by [back]. Only the features [high] and [labial] occur in the underlying representation; the feature [back] is supplied by a default rule. Notice that the feature [labial] separates [o] from the other vowels which is exactly what we want since [o] never participates in vowel alternation. (The feature [-labial] is not indicated for [i], [a] and [o], since it is redundant for vowel alternation; that is, any vowel which lacks the feature [labial] is predictably a [-labial] vowel.)

I suggest that we can account for surface vowel alternation between [i], [a] and [ɨ] by assuming that [i] is assigned the single feature [high], [a] is assigned the single default feature [back], and [ɨ] has no separate features of its own, but is simply a combination of the features [high] and [back]. This agrees with the claim that [ɨ] is a complex vowel which can, in certain environments, decompose into the two vowels [i] and [a], as in the perfective prefix allomorphs *ʔiN-* and *ʔiyaN-* (see section 7.2). It also agrees with the claim that as an epenthetic vowel, [ɨ] may surface as any one of three forms: [a] (or the feature [back]); [i] (or the feature [high]); and [ɨ] (or the features [high] and [back]). If we accept that [ɨ] is a complex vowel, then we need posit only two features to account for the surface alternations between [i], [a] and [ɨ]: the feature [high] and the default feature [back], as seen in (104).

(104)

[high]	[labial]
[back]	

4.8.2 ALTERNATIONS INVOLVING [+LABIAL]

We have seen that while the [-labial] surface vowels [i], [a] and [ɨ] alternate with each other, the [+labial] surface vowel [o] (or [u]) never alternates with the other vowels. On the other hand, we have also seen that while the [-labial] surface consonants [j] and [y] never alternate with other consonants, the [+labial] surface consonants [b], [m], [w] and [g^w] do alternate with each other. If we assume that the feature [+labial] is the basis for the alternation involving [b], [m], [w] and [g^w] and that these surface consonants are underlyingly the segments *b*, *m* and *g^w*, we can assign features to these segments in (105) much in the way we assigned features to the vowels in (103).

(105)

<i>b</i>	<i>g^w</i>
[-back]	[+back]
	[+high]
<i>m</i>	
[-high]	

In (105), the feature [+labial] is not indicated since it is redundant for this pattern of alternation; that is, any consonant which lacks the feature [+labial] is predictably [-labial] and cannot participate in the alternation. (The other redundant feature is [+voice] since *p* also does not participate in the alternation.) The features assigned to the consonants in (105) are the same as those assigned to the vowels in (103): the feature [-back] is assigned to *b*; the feature [-high] to *m*; and the features [+back] and [+high] to *g^w*. The only difference in the assignment for [-labial] vowels and [+labial] consonants is that, for vowels, the features are privative, but, for consonants, the features have binary values.

The result is a pattern that makes an interesting comparison with the analysis presented for vowel alternation. Those consonants which are not complex segments, that is *b* and *m*, have only one feature as do the vowel *i* and the fully underspecified segment (if we count the default feature [back] for the fully underspecified segment). The complex consonant *g^w*, however, has two features. This pattern contrasts with the analysis of vowel alternation in (104) in which the composite vowel [ɨ] has no features in the underlying representation. This suggests that features are masked or cancelled in the epenthetic segment [ɨ], but not in the underlying segment *g^w*.

4.9 SUMMARY OF UNDERLYING SEGMENTS AND ASSOCIATION RULES

Having attempted to account for all the surface segments, the following is an inventory of the segments occurring in the underlying representation of Karao.

(106) Underlying segments

Fully specified segments

<i>p</i>	<i>t</i>	<i>k</i>	<i>k̥</i>
<i>b</i>	<i>d</i>		
		<i>č</i>	
<i>m</i>	<i>n</i>	<i>ŋ</i>	
	<i>s</i>		

Partially specified segments

[high]	[labial]
--------	----------

Fully underspecified segment

[]

All twenty-two surface consonants and four surface vowels can be derived from fourteen underlying segments: eleven fully specified segments, two partially specified segments, and one fully underspecified segment. This inventory underscores the claim that the central problem in Karao phonology is a lack of sufficient phonetic material for positions in the underlying moraic structure.

The following summarises the underlying structure of Karao surface syllables and the rules determining the association of phonetic material with that structure. I have argued that underlying every surface syllable is a single structure consisting of two moras, as in (107).

(107) Underlying Bimoraic Structure

μ μ

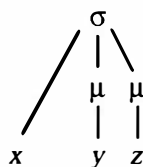
Syllable structure does not occur in the underlying representation but is supplied by an algorithm: the first mora is dominated by the syllable node, forming the nucleus; the second mora joins with the syllable node, forming the coda; and the onset position, having no mora, joins directly to the syllable node, as in (108).

(108) Syllabified Structure

Syllable tier

Moraic tier

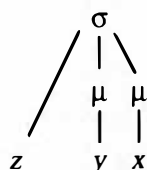
Melody tier



Phonetic material is assigned to three separate melody tiers, according to degree of specification. The fully underspecified segment [] (surface [a] or surface [ʔ]) is assigned to one tier; the partially specified segments [high] and [labial] are assigned to another tier; fully specified segments are assigned to a third tier.

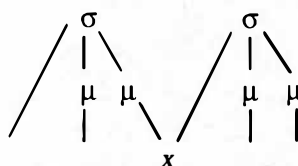
The preferred means of associating phonetic material with the moraic structure is single association: a separate phonetic segment is assigned to each position in the underlying representation, as in (109). This manner of association allows the underlying structure to surface as a closed (CVC) syllable.

(109) Single Association



If the underlying representation lacks sufficient phonetic material for a position, then segments can associate in various ways to supply material for that position. For codas lacking material, a segment associated with an adjacent onset can multiply associate with the preceding coda, as in (110).

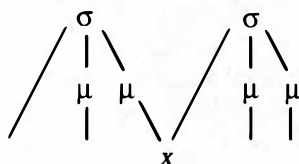
(110) Multiple Association of Consonant



A segment multiply associated with consonant positions undergoes weakening when preceded by a vowel in the underlying representation, as in (111).

(111) Consonant Weakening

Underlying form

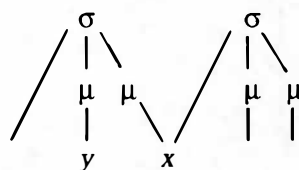


Surface form

[x₁x₁]

Note: x₁ is a set 1 consonant.

Underlying form



Surface form

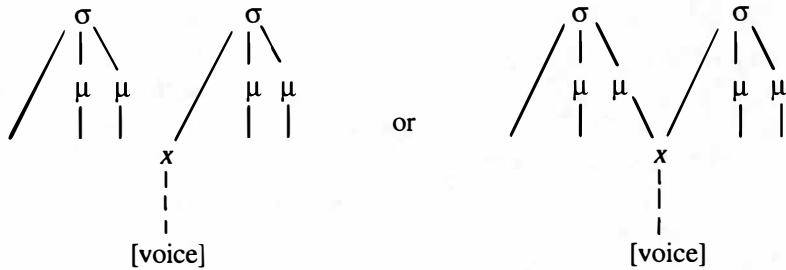
[yx₂]

Note: x₂ is a set 2 consonant.

The segments *k* and *č* undergo weakening when the feature [voice] is added, as in (112).

(112)

Voicing

Note: *x* is *k*.Note: *x* is *č*.

For codas, or adjacent codas and onsets, lacking material, a [high] or [labial] feature in the preceding nucleus can spread to the consonant positions, as in (113).

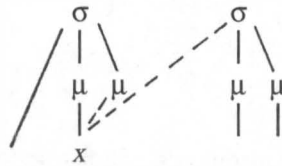
(113)

Vowel Spreading

a.



b.

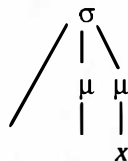
Note: *x* is the feature [high] or [labial].

For any nucleus lacking material, an epenthetic complex vowel is supplied. The epenthetic complex vowel is composed of two segments: the feature [high] and a fully underspecified segment. (The redundant feature [back] is assigned to the fully underspecified segment, allowing it to surface as [a].) If a specified segment is associated with the coda of the unit in which the epenthetic vowel is inserted, both segments of the epenthetic vowel remain associated with the nucleus, and the vowel surfaces as [i], as in (114). In unaffixed roots, an epenthetic vowel occurs only in this environment and always surfaces as [i].

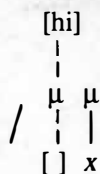
(114)

Vowel Epenthesis: Variant [i]

Underlying form



Vowel epenthesis



Redundant feature assignment

[back]

Surface form

[ix]

Note: *x* is a specified segment.

(115)

[back] Redundant Feature Assignment

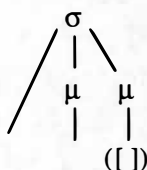
[] --> [back]

If material is not associated with the coda, or if a fully underspecified segment (surface [?]) is associated with the coda, the feature [high] of the epenthetic vowel delinks, leaving only the fully underspecified segment associated with the nucleus, and the vowel surfaces as [a], as in (116).

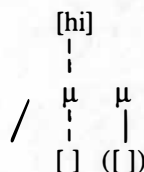
(116)

Vowel Epenthesis: Variant [a]

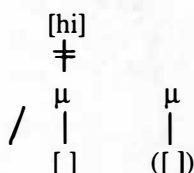
Underlying form



Vowel epenthesis



[high] delinking



Redundant feature assignment

[back]

[back]

Surface form

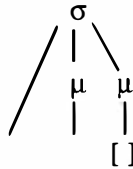
[a(?)]

When the prefix *may-* attaches to a $?iC_1C_1VC$ root or a $?aCVC$ root, the C_1 consonant delinks from the first coda of the root, and a fully underspecified segment (surface [?]) is associated with the coda. Then either the feature [high] of the epenthetic vowel delinks, and the vowel surfaces as [a], or the fully underspecified segment is deleted, and the epenthetic

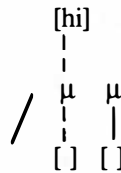
vowel surfaces as [i]. The variants [a] and [i] occur only in affixed forms, never in unaffixed roots, and are represented in (117).

(117) Vowel Epenthesis: Variant [a] or [i]

Underlying form

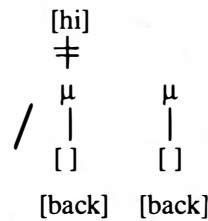


Vowel epenthesis



Variant [a]

[high] delinking

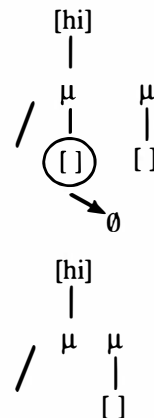


Redundant feature assignment

Surface form [aʔ]

Variant [i]

Vowel deletion



Redundant feature assignment

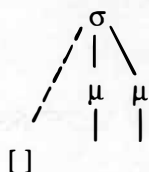
Surface form [iʔ]

For an onset position lacking material, a fully underspecified segment is supplied epenthetically, and is assigned the redundant feature [back], surfacing as [ʔ], as in (118).

(118)

Glottal Epenthesis

Underlying form

Redundant feature
assignment

[back]

Surface form

[?]

For a coda position lacking phonetic material, epenthetic material is never supplied, although a fully underspecified segment (i.e. surface [?]) can be added by rule.

These rules account for the association of phonetic material with moraic positions in the underlying representation of unaffixed roots; they also account for all surface variations occurring in those roots. If a position in the underlying representation lacks phonetic material and is unable to acquire such material by means of the preceding rules, the position will not surface. Since epenthetic material is always supplied for all onset and nucleus positions that cannot acquire phonetic material by any other means, the phonological system guarantees that underlying bimoraic units in unaffixed roots will always surface minimally as open syllables. Our claim, however, has been that open surface syllables represent defective underlying bimoraic units that have failed to acquire sufficient phonetic material for all positions within the underlying structure. Further evidence that there is a drive in the language towards closed surface syllables occurs in alternations triggered by affixation which we will consider next.

CHAPTER 5

MORPHOLOGICAL SURFACE ALTERNATIONS

Karao has a complex system of morphological alternation which is typified by verb affixation. In this section, I present a taxonomy of the most common alternations that occur with verb affixation, beginning with the simplest alternations and continuing to the more complex. Following this overview, I will attempt to account for all the surface variations by means of the underlying bimoraic structure posited earlier and a set of rules. Let us begin by reviewing the root types found in Karao, since these are central to the system of morphological alternations.

5.1 ROOT TYPES

The root is the centre of the system of morphological alternation. The alternations that occur in both affixes and roots depend upon the canonical shape of the root of which there are four types: (1) $CV_1C_1C_2V(C)$, (2) $CV_1C_1V(C)$, (3) $CaC_1V(C)$, and (4) $CiC_1C_1V(C)$. In a $CV_1C_1C_2V(C)$ root, V_1 is any vowel, and in a $CV_1CV(C)$ root, V_1 is either *o* or *i*. Examples of each type are given in (119).

(119) Root type			
$CV_1C_1C_2V(C)$	<i>soŋbat</i>	[suŋbat]	to answer
	<i>din̄din̄</i>	[din̄din̄]	to forget
	<i>baʔj̄is</i>	[baʔj̄is]	to borrow
	<i>k̄il̄jaw</i>	[k̄il̄jaw]	to shout
	<i>ʔosʔos</i>	[ʔosʔos]	to use an ʔosʔos tool
	<i>ʔik̄dit</i>	[ʔɛk̄dit]	to crush lice
	<i>ʔak̄do</i>	[ʔak̄do]	to serve rice
	<i>ʔiḡči</i>	[ʔiḡči]	to hold in the hand
	<i>doθo</i>	[doθo]	to cook
	<i>bilin</i>	[bilin]	to give advice
$CV_1C_1V(C)$	<i>ʔolop</i>	[ʔulup]	to take someone along
	<i>ʔīris</i>	[ʔīris]	to crush hot peppers
$CaC_1V(C)$	<i>sax̄it</i>	[sax̄et]	to get sick
	<i>ʔala</i>	[ʔala]	to get
$CiC_1C_1V(C)$	<i>d̄ip̄ik̄</i>	[d̄ipp̄ik̄]	to get wet
	<i>ʔitom</i>	[ʔit̄com]	to add

5.2 ALTERNATIONS OCCURRING WITH VERB AFFIXATION

Each root type undergoes a different set of alternations when affixed. In this survey, I present the surface alternations occurring in each root type with verb affixation.

5.2.1 CV₁C₁C₂V(C) ROOTS

The CV₁C₁C₂V(C) root undergoes the fewest alternations with the addition of verb affixes. These alternations are given in (120) and (121).

In (120), the following affixes are added to the root *soŋbat* [suŋbat] 'to answer': *man-*, *?iyan-*, *-an*, *-iy--an*, *mi--an*, and *?i--an*. The infix *-iy-* in the affix *-iy--an* is realised as *-iy-* following all vowels except *i*; following *i*, it is realised as *-in-*.

(120) *soŋbat* 'to answer'

<i>man-</i>	+	<i>soŋbat</i>	-->	<i>mansoŋbat</i>	[mansuŋbat]
<i>?iyan-</i>	+	<i>soŋbat</i>	-->	<i>?iyansoŋbat</i>	[?iyansuŋbat]
<i>soŋbat</i>	+	<i>-an</i>	-->	<i>soŋbaθan</i>	[suŋbaθan]
<i>soŋbat</i>	+	<i>-iy--an</i>	-->	<i>siyoŋbaθan</i>	[siyuŋbaθan]
<i>soŋbat</i>	+	<i>mi--an</i>	-->	<i>miŋsoŋbaθan</i>	[miŋsuŋbaθan]
<i>soŋbat</i>	+	<i>?i--an</i>	-->	<i>?iŋsoŋbaθan</i>	[?iŋsuŋbaθan]

When the prefixes *man-* and *?iyan-* are added to the root, *n* of the prefix assimilates to the same point of articulation as the initial consonant of the root. When the suffix *-an* is added, *t* changes from a final root position to an intervocalic position and is replaced by *θ*, its more sonorant set 2 counterpart. When the prefixes *mi-* and *?i-* are added, *s* in the initial root position geminates following *i* of the prefix.

In (121), the following affixes are added to *soŋbat* [suŋbat] 'to answer': *miŋi-*, *?iŋi-*, *?i-*, *?in-*, *may-* and *?iyay-*.

(121) *soŋbat* 'to answer'

<i>miŋi-</i>	+	<i>soŋbat</i>	-->	<i>miŋisoŋbat</i>	[miŋiŋisuŋbat]
<i>?iŋi-</i>	+	<i>soŋbat</i>	-->	<i>?iŋisoŋbat</i>	[?iŋiŋisuŋbat]
<i>?i-</i>	+	<i>soŋbat</i>	-->	<i>?isoŋbat</i>	[?isuŋbat]
<i>?in-</i>	+	<i>soŋbat</i>	-->	<i>?insoŋbat</i>	[?insuŋbat]
<i>may-</i>	+	<i>soŋbat</i>	-->	<i>maysoŋbat</i>	[maysuŋbat]
<i>?iyay-</i>	+	<i>soŋbat</i>	-->	<i>?iyaysoŋbat</i>	[?iyaysuŋbat]

No alternations occur in either the root or the affixes.

A CV₁C₁C₂V(C) root beginning with a glottal stop (that is, [?]V₁C₁C₂V(C)) triggers an additional alternation: vowel substitution in prefixes ending with *i*. In (122), the following affixes are added to the root *?os?os* [ʔosʔos] 'to use an *?os?os* tool': *miN-*, *?iN-*, *-in-*, *-iy-*, *mi-* and *?i-*.

(122) ?os?os 'to use an ?os?os tool'

<i>miN-</i>	+	?os?os	-->	<i>miŋos?os</i>	[miŋŋos?os]
?iN-	+	?os?os	-->	?iŋos?os	[?iŋŋos?os]
?os?os	+	-in	-->	?os?osin	[?os?osin]
?os?os	+	-iy-	-->	?iyos?os	[?iyos?os]
<i>mi-</i>	+	?os?os	-->	<i>ma?os?os</i>	[ma?os?os]
?i-	+	?os?os	-->	?a?os?os	[?a?os?os]

When the prefixes *miN-* and *?iN-* are added to a root, *N* of the prefix typically assimilates to the same point of articulation as the initial consonant of the root, and the initial consonant of the root is deleted. In (122), the initial consonant of the root is a glottal stop, and so *N* becomes default *ŋ*. When the prefix *mi-* and *?i-* are added to the root, *i* of the prefix becomes *a*.

In (123), the following affixes are added to *?obda* [ʔubda] 'to work': *miŋi-*, *?iŋi-*, *?i-*, *?in-*, *may-* and *?iyay-*.

(123) ?obda 'to work'

<i>miŋi-</i>	+	?obda	-->	<i>miŋi?obda</i>	[miŋŋiʔubda]
?iŋi-	+	?obda	-->	?iŋi?obda	[?iŋŋiʔubda]
?i-	+	?obda	-->	?i?obda	[?iʔubda]
?in-	+	?obda	-->	?in?obda	[?inʔubda]
<i>may-</i>	+	?obda	-->	<i>may?obda</i>	[mayʔubda]
?iyay-	+	?obda	-->	?iyay?obda	[?iyayʔubda]

No alternations occur in either the root or the affixes.

Alternations occurring with a CV₁C₁C₂V(C) root type typically occur with all root types and are summarised as follows:

(a) When a prefix ending with *n* attaches to any root, the *n* of the prefix assimilates to the same point of articulation as the initial consonant of the root. If the initial consonant is a glottal stop, the prefix nasal remains *n*.

(b) When a prefix ending with *N* attaches to any root, the *N* of the prefix assimilates to the same point of articulation as the initial consonant of the root, and the initial consonant of the root is deleted. If the initial consonant is a glottal stop, *N* changes to default *ŋ*.

(c) When a prefix ending with *i* is added to a root, the initial consonant of the root geminates following *i*. If the initial consonant of the root is a glottal stop, *i* of the prefix changes to *a*.

(d) All suffixes in Karao begin with a vowel. When a suffix is added to a root ending with a consonant, the final root consonant changes to its set 2 counterpart if the preceding vowel is not *i*, or the consonant changes to its set 1 counterpart and geminates if the preceding vowel is *i*. When a suffix is added to a root ending with a vowel, a glottal stop is inserted between the final root vowel and the suffix vowel.

Other root types undergo additional alternations, depending upon the canonical shape of the root. We will now consider these alternations, beginning with the ones that occur in a CV₁C₁V(C) root type. (Alternations typical of all root types have been given above and will not be referred to in the following descriptions.)

5.2.2 CV₁C₁V(C) ROOTS

A CV₁C₁V(C) root in which V₁ is *o* or *i* participates in all the alternations that occur with CV₁C₁C₂V(C) roots. With certain affixes, the intervocalic C₁ in a CV₁C₁V(C) root can also be replaced by another consonant; specifically, if C₁ is a set 2 consonant, then it is replaced by its less sonorant set 1 counterpart. Consonant substitution in a CV₁C₁V(C) root is optional, but commonly occurs. The alternation is seen in (124) and (125).

In (124), the following affixes are added to *doθo* [doθo] 'to cook': *man-*, *?iyan-*, *-in*, *-iy-*, *mi-* and *?i-*.

(124) *doθo* 'to cook'

<i>man-</i>	+	<i>doθo</i>	-->	<i>mandoto</i>	[mandoto]	
				~	<i>mandotto</i>	[mandotto]
<i>?iyan-</i>	+	<i>doθo</i>	-->	<i>?iyandoθo</i>	[?iyandoθo]	
<i>doθo</i>	+	<i>-in</i>	-->	<i>doto?in</i>	[doto?in]	
				~	<i>dotto?in</i>	[dotto?in]
<i>doθo</i>	+	<i>-iy-</i>	-->	<i>diyoθo</i>	[diyoθo]	
<i>mi-</i>	+	<i>doθo</i>	-->	<i>midoto</i>	[middoto]	
				~	<i>midotto</i>	[middotto]
<i>?i-</i>	+	<i>doθo</i>	-->	<i>?idoθo</i>	[?iddoθo]	

When the affixes *man-*, *-in* and *mi-* are added to the root, *θ* in the C₁ root position is replaced by *t*, its less sonorant counterpart; *t* geminates optionally.

In (125), the following affixes are added to *doθo* [doθo] 'to cook': *mi?i-*, *?i?i-*, *?i-*, *?in-*, *may-* and *?iyay-*.

(125) *doθo* 'to cook'

<i>miŋi-</i>	+	<i>doθo</i>	-->	<i>miŋidoto</i>	[miŋidoto]	
				~	<i>miŋidotto</i>	[miŋidotto]
<i>ʔiŋi-</i>	+	<i>doθo</i>	-->	<i>ʔiŋidoθo</i>	[ʔiŋidoθo]	
<i>ʔi-</i>	+	<i>doθo</i>	-->	<i>ʔidoθo</i>	[ʔidoθo]	
<i>ʔin-</i>	+	<i>doθo</i>	-->	<i>ʔindoθo</i>	[ʔindoθo]	
<i>may-</i>	+	<i>doθo</i>	-->	<i>maydoto</i>	[maydoto]	
				~	<i>maydotto</i>	[maydotto]
<i>ʔiyay-</i>	+	<i>doθo</i>	-->	<i>ʔiyaydoθo</i>	[ʔiyaydoθo]	

When *mi?i-* and *may-* are added, *θ* in the C₁ root position is replaced by *t*, its less sonorant counterpart, and *t* geminates optionally.

A CV₁C₁V(C) root beginning with a glottal stop (that is, [?]V₁C₁V(C)) can also undergo consonant substitution in the C₁ root position. In (126), the following affixes are added to the root *ʔiʔis* ['iʔis] 'to crush hot peppers': *mɨN-*, *ʔiN-*, *-in*, *-in-*, *mɨ-* and *ʔi-*.

(126) *ʔiʔis* 'to crush hot peppers'

<i>mɨN-</i>	+	<i>ʔiʔis</i>	-->	<i>mɨŋiʔis</i>	[mɨŋiʔis]
<i>ʔiN-</i>	+	<i>ʔiʔis</i>	-->	<i>ʔiŋiʔis</i>	[ʔiŋiʔis]
<i>ʔiʔis</i>	+	<i>-in</i>	-->	<i>ʔiʔisɨn</i>	[ʔiʔisɨn]
<i>ʔiʔis</i>	+	<i>-in-</i>	-->	<i>ʔiniʔis</i>	[ʔiniʔis]
<i>mɨ-</i>	+	<i>ʔiʔis</i>	-->	<i>maʔiʔis</i>	[maʔiʔis]
<i>ʔi-</i>	+	<i>ʔiʔis</i>	-->	<i>ʔaʔiʔis</i>	[ʔaʔiʔis]

When the affixes *mɨN-*, *-in* and *mɨ-* are added, *ʔ* in the C₁ root position is replaced by *č*, its less sonorant counterpart.

In (127), the following affixes are added to *ʔiʔot* ['iʔot] 'to tighten by twisting': *mɨŋi-*, *ʔiŋi-*, *ʔi-*, *ʔin-*, *may-* and *ʔiyay-*.

(127) *ʔiʔot* 'to tighten by twisting'

<i>mɨŋi-</i>	+	<i>ʔiʔot</i>	-->	<i>mɨŋiʔiʔot</i>	[mɨŋiʔiʔot]
<i>ʔiŋi-</i>	+	<i>ʔiʔot</i>	-->	<i>ʔiŋiʔiʔot</i>	[ʔiŋiʔiʔot]
<i>ʔi-</i>	+	<i>ʔiʔot</i>	-->	<i>ʔiʔiʔot</i>	[ʔiʔiʔot]
<i>ʔin-</i>	+	<i>ʔiʔot</i>	-->	<i>ʔinʔiʔot</i>	[ʔinʔiʔot]
<i>may-</i>	+	<i>ʔiʔot</i>	-->	<i>mayʔiʔot</i>	[mayʔiʔot]
<i>ʔiyay-</i>	+	<i>ʔiʔot</i>	-->	<i>ʔiyayʔiʔot</i>	[ʔiyayʔiʔot]

When *mɨŋi-* and *may-* are added, *ʔ* in the C₁ root position of *ʔiʔot* is replaced by *č*, its less sonorant counterpart.

5.2.3 CaC₁V(C) ROOTS

A CaC₁V(C) root has several alternation patterns, depending on the affixes that attach to it. The first pattern involves vowel substitution in which *a* in the V₁ root position is replaced by *ɨ* or *i*, and C₁ consonant substitution, as described above. The pattern is illustrated in (128).

In (128), the following affixes are added to *saxit* [saxet] *ʔon-*, *-im-*, *man-*, *ʔiyan-*, *mɨN-*, *ʔiN-*, *-an*, *-iy--an*, *mɨ--an* and *ʔi--an*. Depending on the affixes that occur with it, *saxit* has several meanings.

(128) *saxit* 'to be painful'

<i>ʔon-</i>	+	<i>saxit</i>	-->	<i>ʔonsaxit</i>	[ʔonsaxet]
<i>saxit</i>	+	<i>-im-</i>	-->	<i>simaxit</i>	[simaxet]

saxit 'to get sick'

<i>man-</i>	+	<i>saxit</i>	-->	<i>mansiḳit</i>	[mansiḳket]
<i>?iyan-</i>	+	<i>saxit</i>	-->	<i>?iyansaxit</i>	[?iyansaxet]

saxit 'to hurt someone'

<i>miN-</i>	+	<i>saxit</i>	-->	<i>miniḳit</i>	[minniḳet]
<i>?iN-</i>	+	<i>saxit</i>	-->	<i>?ina_xit</i>	[?innaxet]
<i>saxit</i>	+	<i>-an</i>	-->	<i>siḳiθan</i>	[siḳḳeθan]
<i>saxit</i>	+	<i>-iy--an</i>	-->	<i>siḳiθan</i>	[siḳeθan]
<i>saxit</i>	+	<i>mi--an</i>	-->	<i>missiḳiθan</i>	[missiḳḳiθan]
<i>saxit</i>	+	<i>?i--an</i>	-->	<i>?isaxitan</i>	[?issaxetan]

When the affixes *man-*, *miN-*, *-an* and *mi--an* are added to the root, *a* in the V_1 root position is replaced by *i*; *x* in the C_1 root position is replaced by *ḳ*, its less sonorant counterpart; and *ḳ* geminates following *i*. When *-i--an*, an allomorph of *-iy--an*, is added, the infix *-i-* replaces *a* in the V_1 root position, and *ḳ* replaces *x* in the C_1 root position.

The second alternation pattern is a surface variation of the first pattern: it involves the same affixes as in (128), and the affixed forms in (128) and (129) have the same meaning.

(129) *saxit* 'to get sick'

<i>man-</i>	+	<i>saxit</i>	-->	<i>mansaxit</i>	[mansaxet]
<i>?iyan-</i>	+	<i>saxit</i>	-->	<i>?iyansaxit</i>	[?iyansaxet]

saxit 'to hurt someone'

<i>miN-</i>	+	<i>saxit</i>	-->	<i>minaxit</i>	[minnaxet]
<i>?iN-</i>	+	<i>saxit</i>	-->	<i>?ina_xit</i>	[?innaxet]
<i>saxit</i>	+	<i>-an</i>	-->	<i>saxitan</i>	[saxetan]
<i>saxit</i>	+	<i>-iy--an</i>	-->	<i>siyaxitan</i>	[siyaxetan]
<i>saxit</i>	+	<i>mi--an</i>	-->	<i>misaxitan</i>	[missaxetan]
<i>saxit</i>	+	<i>?i--an</i>	-->	<i>?isaxitan</i>	[?issaxetan]

The second pattern differs from the first one in three ways: (1) when *man-*, *miN-*, *-an* and *mi--an* are added to the root, no alternation occurs in the V_1 and C_1 root positions; (2) the perfective form of *-an* is *-iy--an* rather than *-i--an*; and (3) when the infix *-iy-* is added, no V_1 deletion occurs in the root.

The affixes *miŋi-*, *?iŋi-*, *?i-*, *?in-*, *may-* and *?iyay-* trigger changes similar to the first alternation pattern, as seen in (130).

(130) *saxit* 'to cause to get sick'

<i>mɨŋi-</i>	+	<i>saxit</i>	-->	<i>mɨŋisɨkɨt</i>	[mɨŋɨsɨkɨt]
<i>ʔiŋi-</i>	+	<i>saxit</i>	-->	<i>ʔiŋisaxit</i>	[ʔiŋɨsaxɨt]
<i>ʔi-</i>	+	<i>saxit</i>	-->	<i>ʔisaxit</i>	[ʔisaxɨt]
<i>ʔin-</i>	+	<i>saxit</i>	-->	<i>ʔinsaxit</i>	[ʔinsaxɨt]
<i>may-</i>	+	<i>saxit</i>	-->	<i>maysɨkɨt</i>	[maysɨkɨt]
<i>ʔiyay-</i>	+	<i>saxit</i>	-->	<i>ʔiyaysaxit</i>	[ʔiyaysaxɨt]

When *mɨŋi-* and *may-* are added to the root, *a* in the V_1 root position is replaced by *ɨ*; *x* in the C_1 root position is replaced by *k*; and *k* geminates following *ɨ*.

A $CaC_1V(C)$ root beginning with a glottal stop (that is, $ʔaC_1V(C)$) undergoes all the alternations occurring in $CaC_1V(C)$ roots and two more: (1) with certain affixes, a glottal stop is inserted following *a* in the V_1 root position, and (2) with certain prefixes, *a* in the V_1 root position is deleted. A $ʔaVC_1V(C)$ root may undergo any one of three alternation patterns which also have several surface variations.

The first alternation pattern is given in (131). In (131), the following affixes are added to *ʔala* ['ala] 'to get': *mɨN-*, *ʔiN-*, *-in*, *-iy-*, *mɨ-* and *ʔi-*.

(131) *ʔala* 'to get'

<i>mɨN-</i>	+	<i>ʔala</i>	-->	<i>mɨŋɨda</i>	[mɨŋɨdda]	
<i>ʔiN-</i>	+	<i>ʔala</i>	-->	<i>ʔiŋala</i>	[ʔiŋɨala]	
<i>ʔala</i>	+	<i>-in</i>	-->	<i>ʔaʔdaʔin</i>	[ʔaʔdaʔin]	
				~	<i>ʔɨdaʔin</i>	[ʔɨddaʔin]
<i>ʔala</i>	+	<i>-iy-</i>	-->	<i>ʔida</i>	[ʔida]	
<i>mɨ-</i>	+	<i>ʔala</i>	-->	<i>maʔda</i>	[maʔda]	
<i>ʔi-</i>	+	<i>ʔala</i>	-->	<i>ʔiyaʔda</i>	[ʔiyaʔda]	

When *mɨN-* is added to the root, *a* in the V_1 root position is replaced by *ɨ*; *l* in the C_1 root position is replaced by *d*, its less sonorant set 1 counterpart; and *d* geminates following *ɨ*.

When *-in* is added, two surface variations can occur. In the first variation, a glottal stop is inserted following *a* in the V_1 root position, and *l* in the C_1 position changes to *d*, its less sonorant counterpart. In the second variation, *a* in the V_1 position is replaced by *ɨ*; *l* in the C_1 position is replaced by *d*; and *d* geminates following *ɨ*.

When the infix *-i-*, an allomorph of *-iy-*, is added, *a* in the V_1 root position is deleted; *-i-* is inserted in its place; and *l* in the C_1 root position is replaced by *d*, its set 1 counterpart.

When the prefixes *ma-*, an allomorph of *mɨ-*, and *ʔiya-*, an allomorph of *ʔi-*, are added, *a* in the V_1 root position is deleted. Vowel deletion triggers resyllabification, and *l* in the C_1 root position is replaced by *d*.

The second alternation pattern is given in (132). The pattern is a surface variation: it involves the same affixes as in (131), and the affixed forms in (131) and (132) have the same meaning.

(132) ?ala 'to get'

<i>mɪN-</i>	+	?ala	-->	<i>mɪŋala</i>	[mɪŋgala]
?iN-	+	?ala	-->	?iŋala	[?iŋgala]
?ala	+	-in	-->	?ala?in	[?ala?in]
?ala	+	-iy-	-->	?iyala	[?iyala]
<i>mi-</i>	+	?ala	-->	<i>ma?ala</i>	[ma?ala]
?i-	+	?ala	-->	?a?ala	[?a?ala]

In (132), the second alternation pattern differs from the first in several ways: (1) no alternation occurs in the V₁ and C₁ root positions with the addition of any affixes; (2) for the perfective form of *-in*, the infix *-iy-* rather than *-i-* is added to the root; (3) for the prefixes *mɪ-* and *?i-*, *ma-* (an allomorph of *mɪ-*) is added to the root as in the first pattern; however, *?a-* (an allomorph of *?i-*) is added to the root in the second pattern, rather than *?iya-* as in the first pattern.

The third alternation pattern is given in (133) and involves the following affixes: *mɪŋi-*, *?iŋi-*, *?i-*, *?in-*, *may-* and *?iyay-*.

(133) ?ala 'to get'

<i>mɪŋi-</i>	+	?ala	-->	<i>mɪŋi?da</i>	[mɪŋŋi?da]
?iŋi-	+	?ala	-->	?iŋi?da	[?iŋŋi?da]
?i-	+	?ala	-->	?i?da	[?i?da]
?in-	+	?ala	-->	?in?ala	[?in?ala]
<i>may-</i>	+	?ala	-->	<i>may?a?da</i>	[may?a?da]
			~	<i>may?i?da</i>	[may?i?da]
			~	<i>may?ɪda</i>	[may?ɪdda]
?iyay-	+	?ala	-->	?iyay?ala	[?iyay?ala]

In (133), when *mɪŋi-*, *?iŋi-* and *?i-* are added, *a* in the V₁ root position is deleted. Vowel deletion triggers resyllabification, and *l* in the C₁ position changes to *d*.

When *may-* is added to the root, three surface variations are possible. In the first variation, a glottal stop is inserted following *a* in the V₁ root position, and *l* becomes *d*. In the second variation, the alternations are the same as in the first variation, except that *a* in the V₁ root position is replaced by *i*. In the third variation, *a* in the V₁ position is replaced by *ɪ*; *l* in the C₁ position is replaced by *d*; and *d* geminates following *ɪ*.

5.2.4 C_iC₁C₁V(C) ROOTS

A C_iC₁C₁V(C) root undergoes two alternations that are unique to this root type: consonant copying; and gemination reduction. These alternations are shown in (134) and (135).

In (134), the following affixes are added to *dipɪk* [dɪppɪk] 'to get wet': *man-*, *?iyan-*, *mɪN-*, *?iN-*, *-in*, *-iy-*, *mɪ-* and *?i-*.

(134) *dipik* 'to get wet'

<i>man-</i>	+	<i>dipik</i>	-->	<i>mandilpik</i>	[mandilpik]
<i>?iyan-</i>	+	<i>dipik</i>	-->	<i>?iyandipik</i>	[?iyandippik]
<i>miN-</i>	+	<i>dipik</i>	-->	<i>minpik</i>	[minpik]
<i>?iN-</i>	+	<i>dipik</i>	-->	<i>?iyanpik</i>	[?iyanpik]
<i>dipik</i>	+	<i>-in</i>	-->	<i>dilpikkın</i>	[dilpikkın]
<i>dipik</i>	+	<i>-iy-</i>	-->	<i>dimpik</i>	[dimpik]
<i>mi-</i>	+	<i>dipik</i>	-->	<i>milpik</i>	[milpik]
<i>?i-</i>	+	<i>dipik</i>	-->	<i>?iyalpik</i>	[?iyalpik]

When *man-* and *-in* are added to the root, *d* in the initial root position is copied and inserted following *i* in the V_1 root position, becoming *l*, its coda counterpart, and the gemination of *p* is reduced.

When *miN-* and *?iyaN-* (an allomorph of *?iN-*) are added, the nasal of the prefix assimilates to the same point of articulation as *d* in the initial root position; both *d* and *i* in the initial syllable of the root are deleted; the gemination of *p* is reduced; and resyllabification occurs.

When the infix *-in-* (an allomorph of *-iy-*) is added, *i* in the V_1 root position is deleted; the infix *-in-* is inserted following *d*.

When *mi-* and *?iya-* (an allomorph of *?i-*) are added, *i* in the V_1 root position is deleted; resyllabification occurs; *d* is replaced by *l*, its coda counterpart; and the gemination of *p* is reduced.

In (135), the following affixes are added to *dipik* [dippik] 'to get wet': *mıgi-*, *?ıgi-*, *?i-*, *?in-*, *may-* and *?iyay-*.

(135) *dipik* 'to get wet'

<i>mıgi-</i>	+	<i>dipik</i>	-->	<i>mıgilpik</i>	[mıgilpik]
<i>?ıgi-</i>	+	<i>dipik</i>	-->	<i>?ıgilpik</i>	[?ıgilpik]
<i>?i-</i>	+	<i>dipik</i>	-->	<i>?ilpik</i>	[?ilpik]
<i>?in-</i>	+	<i>dipik</i>	-->	<i>?indipik</i>	[?indippik]
<i>may-</i>	+	<i>dipik</i>	-->	<i>maydilpik</i>	[maydilpik]
<i>?iyay-</i>	+	<i>dipik</i>	-->	<i>?iyaydipik</i>	[?iyaydippik]

When *mıgi-*, *?ıgi-* and *?i-* are added, *i* in the V_1 root position is deleted; resyllabification occurs; *d* is replaced by *l*, its coda counterpart; and the gemination of *p* is reduced. When *may-* is added, *d* in the initial root position is copied and inserted following *i*, becoming *l*; and the gemination of *p* is reduced.

A $CiC_1C_1V(C)$ root that begins with a glottal stop (that is, $?iC_1C_1V(C)$) undergoes alternations occurring in $CiC_1C_1V(C)$ and $?aC_1V(C)$ roots. Certain alternations have two surface variations, which are shown in (136) and (137).

In (136), the following affixes are added to *?ičom* [*?itčom*]: *man-*, *?iyan-*, *mɪN-*, *?iN-*, *-an*, *-iy--an*, *mɪ--an* and *?i--an*. The root *?ičom* has different meanings depending on the affixes.

(136) *?ičom* 'to put together'

<i>man-</i>	+	<i>?ičom</i>	-->	<i>man?a?čom</i>	[<i>man?a?čom</i>]
<i>?iyan-</i>	+	<i>?ičom</i>	-->	<i>?iyan?ičom</i>	[<i>?iyan?itčom</i>]

?ičom 'to add some'

<i>mɪN-</i>	+	<i>?ičom</i>	-->	<i>mɪŋčom</i>	[<i>mɪŋčom</i>]
<i>?iN-</i>	+	<i>?ičom</i>	-->	<i>?iyančom</i>	[<i>?iyančom</i>]

<i>?ičom</i>	+	<i>-an</i>	-->	<i>?a?čoman</i>	[<i>?a?čoman</i>]
<i>?ičom</i>	+	<i>-iy--an</i>	-->	<i>?inčoman</i>	[<i>?inčoman</i>]

<i>?ičom</i>	+	<i>mɪ--an</i>	-->	<i>ma?čoman</i>	[<i>ma?čoman</i>]
<i>?ičom</i>	+	<i>?i--an</i>	-->	<i>?iya?čoman</i>	[<i>?iya?čoman</i>]

When *man-* and *-an* are added to the root, the glottal stop in the initial root position is copied and inserted following *ɪ* in the V_1 root position, and the gemination of the affricate *č* is reduced; *ɪ* in the V_1 root position is replaced by *a*.

When *mɪN-* and *?iyaN-* (an allomorph of *?iN-*) are added, the nasal of the prefix becomes *ŋ* before the initial glottal stop of the root; the glottal stop and *ɪ* in the initial syllable of the root are deleted; and the gemination of *č* is reduced.

When *-in--an* (an allomorph of *-iy--an*) is added, *ɪ* in the V_1 root position is deleted; the infix *-in-* is inserted following the glottal stop; and the gemination of *č* is reduced.

When *ma--an* (an allomorph of *mɪ--an*) and *?iya--an* (an allomorph of *?i--an*) are added, *ɪ* in the V_1 root position is deleted; the gemination of *č* is reduced; and resyllabification takes place.

In (137), the following affixes are added to *?ičom* [*?itčom*]: *mɪŋi-*, *?iŋi-*, *?i-*, *?in-*, *may-* and *?iyay-*.

(137) *?ičom* 'to add all of something'

<i>mɪŋi-</i>	+	<i>?ičom</i>	-->	<i>mɪŋi?čom</i>	[<i>mɪŋi?čom</i>]
<i>?iŋi-</i>	+	<i>?ičom</i>	-->	<i>?iŋi?čom</i>	[<i>?iŋi?čom</i>]
<i>?i-</i>	+	<i>?ičom</i>	-->	<i>?i?čom</i>	[<i>?i?čom</i>]
<i>?in-</i>	+	<i>?ičom</i>	-->	<i>?in?ičom</i>	[<i>?in?itčom</i>]
<i>may-</i>	+	<i>?ičom</i>	-->	<i>may?a?čom</i>	[<i>may?a?čom</i>]
			~	<i>may?i?čom</i>	[<i>may?i?čom</i>]
<i>?iyay-</i>	+	<i>?ičom</i>	-->	<i>?iyay?ičom</i>	[<i>?iyay?itčom</i>]

When *mɪŋi-*, *?iŋi-* and *?i-* are added, *ɪ* in the V_1 root position is deleted, and the gemination of *č* is reduced. When *may-* is added, the glottal stop in the initial root position is copied and inserted following *ɪ* in the V_1 root position; the gemination of *č* is reduced; *ɪ* in the V_1 root position is replaced by either *a* or *i*.

5.3 SUMMARY OF MORPHOLOGICAL SURFACE ALTERNATIONS

One of the striking features in this pattern of surface alternations is that relatively few alternations occur in roots in which the first syllable is a closed surface syllable while many more alternations occur in roots in which the first syllable is an open surface syllable. Thus, any analysis of the Karao phonological system must account for the relative stability of roots with initial closed syllables in contrast to the relative instability of roots with initial open syllables. Another significant feature is the varying degrees of stability exhibited by CVCVC and C_iC₁C₁VC root types; specifically, CV₁CVC roots in which V₁ is *i* or *o* undergo fewer alternations than CaCVC roots and C_iC₁C₁VC roots. Again, a proposed analysis must account for these facts as well.

CHAPTER 6

AN AUTOSEGMENTAL ANALYSIS

Having presented the range of typical morphological alternations occurring with verb affixation, we will now see if we can account for them. To do so, I assume a single underlying bimoraic structure for all surface syllable types and the set of rules defining the association of phonetic material with the underlying representation, as described earlier. As we will see, some of the rules for morphological alternation lack the simplicity one would hope for; however, I provide evidence to show that despite what the rules may lack in elegance, they appear to be the best explanation for the alternations triggered by affixation. Let us first consider those alternations that occur with all root types.

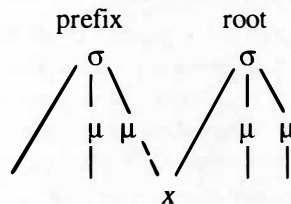
6.1 ALTERNATIONS AFFECTING ALL ROOT TYPES

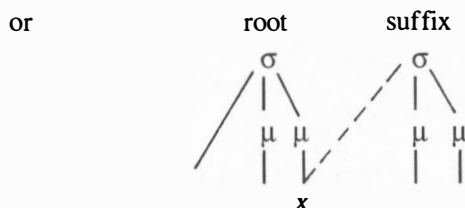
With the addition of an appropriate affix, all root types may participate in six alternations: (1) multiple association of the initial or final consonant of a root, (2) delinking of the final consonant of a root, (3) vowel spreading, (4) vowel delinking, (5) nasal assimilation in which the first consonant of the root is retained, and (6) nasal assimilation in which the first consonant of the root is lost.

6.1.1 MULTIPLE ASSOCIATION OF CONSONANTS ACROSS SYLLABLE BOUNDARIES

Multiple association of consonants across syllable boundaries is a common morphological alternation in Karao and occurs with all root types. (Multiple association of consonants within a syllable is limited to certain root types and will be described later.) Certain prefixes lack phonetic material for their final coda. When these prefixes are added to a root in which the initial onset is associated with phonetic material in the underlying representation, the material in the root onset multiply associates, supplying the prefix coda with material. All suffixes, on the other hand, lack phonetic material for their initial onset. When suffixes are added to a root in which the final coda is associated with phonetic material, the material in the root coda multiply associates with the suffix onset. The rule for multiple association of consonants across syllable boundaries is given in (138).

(138) Multiple Association of Consonant 1



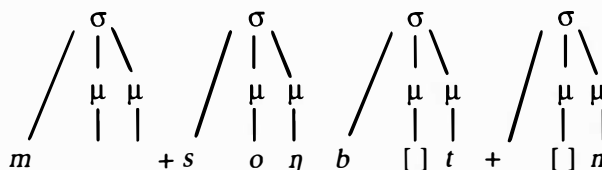


This rule is identical to the Multiple Association of Consonant rule given earlier which describes the association of a single segment with two consonant positions within a root (see section 4.3.2). What (138) shows is that multiple association of a consonant occurs across syllable boundaries between morphemes exactly as it does across syllable boundaries within a morpheme (e.g. an unaffixed root). It also shows that multiple association can occur either leftwards or rightwards, depending on the initial association of the phonetic segment in the underlying representation. An example is given in (139).

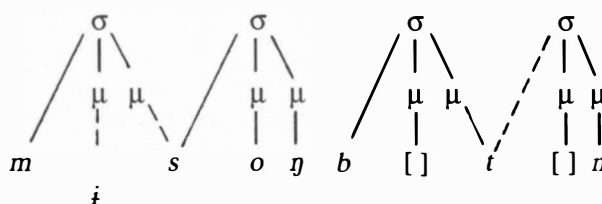
(139) *sonbat* 'to answer'

Underlying form

Affixation



Multiple association



Vowel epenthesis

Redundant feature
assignment



Surface form

[missunbatan] 'to be answered'

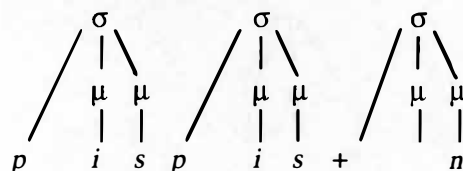
In (139), the prefix *mi-* lacks phonetic material for its coda, and the suffix *-an* lacks material for its onset. When these affixes are added to the root *sonbat* [sunbat] 'to answer', *s* in the initial onset of the root multiply associates with the empty coda of the prefix, surfacing as a geminate [s], and *t* in the final coda position of the root multiply associates with the empty onset of the suffix, surfacing as [θ]; vowel epenthesis and redundant feature assignment follow.

The only restriction on this rule is that the segments *b*, *m*, *n*, *η* and *s* may not associate in this manner following a vowel in the underlying representation. Recall that the segments *n*, *η* and *s* have only one surface form, and that *b* typically surfaces only as [b], and *m* only as [m], except in a limited class of words. When these segments are not preceded by a vowel in the underlying representation, they are free to multiply associate; however, when they are preceded by a vowel in the underlying representation, they never multiply associate. Thus, when suffixes are added to roots ending with *b*, *m*, *n*, *η* and *s*, and these consonants are preceded by vowels in the underlying representation, multiple association fails to occur; instead *b*, *m*, *n*, *η* and *s* delink from the final coda of the root and reassociate with the onset of the suffix, as shown in (140).

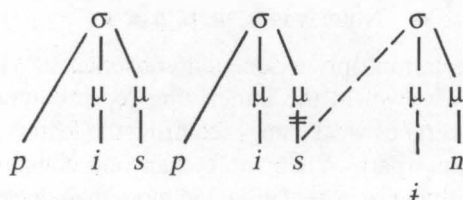
(140) *pispis* 'to choose'

Underlying form

Affixation



Delinking



Vowel epenthesis

Surface form

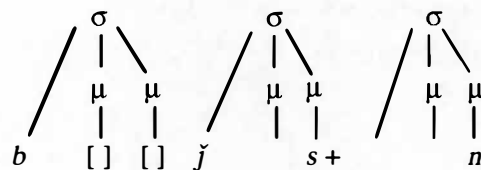
[pispisin]

In (140), the root *pispis* [pispis] 'to choose' ends with the consonant *s*, and *s* is preceded by a vowel in the underlying representation. When the suffix *-an* attaches to the root, *s* in the final coda of the root delinks and reassociates with the suffix onset, providing phonetic material for that position. (Proof that *s* is not multiply associated is that Karao speakers can pause before *s*, as in [pis\$pi\$sin].) Compare (140) with (141) in which *s* in the final coda of the root is not preceded by a vowel in the underlying representation.

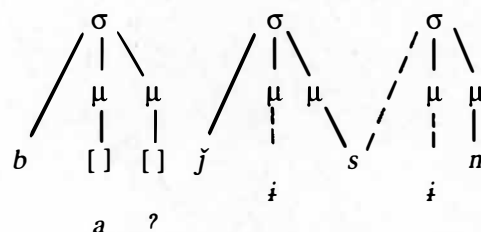
(141) *baʔjis* 'to borrow'

Underlying form

Affixation



Multiple association



Vowel epenthesis

Redundant feature assignment

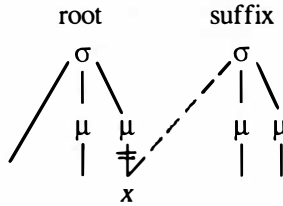
Surface form

[baʔjisin]

In (141), the root *baʔjis* [baʔjis] 'to borrow' ends with the consonant *s*, and *s* is not preceded by a vowel in the underlying representation. When the suffix *-an* attaches to the root, *s* in the final coda of the root multiply associates with the suffix onset. (Proof that *s* is multiply associated is that Karao speakers cannot pause before, between or after the sequence [ss].) A rule for this type of consonant delinking is given in (142).

(142)

Consonant Delinking 1

Note: *x* is *b, m, n, ŋ* or *s*.

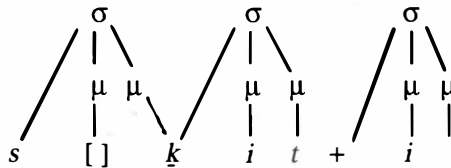
One constraint affects multiply associated consonants. When a consonant is multiply associated following a vowel in the underlying representation, the multiply associated consonant typically undergoes weakening, acquiring the feature [continuant], and surfaces as its more sonorant counterpart. When more than one consonant is eligible for multiple association in the underlying representation and more than one of these consonants follows a vowel, it is possible for all of the consonants to multiply associate, weaken, and surface as their more sonorant counterparts. This results in a surface string of weak set 2 intervocalic consonants. A more common pattern, however, is for only one of the multiply associated consonants to surface as its weak counterpart; the other consonant surfaces as a strong set 1 consonant.

Before discussing consonant strings in detail, I should point out that the morphological and phonological facts of Karao are such that a word rarely has more than two intervocalic consonants. Even when there are more than two intervocalic consonants, in most cases, only two will actually be eligible for the alternations described here. In effect then, we are talking about pairs of intervocalic surface consonants. An example of alternation in two successive multiply associated consonants is seen in (143).

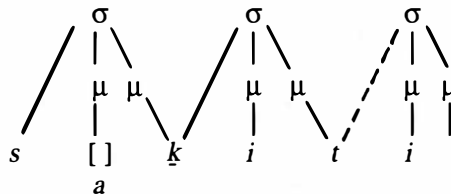
(143) *saxit* + *-i* 'to hurt someone'

Underlying form

Affixation



Multiple association

Redundant feature
assignment

Surface form

[saxɛθi] or [saxetti]

In (143), *k* of the unaffixed root *saxit* [saxet] 'sick' is already multiply associated. When the suffix *-i* is added to the root, *t* in the root coda multiply associates with the suffix onset, allowing the suffix to surface. Redundant feature assignment occurs last. As (143) shows, the affixed form may surface as [saxɛθi] in which case multiply associated *k* and *t* both

undergo weakening, or as [saxetti], the more commonly occurring form, in which case only multiply associated *k* weakens, and multiply associated *t* surfaces as a geminate consonant. (Note that when contiguous to *ɣ* in a closed syllable, *i* surfaces as [ɛ].)

This pattern of surface dissimilation in consonants suggests that there is a preferred word pattern in Karao which can be defined as follows: the preferred word pattern contains only one [continuant] consonant. This statement, however, does not explain all of the surface variations in consonants in (144).

- (144) *saxit* [saxet] + *-i* --> [saxɛθi] or [saxetti] to hurt someone
kalat [kalat] + *-a* --> [kalaθa] or [kalatta] to bite
poyok [puyok] + *-a* --> [puyoxa] or [puyokka] to rub
ʔaθiw [ʔaθiw] + *-a* --> [ʔaθiwa] or [ʔattiwa] to lose something
ʔalad [ʔalad] + *-a* --> [ʔalaʔa] or [ʔalača] to surround with a fence
koyod [kuyud] + *-a* --> [kuyuʔa] to pull

The list in (144) shows that in a series of multiply associated consonants, those consonants that produce more sonorant weakened forms, such as surface liquids and glides, are more likely to undergo weakening than those that produce less sonorant weakened forms, such as fricatives. It also shows that a series of more sonorant weakened forms, such as liquids and glides, will surface as long as the consonants are not identical in the feature [consonantal]; that is, consonants that weaken to liquids and glides will all undergo weakening so long as the result is not a series of all surface liquids (or, probably, all glides), although a series consisting of a liquid and a glide is permitted. In short, the preferred consonant string condition appears to apply to [continuant] consonants, but not to all [continuant] consonants. The question then is: what are the criteria that determine which [continuant] consonants will undergo weakening and which ones will not?

Three features are crucial for determining the well-formedness of a consonant string: (1) [continuant], (2) [sonorant], and (3) [consonantal]. These features function as a single unit, forming a phonological class. The features are hierarchically organised and are either present or absent, as shown in (145).

- (145)
- | |
|---------------|
| [consonantal] |
| |
| [sonorant] |
| |
| [continuant] |

It is important to note that this well-formedness condition applies only to multiply associated consonants that are preceded by a vowel in the underlying representation; only consonants that lack the feature [continuant] and then acquire it by means of weakening are governed by this condition. This structural description is necessary in order to account for the asymmetrical behaviour of *s*. Phonetically *s* is a [continuant] consonant, but we have already noted that it does not behave like other surface fricatives. For example, while *s* may multiply associate if it does not follow a vowel in the underlying representation, it never multiply associates if it does follow a vowel. This suggests that *s* is unspecified for the feature [continuant] and so is invisible to the well-formedness condition affecting underlying consonants that weaken to surface fricatives.

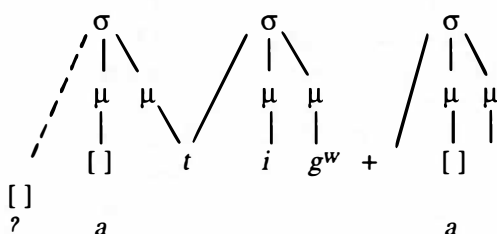
Following Archangeli and Pulleyblank (1986), I propose that the feature [continuant] exists on a separate hierarchical tier, and that the well-formedness condition scans this tier first in order to identify adjacent [continuant] consonants. Once it locates two adjacent [continuant] consonants, it then scans the [sonorant] and [consonantal] tiers in order to determine whether the consonant pattern must be repaired, by blocking consonant weakening, in order to surface as a well-formed word. The following statements describe this process; each statement is followed by an example. (In the examples, the symbol 'o' indicates the absence of a feature.)

Once adjacent [continuant] features are found on the [continuant] tier, the [sonorant] tier is scanned. If one [continuant] consonant lacks the feature [sonorant], weakening is blocked in that consonant. This statement implies that weakening is blocked on the basis of consonant strength, as shown in (146). (In the following examples, epenthetic material and redundant features are added to the underlying representation in order to simplify the derivation.)

(146) ?aθiw + -a 'to lose something'

Underlying form

Affixation



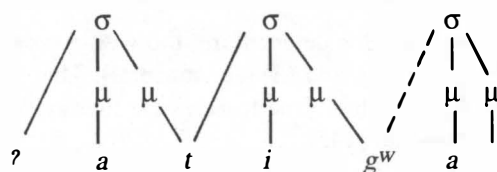
Glottal epenthesis

Redundant feature assignment

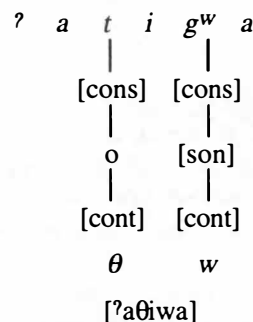
Surface form

[?aθiw + a]

Multiple association



Variation 1



Consonantal tier

Sonorant tier

Continuant tier

Surface form

[?aθiwa]

Variation 2

	<i>ʔ</i>	<i>a</i>	<i>t</i>	<i>i</i>	<i>g^w</i>	<i>a</i>
Consonantal tier			[cons]		[cons]	
Sonorant tier			o		[son]	
Continuant tier			≠			
Weakening blocking			[cont]		[cont]	
Surface form			<i>t</i>		<i>w</i>	
						[ʔattiwa]

In the root *ʔaθiw* [ʔaθiw] ‘to lose something’ in (146), *t* and *g^w* follow vowels in the underlying representation, and *t* is already multiply associated. When the suffix *-a* is added, *g^w* also multiply associates in order to provide phonetic material for the suffix onset. With multiple association, both consonants weaken and acquire the feature [continuant], surfacing as the [θ] and [w], as shown in variation 1. Since both [θ] and [w] have the feature [continuant], weakening may be blocked. As multiply associated *t* (surface [θ]) has no [sonorant] feature, it is less sonorant than multiply associated *g^w* (surface [w]) which does have a [sonorant] feature; consequently, weakening is blocked in multiply associated *t*, by delinking the [continuant] tier, and *t* surfaces as the geminate sequence [tt], as shown in variation 2. This indicates that, for [continuant] consonants with non-identical [sonorant] features, weakening is blocked in the least sonorant [continuant] consonant. We can verify that weakening in [continuant] consonants is blocked on the basis of consonant strength (rather than position in the consonant string) by comparing (146) with (147).

(147) *ʔawit* + *-a* ‘to raise a child as one's own’

Underlying form

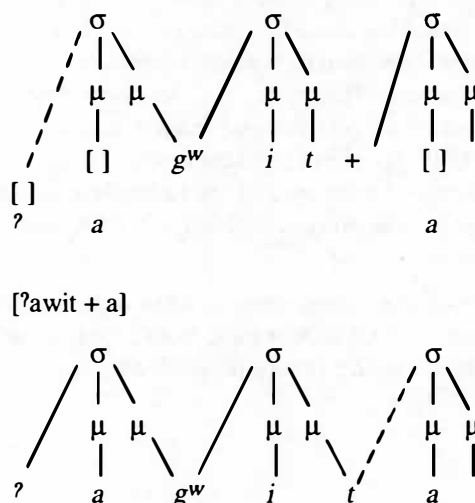
Affixation

Glottal epenthesis

Redundant feature
assignment

Surface form

Multiple association



Variation 1

	?	a	g ^w	i	t	a
Consonantal tier			[cons]		[cons]	
Sonorant tier			[son]		o	
Continuant tier			[cont]		[cont]	
			w		θ	
Surface form			[ʔawiθa]			

Variation 2

	?	a	g ^w	i	t	a
Consonantal tier			[cons]		[cons]	
Sonorant tier			[son]		o	
					≠	
Continuant tier			[cont]		[cont]	
Weakening blocking			w		t	
Surface form			[ʔawitta]			

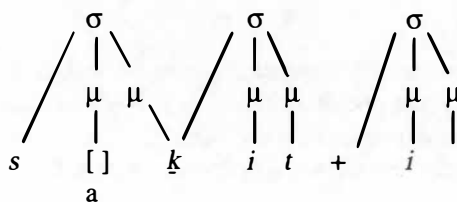
In (147), *t* and *g^w* occur in reverse order in the root *ʔawit* [ʔawit] ‘to raise a child as one’s own’. Both *t* and *g^w* follow vowels in the underlying representation, and *g^w* is already multiply associated. When the suffix *-a* is added, *t* in the final root coda multiply associates with the suffix onset. With multiple association, both consonants weaken and acquire the feature [continuant], surfacing as the [w] and [θ], as shown in variation 1. Since both [w] and [θ] have the feature [continuant], weakening may be blocked. As multiply associated *t* (surface [θ]) has no [sonorant] feature, it is less sonorant than multiply associated *g^w* (surface [w]) which does have a [sonorant] feature; consequently, weakening is blocked in multiply associated *t*, by delinking the [continuant] tier, and *t* surfaces as the geminate sequence [tt], as shown in variation 2. This example shows that, in a string of adjacent [continuant] consonants, weakening is blocked in the less sonorant consonant, regardless of its position in the consonant string.

If both adjacent [continuant] consonants lack the feature [sonorant], weakening is blocked in the second consonant. In other words, if both [continuant] consonants are obstruents, position in the consonant string determines which consonant will weaken, as shown in (148).

(148) *saxit* + *-i* 'to hurt someone'

Underlying form

Affixation

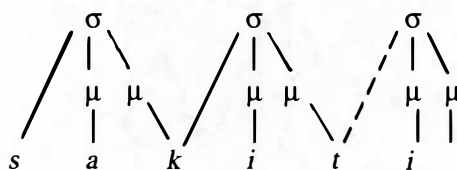
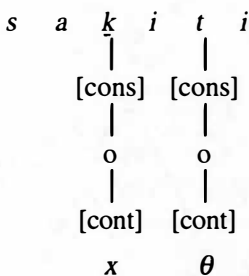


Redundant feature assignment

Surface form

[saxet + i]

Multiple association

Variation 1

Consonantal tier

[cons] [cons]

Sonorant tier

o o

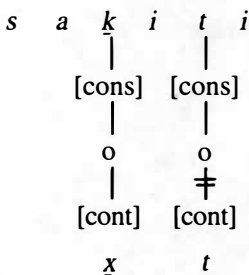
Continuant tier

[cont] [cont]

x θ

Surface form

[saxeθi]

Variation 2

Consonantal tier

[cons] [cons]

Sonorant tier

o o

Continuant tier

[cont] [cont]

x t

Weakening blocking

Surface form

[saxetti]

In the root *saxit* [saxet] 'sick' in (148), *k* and *t* follow vowels in the underlying representation, and *k* is already multiply associated. When the suffix *-i* is added, *t* also multiply associates in order to provide phonetic material for the suffix onset. With multiple association, both consonants weaken and acquire the feature [continuant], surfacing as the [x] and [θ], as shown in variation 1. Since both [x] and [θ] have the feature [continuant], weakening may be blocked. As neither multiply associated *k* (surface [x]) nor multiply

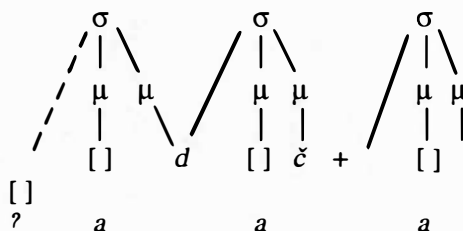
associated *t* (surface [θ]) have a [sonorant] feature (indicating that both will surface as obstruents), weakening is blocked in the second consonant in the string, that is *t*, by delinking the [continuant] tier, and *t* surfaces as the geminate sequence [tt], as shown in variation 2.

If both adjacent [continuant] consonants have the feature [sonorant] and both also have identical [consonantal] assignments, weakening is blocked in the second consonant. In other words, if both [continuant] consonants are liquids, or both consonants are glides, position in the consonant string again determines which consonant will weaken, as shown in (149).

(149) *ʔalad* + *-a* 'to surround with a fence'

Underlying form

Affixation



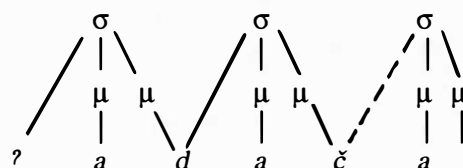
Glottal epenthesis

Redundant feature assignment

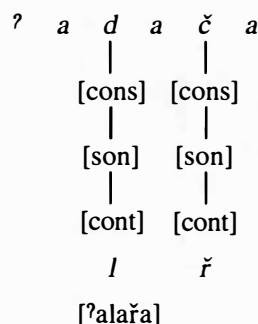
Surface form

[ʔalad + a]

Multiple association



Variation 1



Consonantal tier

Sonorant tier

Continuant tier

Surface form

[ʔalaɾa]

Variation 2

	?	a	d	a	č	a
Consonantal tier			[cons]		[cons]	
Sonorant tier			[son]		[son]	
Continuant tier			[cont]		[cont]	
Weakening blocking			l		č	
Surface form			[ʔalača]			

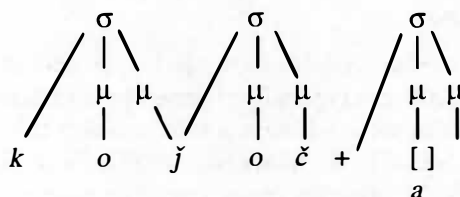
In the root *ʔalad* [ʔalad] ‘fence’ in (149), *d* and *č* follow vowels in the underlying representation, and *d* is already multiply associated. When the suffix *-a* is added, *č* also multiply associates with the suffix onset. With multiple association, both consonants weaken and acquire the feature [continuant], surfacing as the [l] and [ř], as shown in variation 1. Since both [l] and [ř] have the feature [continuant], weakening may be blocked. Both multiply associated *d* (surface [l]) and multiply associated *č* (surface [ř]) have [sonorant] and [consonantal] features (indicating that both will surface as liquids), and so weakening is blocked in the second consonant in the string, that is *č*, by delinking the [continuant] tier, and *č* surfaces as [č], as shown in variation 2.

If both adjacent [continuant] consonants have the feature [sonorant], but non-identical [consonantal] assignments, weakening is not blocked in either consonant. In other words, if both [continuant] consonants are sonorants, but not two liquids or two glides, then weakening is permitted in both consonants, as shown in (150).

(150) *koyod* + *-a* ‘to pull’

Underlying form

Affixation

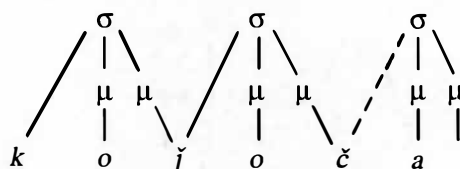


Redundant feature assignment

Surface form

[kuyud + a]

Multiple association



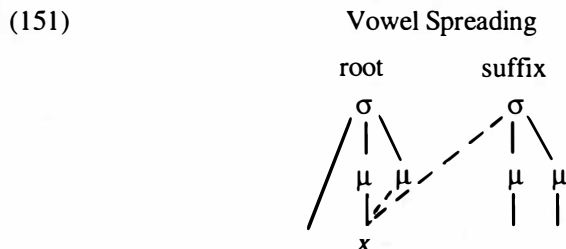
	<i>k</i>	<i>o</i>	<i>ǰ</i>	<i>o</i>	<i>č</i>	<i>a</i>
Consonantal tier			 o		 [cons]	
Sonorant tier			 [son]		 [son]	
Continuant tier			 [cont]		 [cont]	
			<i>y</i>		<i>ř</i>	
Surface form			[kuyuřa]			

In the root *koyod* [kuyud] 'to pull' in (150), *ǰ* and *č* follow vowels in the underlying representation, and *ǰ* is already multiply associated. When the suffix *-a* is added, *č* also multiply associates with the suffix onset. With multiple association, both consonants weaken and acquire the feature [continuant], surfacing as the [y] and [ř], as shown in variation 1. Since both [y] and [ř] have [continuant] and [sonorant] features, but non-identical [consonantal] feature assignments, weakening is not blocked in either consonant.

To summarise, the feature [continuant] defines a class of consonants in Karao. When these consonants occur in strings, they are subject to a well-formedness condition which states that the preferred word pattern contains only one [continuant] consonant. If adjacent [continuant] consonants occur in the underlying representation due to multiple association of consonants following vowels, weakening is typically blocked in one of the consonants. The features [sonorant] and [consonantal] are required in order to determine which [continuant] consonant in a string will undergo weakening. The features [continuant], [sonorant], and [consonantal] are organised hierarchically on separate tiers; each tier is scanned, starting with the [continuant] tier, for information necessary for correct application of the well-formedness condition.

6.1.2 VOWEL SPREADING

Vowel spreading across syllable boundaries is another common morphological alternation. Vowel spreading is typically triggered by suffixation: when a suffix that lacks phonetic material for its onset is added to a root in which the feature [high] or [labial] has spread from the final nucleus to the final coda, the feature [high] or [labial] will also spread to the onset of the suffix. The rule for vowel spreading is given in (151).



Note: x is the feature [high] or [labial].

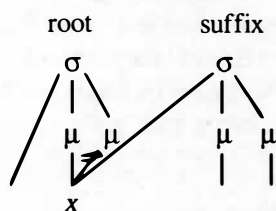
This rule is identical to the Vowel Spreading rule presented earlier for unfixed roots (see section 4.3.5). What (151) shows is that vowel spreading occurs across syllable boundaries

between morphemes just as it does across syllable boundaries within a morpheme. There is one difference, however, between vowel spreading triggered by affixation and vowel spreading occurring in an unaffixed root. In an unaffixed root, the feature [high] or [labial] can associate with two positions – a nucleus and the following coda, or with three positions – a nucleus, the following coda, and an adjacent onset. When vowel spreading is triggered by affixation, the feature [high] or [labial] always spreads to three positions – a nucleus, the following coda, and an adjacent onset. Affixation never triggers vowel spreading in which the feature [high] or [labial] associates with just two positions – a nucleus and the following coda.

When the feature [high] or [labial] spreads from the final nucleus and coda of a root to the onset of a suffix, the feature may optionally delink from the final coda of the root, while remaining associated with the root nucleus and the suffix onset. Normally, vowel delinking occurs only in this environment; when the feature [high] or [labial] is multiply associated with a nucleus, the following coda, and an adjacent onset, within a word (for example, as a result of infixation), the feature does not delink from the coda. (Reduplication, however, can trigger vowel delinking within a root, as we will see in section 8.2.) The rule for vowel delinking is given in (152).

(152)

Vowel Delinking



Note: x is the feature [high] or [labial].

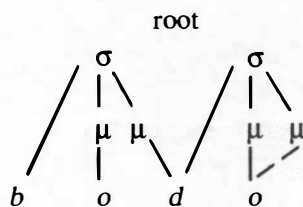
An example of vowel spreading and vowel delinking across morpheme boundaries is given in (153).

(153) *bolow* 'to bark'

Underlying form

Vowel spreading

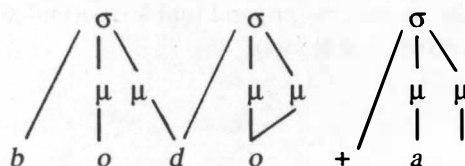
in root



Surface form

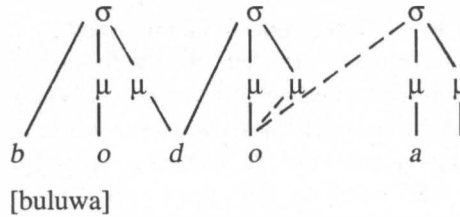
[buluw]

Affixation



Variation 1

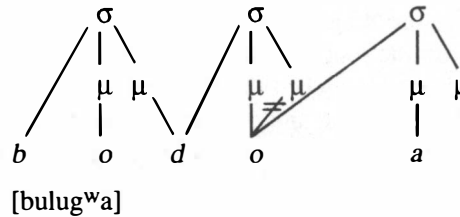
Vowel spreading
in suffixed root



Surface form

Variation 2

Vowel delinking



Surface form

In the root *bolow* [buluw] 'to bark' in (153), the feature [labial] in the final nucleus spreads to the final coda. The suffix *-a*, like all suffixes, lacks phonetic material for its onset. When *-a* is added to the root *bolow*, the feature [labial] in the final nucleus spreads to the final coda of the root and the onset of the suffix, and the root surfaces as [buluwa], as shown in variation 1. Following vowel spreading to the suffix onset, the feature [labial] optionally delinks from the final coda of the root, remaining multiply associated with the root nucleus and the suffix onset, as shown in variation 2.

6.1.3 NASAL ASSIMILATION 1

Nasal assimilation occurs in prefixes and infixes in which the final coda is associated with *n* in the underlying representation. When either affix is added to a root, the place feature of the following root consonant spreads to the affix nasal. Although this alternation occurs in both prefixes and infixes, these affixes have different restrictions and so are discussed separately.

6.1.3.1 PREFIXES

The surface forms for prefix nasals are listed in (154).

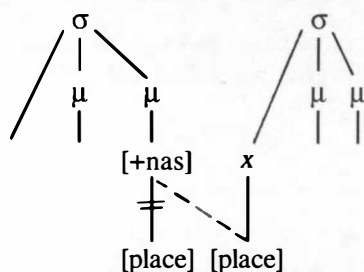
- (154) [m] before [p, b]
 [n] before [t, d, č, ʝ, n, s]
 [ŋ] before [k, ɣ, g^w, ŋ]

Notice that although the sequences [nn] and [ŋŋ] are permitted, the sequence *[mm] is not permitted with these prefixes (see below).

The rule for this type of nasal assimilation is represented in (155).

(155)

Nasal Assimilation 1

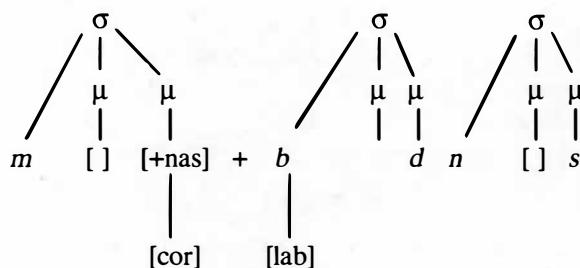


For this type of nasal assimilation, the affix nasal is *n* in the underlying representation; that is, the affix nasal is assigned a [coronal] place feature in the underlying representation. This claim is based on two observations. Firstly, this type of nasal assimilation is optional, and when the place feature of the following consonant does not spread to the affix nasal, the nasal always surfaces as [n]. Furthermore, when the affix nasal attaches to a root in which the initial onset lacks an underlying segment (and so surfaces as [ʔ]), the affix nasal always surfaces as [n]. From this evidence, I conclude that in the underlying representation, the affix nasal is assigned the place feature [coronal], and that when assimilation takes place, the place feature of the following consonant spreads to the affix nasal, causing the [coronal] place feature to delink from the nasal, as shown in (156).

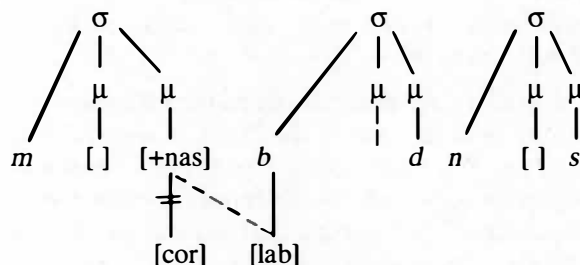
(156) *bɪlnas* 'to rinse'

Underlying form

Affixation



Nasal assimilation 1



Vowel epenthesis
Redundant feature
assignment

Surface form

a *i* *a*
[mambɪlnas]

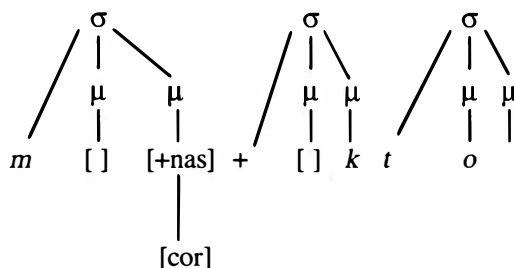
When *man-* is added to the root *bilnas* [bilnas] 'to rinse' in (156), the [labial] place feature associated with *b* in the initial onset of the root spreads to the nasal of the prefix; the [coronal] place feature of the prefix nasal delinks; and the prefix nasal surfaces as [m].

If the consonant following the prefix nasal lacks phonetic material in the underlying representation, the place feature of the affix nasal does not delink, and the nasal surfaces as [n], as shown in (157).

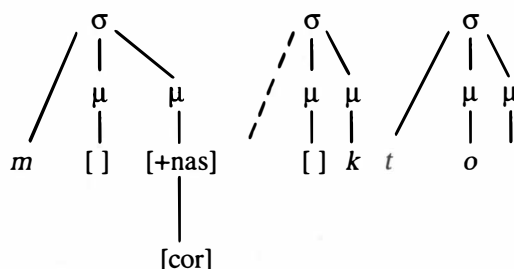
(157) ?*agto* 'to carry on the head'

Underlying form

Affixation

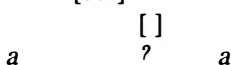


Nasal assimilation 1



Glottal epenthesis

Redundant feature
assignment



Surface form

[manʔagtu]

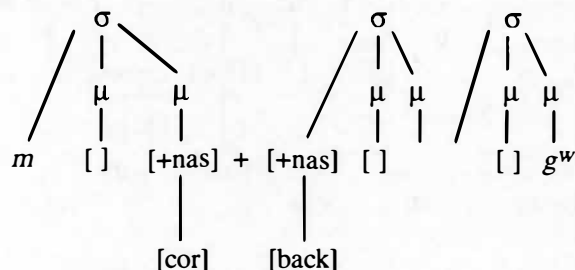
When *man-* is added to the root ?*agto* [ʔagtu] 'to carry on the head' in (157), no nasal assimilation takes place since the initial onset of the root lacks phonetic material in the underlying representation; the prefix nasal retains its association with its place feature [coronal] and surfaces as [n].

This type of nasal assimilation has one restriction: when a prefix ending with *n* attaches to a word beginning with *m*, nasal assimilation is blocked, and the sequence *[mm] is not permitted to surface. This restriction is of particular interest since the sequences [nn] and [ŋŋ] do occur. The question is: why is the sequence *[mm] prohibited when all other nasal sequences are permitted? The fact that [nn] and [ŋŋ] are allowed to surface as a result of nasal assimilation indicates that the restriction on *[mm] is not due to a violation of the preferred syllable contact condition (which does not allow an adjacent coda and onset to be associated with separate identical phonetic segments in the underlying representation), as the following example shows.

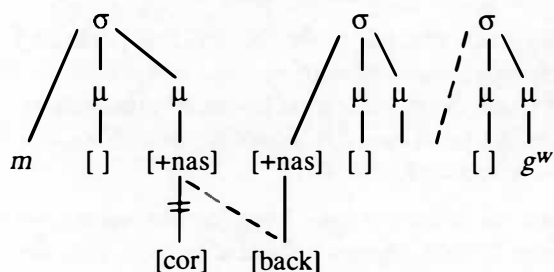
(158) *ŋaʔaw* 'bad'

Underlying form

Affixation



Nasal assimilation 1



Glottal epenthesis

Redundant feature assignment

$$a \quad a \quad \begin{matrix} [] \\ ? \end{matrix} \quad a$$

Surface form

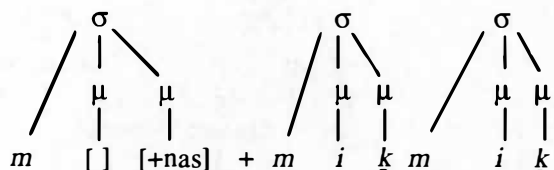
[manɲaʔaw] 'to make bad'

When the prefix *man-* is added to the root *ŋaʔaw* [ŋaʔaw] ‘bad’ in (158), the place feature [back] associated with **ŋ** in the initial onset of the root spreads to the prefix nasal; the place feature [coronal] delinks from the prefix nasal, and the prefix nasal surfaces as [ŋ], resulting in the surface sequence [ŋŋ]. Despite the preference for syllable contacts composed of non-identical phonetic segments, sequences of identical nasals resulting from nasal assimilation are apparently tolerated. This suggests that the restriction on the sequence *[mm] must have to do with the feature [labial], as the next example shows.

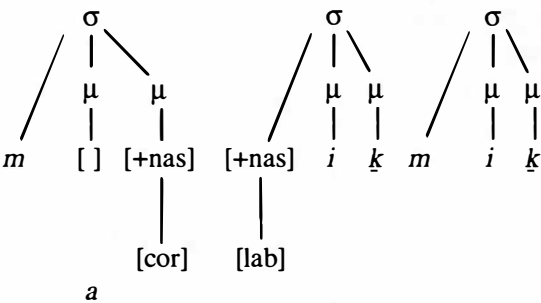
(159) *mikmik* 'to mash food'

Underlying form

Affixation



Nasal assimilation 1
blocked



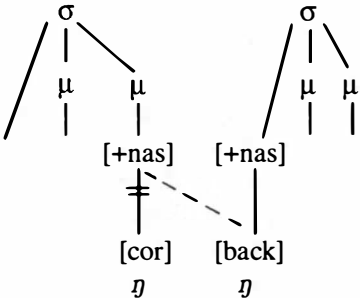
Redundant feature
assignment

Surface form [manmekmek]

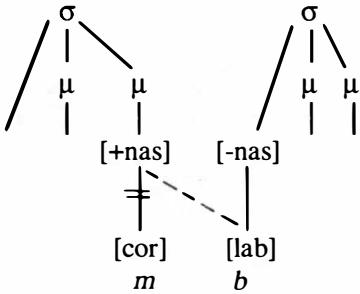
When the prefix *man-* attaches to the root *mikmik* [mekmek] ‘to mash food’ in (159), the place feature [labial] associated with *m* in the initial onset of the root does not spread to the prefix nasal. Instead, the place feature [coronal] remains linked to the prefix nasal, and the nasal surfaces as [n], producing the sequence [nm]. (Note that in a closed syllable, *i* surfaces as [ε] when contiguous to *k*.)

If we compare the following underlying representations, we see that the prohibition on the surface sequence *[mm] appears to be due to a combination of the features [+nasal] and [labial], as shown in (160).

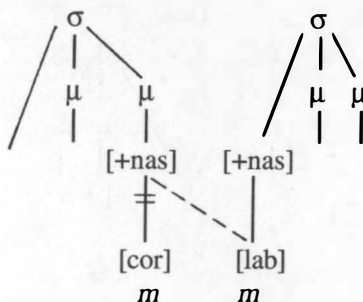
(160) a. Representation for sequence [ŋŋ]



b. Representation for sequence [mb]



c. Representation for sequence *[mm]



The underlying representation in (160a) shows that the feature [+nasal] may be assigned independently to adjacent positions on the moraic tier; (160b) shows that the feature [labial] may spread to adjacent positions on the moraic tier so long as those positions are not both independently associated with [+nasal]; (160c) shows that the feature [labial] cannot spread to adjacent positions on the moraic tier if those positions are both independently associated with [+nasal].

The representation in (160c) is reminiscent of the underlying representations for the Adjacent Mora Prohibition. Recall that the prohibition blocks identical segments on one tier from associating with adjacent positions on the moraic tier. The fact that the sequences [nn] and [ŋŋ] are permitted to surface following nasal assimilation shows that the prohibition will allow certain exceptions; however, it will not permit the sequence [mm] to surface, and so it appears that the feature [labial] is the crucial factor.

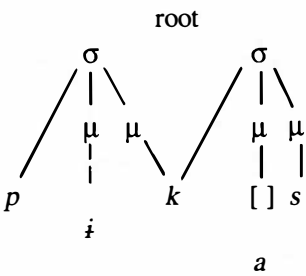
Assuming that the Adjacent Mora Prohibition will not tolerate separate [labial] features associating with adjacent positions on the moraic tier, the restriction on the sequence *[mm] can be explained if we assume again that features are organised hierarchically. The feature [labial] appears to be dominated by the feature [nasal]; this agrees with proposals that the nasal node dominates the place node in the hierarchical structure of features. The fact that nasal assimilation requires that a place feature associate first with the nasal node before associating with the moraic tier is apparently the source of the restriction on the sequence *[mm]. Once the [labial] feature spreads to two nasal nodes that have the same value (that is [+nasal]) and these [+nasal] features are independently associated with adjacent positions on the moraic tier, the structure is deemed a violation of the Adjacent Mora Prohibition. I cannot explain why the place feature [labial] is blocked when all other place features apparently are allowed to associate in this way as part of this type of nasal assimilation, but the phonetic facts indicate that it is so.

6.1.3.2 INFIXES

The possible surface forms for infix nasals are identical to those listed in (154), with the exception that assimilation is blocked before another nasal. The following is an example of nasal assimilation occurring in the infix *-in-*.

(161) *pikas* ‘to pick large fruit’

Underlying form



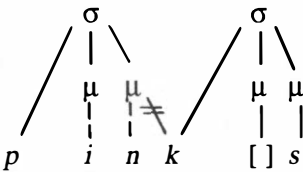
Vowel epenthesis
Redundant feature
assignment

Surface form

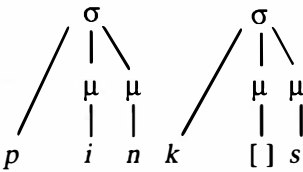
[pikkas]

Infixation

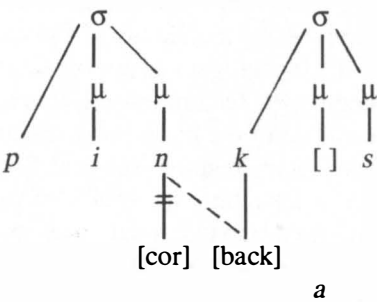
Delinking



Resyllabification



Nasal assimilation



Redundant feature
assignment

Surface form

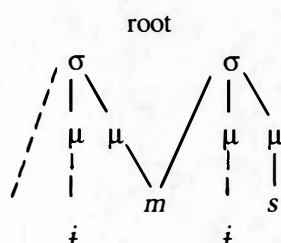
[piŋkas]

In (161), the infix *-in-* is inserted following the initial onset of the root *pikas* [pikkas] ‘to pick large fruit’; the feature [back] of *k* spreads to the nasal of the infix, causing the feature [coronal] to delink; and the infix nasal surfaces as [ŋ].

When the infix *-in-* is inserted in a root before a root nasal, the place feature of the root nasal does not spread to the infix nasal; instead, the infix nasal undergoes different alternations depending upon the place feature of the root nasal. When the following root nasal is *m*, assimilation is blocked in the infix nasal just as it is in the prefix nasal, and the infix nasal surfaces as [n], as shown in (162).

(162) *ʔimis* 'to bathe'

Underlying form



Vowel epenthesis

Glottal epenthesis

Redundant feature assignment

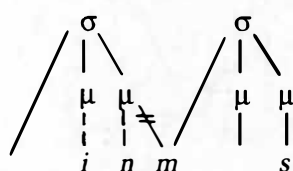
[]
ʔ

Surface form

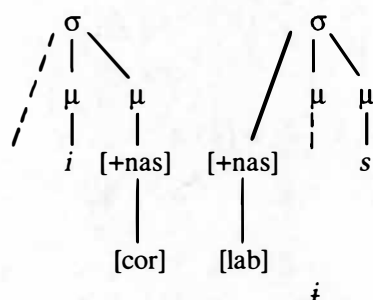
[ʔimɪs]

Infixation

Delinking



Resyllabification



Vowel epenthesis

Glottal epenthesis

Redundant feature assignment

[]
ʔ

Surface form

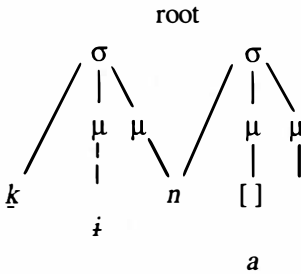
[ʔinɪs]

In (162) the infix *-in-* is inserted following the initial onset of the root *ʔimis* [ʔimɪs] 'to bathe'; the place feature [labial] of the following *m* does not spread to the infix nasal; instead the infix nasal remains *n*. We may assume that nasal assimilation in an infix is blocked before *m* just as it is in a prefix nasal.

When the infix *-in-* is inserted before *n* or *ŋ*, the assimilation pattern differs from the one occurring with prefix nasals. Recall that when a prefix nasal occurs before the root nasal *n* or *ŋ*, the place feature of the root nasal spreads to the prefix nasal, producing the surface sequences [nn] and [ŋŋ]. Although this assimilation pattern is permitted across morpheme boundaries with prefixation, it apparently is not permitted between morphemes with infixation. When the infix *-in-* is inserted before the root nasal *n* or *ŋ*, the infix nasal is deleted altogether, as seen in (163) and (164).

(163) *kina* ‘to hit’

Underlying form



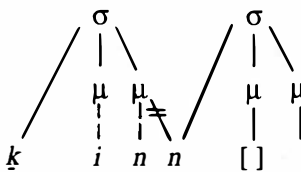
Vowel epenthesis
Redundant feature
assignment

Surface form

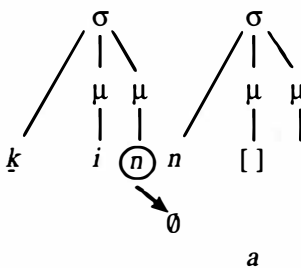
[kɪnna]

Infixation

Delinking



Nasal deletion



Redundant feature
assignment

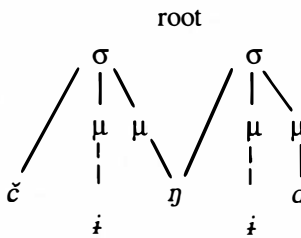
Surface form

[kɛna]

In (163), the infix *-in-* is inserted following the initial onset of the root *kina* [kɪnna] ‘to hit’; the place feature of *n* in the root does not spread to the infix nasal; instead, the infix nasal is deleted. (Note that following *k* in an open syllable, *i* surfaces as [e].) The same alternation occurs when *-in-* occurs before *ŋ*, as the next example shows.

(164) *čiŋil* ‘to hear’

Underlying form



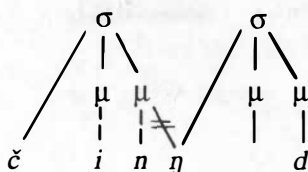
Vowel epenthesis

Surface form

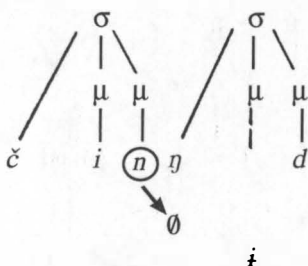
[čɪŋɪɪl]

Infixation

Delinking



Nasal deletion



Vowel epenthesis

Surface form

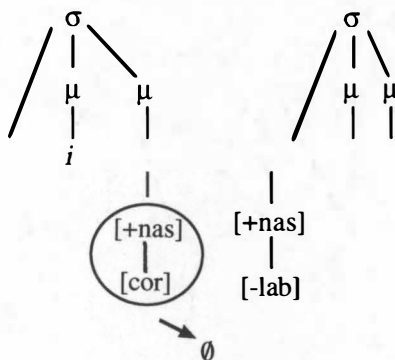
[čɪŋɪl]

In (164), the infix *-in-* is inserted following the initial onset of the root *čɪŋɪl* [čɪŋɪl] ‘to hear’, and the infix nasal is deleted before *ŋ*.

The alternations in (163) and (164) appear to be result of the Adjacent Mora Prohibition which prohibits identical segments on a melody tier from associating with adjacent positions on the moraic tier in the underlying representation. While violations of this prohibition due to nasal assimilation are permitted between prefixes and roots, they are not permitted between infixes and roots. (Apparently, the infix nasal is not deleted preceding *m* in the root, since nasal assimilation is blocked in an [nm] sequence in all occurrences.) The nasal of the infix is deleted rather than the nasal of the root since codas are not obligatory, but onsets are; this deletion rule is represented in (165).

(165)

Nasal Deletion



6.1.4 NASAL ASSIMILATION 2

Nasal assimilation occurs in prefixes in which the final coda is associated with the feature [nasal] only; that is, the feature [nasal] has no place feature specification in the underlying representation. (A nasal that has no place feature specification is represented as *N*.) When a prefix ending with *N* is added to a root, the place feature of the initial root consonant spreads to the prefix nasal; the initial root consonant delinks from the moraic tier; and the prefix nasal

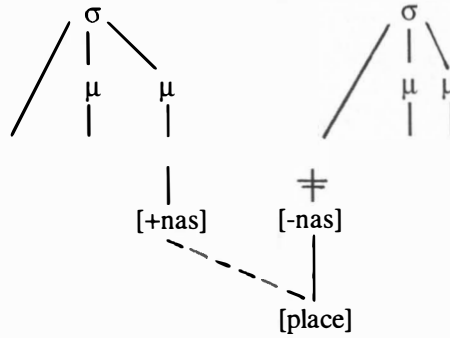
spreads to the initial onset of the root. The rule for this type of nasal assimilation is represented in (166), followed by an example in (167).

(166)

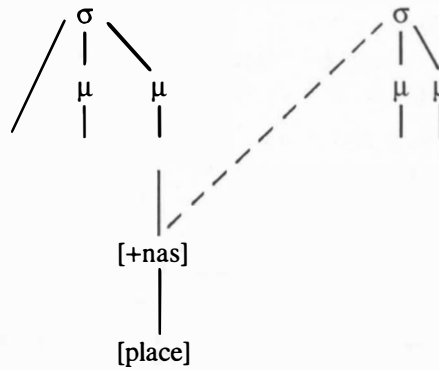
Nasal Assimilation 2

Place assimilation

Delinking



Multiple association

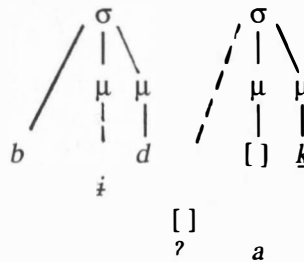


Notice that this type of nasal assimilation does not violate the Adjacent Mora Prohibition, since only one segment is associated with the two adjacent positions in the moraic tier.

(167) *bilʔak* 'to wash clothes'

Underlying form

root



Vowel epenthesis

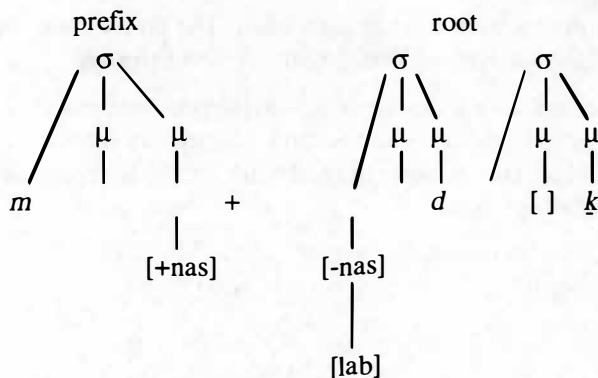
Glottal epenthesis

Redundant feature assignment

Surface form

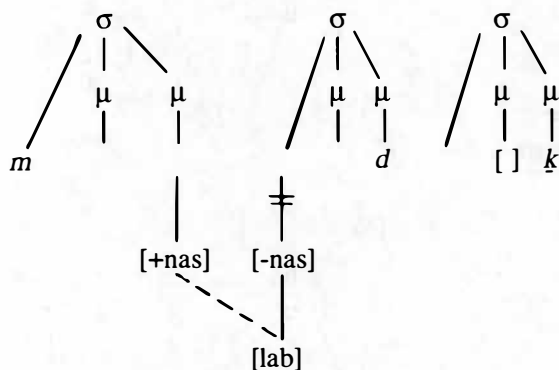
[bilʔak]

Affixation

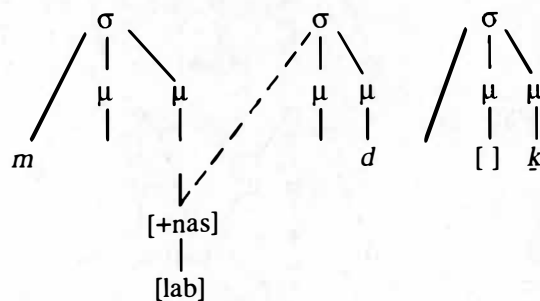


Place assimilation

Delinking



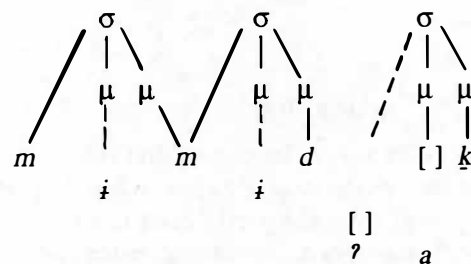
Multiple association



Vowel epenthesis

Glottal epenthesis

Redundant feature assignment



Surface form

[mimmi?ak]

In (167), the prefix *mɨN-* attaches to the root *biʔak* [biʔak] 'to wash clothes'; the [labial] feature of *b* in the root onset spreads to the prefix nasal; *b* delinks from the moraic tier,

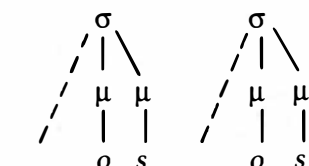
leaving the initial root onset unassociated. The prefix nasal then spreads to the root onset, resulting in the surface sequence [mm].

When the initial onset of a root has no phonetic material in the underlying form, the prefix nasal is assigned a default place feature, specifically [back], and the nasal surfaces as [ŋ], as shown in (168). (In the derivation, default [back] is represented as 'ŋ' on the 'Redundant feature assignment' line.)

(168) ?os?os 'to use an ?os?os tool'

Underlying form

root



Glottal epenthesis

Redundant feature assignment



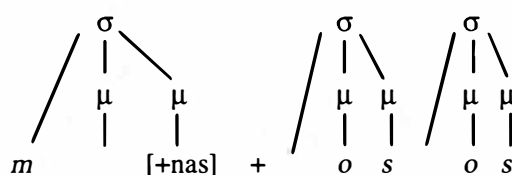
Surface form

[?os?os]

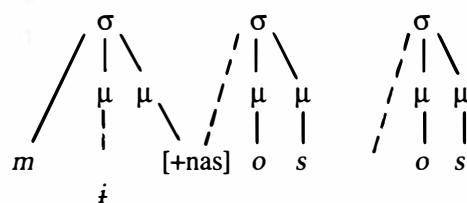
Affixation

affix

root



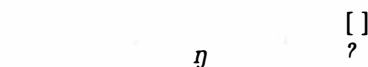
Multiple association



Vowel epenthesis

Glottal epenthesis

Redundant feature assignment



Surface form

[mɪŋŋos?os]

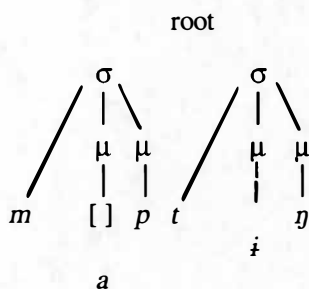
In the root ?os?os [?os?os] 'to use an ?os?os tool' in (168), the initial onset of the root lacks phonetic material in the underlying representation. When the prefix *mɪN-* attaches to the root, the feature [+nasal] spreads from the prefix coda to the initial onset of the root; and the redundant feature [back] is assigned, providing a place feature for the [+nasal] segment. I assume that [back] here is the same redundant feature that is assigned to a fully underspecified segment, the difference being that here [back] is assigned to a consonant position associated with a [+nasal] feature, which results in a surface [ŋ].

There is one restriction on nasal assimilation of this type: prefixes ending with *N*, that is *mɪN-* and *?iN-*, never occur with roots beginning with nasals; instead, *mɪN-* is replaced by *man-*, and *?iN-* by *?iyan-*. Thus the root *maptiŋ* [maptiŋ] 'good' occurs with the affixes *-in*

and *-iy-*, and *mɪ-* and *ʔɪ-*. Roots occurring with these affixes typically also occur with *mɪN-* and *ʔɪN-*; however, *maptɪŋ* occurs with *man-* and *ʔiyan-* instead. (Normally, the affixes *man-* and *ʔiyan-* do not occur in the same paradigm as *-ɪn*, *-iy-*, *mɪ-* and *ʔɪ-*.) This restriction appears to be an attempt to avoid surface homophony. As it turns out, the passive prefixes *mɪ-* and *ʔɪ-* produce the same surface forms as would be produced by the active prefixes *mɪN-* and *ʔɪN-*, as shown in (169) and (170).

(169) *maptɪŋ* 'good'

Underlying form



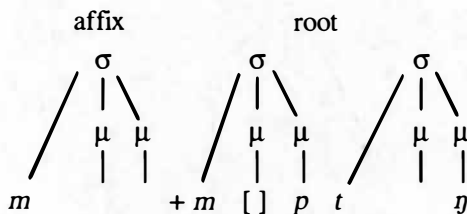
Vowel epenthesis

Redundant feature
assignment

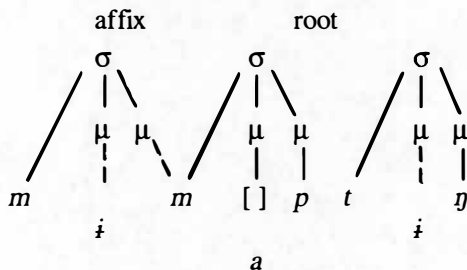
Surface form

[maptɪŋ]

Affixation



Multiple association



Vowel epenthesis

Redundant feature
assignment

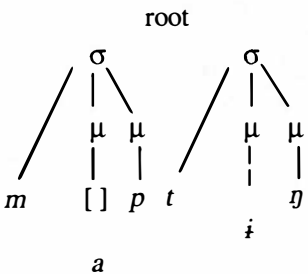
Surface form

[mɪmmaptɪŋ] 'to be made better'

In (169), the prefix *mɪ-* attaches to the root *maptɪŋ* 'good'; *m* in the initial onset of the root multiply associates with the coda of the prefix; vowel epenthesis and redundant feature assignment follow. Compare (169) with the derivation for the unattested *mɪN-+matpɪŋ* form in (170).

(170) *maptiŋ* 'good'

Underlying form

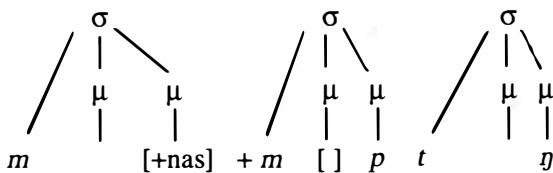


Vowel epenthesis
Redundant feature
assignment

Surface form

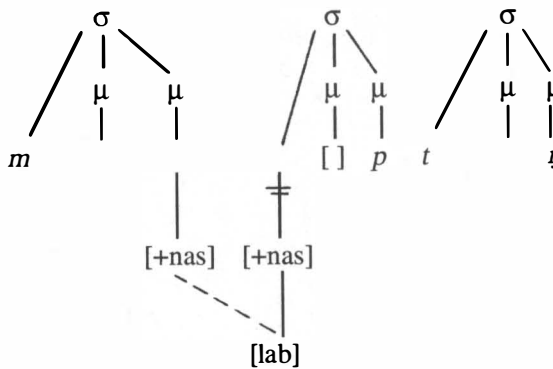
[maptiŋ]

Affixation

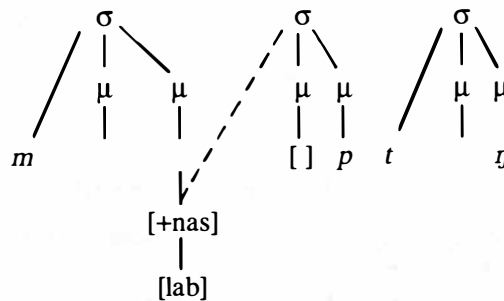


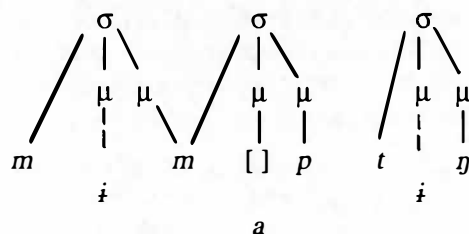
Place assimilation

Delinking



Multiple association





Vowel epenthesis
Redundant feature
assignment

Surface form

*[mimmaptiŋ] 'to make better'

In (170), the prefix *miN-* attaches to the root *maptiŋ* 'good'; the [labial] feature of *m* spreads to the prefix nasal; *m* (or [+nasal]) delinks from the moraic tier; the prefix nasal then spreads to the initial onset of the root, resulting in the surface sequence [mm]; this, however, is an unattested form for this meaning.

A comparison of (169) and (170) shows that the prefix *miN-* would produce the same surface form as *mi-* when attached to a root beginning with a nasal. Furthermore, these surface forms would occur in identical syntactic constructions in that both *miN-* and *mi-* would attach to verbs that take only one core argument; consequently, context alone would indicate whether the clause was an active or a passive construction. These facts suggest that the restriction which prohibits prefixes ending with *N* from attaching to roots beginning with nasals exists to prevent surface homophony.

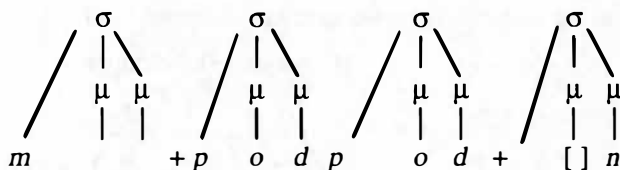
6.2 ALTERNATIONS AFFECTING CVCVC AND C_iC₁C₁VC ROOT TYPES

If the first syllable of a root is a closed surface syllable that forms a preferred syllable contact with the following syllable, that is a CVC₁C₂VC root, then no other alternations occur when a prefix or suffix is added to the root, as illustrated in (171).

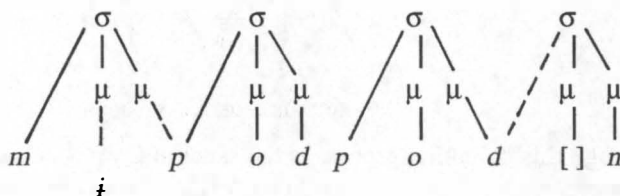
(171) *polpol* 'to undress'

Underlying form

Affixation



Multiple association



Vowel epenthesis
Redundant feature
assignment

Surface form

[mippulpulan]

In (171), the affix *mi--an* attaches to the CVC_1C_2VC root *polpol* [pulpul] 'to undress'. The consonant *p* in the initial root onset spreads to the coda of the prefix, and *d* in the final root coda spreads to the onset of the suffix; vowel epenthesis and redundant feature assignment follow. No other alternations occur.

On the other hand, if the first syllable of a root is an open surface syllable, forming a CVCVC root, or if the first syllable ends in a geminate consonant, forming a $C\dot{C}C_1C_1VC$ root, then five additional alternations can occur in the root, depending on the canonical shape of the root and the first vowel of the root. (In all root types, the final coda is optional and does not affect the application of the following rules.) These additional alternations are: (1) delinking of multiply associated medial consonants, (2) devoicing, (3) vowel deletion, (4) delinking of singly associated initial consonants, and (5) multiple association of a consonant within a syllable.

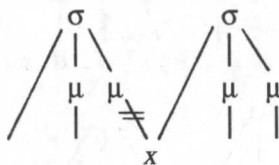
I have proposed that in surface representations, open syllables and syllables ending in a geminate cluster are in fact defective closed syllables. I continue this line of argumentation and suggest that each of the phonological alternations that occur in CVCVC and $C\dot{C}C_1C_1VC$ root types is an attempt to repair underlying bimoraic units that lack sufficient material to surface as closed syllables. The target of these alternations is the first bimoraic unit of the root, that is, the first surface syllable; the alternations do not affect non-initial bimoraic units in a root. As we will see, different root types are eligible for different phonological alternations, and different root types have different potential for achieving closed surface syllables, as a result of these phonological alternations. In other words, while some root types always succeed in achieving closed surface syllables following phonological alternations, others never do. In spite of this fact, I argue that these five phonological alternations move all CVCVC and $C\dot{C}C_1C_1VC$ roots closer to the preferred surface form.

6.2.1 DELINKING OF MULTIPLY ASSOCIATED CONSONANTS IN MEDIAL ROOT POSITIONS

Consonant delinking can take place in a multiply associated C_1 consonant in either a CV_1C_1VC or $C\dot{C}C_1C_1VC$ root type. In this alternation, the multiply associated consonant delinks from the preceding coda position, but remains associated with the following onset position in the underlying representation, as shown in (172).

(172)

Consonant Delinking 2



Note: *x* is a set 1 consonant.

Although this delinking process is the same in CV_1C_1VC and $C\dot{C}C_1C_1VC$ root types, the environments are slightly different. In a CV_1C_1VC root type, the first vowel of the root must be associated with either the feature [high] (*i*) or [labial] (*o*) in the underlying representation. (Delinking does not occur if the first root vowel is associated with a fully underspecified segment (i.e. surface [a]).) On the other hand, in a $C\dot{C}C_1C_1VC$ root type, the first vowel of the root is never associated with phonetic material in the underlying representation.

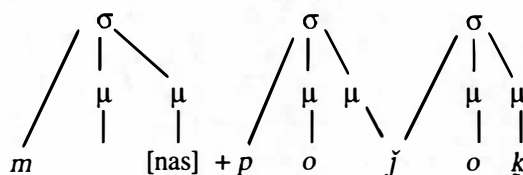
The delinking process also produces different surface forms depending on the root type. In a $C_1C_1C_1VC$ root type, when the multiply associated medial consonant delinks, the singly associated initial consonant also delinks. Since these two alternations always occur together, I will defer a discussion of the $C_1C_1C_1VC$ root type until both types of consonant delinking can be described. For this discussion, we look at the CV_1C_1VC root type, which is representative of this type of delinking.

When an appropriate affix is added to a CV_1C_1VC root type in which the medial C_1 consonant is multiply associated in the underlying representation, the C_1 consonant delinks from the preceding coda and surfaces as a strong set 1 consonant, as shown in (173).

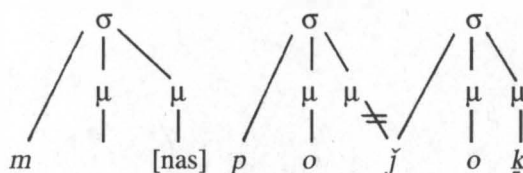
(173) *poyok* 'to rub'

Underlying form

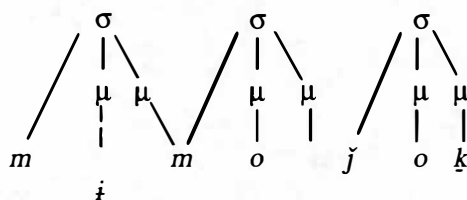
Affixation



Consonant delinking 2



Nasal assimilation 2



Vowel epenthesis

Surface form

[mimmuʝok]

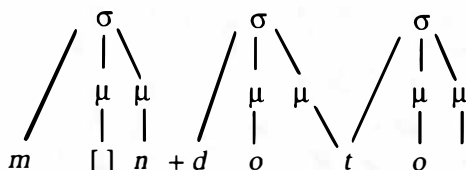
In the CV_1C_1VC root *poyok* [puyok] 'to rub' in (173), the C_1 consonant *j* is multiply associated in the underlying representation, surfacing as [y]. When the prefix *miN-* attaches to the root, *j* delinks from the preceding coda, but remains associated with the following onset, surfacing as [j]. Nasal Assimilation 2 and vowel epenthesis take place. Notice that glottal epenthesis does not occur in the empty coda of the root following consonant delinking. This motivates the claim that a fully underspecified segment (surface [ʔ]) is added to a coda position by lexical rule only.

In a CV_1C_1VC root type, there is one exception to this type of consonant delinking: if the C_1 root consonant in the underlying representation is *p*, *t* or *k*, consonant delinking is optional. That is, following affixation, *p*, *t* and *k* can delink from the coda position, surfacing as single strong consonants, or they can remain multiply associated in which case consonant weakening is blocked, and the multiply associated consonants surface as geminate clusters composed of strong consonants, as in (174).

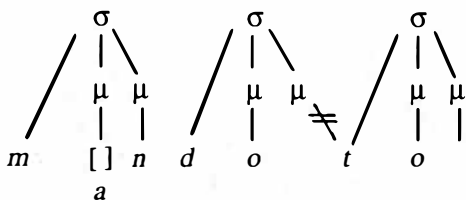
(174) *doθo* 'to cook'

Underlying form

Affixation

Variation 1

Consonant delinking 2

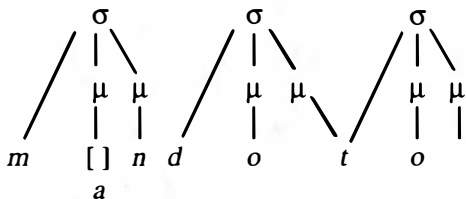
Redundant feature
assignment

Surface form

[mandoto]

Variation 2

Weakening blocking

Redundant feature
assignment

Surface form

[mandotto]

In the CV_1C_1VC root *doθo* [doθo] 'to cook' in (174), the C_1 consonant *t* is multiply associated in the underlying representation. In variation 1, when the prefix *man-* attaches to the root, *t* delinks from the preceding coda and surfaces as [t], a strong consonant. In variation 2, *t* does not delink; instead, consonant weakening is blocked, and *t* surfaces as [tt], a geminate cluster composed of strong consonants.

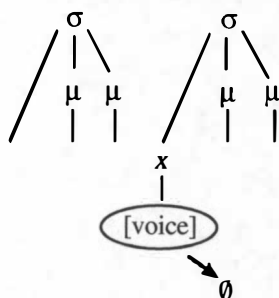
These facts indicate that in certain environments, multiply associated *p*, *t* and *k* are sufficiently strong enough to resist weakening even though preceded by a vowel in the underlying representation, and so do not have to delink from the preceding coda in order to surface as strong consonants. To explain this exception, I propose that Consonant Delinking 2 is one of several strategies employed to repair defective bimoraic units. The strategy here appears to be: associate phonetic material with the second onset of the root in such a way that it surfaces as a strong set 1 consonant. Since a multiply associated consonant typically undergoes weakening when preceded by a vowel in the underlying representation, it is usually necessary to first delink the consonant from the first coda of the root so that it is singly associated with the second onset before it can surface as a strong consonant. The consonants *p*, *t* and *k* are an exception to this pattern in that they can resist the weakening effect of a preceding vowel when they are multiply associated, if required to surface as

strong consonants; consequently, for these consonants, delinking is optional in this environment (see footnote 6).

6.2.2 DEVOICING

Recall that in the C_1 position in a CV_1C_1VC root, surface [g] is underlyingly a singly associated k to which the feature [voice] has been added. Recall also that surface [ř] in the same position is underlyingly a multiply associated \check{c} to which the feature [voice] has been added. When an appropriate affix is added to a CV_1C_1VC root in which C_1 is [g] or [ř], the feature [voice] is deleted from the corresponding C_1 segment in the underlying representation. The rule of devoicing is given in (175).

(175) Devoicing



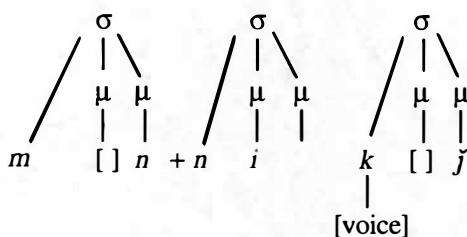
Note: x is k or \check{c} .

An example of [g] devoicing is given in (176).

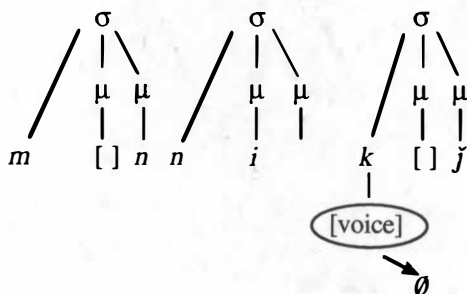
(176) *nigay* 'to gather vegetables for a viand'

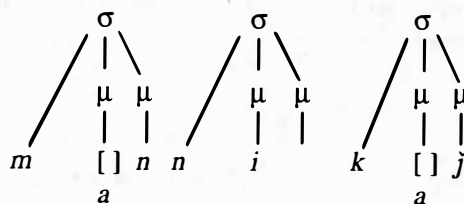
Underlying form

Affixation



Devoicing





Redundant feature
assignment

Surface form [mannikay]

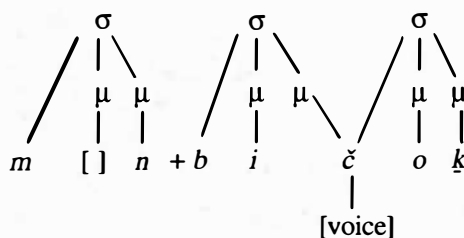
In the CV₁C₁VC surface root *nigay* [nigay] 'to gather vegetables for a viand' in (176), the feature [voice] is associated with **k** in the C₁ root position, and **k** is singly associated in the underlying representation. When the prefix *man-* attaches to the root, the feature [voice] is deleted, and **k** surfaces as [k]. Redundant feature assignment occurs last.

An example of [ř] devoicing is given in (177).

(177) *biřok* 'to blow'

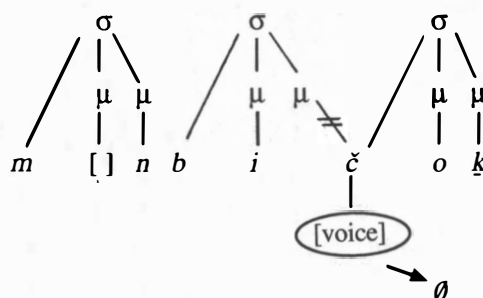
Underlying form

Affixation



Consonant delinking 2

Devoicing



Nasal assimilation 1
Redundant feature
assignment

Surface form [mambičok]

In the CV₁C₁VC surface root *biřok* [biřok] 'to blow' in (177), the feature [voice] is associated with **č** in the C₁ root position, and **č** is multiply associated with the first coda and

the second onset of the root in the underlying representation. When the prefix *man-* attaches to the root, *č* delinks from the first coda of the root, but remains associated with the second onset; the feature [voice] is deleted; and *č* surfaces as [č]. Nasal assimilation occurs in the prefix nasal, and redundant feature assignment takes place last.

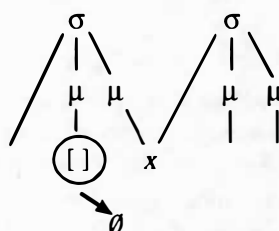
Devoicing then is another strategy to associate phonetic material with the second onset of a root in such a way that it surfaces as a strong set 1 consonant.

6.2.3 VOWEL DELETION

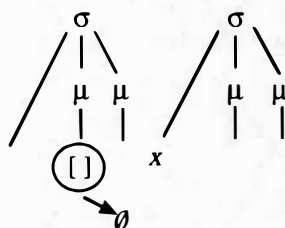
When an appropriate affix is added to a CaCVC root in which the first vowel is a fully underspecified segment (surface [a]), the fully underspecified segment is deleted. The medial consonant following the vowel can be multiply or singly associated. The rule for vowel deletion is given in (178).

(178)

Vowel Deletion



or

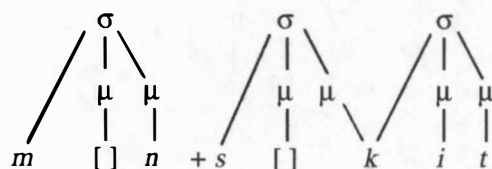


The following is an example of vowel deletion in a CaCVC root in which the root medial consonant is multiply associated.

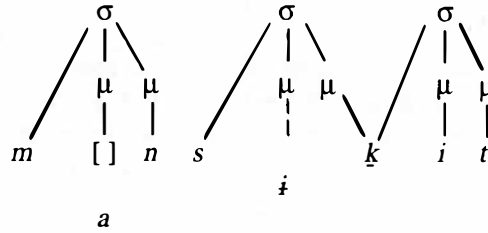
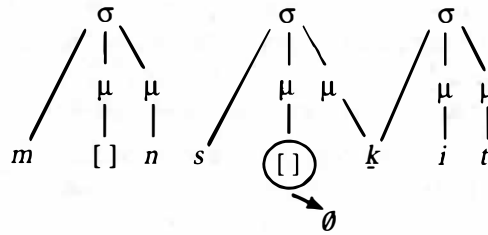
(179) *saxit* 'to get sick'

Underlying form

Affixation



Vowel deletion



Vowel epenthesis
Redundant feature
assignment

Surface form [mansikk̥et]

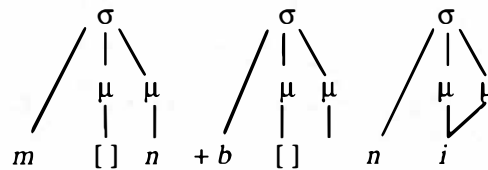
In the CaCVC root *sax̣it* [sax̣et] ‘to get sick’ in (179), the medial consonant *ḳ* is multiply associated with the first coda and the second onset of the root. When the prefix *man-* attaches to the root, the fully underspecified segment in the V_1 root position is deleted; the epenthetic vowel is inserted in the V_1 position, surfacing as [i]; and the multiply associated medial consonant surfaces as [ḳḳ], a strong geminate cluster.

In a few CaCVC roots, the first coda is unassociated, and the medial consonant is singly associated with the second onset. In these roots, after the fully underspecified segment is deleted, the medial consonant spreads to the first coda of the root, as shown in (180).

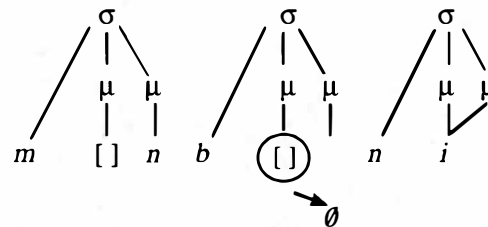
(180) *baniy* ‘leg band’

Underlying form

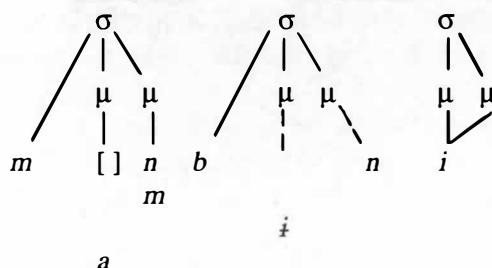
Affixation



Vowel deletion



Multiple association 1



Nasal assimilation 1

Vowel epenthesis

Redundant feature
assignment

Surface form

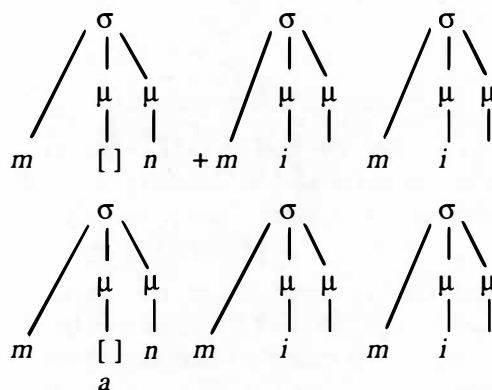
[mambinnii]

In the CaCVC root *baniy* [baniy] 'leg band' in (180), the first coda of the root is unassociated, and the medial consonant *n* is singly associated with the second onset of the root. When the prefix *man-* attaches to the root, the fully underspecified segment in the V_1 root position is deleted, and *n* spreads to the first coda of the root, surfacing as [nn], a strong geminate cluster. Nasal assimilation occurs in the prefix nasal, and an epenthetic vowel is added to the V_1 root position, surfacing as [i]. Spreading of the medial consonant occurs only when the vowel in the V_1 root position is deleted; otherwise, spreading does not take place, as shown in (181).

(181) *mimi* 'to urinate'

Underlying form

Affixation

Redundant feature
assignment

Surface form

[manmimi]

In the CV₁CVC root *mimi* [mimi] 'to urinate' (181), the first coda of the root is unassociated, and the root medial *m* is singly associated with the second onset of the root. When the prefix *man-* attaches to the root, no change occurs in the word: the V_1 root vowel *i* does not delete, and the root medial consonant does not spread.

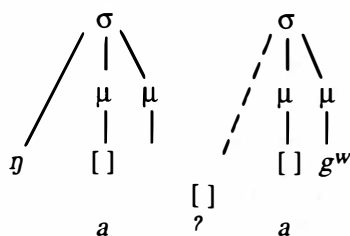
Recall that *n* has only one surface form and so cannot multiply associate with two consonant positions when preceded by a vowel in the underlying representation; however, when the fully underspecified vowel in the V_1 root position is deleted, *n* in the second onset can spread to the preceding coda. For the consonants *b*, *m*, *n*, *ŋ* and *s* which have only one surface form, vowel deletion must occur before the consonant can spread to the preceding coda.

There is one exception to vowel deletion in the CaCVC root type: if the second onset of the root lacks phonetic material in the underlying representation, vowel deletion is blocked, as shown in (182).

(182) *ŋaʔaw* 'bad'

Underlying form

root

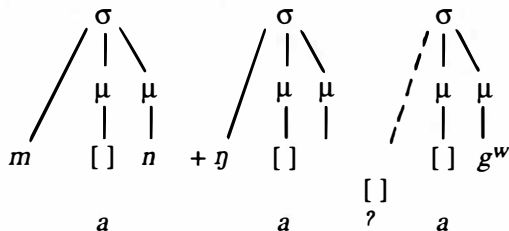


Glottal epenthesis
Redundant feature
assignment

Surface form

[ŋaʔaw]

Affixation



Glottal epenthesis
Redundant feature
assignment

Surface form

[manŋaʔaw] 'to make bad'

In the CaCVC root *ŋaʔaw* [ŋaʔaw] 'bad' in (182), the second onset is unassociated with phonetic material. When *man-* is added to the root, vowel deletion in the V_1 root position is blocked. No alternations occur other than glottal epenthesis and redundant feature assignment.

This discussion of CaCVC roots raises two questions: (1) Why does the fully underspecified segment delete in the root V_1 position of the CaCVC root type? and (2) Why does delinking fail to occur in a multiply associated medial consonant of the CaCVC root type? In other words, why doesn't the CaCVC root type behave like the CV_1CVC root type in which V_1 is *i* or *o*?

The answer appears to lie in two factors. The first factor has to do with the preservation of phonetic material in the underlying representation. If we take the question about vowel deletion, we can turn it around and ask: why don't [high] (*i*) and [labial] (*o*) delete under the same conditions when they occur in the V_1 position of a CV_1CVC root type? I suggest that part of the reason is that Karao apparently has a conservation principle which states that specified phonetic material in the underlying representation is always preserved. Such a principle seems appropriate for a phonological system that has a shortage of underlying phonetic material in the first place. Since the features [high] and [labial] are specified segments, the conservation principle prohibits their deletion from the underlying representation. In contrast, the fully underspecified segment lacks specified features and so it can be deleted, if there is motivation for doing so.

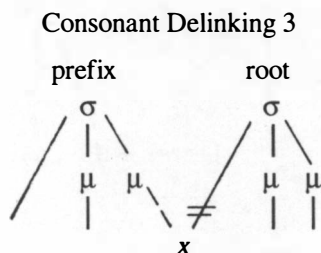
This brings us to the second factor for the asymmetrical behaviour of CaCVC roots: the drive towards closed surface syllables. If the primary motivation for phonological alternations in Karao is to produce closed surface syllables, then preserving specified material in the underlying representation is desirable, since a bimoraic unit that has singly associated specified material for each of its positions will surface as a closed syllable. On the other hand, preserving a fully underspecified segment in the underlying representation is desirable only if the following coda is singly associated with its own phonetic material, since this association produces a closed surface syllable. If the coda and onset following the fully underspecified segment are multiply associated with the same consonant, there is no advantage in preserving the underspecified segment, since the segment weakens the consonant, producing an open surface syllable followed by a weak set 2 consonant in the surface representation. In fact, there is actually an advantage in deleting the fully underspecified segment in such an environment, since a multiply associated consonant surfaces as a strong geminate cluster when no vowel precedes it in the underlying representation. The same advantage applies to CaCVC roots in which the medial consonant is not multiply associated; that is, the first coda of the root is empty, and the second onset is singly associated with a consonant. For such roots, deleting the fully underspecified segment in the V_1 root position allows the medial consonant to spread to the first coda, producing a strong geminate cluster in the medial position.

All this suggests that the function of vowel deletion in a CaCVC root type is to allow a multiply associated medial consonant to surface as a geminate consonant cluster. Although a geminate consonant cluster does not produce a closed surface syllable with a preferred syllable contact, the phonological system apparently considers a geminate cluster a closer surface approximation to this preferred form than an open syllable, since vowel deletion in a CaCVC root type, though optional, occurs frequently. Thus, we may assume that vowel deletion is another strategy for repairing defective underlying bimoraic units. In this case, the strategy is: delete a fully underspecified segment in the V_1 root position so that the following multiply associated consonant can surface as a strong geminate cluster.

6.2.4 DELINKING OF SINGLY ASSOCIATED CONSONANTS IN INITIAL ROOT POSITIONS

Consonant delinking can take place in a singly associated consonant in the initial onset of a $C\dot{C}C_1C_1VC$ root type. When a prefix lacking phonetic material for its coda is added to a $C\dot{C}C_1C_1VC$ root type, the consonant in the initial onset of the root delinks and reassociates with the prefix coda, as shown in (183).

(183)

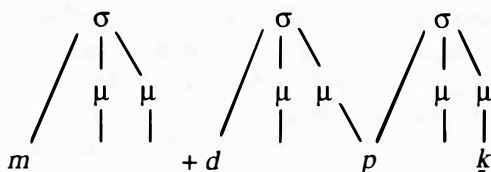


In a $C\dot{C}C_1C_1VC$ root type, delinking of the singly associated consonant in the initial root position and the multiply associated consonant in the medial root position always take place together. Following delinking in both positions, the first bimoraic unit of the root is also always deleted, and resyllabification takes place, as seen in (184).

(184) *dipik* 'to get wet'

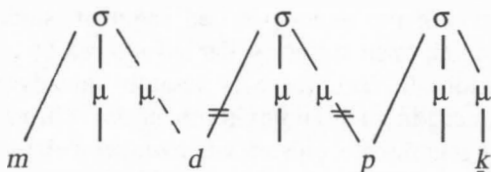
Underlying form

Affixation

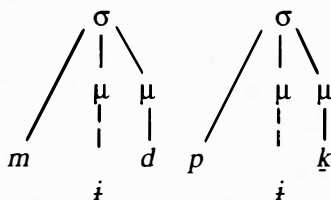


Consonant delinking 3

Consonant delinking 2



Resyllabification



Vowel epenthesis

Surface form

[mɪlpik]

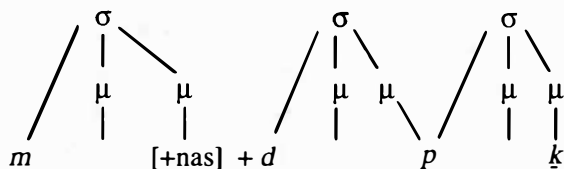
In (184), the prefix *mi-* is added to the $C_1C_1C_1VC$ root *dipik* [dɪppik] 'to get wet'. Following affixation, *d* in the initial onset of the root delinks and reassociates with the prefix coda (Consonant Delinking 3); *p* in the medial position of the root delinks from the preceding coda, and remains associated with the second onset of the root (Consonant Delinking 2); the first bimoraic unit of the root is deleted; and resyllabification takes place. Vowel epenthesis follows last. Notice that this alternation produces a closed surface syllable with a preferred syllable contact.

The following example demonstrates that Nasal Assimilation 2 must apply before Consonant Delinking 3.

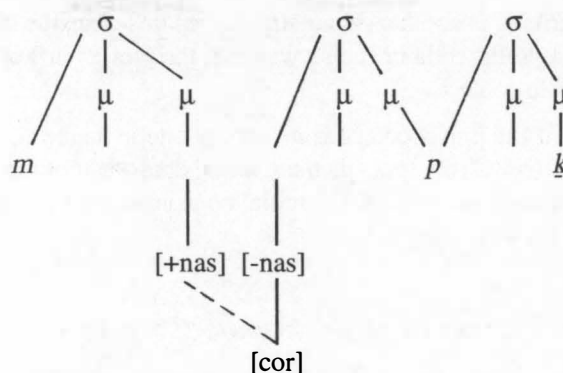
(185) *dipik* 'to get wet'

Underlying form

Affixation

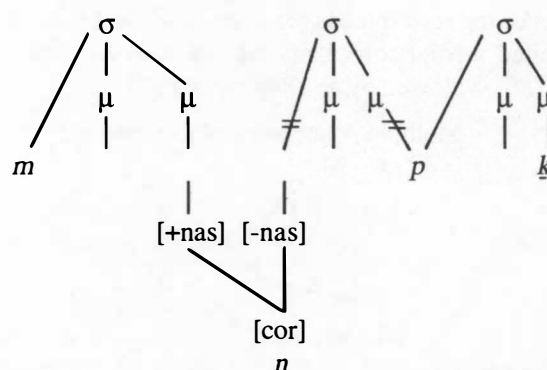


Nasal assimilation 2

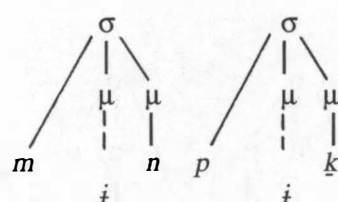


Consonant delinking 3

Consonant delinking 2



Resyllabification



Vowel epenthesis

Surface form

[mɪnpɪk]

In (185), the prefix *mɪN-* is added to the $C_iC_1C_1VC$ root *dɪpɪk* [dɪppi \dot{k}] 'to get wet'. Following affixation, the place feature [coronal] associated with *d* in the first onset of the root spreads to the prefix nasal; *d* delinks from the mora tier, leaving the first onset of the root unassociated (Consonant Delinking 3); *p* delinks from the first coda of the root (Consonant Delinking 2); the first bimoraic unit of the root is deleted; and resyllabification follows. Notice that the feature [coronal] of *d* in the initial onset of the root spreads to the prefix nasal before *d* delinks from the mora tier.

If we compare (184) and (185), we see that both prefixes allow the consonant in the initial onset of the root (or its place feature) to reassociate with the coda of the prefix, triggering resyllabification in the process. For example in (184), the prefix coda lacks phonetic material, and, as a result, the initial consonant of the $C_iC_1C_1VC$ root type is able to reassociate with the coda following delinking from the initial onset of the root. In (185), the prefix nasal lacks a place feature, and the initial consonant of the root is able to reassociate its place feature to the prefix coda and delink from the mora tier (a typical Nasal Assimilation 2 alternation pattern). In both environments, delinking and resyllabification produce closed surface syllables with preferred syllable contacts. We may conclude then that this type of

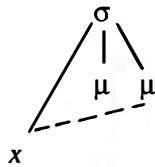
consonant delinking is another repair strategy. In this case, the strategy is: associate phonetic material with a prefix coda in such a way that the prefix surfaces as a closed syllable with a preferred syllable contact.

In contrast, if the prefix coda has its own phonetic material, or if an appropriate suffix is added to a $C_iC_1C_1VC$ root type, then the initial consonant of the root cannot reassociate with a preceding coda. In such cases, the initial consonant does not delink, but rather, spreads to the coda of its own syllable.

6.2.5 MULTIPLE ASSOCIATION OF CONSONANTS WITHIN SYLLABLES

When a prefix or a suffix ending with a consonant attaches to a $C_iC_1C_1VC$ root type, the initial consonant of the root spreads from the first onset to the first coda of the root, and the multiply associated medial consonant delinks from the first coda of the root. The rule is represented in (186), followed by an example in (187).

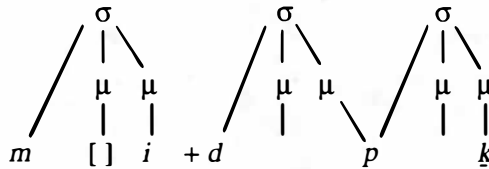
(186) Multiple Association of Consonant 2



(187) *dipik* 'to get wet'

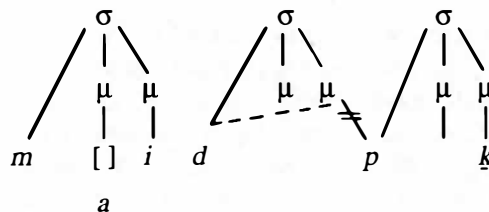
Underlying form

Affixation



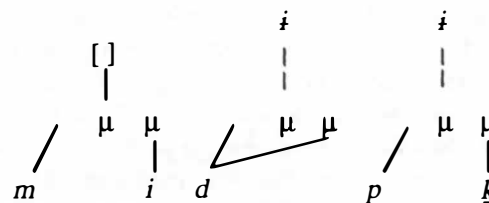
Multiple association 2

Consonant delinking 2



Redundant feature assignment

Vowel epenthesis



Surface form

[maydɪlpɪk]

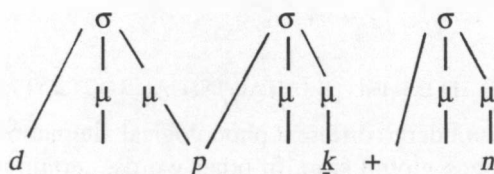
In (187), *may-* (underlyingly *mai*) is added to the $C_iC_1C_1VC$ root *dipik* [dɪppɪk] 'to get wet' (see footnote 8). Since phonetic material is associated with the coda of the prefix, *d* in the first onset of the root cannot delink and reassociate with the prefix coda; instead, *d* spreads to the first coda of the root, surfacing as [ɪ]. Then *p* in the medial root position delinks from the first coda of the root, but remains associated with the second onset. Vowel epenthesis and redundant feature assignment follow. Notice that this alternation produces a closed surface syllable with a preferred syllable contact.

In the next example, a suffix ending with a consonant is added to a $C_iC_1C_1VC$ root type, and the consonant in the first onset of the root spreads to the coda of its syllable.

(188) *dipik* 'to get wet'

Underlying form

Affixation

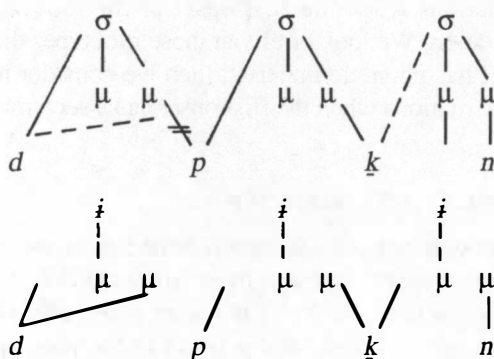


Multiple association 2

Consonant delinking 2

Multiple association 1

Vowel epenthesis



Surface form

[dɪlpɪkɪn]

In (188), the suffix *-in* is added to the $C_iC_1C_1VC$ root *dipik* [dɪppɪk] 'to get wet'. Since there is no empty coda preceding the first onset of the root, *d* in the first root onset cannot delink and reassociate following affixation. Instead, *d* spreads to the coda of its syllable, surfacing as [ɪ] (Multiple Association 2); and *p* delinks from the first coda of the root (Consonant Delinking 2). The consonant *k* in the final root coda spreads to the empty onset of the suffix (Multiple Association 1), and vowel epenthesis follows. Notice again that multiple association of *d* in the first syllable of the root produces a closed surface syllable with a preferred syllable contact.

Consonant spreading within a syllable is one more repair strategy for defective bimoraic units. The strategy is: associate phonetic material with the first coda of a root in such a way that the first bimoraic unit of the root surfaces as a closed syllable with a preferred syllable.

The spreading of a consonant from the onset to the coda of the first bimoraic unit, as shown in (187) and (188), provides support for the claim that fully specified segments, partially specified segments (i.e. [high] and [labial]), and the fully underspecified segment must exist on separate tiers. Specifically, consonant spreading only occurs in an initial bimoraic unit that has an empty nucleus; consequently, both consonant spreading and vowel

epenthesis must take place in the same unit without crossing association lines. Recall that the epenthetic complex vowel is composed of the partially specified feature [high] and the fully underspecified segment (surface [a]). In order to represent the fact that the epenthetic complex vowel is a single articulation (rather than a sequence of articulations), each segment must be placed on a separate tier so that the segments can converge simultaneously on a single mora. If the feature [high] or the fully underspecified segment of the epenthetic complex vowel occurs on the same tier as the spreading consonant, consonant spreading and vowel epenthesis in that same bimoraic unit would create a line crossing situation. In order to avoid such a situation, each segment must be placed on a separate tier: the fully underspecified segment is placed on one tier; the feature [high] is placed on a tier for partially specified segments; and the consonant in the first onset of the root is placed on a tier for fully specified segments. From these facts, we see that it is necessary to posit three separate melody tiers for Karao.

6.3 ALTERNATIONS AFFECTING GLOTTAL-INITIAL ROOT TYPES

Certain root types undergo different phonological alternations when the initial consonant of the root is a surface glottal stop. In other words, certain root types undergo different phonological alternations when the first onset of the root lacks phonetic material in the underlying representation. We look briefly at those root types that behave identically whether or not the first onset has phonetic material; then we consider in detail those root types that undergo different alternations when the first onset lacks such material.

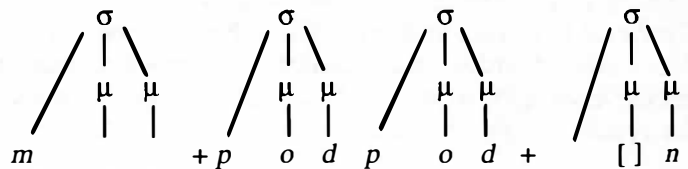
6.3.1 $?VC_1C_2VC$ AND $?V_1CVC$ ROOT TYPES

Those root types that behave identically whether or not the first onset has phonetic material in the underlying representation are: (1) CVC_1C_2VC and $?VC_1C_2VC$, and (2) CV_1CVC and $?V_1CVC$ in which V_1 is *i* or *o*. When affixes are added to a CVC_1C_2VC or a $?VC_1C_2VC$ root type, no alternations occur in the root. An example of a CVC_1C_2VC root type found in (171) above is repeated in (189) below; an example of the $?VC_1C_2VC$ root type is given in (190).

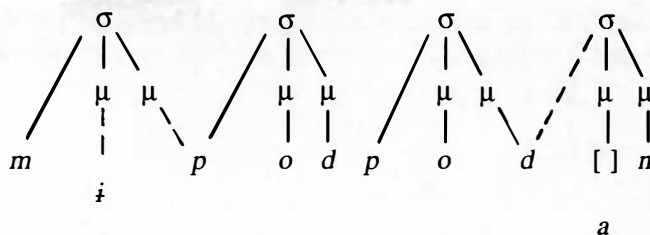
(189) *polpol* 'to undress'

Underlying form

Affixation



Multiple association



Vowel epenthesis
Redundant feature
assignment

Surface form

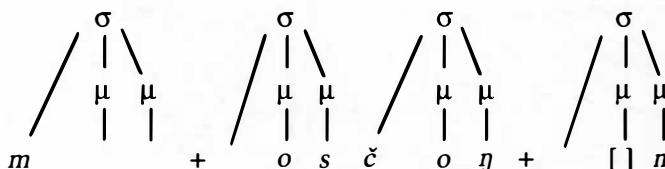
[mɪppulpulan]

In (189), the affix *mɪ--an* attaches to the CVC_1C_2VC root *polpol* [pulpul] 'to undress'. The consonant *p* in the initial root onset spreads to the coda of the prefix, and *d* in the final root coda spreads to the onset of the suffix; vowel epenthesis and redundant feature assignment follow. No other alternations occur.

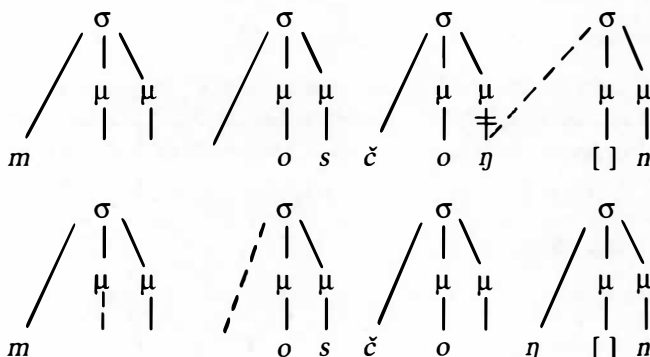
(190) ?osčonj 'to look down at something'

Underlying form

Affixation



Consonant delinking 1



Vowel epenthesis
Glottal epenthesis
Redundant feature
assignment

Surface form

[maʔosčonjan]

In (190), the affix *mɪ--an* attaches to the $?VC_1C_2VC$ root *?osčonj* [ʔosčonj] 'to look down at something'. The consonant *ŋ* in the final root coda delinks and reassociates with the suffix onset; vowel and glottal epenthesis take place; and redundant feature assignment occurs last. No other alternations occur.

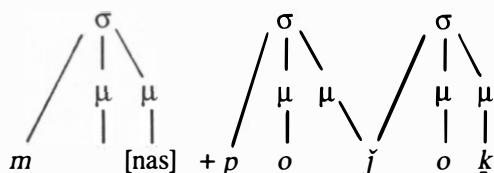
When certain affixes are added to a CV_1CVC or a $?V_1CVC$ root type in which V_1 is *i* or *o*, a multiply associated medial consonant delinks from the first coda of the root (but remains

associated with the second onset). An example of a CV₁CVC root type found in (173) above is repeated in (191) below; an example of a [?]V₁CVC root type is given in (192).

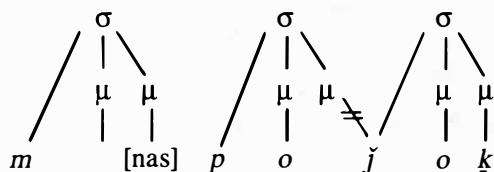
(191) *poyok* 'to rub'

Underlying form

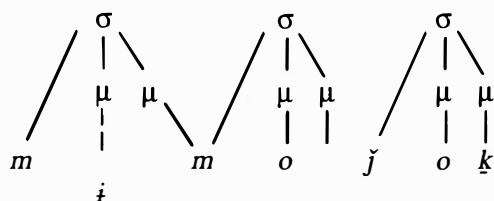
Affixation



Consonant delinking 2



Nasal assimilation 2



Vowel epenthesis

Surface form

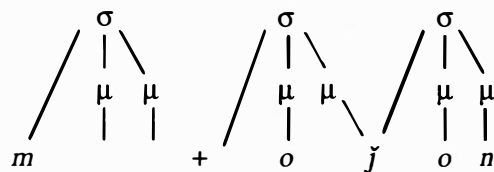
[m̥immujo̞k]

In (191), the prefix *m̥N-* attaches to the CV₁C₁VC surface root *poyok* [puyok] 'to rub'. The medial consonant *j* delinks from the first coda of the root, but remains associated with the second onset, surfacing as [j̥]. Nasal Assimilation 2 and vowel epenthesis take place.

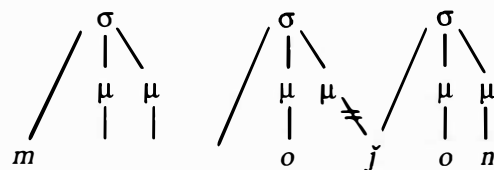
(192) *ʔoyon* 'to carry on the back using a head strap'

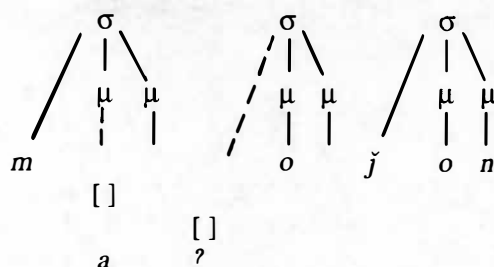
Underlying form

Affixation



Consonant delinking 2





Vowel epenthesis
Glottal epenthesis
Redundant feature
assignment

Surface form [maʔoʝon]

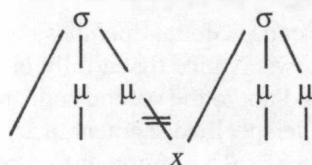
In (192), the prefix *mi-* attaches to the $\text{?V}_1\text{CVC}$ root *ʔoyon* [ʔoyon] ‘to carry on the back using a head strap’. The medial consonant *j* delinks from the first coda (but remains associated with the second onset); vowel and glottal epenthesis take place; and redundant feature assignment occurs last.

6.3.2 ADDITION OF A FULLY UNDERSPECIFIED SEGMENT TO A ROOT CODA

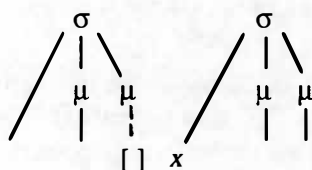
Those root types that do not behave identically when the first onset of the root lacks phonetic material in the underlying representation are: (1) $\text{CiC}_1\text{C}_1\text{VC}$ and $\text{?iC}_1\text{C}_1\text{VC}$, and (2) CaCVC and ?aCVC . When certain affixes are added to a $\text{CiC}_1\text{C}_1\text{VC}$ root type, we have seen that the consonant in the first onset of the root typically spreads to the coda of its syllable, and the multiply associated medial consonant delinks from the first coda, as shown in (187) and (188) above. When the same affixes are added to a $\text{?iC}_1\text{C}_1\text{VC}$ root type, consonant spreading in the first syllable of the root cannot take place because the initial onset of the root lacks phonetic material in the underlying representation. Instead, the multiply associated medial consonant of the root delinks from the first coda of the root, and a fully underspecified segment is added to the first coda of the root, surfacing as [ʔ]. The rule is given in (193).

(193) Root Coda

Consonant delinking 2



Root coda



Redundant feature
assignment

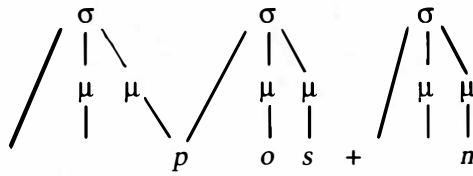
[back]

The following is an example of the addition of a fully underspecified segment in the first coda of a $\text{?iC}_1\text{C}_1\text{VC}$ root type.

(194) *ʔipos* 'to consume'

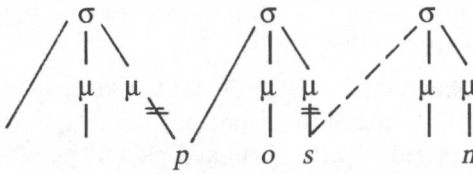
Underlying form

Affixation

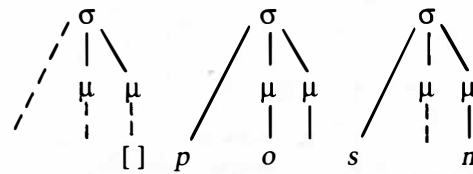


Consonant delinking 2

Consonant delinking 1



Root coda



Vowel epenthesis

Glottal epenthesis

Redundant feature

assignment



Surface form

[ʔaʔposin]

In (194), the suffix *-in* is added to the $\text{ʔC}_1\text{C}_1\text{VC}$ root *ʔipos* [ʔippos] 'to consume'. The first onset of the root lacks phonetic material, and so consonant spreading within the first bimoraic unit cannot take place; instead, *p* delinks from the first coda, but remains associated with the second onset; a fully underspecified segment is added to the first coda; and *s* delinks from the final coda of the root and reassociates with the onset of the suffix. Vowel epenthesis takes place, and the epenthetic vowel surfaces as [a] preceding the fully underspecified segment (surface [ʔ]) in the first coda. Glottal epenthesis occurs in the initial onset, and redundant feature assignment follows. Notice that a fully underspecified segment is added only to the first coda of the root, and not to the second coda; this fact supports the claim that although the addition of a fully underspecified segment to an onset position is accomplished by an epenthetic rule, the addition of such a segment to a coda position is not. Following alternations, the initial bimoraic unit of the affixed form surfaces as a closed syllable with a preferred syllable contact.

Before leaving this example, I should note that the addition of a fully underspecified segment to the first coda of a $\text{ʔC}_1\text{C}_1\text{VC}$ root is optional. If the C_1 root consonant does not delink, an epenthetic vowel is added to the V_1 root position, surfacing as [i]. The affixed form in (194) would surface then as [ʔipposin], rather than as [ʔaʔposin].

The addition of a fully underspecified segment to a coda position also occurs in ʔaCVC roots. When the same affixes are added to a ʔaCVC root type, the affixed form undergoes one of two surface alternation patterns. In the first pattern, the ʔaCVC root type follows the same alternations as a CaCVC root type, as shown in (195); in the second pattern, the ʔaCVC

root type undergoes vowel deletion and then follows the same alternations as a ${}^{\text{h}}\text{C}_1\text{C}_1\text{VC}$ root type, as shown in (196).

(195) *ʔapit* 'to harvest produce'

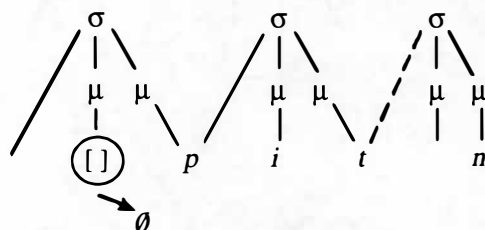
Underlying form

Affixation



Vowel deletion

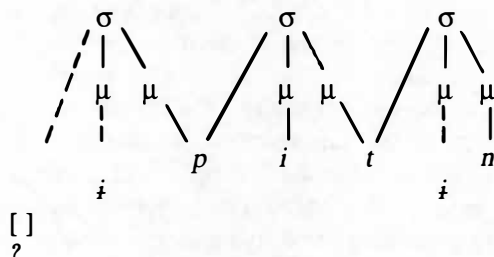
Multiple association 1



Vowel epenthesis

Glottal epenthesis

Redundant feature
assignment



Surface form

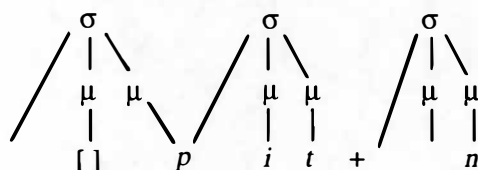
[ʔɪppiθin]

In (195), the suffix *-in* is added to the ${}^{\text{h}}\text{aCVC}$ root *ʔapit* [ʔapit] 'to harvest produce', and the affixed form undergoes the same alternation as a CaCVC root type: the fully underspecified segment in the V_1 root position is deleted; *t* in the final coda of the root multiply associates with the onset of the suffix; vowel epenthesis takes place in the first nucleus; and glottal epenthesis occurs in the first onset. Notice that the medial root consonant *p* remains multiply associated, and that the epenthetic vowel surfaces as [ɪ] in the first nucleus. Now compare the alternation pattern in (195) with the pattern in (196).

(196) *ʔapit* 'to harvest produce'

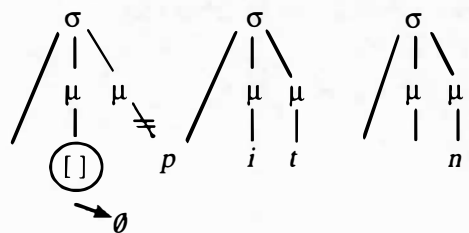
Underlying form

Affixation



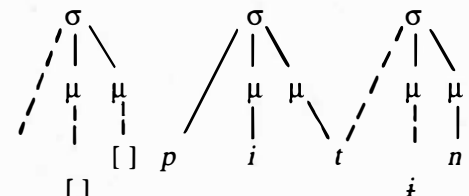
Vowel deletion

Consonant delinking 2



Root coda

Multiple association 1



Vowel epenthesis

Glottal epenthesis

Redundant feature assignment

[]
?
a ?

Surface form

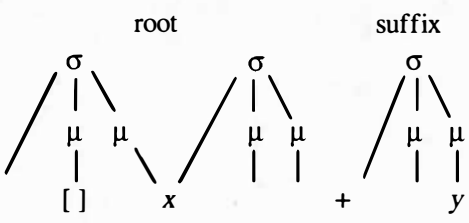
[ʔaʔpiθɪn]

In (196), the suffix *-in* is added to the *ʔaCVC* root *ʔapit* [ʔapit] ‘to harvest produce’, and the fully underspecified segment in the *V₁* root position is deleted, just as it is in (195). Following vowel deletion, however, the affixed form undergoes an alternation that typically occurs in a *ʔiC₁C₁VC* root type, but not in a *CaCVC* root type: *p* in the medial root position delinks from the first coda, but remains associated with the second onset; a fully underspecified segment is added to the first coda; and *t* in the final coda of the root multiply associates with the onset of the suffix. Vowel epenthesis takes place, and the epenthetic vowel surfaces as [a] preceding the fully underspecified segment (surface [ʔ]) in the first coda. Glottal epenthesis occurs in the first onset, and redundant feature assignment follows. Again, the initial bimoraic unit of the affixed form surfaces as a closed syllable with a preferred syllable contact.

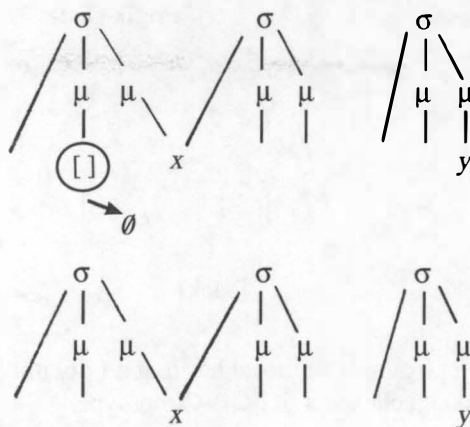
At this point, we may ask: why do *ʔaCVC* and *ʔiC₁C₁VC* root types produce similar surface forms? If we compare the underlying representations of *ʔaCVC* and *ʔiC₁C₁VC* root types in (197), we see that following vowel deletion in a *ʔaCVC* root type, the underlying representations for both root types are identical.

(197) a. *ʔaCVC* root type

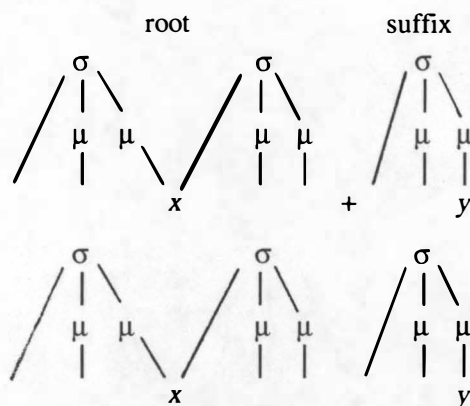
Underlying form



Vowel deletion

b. $\text{?iC}_1\text{C}_1\text{VC}$ root type

Underlying form



As (197) shows, once vowel deletion occurs in a ?aCVC root type, the underlying structure of the ?aCVC root type is the same as the structure of a $\text{?iC}_1\text{C}_1\text{VC}$ root type. This suggests that once different root types achieve identical underlying structures, they are eligible for the same alternations. As it turns out, only the ?aCVC and $\text{?iC}_1\text{C}_1\text{VC}$ root types ever actually do achieve identical structures; no other pair of root types achieves exactly the same underlying structures. If we accept this proposal, we can account for the similarity in ?aCVC and $\text{?iC}_1\text{C}_1\text{VC}$ surface forms following phonological alternations. Specifically, we can argue that ?aCVC and $\text{?iC}_1\text{C}_1\text{VC}$ root types produce similar surface forms, because at some point in a derivation, they have identical structures and, at that point, may undergo identical alternations; thus, it is not surprising that their subsequent surface forms should be similar.

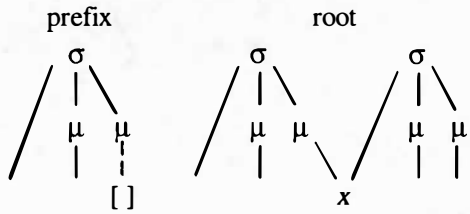
6.3.3 ADDITION OF A FULLY UNDERSPECIFIED SEGMENT TO A PREFIX CODA

When a prefix with an empty final coda is added to a $\text{CiC}_1\text{C}_1\text{VC}$ root type, the consonant in the first onset of the root typically delinks and reassociates with the prefix coda. When the same prefix is added to a $\text{?iC}_1\text{C}_1\text{VC}$ root type, the first onset of the root lacks phonetic material in the underlying representation, and so a fully underspecified segment is added to the empty prefix coda instead. This rule always occurs with the Consonant Delinking 2 rule. The Prefix Coda rule is given in (198).

(198)

Prefix coda

Prefix Coda



Redundant feature assignment

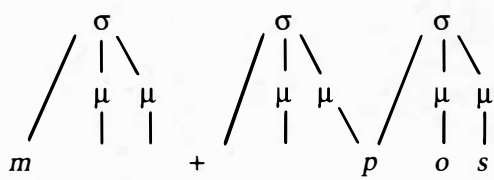
[back]

The following is an example of the addition of a fully underspecified segment to a prefix coda, when the prefix attaches to a ?iC₁C₁VC root type.

(199) ?ipos 'to consume'

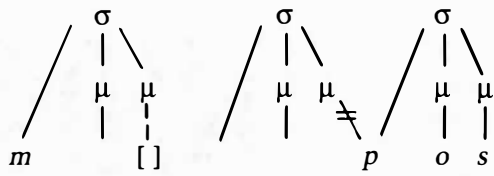
Underlying form

Affixation

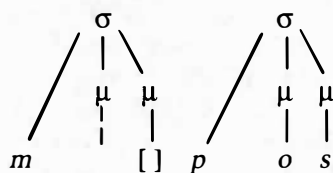


Prefix coda

Consonant delinking 2



Resyllabification



Vowel epenthesis
Redundant feature assignment

[]
a ?

Surface form

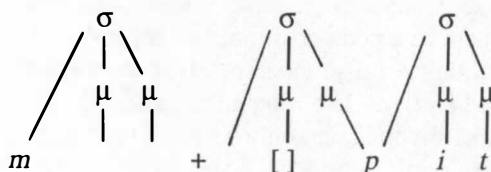
[maʔpos]

In (199), the prefix *mi-*, a prefix with an empty coda, is added to the ?iC₁C₁VC root *?ipos* [ʔippos] 'to consume'. Since the initial onset of the root cannot supply phonetic material for the empty prefix coda, a fully underspecified segment is added to the prefix coda; *p* in the medial position of the root delinks from the first coda, but remains associated with the second onset of the root; the first bimoraic unit of the root is deleted; and resyllabification takes place. Vowel epenthesis occurs in the first nucleus, and the epenthetic vowel surfaces as [a] preceding the fully underspecified segment in the prefix coda; redundant feature assignment occurs last. Notice that the first bimoraic unit of the affixed root surfaces as a closed syllable with a preferred syllable contact. Now compare the ?iC₁C₁VC root in (199) with the ?aCVC root in (200).

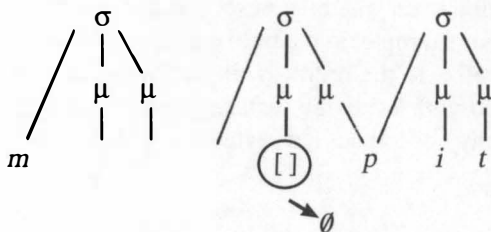
(200) *ʔapit* 'to harvest produce'

Underlying form

Affixation

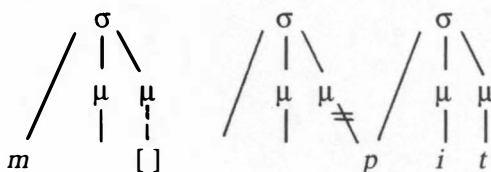


Vowel deletion

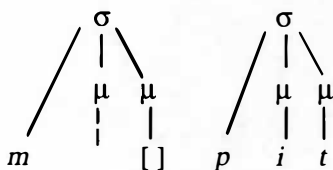


Prefix coda

Consonant delinking 2

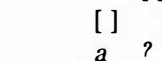


Resyllabification



Vowel epenthesis

Redundant feature assignment



Surface form

[maʔpit]

In (200), the prefix *mi-* is added to the *ʔaCVC* root *ʔapit* [ʔapit] 'to harvest produce'. Following affixation, the fully underspecified segment in the V_1 position of the root is deleted. At this point, the underlying structure of the *ʔaCVC* root in (200) is identical to the structure of the *ʔiC₁C₁VC* root in (199). From this point on, the *ʔaCVC* root undergoes the same alternations as the *ʔiC₁C₁VC* root in (199): a fully underspecified segment is added to the prefix coda; *p* in the medial position of the root delinks from the first coda, but remains associated with the second onset of the root; the first bimoraic unit of the root is deleted; and resyllabification follows. Vowel epenthesis occurs in the first nucleus, and the epenthetic vowel surfaces as [a] preceding the fully underspecified segment in the prefix coda; redundant feature assignment takes place last. Here again the first bimoraic unit of the affixed root surfaces as a closed syllable with a preferred syllable contact.

Before leaving this example, I should point out that when a prefix with an empty coda is added to a *ʔaCVC* root, an epenthetic vowel is never inserted in the V_1 root position after vowel deletion, as it is in the *CaCVC* alternation pattern. Instead, once vowel deletion has

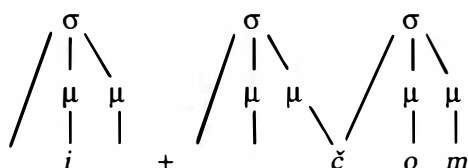
taken place, a ?aCVC root always follows the ?iC₁C₁VC pattern. Thus, for (200), the surface form *[ma?ippit] is not possible.

Although the Root Coda rule and the Prefix Coda rule both involve adding a fully underspecified segment to a coda position, two separate rules have been posited, since the environments for adding a fully underspecified segment to a coda position are slightly different for roots and prefixes. In a root, a fully underspecified segment can be added to the empty coda of the first bimoraic unit only when all three positions of the first unit are empty. On the other hand, in a prefix, a fully underspecified segment can be added to the empty coda of a final bimoraic unit even when the onset and nucleus of the final unit are associated with phonetic material. For example, in the prefix *mɪ-* in (199) and (200), *m* is associated with the first onset of the prefix. In the prefix ?i- in (201), the onset of the prefix is empty, but the nucleus is associated with *i* (i.e. the feature [high]) in the underlying representation. In all three examples, a fully underspecified segment is added to the empty coda of the prefix.

(201) ?ičom 'to add'

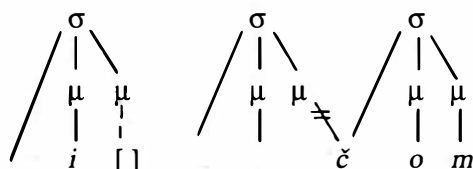
Underlying form

Affixation

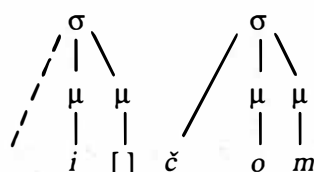


Prefix coda

Consonant delinking 2



Resyllabification



Glottal epenthesis

Redundant feature assignment



Surface form

[?i?čom] 'to add all of something'

In (201), the prefix ?i- is added to the ?iC₁C₁VC root ?ičom [?ičom] 'to add'. Following affixation, a fully underspecified segment is added to the prefix coda; č in the medial position of the root delinks from the first coda, but remains associated with the second onset of the root; the first bimoraic unit of the root is deleted; and resyllabification follows. Glottal epenthesis occurs in the first onset of the affixed root, and redundant feature assignment occurs last.

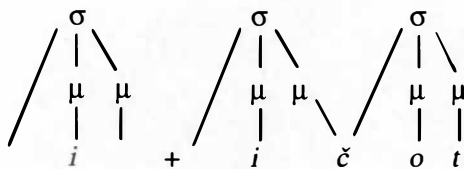
For a prefix coda, the crucial environment appears to be the first onset and nucleus of the root: if the first onset and the first nucleus of a ?iC₁C₁VC or ?aCVC root lack phonetic material, a fully underspecified segment is added to an empty prefix coda. In (201), both the

first onset and the first nucleus of the root lack phonetic material, and a fully underspecified segment is added to the prefix coda. Compare (201) with (202) in which the first nucleus of the root is associated with phonetic material in the underlying representation.

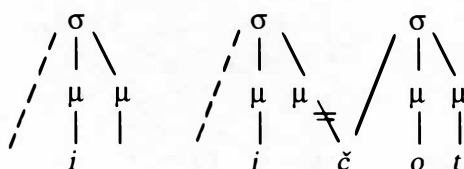
(202) *ʔiřot* 'to tighten by twisting'

Underlying form

Affixation



Consonant delinking 2



Glottal epenthesis
Redundant feature
assignment

[]
?
[]
?

Surface form

[ʔiʔičot]

In the $\text{ʔV}_1\text{CVC}$ root *ʔiřot* [ʔirot] 'to tighten by twisting' in (202), the first nucleus of the root is associated with the segment *i* in the underlying representation. When the prefix *ʔi-* is added to the root, *č* in the medial position of the root delinks from the first coda, but remains associated with the second onset of the root; glottal epenthesis in onset positions and redundant feature assignment occur last. Notice that a fully underspecified segment is not added to the empty prefix coda.

These examples demonstrate that although the addition of a fully underspecified segment in the coda of a root and prefix appear similar, the environments that trigger the alternation in roots and prefixes are different. For these reasons, I have posited one rule for adding a fully underspecified segment to the coda of a root, and another rule for adding the same segment to the coda of a prefix.

6.4 SUMMARY OF ALTERNATIONS AFFECTING ROOT TYPES

The following is a summary of alternations affecting root types with verb affixation. Six alternations may occur with all root types: (1) Multiple Association of Consonant 1, (2) Consonant Delinking 1, (3) Vowel Spreading, (4) Vowel Delinking, (5) Nasal Assimilation 1 and (6) Nasal Assimilation 2. (Nasal Deletion also occurs in $\text{CiC}_1\text{C}_1\text{VC}$ roots with infixation.)

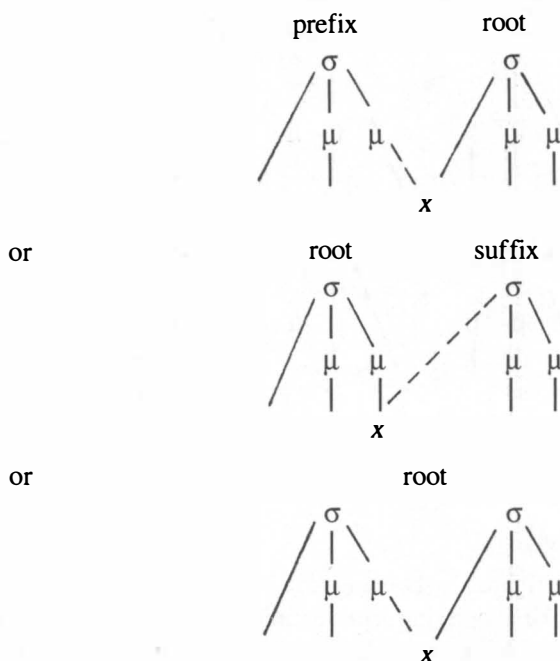
When a prefix with an empty coda or a suffix with an empty onset is added to any root, phonetic material that is singly associated with the adjacent root position spreads to the empty position of the affix. That is, a consonant in the first onset of the root spreads to the empty coda of the prefix, and a consonant in the final coda of the root spreads to the empty onset of the suffix. Also, following vowel deletion in a CaCVC root type, a consonant with only one

surface form (i.e. *b*, *m*, *n*, *ŋ* or *s*) spreads from the second onset of the root to the preceding coda.

The rule for multiple association of consonants in these environments is given in (203).

(203)

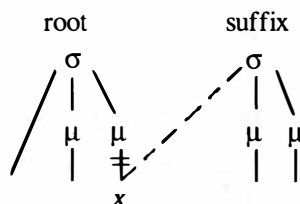
Multiple Association of Consonant 1



Two restrictions apply to this rule. The first restriction is: the consonants *b*, *m*, *n*, *ŋ* and *s* cannot associate in this manner when preceded by a vowel in the underlying representation. When a suffix is added to a root ending with *b*, *m*, *n*, *ŋ* or *s*, and the consonant is preceded by a vowel, the consonant delinks from the final coda of the root and reassociates with the onset of the suffix. The rule is given in (204).

(204)

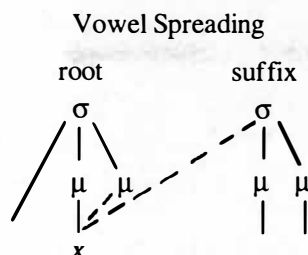
Consonant Delinking 1



The second restriction on multiple association of consonants is a well-formedness condition which states that a preferred word pattern contains only one [continuant] consonant. If adjacent [continuant] consonants occur in the underlying representation due to multiple association of consonants following vowels, consonant weakening is typically blocked in one of the consonants.

When a suffix with an empty onset is added to a root in which the feature [high] or [labial] in the final nucleus spreads to the final coda, the feature [high] or [labial] will also spread to the suffix onset. The rule for vowel spreading is given in (205).

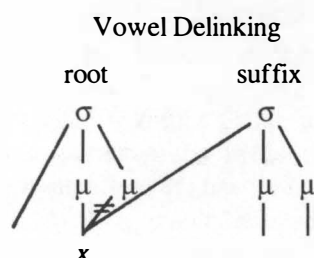
(205)



Note: *x* is the feature [high] or [labial].

Following vowel spreading in this environment, the feature [high] or [labial] optionally delinks from the root coda, remaining multiply associated with the final nucleus of the root and the onset of the suffix. The rule for vowel delinking is given in (206).

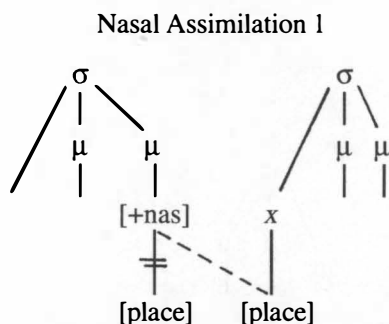
(206)



Note: *x* is the feature [high] or [labial].

Two types of nasal assimilation occur in affixes. The first type occurs in prefixes and infixes that end with *n* in the underlying representation. In these affixes, the nasal has its own place feature which is [coronal]. When such an affix is added to a root, the place feature of the following root consonant spreads to the affix nasal and the [coronal] feature delinks. The rule is given in (207).

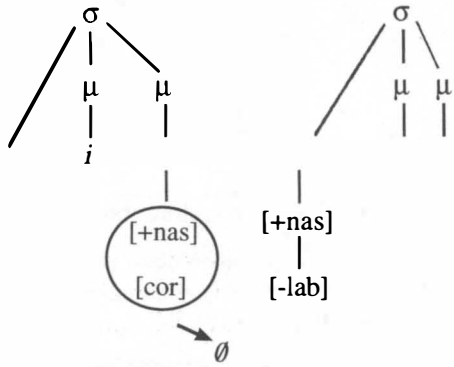
(207)



Different restrictions apply to this type of nasal assimilation, depending on whether the affix is a prefix or an infix. When a prefix ending with *n* attaches to a root beginning with *m*, nasal assimilation is blocked, and the sequence surfaces as [nm]. On the other hand, when an infix ending with *n* is inserted before a root nasal, the infix nasal does not assimilate; instead, the infix nasal surfaces as [n] if the root nasal is *m*, or it is deleted altogether if the root nasal is *n* or *ŋ*. (Nasal deletion occurs only in C_iC₁C₁VC roots.) The nasal deletion rule is shown in (208).

(208)

Nasal Deletion



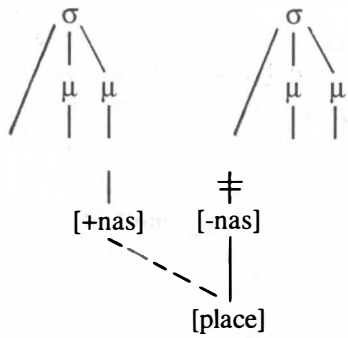
The second type of nasal assimilation occurs in prefixes that end with the feature [nasal], in which case [nasal] has no place specification. (A nasal with no place specification is represented as *N*.) When a prefix ending with *N* is added to a root, the place feature of the consonant in the first onset of the root spreads to the prefix nasal; the consonant in the first onset then delinks from the moraic tier; and the prefix nasal spreads to the first onset of the root. The rule for this type of nasal assimilation is given in (209).

(209)

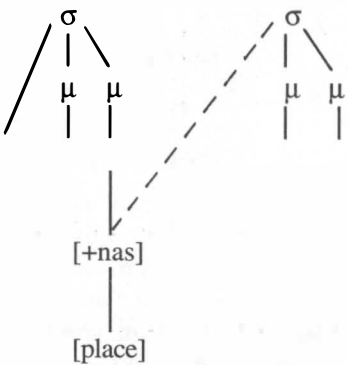
Nasal Assimilation 2

Place assimilation

Consonant delinking

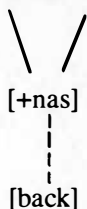


Multiple association



When the first onset of a root lacks phonetic material in the underlying representation, the prefix nasal is assigned the default place feature [back] and surfaces as [ŋ], as shown in (210).

(210) [back] Redundant Feature Assignment for Nasal

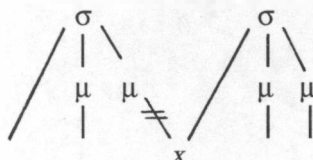


One restriction applies to this type of assimilation: prefixes ending with *N*, namely *m̥N-* and *ʔN-*, never occur with roots beginning with nasals; instead, *m̥N-* is replaced by *man-*, and *ʔN-* by *ʔiyan-*.

Five additional alternations may occur in CV_1C_1VC and CiC_1C_1VC root types, depending on the canonical shape of the root and the vowel in the V_1 root position. These alternations are: (1) Consonant Delinking 2, (2) Devoicing, (3) Vowel Deletion, (4) Consonant Delinking 3 and (5) Multiple Association of Consonant 2.

When an appropriate affix is added to a CV_1C_1VC or CiC_1C_1VC root type, a multiply associated consonant in the C_1 position delinks from the first coda of the root, but remains associated with the second onset of the root. In a CV_1C_1VC root type, the first nucleus of the root must be associated with *i* or *o* in the underlying representation; in a CiC_1C_1VC root type, the first nucleus of the root is never associated with phonetic material. This rule is given in (211).

(211) Consonant Delinking 2



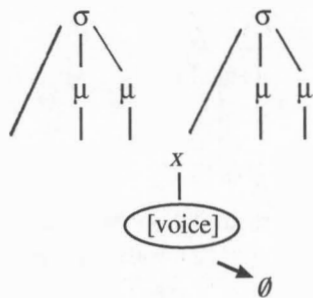
Note: *x* is a set 1 consonant.

In a CV_1C_1VC root type, one restriction applies: if the C_1 consonant is *p*, *t* or *k*, consonant delinking is optional. If the C_1 consonant does not delink, then weakening in the multiply associated C_1 consonant is blocked, and the consonant surfaces as a strong geminate cluster.

When an appropriate affix is added to a CV_1C_1VC root in which C_1 is [g] or [ʃ], the feature [voice] is deleted from the corresponding C_1 segment in the underlying representation. The rule for devoicing is given in (212).

(212)

Devoicing

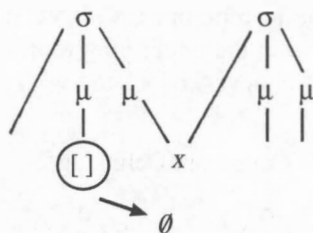


Note: x is k or \check{c} .

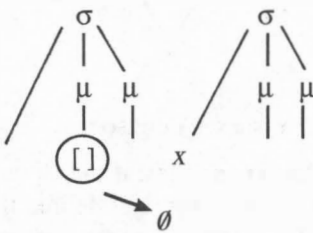
When an appropriate affix is added to a CaCVC root type, the fully underspecified segment in the V_1 root position (surface [a]) is deleted. The following consonant may or may not be multiply associated. The rule is given in (213).

(213)

Vowel Deletion



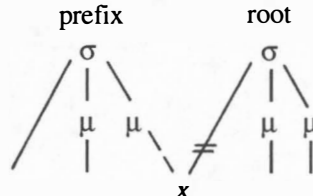
or



When a prefix with an empty coda is added to a CiC_1C_1VC root type, the consonant in the first onset of the root delinks and reassociates with the prefix coda. The rule is given in (214).

(214)

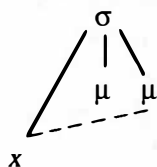
Consonant Delinking 3



When a prefix or suffix ending with a consonant is added to a CiC_1C_1VC root type (and the consonant in the initial onset of the root is unable to delink and reassociate with a

preceding coda), the initial consonant spreads from the first onset of the root to the first coda. The rule is given in (215).

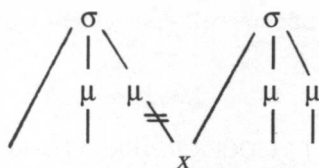
(215) Multiple Association of Consonant 2



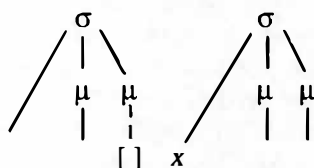
Two additional alternations may occur in ${}^?iC_1C_1VC$ and ${}^?aCVC$ root types. These alternations are: (1) the Root Coda rule; and (2) the Prefix Coda rule. When a prefix or suffix ending with a consonant is added to a ${}^?iC_1C_1VC$ or ${}^?aCVC$ root type, the fully underspecified segment in the V_1 position of the ${}^?aCVC$ root is deleted; then, in both root types, the multiply associated medial consonant delinks from the first coda of the root, and a fully underspecified segment is added to the first coda of the root. The rule is given in (216).

(216) Root Coda

Consonant delinking 2



Root coda



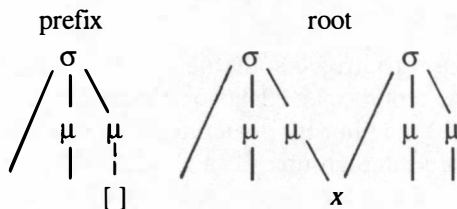
Redundant feature assignment

[back]

When a prefix with an empty coda is added to a ${}^?iC_1C_1VC$ or ${}^?aCVC$ root type, the fully underspecified segment in the V_1 position of the ${}^?aCVC$ root is deleted; then, in both root types, a fully underspecified segment is added to the final coda of the prefix. This rule always occurs with the Consonant Delinking 2 rule. The rule is given in (217).

(217) Prefix Coda

Prefix coda



Redundant feature assignment

[back]

Rules are ordered as follows:

- (a) Firstly, if the medial consonant of a CaCVC root is **b, m, n, ŋ** or **s**, the Vowel Deletion rule must occur before the Multiple Association of Consonant 1 rule; that is the fully underspecified segment (surface [a]) must be deleted from a V₁ root position before a medial consonant with only one surface form can spread from the second onset to the preceding coda.
- (b) Secondly, the Nasal Assimilation 2 rule must occur before the Consonant Delinking 2 rule applies to the initial consonant of the root; that is, the place feature of the initial consonant must spread to the [nasal] segment (N) of the prefix before the root consonant delinks from the moraic structure.
- (c) Thirdly, the Vowel Deletion rule must occur before the Root Coda rule; that is, a fully underspecified segment in the V₁ root position of a ?aCVC root (surface [a]) must delink before a fully underspecified segment (surface [ʔ]) can be added to the first coda of the root.
- (d) Fourthly, the Vowel Deletion rule must occur before the Prefix Coda rule; that is, a fully underspecified segment in the V₁ root position of a ?aCVC root (surface [a]) must delink before a fully underspecified segment (surface [ʔ]) can be added to the final coda of a prefix.

6.5 PREFIXES AND SUFFIXES THAT TRIGGER ALTERNATIONS

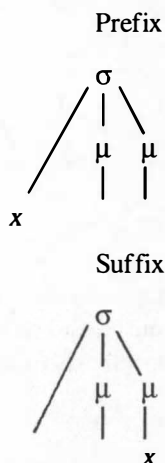
Frequent use has been made of the phrase 'appropriate affix' in the discussion of morphological alternations in verbs, an 'appropriate affix' being implicitly one that triggers alternations in a verb root. In this section, we will consider the characteristics of an 'appropriate affix'; that is, the characteristics of an affix which causes alternations in roots. (The discussion here will be concerned with prefixes and suffixes, since they share certain characteristics; infixes, on the other hand, have different characteristics and will be treated separately.)

Alternations in roots may be lexically determined or phonologically determined. In general, most alternations are phonologically determined; that is, in those affixes that trigger alternations, we can identify specific phonological criteria that separate these affixes from those that do not trigger alternations. There are, however, affixes that meet these phonological criteria, but which fail to trigger alternations. These affixes suggest that morphological alternation in roots is not simply an automatic phonologically-determined system, but rather a complex system that is in part lexically determined, and in part phonologically determined.

Whether or not an affix triggers alternations in a root depends on two factors: (1) the canonical shape of the root type and the phonetic material associated with moraic positions in that root type; and (2) the phonetic material associated with moraic positions in the affix. Root types divide into three groups: (1) a CVC₁C₂VC root type in which the first surface syllable is a closed syllable with a preferred syllable contact; (2) a CV₁CVC root type in which the first surface syllable is an open syllable (V₁ may be [i], [o] or [a]); and (3) a C_iC₁C₁VC root type in which C₁ is a geminate consonant cluster. (A ?aCVC root type is also included in the last group when it patterns like a ?iC₁C₁VC root type.)

These three groups reflect several facts about the interaction between affixes and root types. The first fact is: certain alternations apply to all root types, but other alternations apply only to CVCVC and $C_iC_1C_1VC$ root types. The second fact is: for alternations occurring in CVCVC and $C_iC_1C_1VC$ root types, the majority of these alternations are triggered only if the first onset of a prefix, or the final coda of a suffix, is associated with phonetic material in the underlying representation; that is, the first onset of a prefix must be a consonant other than a surface glottal stop, and the final coda of a suffix must be [n], as shown in (218).

(218) Affixes triggering alternations within roots



The third fact is: for alternations occurring in a $C_iC_1C_1VC$ root type, some alternations are triggered only if the affix meets the phonological criteria in (218), but other alternations occur whether or not these particular criteria are met. (This fact also applies to a $?aCVC$ root type when it follows a $?iC_1C_1VC$ pattern.) As the interaction between affixes and root types is rather complex, we will consider each claim in turn, beginning with those alternations that occur with all root types.

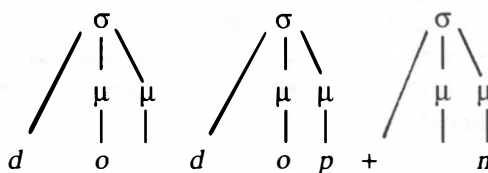
Alternations that occur with all root types are essentially attempts to supply missing phonetic material for positions within affixes. This contrasts with alternations that typically occur only with CVCVC and $C_iC_1C_1VC$ root types in which case the alternations are attempts to associate material with positions within a root in such a way as to produce closed surface syllables with preferred syllable contacts. As it turns out, all root types will cooperate and supply missing material for an affix, provided the crucial root position has phonetic material to share. This pattern is illustrated by the Multiple Association of Consonant 1 rule and the Nasal Assimilation 1 rule.

The Multiple Association of Consonant 1 rule occurs when a prefix with an empty coda, or any suffix, attaches to a root. (Recall that all suffixes lack phonetic material for their onsets.) Following affixation, phonetic material associated with the adjacent root position spreads to the empty affix position. Any affix that lacks phonetic material in this way causes the phonetic material in the adjacent root position to spread to the empty affix position, provided that the adjacent root position has its own phonetic material, as shown in examples (219) and (220).

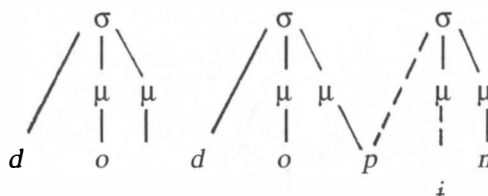
(219) *dodop* 'to speak softly'

Underlying form

Affixation



Multiple association 1



Vowel epenthesis

Surface form

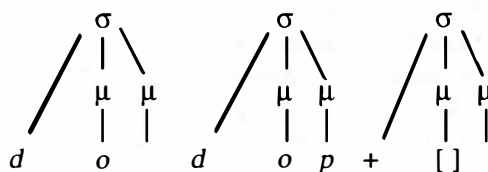
[dudupin]

In (219), the suffix *-in* (imperfective aspect) is added to the root *dodop* [dudup] 'to speak softly'. The suffix lacks phonetic material for its onset, and so *p* in the final coda of the root multiply associates with the suffix onset. Vowel epenthesis follows.

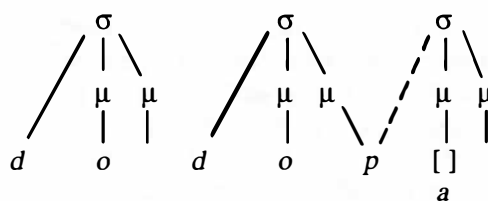
(220) *dodop* 'to speak softly'

Underlying form

Affixation



Multiple association 1



Redundant feature assignment

Surface form

[dudupa]

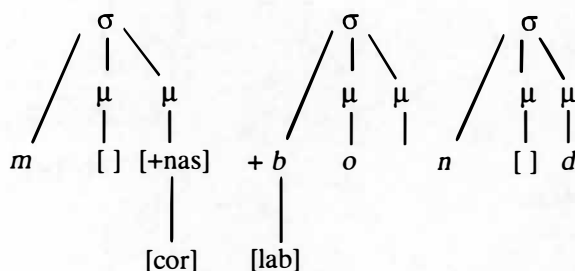
In (220), the suffix *-a* (progressive aspect) is added to the same root, and again *p* in the final coda of the root multiply associates with the suffix onset; redundant feature assignment follows. Notice that in (219) and (220), multiple association occurs whether or not the coda of the suffix is associated with phonetic material in the underlying representation.

The Nasal Assimilation 1 rule occurs when a prefix (or an infix) ending with *n* attaches to a root; *n* is specified for the place feature [coronal]. After affixation, the place feature of the following root consonant spreads to the affix nasal, and the affix nasal delinks from its [coronal] place feature. Any affix ending with *n* causes the place feature in the adjacent root consonant to spread to the affix nasal, as seen in examples (221) and (222).

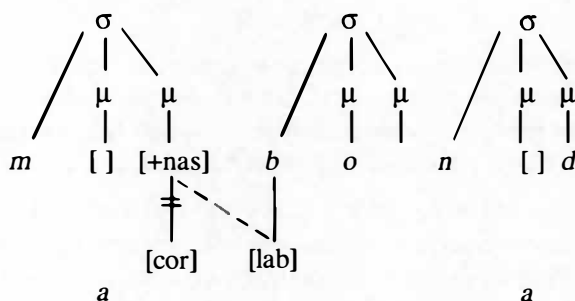
(221) *bonal* 'to transfer'

Underlying form

Affixation



Nasal assimilation 1



Redundant feature assignment

Surface form

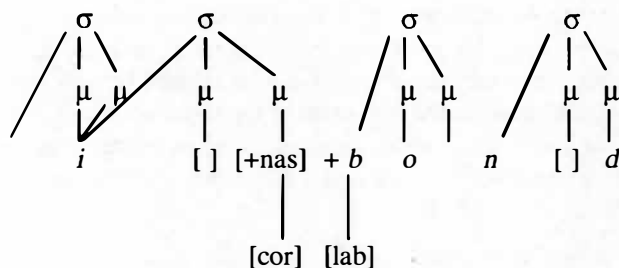
[mambunal]

In (221), the prefix *man-* (imperfective aspect) attaches to the root *bonal* [bunal] 'to transfer'. The prefix ends with *n*, and so the place feature [labial] of *b* in the first onset of the root spreads to the prefix nasal, and the nasal delinks from its place feature [coronal], surfacing as [m]. Redundant feature assignment occurs last.

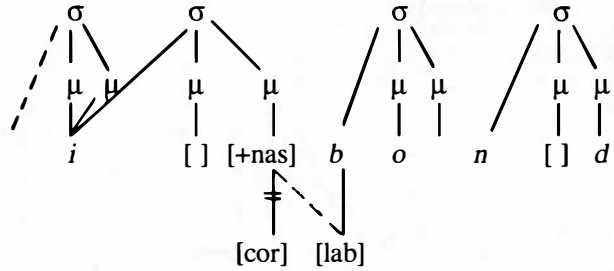
(222) *bonal* 'to transfer'

Underlying form

Affixation



Nasal assimilation 1



Glottal epenthesis

[]

Redundant feature
assignment

?

a

a

Surface form

[ʔiyambunə]

In (222), the prefix *ʔyan-* (perfective aspect) is added to the same root, and nasal assimilation takes place, as in (221). Glottal epenthesis also occurs in the initial onset of the prefix. Notice that nasal assimilation in (221) and (222) occurs whether or not the initial onset of the prefix is associated with phonetic material in the underlying representation.

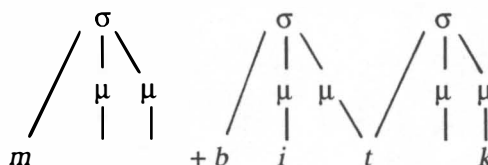
Alternations that occur only in CVCVC and CiC₁C₁VC root types are attempts to associate phonetic material with positions within a root. I have argued that these alternations are attempts to repair defective bimoraic units that lack sufficient material to surface as closed syllables with preferred syllable contacts. What is of interest for our discussion of affixes is that only affixes that meet the phonological criteria presented in (218) will trigger alternations of this sort. That is, a prefix will trigger alternations in a CVCVC or CiC₁C₁VC root only if the initial onset of the prefix is associated with phonetic material; if the initial onset lacks phonetic material, alternations in the root will fail to take place. In the same way, a suffix will trigger alternations in these roots only if the final coda of the suffix is associated with phonetic material; if the final coda lacks such material, alternations in the root will fail to occur. This pattern is illustrated by the Consonant Delinking 2 rule and the Vowel Deletion rule in a CVCVC root.

The Consonant Delinking 2 rule occurs when a prefix or suffix attaches to a CVCVC root type; however, in order to trigger alternation, the initial onset of the prefix, or the final coda of the suffix, must be associated with phonetic material in the underlying representation. Once these criteria are met, the affix causes a multiply associated consonant in the medial root position to delink from the first coda of the root (while remaining associated with the second onset of the root). If the prefix lacks phonetic material for its initial onset, or the suffix lacks phonetic material for its final coda, delinking will not take place. This pattern is shown in examples (223) and (224).

(223) *biθi:g* 'to be poor'

Underlying form

Affixation

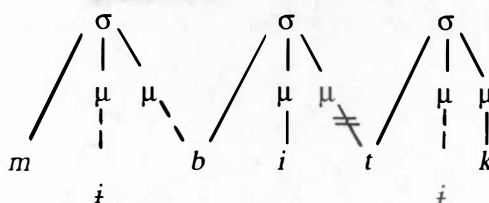


Multiple association 1

Consonant delinking 2

Vowel epenthesis

Surface form



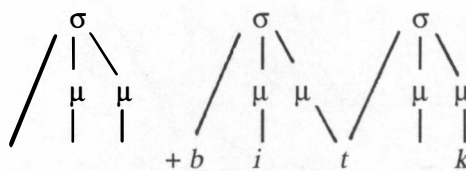
[mɪbbɪtɪg]

In (223), the prefix *mi-* (imperfective aspect) attaches to the CVCVC root *biθig* [biθig] 'to be poor', and *b* in the first onset of the root spreads to the empty coda of the prefix (Multiple Association 1). Since the initial onset of the prefix is associated with *m* in the underlying representation, consonant delinking takes place in the root; specifically, *t* in the medial root position delinks from the first coda of the root, but remains associated with the second onset of the root. Vowel epenthesis occurs last.

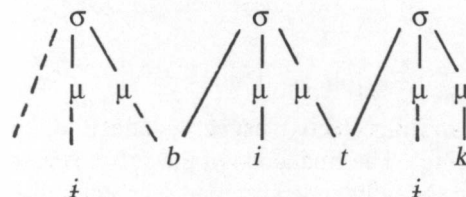
(224) *biθig* 'to be poor'

Underlying form

Affixation



Multiple association 1



Vowel epenthesis

Glottal epenthesis

Redundant feature assignment

[]
?

Surface form

[ʔɪbbiθig]

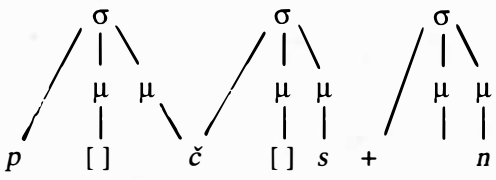
In (224), the prefix *ʔi-* (perfective aspect) attaches to the same root; however, the initial onset of the prefix lacks phonetic material, and so delinking does not occur in the medial consonant of the root. On the other hand, *b* in the first onset of the root spreads as before, and vowel and glottal epenthesis occur last.

The Vowel Deletion rule occurs when a prefix or suffix attaches to a CaCVC root type. Again, in order to trigger alternation, the initial onset of the prefix, or the final coda of the suffix, must be associated with phonetic material in the underlying representation. Once an affix meets these criteria, the fully underspecified segment in the V_1 root position (surface [a]) is deleted. On the other hand, if the prefix lacks phonetic material for its initial onset, or the suffix lacks material for its final coda, vowel deletion will not occur. This pattern is shown in examples (225) and (226).

(225) *pařas* 'to attempt to do something'

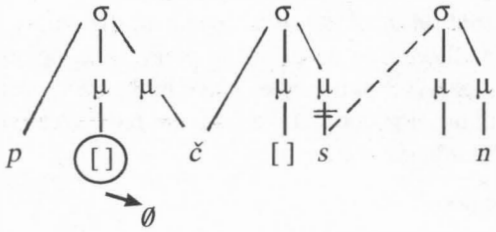
Underlying form

Affixation



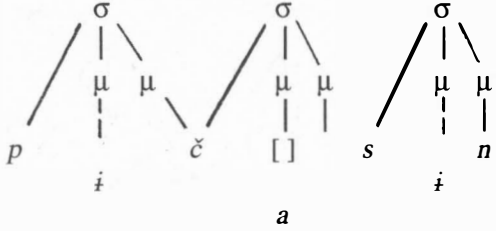
Vowel deletion

Consonant delinking 1



Vowel epenthesis

Redundant feature assignment



Surface form

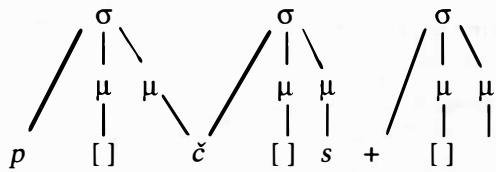
[pītčasɪn]

In (225), the suffix *-in* (imperfective aspect) is added to the CaCVC root *pařas* [pařas] 'to attempt to do something'. The final coda of the suffix is associated with *n* in the underlying representation, and so the fully underspecified segment in the V₁ root position is deleted. The consonant *s* delinks from the final coda of the root and reassociates with the empty onset of the suffix (Consonant Delinking 1); vowel epenthesis and redundant feature assignment occur last.

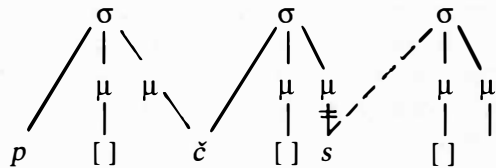
(226) *pařas* 'to attempt to do something'

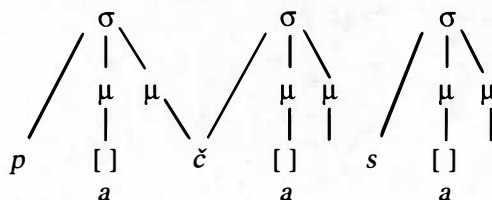
Underlying form

Affixation



Consonant delinking 1





Redundant feature
assignment

Surface form [pařasa]

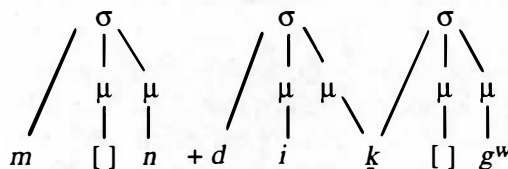
In (226), the suffix *-a* (progressive aspect) attaches to the same root; however, the final coda of the suffix lacks phonetic material, and so vowel deletion in the root does not take place. The consonant *s* delinks from the final coda of the root and reassociates with the empty onset of the suffix as before; redundant feature assignment occurs last.

In (223)-(226), the imperfective affixes always trigger alternations in the CVCVC root whereas the non-imperfective affixes do not (if we discount *-a* as an imperfective affix). Thus, one might suppose that alternations in a root are lexically determined by imperfectivity; that is, one could argue that alternations in a CVCVC root type are triggered only by imperfective affixes. If we consider the following examples in which both prefixes are imperfective affixes, we see that this hypothesis is not correct. In (227), the first onset of the prefix is associated with phonetic material in the underlying representation; but in (228), it is not.

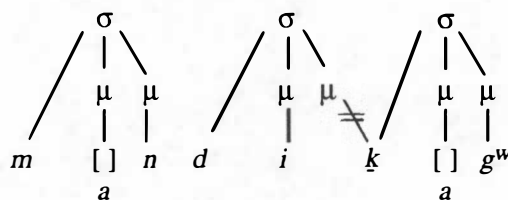
(227) *diřaw* 'to take an indirect route'

Underlying form

Affixation



Consonant delinking 2



Redundant feature
assignment

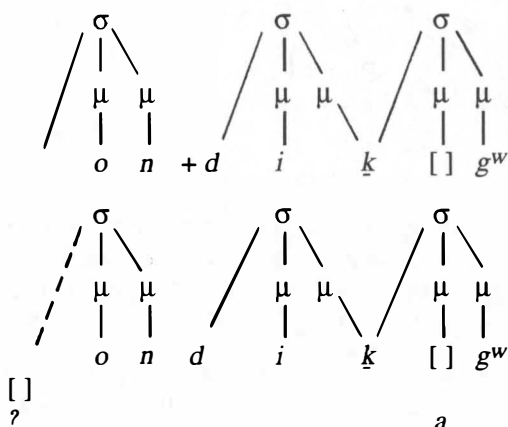
Surface form [mandiřaw]

In (227), the imperfective prefix *man-* is added to the CVCVC root *diřaw* [diřaw] 'to take an indirect route' (or 'to go the long way around'). The initial onset of the prefix is associated with *m* in the underlying representation, and we see that *k* in the medial root position delinks from the first coda of the root, but remains associated with the second onset of the root (Consonant Delinking 2); redundant feature assignment follows. Now compare (227) with (228), in which the initial onset of the imperfective prefix lacks phonetic material.

(228) *dixaw* 'to take an indirect route'

Underlying form

Affixation



Glottal epenthesis

Redundant feature
assignment

Surface form

[ʔondixaw]

In (228), the imperfective prefix *ʔon-* is added to the same root. The initial onset of the prefix lacks phonetic material, and we see that *k* in the medial root position does not delink. Glottal epenthesis and redundant feature assignment occur as usual.

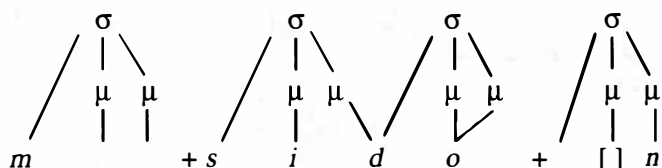
Examples (227) and (228) demonstrate that an imperfective prefix will not trigger alternations within a CVCVC root type unless the initial onset of the prefix is associated with phonetic material. Thus, we conclude that these alternations are not lexically determined by imperfectivity.

Some affixes in Karao are discontinuous in that they consist of two morphemes placed in different positions in a root; specifically, a discontinuous affix consists of either a prefix and a suffix, an infix and a suffix or a prefix and an infix. When both a prefix and a suffix attach to a CVCVC root type, it is the prefix that triggers alternation, as the following examples illustrate.

(229) *silow* 'to illuminate a location'

Underlying form

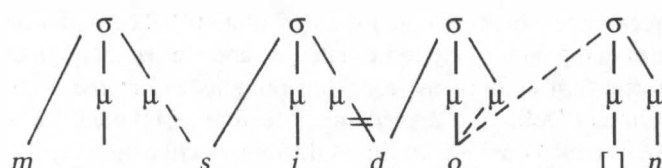
Affixation

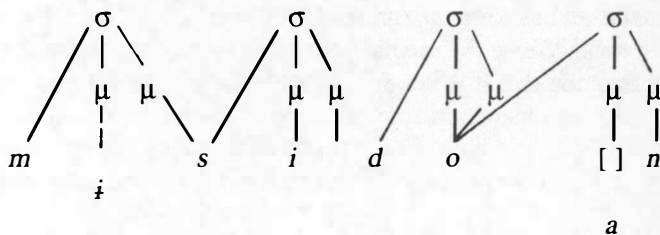


Multiple association 1

Consonant delinking 2

Vowel spreading





Vowel epenthesis
Redundant feature
assignment

Surface form [missidowan]

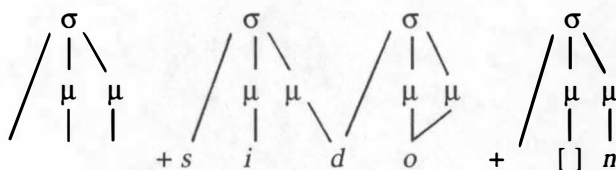
In (229), the discontinuous affix *mi--an* attaches to the CVCVCV root *silow* [silow] 'to illuminate a location'. Both *mi-* and *-an* satisfy the phonological criteria in (218) for triggering alternations within a root; that is, the first onset of the prefix *mi-* is associated with phonetic material, and the final coda of the suffix *-an* is also associated with phonetic material, and so alternations take place within the root. Specifically, *d* in the medial root position delinks from the first coda of the root, but remains associated with the second onset of the root. Other alternations also take place: *s* in the first onset of the root spreads to the empty coda of the prefix; *o* in the final nucleus of the root spreads to the empty coda of the root and to the empty onset of the suffix; and vowel epenthesis and redundant feature assignment occur last.

In (229), both the prefix and suffix satisfy the phonological criteria for triggering alternations within a CVCVCV root; consequently, it is ambiguous whether it is the prefix or the suffix that actually triggers consonant delinking in the medial consonant of the root. Consider now (230) in which the suffix satisfies the phonological criteria for triggering alternations within a root, but the prefix does not.

(230) *silow* 'to illuminate a location'

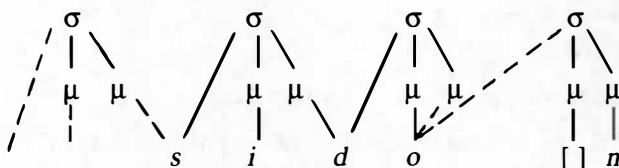
Underlying form

Affixation



Multiple association 1

Vowel spreading



Vowel epenthesis
Glottal epenthesis
Redundant feature
assignment

[]
?
a

Surface form [ʔissilowan]

In (230), the discontinuous affix *ʔi--an* attaches to the CVCVCV root *silow* [silow]. Only the suffix *-an* satisfies the phonological criteria for triggering alternations within a root; that is,

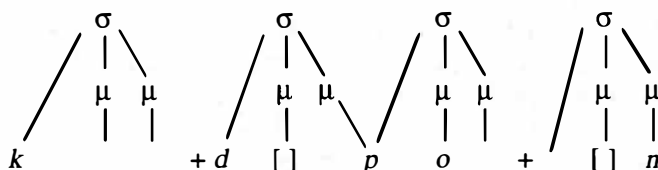
the suffix *-an* has phonetic material for its coda, but the prefix *ki-* lacks phonetic material for its first onset. Since the medial consonant of the root does not delink as it does in (229), we must conclude that it is the prefix that is the trigger for alternations within a CVCVC root. Other alternations which supply phonetic material for positions in the affixes take place as usual: *s* in the first onset of the root and *o* in the last nucleus of the root spread as before; glottal and vowel epenthesis occur in the prefix; and redundant feature assignment occurs last.

Further proof that it is the prefix, rather than the suffix, that triggers alternations within a CVCVC root type is seen in the following examples in which the prefix always satisfies the phonological criteria for triggering alternations, but the suffix does not.

(231) *dapo* 'to come from'

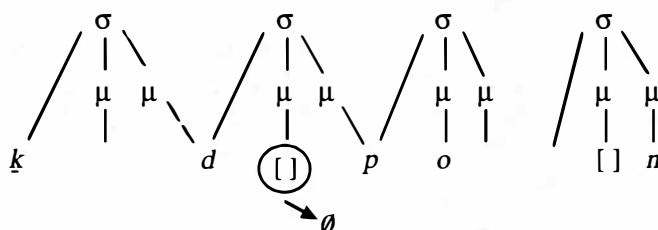
Underlying form

Affixation



Multiple association 1

Vowel deletion

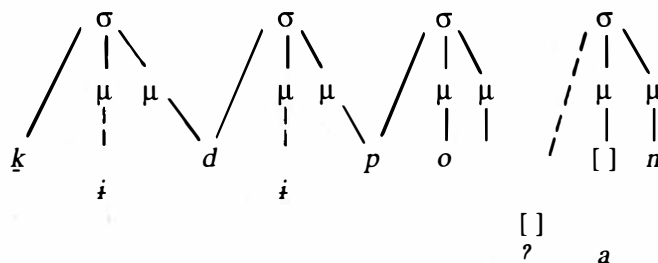


Vowel epenthesis

Glottal epenthesis

Redundant feature

assignment



Surface form

[kidiɸpuʔan]

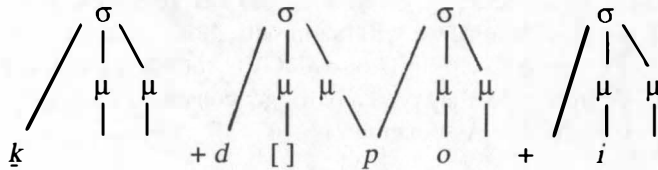
In (231), the discontinuous affix *ki--an* attaches to the CVCVC root *dapo* [dapu] 'to come from', producing the nominal 'place of origin'. Both *ki-* and *-an* satisfy the phonological criteria for triggering alternations within a root; the first onset of the prefix *ki-* is associated with phonetic material, and the final coda of the suffix *-an* is also associated with phonetic material. Since these criteria are met, the fully underspecified segment in the V₁ root position (surface [a]) is deleted. Other alternations also take place: *d* in the first onset of the root spreads to the empty coda of the prefix; vowel epenthesis takes place; glottal epenthesis occurs in the empty onset of the suffix; and redundant feature assignment occurs last. Now

consider (232) in which the prefix satisfies the phonological criteria for triggering alternations within a root, but the suffix does not.

(232) *dapɔ* 'to come from'

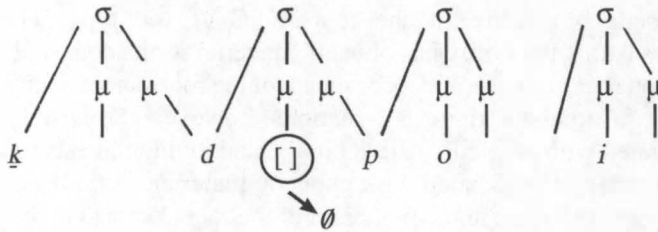
Underlying form

Affixation



Multiple association 1

Vowel deletion

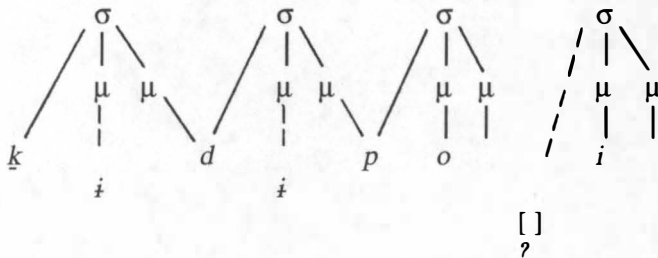


Vowel epenthesis

Glottal epenthesis

Redundant feature

assignment



Surface form

[kɪɪppuʔi]

In (232), the discontinuous affix *ki-i* attaches to the CVCVC root *dapɔ* [dapu] 'to come from', producing another form of the nominal 'place of origin'. Only the prefix *ki-* satisfies the phonological criteria for triggering alternations within a root; specifically, the first onset of the prefix *ki-* is associated with phonetic material, but the final coda of the suffix *-i* lacks phonetic material for its final coda. Since the fully underspecified segment in the V_1 root position is deleted just as it is in (231), we have clear evidence that it is the prefix which triggers alternations within a CVCVC root. Other alternations take place as before: *d* in the first onset of the root spreads to the empty coda of the prefix; vowel epenthesis takes place; glottal epenthesis occurs in the empty onset of the suffix; and redundant feature assignment occurs last.

Based on this evidence, we conclude that, in certain root types, alternations are, at least in part, phonologically determined, rather than lexically determined. It is also clear that the phonological criterion that triggers these alternations is the presence of phonetic material in the initial onset of a prefix, or, if a prefix is not present, the presence of material in the final coda of a suffix. We will now turn to the interaction between affixes and a CiC_1C_1VC root type.

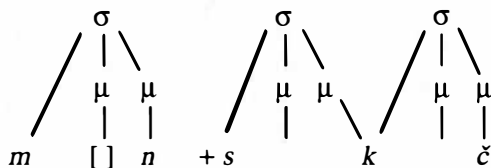
The interaction between affixes and a $C_iC_1C_1VC$ root type is unique: with a $CVCVC$ root type, all affixes that trigger alternations within the root must meet the phonological criteria given in (218); however, with a $C_iC_1C_1VC$ root type, some affixes trigger alternations without meeting these criteria. In other words, some affixes trigger alternations within a $C_iC_1C_1VC$ root whenever they are added to a $C_iC_1C_1VC$ root, even though they must meet the phonological criteria given in (218) before they can do so in a $CVCVC$ root. To investigate this pattern, we will begin with those affixes that follow the same pattern when added to either a $C_iC_1C_1VC$ or a $CaCVC$ root type. When these affixes are added to a $C_iC_1C_1VC$ root type, they typically trigger consonant spreading within the first bimoraic unit of the root (Multiple Association 2).

The Multiple Association 2 rule can occur when a prefix that has phonetic material for its final coda, or a suffix, attaches to a $C_iC_1C_1VC$ root type. (The significant fact about these affixes is that the prefix has phonetic material for its coda and the suffix does not precede the root; therefore, the initial consonant of the root cannot delink and reassociate with a prefix coda.) In order to trigger alternations, however, the initial onset of the prefix must be associated with phonetic material in the underlying representation, and the final coda of the suffix must be associated with phonetic material. Once these criteria are met, the affixes cause the consonant in the first onset of the root to spread to the first coda of the root, as seen in examples (233) and (234).

(233) *sikid* 'to wait'

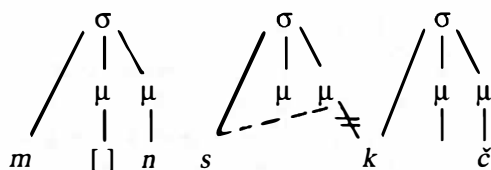
Underlying form

Affixation

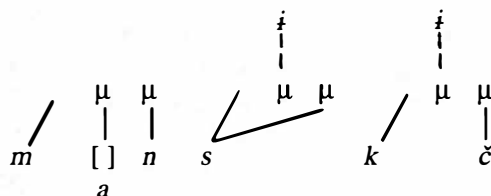


Multiple association 2

Consonant delinking 2



Vowel epenthesis



Redundant feature assignment

Surface form

[mansikid]

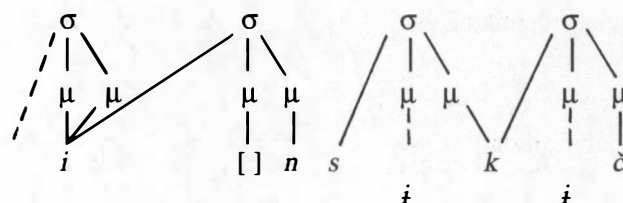
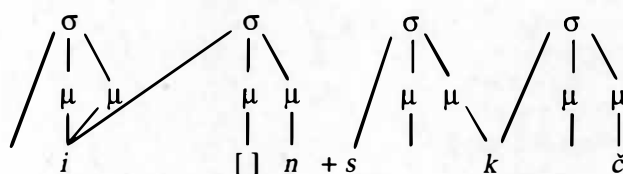
In (233), the prefix *man-* attaches to the root *sikid* [sikkid] 'to wait'. In the prefix, the initial onset of the prefix is associated with *m*, and the coda with *n*, and so *s* in the first onset of

the root spreads to the first coda of the root, and *k* in the medial root position delinks from the first coda. Vowel epenthesis follows, and redundant feature assignment occurs last.

(234) *sikid* 'to wait'

Underlying form

Affixation



Vowel epenthesis

Glottal epenthesis

Redundant feature

assignment

[]

?

a

Surface form

[ʔiyansikkid]

In (234), the prefix *ʔiyan-* is added to the same root; however, the initial onset of the prefix lacks phonetic material in the underlying representation, and so consonant spreading and delinking do not take place in the root. Vowel epenthesis takes place; glottal epenthesis occurs in the initial onset of the prefix; and redundant feature assignment occurs last.

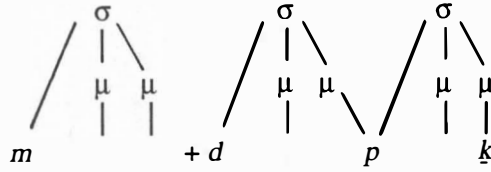
Now let us consider a set of affixes which must meet the phonological criteria in (218) when triggering alternations in a CVCVC root, but which are not required to meet these criteria when triggering alternations in a C_iC₁C₁VC root. Affixes of this type typically trigger consonant delinking and resyllabification in C_iC₁C₁VC roots.

Recall that the Consonant Delinking 3 rule (in the initial onset of a root) and the Consonant Delinking 2 rule (in the medial position of a root) always occur together in a C_iC₁C₁VC root type. Following delinking in both positions, the first bimoraic unit of the root is deleted, and resyllabification occurs. These alternations are always triggered by prefixes in which the coda has no phonetic material (for example, *mi-* and *ʔi-*), or in which the coda is associated with the feature [nasal] and lacks a place feature specification (as in *miN-* and *ʔiyaN-*). These prefixes trigger delinking and resyllabification in a C_iC₁C₁VC root whether or not the onset of the prefix is associated with phonetic material in the underlying representation, as shown in (235) and (236).

(235) *dipik* 'to get wet'

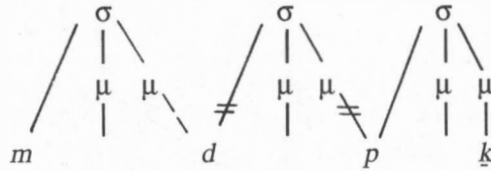
Underlying form

Affixation

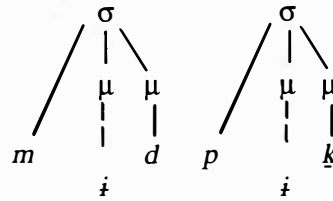


Consonant delinking 3

Consonant delinking 2



Resyllabification



Vowel epenthesis

Surface form

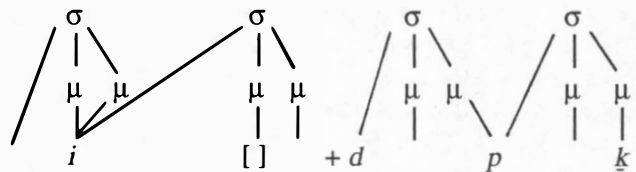
[mɪlpik]

In (235), the prefix *mi-* attaches to the $C_iC_1C_1VC$ root *dipik* [dippik] 'to get wet'. Following affixation, *d* in the initial onset of the root delinks and reassociates with the prefix coda (Consonant Delinking 3); *p* in the medial position of the root delinks from the first coda of the root, but remains associated with the second onset of the root (Consonant Delinking 2); the first bimoraic unit of the root is deleted; and resyllabification takes place. Vowel epenthesis occurs last. Compare (235) with (236) in which the prefix lacks phonetic material for its onset.

(236) *dipik* 'to get wet'

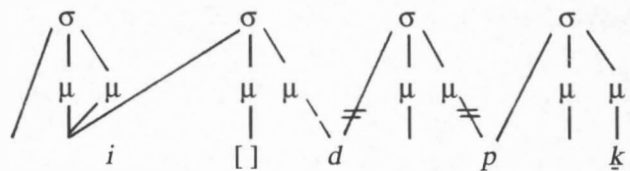
Underlying form

Affixation

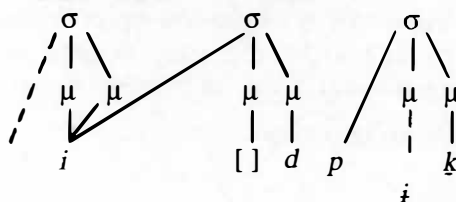


Consonant delinking 3

Consonant delinking 2



Resyllabification



Vowel epenthesis

Glottal epenthesis

Redundant feature
assignment

[ʔ]

?

a

Surface form

[ʔiyalpik]

In (236), the prefix *ʔiya-* (an allomorph of *ʔi-*) attaches to the $C_iC_1C_1VC$ root *dipik* [dippik] 'to get wet'. Following affixation, the same alternations occur as in (235): *d* in the initial onset of the root delinks and reassociates with the prefix coda; *p* in the medial position of the root delinks from the first coda of the root, but remains associated with the second onset of the root; the first bimoraic unit of the root is deleted, and resyllabification follows. Vowel epenthesis takes place; glottal epenthesis occurs in the initial onset of the prefix; and redundant feature assignment takes place last.

The question is: how can we explain the fact that the affixes *man-* and *ʔyan-* must meet the phonological criteria placed on affixes for triggering alternations when they attach to a $C_iC_1C_1VC$ root, but the affixes *mi-* and *ʔiya-* do not? One possible explanation lies in the difference in the prefixes. Notice that for both *man-* and *ʔyan-*, the final coda of each prefix is associated with phonetic material, namely *n*, in the underlying representation; for *mi-* and *ʔiya-*, however, the final coda of each prefix lacks phonetic material. Recall that all roots attempt to supply material for the empty coda of any prefix and the empty onset of any suffix. This apparently is what a $C_iC_1C_1VC$ root attempts to do when *mi-* and *ʔiya-* are added to the root; however, of all the root types, the $C_iC_1C_1VC$ root type is the most deficient in terms of phonetic material in the underlying representation. So then, in order to supply phonetic material for the empty coda of a prefix, the consonant associated with the first onset of a $C_iC_1C_1VC$ root type must delink from its position and reassociate with the prefix coda; it cannot remain associated with the first onset of the root and spread to the coda of the prefix, as does the initial consonant in a CVCVC root type. Recall also that consonant delinking in the first onset of a $C_iC_1C_1VC$ root type is always accompanied by consonant delinking in the medial position of the root. Delinking in both positions is followed by the deletion of the first bimoraic unit of the root, and resyllabification follows. This suggests that all prefixes lacking sufficient material for their coda trigger alternations in a $C_iC_1C_1VC$ root type simply because these alternations are the only means by which a $C_iC_1C_1VC$ root type can supply material for an empty prefix coda. Notice that once a $C_iC_1C_1VC$ root type has managed to supply material for an empty prefix coda, it has also achieved a closed surface syllable with a preferred syllable contact; consequently, there is no need for further alternation within the root itself. As for the prefixes *man-* and *ʔyan-*, since they have phonetic material for their final codas, they trigger alternations within a $C_iC_1C_1VC$ root only when they meet the phonological criteria in (218).

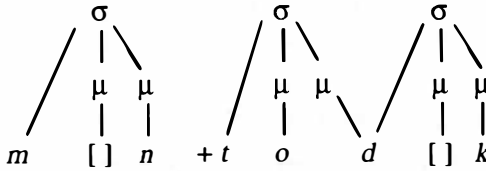
Before leaving the subject of affixes, there is one more issue to address. I mentioned earlier that some alternations triggered by affixes appeared to be morphologically determined. This claim is based on the fact that although a prefix may satisfy the phonological criteria for triggering alternations within a root, it will fail to do so when signalling certain kinds of

grammatical information, such as progressive aspect or reciprocal action. This behaviour is illustrated in (237) by the CVCVC root *tolag* ‘to make an agreement’; the prefix *man-* is added to the root *tolag*, and alternations are triggered within the root as usual.

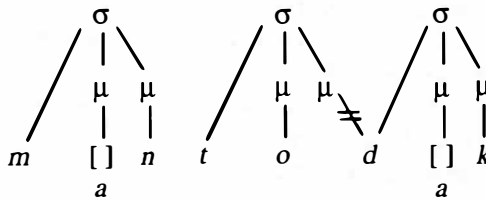
(237) *tolag* ‘to make an agreement’

Underlying form

Affixation



Consonant delinking 2



Redundant feature assignment

Surface form

[mantudag]

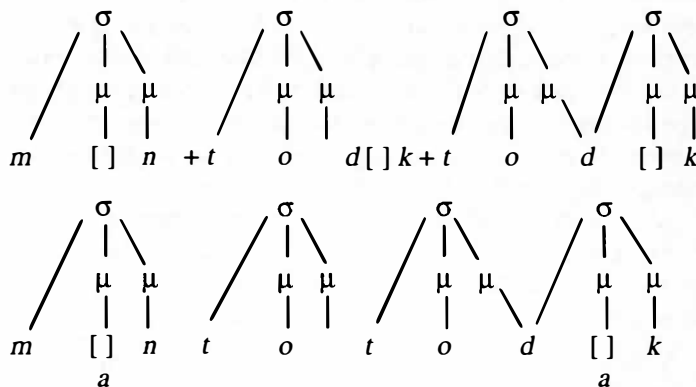
In (237), the prefix *man-* attaches to the CVCVC root *tolag* [tulag] ‘to make an agreement’. The first onset of the prefix is associated with phonetic material, and so alternations are triggered within the root. Specifically, *d* delinks from the first coda of the root, but remains associated with the second onset; redundant feature assignment follows. Now let us consider the pattern for signalling progressive aspect.

One way to signal progressive aspect in Karao is to add the prefix *man-* to a root and reduplicate the first surface syllable (or the first underlying bimoraic unit) of the root, as shown in (238).

(238) *tolag* ‘to make an agreement’

Underlying form

Affixation and reduplication



Redundant feature assignment

Surface form

[mantutulag] progressive aspect

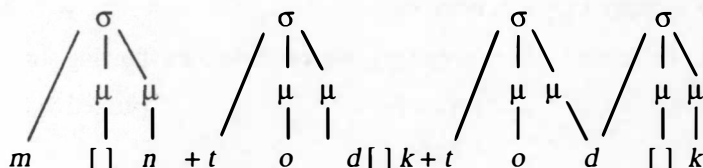
In (238), the prefix *man-* is added to the CVCVC root *tolag* [tulag] and the first bimoraic unit of the root is reduplicated, signalling progressive aspect. (See Chapter 8 for a discussion of reduplication.) Despite the fact that the onset of the prefix is associated with *m* and so satisfies the phonological criteria for triggering alternations within a root, no alternations occur. That is, *d* in the root does not delink from the first coda of the root as it does in (237); only redundant feature assignment takes place as usual. Now let us consider the pattern for signalling reciprocal action between three or more participants.

To signal reciprocal action between three or more participants, the same pattern is followed as in (238): the prefix *man-* is added to the root and the first surface syllable (or the first underlying bimoraic unit) of the root is reduplicated; however, this time alternations do occur within the root, as shown in (239).

(239) *tolag* 'to make an agreement'

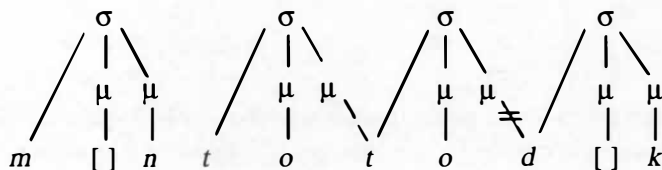
Underlying form

Affixation
and reduplication

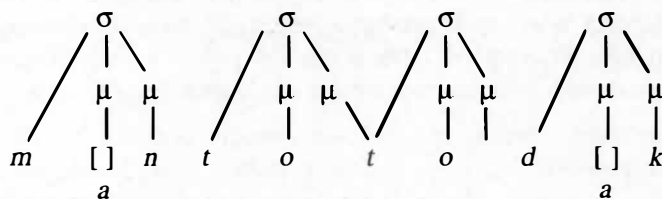


Multiple association 1

Consonant delinking 2



Redundant feature
assignment



Surface form

[mantuθudag] reciprocal action between three or more participants

In (239), the prefix *man-* is added to the CVCVC root *tolag* [tulag] and the first bimoraic unit of the root is reduplicated. Alternations take place within the root, signalling reciprocal action between three or more participants. Specifically, *t* in the first onset of the root spreads to the empty coda of the reduplicated unit; *d* in the medial root position delinks from the first coda of the root, but remains associated with the second onset; redundant feature assignment occurs last. Since the phonological environments in (238) and (239) are identical, we must conclude that alternations triggered in the root are morphologically determined for these particular patterns.

CHAPTER 7

MORPHOLOGY OF INFIXATION

Affixes in Karao include not only prefixes and suffixes, but also infixes. Infixes insert immediately following the initial onset of a surface morpheme; the morpheme can be either a root or a prefix. With verbs, infixes usually signal perfective aspect, but they can also signal reciprocal action. In this discussion, we are concerned mainly with perfective infixes, since this provides us with the most typical illustration of infixation.

7.1 INFIXATION IN ROOTS

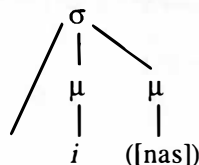
Perfective infixes occurring in roots have the following surface forms:

(240)	imperfective	perfective
	<i>ʔon-</i>	<i>-im-</i>
	<i>-in</i>	<i>-iy-</i>
	or <i>-an</i>	or <i>-in-</i>
		or <i>-i-</i>

The infix *-im-* is the perfective form of *ʔon-*, as in *ʔonkowan* ([ʔonkowan] or [ʔonkwan]) and *kimowan* ([kemowan]) ‘to come/go’. (Following *k* in an open syllable, *i* surfaces as [e].) The surface infix *-iy-* is the perfective form of *-in*, as in *boḵboxin* [buḵbuḵin] and *biyokboḵ* [biyukbuḵ] ‘to cut meat into large pieces’, or *-an*, as in *sonbaḵan* [sunbaḵan] and *siyonbaḵan* [siyunaḵan] ‘to answer’. The forms *-in-* and *-i-* are allomorphs of *-iy-*. All these perfective surface forms can be derived from a single underlying morpheme.

The perfective morpheme has two components: (1) the perfective segment [high] (represented as *i* in rules and derivations), and (2) a bimoraic perfective template. The components may occur separately or together, depending upon the phonological environment. When the perfective segment [high] and the perfective template occur together, the segment [high] always associates with the first mora of the template. A nasal can also associate with the second mora of the template: if the perfective morpheme is the counterpart of the prefix *ʔon-*, the nasal is *m*; if the morpheme is the counterpart of the suffixes *-in* or *-an*, the nasal is *n*. The schema for the perfective morpheme is given in (241).

(241) Perfective Morpheme



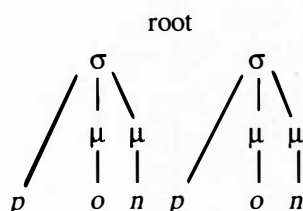
Perfective infixation, like other phonological alternations in Karao, interacts with the canonical shape of the root to which it is added. Specifically, the selection of a perfective allomorph is determined by the canonical shape of the root type and the phonetic material associated with moraic positions within the root type. Let us begin then with a $CV_1C_1C_2VC$ root type, since this root type illustrates the most common form of perfective infixation.

7.1.1 $CV_1C_1C_2VC$ ROOT TYPE

In a $CV_1C_1C_2VC$ root type, the bimoraic perfective template inserts immediately following the initial onset of the root. If V_1 of the root lacks phonetic material, or if it associates with any vowel other than *i*, then the perfective segment [high] associates with the first mora of the template, and spreads to the first coda and the second onset of the infixed root, as shown in (242).

(242) *ponpon* 'to stack'

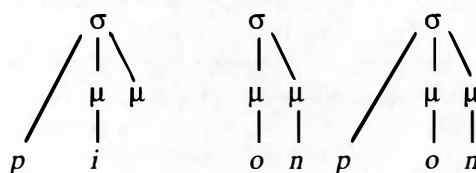
Underlying form



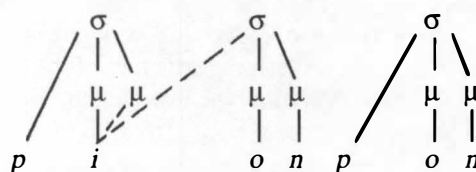
Surface form

[ponpon]

Infixation



Vowel spreading



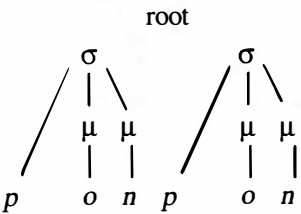
Surface form

[piyonpon]

In (242), a perfective template is added to *ponpon* [ponpon] 'to stack', a $CV_1C_1C_2VC$ root in which V_1 is *o*. The template is inserted immediately following *p* in the initial onset of the root, and the first bimoraic unit of the root changes from one unit composed of two moras to two units composed of two moras each. The perfective segment [high] (or *i*) associates with the first nucleus, then spreads to the first coda and the second onset, surfacing as the sequence [iy]. Recall that the feature [high] must associate with three underlying positions – a nucleus, the following coda, and an adjacent onset – in order to surface as the sequence [iy] (see section 4.3.5). If we posit only one mora for the template, as in (243), [high] spreading would produce the surface sequence [iɿ].

(243) *ponpon* 'to stack'

Underlying form



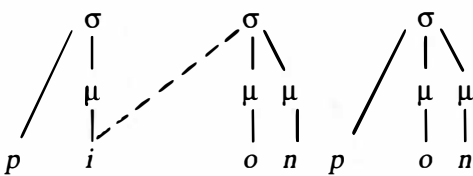
Surface form

[ponpon]

Inflection



Vowel spreading



Surface form

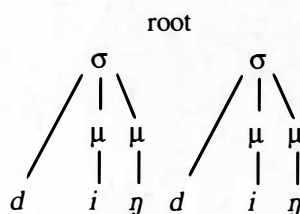
*[pi̯jonpon]

In (243), a template composed of only one mora is inserted immediately following *p* in the initial onset of the root. Following inflection, the perfective segment [high] in the first nucleus spreads to the second onset. The perfective segment [high] is not multiply associated with two consonant positions, and so it cannot surface as [y]; instead, it surfaces as [j̥] in the onset position, following the distribution pattern for [y] and [j̥]. This alternation produces the surface sequence [i̯j̥], a sequence that never occurs in this word position. In order to account for the sequence [iy] in (242), we must assume that the perfective segment [high] associates with three positions in the underlying structure. For this reason, I have posited two moras, rather than one, in the underlying structure of the perfective template. Now let us consider inflection in a CV₁C₁C₂VC root type in which the V₁ position is associated with the vowel *i* (or the feature [high]).

In a CV₁C₁C₂VC root type in which V₁ is *i*, the perfective template inserts immediately following the initial onset of the root, as before, and the perfective segment [high] associates with the first mora of the template. The perfective segment [high], however, cannot spread to the following coda and onset as in (242), because the V₁ root position is also associated with the feature [high], that is *i*. If the perfective segment [high] spreads to the adjacent coda and onset, it would violate the Adjacent Mora Prohibition which does not allow two identical segments on the same tier to associate with adjacent positions on the moraic tier (see section 4.7.2). To avoid violating this prohibition, vowel spreading is blocked, and the nasal *n* associates with the second mora of the perfective template, as shown in (244).

(244) *dinɖin* 'to forget'

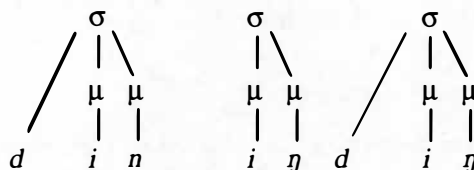
Underlying form



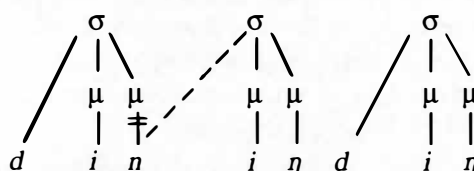
Surface form

[dinɖin]

Infixation



Consonant delinking 1



Surface form

[dinɖinɖin]

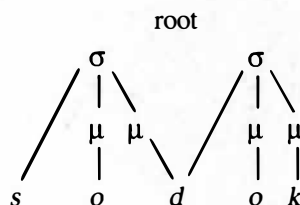
In (244), the perfective template is added to *dinɖin* [dinɖin] 'to forget', a CV₁C₁C₂VC root in which V₁ is *i*. The template is inserted immediately following *d* in the initial onset of the root, and the first bimoraic unit of the root changes from one unit of two moras to two units of two moras each. The perfective segment [high] (or *i*) associates with the first nucleus, and the nasal *n* with the first coda. The nasal *n* then delinks from the first coda and reassociates with the second onset, since the second onset lacks phonetic material. Notice that perfective *i* in the first nucleus does not spread to the first coda after *n* delinks. This verifies the claim that vowel spreading triggered by affixation occurs only when both the following coda and an adjacent onset are empty; thus, we conclude that vowel spreading is lexically determined.

7.1.2 CV₁CVC ROOT TYPE

The perfective surface forms [-iy-] and [-in-] also occur in a CV₁CVC root type. If V₁ of the root is *o* or the fully underspecified segment (surface [a]), then a perfective template inserts immediately following the initial onset of the root; the perfective segment [high] associates with the first mora of the template and then spreads to the first coda and the second onset, following the pattern in (242). An example is given in (245).

(245) *solog* 'to tease'

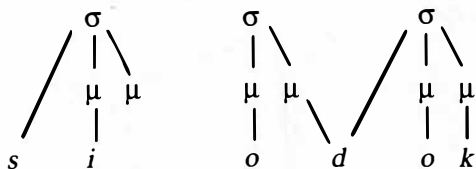
Underlying form



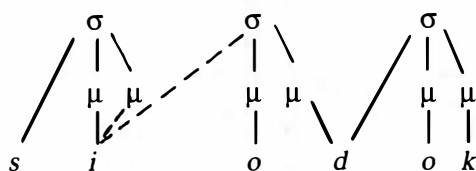
Surface form

[sulug]

Infixation



Vowel spreading



Surface form

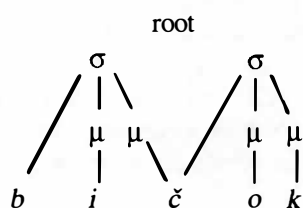
[siyulug]

In (245), the perfective template is added to *solog* [sulug] 'to tease', a CV₁CVC root in which V₁ is *o*. The template is inserted immediately following *s* in the initial onset of the root, and the first bimoraic unit of the root changes from one unit of two moras to two units of two moras each. The perfective segment [high] associates with the first nucleus, then spreads to the first coda and the second onset, surfacing as the sequence [iy]. Notice that *d* remains multiply associated following infixation.

If V₁ in a CV₁CVC root type is *i*, then the perfective template inserts immediately following the initial onset of the root; the perfective segment [high] associates with the first mora of the template; and the nasal *n* associates with the second mora, following the pattern in (244). An example is given in (246).

(246) *biřok* 'to blow up'

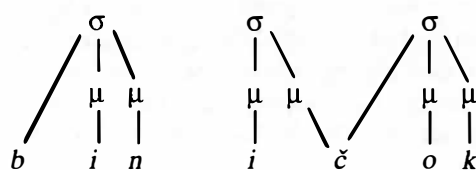
Underlying form



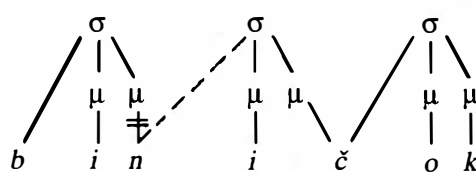
Surface form

[biřok]

Infixation



Consonant delinking 1



Surface form

[biniřok]

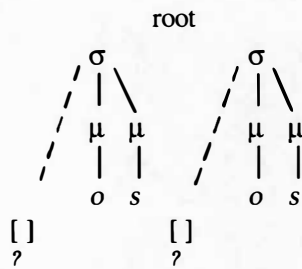
In (246), the perfective template is added to *biřok* [biřok] ‘to blow up’, a CV₁CVC root in which V₁ is *i*. The template is inserted immediately following *b* in the initial onset of the root, and the first bimoraic unit of the root changes from one unit of two moras to two units of two moras each. The perfective segment [high] associates with the first nucleus, and the nasal *n* with the first coda. The nasal *n* then delinks from the first coda and reassociates with the second onset. Notice again that *ř* in the medial root consonant remains multiply associated.

These are the only root types that receive a perfective template. This raises the question: how does one predict whether or not a perfective template will be added to any given root type? If we examine a variety of CV₁C₁C₂VC and CV₁CVC roots, we can identify the specific phonological environment in which a perfective template is added in each root type. Let us begin with a CV₁C₁C₂VC root type.

A perfective template is always added to a CV₁C₁C₂VC root type. The reason for this, as we will see, is that the first coda of a CV₁C₁C₂VC root type is singly associated with phonetic material. First notice that a template is added to a CV₁C₁C₂VC root even if the initial onset of the root lacks phonetic material, as shown in (247).

(247) ?os?os ‘to use an ?os?os tool’

Underlying form



Glottal epenthesis
Redundant feature
assignment

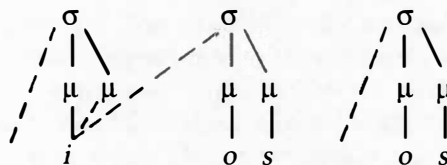
Surface form

[?os?os]

Inflection



Vowel spreading



Glottal epenthesis
Redundant feature
assignment

Surface form

[?iyos?os]

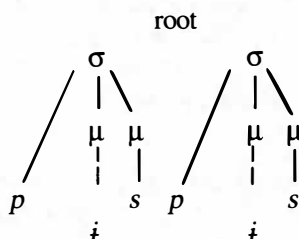
In (247), a perfective template is added to ?os?os [?os?os] ‘to use an ?os?os tool’, a CV₁C₁C₂VC root in which the initial onset of the root lacks phonetic material. The template

is inserted immediately following the initial onset of the root; the perfective segment [high] associates with the first nucleus, then spreads to the first coda and the second onset, surfacing as the sequence [iy]. Glottal epenthesis takes place in onset positions, and redundant feature assignment occurs last.

Now notice that a perfective template is added to a $CV_1C_1C_2VC$ root type even if the V_1 position of the root lacks phonetic material, as shown in (248).

(248) *pɪspɪs* 'to squeeze'

Underlying form

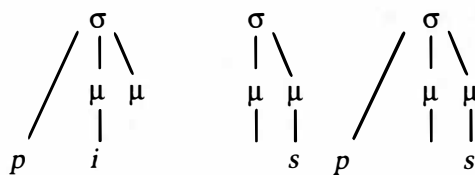


Vowel epenthesis

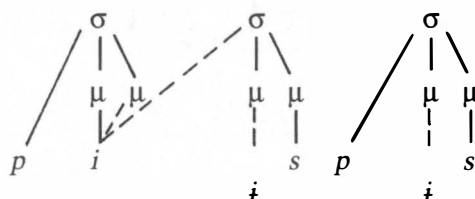
Surface form

[pɪspɪs]

Inflection



Vowel spreading



Vowel epenthesis

Surface form

[piyɪspɪs]

In (248), a perfective template is added to *pɪspɪs* [pɪspɪs] 'to squeeze', a $CV_1C_1C_2VC$ root in which V_1 lacks phonetic material in the underlying representation. The template is inserted immediately following *p* in the initial onset of the root; the perfective segment [high] associates with the first nucleus, then spreads to the first coda and the second onset, surfacing as the sequence [iy]. Vowel epenthesis occurs last.

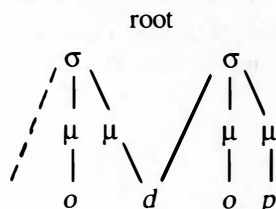
These examples show that the addition of a perfective template in a $CV_1C_1C_2VC$ root type is not triggered by the association of phonetic material with the first onset or the first vowel position of the root. From this evidence, we must assume that it is the association of phonetic material with the first coda of the root that is the phonological trigger for the addition of the perfective template; that is, if the first coda of a root is singly associated with a segment in the underlying representation, then a perfective template will be added to the root. The canonical shape of a $CV_1C_1C_2VC$ root type guarantees that this structural description is always met, and so a perfective template is always added to this root type. Now consider a CV_1CVC root type in which the first coda is not singly associated with phonetic material.

A perfective template is always added to a CV_1CVC root type if the V_1 position of the root is associated with *i*, *o* or a fully underspecified segment (surface [a]) in the underlying

representation. The template is added whether or not phonetic material is associated with the initial onset of the root, as shown in (249).

(249) *ʔolop* 'to take someone along'

Underlying form



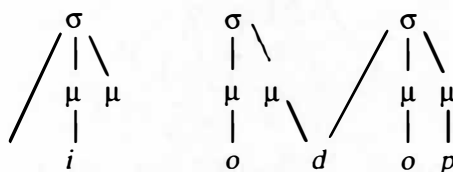
Glottal epenthesis
Redundant feature
assignment

[]
ʔ

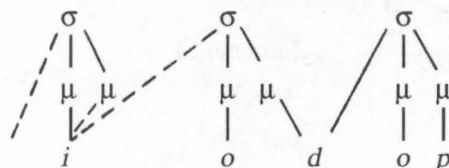
Surface form

[ʔulup]

Infixation



Vowel spreading



Glottal epenthesis
Redundant feature
assignment

[]
ʔ

Surface form

[ʔiyulup]

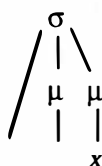
In (249), the perfective template is added to *ʔolop* [ʔulup] 'to take someone along', a CV₁CVC root in which the initial onset of the root lacks phonetic material. The template is inserted immediately following the initial onset of the root; the perfective segment [high] associates with the first nucleus, then spreads to the first coda and the second onset, surfacing as the sequence [iy]. Glottal epenthesis takes place in the initial onset of the affixed root, and redundant feature assignment occurs last.

I have argued that the medial consonant of a CV₁CVC root type is either multiply associated with the first coda and the second onset of the root, or less commonly, singly associated with the second onset of the root in the underlying representation. By definition then, the first coda of a CV₁CVC root can never be singly associated with phonetic material; consequently, the phonological environment required for the addition of a perfective template in a CV₁CVC root cannot be the same as the environment in a CV₁C₁C₂VC root. From these facts, we may assume that it is the association of phonetic material to the V₁ position of a CV₁CVC root type that triggers the addition of a perfective template. Specifically, if the V₁ position in a CV₁CVC root is associated with a segment, that is *i*, *o* or a fully underspecified segment, in the underlying representation, a perfective template will be inserted.

The environments for adding a perfective template to a $CV_1C_1C_2VC$ or CV_1CVC root type can be summarised as follows: a perfective template is added to a $CV_1C_1C_2VC$ or CV_1CVC root if either mora in the first underlying bimoraic unit of the root is singly associated with a segment in the underlying representation. These environments are represented in the following schemata: (250a) represents the first bimoraic unit of a $CV_1C_1C_2VC$ root type; (250b) represents the first bimoraic unit of a CV_1CVC root type.

(250)

a. $CV_1C_1C_2VC$ root



b. CV_1CVC root

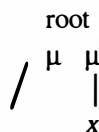


The following rule represents infixation in which a perfective template is added to the first underlying bimoraic unit of a morpheme.

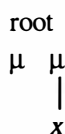
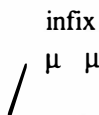
(251)

Infixation 1

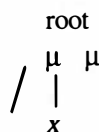
a. $CV_1C_1C_2VC$ root



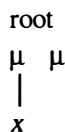
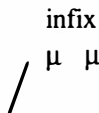
Infixation



b. CV_1CVC root



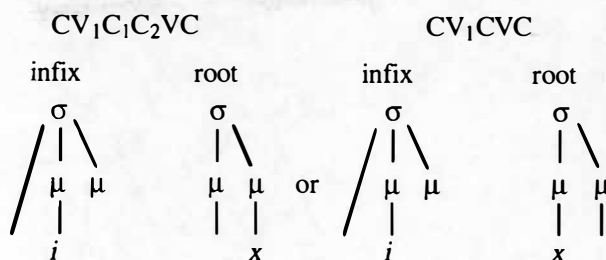
Infixation



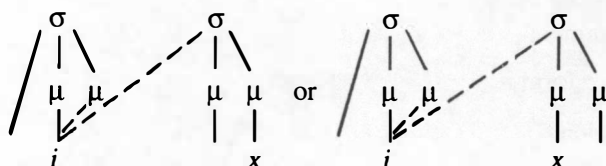
Following the addition of a perfective template, the perfective segment [high] may be added to the nucleus of the template. If the V_1 root position is unassociated, or if it is associated with any segment other than the feature [high] (or \dot{I}), the perfective segment [high] spreads to the first coda and second onset of the word, as shown in (252).

(252)

Infixation



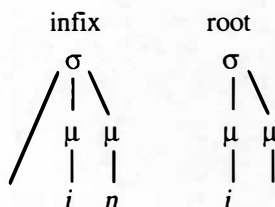
Vowel spreading



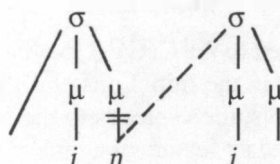
If the V₁ root position is associated with the feature [high] (or *i*), the nasal *n* is added to the second mora of the template; *n* then delinks and reassociates with the following empty onset, as shown in (253).

(253)

Infixation



Consonant delinking 1



The only exception to the representation in (253) is *-im-*, the perfective form of *?on-*: the nasal *m*, rather than *n*, associates with the second mora of the template. (The infix *-im-* has no allomorphs.) Now let us consider infixation in which no template is added.

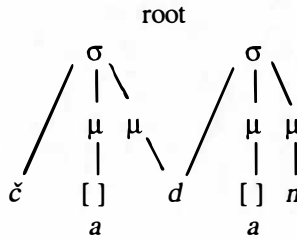
In the CaCVC and CiC₁C₁VC root types, a bimoraic template is not added when perfective infixation takes place. Since these root types have different infixation patterns, we will consider each one in turn, beginning with the CaCVC root type.

7.1.3 CaCVC ROOT TYPE

A CaCVC root type is unique in that it can pattern like a CVCVC root or a CiC₁C₁VC root. When perfective infixation takes place in a CaCVC root type, the root undergoes one of two alternation patterns. In the first alternation pattern, the fully underspecified segment in the V₁ position of the root (surface [a]) is not deleted; instead, the segment is retained and the root follows the CVCVC infixation pattern in (245) and (249). That is, a perfective template is added following the initial onset of the root; the perfective segment [high] is associated with the first nucleus, and spreads to the first coda and the second onset, as shown in (254).

(254) *čalan* 'path'

Underlying form

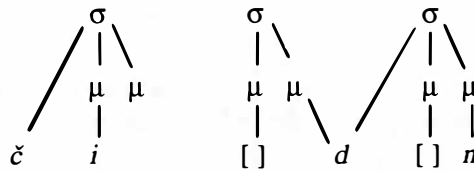


Redundant feature assignment

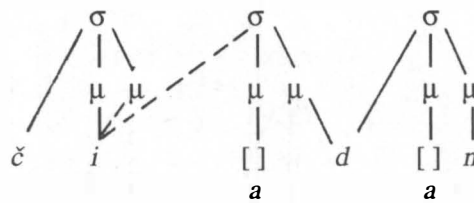
Surface form

[čalan]

Infixation



Vowel spreading



Redundant feature assignment

Surface form

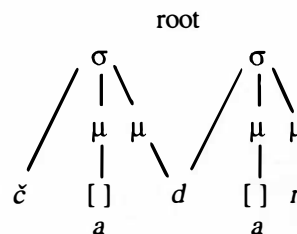
[čiyalan] 'to follow a route'

In (254), a perfective template is added to the CaCVC root *čalan* [čalan] 'path'. The template is inserted immediately following *č* in the initial onset of the root; the perfective segment [high] associates with the first nucleus, then spreads to the first coda and the second onset, surfacing as the sequence [iy]. Redundant feature assignment occurs last.

In the second pattern, the fully underspecified segment in the V_1 position of the root (surface [a]) is deleted, and the perfective segment [high] is inserted in its place; no extra moras are added to the root. If the medial consonant of the root is multiply associated, it will also delink from the first coda of the root, remaining associated with the second onset, as shown in (255).

(255) *čalan* 'path'

Underlying form



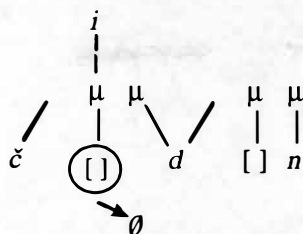
Redundant feature assignment

Surface form

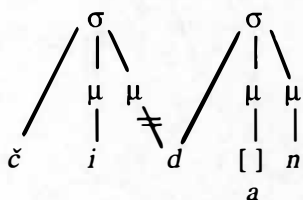
[čalan]

Infixation

Vowel deletion



Consonant delinking 2



Redundant feature assignment

Surface form

[čidan] 'to follow a route'

In (255), the perfective segment [high] is added to the CaCVC root *čalan* [čalan] 'path'. The fully underspecified segment in the V_1 position of the root is deleted, and the perfective segment [high] is inserted in its place; *d* delinks from the first coda (but remains associated with the second onset), surfacing as [d]. Redundant feature assignment occurs last.

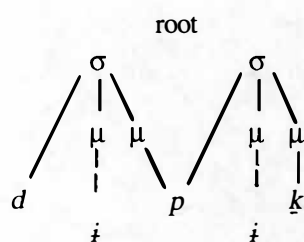
There is one exception to the second infixation pattern in a CaCVC root type. If the second onset of a CaCVC root lacks phonetic material in the underlying representation, then vowel deletion is blocked, just as it is with the addition of prefixes and suffixes (see section 6.2.3). In such CaCVC roots, only the first alternation pattern occurs. An example is the root *ŋaʔaw* in which only the form [ŋiyaʔaw] is permitted; the form *[ŋiʔaw] is unattested. Now let us consider infixation in a CiC₁C₁VC root type.

7.1.4 CiC₁C₁VC ROOT TYPE

When perfective infixation takes place in a CiC₁C₁VC root type, the root undergoes only one alternation pattern. In this root type, the V_1 root position lacks phonetic material in the underlying representation, and so the perfective segment [high] is inserted in this position; the nasal *n* is also inserted in the first coda; no extra moras are added to the root. Following infixation, the multiply associated consonant in the medial root position delinks from the first coda of the root, but remains associated with the second onset, as shown in (256).

(256) *dipik* 'to get wet'

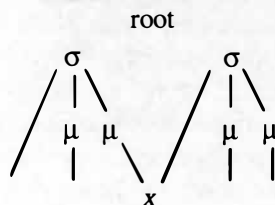
Underlying form



Vowel epenthesis

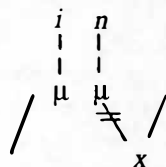
Surface form

[dɪpɪk]

b. $C\bar{i}C_1C_1VC$ root

Infixation

Consonant delinking 2



A comparison of CV_1CVC , $CaCVC$ and $C\bar{i}C_1C_1VC$ root types raises two questions. The first question is: why is a perfective template always added to a CV_1CVC root type, but optionally added to a $CaCVC$ root type, and never added to a $C\bar{i}C_1C_1VC$ root type? An answer can be found in the two surface patterns triggered by infixation in a $CaCVC$ root type: if the fully underspecified segment in the V_1 root position (surface [a]) is not deleted, a perfective template is added to the root; however, if the segment is deleted, a mora is available for the perfective segment [high] (or \bar{i}) to associate with, and no extra moras are added. Thus, the addition of a perfective template in $CaCVC$ roots is directly related to the deletion of the fully underspecified segment in the V_1 root position. On the basis of this fact, we may assume that a perfective template is always added to CV_1CVC roots in which V_1 is \bar{i} or \bar{o} , because \bar{i} and \bar{o} are specified segments which are never deleted from the underlying representation. Since specified segments are never deleted, the first mora of the root is always associated with phonetic material, and so a perfective template must always be added in order to provide a mora to associate with the perfective segment [high]. On the other hand, a template is not added to $C\bar{i}C_1C_1VC$ roots because the V_1 root position is never associated with phonetic material in the underlying representation, and so the first mora in the root is always available to associate with the perfective segment [high].

This explanation applies only to CV_1CVC and $C\bar{i}C_1C_1VC$ root types, however, since we noted earlier that a perfective template is always added to a $CV_1C_1C_2VC$ root even when the V_1 root position lacks phonetic material. For example, in (248) a perfective template is added to the root *pispis* 'to squeeze', producing the surface form [piy̥ispis]. The surface vowel [i̥] in the V_1 root position indicates that the corresponding position in the underlying representation lacks phonetic material, and so a mora is available to associate with the perfective segment [high]. Thus, we would expect the perfective segment [high] to insert in the V_1 root position, producing *[pispis̥]; however, this is an unattested form. What we find instead is that a perfective template is always added to a $CV_1C_1C_2VC$ root, even if the V_1 root position is empty and available to associate with the perfective segment [high].

The second question raised by a comparison of CV_1CVC , $CaCVC$ and $C\bar{i}C_1C_1VC$ root types has to do with the delinking of a multiply associated consonant in the medial root position. Specifically, why does a multiply associated consonant delink in a $CaCVC$ or $C\bar{i}C_1C_1VC$ root type, but not in a CV_1CVC root type in which V_1 is \bar{i} or \bar{o} ? Again, an answer can be found in the two surface patterns occurring in a $CaCVC$ root type. Let us assume that infixation triggers delinking in a multiply associated consonant in the medial root position. If the fully underspecified segment in the V_1 root position (surface [a]) of a $CaCVC$ root is not deleted, a perfective template is added to the root. With the addition of the

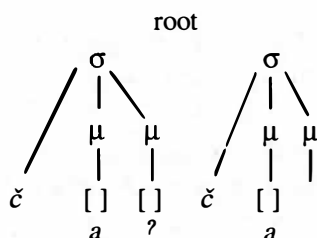
perfective template, the multiply associated consonant shifts from the first medial position in the word to the second medial position; and the consonant does not delink, as shown in [čiyalan] in (254). On the other hand, if the fully underspecified segment in the V_1 root position is deleted, a perfective template is not added. Thus, the multiply associated consonant remains in the first medial position; and the consonant delinks from the first coda, remaining associated with the second onset, as shown in [čidan] in (255). Notice that the multiply associated consonant delinks if it remains in the first medial position, but does not delink if it shifts to the second medial position.

The next question then is: why doesn't delinking occur in the first medial position when a perfective template is added, since the perfective segment [high] in the V_1 root position will always multiply associate with the first coda, and the second onset of the word in this environment? That is, why do we get [ʔiyulup] in (249) rather than *[ʔiʃulup], an unattested form? We have noted earlier that when the feature [high] is multiply associated in this manner, it never delinks from a coda in this word position. Apparently, it is this restriction that blocks the feature [high] from delinking in the first medial position.

Before leaving infixation in roots, it should be noted that not all infixes occurring in verb roots are as complex as the perfective infix. The reciprocal affix, for example, has only one surface form which consists of the prefix *man-* and the infix *-in-*. With affixation, the prefix *man-* attaches to the root and *n* of the prefix undergoes nasal assimilation; a bimoraic template is inserted immediately following the initial consonant of the root; *i* of the reciprocal infix associates with the first mora of the template and *n* with the second mora; then *n* delinks and reassociates with the following onset. No other alternations occur regardless of the root type. Examples are given below.

(258) čaʔča 'to help'

Underlying form

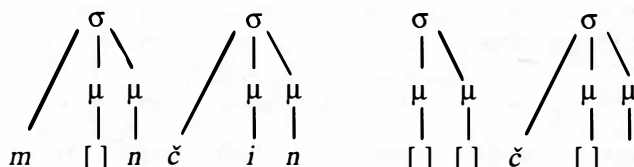


Redundant feature assignment

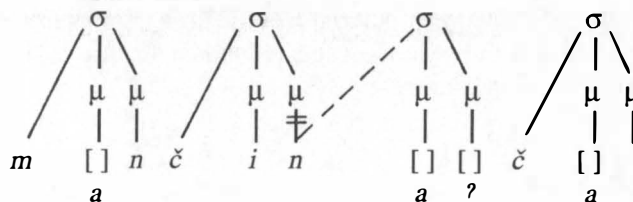
Surface form

[čaʔča]

Affixation



Consonant delinking 1



Redundant feature
assignment

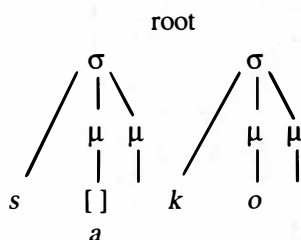
Surface form

[mančina?ča] 'to help each other'

In (258), the reciprocal affix is added to the CVC₁C₂VC root *ča?ča* [ča?ča] 'to help'. The prefix *man-* attaches to the root; a bimoraic template is inserted immediately following *č* in the initial onset of the root; *i* of the infix associates with the first mora of the template and *n* with the second mora. Following infixation, *n* of the infix delinks from the first coda of the root and reassociates with the second onset; redundant feature assignment occurs last. Since *ča?ča* is a stable CVC₁C₂VC root, we would not expect to see any other alternations occur within the root. Now compare (258) with the CaCVC root in (259) and the CiC₁C₁VC root in (260).

(259) *sago* 'to splash'

Underlying form

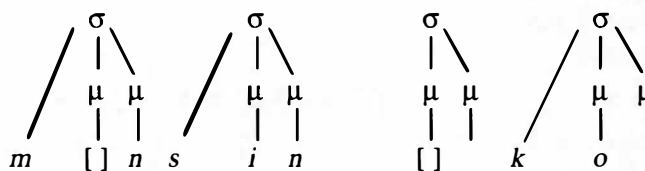


Redundant feature
assignment

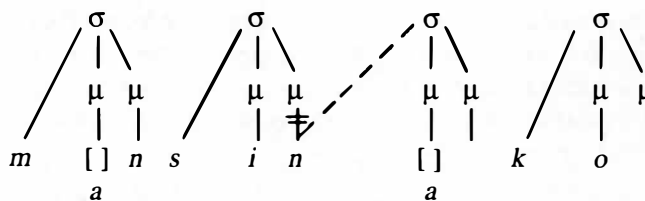
Surface form

[sagu]

Affixation



Consonant delinking 1



Redundant feature
assignment

Surface form

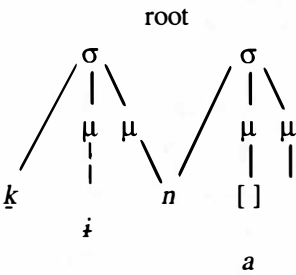
[mansinagu] 'to splash each other'

In (259), the reciprocal affix is added to the CaCVC root *sago* [sagu] 'to splash'. The prefix *man-* attaches to the root; a bimoraic template is inserted immediately following *s* in the initial onset of the root; *i* of the infix associates with the first mora of the template and *n* with the

second mora. Following infixation, *n* of the infix delinks from the first coda of the root and reassociates with the second onset; redundant feature assignment occurs last. No other alternations occur in the root.

(260) *kina* ‘to hit’

Underlying form

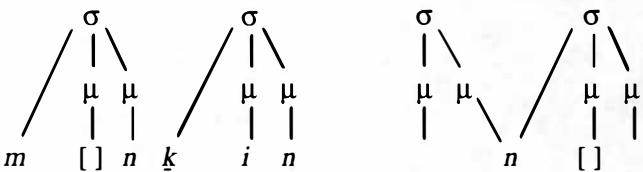


Vowel epenthesis
Redundant feature
assignment

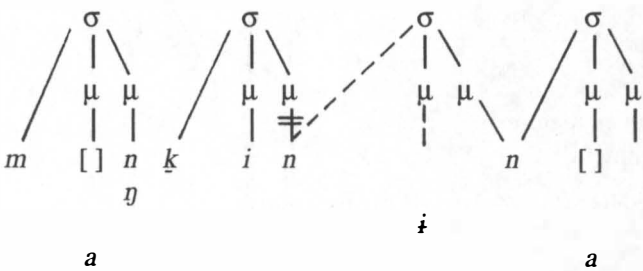
Surface form

[kɪnna]

Affixation



Consonant delinking 1



Nasal assimilation 1
Vowel epenthesis
Redundant feature
assignment

Surface form

[maŋkɪnɪnna] ‘to hit each other’

In (260), the reciprocal affix is added to the C_iC₁C₁VC root *kina* [kɪnna] ‘to hit’. The prefix *man-* attaches to the root and *n* of the prefix undergoes nasal assimilation, surfacing as [ŋ]; then a bimoraic template is inserted immediately following *k* in the initial onset of the root; *i* of the infix associates with the first mora of the template and *n* with the second mora. Following infixation, *n* of the infix delinks from the first coda of the root and reassociates with the second onset; vowel epenthesis and redundant feature assignment occur last. Again, no other alternations occur in the root.

Examples (258)-(260) show that neither prefixation nor infixation triggers phonological alternations within the root (other than those required by syllable well-formedness conditions), thus indicating that phonological alternations triggered in a root are morphologically determined, depending on the grammatical meaning of the affix.

7.2 INFIXATION IN PREFIXES AND VOWEL DECOMPOSITION

Inflection also occurs in prefixes to produce perfective forms, as shown in (261). When perfective inflection occurs in certain prefixes, vowel decomposition is triggered.

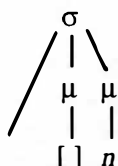
(261)	imperfective	perfective
	<i>man-</i>	<i>ʔiyan-</i>
	<i>miN-</i>	<i>ʔiN-</i>
		or <i>ʔiyaN-</i>
	<i>mi-</i>	<i>ʔi-</i>
	or <i>ma-</i>	or <i>ʔa-</i>
		or <i>ʔiya-</i>

Of particular interest to us are the perfective prefixes that have allomorphs, namely *ʔiN-* and *ʔiyaN-*, and *ʔi-* and *ʔiya-*, since the alternation between the single surface vowel [ɨ], and the two surface vowels [i] and [a] motivates the claim that [ɨ] undergoes decomposition in certain environments. Before discussing vowel decomposition, however, we need to look briefly at the morphology of imperfective and perfective prefixes, and inflection as it occurs in perfective prefixes. As we will see, imperfective prefixes are important for our discussion of vowel decomposition because they allow us to establish certain facts about the presence and identity of vowels in the underlying representations of prefixes; perfective prefixes are important because they allow us to identify the environment in which vowel decomposition takes place, and the means by which it occurs. Let us begin with those prefixes that do not involve vowel decomposition.

7.2.1 PREFIXES *man-* AND *ʔiyan-*

All the surface forms of the prefixes in (261) are derived from a single underlying bimoraic template. For each pair of imperfective and perfective prefixes, certain phonetic material is associated with the underlying template to create a base form. For example, the base form for the prefixes *man-* and *ʔiyan-* is a single bimoraic template in which a fully underspecified segment (surface [a]) is associated with the first mora and the nasal *n* with the second mora, as shown in (262).

(262) prefix base

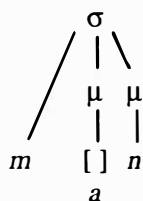


We know that a fully underspecified segment is associated with the first mora in the underlying representation of the base form in (262) because (1) imperfective *man-* and perfective *ʔiyan-* each have only one surface form and the fully underspecified segment (surface [a]) is present in the surface form of both prefixes, and (2) if the vowel associated with the first mora of the prefix was supplied epenthetically, it would surface as [ɨ], not [a], since the coda of the base form is associated with phonetic material (see section 4.5).

Both *man-* and *?iyan-* can be derived from this base form. The imperfective prefix *man-* is created in (263) by associating the nasal *m* with the onset of the base form in (262). Redundant feature assignment follows.

(263)

Underlying form



Redundant feature assignment

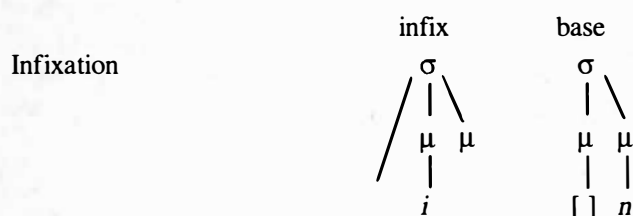
Surface form

[*man-*]

The perfective prefix *?iyan-* is created in (264) by adding a perfective morpheme (i.e. a perfective template and the perfective segment [high]) to the base form.

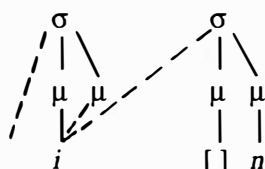
(264)

Underlying form



Inflection

Vowel spreading



Glottal epenthesis

Redundant feature assignment

Surface form

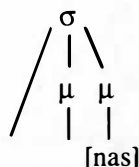
[*?iyan-*]

In (264), the coda of the prefix base is singly associated with phonetic material, and so a perfective template can be added to the base. The template is inserted immediately following the initial onset of the base; the perfective segment [high] associates with the first mora of the template and then spreads to the first coda and the second onset of the prefix; glottal epenthesis occurs in the initial onset of the prefix, and redundant feature assignment occurs last. Now let us consider the prefixes *mɪN-* and *?iN-*, and *mɪ-* and *?i-*.

7.2.2 PREFIXES *mɪN-* AND *ʔɪN-*

The base form for the prefixes *mɪN-* and *ʔɪN-* is a single bimoraic template in which the feature [nasal] is associated with the coda; no phonetic material is associated with the nucleus, as shown in (265).

(265) prefix base

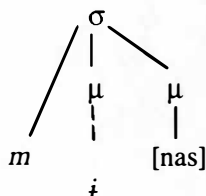


Evidence that the base form in (265) lacks phonetic material for its nucleus is that the imperfective prefix *mɪN-* always surfaces with [ɪ] for its nucleus, regardless of the root type to which it attaches.

The imperfective prefix *mɪN-* is created in (266) by associating the nasal *m* with the onset of the base form in (265). Vowel epenthesis follows.

(266)

Underlying form



Vowel epenthesis

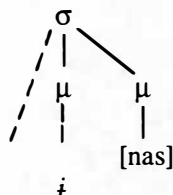
Surface form

[*mɪN-*]

The perfective prefix *ʔɪN-* has two allomorphs: *ʔɪN-* and *ʔiyaN-*. The allomorph *ʔɪN-* is created in (267) by simply adding epenthetic material to the onset and the nucleus of the base form; a perfective template is not added to the base form because phonetic material is not singly associated with the coda when the prefix attaches to a root. Later on I argue that the allomorph *ʔiyaN-* has undergone vowel decomposition and discuss it with other examples of vowel decomposition.

(267)

Underlying form



Vowel epenthesis

Glottal epenthesis

Redundant feature
assignment

Surface form

[]

ʔ

[*ʔɪN-*]

7.2.3 PREFIXES *mi-* AND *?i-*

The base form for the prefixes *mi-* and *?i-* is simply a single bimoraic template; no phonetic material is associated with any position in the template, as shown in (268).

(268)

prefix base

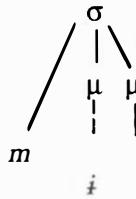


Evidence that the base form in (268) lacks phonetic material for its nucleus is that the imperfective prefix *mi-* always surfaces with [i] when phonetic material is acquired for the prefix coda. When phonetic material is not acquired for the prefix coda, or when a fully underspecified segment is associated with the coda, the prefix surfaces with [a]. This pattern follows the typical distribution of surface allomorphs for the epenthetic vowel (see section 4.5).

The imperfective prefix *mi-* is created in (269) by associating the nasal *m* with the onset of the prefix base. Vowel epenthesis follows.

(269)

Underlying form



Vowel epenthesis

Surface form

[mi-]

The perfective prefix *?i-* has three allomorphs: *?i-*, *?a-* and *?iya-*. The allomorph *?i-* is created in (270) by adding epenthetic material to the onset and nucleus of the base form. When phonetic material is not acquired for the prefix coda, the prefix surfaces with [a], instead of [i]. Again, a perfective template is not added to the base form because phonetic material is not singly associated with the coda when the prefix attaches to a root. I suggest that the allomorph *?iya-* has also undergone vowel decomposition and this will be discussed later.

(270)

Underlying form



Vowel epenthesis

Glottal epenthesis

Redundant feature
assignment

Surface form

[]
?
[?i-]

7.2.4 VOWEL DECOMPOSITION

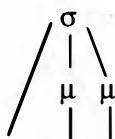
We have noted that certain perfective prefixes have more than one surface form, namely ʔiN- and ʔiyaN- , and ʔi- , ʔa- and ʔiya- . These prefixes raise two questions: (1) How can we predict which allomorphs will occur with a given root? and (2) How can we account for the difference in the moraic structure and the phonetic material of the allomorphs themselves?

To answer the first question, the selection of a perfective allomorph depends once again upon the canonical shape of the root type to which it attaches, and phonetic material associated with moraic positions within the root type. Specifically, the prefixes ʔiyaN- and ʔiya- attach to a $\text{CiC}_1\text{C}_1\text{VC}$ root type (and a $\text{ʔaC}_1\text{VC}$ root type when it patterns like a $\text{ʔiC}_1\text{C}_1\text{VC}$ root type), and the prefixes ʔiN- and ʔi- attach to all other root types. Examples will be given shortly.

To answer the second question, the fact that $[\text{i}]$ alternates with $[\text{i}]$ and $[\text{a}]$ in certain prefixes motivates the claim that $[\text{i}]$ is a complex vowel composed of a fully underspecified segment (surface $[\text{a}]$) and the feature $[\text{high}]$. (Each segment occurs on a separate tier, and associates simultaneously with the same mora on the timing tier.) I suggest that, in certain environments, $[\text{i}]$ decomposes into these two segments. Specifically, I argue that the allomorph ʔiyaN- is derived from the same base form as the prefix ʔiN- , and ʔiya- from the same base form as ʔi- ; however, when these base forms are added to a $\text{CiC}_1\text{C}_1\text{VC}$ root (or a ʔaCVC root), a perfective template is added to the prefix, and vowel decomposition is triggered in the epenthetic vowel when it is added to the perfective form of either prefix. In order to describe this process, we need to consider again the base forms from which ʔiN- and ʔiyaN- , and ʔi- and ʔiya- are derived. We will focus on the form ʔiya- , since it occurs in all the environments that trigger vowel decomposition.

Recall that the base form for the perfective prefix ʔi- is a single bimoraic template to which no phonetic material is associated; the base form is given again in (271).

(271) prefix base

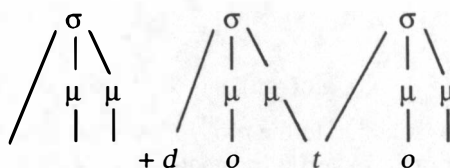


When this prefix is added to any root type other than $\text{CiC}_1\text{C}_1\text{VC}$ or ʔaCVC , a perfective template is not added to the prefix, since phonetic material is never singly associated with the prefix coda. A fully underspecified segment is supplied for the onset, surfacing as $[\text{ʔ}]$, and an epenthetic vowel is supplied for the nucleus, surfacing as $[\text{i}]$, as in (272).

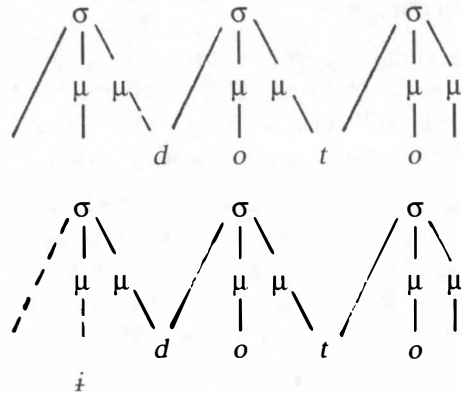
(272) *doθo* 'to cook'

Underlying form

Affixation



Multiple association 1



Vowel epenthesis
Glottal epenthesis
Redundant feature
assignment

[]
?

Surface form

[ʔiddoθo]

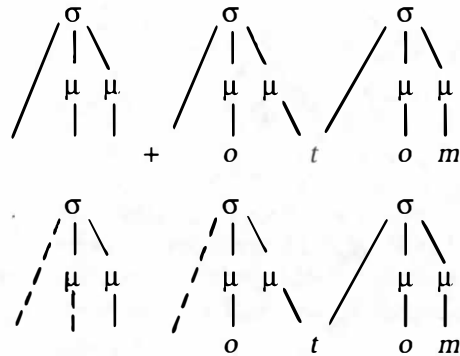
In (272), the prefix *ʔi-* is added to the root *dɒθo* [dɒθo] ‘to cook’. The consonant *d* in the first onset of the root spreads to the prefix coda; an epenthetic vowel is added to the prefix nucleus, surfacing as [i]; glottal epenthesis takes place in the initial onset of the prefix; and redundant feature assignment follows last. A perfective template is not added to the prefix because the prefix coda is not singly associated with a segment in the derivation.

If the prefix coda fails to acquire phonetic material altogether, the epenthetic vowel surfaces as [a], as in (273).

(273) *ʔoθom* ‘to wrap’

Underlying form

Affixation



Vowel epenthesis
Glottal epenthesis
Redundant feature
assignment

[]
[] a []
? ? ?

Surface form

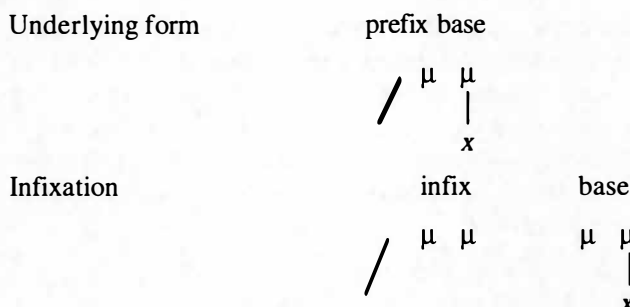
[ʔaʔoθom]

In (273), the prefix *ʔi-* is added to the root *ʔoθom* [ʔoθom] ‘to wrap’. Since the initial onset of the root lacks phonetic material, no material is acquired for the prefix coda. (A fully underspecified segment cannot be supplied for the prefix coda because the first nucleus of the

root is associated with a segment.) An epenthetic vowel is added to the prefix nucleus, surfacing as [a] since it precedes an empty coda; glottal epenthesis takes place in onset positions; and redundant feature assignment follows last. Again, a perfective template is not added to the prefix because the prefix coda is not singly associated with a segment in the derivation.

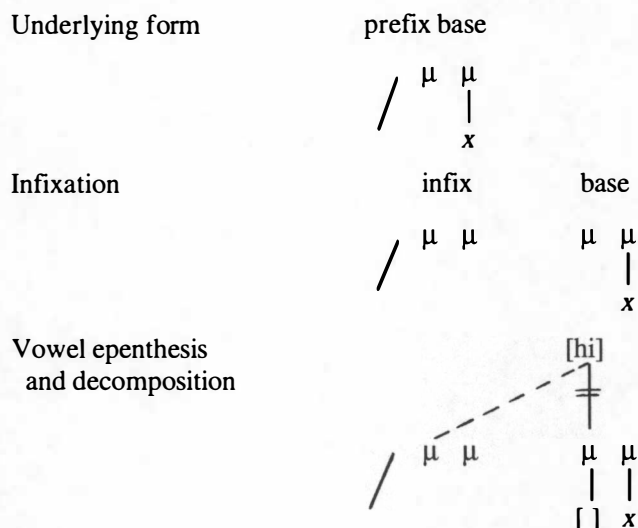
In contrast to (272) and (273), when the prefix ʔi- is added to a $\text{CiC}_1\text{C}_1\text{VC}$ root type (or a $\text{ʔaC}_1\text{VC}$ root type if it follows a $\text{ʔiC}_1\text{C}_1\text{VC}$ pattern), phonetic material is always acquired and singly associated with the prefix coda, and so the prefix is eligible to receive a perfective template, as shown in (274).

(274)

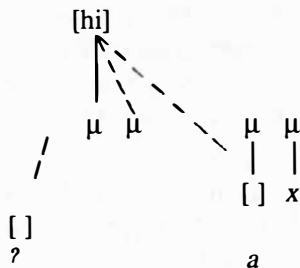


In (274), only the perfective template is added to the prefix; the perfective segment [high] is absent. I have claimed that [i] is composed of two segments: a fully underspecified segment and the feature [high] (see section 4.5). In the specific environment shown in (270) in which an empty nucleus is followed by a coda that is singly associated with phonetic material, we know that a perfective template will be added to the prefix base, and that an epenthetic vowel will be added to the nucleus of the base. I propose that the perfective segment [high] is not added in (274) along with the perfective template because, in this particular environment, the epenthetic complex vowel [i] decomposes and provides phonetic material for the nucleus of both the perfective template and the prefix base, as in (275).

(275)



Vowel spreading



Glottal epenthesis

Redundant feature
assignment

Surface form

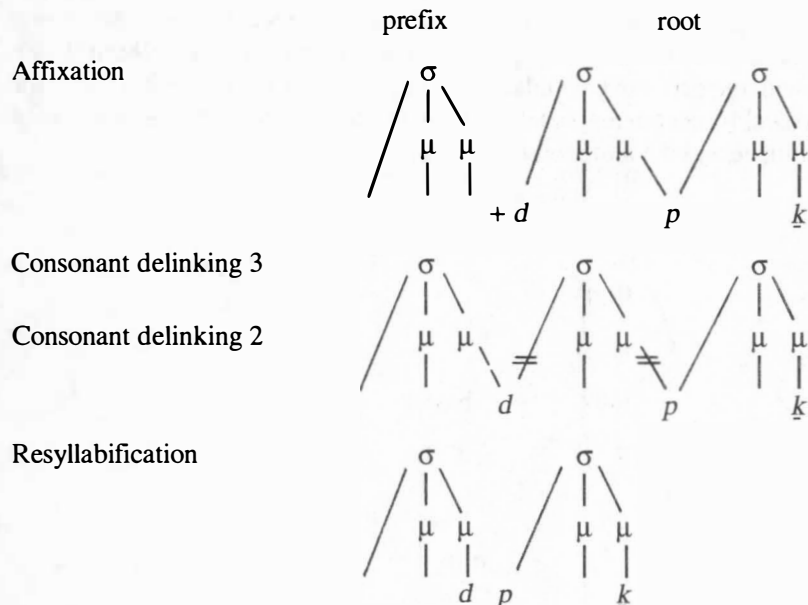
[ʔiya-]

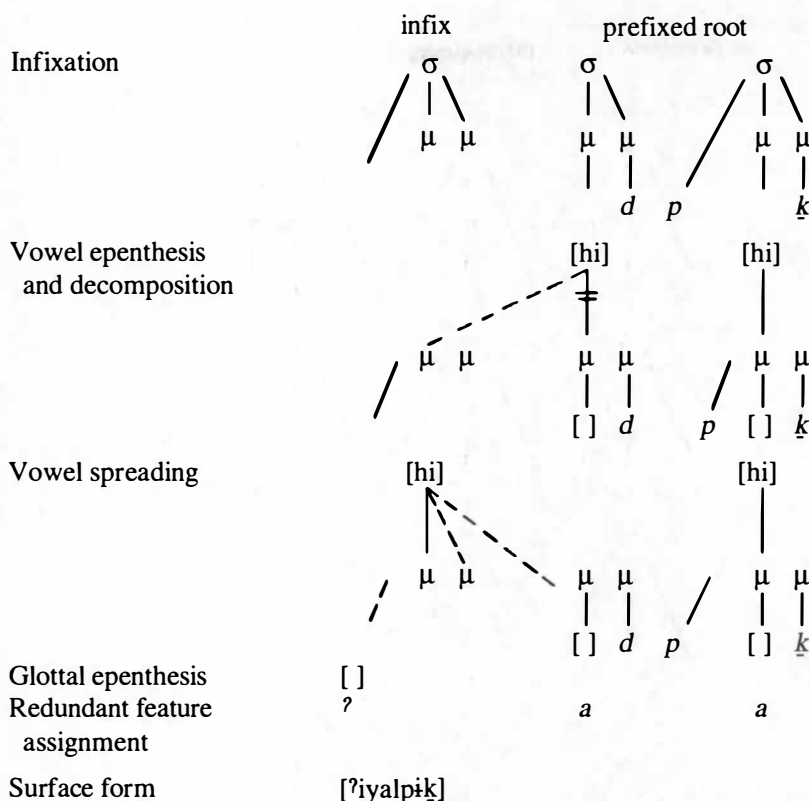
In (275), a perfective template is added to the prefix base, and an epenthetic vowel is added to the nucleus of the prefix base. The feature [high] of the epenthetic vowel delinks from the nucleus of the prefix base and reassociates with the nucleus of the perfective template; the fully underspecified segment remains associated with the nucleus of the prefix base. Once vowel decomposition takes place, the feature [high] spreads from the first nucleus to the first coda and the second onset of the prefix; glottal epenthesis occurs in the initial onset of the prefix; and redundant feature assignment occurs last.

Vowel decomposition in a prefix is most clearly demonstrated when the prefix *ʔiya-* attaches to a $C_iC_1C_1VC$ root in which the initial onset of the root is associated with phonetic material in the underlying representation, as illustrated in (276).

(276) *dipik* 'to get wet'

Underlying form





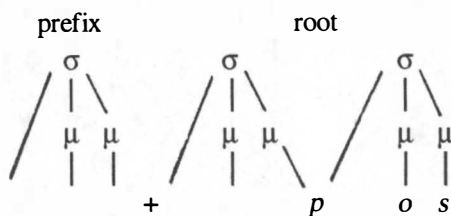
In (276), the perfective prefix ?i- is added to the $\text{CiC}_1\text{C}_1\text{VC}$ root dipik $[\text{dipik}]$ 'to get wet'. Following affixation, d in the initial onset of the root delinks and reassociates with the prefix coda; p in the medial position of the root delinks from the first coda of the root and remains associated with the second onset of the root; the first bimoraic unit of the root is deleted; and resyllabification occurs next. Once resyllabification has taken place, the coda of the prefix is singly associated with phonetic material, namely d , and so a perfective template is added to the prefix. At this point, an epenthetic vowel is added to the nucleus of the prefix, and the epenthetic vowel decomposes: the feature $[\text{high}]$ delinks from the nucleus of the prefix base and reassociates with the nucleus of the perfective template; the fully underspecified segment remains associated with the nucleus of the prefix base. Once the feature $[\text{high}]$ reassociates, it spreads from the first nucleus to the first coda and the second onset of the prefix. Glottal epenthesis occurs in the initial onset of the prefix, and redundant feature assignment occurs last.

Vowel decomposition also occurs in a prefix when it attaches to a $\text{?iC}_1\text{C}_1\text{VC}$ or ?aCVC root type in which no phonetic material is associated with the initial onset of the root. When the prefix ?i- (or ?iN-) is added to a $\text{?iC}_1\text{C}_1\text{VC}$ root type, a fully underspecified segment is always added to the coda of the prefix. (Recall that a fully underspecified segment (surface $[\text{a}]$) is added to a prefix coda when both the initial onset and the first nucleus of the root lack phonetic material.) Once the prefix coda is singly associated with a fully underspecified segment, a perfective template is added to the prefix, and vowel decomposition occurs, as shown in (277).

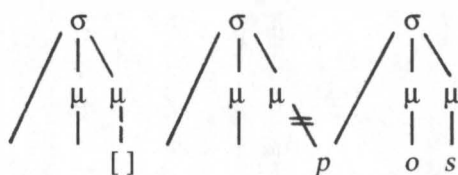
(277) *ʔipos* 'to consume'

Underlying form

Affixation

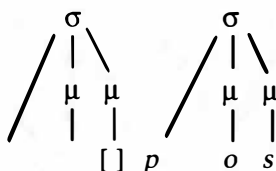


Prefix coda

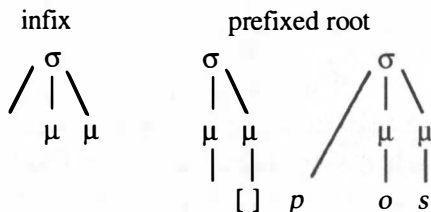


Consonant delinking 2

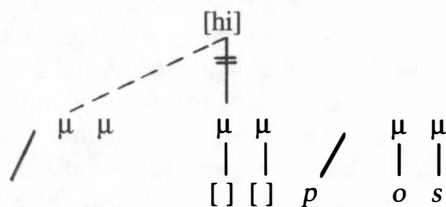
Resyllabification



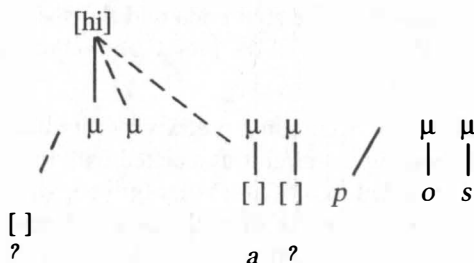
Infixation



Vowel epenthesis and decomposition



Vowel spreading



Glottal epenthesis
Redundant feature
assignment

Surface form

[ʔiyaʔpos]

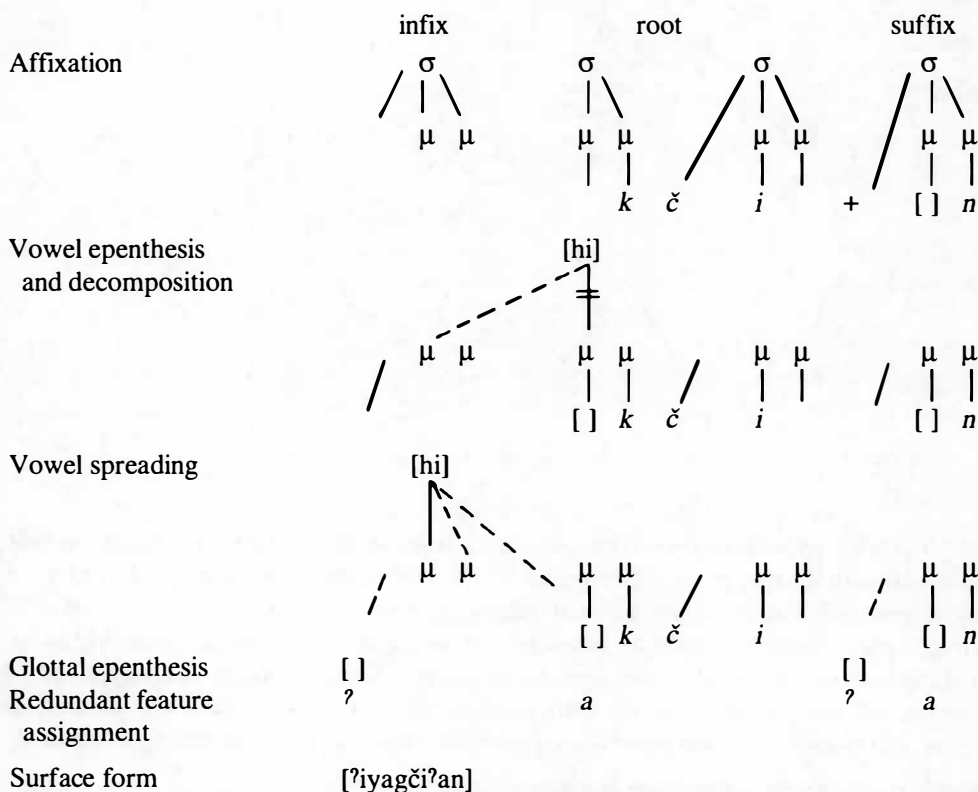
In (277), the perfective prefix ʔi- is added to the $\text{ʔiC}_1\text{C}_1\text{VC}$ root ʔipos [ʔippos] ‘to consume’. Following affixation, a fully underspecified segment is added to the prefix coda; p in the

medial root position delinks from the first coda of the root and remains associated with the second onset of the root; the first bimoraic unit of the root is deleted; and resyllabification takes place. Since the prefix coda is singly associated with a fully underspecified segment, a perfective template is added to the prefix. Once the perfective template is inserted, an epenthetic vowel is added to the nucleus of the prefix base and vowel decomposition follows: the feature [high] delinks from the nucleus of the prefix base and reassociates with the nucleus of the perfective template; the fully underspecified segment remains associated with the nucleus of the prefix base. The feature [high] then spreads from the first nucleus to the first coda and the second onset of the prefix. Glottal epenthesis takes place in the initial onset of the prefix, and redundant feature assignment occurs last.

Vowel decomposition is not restricted to prefixes. When a perfective template is added to a ${}^?iC_1C_2VC$ root in which the first nucleus lacks phonetic material and the first coda is singly associated with phonetic material in the underlying representation, an epenthetic vowel inserted in the V_1 root position may undergo decomposition, just as it does in a prefix. Vowel decomposition in roots differs from vowel decomposition in prefixes in that decomposition is optional in roots, but obligatory in prefixes. The following example illustrates vowel decomposition in the ${}^?iC_1C_2VC$ root ${}^?igči$.

(278) ${}^?igči$ 'to hold in the hand'

Underlying form



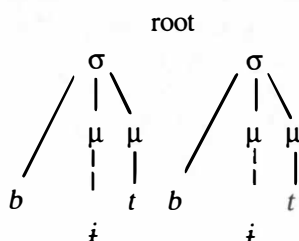
In (278), the discontinuous perfective affix $-i-an$ is added to the ${}^?iC_1C_2VC$ root ${}^?igči$ [${}^?igči$] 'to hold in the hand'. Since the first coda of the root is singly associated with phonetic material, a perfective template is added immediately following the initial onset of the root. An

epenthetic vowel is added to the V_1 root position and vowel decomposition follows: the feature [high] delinks from the nucleus of the root and reassociates with the nucleus of the perfective template; the fully underspecified segment remains associated with the first nucleus of the root. The feature [high] then spreads from the first nucleus to the first coda and the second onset of the affixed root. Glottal epenthesis takes place in onset positions, and redundant feature assignment occurs last. If vowel decomposition does not take place, the affixed root surfaces as [ʔiyǝgčǝʔan], although the form [ʔiyagčǝʔan] is more common.

It is important to note that vowel decomposition occurs only if the perfective template is added to a bimoraic unit in which both the onset and nucleus lack phonetic material. If the onset is associated with phonetic material, then the epenthetic vowel does not decompose following the addition of a perfective template, as demonstrated in (279).

(279) *bǝtbǝt* 'to cut with a *bolo*'

Underlying form

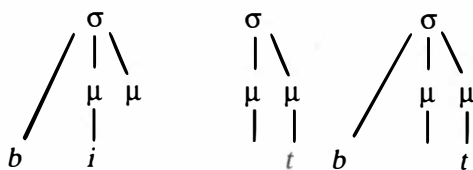


Vowel epenthesis

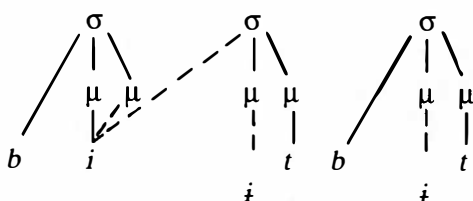
Surface form

[bǝtbǝt]

Infixation



Vowel spreading



Vowel epenthesis

Surface form

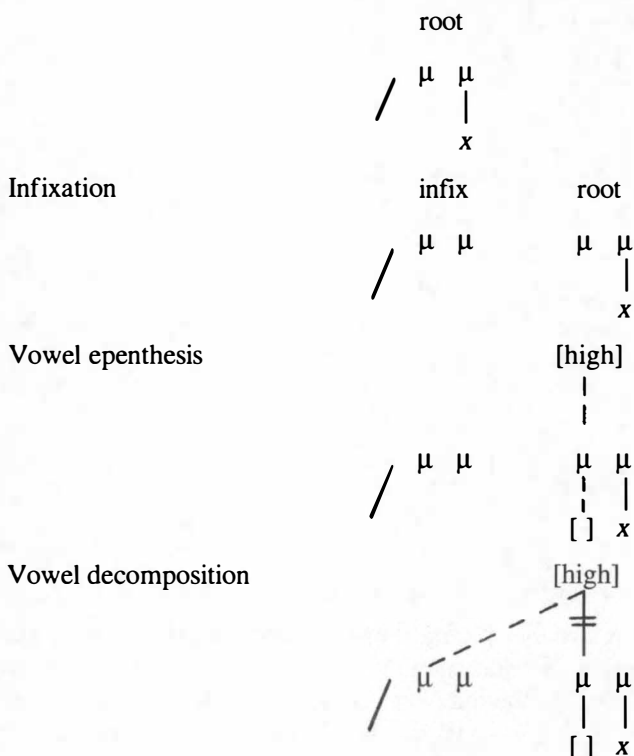
[biyǝtbǝt]

In the CVC_1C_2VC root *bǝtbǝt* [bǝtbǝt] 'to cut with a *bolo*' in (279), the first coda of the root is singly associated with phonetic material in the underlying representation, and so a perfective template is inserted immediately following *b* in the initial onset of the root. The perfective segment [high] is added to the nucleus of the perfective template, spreading to the first coda and the second onset; vowel epenthesis follows. Since the surface form *[biyatbǝt] is unattested, we must assume that the association of phonetic material with the onset of an underlying unit blocks vowel decomposition in that unit when a perfective template is added.

The rule for vowel decomposition is given in (280).

(280)

Vowel Decomposition

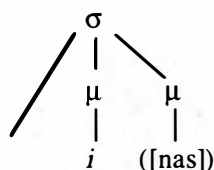


7.3 SUMMARY OF PERFECTIVE INFIXATION AND VOWEL DECOMPOSITION

The perfective morpheme has two components: (1) a perfective segment, and (2) a bimoraic template. The basic underlying form of the perfective segment is the feature $[high]$, or i . The perfective segment $[high]$ may also occur with a nasal segment, either n or m , depending on the imperfective form of the affix, and the root type in which the perfective morpheme occurs. The underlying representation of the perfective morpheme is illustrated in (281).

(281)

Perfective Morpheme



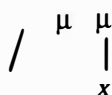
A perfective template may be added to a root or a prefix; the addition of the template depends upon the association of phonetic material with moras in the first underlying bimoraic unit of the root or prefix. Specifically, a template is added to a bimoraic unit if either mora of the unit is singly associated with a segment. The rule in (282) represents infixation involving the addition of a perfective template: (282a) represents the first bimoraic unit of a $CV_1C_1C_2VC$ root, or a CVC prefix; (282b) represents the first bimoraic unit of a CV_1CVC root type.

(282)

a. CV₁C₁C₂VC root
or CVC prefix

Infixation 1

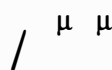
root or prefix



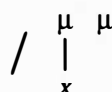
Infixation

infix

root or prefix

b. CV₁CVC root

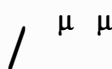
root



Infixation

infix

root



If a perfective template is added to a root or prefix, it inserts immediately following the onset of the first bimoraic unit. Following the addition of the template, the perfective segment [high] may associate with the first mora of the template. If the V₁ position of the root or prefix lacks phonetic material, or if the V₁ position is associated with *o* or a fully underspecified segment (i.e. surface [a]) in the underlying representation, the perfective segment [high] spreads to the first coda and the second onset, surfacing as [iy], as in (283).

(283)

CV₁C₁C₂VC root
or CVC prefixCV₁CVC root

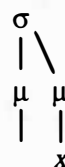
Infixation

infix

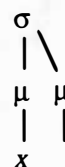
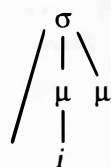
root
or prefix

infix

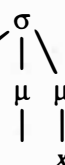
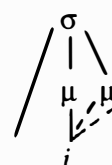
root



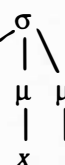
or



Vowel spreading



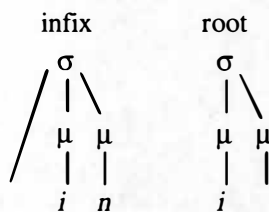
or



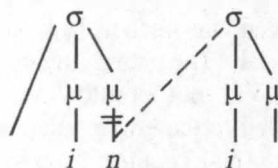
If the V₁ position of a root is associated with the feature [high] (or *i*), the perfective segment [high] does not spread; instead, the nasal *n* is added to the second mora of the template; *n* then delinks and reassociates with the following onset, surfacing as [in], as shown in (284).

(284)

Infixation



Consonant delinking 1

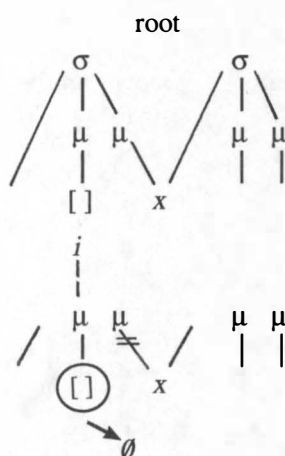


The only exception to the representation in (284) is *-im-*, the perfective form of *ʔon-*, in which the nasal of the perfective morpheme is *m*, rather than *n*.

If perfective infixation occurs in a *CaCVC* root in which [a] in the V_1 root position has been deleted, or in a CiC_1C_1VC root, then a perfective template is not added to the root. Instead, in a *CaCVC* root, the perfective segment [high] is added to the first nucleus of the root and the first coda is left unassociated; in a CiC_1C_1VC root, the perfective segment [high] is added to the first nucleus of the root and the nasal *n* to the first coda. The rule in (285) represents infixation in *CaCVC* and CiC_1C_1VC roots.

(285)

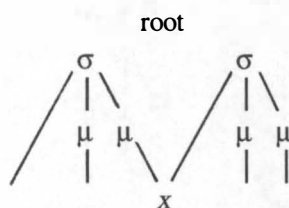
Infixation 2

a. CaC_1VC root

Infixation

Vowel deletion

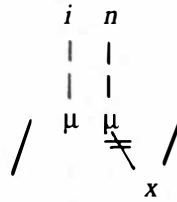
Consonant delinking 2

b. CiC_1C_1VC root

Infixation

i n

Consonant delinking 2

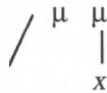


Vowel decomposition may occur in the perfective prefixes ?i- or ?iN-, or in a ?iC₁C₂CVC root. Vowel decomposition is triggered when a perfective template is added to an underlying bimoraic unit in which both the onset and the nucleus lack phonetic material, and the coda is singly associated with phonetic material. (The underlying target unit can be a prefix base or the first bimoraic unit of a ?iC₁C₂CVC root.) Following the addition of the perfective template, an epenthetic vowel is added to the empty nucleus of the target unit and vowel decomposition takes place: the feature [high] delinks from the nucleus of the target unit and reassociates with the nucleus of the perfective template; the fully underspecified segment remains associated with the nucleus of the target unit. The feature [high] then spreads from the nucleus of the perfective template to the first coda and the second onset of the infixed unit. Glottal epenthesis occurs in the initial onset of the infixed unit, and redundant feature assignment occurs last. The rule for vowel decomposition is given in (286).

(286)

Vowel Decomposition

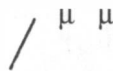
root or prefix



Infixation

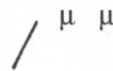
infix

root or prefix



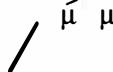
Vowel epenthesis

[high]



Vowel decomposition

[high]



Vowel decomposition is obligatory in prefixes, but optional in roots. Also, vowel decomposition is blocked if the onset of the target unit, to which the perfective template is added, is associated with a segment in the underlying representation.

CHAPTER 8

REDUPLICATION

Reduplication offers further support for a moraic analysis of morphological alternations and the claim that a single bimoraic unit underlies all surface syllables. It also gives a unique example of vowel decomposition occurring in combination with reduplication.

Marantz (1982) describes reduplication as a normal affixation process in which a reduplicating affix is added to a stem. The unique feature of reduplication is that the phonetic material associated with the reduplicating affix is identical, or at least similar, to material associated with the root. Marantz accounts for this similarity by suggesting that phonetic material is acquired for a reduplicating affix by copying the melody tiers of the stem and associating that material with the affix. Once the phonetic material is accounted for, we find that a reduplicating affix simply attaches to the stem like any other affix.

Marantz's proposal is particularly suited to Karao reduplication, because it allows us to claim that, in general, reduplicating affixes are governed by the same principles as non-reduplicating affixes. Specifically, it allows us to claim that (1) allomorphs of reduplicating affixes are selected according to the canonical shape of a root, as are allomorphs of non-reduplicating affixes, and (2) the order in which reduplicating and non-reduplicating affixation occurs is motivated by a drive towards closed surface syllables. For these reasons, I adopt Marantz's proposal for this discussion.

Reduplication in Karao is a complex system that conveys different kinds of grammatical information. In this discussion, two types of reduplication are considered: one that signals continuous, intensive or repeated action; and another that signals the comparison of two items. (In the case of reduplication signalling continuous, intensive or repeated action, the specific meaning of the reduplicating affix depends upon the semantics of the root to which it is added.)

8.1 REDUPLICATION SIGNALLING CONTINUOUS, INTENSIVE OR REPEATED ACTION

The reduplicating affix that signals continuous, intensive or repeated action (hereafter 'continuous reduplication') has no moraic structure of its own. That is, the affix has no moras or association lines or phonetic material of its own; instead, it borrows a specified number of moras, the association lines connected with those moras, and phonetic material from the stem. This guarantees that the borrowed phonetic material will be associated with the borrowed moras in the reduplicating affix just as it is in the stem. The reduplicating affix itself contains only information about how much moraic structure is to be borrowed from the stem; that is, how many moras along with their association lines are to be copied. As it turns out, a continuous reduplicating affix has three allomorphs: one specified for two moras; one specified for three moras; and one specified for four moras. The selection of a continuous reduplicating allomorph depends upon the canonical shape of the root to which it is added.

Continuous reduplication frequently occurs in affixed roots. I propose that, except for infixes in certain root types, non-reduplicating affixes are added before reduplicating affixes, since phonological alternations triggered in a root by non-reduplicating affixation are copied in the reduplicated unit. Late phonological rules, however, such as epenthesis and redundant feature assignment appear to occur after the addition of copied material to the reduplicating affix (except in the case of vowel decomposition, as we will see later).

8.1.1 ROOT AND NON-REDUPLICATING AFFIX DO NOT RESYLLABIFY

Different patterns of reduplication take place in affixed roots depending on whether or not the root resyllabifies with a non-reduplicating affix. By resyllabification here, I mean that phonetic material in the root becomes singly associated with a prefix coda or the perfective segment [high] associates with a mora of a root (rather than a mora of an inserted perfective template). Whether or not a root resyllabifies when a non-reduplicating affix is added to it depends on the specific affix and the canonical shape of the root. Let us first consider reduplication patterns in which a root and a non-reduplicating affix do not resyllabify, starting with a CVC_1C_2VC root type.

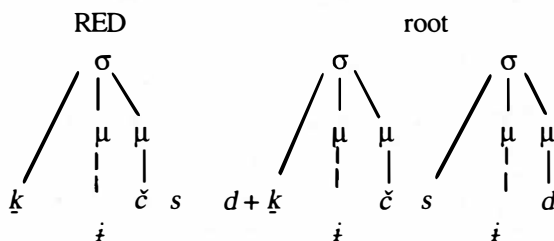
8.1.1.1 CVC_1C_2VC ROOT TYPE

When a continuous reduplicating affix is added to a CVC_1C_2VC root, the affix occurs as an allomorph specified for two moras: the first two moras of the root are copied along with their association lines to indicate how phonetic material is to be connected to those moras. Following Marantz, all melody tiers are also copied and phonetic material is associated with the copied moras as dictated by the association lines; phonetic material that is left unassociated does not surface. An example in which a reduplicating affix (RED) is added to a CVC_1C_2VC root is given in (287).

(287) *kidsil* [*kidsil*] 'to behave badly'

Underlying form

Affixation



Vowel epenthesis

Surface form

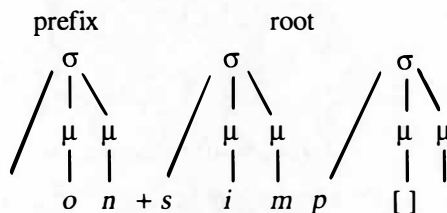
[*kɪdkɪdsil*] (intensive)

When non-reduplicating prefixes and suffixes and reduplicating affixes both occur with a CVC_1C_2VC root, the non-reduplicating affix is added first and then the reduplicating affix, as shown in (288).

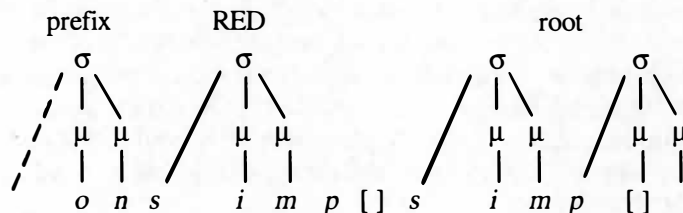
(288) *simpa* 'to settle down'

Underlying form

Affixation



Reduplication



Glottal epenthesis

Redundant feature

assignment



Surface form

[ʔonsimsimpa] (intensive)

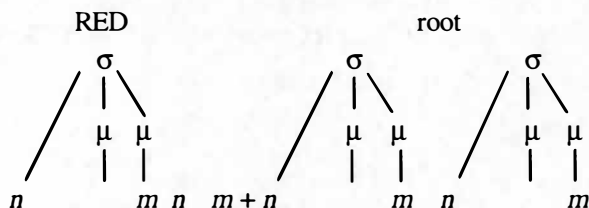
In (288), the prefix *ʔon-* is added to the CVC_1C_2VC root *simpa* [simpa] 'to settle down', and no alternations occur in the root. Since *simpa* is a CVC_1C_2VC root, a reduplicating allomorph specified for two moras is inserted between the prefix *ʔon-* and the root. The first two moras of the root and their association lines are copied for the reduplicating affix; then all melody tiers of the root are copied and connected to the borrowed moras as dictated by the association lines. Glottal epenthesis and redundant feature assignment occur last.

When a reduplicating affix and an infix occur with a CVC_1C_2VC root, the order of affixation reverses: the reduplicating affix attaches first and then the infix is inserted immediately following the initial onset of the reduplicated unit, rather than the root, as shown in (289).

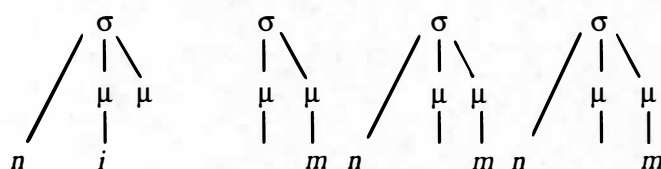
(289) *nimnim* 'to think'

Underlying form

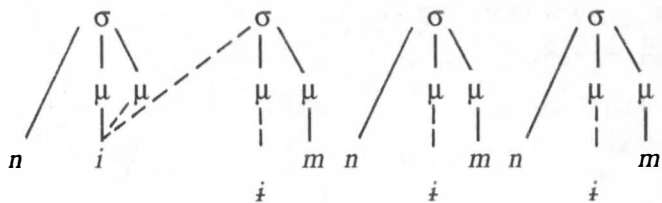
Reduplication



Infixation



Vowel spreading



Vowel epenthesis

Surface form

[niyĩmnĩmnĩm] (continuous)

The root *nĩmnĩm* [nĩmnĩm] ‘to think’ in (289) is a CVC₁C₂VC root, and so a reduplicating allomorph specified for two moras is added to the root. The first two moras of the root and their association lines are copied; then all melody tiers of the root are copied and connected to the borrowed moras. Following reduplication, a perfective template is added immediately following the onset of the first bimoraic unit, and the perfective segment [high] is associated with the nucleus of the template, spreading to the first coda and the second onset of the infixed unit. Vowel epenthesis occurs last. Now let us consider reduplication in CVCVC and CĩC₁C₁VC roots.

8.1.1.2 CVCV₂C AND CĩC₁C₁V₂C ROOT TYPES

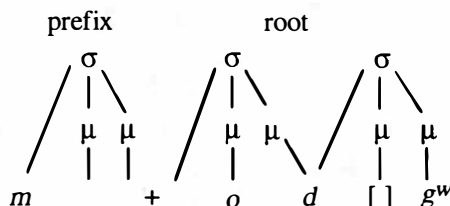
When a continuous reduplicating affix occurs with a CVCV₂C or CĩC₁C₁V₂C root in which V₂ is associated with phonetic material in the underlying representation, an allomorph specified for three moras is added to the root. A three-mora allomorph typically ignores syllabification in the root; that is, the reduplicating allomorph borrows all the moras underlying the first syllable of the root, but only the first mora underlying the second syllable.

Reduplication in a CVCV₂C root type provides evidence that non-reduplicating affixes are added to a root before reduplication takes place. Specifically, when a non-reduplicating affix triggers phonological alternations in a CVCV₂C root, these alternations also show up in the reduplicated unit. I have argued that such phonological alternations are an attempt to associate phonetic material with positions in the initial underlying bimoraic unit of the root in such a way as to produce a closed surface syllable with a preferred syllable contact. Thus, the priority given to affixes triggering phonological alternations within a root supports the claim that a drive towards closed surface syllables is a central function of the phonological system of Karao. Once these alternations take place, reduplication may follow. An example in which a verb prefix and a reduplicating affix are added to a CVCV₂C root is given in (290).

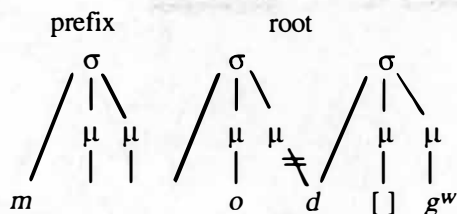
(290) ?olaw ‘to be dizzy or confused’

Underlying form

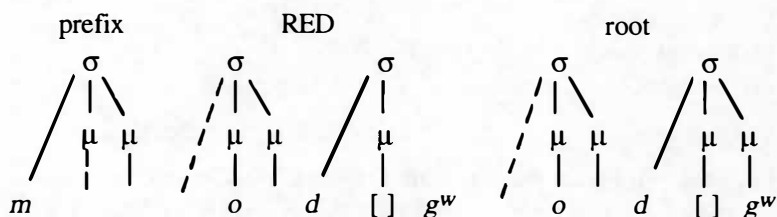
Affixation



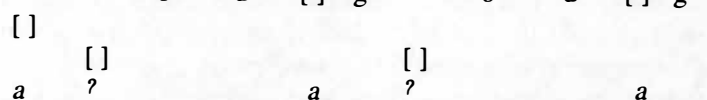
Consonant
delinking 2



Reduplication



Vowel epenthesis
Glottal epenthesis
Redundant feature
assignment



Surface form

[maʔudaʔudaw] (continuous)

In (290), the prefix *mɪ-* is added to the CVCV₂C root *olaw* [ʔulaw] 'to be dizzy or confused'; *d* in the medial root position delinks from the first coda of the root, but remains associated with the second onset. Since *ʔolaw* is a CVCV₂C root in which the V₂ position is associated with phonetic material in the underlying representation, a reduplicating allomorph specified for three moras is inserted between the prefix *mɪ-* and the root. The first three moras of the root and their association lines are copied; then all melody tiers of the root are copied and connected to the borrowed moras as dictated by the association lines. Vowel and glottal epenthesis follow, and redundant feature assignment occurs last.

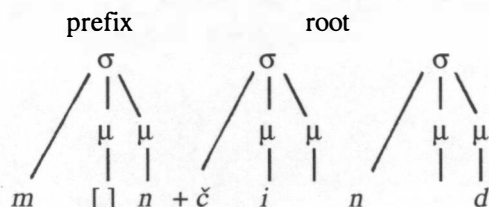
8.1.1.3 CVCiC AND CiC₁C₁iC ROOT TYPES

When a continuous reduplicating affix occurs with a CVCiC or CiC₁C₁iC root type in which the V₂ position of the root lacks phonetic material in the underlying representation (and so surfaces as [i]), an allomorph specified for four moras is added to the root. What is of interest about this allomorph is that the last association line is specified for multiple association; that is, the association line will connect only with a segment that is already associated with a mora in the underlying representation, as shown in (291).

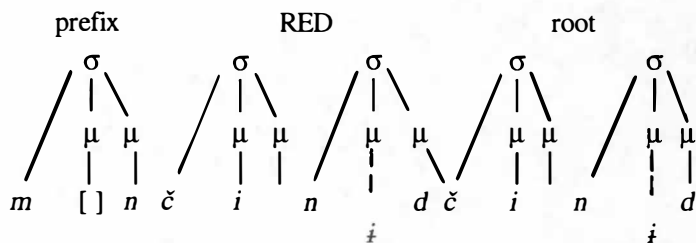
(291) *činił* 'to be carefree'

Underlying form

Affixation



Reduplication



Vowel epenthesis

Redundant feature
assignment

a

Surface form

[mančiniłčinił] (continuous)

In (291), the prefix *man-* is added to the CVC_iC root *činił* [činił] 'to be carefree', and no alternations are triggered in the root. Since *činił* is a CVC_iC root in which the V₂ position lacks phonetic material in the underlying representation, a reduplicating allomorph specified for four moras is inserted between the prefix *man-* and the root. The first four moras of the root and their association lines are copied; then all melody tiers of the root are copied and connected to the borrowed moras as dictated by the association lines. Notice that the last association line of the reduplicating affix connects with *č*, rather than *d*. In a four-mora allomorph, the last association line must connect with a segment that is already associated with a mora. Since *d* is not associated with a mora, it is passed over, and the association line connects with *č*, the first underlying segment that is already associated with a mora. Let us now consider reduplication patterns in which a root and a non-reduplicating affix resyllabify.

8.1.2 ROOT AND NON-REDUPLICATING AFFIX RESYLLABIFY

Root types that can resyllabify with a non-reduplicating affix are CaCVC and C_iC₁C₁VC. For these root types, non-reduplicating affixes are added before reduplicating affixes (since non-reduplicating affixes trigger resyllabification which typically moves the initial underlying bimoraic unit of the root closer to a closed surface syllable with a preferred syllable contact). Once resyllabification has occurred, a reduplicating affix is added to the affixed root, and material is copied from the affixed root, rather than the root alone. Since the non-reduplicating affix and the root have resyllabified, the reduplicating affix is added to the beginning of the affixed root. The allomorphs for the continuous reduplicating affix are selected on the basis of the canonical shape of the affixed root, rather than the unaffixed root.

8.1.2.1 CaCV₂C ROOT TYPE WITH A PERFECTIVE INFIX

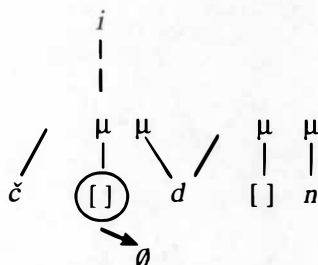
When a perfective infix is added to a CaCV₂C root type in which the V₂ root position is associated with phonetic material in the underlying representation, the affixed root has a CVCV₂C shape, and a reduplicating allomorph specified for three moras is added to the affixed root, as seen in (292).

(292) *čalan* 'path'

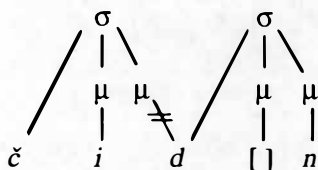
Underlying form

Infixation

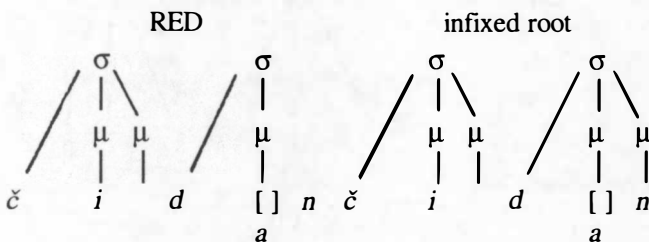
Vowel deletion



Consonant delinking 2



Reduplication



Redundant feature assignment

Surface form

[čidačidan] (continuous) 'to follow a route'

In (292), perfective infixation occurs in the CaCV_2C root *čalan* [čalan] 'path': the perfective segment [high] is inserted in the V_1 root position; the fully underspecified segment in the V_1 root position is deleted; and *d* in the medial root position delinks from the first coda of the root, but remains associated with the second onset of the root. Following these alternations, the affixed root *čidan* has a CVCV_2C shape in which the V_2 position is associated with phonetic material in the underlying representation, and so an allomorph specified for three moras is added to the beginning of the affixed root. The first three moras of the affixed root and their association lines are copied; then all melody tiers of the root are copied and connected to the borrowed moras; redundant feature assignment occurs last. (The same pattern occurs when an infix is added to a CVCiC root type; however, for this root type, a reduplicating allomorph specified for four moras is added to the affixed root – see example (291).)

8.1.2.2 $\text{CiC}_1\text{C}_1\text{VC}$ ROOT TYPE WITH A PERFECTIVE INFIX

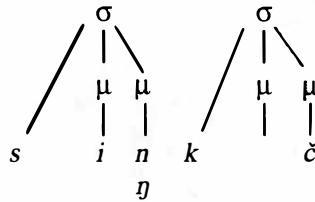
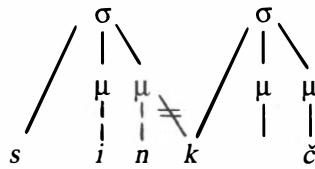
When a perfective infix is added to a $\text{CiC}_1\text{C}_1\text{VC}$ root type, the affixed root changes to a $\text{CVC}_1\text{C}_2\text{VC}$ shape, and a reduplicating allomorph specified for two moras is added to the affixed root. For a $\text{CiC}_1\text{C}_1\text{VC}$ root type, the perfective allomorph is *-in-*. Notice that the nasal of the infix assimilates before material is copied from the affixed root and associated with the reduplicating affix, as shown in (293).

(293) *sikid* 'to wait'

Underlying form

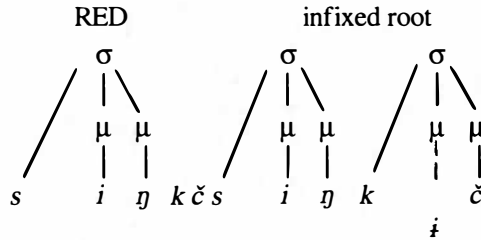
Infixation

Consonant delinking 2



Nasal assimilation 1

Reduplication



Vowel epenthesis

Surface form

[sɪŋsɪŋkɪd] (continuous)

In (293), perfective infixation occurs in the CiC_1C_1VC root *sikid* [sikkid] 'to wait': the perfective allomorph *in* is inserted immediately following the initial onset of the root; *k* in the medial root position delinks from the first coda of the root, but remains associated with the second onset of the root; the nasal of the infix assimilates, surfacing as [ŋ]. Following these alternations, the affixed root *sinikid* has a CVC_1C_2VC shape, and so an allomorph specified for two moras is added to the beginning of the affixed root. The first two moras of the affixed root and their association lines are copied; then all melody tiers of the root are copied and connected to the borrowed moras; vowel epenthesis occurs last. Notice that the nasal [ŋ] copied from the affixed root remains [ŋ] in the reduplicated unit. We will now consider reduplication involving $?aCVC$ and $?iC_1C_1VC$ root types and prefixes that resyllabify with the root.

8.1.2.3 $?aCVC$ AND $?iC_1C_1VC$ ROOT TYPES WITH A PREFIX

When the prefix *mi-* is added to a $?aCVC$ or $?iC_1C_1VC$ root type, the affixed root changes to a CVC_1C_2VC shape, and a reduplicating allomorph specified for two moras is added to the affixed root, as shown in (294).

(294) *ʔikɪt* 'to be quiet'

Underlying form

Affixation

Prefix coda

Consonant delinking 2

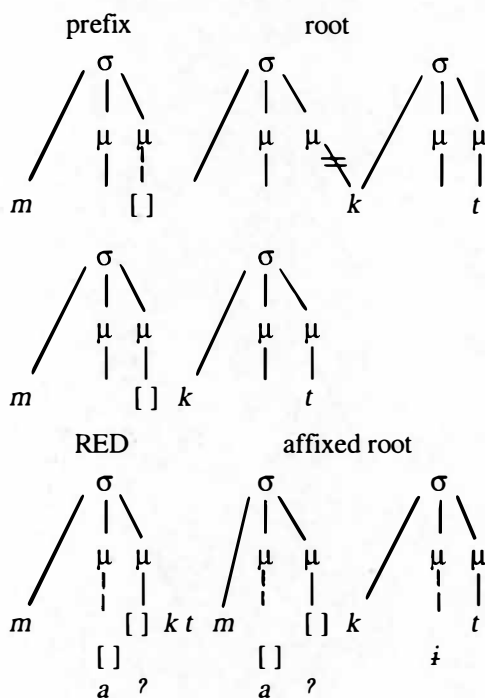
Resyllabification

Reduplication

Vowel epenthesis

Redundant feature
assignment

Surface form



[maʔmaʔkit] (intensive)

In (294), the prefix *m-* is added to the root *ʔikɪt* [*ʔikɪt*] 'to be quiet'. Following the addition of *m-*, a fully underspecified segment is added to the prefix coda; *k* in the medial position of the root delinks from the first coda of the root, but remains associated with the second onset; the first bimoraic unit of the root is deleted; and resyllabification takes place. Following resyllabification, the affixed root has a CVC₁C₂VC shape, and so an allomorph specified for two moras is added to the beginning of the affixed root. The first two moras of the affixed root and their association lines are copied; then all melody tiers of the root are copied and connected to the borrowed moras. Vowel epenthesis and redundant feature assignment follow last.

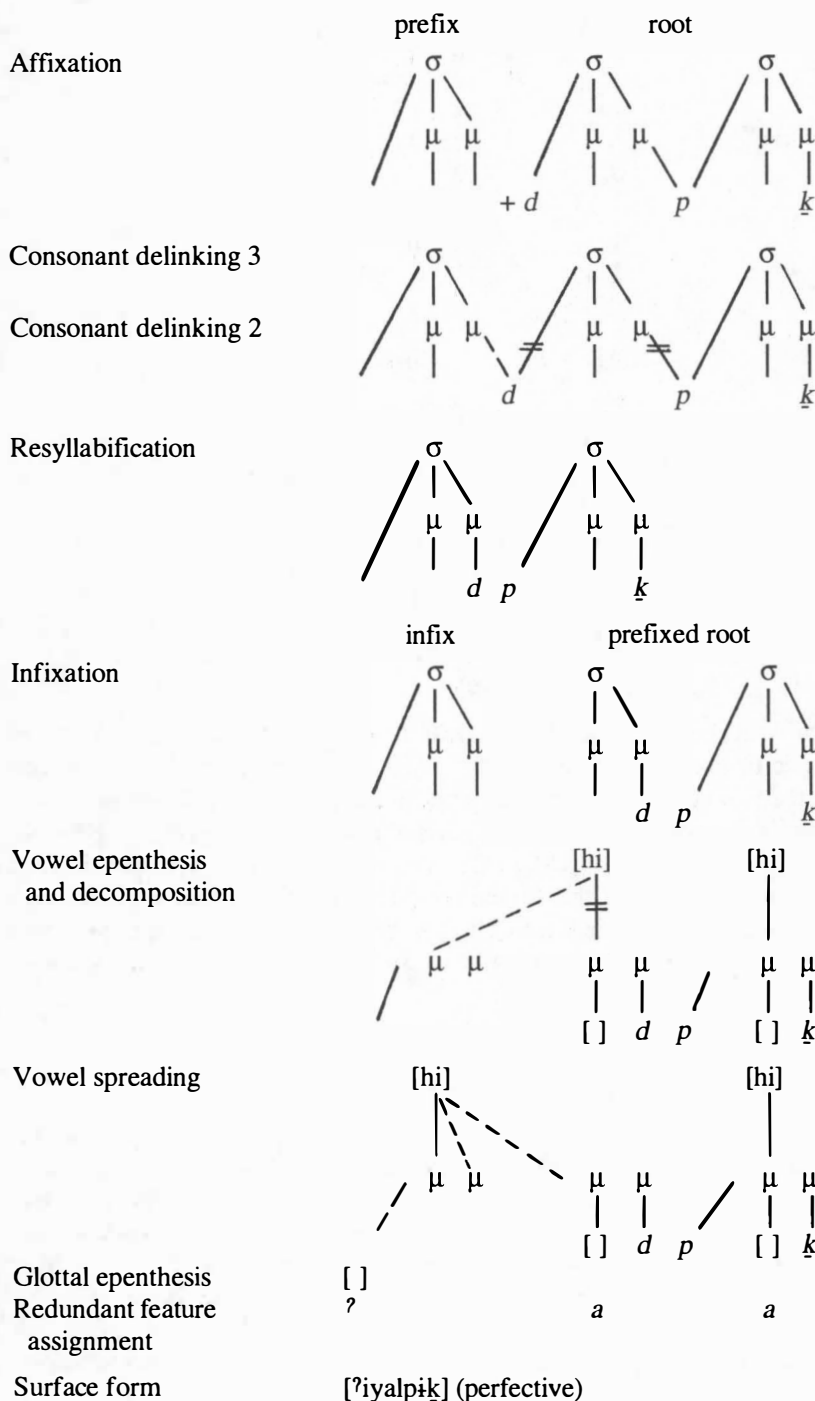
8.1.2.4 C_iC₁C₁VC ROOT TYPE WITH VOWEL DECOMPOSITION

The final continuous reduplication pattern involves a C_iC₁C₁VC root type and the perfective prefix *ʔ-*. When both a non-reduplicating and a reduplicating affix are added to a C_iC₁C₁VC root, affixation occurs in the usual order: the non-reduplicating affix is added first, since it triggers resyllabification; then the reduplicating affix is added second. Recall that when *ʔ-* is added to a C_iC₁C₁VC root type, a perfective template is inserted in the prefix, triggering vowel decomposition in the epenthetic vowel of the prefix (see section 7.2.4). These phonological alternations subsequently interact with reduplication, as illustrated in (295) and (296). In (295), the prefix *ʔ-* is added to the C_iC₁C₁VC root *dɪpɪk*

[dɪppɪk] to produce the affixed root [ʔiyalpɪk]; in (296), I show how we can derive the reduplicated form [ʔiyalpɪk] from [ʔiyalpɪk].

(295) *dɪpɪk* 'to get wet'

Underlying form

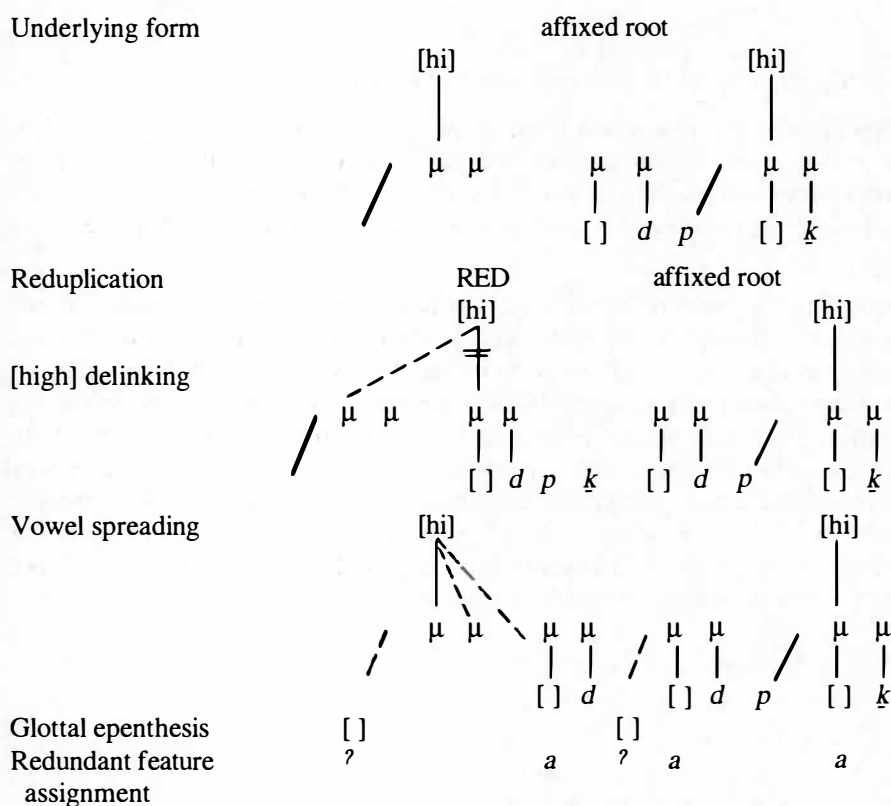


In (295), the perfective prefix ʔi- is added to the $\text{CiC}_1\text{C}_1\text{VC}$ root dipik [dɪppɪk] 'to get wet'. Following affixation, d in the initial onset of the root delinks and reassociates with the prefix coda; p in the medial position of the root delinks from the first coda of the root and remains associated with the second onset of the root; the first bimoraic unit of the root is deleted; and resyllabification occurs next. Once resyllabification has taken place, the coda of the prefix is singly associated with the segment d , and so a perfective template is added to the prefix. At this point, vowel epenthesis occurs across the word, and an epenthetic vowel is inserted in the nucleus of the prefix. The epenthetic vowel of the prefix then decomposes: the feature [high] delinks from the nucleus of the prefix and reassociates with the nucleus of the perfective template; the fully underspecified segment remains associated with the nucleus of the prefix. Once the feature [high] reassociates with the nucleus of the template, it spreads to the first coda and the second onset of the prefix. Glottal epenthesis and redundant feature assignment occur last.

Taking the affixed root $[\text{ʔiyalpi}k]$, a reduplicating allomorph specified for two moras is added, producing the form $[\text{ʔiyal}^{\text{RED}}\text{alpi}k]$ in (296). Notice that the second syllable of $[\text{ʔiyalpi}k]$ is a closed syllable with a preferred syllable contact.

(296) $[\text{ʔiyalpi}k]$ from $\text{ʔi-} + \text{dipik}$

Underlying form



Surface form

$[\text{ʔiyal}^{\text{RED}}\text{alpi}k]$ (intensive/perfective)

In (296) we have an example of how vowel decomposition is employed in order to take advantage of an underlying bimoraic unit produced by resyllabification when this unit will produce a closed surface syllable with a preferred syllable contact. After the alternations in

(295) have taken place, a continuous reduplicating affix is added to the affixed root [ʔiyalpiḱ]. Instead of getting an allomorph specified for three moras, as we would expect since the first two surface syllables of [ʔiyalpiḱ] have a CVCVC shape, we get an allomorph specified for two moras. Apparently, for the purposes of reduplication, the system ignores the feature [high] and the first two moras of the affixed root when the feature [high] and the two moras function as a perfective morpheme; instead, a reduplicating allomorph specified for two moras is added to the affixed root, since the second and third bimoraic units of the affixed root (that is [alpiḱ]) have the same canonical shape as a CVC₁C₂VC root. Then, ignoring the first two moras of the affixed root, the system copies the second two moras and their association lines. Starting again with the second two moras, all melody tiers of the root are copied and connected to the borrowed moras. Notice, however, that the copied material is associated with the second pair of moras, not the first pair. With the association of the copied material, the feature [high] delinks again and reassociates with the first mora of the reduplicated form which is the correct position for the perfective segment [high]; the feature [high] then spreads to the first coda and the second onset, as usual. Glottal epenthesis and redundant feature assignment occur last. This unique alternation offers further support for the claim that a drive towards closed surface syllables is a central function of the Karao phonological system.

8.2 REDUPLICATION SIGNALLING COMPARISON BETWEEN TWO ITEMS

Reduplication that signals comparison between two items is a fairly simple process. We are interested in this type of reduplication because it triggers the addition of a fully underspecified segment (surface [ʔ]) in the first coda of CVCVC surface roots. This fact provides further evidence for the claim that underlying an open (CV) surface syllable is a bimoraic unit.

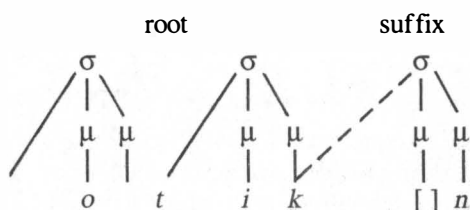
A comparative affix has two components: (1) a reduplicating prefix that consists of two moras with association lines dictating that copied material is associated in a one-to-one manner with positions in the affix; and (2) the suffix *-an*. We may assume that the suffix *-an* is added first, since phonological alternations triggered in the root also occur in the reduplicating affix. (This follows the pattern in verb affixation in which a suffix with phonetic material associated with its coda triggers alternations in a root.) Late rules, such as epenthesis and redundant feature assignment, occur after the reduplicating affix is added. An example is given in (297). (For convenience, only the root melody will be copied in the derivations below, although we would expect that the melody for the entire affixed root would be copied. Since the suffix melody never surfaces, for our purposes, nothing is lost by omitting it.)

(297) ʔotik 'small'

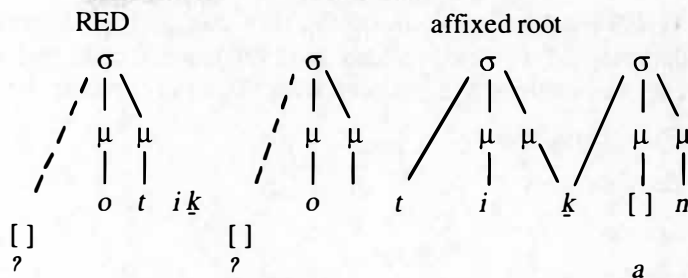
Underlying form

Affixation

Multiple association 1



Reduplication



Glottal epenthesis
Redundant feature
assignment

Surface form [ʔotʔotɛxan] 'smaller'

In (297), the suffix *-an* is added to the CVCVC root *ʔotik* [ʔotɛk] 'small', and *k* in the final coda of the root multiply associates with the onset of the suffix. Then a two-mora comparative reduplicating affix is added to the beginning of the affixed root; all melody tiers are copied and associated in a one-to-one manner with positions in the reduplicating affix. Glottal epenthesis and redundant feature assignment occur last.

In certain roots, comparative affixation triggers the addition of a fully underspecified segment in the first coda of the root; this phonological alternation is then copied to the reduplicating affix, as shown in the CVCVC root *banay* in (298).

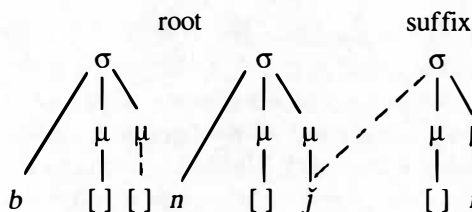
(298) *banay* 'big'

Underlying form

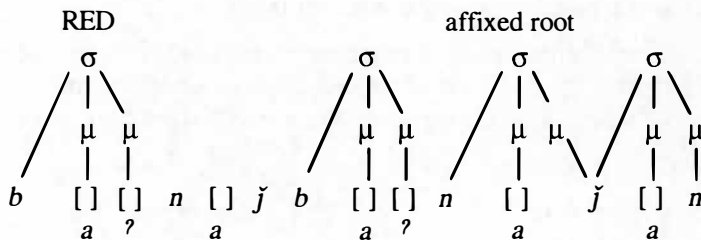
Affixation

Root coda

Multiple association 1



Reduplication



Redundant feature
assignment

Surface form [baʔbaʔnayan] 'bigger'

In (298), the suffix *-an* is added to the CVCVC root *banay* [banay] 'big'; a fully underspecified segment is added to the first coda of the root; and *j* in the final coda of the root multiply associates with the onset of the suffix. A two-mora comparative reduplicating affix is added to the beginning of the affixed root; all melody tiers are copied and associated in a one-to-one manner with positions in the reduplicating affix. Redundant feature assignment occurs last. Notice that when a fully underspecified segment is added to the first coda of the root, it is copied to the reduplicating affix.

In (298), the first coda of the root *banay* ‘big’ is unassociated before a fully underspecified segment is added; in (299), the first coda position of the root *kayaŋ* ‘tall’ is already associated with a segment; however, a fully underspecified segment is still added.

(299) *kayaŋ* ‘tall’

Underlying form

Affixation

Root coda

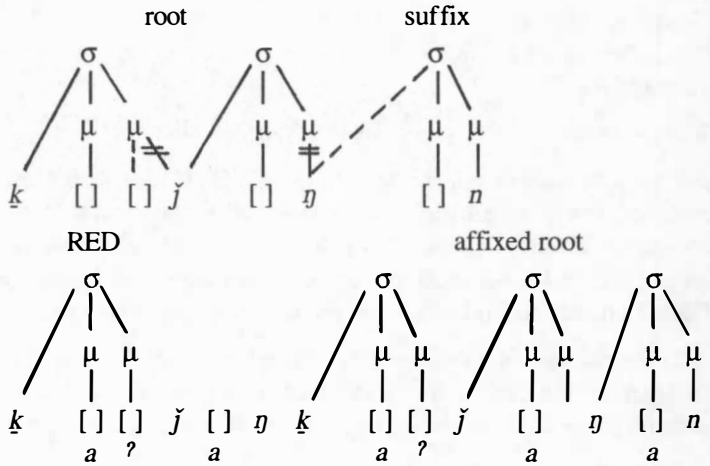
Consonant delinking 2

Consonant delinking 1

Reduplication

Redundant feature assignment

Surface form



[kaʔkaʔjaŋan] ‘taller’

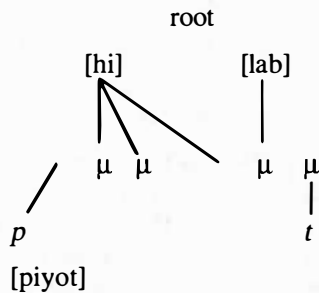
In (299), the suffix *-an* is added to the CVCVC root *kayaŋ* [kayaŋ] ‘tall’; a fully underspecified segment is added to the first coda of the root; *j* in the medial root position delinks from the first coda of the root, but remains associated with the second onset; and *ŋ* in the final coda of the root delinks and reassociates with the onset of the suffix. A two-mora comparative reduplicating affix is added to the beginning of the affixed root; all melody tiers are copied and associated in a one-to-one manner with positions in the reduplicating affix. Redundant feature assignment occurs last.

In our final example of comparative reduplication, the addition of a fully underspecified segment in the first coda of the root offers us a rare illustration of the feature [high] delinking from the second of three positions to which it is multiply associated.

(300) *piyot* ‘thin’

Underlying form

Surface form



Affixation

Root coda

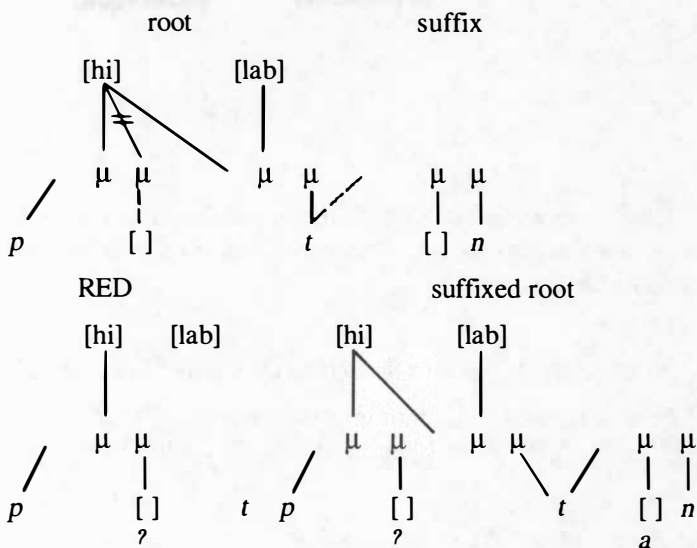
Vowel delinking

Multiple association 1

Reduplication

Redundant feature
assignment

Surface form



[piʔpiʔjoθan] 'thinner'

In (300), the feature [high] in the CVCVC root *piyot* [piyot] 'thin' is multiply associated with the first nucleus, the first coda, and the second onset. When the suffix *-an* is added, a fully underspecified segment is added to the first coda of the root; and the feature [high] delinks from the first coda, but remains multiply associated with the first nucleus and the second onset, surfacing as [j] in the second onset. A two-mora comparative reduplicating affix is added to the beginning of the affixed root; all melody tiers are copied and associated in a one-to-one manner with positions in the reduplicating affix. Redundant feature assignment occurs last.

APPENDIX

This appendix includes all the major phonological rules affecting Karao roots; each rule is illustrated with an example. The reader should refer to the body of this work for details about a specific rule.

1. ALTERNATIONS OCCURRING IN UNAFFIXED ROOTS

Four alternations commonly occur in unaffixed roots: (1) Consonant Weakening, (2) Voicing, (3) Vowel Epenthesis and (4) Glottal Epenthesis.

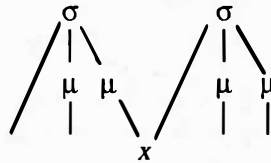
1.1 CONSONANT WEAKENING RULE

A segment multiply associated with two adjacent consonant positions undergoes weakening when preceded by a vowel in the underlying representation. The rule of consonant weakening is given in (301), and an example follows in (302).

(301)

Consonant Weakening

Underlying form

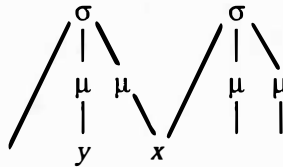


Surface form

[x₁x₁]

Note: x₁ is a set 1 consonant.

Underlying form



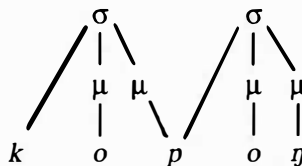
Surface form

[yx₂]

Note: x₂ is a set 2 consonant.

(302) *koɸoŋ* 'rice stalk'

Underlying form



Surface form

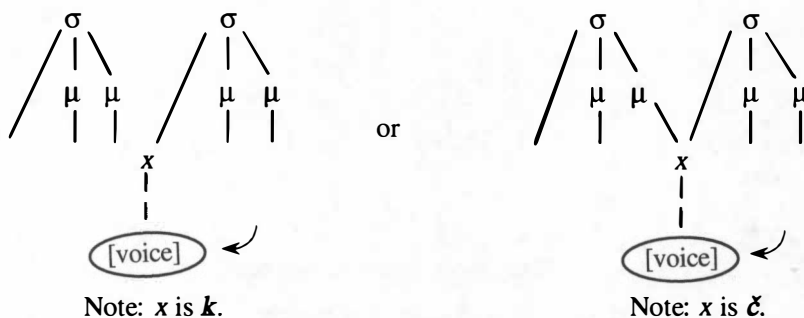
[kuɸoŋ]

In (302), the segment *p* is multiply associated with two adjacent consonant positions and is preceded by the vowel *o* in the underlying representation; consequently, *p* undergoes weakening and surfaces as [p̥].

1.2 VOICING RULE

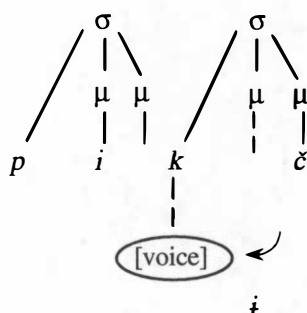
The segments *k* and *č* undergo weakening when the feature [voice] is added to either segment. The voicing rule is given in (303), and an example follows in (304).

(303) Voicing



(304) *pigiɖ* 'to heal'

Underlying form



Vowel epenthesis

Surface form

[pigiɖ]

1.3 VOWEL EPENTHESIS RULE

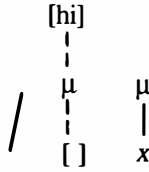
An epenthetic complex vowel is supplied for any nucleus lacking material. The epenthetic complex vowel is composed of two segments: the feature [high] and a fully underspecified segment. (The redundant feature [back] is assigned to the fully underspecified segment, allowing it to surface as [a].) If a specified segment is associated with the coda of the unit in which the epenthetic vowel is inserted, both segments of the epenthetic vowel remain associated with the nucleus, and the vowel surfaces as [ɨ]. In unaffixed roots, an epenthetic vowel occurs only in this environment and always surfaces as [ɨ]. Schemata for the variant [ɨ] is given in (305), and for redundant feature assignment in (306); an example of the variant [ɨ] follows in (307).

(305) Vowel Epenthesis: Variant [ɪ]

Underlying form



Vowel epenthesis



Redundant feature assignment

[back]

Surface form

$$[\dot{t}X]$$

Note: x is a specified segment.

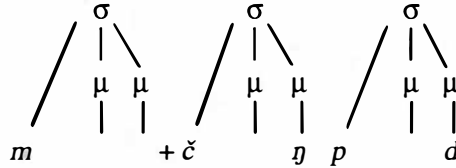
(306) [back] Redundant Feature Assignment

[] --> [back]

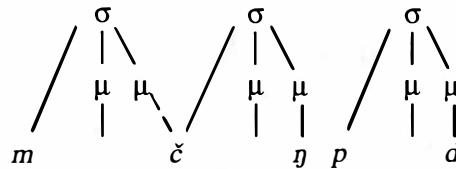
(307) *č̣iŋpɪl* ‘to strike with the fists’

Underlying form

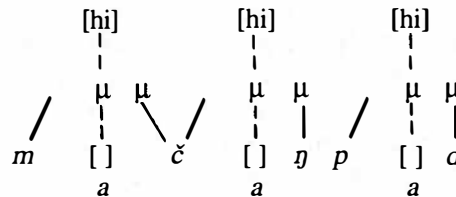
Affixation



Multiple association 1



Vowel epenthesis



Redundant feature assignment

a

a

3

Surface form

[mitčɪŋpɪl]

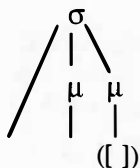
In (307), the affix *mi-* is added to the root *čipil* [čipil] ‘to strike with the fists’; *č* in the first onset of the root multiply associates with the empty prefix coda; and vowel epenthesis

occurs in all nuclei. Since the codas of all the underlying bimoraic units are associated with specified segments, the epenthetic vowel surfaces as [ɨ] in all units.

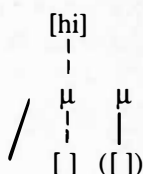
If material is not associated with the coda of the underlying unit, or if a fully underspecified segment (surface [ʔ]) is associated with the coda, the feature [high] of the epenthetic vowel delinks, leaving only the fully underspecified segment associated with the nucleus, and the vowel surfaces as [a]. A schema for variant [a] is given in (308), and an example follows in (309).

(308) Vowel Epenthesis: Variant [a]

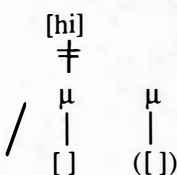
Underlying form



Vowel epenthesis



[high] delinking



Redundant feature assignment

[back] [back]

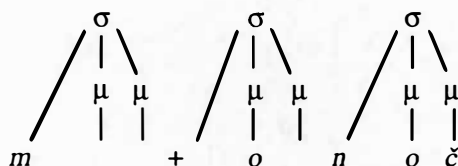
Surface form

[a(ʔ)]

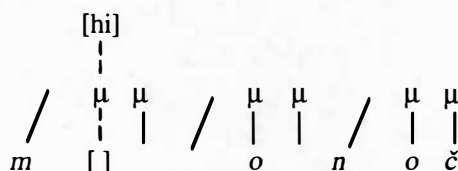
(309) ʔonod 'to follow'

Underlying form

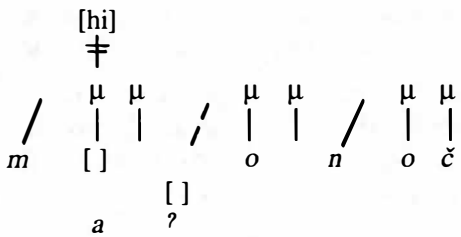
Affixation



Vowel epenthesis



[high] delinking



Glottal epenthesis
Redundant feature
assignment

Surface form [maʔonud]

In (309), the affix *mi-* is added to the root *ʔonod* [ʔonud] 'to follow'; vowel epenthesis occurs in prefix nucleus. Since the coda of the prefix lacks phonetic material, the feature [high] delinks from the nucleus, and the epenthetic vowel surfaces as [a].

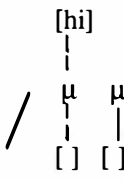
When the prefix *may-* attaches to a *ʔiC₁C₁VC* or *ʔaC₁VC* root, the C₁ consonant delinks from the first coda of the root; a fully underspecified segment (surface [ʔ]) is added to the first coda; and either the feature [high] delinks, and the vowel surfaces as [a], or the fully underspecified segment is deleted, and the epenthetic vowel surfaces as [i]. The variants [a] and [i] occur only in affixed roots, never in unaffixed roots. A schema for the variant [a] or [i] is given in (310), and an example follows in (311).

(310) Vowel Epenthesis: Variant [a] or [i]

Underlying form

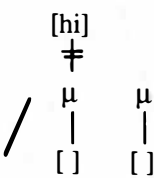


Vowel epenthesis



Variant [a]

[high] delinking



Redundant feature
assignment

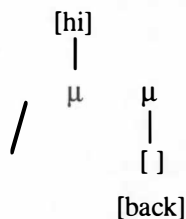
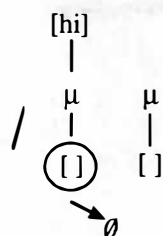
[back] [back]

Surface form

[aʔ]

Variant [i]

Vowel deletion

Redundant feature
assignment

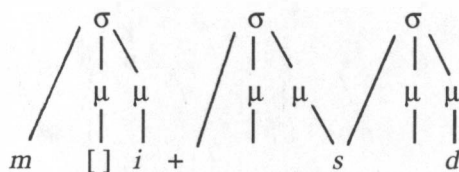
Surface form

[iʔ]

(311) ?is#l 'to say something'

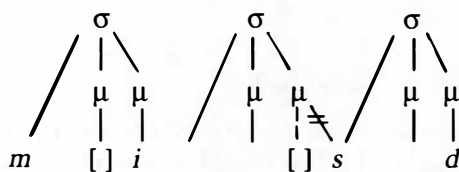
Underlying form

Affixation

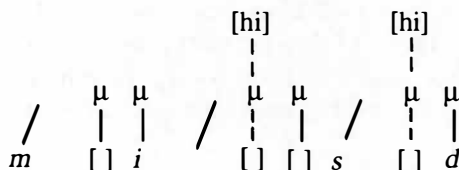


Root coda

Consonant delinking 2

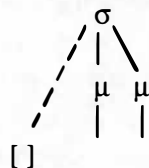


Vowel epenthesis



(312) Glottal Epenthesis

Underlying form

Redundant feature
assignment

[back]

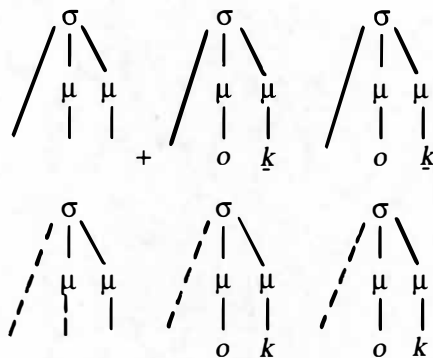
Surface form

[ʔ]

(313) ʔokʔok 'to cough'

Underlying form

Affixation

Vowel epenthesis
Glottal epenthesis
Redundant feature
assignment

[] [] []
ʔ a ʔ ʔ

Surface form

[ʔaʔokʔok]

In (313), the affix ʔi- is added to the root ʔokʔok [ʔokʔok] 'to cough', and vowel epenthesis occurs in the prefix nucleus. A fully underspecified segment is added to all empty onsets, surfacing as [ʔ].

2. ALTERNATIONS TRIGGERED BY AFFIXATION AFFECTING ALL ROOT TYPES

Seven alternations triggered by verb affixation may occur with all root types: (1) Multiple Association of Consonant 1, (2) Consonant Delinking 1, (3) Vowel Spreading, (4) Vowel Delinking, (5) Nasal Assimilation 1, (6) Nasal Deletion and (7) Nasal Assimilation 2.

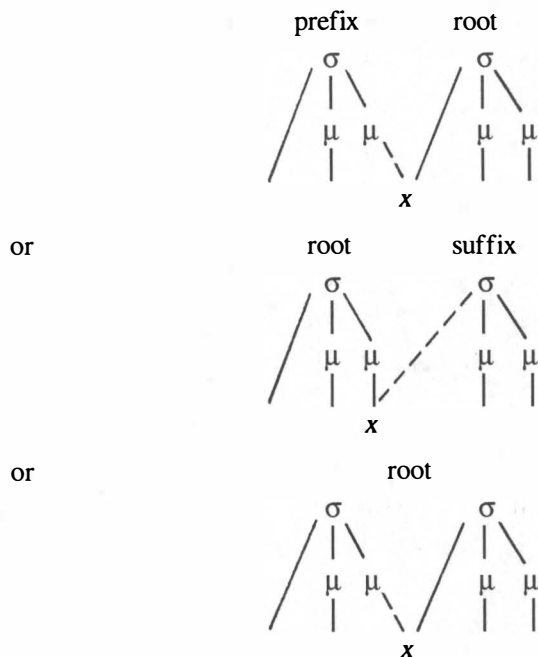
2.1 MULTIPLE ASSOCIATION OF CONSONANT 1 RULE

When a prefix with an empty coda or a suffix with an empty onset is added to any root, phonetic material that is singly associated with the adjacent root position spreads to the empty position of the affix. That is, a consonant in the first onset of the root spreads to the empty coda of the prefix, and a consonant in the final coda of the root spreads to the empty onset of

the suffix. Also, following vowel deletion in a CaCVC root type, a consonant with only one surface form (i.e. *b*, *m*, *n*, *ŋ* or *s*) spreads from the second onset of the root to the preceding coda.

The rule for multiple association of consonants in these environments is given in (314), and an example follows in (315).

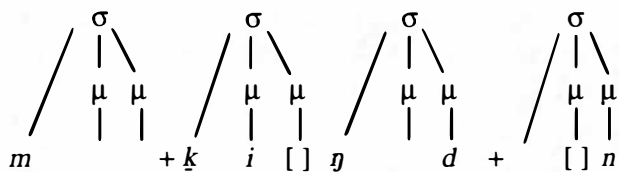
(314) Multiple Association of Consonant 1



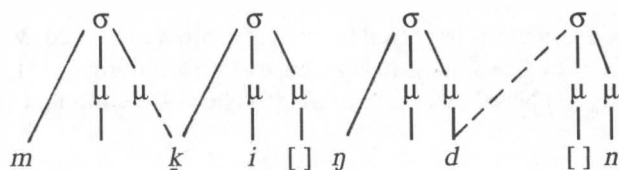
(315) *kɪʔŋil* 'to listen'

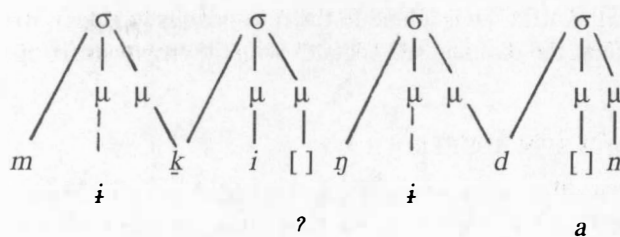
Underlying form

Affixation



Multiple association 1





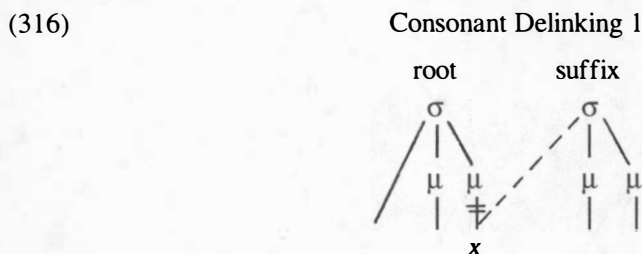
Vowel epenthesis
Redundant feature
assignment

Surface form [mɪḳḳeʔɪɪddan]

In (315), the discontinuous affix *mi--an* is added to the root *kɪʔɪl* [kɪʔɪl] 'to listen'; *ḳ* in the first onset of the root spreads to the empty prefix coda, and *d* in the final coda of the root spreads to the empty suffix onset. Vowel epenthesis and redundant feature assignment follow. (The vowel *i* surfaces as [e] following *ḳ*.)

2.2 CONSONANT DELINKING 1 RULE

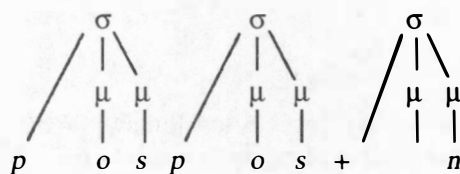
The segments *b*, *m*, *n*, *ŋ* and *s* cannot multiply associate with two adjacent consonant positions when preceded by a vowel. When a suffix is added to a root ending with *b*, *m*, *n*, *ŋ* or *s*, and the consonant is preceded by a vowel, the consonant delinks from the final coda of the root and reassociates with the onset of the suffix. The rule is given in (316), and an example follows in (317).



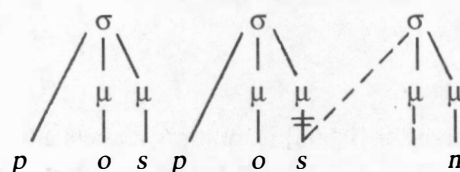
(317) *pospos* 'to finish up'

Underlying form

Affixation



Consonant delinking 1



Vowel epenthesis

Surface form

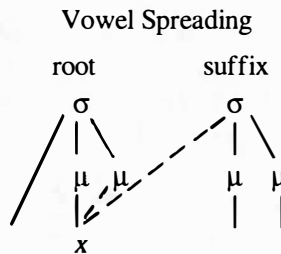
[mɪpposposɪn]

In (317), the affix *-in* is added to the root *pospos* [pospos] ‘to finish up’; *s* delinks from the final coda of the root and reassociates with the empty suffix onset; vowel epenthesis follows.

2.3 VOWEL SPREADING RULE

When a suffix with an empty onset is added to a root in which the feature [high] or [labial] in the final nucleus spreads to the final coda, the feature [high] or [labial] will also spread to the suffix onset. The rule for vowel spreading is given in (318), and an example follows in (319).

(318)

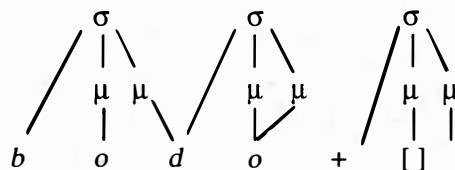


Note: *x* is the feature [high] or [labial].

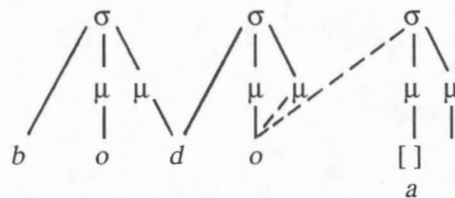
(319) *bolow* ‘to bark’

Underlying form

Affixation



Vowel spreading



Redundant feature
assignment

Surface form

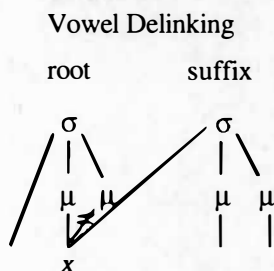
[buluwa]

In (319), the affix *-a* is added to the root *bolow* [buluw] ‘to bark’; the feature [labial] (or *o* in the derivation) in the final nucleus of the root spreads to the empty coda of the root and to the empty onset of the suffix. Redundant feature assignment occurs last.

2.4 VOWEL DELINKING RULE

When the feature [high] or [labial] is multiply associated with a nucleus, the following coda, and an adjacent onset, the feature can delink from the coda position, remaining multiply associated with the nucleus and the onset. The rule for vowel delinking is given in (320), and an example follows in (321).

(320)

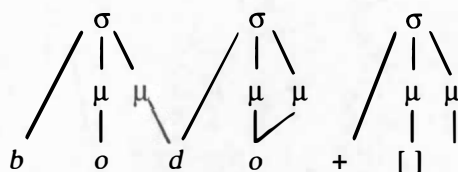


Note: *x* is the feature [high] or [labial].

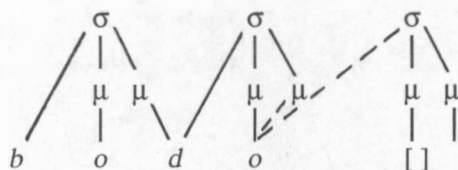
(321) *bolow* 'to bark'

Underlying form

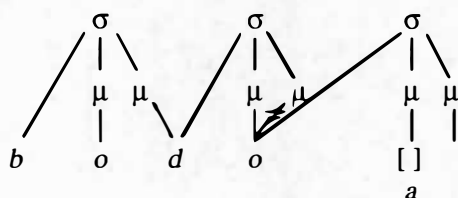
Affixation



Vowel spreading



Vowel delinking



Redundant feature
assignment

Surface form

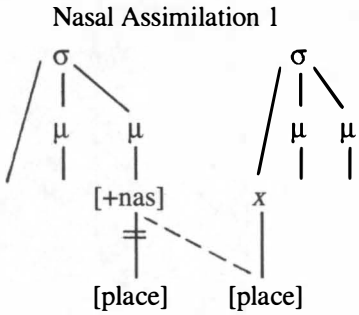
[bulug^wa]

In (321), the affix *-a* is added to the root *bolow* [buluw] 'to bark'; the feature [labial] (or *o*) in the final nucleus of the root spreads to the empty coda of the root and to the empty onset of the suffix. Following vowel spreading, the feature [labial] delinks from the coda position, but remains associated with the nucleus and the onset. Redundant feature assignment occurs last.

2.5 NASAL ASSIMILATION 1 RULE

In prefixes and infixes that end with *n* in the underlying representation, the nasal *n* has its own place feature which is [coronal]. When such an affix is added to a root, the place feature of the following root consonant spreads to the affix nasal and the [coronal] feature delinks from the nasal. (This type of nasal assimilation is blocked when a prefix ending with *n* attaches to a root beginning with *m*.) The rule is given in (322), and an example follows in (323).

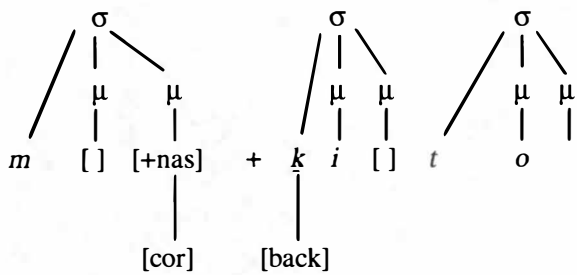
(322)



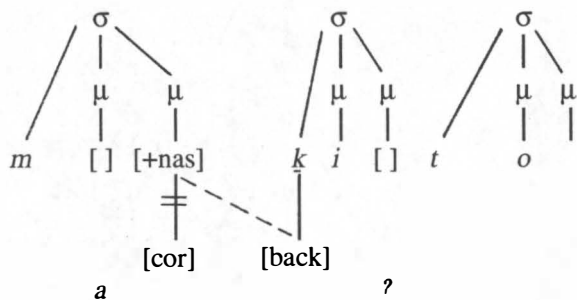
(323) *kiʔto* ‘to stutter’

Underlying form

Affixation



Nasal assimilation 1



Redundant feature assignment

Surface form [maŋkeʔto]

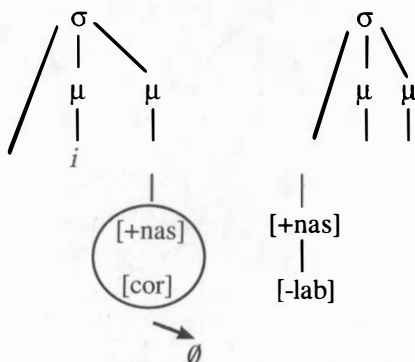
In (323), the affix *man-* is added to the root *kiʔto* [keʔto] ‘to stutter’; the [back] place feature associated with *k* in the initial onset of the root spreads to the nasal of the prefix; the [coronal] place feature of the prefix nasal delinks; and the prefix nasal surfaces as [ŋ]. Redundant feature assignment follows. (The vowel *i* surfaces as [e] following *k*.)

2.6 NASAL DELETION RULE

When an infix ending with *n* is inserted before a root nasal, the infix nasal does not assimilate; instead, the infix nasal surfaces as [n] if the root nasal is *m*, or is deleted altogether if the root nasal is *n* or *ŋ*. The Nasal Deletion rule is shown in (324), and an example follows in (325).

(324)

Nasal Deletion

(325) *sinit* 'to offend'

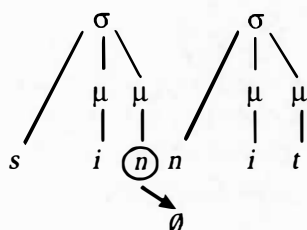
Underlying form

Infixation

Consonant delinking 2



Nasal deletion



Surface form

[sinit]

In (325), the infix *-in-* is inserted following the initial onset of the root *sinit* [sinnit] 'to offend'. Before *n* of the root, the infix nasal is deleted.

2.7 NASAL ASSIMILATION 2 RULE

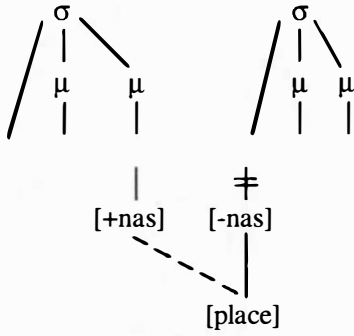
In prefixes that end with the feature [nasal], the feature [nasal] has no place specification. (A nasal with no place specification is represented as *N*.) When a prefix ending with *N* is added to a root, the place feature of the consonant in the first onset of the root spreads to the prefix nasal; the consonant in the first onset then delinks from the moraic tier; and the prefix nasal spreads to the first onset of the root. There is one restriction: prefixes ending with *N*, namely *mN-* and *?N-*, never occur with roots beginning with nasals; instead, *mN-* is replaced by *man-*, and *?N-* by *?yan-*. The rule for Nasal Assimilation 2 is given in (326).

(326)

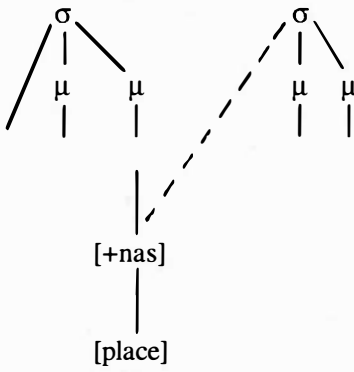
Nasal Assimilation 2

Place assimilation

Consonant delinking



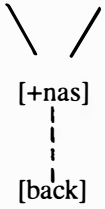
Multiple association



When a prefix ending with *N* is added to a root that lacks phonetic material in the underlying representation for the first onset of a root, the prefix nasal is assigned the default place feature [back] and surfaces as [ŋ], as shown in (327).

(327)

[back] Redundant Feature Assignment for Nasal

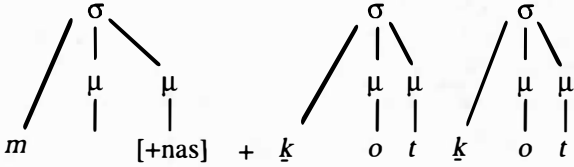


An example of the Nasal Assimilation 2 rule is given in (328).

(328) *kotkot* 'to dig shallowly'

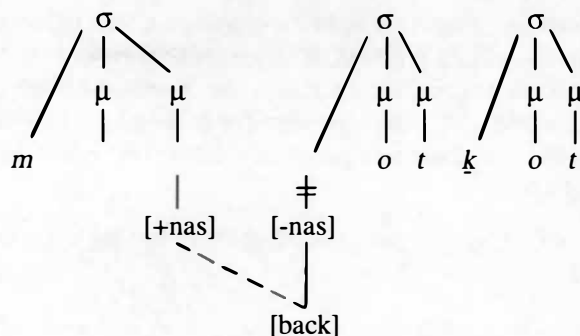
Underlying form

Affixation

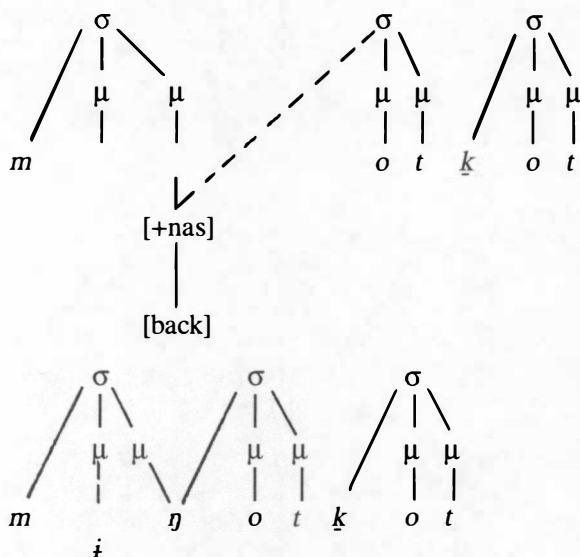


Place assimilation

Consonant delinking



Multiple association



Vowel epenthesis

Surface form

[mɪŋgotkɔt]

In (328), the affix *mɪN-* is added to the root *kɔtkɔt* [kɔtkɔt] ‘to dig shallowly’; the [back] place feature of *k* in the initial onset of the root spreads to the prefix nasal; *k* delinks from the moraic tier, leaving the initial root onset unassociated. The prefix nasal then spreads to the root onset, surfacing as the sequence [ŋɪ]. Vowel epenthesis occurs last.

3. ALTERNATIONS TRIGGERED BY AFFIXATION AFFECTING CVCVC AND C_iC₁C₁VC ROOT TYPES

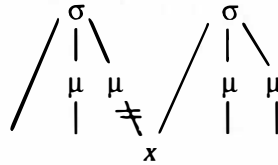
Five additional alternations may occur in CVCVC and C_iC₁C₁VC root types, depending on the canonical shape of the root and the vowel in the V₁ root position. These alternations are: (1) Consonant Delinking 2, (2) Devoicing, (3) Vowel Deletion, (4) Consonant Delinking 3 and (5) Multiple Association of Consonant 2.

3.1 CONSONANT DELINKING 2 RULE

When an appropriate affix is added to a CVC₁VC or C_iC₁C₁VC root type, a multiply associated consonant in the C₁ position delinks from the first coda of the root, but remains

associated with the second onset of the root. In a CVC_1VC root type, the first nucleus of the root must be associated with *i* or *o* in the underlying representation; in a $C\check{C}C_1C_1VC$ root type, the first nucleus of the root is never associated with phonetic material. If the C_1 consonant in a CVC_1VC root type is *p*, *t* or *k*, delinking is optional, in which case if the C_1 does not delink, it surfaces as a geminate cluster. This rule is given in (329), and an example follows in (330).

(329) Consonant Delinking 2

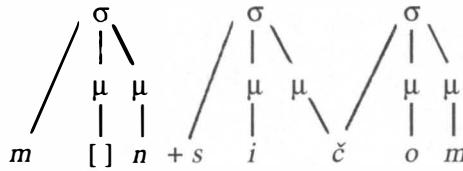


Note: *x* is a set 1 consonant.

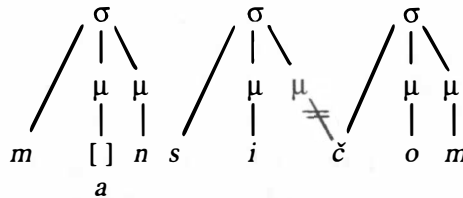
(330) *siřom* 'shade'

Underlying form

Affixation



Consonant delinking 2



Redundant feature assignment

Surface form

[mansičom] 'to be positioned in the shade'

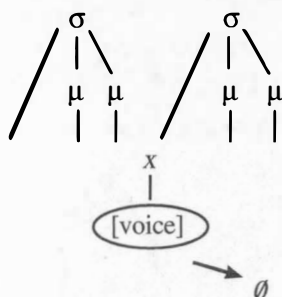
In the CVC_1VC surface root *siřom* [siřom] 'shade' in (330), the C_1 consonant *č* is multiply associated in the underlying representation. When the prefix *man-* attaches to the root, *č* delinks from the first coda of the root, but remains associated with the second onset, surfacing as [č]. Redundant feature assignment occurs last.

3.2 DEVOICING RULE

When an appropriate affix is added to a CVC_1VC root in which C_1 is [g] or [ř], the feature [voice] is deleted from the corresponding C_1 segment in the underlying representation. The rule for devoicing is given in (331), and an example follows in (332).

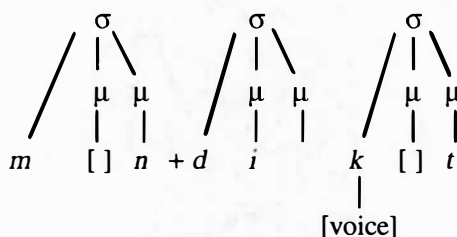
(331)

Devoicing

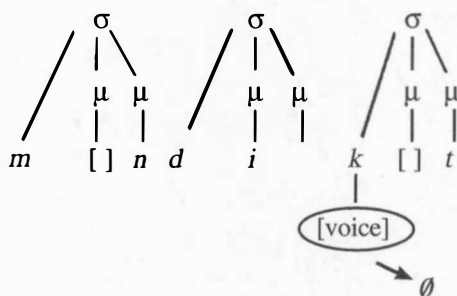
Note: x is k or \check{c} .(332) *digat* 'hardship'

Underlying form

Affixation



Devoicing

Redundant feature
assignment

Surface form

[mandikat] 'to have difficulty'

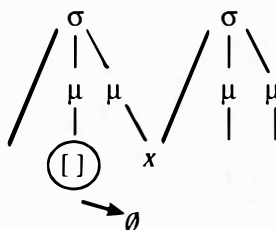
In the CVC₁VC surface root *digat* [digat] 'hardship' in (332), the feature [voice] is associated with the C₁ consonant k , and k is singly associated in the underlying representation, surfacing as [g]. When the prefix *man-* attaches to the root, the feature [voice] is deleted, and k surfaces as [k]. Redundant feature assignment occurs last.

3.3 VOWEL DELETION RULE

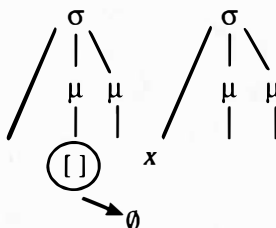
When an appropriate affix is added to a CaCVC root type, the fully underspecified segment in the V_1 root position (surface [a]) is deleted. The following consonant may or may not be multiply associated. The rule is given in (333), and an example follows in (334).

(333)

Vowel Deletion

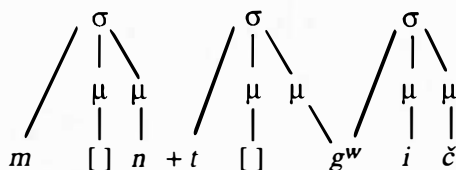


or

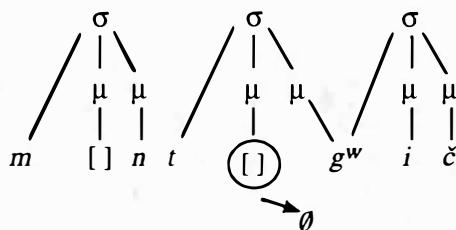
(334) *tawid* 'inheritance'

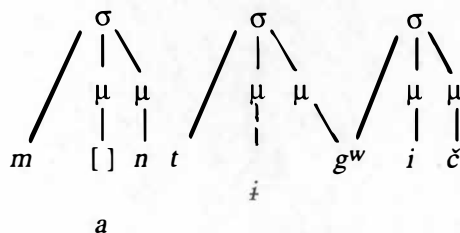
Underlying form

Affixation



Vowel deletion





Vowel epenthesis
Redundant feature
assignment

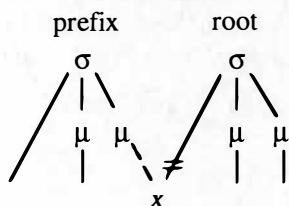
Surface form [mantiggwid] 'to inherit'

In (334), the affix *man-* attaches to the CaCVC root *tawid* [tawid] 'inheritance'; the fully underspecified segment in the V_1 root position is deleted; and an epenthetic vowel is inserted in the V_1 position, surfacing as [ɪ]. Redundant feature assignment occurs last.

3.4 CONSONANT DELINKING 3 RULE

When a prefix with an empty coda is added to a CiC_1C_1VC root type, the consonant in the first onset of the root delinks and reassociates with the prefix coda. The rule is given in (335), and an example follows in (336).

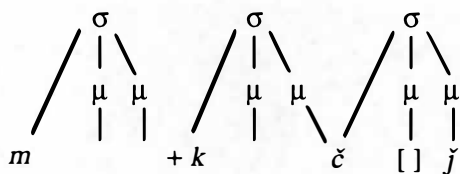
(335) Consonant Delinking 3



(336) *kičay* 'landslide'

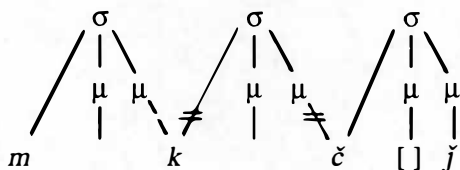
Underlying form

Affixation

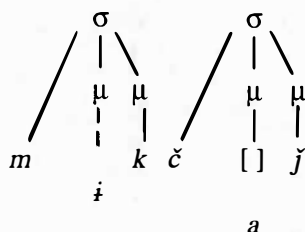


Consonant delinking 3

Consonant delinking 2



Resyllabification



Vowel epenthesis

Redundant feature assignment

Surface form

[mɪgčay] 'to be eroded'

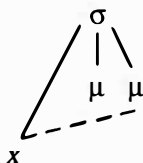
In (336), the affix *mɪ-* attaches to the C_1C_1VC root *kɪčay* [kɪčay] 'landslide'; *k* in the initial onset of the root delinks and reassociates with the empty prefix coda, surfacing as [g] (Consonant Delinking 3); *č* in the medial root position delinks from the preceding coda, but remains associated with the second onset of the root (Consonant Delinking 2); the first bimoraic unit of the root is deleted; and resyllabification takes place. Vowel epenthesis and redundant feature assignment follow.

3.5 MULTIPLE ASSOCIATION OF CONSONANT 2 RULE

When a prefix or suffix ending with a consonant is added to a C_1C_1VC root type (thereby rendering it impossible for the consonant in the initial onset of the root to delink and reassociate with a preceding coda), the initial consonant spreads from the first onset of the root to the first coda of the root. The rule is given in (337), and an example follows in (338).

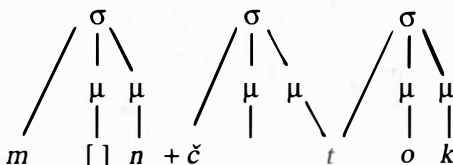
(337)

Multiple Association of Consonant 2

(338) *čɪtog* 'to throw a round object'

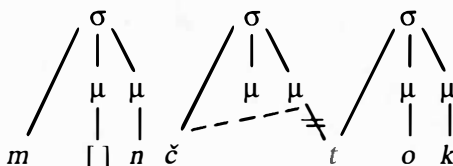
Underlying form

Affixation

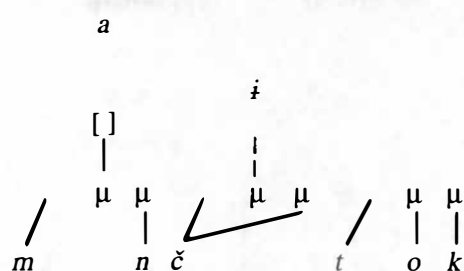


Multiple association 2

Consonant delinking 2



Redundant feature
assignment
Vowel epenthesis



Surface form

[mančɪdʊg]

In (338), the affix *man-* attaches to the C_1C_1VC root *čɪtʊg* [čɪttug] 'to throw a round object'; *č* in the initial onset of the root spreads to the first coda of the root, surfacing as [d] (Multiple Association 2); *t* in the medial root position delinks from the first coda of the root, but remains associated with the second onset (Consonant Delinking 2). Vowel epenthesis and redundant feature assignment follow.

4. ALTERNATIONS TRIGGERED BY AFFIXATION AFFECTING $?C_1C_1VC$ AND $?aCVC$ ROOT TYPES

Two additional alternations may occur with $?C_1C_1VC$ and $?aCVC$ root types: (1) the Root Coda rule, and (2) the Prefix Coda rule.

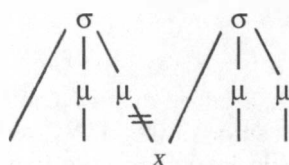
4.1 ROOT CODA RULE

When a prefix or suffix ending with a consonant is added to a $?C_1C_1VC$ or $?aCVC$ root type, the fully underspecified segment in the V_1 position of the $?aCVC$ root is deleted; then, in both root types, the multiply associated medial consonant delinks from the first coda of the root; and a fully underspecified segment is added to the first coda of the root, surfacing as [ʔ]. The rule is given in (339), and an example follows in (340).

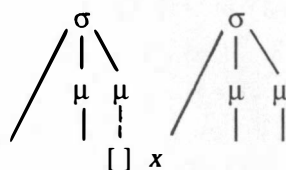
(339)

Root Coda

Consonant delinking 2



Root coda



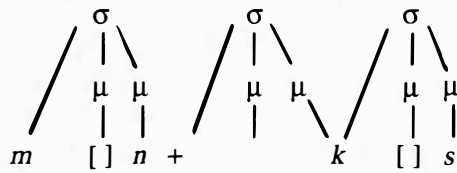
Redundant feature
assignment

[back]

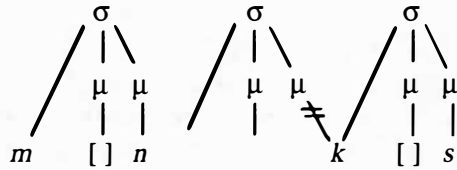
(340) *ʔikas* 'to fall'

Underlying form

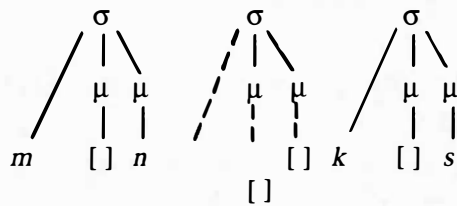
Affixation



Consonant delinking 2



Root coda



Vowel epenthesis

Glottal epenthesis

Redundant feature assignment

a $?$ a $?$ a

Surface form

[manʔaʔkas]

In (340), the affix *man-* attaches to the $\text{ʔiC}_1\text{C}_1\text{VC}$ root *ʔikas* [ʔikkas] 'to fall'; *k* in the medial root position delinks from the first coda of the root, but remains associated with the second onset (Consonant Delinking 2); and a fully underspecified segment is added to the first coda of the root, surfacing as [ʔ] (Root Coda). Vowel and glottal epenthesis take place, and redundant feature assignment follows.

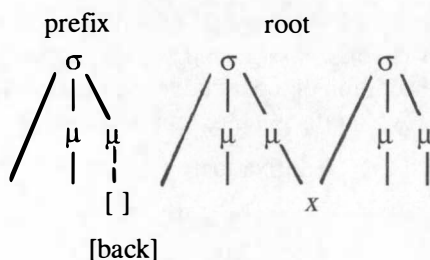
4.2 PREFIX CODA RULE

When a prefix with an empty coda is added to a $\text{ʔiC}_1\text{C}_1\text{VC}$ or ʔaCVC root type, the fully underspecified segment in the V_1 position of the ʔaCVC root is deleted; then, in both root types, a fully underspecified segment is added to the final coda of the prefix. This rule always occurs with the Consonant Delinking 2 rule. The rule is given in (341), and an example follows in (342).

(341)

Prefix Coda

Prefix coda

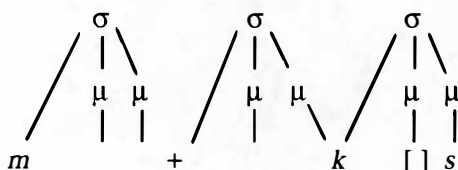


Redundant feature
assignment

(342) *ʔik*as 'to fall'

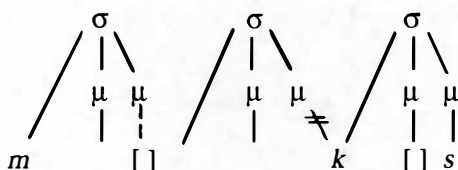
Underlying form

Affixation

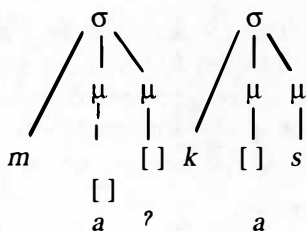


Prefix coda

Consonant delinking 2



Resyllabification



Vowel epenthesis

Redundant feature
assignment

Surface form

[maʔkas]

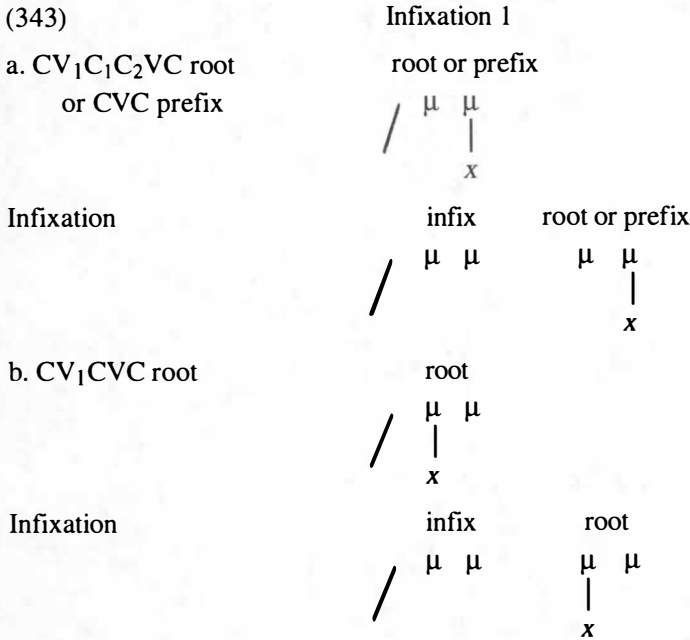
In (342), the affix *mi-* attaches to the $\text{ʔC}_1\text{C}_1\text{VC}$ root *ʔikas* [ʔikkas] 'to fall'; a fully underspecified segment is added to the coda of the prefix, surfacing as [ʔ] (Prefix Coda); *k* in the medial root position delinks from the first coda of the root, but remains associated with the second onset (Consonant Delinking 2); the first bimoraic unit of the root is deleted; and resyllabification takes place. Vowel epenthesis and redundant feature assignment follow.

5. PERFECTIVE INFIXATION

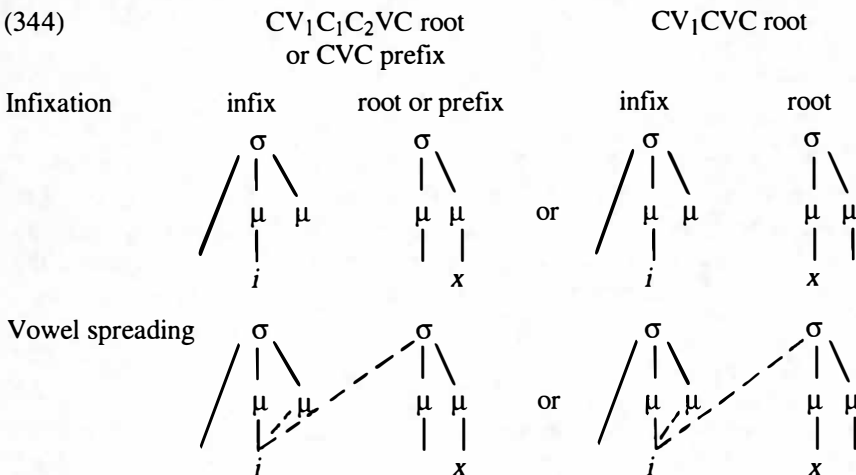
The perfective morpheme has two components: (1) a perfective segment, and (2) a bimoraic template. The basic underlying form of the perfective segment is the feature [high], or *i*. The perfective segment [high] may also occur with a nasal segment, either *n* or *m*. An infix typically inserts immediately following the initial onset of a word.

5.1 INFIXATION 1 RULE

A perfective template is added to the first underlying bimoraic unit of a root or a prefix, if either mora of the unit is singly associated with a segment. The rule in (343) represents infixation involving the addition of a perfective template; (343a) represents the first unit of a CV₁C₁C₂VC root, or a CVC prefix; (343b) represents the first unit of a CV₁CVC root type.

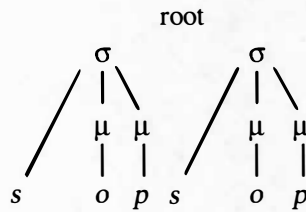


Following the addition of the template, the perfective segment [high] associates with the first mora of the template. If the V₁ position of a root lacks phonetic material, or if the V₁ position is associated with *o* or a fully underspecified segment (i.e. surface [a]) in the underlying representation, the perfective segment [high] spreads to the first coda and the second onset, surfacing as [iy], as in (344); an example follows in (345).

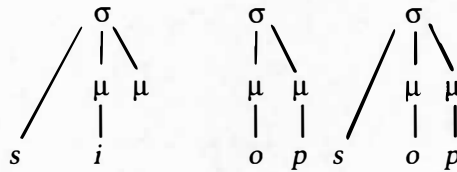


(345) *sopsop* 'to suck'

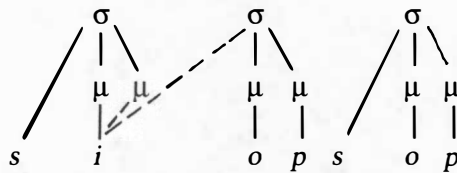
Underlying form



Infixation



Vowel spreading



Surface form

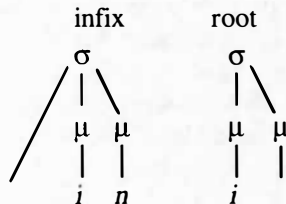
[siyupsup]

In (345), a perfective template is added to *sopsop* [supsup] 'to suck', in a $CV_1C_1C_2VC$ root in which V_1 is *o*. The template is inserted immediately following *s* in the initial onset of the root. The perfective segment [high], or *i*, associates with the nucleus of the template, and then spreads to the first coda and the second onset.

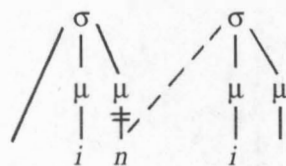
If the V_1 position of a root is associated with the feature [high] (or *i*), the perfective segment [high] does not spread; instead, the nasal *n* is added to the second mora of the template; *n* then delinks and reassociates with the following onset, surfacing as [in], as in (346). The only exception is *-im-*, the perfective form of *ʔon-*, in which the nasal of the perfective morpheme is *m*, rather than *n*.

(346)

Infixation



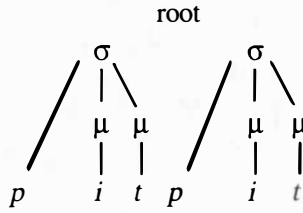
Consonant delinking 1



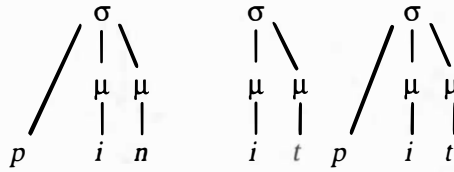
An example of the [-in-] allomorph is given in (347).

(347) *pitpit* 'to flatten'

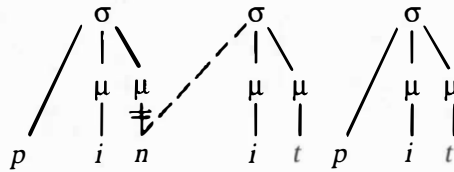
Underlying form



Infixation



Consonant delinking 1



Surface form

[pinitpit]

In (347), a perfective template is added to *pitpit* [pitpit] 'to flatten', in a CV₁C₁C₂VC root in which V₁ is *i*. The template is inserted immediately following *p* in the initial onset of the root. The perfective segment [high], or *i*, associates with the nucleus of the template, and the nasal *n* with the first coda. Then nasal *n* delinks from the first coda and reassociates with the second onset.

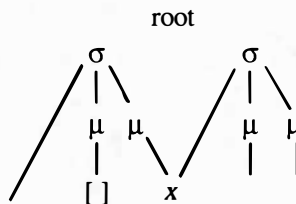
5.2 INFIXATION 2 RULE

If perfective infixation occurs in a CaCVC root in which [a] in the V₁ root position has been deleted, or in a CiC₁C₁VC root, then a perfective template is not added to the root. Instead, in a CaCVC root, the perfective segment [high] is added to the first nucleus of the root and the first coda is left unassociated; in a CiC₁C₁VC root, the perfective segment [high] is added to the first nucleus of the root and the nasal *n* to the first coda. The rule in (348) represents infixation in CaCVC and CiC₁C₁VC roots.

(348)

Infixation 2

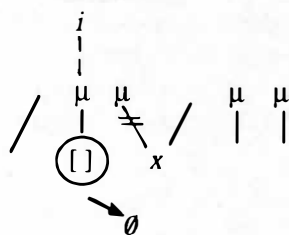
a. CaCVC root



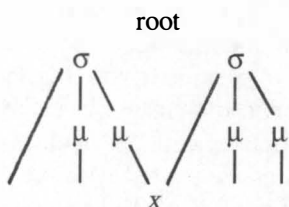
Infixation

Vowel deletion

Consonant delinking 2

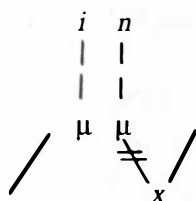


b. C_1C_1VC root



Infixation

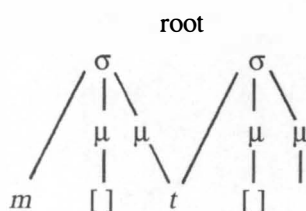
Consonant delinking 2



An example of infixation in a CaCVC root is given in (349).

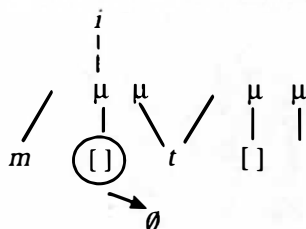
(349) *maθa* 'to see'

Underlying form

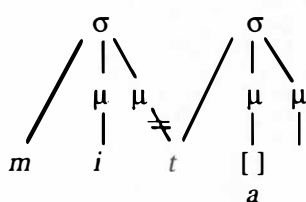


Infixation

Vowel deletion



Consonant delinking 2



Redundant feature assignment

Surface form

[mita]

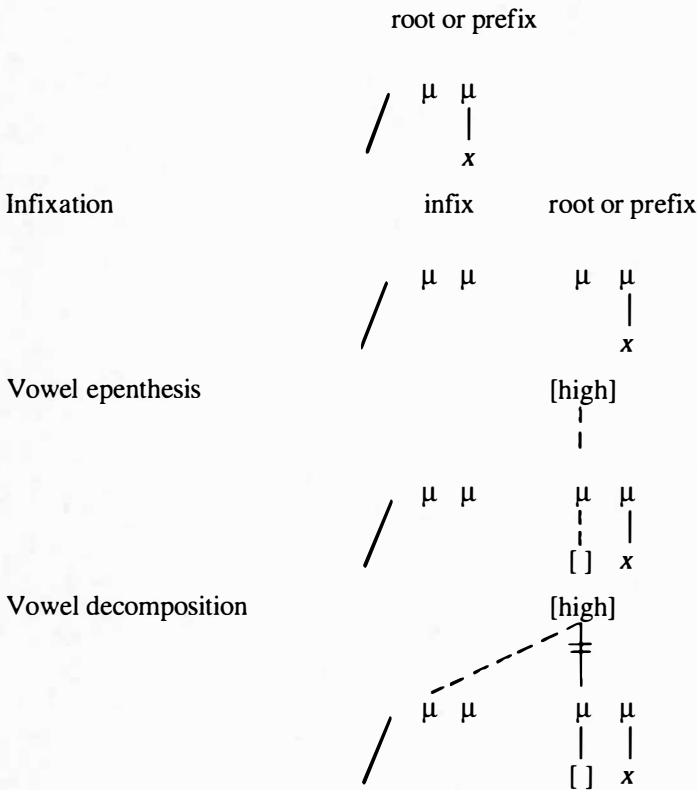
In (349), the perfective segment [high], or *i*, is added to the CaCVC root *maθa* [maθa] ‘to see’; the fully underspecified segment in the V₁ root position is deleted, and the perfective segment [high] is inserted in its place. Then *t* delinks from the first coda of the root, but remains associated with the second onset. Redundant feature assignment occurs last.

6. VOWEL DECOMPOSITION

Vowel decomposition occurs in the perfective prefixes *?i-* or *?iN-*, or in a *?iC₁C₂CVC* root. When a perfective template is added to the base of a *?i-* or *?iN-* prefix, or the first bimoraic unit of a *?iC₁C₂CVC* root, an epenthetic vowel is added to the empty nucleus of the target bimoraic unit and vowel decomposition takes place: the feature [high] delinks from the nucleus of the target unit and reassociates with the nucleus of the perfective template; the fully underspecified segment remains associated with the nucleus of the target unit. The feature [high] then spreads from the nucleus of the perfective template to the first coda and the second onset of the infixed unit. The rule for vowel decomposition is given in (350), and an example follows in (351).

(350)

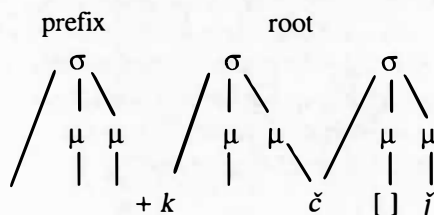
Vowel Decomposition



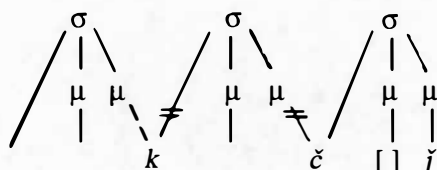
(351) *kīčay* 'landslide'

Underlying form

Affixation

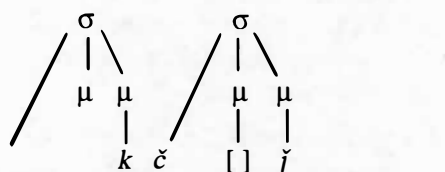


Consonant delinking 3

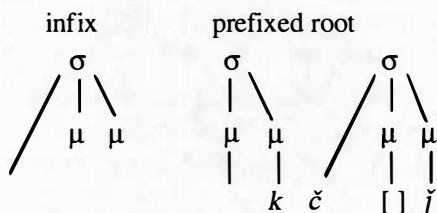


Consonant delinking 2

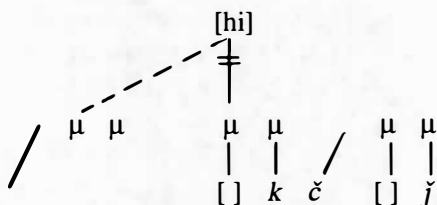
Resyllabification



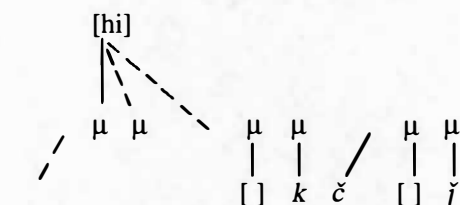
Infixation



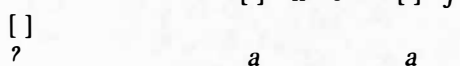
Vowel epenthesis and decomposition



Vowel spreading



Glottal epenthesis
Redundant feature
assignment



Surface form

[ʔiyagčay] 'to be eroded'

In (351), the affix *ʔi-* attaches to the C_iC_1VC root *kīčay* [kitčay] ‘landslide’; *k* in the initial onset of the root delinks and reassociates with the empty prefix coda, surfacing as [g];

č in the medial root position delinks from the preceding coda, but remains associated with the second onset of the root; and resyllabification takes place. Following resyllabification, a perfective template is added to the prefix, and an epenthetic vowel is added to the nucleus of the prefix base. The epenthetic vowel then decomposes: the feature [high] delinks from the nucleus of the prefix base and reassociates with the nucleus of the perfective template; the fully underspecified segment remains associated with the nucleus of the prefix base. Once the feature [high] reassociates, it spreads to the first coda and the second onset of the prefix. Glottal epenthesis occurs in the initial onset of the prefix, and redundant feature assignment occurs last.

7. RULE ORDERINGS

Rules are ordered in the following ways:

- (a) Firstly, if the medial consonant of a CaCVC root is **b, m, n, ŋ** or **s**, the Vowel Deletion rule must occur before the Multiple Association of Consonant 1 rule; that is, the fully underspecified segment (i.e. surface [a]) must be deleted from a V₁ root position before a medial consonant with only one surface form can spread from the second onset to the preceding coda.
- (b) Secondly, the Nasal Assimilation 2 rule must occur before the Consonant Delinking 2 rule applies to the initial consonant of the root; that is, the place feature of the initial consonant must spread to the [nasal] segment (**N**) of the prefix before the root consonant delinks from the moraic structure.
- (c) Thirdly, the Vowel Deletion rule must occur before the Root Coda rule; that is, a fully underspecified segment in the V₁ position of a ?aCVC root (surface [a]) must delink before a fully underspecified segment (surface [ʔ]) can be added to the first coda of the root.
- (d) Fourthly, the Vowel Deletion rule must occur before the Prefix Coda rule; that is, a fully underspecified segment in the V₁ position of a ?aCVC root (surface [a]) must delink before a fully underspecified segment (surface [ʔ]) can be added to the final coda of a prefix.

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