8 Morphophonemic Analysis

Morphophonemic analysis designates the analytic procedure whereby paradigms with phonological alternations are reduced to underlying representations and phonological rules. The Chimwiini example from the previous chapter is one instance of morphophonemic analysis. This chapter lays out a general method for morphophonemic analysis and illustrates it with an extended example.

8.1 A Method for Morphophonemic Analysis

When we conduct morphophonemic analysis, we seek to establish a connection between data and theory. The theory in question is the one given in the previous chapter: that morphemes are stored in the lexicon in an invariant phonemic form, are strung together by morphological and syntactic rules, and are then converted to their surface forms by a sequence of phonological rules (often neutralizing), applied in a particular order. The purpose of morphophonemic analysis is to discover a set of underlying forms and ordered rules that is consistent with the data; and the payoff is that seemingly complex patterns are often reduced to simplicity.

Morphophonemic analysis may be contrasted with phonemic analysis, covered in chapter 2. Phonemic analysis is a more limited form of phonological analysis that seeks only to discover the non-neutralizing (allophonic) rules of the phonology. In phonemic analysis, only the distribution and similarity of the phones is examined. Therefore, the data need not be grouped in paradigms, but need only comprise a sufficiently large and representative set of words.[1]

[1] The term "morphophonemic analysis" has a now obscure origin. In the 1940s and 1950s, many phonologists worked with a theory in which (roughly) all neutralizing rules were assumed to apply before all allophonic rules. This in effect divided the phonology into two components: a neutralizing component, whose units were called "morphophonemes," and a non-neutralizing component, which dealt with phonemes and allophones. This bifurcated-phonology theory is widely considered untenable today, but "morphophonemics" remains a useful term for characterizing the study of neutralizing phonological rules as they apply in paradigms.

Like phonemic analysis, morphophonemic analysis can be pursued with a systematic method, which is laid out in the sections that follow. Here is the method in broadest outline:

Procedure for Morphophonemic Analysis
- Examine the data, consulting the glosses, and make a provisional division of the forms into morphemes.
- Find each morpheme that alternates, and locate all of its allomorphs.
- Within each allomorph, locate the particular segment or segments that alternate.
- Considering the logical possibilities, set up the underlying representations so that all the allomorphs of each morpheme can be derived from a single underlying representation by general phonological rules.

This overall scheme is elaborated step by step below.

8.1.1 Pre-processing the data: phonemicization

It is almost always easier to do morphophonemic analysis with data that are already expressed as phonemes, so if this has not already been done, it is advisable first to reduce the data to phonemes, using the method laid out in chapter 2.

8.1.2 Morpheme division

The next step is to break up the forms into their component morphemes. A potential complication is that phonological alternations may obscure this division. In the hard cases, one must try more than one possibility for "placing the hyphens," ultimately selecting the choice that yields a working analysis. As the words are divided into morphemes, it is usually also possible to state and order the rules of morphology that are active.

8.1.3 Setting up underlying representations

As with morpheme division, the problem of choosing underlying representations often involves considering more than one hypothesis, with the final choice defended by its leading to a working analysis. The following strategy is often helpful. Suppose segment A alternates with segment B in the data. In such a case, the analyst should consider two possibilities:

1 Segments showing A ~ B alternation are underlyingly /A/, which is converted to [B] in certain contexts by one or more phonological rules.

2 Segments showing A ~ B alternation are underlyingly /B/, which is converted to [A] in certain contexts by one or more phonological rules.

In other words, always consider both directions.

To give a concrete example: if we were analyzing Chimwiini (as in the previous chapter), we would find many instances of long vowels alternating with short, as in

[x-s**o:**m-a]	'to read'
[x-s**o**m-o:w-a]	'to be read'

We would consider the possibility that such cases are underlyingly long vowels ('read' = /so:m/), and consider shortening rules (this turns out to be correct), as well as the possibility that these are underlyingly short vowels ('read' = /som/), and consider lengthening rules (this turns out to fail; see §8.1.6 below).

8.1.4 Constructing underlying representations under a particular hypothesis

Assuming that you have picked a particular direction for the rules (/A/ → [B], or /B/ → [A]) and are trying it out, the next step is to construct underlying representations. Here is a recommended procedure.

- Segments that do not alternate can (normally) be assumed to be phonemically identical in their underlying representation to their surface representation. (This presupposes, as already noted, that phonemic analysis is already accomplished, so any positional allophones will already appear in their underlying form.)
- For segments that alternate, follow the hypothesis you made about underlying forms, implementing it consistently through the data. Thus if you are assuming that an alternation A ~ B, found in a particular context, is underlain by A, you should set up /A/ in the underlying representation for all such alternations in that context.
- Be sure that the underlying representation of each morpheme is uniform throughout its paradigm – this is a basic hypothesis of the theory you are assuming.

In our example of [x-s**o:**m-a] ~ [x-s**o**m-o:w-a], under the hypothesis that the rule is a shortening rule, these principles force us to set up the underlying representations /so:m/ for the root, and /-o:w/ for the invariantly long passive suffix.[2]

[2] The final vowel /-a/ turns out to be a special case: its surface length is actually non-distinctive, being determined entirely by the phonological rules. Our grammar will work no matter what underlying length is assigned to this suffix.

8.1.5 Working out the rules

When you have a suitable set of hypothesized underlying forms, it is helpful to arrange them in a row, aligning their corresponding surface forms underneath them, as follows:

‘to read’ (p. 153)	‘to be read’ (p. 153)	‘to stop for one another’ (p. 148)	
/x-soːm-a/	/x-soːm-oːw-a/	/ku-reːb-e̩l-an-a/	underlying forms
. . .	. . .	. . .	*add rules here*
[xsoːma]	[xsomoːwa]	[kurebe̩lana]	surface forms

It is then a matter of coming up with a rule system that will derive the bottom row from the top. If you get stuck doing this, you can try collecting the **local environments** for the sounds that change, as described above for phonemic analysis (§2.10.3).

8.1.6 A clue for choosing underlying representations

When you are deciding whether to set up underlying A and derive B from it, or vice versa (see §8.1.4), there is often a clue in the data to guide you, namely, a contextually limited contrast (§3.6; §6.3). In the present case, note that while vowel length is phonemic in Chimwiini, only short vowels are allowed when more than three syllables from the end of a phrase, or when a long vowel follows. Such limitations are a strong clue that there must be a rule that wipes out the contrast in these environments.[3]

Another way of saying the same thing is: *don’t analyze in a direction opposite to that of a neutralization*. When we analyze Chimwiini with shortening, our analysis fits in well with the contextually neutralized distribution of long and short vowels in the language. If, however, we try to analyze Chimwiini with lengthening, the phonological distribution will stymie us. The following quadruplet of forms should make this point clear.

[x-k**uː**l-a]	‘to extract’	[x-k**u**l-oːw-a]	‘to be extracted’
[x-k**u**l-a]	‘to grow’	[x-k**u**l-oːw-a]	‘to be grown’

The top row of forms shows an alternation between [uː] and [u], which we earlier analyzed assuming underlying /uː/ and the neutralizing rule of Pre-Long

[3] Indeed, under one approach to contextually limited contrast (see §3.6), something like the rules of Preantepenultimate Shortening and Pre-Long Shortening would have to be assumed for Chimwiini, even if the language had no alternations at all.

Shortening (p. 154). It is plain that Pre-Long Shortening is neutralizing, since the passive form of [x-kuːl-a], [x-kul-oːw-a], is identical to the passive of [x-kul-a], meaning 'to grow'. If we had wrongly chosen underlying /u/ for the root meaning 'extract', we would be defeated: no matter what lengthening rule we tried, it would be unable to derive [x-kuːl-a] for 'extract' and [x-kul-a] for 'grow', since these two forms would have the same underlying representation.

8.2 The Isolation Form Shortcut and Why It Sometimes Fails

When one is looking for underlying forms, it is tempting to appeal to a "shortcut" that finds them with great speed:

The Isolation Form Shortcut
"The underlying form of a stem is simply the way that the stem appears in isolation (taking away the effects of any allophonic rules)."

This strategy particularly suggests itself for languages like English, where stems frequently appear alone. Hearing an alternation like ['plænt] ~ ['plænɪŋ] (*plant ~ planting*; see §6.2.2), we are tempted to take the evidence of the isolation form ['plænt] as evidence sufficient in and of itself to justify the underlying form /'plænt/. This turns out to work fine for this particular case, and it also suffices for the Chimwiini example of the previous chapter.

However, the Isolation Form Shortcut does not work in general. The reason for this lies in how the system is set up, and simple logic: it is certainly possible that neutralization rules could apply *just in case no affix is added to a stem*. We would say that in such cases, the affix "protects" the stem from the neutralizing rule, serving as a kind of buffer.

To make this more precise: neutralizing phonological rules are often conditioned by word edge; that is, they have environments like / ___ $]_{word}$. When an affix is present, a stem will be buffered by the affix, and the crucial rule won't apply. Indeed, the rule will apply in *only those members of the paradigm where there is no affix*, so that the buffering effect is absent.

Phonologies that have this kind of phenomenon are quite common, occurring in Korean, Japanese, English, German, Russian, and many other languages. The next section gives a fairly elaborate example from a less familiar language. We will develop the analysis systematically, showing how following the method laid out in §8.1 above can locate the right underlying forms, even where the isolation form shortcut fails.

8.3 Lardil

Lardil is an Australian aboriginal language, spoken on Mornington Island just off the northern coast of the continent in the Bay of Carpinteria. The description and analysis below are taken from the work of the late Kenneth Hale, with additional ideas taken from later researchers who combed through Hale's data seeking further improvements in the analysis. Lardil is of particular interest here because it is a fairly dramatic instance of a language in which the underlying form of a stem cannot be determined from its isolation form.

8.3.1 Segment inventory

As the following chart shows, Lardil has four contrasting vowel qualities, each occurring in short and long versions:

	[+front, −back]	[−front, −back]	[−front, +back]
[+high, −low]	i, iː		u, uː
[−high, +low]	æ, æː[4]	a, aː	

The consonant system of Lardil is more elaborate, with four different types of coronal consonant. The four types form a symmetrical inventory, with apical (tongue tip) and laminal (tongue blade) consonants both in front of and behind the alveolar ridge.

	Labial	Apico-alveolar	Apico-palatal (=retroflex)	Lamino-dental	Lamino-palatal	Velar
Voiceless stops	p	t	ʈ	t̪	tʲ	k
Nasals	m	n	ɳ	n̪	nʲ	ŋ
Tap		ɾ				
Approximants:						
lateral		l				
central	w		ɻ		j	

In features, the coronals of Lardil will be classified here as in table 8.1.

[4] A minority of Lardil speakers use [e] or [ɛ] in place of [æ]; for these speakers, the phonological rules would have to be stated slightly differently.

Table 8.1 Features for coronal consonants in Lardil

[–distributed]		[+distributed]	
[+anterior]	[+anterior]	[+anterior]	[–anterior]
t, n	ʈ, ɳ	t̪, n̪	tʲ, nʲ

8.3.2 Data and beginning analysis

The paradigm data that suffice to get us started consist of uninflected noun stems and two of their inflected forms: the accusative nonfuture, and the accusative future (remarkably, Lardil nouns inflect for tense, in agreement with the verb). In the data, morpheme breaks are marked with hyphens:

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[kæntapal]	[kæntapal-in]	[kæntapal-uɻ]	'dugong'
[t̪uŋal]	[t̪uŋal-in]	[t̪uŋal-uɻ]	'tree'
[kæt̪aɾ]	[kæt̪aɾ-in]	[kæt̪aɾ-uɻ]	'river'
[tʲumuɾ]	[tʲumuɾ-in]	[tʲumuɾ-uɻ]	'coolimon (a container)'
[mijaɻ]	[mijaɻ-in]	[mijaɻ-uɻ]	'spear'

A reasonable preliminary hypothesis for these data is as follows: there is no ending for the uninflected noun, the accusative nonfuture form takes the suffix /-in/, and the accusative future form takes the suffix /-uɽ/. We can write the morphological rules as follows:

Accusative Nonfuture Formation
X → Xin when [Noun, +accusative, –future]

Accusative Future Formation
X → Xuɻ when [Noun, +accusative, +future]

Here are more data:

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[mæla]	[mæla-n]	[mæla-ɻ]	'sea'
[wanka]	[wanka-n]	[wanka-ɻ]	'arm'
[kuŋka]	[kuŋka-n]	[kuŋka-ɻ]	'groin'
[t̪awa]	[t̪awa-n]	[t̪awa-ɻ]	'rat'
[taɾŋka]	[taɾŋka-n]	[taɾŋka-ɻ]	'barracuda'
[tʲæmpæ]	[tʲæmpæ-n]	[tʲæmpæ-ɻ]	'mother's father'
[wiʈæ]	[wiʈæ-n]	[wiʈæ-ɻ]	'interior'

We see here two new allomorphs of the accusative nonfuture and the accusative future suffixes: [-n] and [-ɽ]. These allomorphs apparently are what we get after stems that end in a vowel (for the moment, these stem vowels are limited to /a/ and /æ/; further cases will appear below).

Let us now follow the analytical procedure laid out earlier in this chapter. We have the alternation [-in] ~ [-n] in the accusative nonfuture suffix and [-uɻ] ~ [-ɻ] in the accusative future. According to the principle that tells us to consider both directions, we should think about two possibilities: namely, that the underlying representations are [-in] and [-uɻ], with deletion of vowels, or that the underlying representations are [-n] and [-ɻ], with insertion of vowels.

Consider first the hypothesis that the underlying forms are /-in/ and /-uɻ/. We would set up representative underlying and surface forms as follows, and suppose that mediating between them is a "Rule X," whose nature we have not yet determined:

/kæntapal-in/	/kæntapal-uɻ/	/mæl**a-i**n/	/mæl**a-u**ɻ/	underlying forms
—	—	mælan	mælaɻ	Rule X
[kæntapalin]	[kæntapaluɻ]	[mælan]	[mælaɻ]	surface forms

In fact, this looks straightforward: Lardil, like many other languages, forbids consecutive vowels (a configuration often called **hiatus**), and alters the underlying forms whenever such configurations arise. The hiatuses that are avoided in the above examples are shown in boldface. Apparently, Rule X must be something like this:

Vowel Deletion
[+syllabic] → ∅ / [+syllabic] ___
Delete a vowel after a vowel.

This successfully derives the outputs above from the inputs. In passing, we can note that it also fits what phonologists have learned in language surveys of hiatus resolution: very often, languages avoid hiatus by sacrificing an affix vowel rather than a stem vowel.

Now consider the alternative hypothesis mentioned above: that the vowel ~ zero alternations result from underlying zero, with *insertion* of vowels:

/kæntapal-n/	/kæntapal-ɻ/	/mæla-n/	/mæla-ɻ/	underlying forms
kæntapal**i**n	kæntapal**u**ɻ	—	—	Rule Y
[kæntapalin]	[kæntapal-uɻ]	[mæla-n]	[mæla-ɻ]	surface forms

This doesn't look promising: while we would have no trouble in determining *where* the epenthetic (= inserted) vowel should go (it breaks up word-final consonant sequences), we are basically stuck in determining *which* vowel should be inserted: is it [i] or [u]? There seems to be no principled basis for making this

prediction. A reasonable conclusion, then, is that Rule Y simply doesn't exist, and that this approach is not the right one. We choose instead (at least tentatively) to adopt our earlier hypothesis, that the suffix vowels are underlyingly present but deleted in hiatus.

Our choice represents a use of the principle given in §8.1.6 above, whereby we make use of the patterns of restricted contrast in the language to guide us in the choice of underlying representations: since Lardil makes no contrast of vowel vs. consonant in the position after a vowel (only consonants are legal), the Vowel Deletion analysis, which is based on this pattern, will work. In contrast, any analysis that tried to insert the alternating vowels would be working against the direction of neutralization, since Lardil neutralizes (for example) underlying /a+i/ and /a+u/ as surface [a].

Summing up, the analysis so far includes the two morphological rules of Accusative Nonfuture Formation and Accusative Future Formation, and one phonological rule of Vowel Deletion.

8.3.3 Alternations of vowel quality

A more pervasive alternation is seen in the following forms:

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[ŋuk**a**]	[ŋuk**u**-n]	[ŋuk**u**-ɻ]	'water'
[kaʈ**a**]	[kaʈ**u**-n]	[kaʈ**u**-ɻ]	'child'
[ŋaw**a**]	[ŋaw**u**-n]	[ŋaw**u**-ɻ]	'wife'
[pulp**a**]	[pulp**u**-n]	[pulp**u**-ɻ]	'mound, hill'
[muɳ**a**]	[muɳ**u**-n]	[muɳ**u**-ɻ]	'elbow'

To start, we must first make decisions about the morphological composition of the data. The presentation of the data above, with hyphens, indicates a particular decision on this point: the two suffixes that are underlyingly /-in/ and /-uɻ/ are shown as just [-n] and [-ɻ], under the assumption that these five stems are vowel-final stems and that Vowel Deletion has removed underlying vowels after them. Another possibility to consider is that (say) [ŋukuɻ] should be divided as [ŋuk-uɻ], treating [ŋuk] as a consonant stem. However, under this view we would expect *[ŋuk-in], not [ŋukun], for the accusative nonfuture. For this reason, it appears that these stems must be treated as ending in [u].

In light of this, we must deal with the alternation [a] ~ [u]: the uninflected forms have [a] in the location corresponding to [u] in the suffixed forms, appearing in boldface above. We can as usual consider two analyses.

First, the underlying forms of these stems might simply be the same as the isolation forms, and thus end in /a/ (/ŋuka/, /kaʈa/, /ŋawa/). We then need to figure out just why the /a/s should show up as /u/ when a suffix is present. This turns out to pose insuperable problems. The difficulty is that while the forms just given

do alternate in this way, an earlier set of stems (three of them are repeated below) also end in /a/ and fail to alternate, keeping /a/ across the board.

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[mæl**a**]	[mæl**a**-n]	[mæl**a**-ɻ]	'sea'
[wank**a**]	[wank**a**-n]	[wank**a**-ɻ]	'arm'
[kuŋk**a**]	[kuŋk**a**-n]	[kuŋk**a**-ɻ]	'groin'

The dilemma is made clearest if we give charts showing the sort of derivations that we would want, if this were a workable analysis:

/ŋuka/	/ŋuka-in/	/wanka/	/wanka-in/	underlying forms
—	ŋukan	—	wankan	Vowel Deletion
—	**u**	—	**NO**	Rule X
[ŋuka]	[ŋukun]	[wanka]	[wankan]	surface form

The failure of this account should be clear: Rule X, whatever it is, must somehow convert /ŋuk**a**n/ to [ŋuk**u**n], but not convert /wank**a**n/ to *[wank**u**n]. The number of preceding consonants cannot matter, since /mæla-(i)n/ keeps its /a/: [mælan], just like /wanka/. Unless there is some environment no one has yet noticed that turns out to work, we are exploring a dead end.

Faced with failure from the /a/ → [u] direction for our rule, we can continue by trying the /u/ → [a] direction. What this means is that for those stems that alternate [u] and [a], we set up underlying /u/ in the relevant position. Doing this for the same cases, and setting up the underlying forms, we have the following:

/ŋuku/	/ŋuku-in/	/wanka/	/wanka-in/	underlying forms
—	ŋukun	—	wankan	Vowel Deletion
a	—	—	—	Rule X
[ŋuka]	[ŋukun]	[wanka]	[wankan]	surface form

What is this Rule X that converts /u/ to [a]? Plausibly, its environment is simply word-final position. I will state it tentatively as follows:

Final Lowering (tentative version)
u → a / ___]$_{\text{word}}$
Lower /u/ *to* [a] *if it occurs at the end of a word.*

Does this rule work? Plainly, it does account for the data we are looking at right now, as we have seen no instances of surface [u] in final position. But if it is to count as a valid rule, it must be correct for the language as a whole, because under the theory assumed all words are submitted to the same set of phonological rules. Therefore, to check the analysis properly, we must search the whole

language, to see if word-final /u/'s actually exist: if they do, then our rule cannot work, and we are back at square one.

In actual fact, the rule does work. There *are* some final /u/s, but they have an independent explanation based on rule ordering. This will be given in §8.3.10 below, once we have examined additional data.

8.3.4 Underlying forms are not always isolation forms

The portion of the analysis just established is our first illustration of the inadequacy of the Isolation Form Shortcut (p. 165). It is tempting, from knowing that the stem for 'water' in Lardil pronounced alone is [ŋuka], to assume that the underlying representation of this stem is simply /ŋuka/. However, we need to account not just for this plain-stem form, but for the whole paradigm, and for this purpose the more remote underlying representation /ŋuku/ is needed.

The other lesson that emerges is that a word edge can act as a crucial phonological environment. This is actually quite common in phonology, particularly for the edge that comes at the end of a word. Right word edges, though not audible and not physically articulated, induce a great variety of phonological changes: devoicing (German, Polish, Quiché), vowel lengthening (Chimwiini), glottal stop insertion (Japanese), consonant loss (Catalan), and vowel loss (Latvian, and as we will shortly see, Lardil). The phonological effects of word edges are discussed further in chapter 10.

8.3.5 Generalizing Final Lowering to front vowels

The hypothesis that Final Lowering is a rule of Lardil phonology is further supported when we look at other data:

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[kæɳʈæ]	[kæɳʈ**i**-n]	[kæɳʈ**i**-wuɻ]	'wife'
[ŋiɳæ]	[ŋiɳ**i**-n]	[ŋiɳ**i**-wuɻ]	'skin'
[papæ]	[pap**i**-n]	[pap**i**-wuɻ]	'father's mother'
[tʲimpæ]	[tʲimp**i**-n]	[tʲimp**i**-wuɻ]	'tail'
[nʲæɾwæ]	[nʲæɾw**i**-n]	[nʲæɾw**i**-wuɻ]	'place'

These involve an alternation between a low and a high vowel, [æ] ~ [i], which parallels the alternation we saw earlier of [a] ~ [u]. There is, moreover, another alternation, with [w] appearing in the Accusative Future suffix; more on this shortly.

For the height alternation, the same considerations seen earlier show that the alternation must be due to lowering, not raising: there are stems (repeated below) that have final [æ] throughout the paradigm.

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[tʲæmpæ]	[tʲæmpæ-n]	[tʲæmpæ-ɻ]	'mother's father'
[wiʈæ]	[wiʈæ-n]	[wiʈæ-ɻ]	'interior'

As before, the underlying stem-final vowels must be the ones that appear in the contextual allomorphs: thus [tʲæmpæ] is underlyingly /tʲæmpæ/, while [papæ] is underlyingly /papi/.

The fact that both show up with final [æ] in their isolation forms will follow from a generalized version of Final Lowering, which lowers not just /u/ to [a], but also /i/ to [æ]. To make both changes in one rule, we can use features as follows:

Final Lowering

$$[+\text{syllabic}] \rightarrow \begin{bmatrix} -\text{high} \\ +\text{low} \\ -\text{back} \\ -\text{round} \end{bmatrix} / \_\_\_]_{\text{word}}$$

This rule changes [round], so that /u/ will become unrounded, and it also changes [back], so that /u/ will become central [a] rather than back [ɑ]. These changes are vacuous (harmless) in the case of /i/, which is already [–round, –back].

Here are sample derivations for representative stems ending in /i/ and /æ/:

/papi /	/papi-in/	/wiʈæ/	/wiʈæ-in/	underlying forms
—	papin	—	wiʈæn	Vowel Deletion
æ	—	—	—	Final Lowering
[papæ]	[papin]	[wiʈæ]	[wiʈæn]	surface forms

There is one further detail: recall that after stems ending underlyingly in /i/ (data on p. 171), the accusative future ending /-uɻ/ shows up with the allomorph /-wuɻ/, as in [kæɳʈæ] ~ [kæɳʈi-n] ~ [kæɳʈi-**w**uɻ]. While various analyses are possible, it seems at least reasonable to suppose that this is due to epenthesis of /w/, by the following rule:

/w/ Epenthesis
∅ → w / i ___ u
Insert [w] *between* [i] *and* [u].

This can be seen, like Vowel Deletion, as a hiatus-resolving rule. It is fairly common for languages to resolve high-vowel hiatus by inserting a glide that is **homorganic** (shares the same articulatory position) with one of the two adjacent vowels; here, [w] is homorganic with [u]. Some varieties of English have such glides; they appear in emphatic speaking style and are homorganic with a preceding high vowel: /ˈsuɚ/ → [ˈsu**w**ɚ] *sewer*, /ˈbi-ɪŋ/ → [ˈbiɰɪŋ] *being*.

/w/ Epenthesis must be ordered before Vowel Deletion. Both "try" to resolve hiatus. In cases where the hiatus is /iu/, /w/ Epenthesis gets the first chance, resolving it as [iwu]. The hiatus being resolved, Vowel Deletion is blocked. Vowel Deletion does get to apply, however, in all other cases.

Putting this all together, we can now give a fairly complete analysis of the vowel-final stems. Here are derivations for each of four vowel phonemes of Lardil, /i/, /æ/, /u/, and /a/:

/papi/	/papi-in/	/papi-uɻ/	/wiʈæ/	/wiʈæ-in/	/wiʈæ-uɻ/	underlying forms
—	—	papi**w**uɻ	—	—	—	/w/ Epenthesis
—	papin	—	—	wiʈæn	wiʈæɻ	Vowel Deletion
æ	—	—	—	—	—	Final Lowering
[papæ]	[papin]	[papiwuɻ]	[wiʈæ]	[wiʈæn]	[wiʈæɻ]	surface forms

/ŋuku/	/ŋuku-in/	/ŋuku-uɻ/	/wanka/	/wanka-in/	/wanka-uɻ/	underlying forms
—	—	—	—	—	—	/w/ Epenthesis
—	ŋukun	ŋukuɻ	—	wankan	wankaɻ	Vowel Deletion
a	—	—	—	—	—	Final Lowering
[ŋuka]	[ŋukun]	[ŋukuɻ]	[wanka]	[wankan]	[wankaɻ]	surface forms

8.3.6 A minor phenomenon

The following sections will cover the most important phonological rules of Lardil. However, to make the presentation as clear as possible it will be useful first to dispose of a minor corner of the system. The following data are paradigms of stems that end in a nasal consonant.

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[jaɾaman]	[jaɾaman-in]	[jaɾaman-**k**uɻ]	'horse'
[piɾŋæn]	[piɾŋæn-in]	[piɾŋæn-**k**uɻ]	'woman'
[kaɳtʲin]	[kaɳtʲin-in]	[kaɳtʲin-**k**uɻ]	'wallaby'
[tupalan]	[tupalan-in]	[tupalan-**k**uɻ]	'road'
[maːɳ]	[maːɳ-in]	[maːɳ-**k**uɻ]	'spear'

The accusative nonfuture forms are just as we would expect (no phonology applies), but the accusative future, normally /-uɻ/, shows a curious and unexpected [k]. Various analyses of this /k/ are possible; for now we assume that it is inserted by a rule of epenthesis. Inspection suggests that to get this to work will require a rather complicated and arbitrary-seeming rule:

/k/ Epenthesis
∅ → k / [+nasal] ___ uɻ
Insert [k] *between a nasal sound and a following* /uɻ/ *sequence.*

Here is a sample derivation:

/piɾŋæn-uɻ/	underlying form
k	/k/ Epenthesis
[piɾŋænkuɻ]	surface form

No rule ordering is required. /k/ Epenthesis will serve our purposes for now, deriving the correct Accusative Future forms for nasal stems. However, as it is rather suspect due to its complexity, we will explore an alternative approach in §9.9.

8.3.7 Some more dramatic alternations

The following stems show a pattern of alternation we have not previously seen.

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[jalul]	[jalul**u**-n]	[jalul**u**-ɻ]	'flame'
[majaɾ]	[majaɾ**a**-n]	[majaɾ**a**-ɻ]	'rainbow'
[wiwal]	[wiwal**a**-n]	[wiwal**a**-ɻ]	'bush mango'
[puṯuɻmaɾ]	[puṯuɻmaɾ**a**-n]	[puṯuɻmaɾ**a**-ɻ]	'native companion'
[kaɾikaɾ]	[kaɾikaɾ**i**-n]	[kaɾikaɾ**i**-wuɻ]	'butterfish'
[kaŋkaɻ]	[kaŋkaɻ**i**-n]	[kaŋkaɻ**i**-wuɻ]	'father's father'
[jilijil]	[jilijil**i**-n]	[jilijil**i**-wuɻ]	'species of oyster'

The suffix allomorphs we see ([-n], [-ɻ], [-wuɻ]) are what we would expect, given the preceding stem vowels. However, the stem vowels alternate with zero in the uninflected form, an alternation not previously seen. We must therefore consider two hypotheses, deletion and insertion.

Insertion doesn't look promising, because there is no straightforward basis for determining which vowel should be inserted – it can be [u], [i], or [a] (the absence of cases with [æ] appears to be accidental).

Deletion looks more promising. Examine in particular the following partial derivation, for the paradigm of the stem /kaɾikaɾi/:

/kaɾikaɾi/	/kaɾikaɾi-in/	/kaɾikaɾi-uɻ/	underlying forms
—	—	—	/k/ Epenthesis
—	—	kaɾikaɾiwuɻ	/w/ Epenthesis
—	kaɾikaɾin	—	Vowel Deletion
kaɾikaɾ	**—**	**—**	**Rule X**
[karikaɾ]	[karikarin]	[karikariwuʈ]	surface forms

An encouraging thing to notice, even before we try to figure out Rule X, is that the underlying form, under this analysis, is an "inherently reduplicated" stem,

that is, two copies of /kaɾi/. Many other cases of this type are found in Lardil; for example /jilijili/ and others given below. While /kaɾi/ is apparently not in itself a meaningful morpheme of Lardil, it remains true that quite a few languages (e.g. Ilokano, Toba Batak, Arabic, Hebrew) employ this kind of stem frequently. So this gives the deletion analysis some plausibility, even before we've got the relevant rule worked out.

As for the rule: it appears to delete vowels in final position, a common phonological process (seen also in Menomini, French, Ponapeian, and Middle English). The hard part is to determine why final vowel drop should occur in the forms presently under consideration, but not in the data we saw earlier – which also include underlying final vowels. You may find it useful to look over the data again and try to figure out the answer before going on. The relevant earlier cases to compare are on pp. 167, 169, and 171.

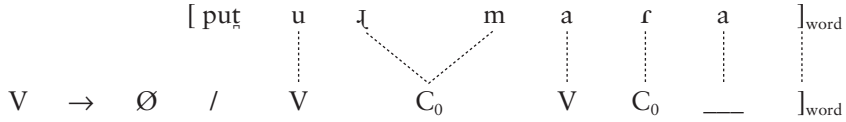
The answer is that vowel drop depends on the underlying length of the stem. Specifically, no stem ever loses its final vowel if it has just two vowels to start with. This restriction can be formalized in the deletion rule, which is stated below. The name of the rule, Apocope ([ə'pɑkəpi]), is a traditional phonological term meaning "deletion in final position":

Apocope

$V \rightarrow \varnothing$ / V C_0 V C_0 ___]$_{word}$

Delete the final vowel of the word if at least two vowels precede it.

The formalism of the rule is explained as follows. C_0, introduced on p. 154, means "any number of consonants." Thus, to apply the rule to a form like /puṯuɻmaɾa/ 'native companion-uninflected', the matchup between rule and form would be as follows:



With the rule of Apocope in place, we can compare the derivations of a short and a long stem. Apocope only applies to /puṯuɻmaɾa/, where enough underlying vowels are present; /papi/ lacks the required three vowels.

/papi/	/papi-in/	/papi-uɻ/	/puṯuɻmaɾa/	/puṯuɻmaɾa-in/	/puṯuɻmaɾa-uɻ/	underlying forms
—	—	papi**w**uɻ	—	—	—	/w/ Epenthesis
—	—	—	—	—	—	/k/ Epenthesis
—	papin	—	—	puṯuɻmaɾan	puṯuɻmaɾaɻ	Vowel Deletion
æ	—	—	—	—	—	Final Lowering
NO	—	—	puṯuɻmaɾ	—	—	Apocope
[papæ]	[papin]	[papiwuʈ]	[puṯuɻmaɾ]	[puṯuɻmaɾan]	[puṯuɻmaɾaɻ]	surface forms

8.3.8 Cluster Reduction

Consider next the following forms.

Uninflected	Acc. Nonfuture	Acc. Future	Gloss
[jukaɾ]	[jukaɾ**pa**-n]	[jukaɾ**pa**-ɻ]	'husband'
[wulun]	[wulun**ka**-n]	[wulun**ka**-ɻ]	'species of fruit'
[wuʈal]	[wuʈal**tʲi**-n]	[wuʈal**tʲi**-wuɻ]	'meat'
[paɳtʲipaɳ]	[paɳtʲipaɳ**tʲi**-n]	[paɳtʲipaɳ**tʲi**-ɻ]	'hat'
[kantukan]	[kantukan**tu**-n]	[kantukan**tu**-ɻ]	'red'
[kaɾwakaɾ]	[kaɾwakaɾ**wa**-n]	[kaɾwakaɾ**wa**-ɻ]	'species of wattle'
[jaɾpajaɾ]	[jaɾpajaɾ**pa**-n]	[jaɾpajaɾ**pa**-ɻ]	'bird species'

Like the previous ones, these show vowel ~ zero alternations, but also consonant ~ zero alternations. For example, in [jukaɾ], both the /p/ and the /a/ seen in [jurkaɾpa] are missing. As before, it is unlikely that the consonants could be derived by insertion, since there are several different consonants that alternate ([p, t, tʲ, k, w] in these forms), and the environment for inserting different consonants would be impossible to state.

Often when the analysis has reached a certain state of development, the best analytic procedure is to set up the most likely underlying forms, run them through the rules developed so far, and see in what way the result diverges from the actual outcomes. At this stage, we have a fairly clear notion that we should not be looking to the uninflected forms, but rather to the suffixed forms, to give us the underlying forms. If we set up our underlying forms and derivations on this basis, we obtain the following set of predicted output forms:

/jukaɾpa/	/jukaɾpa-in/	/jukaɾpa-uɻ/	underlying forms
—	—	—	/k/ Epenthesis
—	—	—	/w/ Epenthesis
—	jukaɾpan	jukaɾpaɻ	Vowel Deletion
—	—	—	Final Lowering
jukaɾp	—	—	Apocope
*[jukaɾp]	[jukaɾpan]	[jukaɾpaɻ]	predicted surface forms

The analysis works except where it generates *[jukaɾp] instead of the correct [jukaɾ]. It would likewise also generate the incorrect *[wulunk], *[wuʈalʲ], *[paɻtʲipaɳtʲ], *[kantukant], *[kaɾwakaɾw], and *[jaɾpajaɾp] for the forms given above. This problem is not hard to fix, provided one notices that no word in Lardil ever ends with a sequence of consonants. What seems to be happening is this: Apocope applies freely to words of sufficient length, and when it creates a final consonant cluster, a further rule eliminates the cluster by deleting its second member.

The rule may be formulated as follows:

Cluster Reduction
$C \rightarrow \varnothing$ / C ___]$_{word}$
Delete a word-final consonant when it is preceded by a consonant.

This leads to the correct outcome, as follows:

/jukaɾpa/	/jukaɾpa-in/	/jukaɾpa-uɻ/	underlying forms
—	—	—	/k/ Epenthesis
—	—	—	/w/ Epenthesis
—	jukaɾpan	jukaɾpaɻ	Vowel Deletion
—	—	—	Final Lowering
jukaɾp	—	—	Apocope
jukaɾ	—	—	Cluster Reduction
[jukaɾ]	[jukaɾpan]	[jukaɾpaɻ]	surface forms

Plainly, Cluster Reduction must be ordered after Apocope, since it is Apocope that exposes the consonant cluster to word-final position.

Cluster Reduction also applies in a few forms that end *underlyingly* in clusters, such as the following:

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[makaɾ]	[makaɾ**k**-in]	[makaɾ**k**-uɻ]	'anthill'
[waŋal]	[waŋal**k**-in]	[waŋal**k**-uɻ]	'boomerang'
[tanʲiɾ]	[tanʲiɾ**k**-in]	[tanʲiɾ**k**-uɻ]	'hip'

Here are derivations for the paradigm of /makaɾk/ 'anthill'.

/makaɾk/	/makaɾk-in/	/makaɾk-uɻ/	underlying forms
—	—	—	/k/ Epenthesis
—	—	—	/w/ Epenthesis
—	—	—	Vowel Deletion
—	—	—	Final Lowering
—	—	—	Apocope
makaɾ	—	—	Cluster Reduction
[makaɾ]	[makaɾkin]	[makaɾkuɻ]	surface forms

8.3.9 Another deletion rule

There is one more rule to be covered whose effects can be seen in the following forms:

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[putu]	[putu**ka**-n]	[putu**ka**-ɻ]	‘short’
[muɾkuni]	[muɾkuni**ma**-n]	[muɾkuni**ma**-ɻ]	‘nullah’[5]
[ŋawuŋa]	[ŋawuŋa**wu**-n]	[ŋawuŋa**wu**-ɻ]	‘termite’
[pukatʲi]	[pukatʲi**ja**-n]	[pukatʲi**ja**-ɻ]	‘scavenger hawk’
[tipiʈi]	[tipiʈi**pi**-n]	[tipiʈi**pi**-wuɻ]	‘species of rock cod’
[t̪aɾawu]	[t̪aɾawut̪**a**-n]	[t̪aɾawut̪**a**-ɻ]	‘trousers’ (< English)
[t̪apu]	[t̪aputʲ**i**-n]	[t̪aputʲ**i**-wuɻ]	‘older brother’
[jaːku]	[jaːku**wa**-n]	[jaːku**wa**-ɻ]	‘blue-tongued lizard’
[ŋunʲiŋu]	[ŋunʲiŋun**ʲi**-n]	[ŋunʲiŋun**ʲi**-wuɻ]	‘message stick’[6]

The uninflected forms are the apparent exceptions to Final Lowering alluded to above in §8.3.4 and §8.3.5. These final high vowels will be explained shortly.

The forms look somewhat like the Cluster Reduction forms of the previous section. Plainly, the final vowels of the stems get deleted, and there is also a consonant ~ zero alternation, but this time not in a cluster. Assuming as before that the underlying forms can be read off the suffixed forms, we want the derivation to do the following:

/putuka/	/putuka-in/	/putuka-uɻ/	underlying forms
—	—	—	/k/ Epenthesis
—	—	—	/w/ Epenthesis
—	putukan	putukaɻ	Vowel Deletion
—	—	—	Final Lowering
putuk	—	—	Apocope
—	—	—	Cluster Reduction
putu	—	—	**Rule X**
[putu]	[putukan]	[putukaɻ]	surface forms

A crucial fact is that no word of Lardil ever ends in /k/, which suggests that any /k/ that is placed at the end of a word by Apocope gets deleted by Rule X. Thus, the analytic strategy that makes sense here is to sort out the consonants of Lardil according to whether they delete, and see if the deletable consonants constitute a natural class.

Before we do this, some further data will be helpful. These are rather simpler forms, in which a consonant deletes, but it is underlyingly final rather than being exposed to final position by Apocope:

[5] According to the *Oxford English Dictionary*, “A watercourse, river-bed, or ravine.”

[6] Hale gives only an underlying represention (/ŋunʲiŋunʲi/) for this form; the paradigm given is constructed using his rules.

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[ʈuɾaɾa]	[ʈuɾaɾaŋ-in]	[ʈuɾaɾaŋ-kuɻ]	‘shark’
[ŋalu]	[ŋaluk-in]	[ŋaluk-uɻ]	‘story’
[kumpu]	[kumpuŋ-in]	[kumpuŋ-kuɻ]	‘anus’
[milwaɾkaɻu]	[milwaɾkaɻuŋ-in]	[milwaɾkaɻuŋ-kuɻ]	‘shovelnose shark’

The underlying representations here would be /ʈuɾaɾaŋ/, /ŋaluk/, and so on.

With these data in hand, we can now sort the consonants of Lardil into those which delete finally and those which do not. In Lardil in general, the following consonants are permitted word-finally:

[t]	as in [ŋawit] ‘stomach’[7]		
[n]	as in [pirŋæn]	[ɳ]	as in [maːɳ]
[l]	as in [jalul]	[ɻ]	as in [mijaɻ]
[ɾ]	as in [majaɾ]		

The following consonants are not observed finally, and indeed are observed to disappear when they would otherwise be expected to occur in final position:

[p] ([tipiʈi], not *[tipiʈip])
[m] ([muɾkuni], not *[muɾkunim])
[w] ([ŋawuŋa], not *[ŋawuŋaw])
[ʈ] ([ʈaɾawu], not *[ʈaɾawuʈ])
[tʲ] ([ʈapu], not *[ʈaputʲ])
[nʲ] ([ŋunʲiŋu], not *[ŋunʲiŋunʲ])
[j] ([pukatʲi], not *[pukatʲij])
[k] ([putu], not *[putuk])
[ŋ] ([ʈuɾaɾa], not *[ʈuɾaɾaŋ])

Consulting the phonetic chart for Lardil (p. 166) it can be seen that the crucial class consists of apicals; that is, only apical consonants can survive in final position. With the features assumed here (p. 167), the apicals are [–distributed], so that the deletion rule can be stated informally as follows:[8]

Non-Apical Deletion
C → ∅ / ___]$_{\text{word}}$ unless C = [–distributed]

[7] The phonology of /t/-stems in Lardil involves complexities treated in the sources (see Further reading) but not covered here. Underlying /t/ is converted in various contexts to [ʈ], [tʲ], or [ɾ].

[8] Here is the fine print concerning Non-apical Deletion. (1) The rule predicts that [ʈ] should be legal at the end of a word, which is not true. The absence of final [ʈ] is due to an additional rule of Sonorantization: /ʈ/ → [ɻ] / ___]$_{\text{word}}$, as in /kiʈikiʈi/ → kiʈikiʈ → [kiʈikiɻ] ‘moon’ (compare Acc. Nonfut. [kiʈikiʈi-n]). (2) There are apparently no stems that have underlying /ɳ/ in a deletable position; the prediction made by the analysis is that if such stems did exist, their final consonants would alternate with zero.

Below are derivations that illustrate the rule. Underlying /putaka/ has a non-apical in the crucial position, which succumbs to Non-Apical Deletion. /jilijili/ has an apical in the analogous location, which survives. The crucial comparison is in boldface.

/putuka/	/putuka-in/	/putuka-uɻ/	/jilijili/	/jilijili-in/	/jilijili-uɻ/	underlying forms
—	—	—	—	—	—	/k/ Epenthesis
—	—	—	—	—	jilijiliwuɻ	/w/ Epenthesis
—	putukan	putukaɻ	—	jilijilin	—	Vowel Deletion
—	—	—	—	—	—	Final Lowering
putuk	—	—	jilijil	—	—	Apocope
—	—	—	—	—	—	Cluster Reduction
putu	—	—	**NO**	—	—	Non-Apical Deletion
[putu]	[putukan]	[putukaɻ]	[jilijil]	[jilijilin]	[jilijiwuɻ]	surface forms

Like Cluster Reduction, Non-Apical Deletion must apply after Apocope, for the same reason: Apocope exposes the deletable consonant to word-final position.

There is another reason why Non-Apical Deletion has to follow Apocope. Suppose we start out with a quadrisyllabic stem like /murkunima/, from p. 181. Apocope removes the final vowel: /murkunim/, and Non-Apical Deletion removes the /m/: /murkuni/. We have exposed a new vowel to word-final position. Now, observe that the resulting word is trisyllabic, but it doesn't undergo Apocope again! That is, we get [murkuni], not *[murkun]. This follows from the analysis, which already is formulated (for independent reasons) so that Apocope precedes Non-Apical Deletion.

This looks like it is a result that comes "for free"; but in fact it depends on a particular assumption about rule ordering, namely that rules have to be applied in a strict order. In a theory where rules were allowed to reapply freely whenever they were applicable, this would not be so.

For roots which end underlying in a non-apical, like /t̪uraraŋ/ (p. 179), the derivations are simpler, involving only Non-Apical Deletion in the uninflected form:

/t̪uraraŋ/	/t̪uraraŋ-in/	/t̪uraraŋ-uɻ/	underlying forms
—	—	t̪araraŋkuɻ	/k/ Epenthesis
—	—	—	/w/ Epenthesis
—	—	—	Vowel Deletion
—	—	—	Final Lowering
—	—	—	Apocope
—	—	—	Cluster Reduction
t̪urara	—	—	Non-Apical Deletion
[t̪urara]	[t̪uraraŋin]	[t̪uraraŋkuɻ]	surface forms

8.3.10 Some further rule orderings

To complete the Lardil analysis, we must establish all relevant rule orderings.

The following forms suffice to show that Cluster Reduction precedes Non-Apical Deletion:

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[muŋkumu]	[muŋkumuŋku-n]	[muŋkumuŋku-ɻ]	'wooden axe'
[tʲumputʲu]	[tʲumputʲumpu-n]	[tʲumputʲumpu-ɻ]	'dragonfly'

That is, for underlying /muŋkumuŋku/, first Apocope deletes the final vowel (/muŋkumuŋk/), then Cluster Reduction deletes the second member of the resulting cluster (/muŋkumuŋ/). Then (and only then) can Non-Apical Deletion delete the word-final /ŋ/, yielding [muŋkumu].

Here is another ordering argument. Review the following forms, which all have been considered earlier when we were setting up the rules of Apocope, Cluster Reduction, and Non-Apical Deletion:

Uninflected	**Acc. Nonfuture**	**Acc. Future**	**Gloss**
[murkuni]	[murkunima-n]	[murkunima-ɻ]	'nullah'
[tipiti]	[tipitipi-n]	[tipitipi-wuɻ]	'species of rock cod'
[putu]	[putuka-n]	[putuka-ɻ]	'short'
[t̪apu]	[t̪aputʲi-n]	[t̪aputʲi-wuɻ]	'older brother'
[ŋalu]	[ŋaluk-in]	[ŋaluk-uɻ]	'story'
[muŋkumu]	[muŋkumuŋku-n]	[muŋkumuŋku-ɻ]	'wooden axe'
[tʲumputʲu]	[tʲumputʲumpu-n]	[tʲumputʲumpu-ɻ]	'dragonfly'

In all of these forms, the uninflected surface stem ends in a high vowel. But earlier in the analysis, we claimed that word-final high vowels were illegal, and wrote a rule of Final Lowering (p. 172) to eliminate them by lowering in final position. The resolution of the problem comes from the observation that final high vowels are well-formed provided that they are not *underlyingly* final, but rather final by virtue of Non-Apical Deletion. That is, all of the final high vowels shown immediately above are in words that expose a final high vowel by deleting a consonant. It is these vowels, and only these, that survive as high.

Analytically, we can get this by ordering Final Lowering before Non-Apical Deletion. This will work, for representative examples, as follows:

/putuka/	/ŋuku/	underlying forms
—	—	/k/ Epenthesis
—	—	/w/ Epenthesis
—	—	Vowel Deletion
—	ŋuk**a**	Final Lowering
putuk	—	Apocope
—	—	Cluster Reduction
put**u**	—	Non-Apical Deletion
[put**u**]	[ŋuk**a**]	surface forms

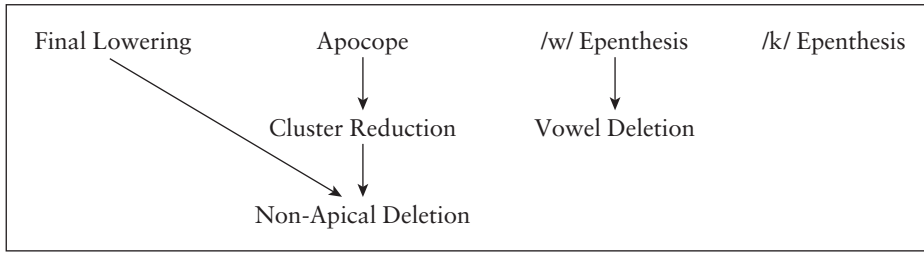


Figure 8.1 Hasse diagram illustrating the ordering of three rules of Lardil

As can be seen, Non-Apical Deletion "applies too late" for the resulting final vowel to be lowered.

The Hasse diagram in figure 8.1 depicts all of the necessary orderings in the analysis. Any arrangement of the rules in a strict linear order that is compatible with the arrows in the diagram will work.

8.3.11 Concluding remarks on Lardil

This completes the analysis of Lardil, insofar as it is covered here (for more, see Further reading). The general lessons that emerge are as follows.

First, Lardil stems alternate in a fairly drastic way, but the system is fundamentally a simple one: the pattern of alternation reduces to a set of phonological rules applied to the output of the morphological component.

Second, Lardil is a classic illustration of the fact that the Isolation Form Shortcut (§8.2) does not always work. Lardil isolation forms are subjected to remarkable processes of right-edge erosion. It is only when a suffix protects the stem from this erosion that the base form of a stem can be seen plainly.

Lastly, although the Lardil facts are complex, they yield to systematic procedures of analysis – something which is useful to remember when you get stuck while doing analytical work. These procedures invoke the following questions: what are the patterns of alternation among morphemes? If these patterns are to be reduced to rule, what is the full set of possibilities for choosing the underlying representations? Considering *each* of these hypotheses, what would the underlying forms look like, and what rules (if any) would suffice to derive the surface forms? Where does there appear to be neutralization (which usually forces a choice as to the "direction" in which the rules apply)? What natural classes are evident in the data pattern? The answers to these questions often will lead to a working analysis.

8.4 Rule-Ordering Terminology

Rule ordering clearly plays a major role in the Lardil analysis. Thus, Lardil is a useful example for learning four terms about rule ordering that are commonly used by phonologists. These terms are **feeding**, **bleeding**, **counterfeeding**, and **counterbleeding**.

8.4.1 Feeding

Observe that Apocope, when it exposes a consonant cluster at the end of a word, thereby *makes it possible* for Cluster Reduction to apply. The following abbreviated derivation (see p. 176 for the original) shows this:

/jukaɾpa/	underlying form
jukaɾp	Apocope
jukaɾ	Cluster Reduction
[jukaɾ]	surface form

This is said to be a case of **feeding**: Apocope "feeds" Cluster Reduction. The term is defined in general as follows.

Rule A **feeds** rule B when:

- A is ordered before B, and
- A creates novel configurations to which B may apply.

8.4.2 Bleeding

Consider next the interaction of /w/ Epenthesis and Vowel Deletion, shown in the following abbreviated derivation (see p. 173 for the original):

/papi-uɻ/	underlying form
papiwuɻ	/w/ Epenthesis
—	Vowel Deletion
[papiwuɻ]	surface form

It is clear that *if /w/ Epenthesis had not applied*, then Vowel Deletion would have had an additional chance to apply, creating *[papiɻ]. Thus, we might say that /w/ Epenthesis, in this particular derivation, "blocks" or "pre-empts" Vowel Deletion. The standard term used, however, is **bleeding**; /w/ Epenthesis bleeds Vowel Deletion. More generally:

Rule A **bleeds** rule B when:

- A is ordered before B, and
- A removes configurations to which B could otherwise have applied.

8.4.3 Counterfeeding

Rule ordering terminology also includes two terms that are useful but tricky: they both mean "is ordered too late to do X." Consider first the derivation of the Lardil form [ŋalu] 'story-uninflected', from underlying /ŋaluk/ (the justification for the underlying form can be seen in the accusative nonfuture [ŋalu**k**-in]). The relevant stages are these:

/ŋaluk/	underlying form
—	Final Lowering
ŋalu	Non-Apical Deletion
[ŋalu]	surface form

Evidently, Non-Apical Deletion *applies too late to feed* Final Lowering (whose action is seen elsewhere in simple derivations like /ŋuku/ → [ŋuka] 'water', p. 170). The term normally used to describe this situation is **counterfeeding**; specifically, Non-Apical Deletion counterfeeds Final Lowering. In general terms:

Rule A **counterfeeds** rule B when:

- A is ordered after B, and
- A creates novel configurations to which B could have applied, if A had been applied before B.

It is useful to think of "counterfeed" as meaning "fails to feed," or "arrives too late to feed." "Counterfeed" is by no means the same as "bleed."

8.4.4 Counterbleeding

The last term of ordering commonly used is **counterbleed**, which means "is ordered too late to bleed." The derivation for [papiwuɻ], already given as an example of bleeding, also illustrates counterbleeding. In particular, Vowel Deletion counterbleeds /w/ Epenthesis.

/papi-uɻ/	underlying form
papiwuɻ	/w/ Epenthesis (p. 172)
—	Vowel Deletion (p. 168)
[papiwuɻ]	surface form

If Vowel Deletion had (counter to fact) applied first, deriving *[papiɻ], it would have bled /w/ Epenthesis. This can be seen most clearly if we provide an incorrect derivation with this opposite order:

/papi-uɻ/	underlying form
papiɻ	Vowel Deletion
—	/w/ Epenthesis
*[papiɻ]	incorrect surface form

In the incorrect derivation Vowel Deletion bleeds /w/ Epenthesis. Therefore, in the correct derivation, with the opposite order, Vowel Deletion counterbleeds /w/ Epenthesis. A definition of counterbleeding is as follows:

Rule A **counterbleeds** rule B when:

- A is ordered after B, and
- A would have removed configurations to which B applies, had A applied first.

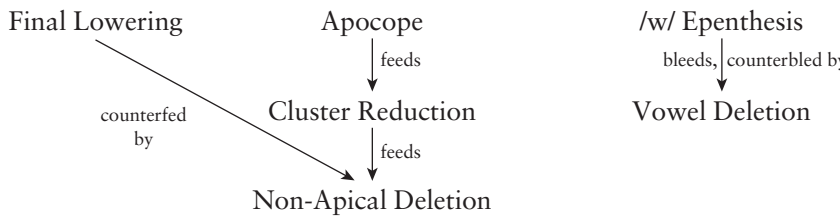
8.4.5 Summary

These four terms, though tricky to learn to use accurately, continue to be employed by phonologists because they provide a clear classification of the reasons why rules have to be ordered. Table 8.2 may be of help in studying these terms.

Table 8.2 Summary of rule ordering terminology

		Rule Ordering	
		A precedes B	A follows B
Does Rule B apply?	B succeeds in applying	A **feeds** B (creates a location where B can apply)	A **counterbleeds** B (ordered too late to remove a location where B can apply)
	B fails to apply	A **bleeds** B (removes a location where B could have applied)	A **counterfeeds** B (ordered too late to create a location where B could apply)

The Hasse diagram for Lardil rule ordering, from p. 182, can be annotated with the reason for each ordering:



Exercises

1 Lardil rule ordering

a. Give an incorrect derivation for Lardil /jukarpa/ 'husband-uninflected', showing what output is obtained if Cluster Reduction is ordered before Apocope (for correct derivation, see p. 177).
b. Give an incorrect derivation for Lardil /putuka/ 'short-uninflected', showing what output is obtained if Apocope is ordered after Non-Apical Deletion (for correct derivation, see p. 180).
c. Give an incorrect derivation for Lardil /muŋkumuŋku/ 'wooden axe-uninflected' (p. 181), showing what output is obtained if Non-Apical Deletion is ordered before Cluster Reduction.

2 Yidiɲ

This problem concerns the phonological alternations that arise in the nominal paradigms of Yidiɲ, an aboriginal language of Queensland, Australia.

Hints: It is probably best to consider the different batches of data in order, rather than trying to solve the problem all at once. If you get stuck, count the number of syllables in all of the words in part (b).

a. Make a phonetic chart for all the sounds in the data.
b. What are the phonemic forms of the stems and case suffixes below? In order to derive the observed phonetic forms, what phonological rules must apply? (You will find one of these rules difficult to formalize; it is all right just to express it clearly in words.) Make sure that your rules predict when vowels will be long. If your rules must be ordered, what is the required ordering?

Absolutive	*Comitative*	*Genitive*	*Comitative + Genitive*	*gloss*
buɲa	buɲaːj	buɲaːn	buɲajini	‘woman’
manu	manuːj	manuːn	manujini	‘treetop’
wuda	wudaːj	wudaːn	wudajini	‘shark’
wugu	wuguːj	wuguːn	wugujini	‘work’
biniːr	biniriji	binirini	biniriji:n	‘money’
wajiːl	wajiliji	wajilini	wajiliji:n	‘red bream’
mindiːr	mindiriji	mindirini	mindiriji:n	‘salt-water centipede’
gambiːɻ	gambiɻaji	gambiɻani	gambiɻaji:n	‘tablelands’
gubuːm	gubumaji	gubumani	gubumaji:n	‘black pine’
gumaːl	gumalaji	gumalani	gumalaji:n	‘stage in the development of grubs’
gindaːn	gindanuji	gindanuni	gindanuji:n	‘moon’
jaguːɲ	jaguɲuji	jaguɲuni	jaguɲuji:n	‘echidna’
gujuːɻ	gujuɻuji	gujuɻuni	gujuɻuji:n	‘storm’
ŋunaŋgara	ŋunaŋgaraːj	ŋunaŋgaraːn	ŋunaŋgarajini	‘whale’
bugamugu	bugamuguːj	bugamuguːn	bugamugujini	‘daylight’
ɟulugunu	ɟulugunuːj	ɟulugunuːn	ɟulugunujini	‘black myrtle’
ɟilibiɻi	ɟilibiɻiːj	ɟilibiɻiːn	ɟilibiɻijini	‘lungfish’

c. Unlike the set of stems previously given, the following stems may appear in odd-syllabled surface forms. They nonetheless show vowel length alternations. You may wish to revise your analysis from the preceding section, or you can write up questions (b) and (c) as one answer.

Absolutive	*Comitative*	*Genitive*	*Comitative + Genitive*	*gloss*
ŋumbuːbu	ŋumbubuji	ŋumbubuni	ŋumbubuji:n	‘new-born baby’
waɻaːba	waɻabaji	waɻabani	waɻabaji:n	‘wide creek’
gujŋgiːlbi	gujŋgilbiji	gujŋgilbini	gujŋgilbiji:n	‘Moreton Bay tree’
gawuːda	gawudaji	gawudani	gawudaji:n	‘coat’
guluːdu	guluduji	guluduni	guludujiːn	‘dove’
bunbuːɟa	bunbuɟaji	bunbuɟani	bunbuɟaji:n	‘(spinning) top’
gabuːɟu	gabuɟuji	gabuɟuni	gabuɟuji:n	‘white clay’
baɟiːnɟi	baɟinɟiji	baɟinɟini	baɟinɟiji:n	‘sutton bird’
giɟaːrɟi	giɟarɟiji	giɟarɟini	giɟarɟiji:n	‘policeman’
guruːŋga	guruŋgaji	guruŋgani	guruŋgaji:n	‘kookaburra’
ɟaraːga	ɟaragaji	ɟaragani	ɟaragaji:n	‘step-relative’
ɟumbaːgi	ɟumbagiji	ɟumbagini	ɟumbagiji:n	‘tobacco’
ɲuruːgu	ɲuruguji	ɲuruguni	ɲuruguji:n	‘sound of talking far off’

d. Explain how your analysis can account for these additional inflected forms, providing underlying forms for the suffixes. The stems are the same as those given already.

Dative	*Accusative*	*Purposive*	*Comitative + Apprehensive*	*"Another"*
buɲaːnda	buɲaːɲ	buɲaːgu	buɲajida	buɲaːbi
manuːnda	manuːɲ	manuːgu	manujida	manuːbi
wudaːnda	wudaːɲ	wudaːgu	wudajida	wudaːbi
wuguːnda	wuguːɲ	wuguːgu	wugujida	wuguːbi
binirinda	biniriɲa	binirigu	biniriji:da	biniribi
wajilinda	wajiliɲa	wajiligu	wajiliji:da	wajilibi
mindirinda	mindiriɲa	mindirigu	mindiriji:da	mindiribi
gambiɻanda	gambiɻaɲa	gambiɻagu	gambiɻaji:da	gambiɻabi
gubumanda	gubumaɲa	gubumagu	gubumaji:da	gubumabi
gumalanda	gumalaɲa	gumalagu	gumalaji:da	gumalabi
gindanunda	gindanuɲa	gindanugu	gindanuji:da	gindanubi
jaguɲunda	jaguɲuɲa	jaguɲugu	jaguɲuji:da	jaguɲubi
gujuɻunda	gujuɻuɲa	gujuɻugu	gujuɻuji:da	gujuɻubi
ŋunaŋgaraːnda	ŋunaŋgaraːɲ	ŋunaŋgaraːgu	ŋunaŋgarajida	ŋunaŋgaraːbi
bugamuguːnda	bugamuguːɲ	bugamuguːgu	bugamugujida	bugamuguːbi
ɟulugunuːnda	ɟulugunuːɲ	ɟulugunuːgu	ɟulugunujida	ɟulugunuːbi
ɟilibiɻiːnda	ɟilibiɻiːɲ	ɟilibiɻiːgu	ɟilibiɻijida	ɟilibiɻiːbi
ŋumbubunda	ŋumbubuɲa	ŋumbubugu	ŋumbubuji:da	ŋumbububi
waɻabanda	waɻabaɲa	waɻabagu	waɻabaji:da	waɻababi
gujŋgilbinda	gujŋgilbiɲa	gujŋgilbigu	gujŋgilbiji:da	gujŋgilbibi
gawudanda	gawudaɲa	gawudagu	gawudaji:da	gawudabi
guludunda	guluduɲa	guludugu	guluduji:da	guludubi
bunbuɟanda	bunbuɟaɲa	bunbuɟagu	bunbuɟaji:da	bunbuɟabi
gabuɟunda	gabuɟuɲa	gabuɟugu	gabuɟuji:da	gabuɟubi
baɟinɟinda	baɟinɟiɲa	baɟinɟigu	baɟinɟiji:da	baɟinɟibi
giɟarɟinda	giɟarɟiɲa	giɟarɟigu	giɟarɟiji:da	giɟarɟibi
guruŋganda	guruŋgaɲa	guruŋgagu	guruŋgaji:da	guruŋgabi
ɟaraganda	ɟaragaɲa	ɟaragagu	ɟaragaji:da	ɟaragabi
ɟumbaginda	ɟumbagiɲa	ɟumbagigu	ɟumbagiji:da	ɟumbagibi
ɲurugunda	ɲuruguɲa	ɲurugugu	ɲuruguji:da	ɲurugubi

Here is some background information on Yidiɲ:

- Absolutive forms are used for the subjects of intransitive verbs and the objects of transitive verbs. A noun would normally be said in isolation in its absolutive form.
- The comitative suffix means essentially 'with' and forms adjectives from nouns.
- The genitive suffix means essentially 'of'.

- The purposive suffix means essentially 'for'; e.g. [ŋaju galiŋ miŋaː-gu] 'I'm going-out for-meat'.
- A noun marked *comitative+apprehensive* means 'for fear of N'.
- Glosses: the echidna is the marsupial porcupine; a kookaburra is a kind of kingfisher; a bream is a kind of fish.

Further reading

Lardil phonology: Kenneth Hale, "Deep-surface canonical disparities in relation to analysis and change: an Australian example," in Thomas Sebeok, ed., *Current Trends in Linguistics 11* (1973: Mouton), pp. 401–58. Further data and close analysis can be found in Terry J. Klokeid's 1976 MIT PhD dissertation *Topics in Lardil grammar*, available at https://dspace.mit.edu. For information on how Lardil phonology has changed in subsequent years, see Norvin Richards (1997) "Old and New Lardil," *MIT Working Papers in Linguistics* 13, available at http://web.mit.edu/norvin/www/papers/Leerdil.pdf.

Later work on Lardil has focused on increasing the generality of the analysis by uniting as many phenomena as possible under a single system. For an analysis that links Non-Apical Deletion to Lardil syllable structure, see Junko Ito's *Syllable Theory in Prosodic Phonology* (1988, Garland). For an analysis that relates Apocope to the length requirements seen in Lardil words, see Karina Wilkinson (1988) "Prosodic structure and Lardil phonology," *Linguistic Inquiry* 19: 325–34. Ito and Wilkinson's ideas are pursued further in Alan Prince and Paul Smolensky's *Optimality Theory: Constraint Interaction in Generative Grammar* (2004, Blackwell), which pursues generality even further with a theory that uses only constraints, and no rules.

For a survey of hiatus resolution (§8.3.2) in a number of languages, see Roderic Casali (1997) "Vowel elision in hiatus contexts: Which vowel goes?," *Language* 73: 493–533. Casali's findings support the general pattern mentioned in the text, whereby stem material is preferentially preserved in hiatus resolution.

For the arguments against the theory of fn. 1, in which all neutralization rules must precede all allophonic ones, see §7.1 (a direct counterexample), as well as Morris Halle's *The Sound Pattern of Russian* (1959, Mouton). Halle's example shows that the same rule is sometimes neutralizing, sometimes allophonic.

The standard terminology for rule ordering (feeding, bleeding, counterfeeding, counterbleeding) was first published in an article by Paul Kiparsky, "Linguistic universals and linguistic change," in Emmon Bach and Robert Harms, eds., *Universals in Linguistic Theory* (1968, Holt, Rinehart and Winston).