

7 Phonological Alternation II

7.1 Phonemic Environments and Rule Ordering

An interesting aspect of phonological systems is that some rules evidently apply in environments that are defined *phonemically*, rather than phonetically. Such a rule looks like it is applying in the wrong environment, if one examines only the phonetic data, but deeper analysis shows the true context. The crucial mechanism for analyzing such cases is to apply the phonological rules in a particular order.

Our discussion of this phenomenon will be based on two phonological rules of North American English. One is found in a large number of dialects, especially in the northeastern US and throughout Canada.

/aɪ/ Raising

$$aɪ \rightarrow \Deltaɪ / \text{---} \begin{bmatrix} -\text{syllabic} \\ -\text{voice} \end{bmatrix}$$

/aɪ/ is realized as [Δɪ] when it precedes a voiceless consonant.

As a result of this rule, we find the following distribution of data.

<i>tripe</i>	/tɹaɪp/	[tɹΔɪp]	<i>tribe</i>	/tɹaɪb/	[tɹaɪb]
<i>right</i>	/ɹaɪt/	[ɹΔɪt]	<i>ride</i>	/ɹaɪd/	[ɹaɪd]
<i>hiker</i>	/haɪkə/	[hΔɪkə]	<i>tiger</i>	/taɪgə/	[taɪgə]
<i>life</i>	/laɪf/	[lΔɪf]	<i>live</i>	/laɪv/	[laɪv]
<i>rifle</i>	/ɹaɪfəl/	[ɹΔɪfəl]	<i>rival</i>	/ɹaɪvəl/	[ɹaɪvəl]
<i>rice</i>	/ɹaɪs/	[ɹΔɪs]	<i>rise</i>	/ɹaɪz/	[ɹaɪz]
			<i>rye</i>	/ɹaɪ/	[ɹaɪ]
			<i>ion</i>	/aɪən/	[aɪən]

The other rule we will need is the rule of Tapping, previously discussed on p. 142. There, we formulated the rule to apply only to /t/. But in fact, Tapping also affects /d/, converting it as well into a tap. The data below demonstrate this. The left column shows instances of phonemic /d/ that fit the environment for

Tapping; namely, they follow a vowel and precede a stressless vowel. The right column shows instances of phonemic /d/ in various other environments.

	Phonemic	Phonetic		Phonemic	Phonetic
<i>Ada</i>	/ˈeɪdə/	[ˈeɪrə]	<i>Dan</i>	/ˈdæn/	[ˈdæn]
<i>ladder</i>	/ˈlædər/	[ˈlæɾər]	<i>adept</i>	/əˈdept/	[əˈdept]
<i>reading</i>	/ˈriːdɪŋ/	[ˈriːɾɪŋ]	<i>Camden</i>	/ˈkæmdən/	[ˈkæmdən]
<i>edify</i>	/ˈɛdɪˌfaɪ/	[ˈɛɾɪˌfaɪ]	<i>Hilda</i>	/ˈhɪldə/	[ˈhɪldə]
<i>sediment</i>	/ˈsedɪmənt/	[ˈsɛɾɪmənt]	<i>Ogden</i>	/ˈəgdən/	[ˈəgdən]
<i>adolescent</i>	/ˌædəˈlesənt/	[ˌæɾəˈlesənt]	<i>Edgar</i>	/ˈɛdgər/	[ˈɛdgər]
			<i>pad</i>	/ˈpæd/	[ˈpæd]

This is the same pattern as was seen for /t/.

The generalized version of Tapping can be stated as follows. The material to the left of the arrow uses the features of chapter 4 to characterize the natural class of alveolar stops:

Tapping (revised)

$$\left[\begin{array}{l} +\text{anterior} \\ -\text{continuant} \end{array} \right] \rightarrow \text{r} / [-\text{consonantal}] \text{ — } \left[\begin{array}{l} +\text{syllabic} \\ -\text{stress} \end{array} \right]$$

An alveolar stop is realized as [ɾ] when it is preceded by a vowel or /ɹ/, and followed by a stressless vowel.

Since Tapping converts both /t/ and /d/ to [ɾ], it converts distinct underlying forms to identical surface forms, and thus counts as a rule of neutralization (for the definition of neutralization, see p. 130). We can see the neutralization in a pair like *heating* vs. *heeding*. The underlying forms are justified by the stems *heat* [hit] and *heed* [hid]. But when the *-ing* suffix is added, Tapping applies, and neutralizes the underlying /t/ and /d/ as [ɾ]:

<i>heating</i>	<i>heeding</i>	
/ˈhit-/ɪŋ/	/ˈhid-/ɪŋ/	lexical entries
'hitɪŋ	'hidɪŋ	Morphology: Present Participle Formation (p. 132)
'hiɾɪŋ	'hiɾɪŋ	Phonology: Tapping
['hiɾɪŋ]	['hiɾɪŋ]	surface forms

At least in fluent speech, for most speakers of North American English *heating* and *heeding* do appear to be pronounced identically, so the example constitutes a true neutralization. Similar examples are given below:

<i>bet</i>	<i>betting</i>	<i>bed</i>	<i>bedding</i>
/ˈbet-/ɪŋ/	/ˈbet-/ɪŋ/	/ˈbed/	/ˈbed-/ɪŋ/
['bet]	['bɛɾɪŋ]	['bed]	['bɛɾɪŋ]

<i>wet</i>	<i>wetting</i>	<i>wed</i>	<i>wedding</i>
/'wɛt/	/'wɛt-ɪŋ/	/'wɛd/	/'wɛd-ɪŋ/
['wɛt]	['wɛɾɪŋ]	['wɛd]	['wɛɾɪŋ]
<i>butt</i>	<i>butted</i>	<i>bud</i>	<i>budded</i>
/'bʌt/	/'bʌt-əd/	/'bʌd/	/'bʌd-əd/
['bʌt]	['bʌɾəd]	['bʌd]	['bʌɾəd]

With the two rules of /aɪ/ Raising and Tapping in hand, we can now see how they might interact. Crucial words that would bear on the question are the following, which for the moment we give in spelled and phonemic form only:

<i>write</i>	<i>writing</i>	<i>ride</i>	<i>riding</i>
/'raɪt/	/'raɪt-ɪŋ/	/'raɪd/	/'raɪd-ɪŋ/
<i>cite</i>	<i>cited</i>	<i>side</i>	<i>sided</i>
/'saɪt/	/'saɪt-əd/	/'saɪd/	/'saɪd-əd/
<i>white</i>	<i>whiter</i>	<i>wide</i>	<i>wider</i>
/'waɪt/	/'waɪt-ə/	/'waɪd/	/'waɪd-ə/

The crucial point is that /aɪ/ Raising depends on the voicing of the following consonant, and Tapping changes the voicing of a /t/. We can ask: will the allophone of /aɪ/ ([aɪ] vs. [ʌɪ]) that emerges depend on the voicing seen in the *phonemic* form of the following consonant (/t/ vs. /d/), or will it depend on its *phonetic* form ([ɾ])? If /aɪ/ Raising depends on a phonemic environment, then we would expect to get [ʌɪ] just in case the following consonant is /t/, even though that consonant actually gets pronounced as [ɾ]. On the other hand, if /aɪ/ Raising depends on the *phonetic* form of the following consonant, it will not apply, since a tap is voiced, and we will get [aɪ] across the board.

It would be nice if we could establish some general principle of phonology that would predict the correct outcome. But this turns out to be impossible: *both* outcomes can be found, depending on the dialect of English one is examining.

For millions of speakers, /aɪ/ Raising depends on the *phonemic* voicing of the following consonant. Because of this, the crucial pairs come out distinct, with [ʌɪ] appearing whenever the following sound is a phonemic /t/:

<i>write</i>	<i>writing</i>	<i>ride</i>	<i>riding</i>
/'raɪt/	/'raɪt-ɪŋ/	/'raɪd/	/'raɪd-ɪŋ/
['ʌɪt]	['ʌɪɾɪŋ]	['raɪd]	['raɪɾɪŋ]
<i>cite</i>	<i>cited</i>	<i>side</i>	<i>sided</i>
/'saɪt/	/'saɪt-əd/	/'saɪd/	/'saɪd-əd/
['ʌɪt]	['ʌɪɾəd]	['saɪd]	['saɪɾəd]
<i>white</i>	<i>whiter</i>	<i>wide</i>	<i>wider</i>
/'waɪt/	/'waɪt-ə/	/'waɪd/	/'waɪd-ə/
['ʌɪt]	['ʌɪɾə]	['waɪd]	['waɪɾə]

There are also millions of speakers who have both /aɪ/ Raising and Tapping, for whom Tapping depends on the *phonetic* voicing of the following consonant. Since a tap is voiced, this means that whenever Tapping is applicable the outcome in these words is [aɪ]:

<i>write</i>	<i>writing</i>	<i>ride</i>	<i>riding</i>
/'aɪt/	/'aɪt-ɪŋ/	/'aɪd/	/'aɪd-ɪŋ/
['aɪt]	['aɪɾ-ɪŋ]	['aɪd]	['aɪɾɪŋ]
<i>cite</i>	<i>cited</i>	<i>side</i>	<i>sided</i>
/'saɪt/	/'saɪt-əd/	/'saɪd/	/'saɪd-əd/
['saɪt]	['saɪɾ-əd]	['saɪd]	['saɪɾ-əd]
<i>white</i>	<i>whiter</i>	<i>wide</i>	<i>wider</i>
/'waɪt/	/'waɪt-ə/	/'waɪd/	/'waɪd-ə/
['waɪt]	['waɪɾ-ə]	['waɪd]	['waɪɾ-ə]

Most other dialects of English lack either /aɪ/ Raising or Tapping or both, and therefore do not bear on the question.

A widely employed method of analyzing differences such as the one just shown is to suppose that phonological rules must be *ordered*. We can imagine phonology as an “assembly line” that takes in phonemic forms, applies phonological rules in a particular order, and outputs phonetic forms. Under such a theory, the difference between the two dialects just described is a difference of rule ordering. In the dialect in which *writing* and *riding* are pronounced distinctly (['aɪɾɪŋ] vs. ['aɪaɪɾɪŋ]), /aɪ/ Raising is order before Tapping; and in the dialect in which *writing* and *riding* are pronounced the same, Tapping is ordered before /aɪ/ Raising.

Here are derivations using both orderings:

/aɪ/ Raising precedes Tapping

<i>write</i>	<i>writing</i>	<i>ride</i>	<i>riding</i>	
/'aɪt/	/'aɪt-ɪŋ/	/'aɪd/	/'aɪd-ɪŋ/	underlying forms
'aɪt	'aɪtɪŋ	—	—	/aɪ/ Raising
—	'aɪɾɪŋ	—	'aɪɾɪŋ	Tapping
['aɪt]	['aɪɾ-ɪŋ]	['aɪd]	['aɪɾɪŋ]	surface forms

Tapping precedes /aɪ/ Raising

<i>write</i>	<i>writing</i>	<i>ride</i>	<i>riding</i>	
/'aɪt/	/'aɪt-ɪŋ/	/'aɪd/	/'aɪd-ɪŋ/	underlying forms
—	'aɪɾɪŋ	—	'aɪɾɪŋ	Tapping
'aɪt	—	—	—	/aɪ/ Raising
['aɪt]	['aɪɾ-ɪŋ]	['aɪd]	['aɪɾɪŋ]	surface forms

Analytically, it is usually fairly easy to determine how two rules must be ordered. One simply tries both possibilities, seeing which one outputs the observed phonetic forms. Often, both will, in which case the ordering doesn't matter.

7.1.1 Rule ordering and minimal pairs

The *writing/riding* example is a case in which a minimal pair ([¹ɹʌɪɹɪŋ]/[¹ɹaɪɹɪŋ]) does not prove a phonemic distinction. Because the phonological rule system manifests the contrast of underlying /t/ vs. /d/ as phonetic [ʌɪ] vs. [aɪ], the minimal pair is misleading with respect to the actual phonemic forms. Such cases are sometimes called **displaced contrasts** – here, the underlying contrast of /t/ vs. /d/ is displaced to surface [ʌɪ] vs. [aɪ].

The general lesson is that the results of any pre-established analytical recipe in phonology should be taken as provisional. An analyst confronting the [¹ɹʌɪɹɪŋ]/[¹ɹaɪɹɪŋ] data for the first time would probably be wise to consider /ʌɪ/ vs. /aɪ/, at least at first, as separate phonemes. Subsequently, when further facts are considered, they would be reanalyzed as allophones.¹ The subsequent facts that force a revision are two: that [ʌɪ] and [aɪ] contrast only before tap, and that the pattern of alternation shows that there is an underlying environment (/ ___ t vs. / ___ d) that conditions the contrast.

7.2 Phonological Alternation and Rule Ordering in Chimwiini

To summarize what we have so far: morphology and syntax string together morphemes in their underlying forms, and phonology then applies to the resulting sequences. Since the morphology and syntax can place phonemes in different environments, different rules will be applicable, often resulting in phonological alternation, including neutralization. Often, we find that the phonological rules must be applied in a particular order, which can create effects like the “pseudo-minimal pairs” of the preceding section.

With this basic analytical scheme, a great deal can be accomplished in analyzing complex phonological and morphological systems. Quite a few languages have numerous morphemes that alternate predictably. The pattern in such languages can often be explicated with just a few phonological rules.

A good example is the phonology of Chimwiini, a language of the Bantu family. Chimwiini is indigenous to Brava, a city in southern Somalia, and can be understood (but only with difficulty) by speakers of Swahili dialects spoken nearby in Kenya. The data and essential generalizations reported here come from research by Charles Kisseberth and Mohammed Abasheikh, who draw on earlier work by Morris Goodman.

¹ Allophones of a particular kind, that is, derived at a “deep” level.

7.2.1 *Chimwiini morphology*

Chimwiini has a morphological system similar to that of Swahili, which we saw on p. 115. Here are a few affixes of Chimwiini and the rules that attach them.

Chimwiini verbal infinitives are formed with the prefix /ku-/, by the following rule:

Infinitive Formation

$V \rightarrow kuV$ when [+infinitive]

For example, the infinitive of the verb stem /re:b/ ‘stop’ is [ku-re:b-a].²

The form [ku-re:b-a] ends in the suffix [-a]. This is the so-called “final vowel,” found in verbs throughout the Bantu language family. The final vowel doesn’t really mean anything, but occurs in a verb that would otherwise end in a consonant (either because its stem ends in a consonant and there are no suffixes, or because its rightmost “real” suffix ends in a consonant). Following traditional Bantuist analytic practice, we can express the rule as a morphological insertion rule general to verbs:

Final Vowel Attachment

$XC \rightarrow XCa$ in verbs

*If a verb would otherwise end in a consonant, add /-a/.*³

/-e:l/ is the applicative suffix. It means that the action of the verb is done on behalf of someone. ([l] is the IPA symbol for a lateral flap.)

Applicative Formation

$V \rightarrow Ve:l$ when [+applicative]

The applicative form of [ku-re:b-a] is [ku-re:b-e:l-a], which means ‘to stop for someone’.

The applicative suffix must be attached to the stem before the final vowel; in terms of rule ordering, this means that Applicative Formation must precede Final Vowel Attachment.

/-an/ is the reciprocal suffix. It means that the entities doing the action of the verb do the action to each other.

Reciprocal Formation

$V \rightarrow Van$ when [+reciprocal]

² When the following stem begins with a voiceless consonant, /ku/ is realized as [x-]; this is due to a phonological rule we will not cover here; it is discussed in Kenstowicz and Kisseberth (1977, 101), cited at the end of this chapter.

³ A possibility to consider is that this is not really morphology but phonology (epenthesis); we will ignore this here, as it is not crucial.

For example, [ku-ɖirk-a] means ‘to reach’, and [ku-ɖirk-an-a] means ‘to reach one another.’ Like Applicative Formation, Reciprocal Formation must be applied before Final Vowel Attachment.

/-o:ɔw/ is the passive suffix; its meaning is “to be Verbed.”

Passive Formation

V → Vo:ɔw when [+passive]

For example, [ku-big-a] means ‘to hit’, and [ku-big-o:ɔw-a] means ‘to be hit’. Passive Formation must also precede Final Vowel Attachment.

With this morphology in hand, we can now begin examining some phonological alternations.

7.2.2 Preantepenultimate Shortening

Minimal and near-minimal pairs, of which the following are examples, show that vowel length in Chimwiini is phonemic.

[x-ku:l-a]	‘to extract’	[x-kul-a]	‘to grow’
[x-te:k-a]	‘to load (an animal)’	[x-tek-a]	‘to fetch’
[x-pe:lɛk-a]	‘to be able to be swept’	[x-pelek-a]	‘to send’
[ku-ba:ram-a]	‘to talk’	[ku-balam-a]	‘to promise’

However, this phonemic length contrast is subject to contextual neutralization. In particular, there is no contrast in positions that are more than three syllables from the end of a phrase (for phrases, see §7.2.4). All vowels occurring in such positions must be short, and when a phonemic long vowel is placed there by morphological processes, it is shortened.

Here is an example. [ku-re:b-a] ‘to stop’ has a phonemic long vowel, which is phonologically legal, being only two syllables from the end. The applicative form of [ku-re:b-a] is [ku-re:b-e.l-a] ‘to stop for someone’. This, too, is phonologically legal, because the long vowel comes only three syllables from the end. But now consider the reciprocal form of [ku-re:b-e.l-a], which is [ku-reb-e.l-an-a] ‘to stop for one another’. The outcome that we would expect, all else being equal, would be *[ku-re:b-e.l-an-a], retaining the long vowel of /re:b/. The reason we get [ku-reb-e.l-an-a] instead is the application of a shortening rule, stated informally as follows:

Preantepenultimate Shortening

Shorten a vowel when at least three vowels follow it.⁴

⁴ Formalizable as [+syllabic] → [-long] / ___ C₀ V C₀ V C₀ V. For the notation C₀, see p. 154 below.

The name of the rule is based on standard phonological terminology:

ultimate = final

penultimate = second to last

antepenultimate = third to last

preantepenultimate = anything before third to last

To understand [ku-reb-e.l-an-a] fully, we can build it up step by step, applying morphological, then phonological rules:

/re:b/	lexical entry for ‘stop’
	Morphological component:
re:b-e.l	Applicative Formation
re:b-e.l-an	Reciprocal Formation
re:b-e.l-an-a	Final Vowel Attachment
ku-re:b-e.l-an-a	Infinitive Formation
	Phonological component:
/ku-re:b-e.l-an-a/	Output of morphology = phonological underlying form
e	Preantepenultimate Shortening
[kurebe.lana]	surface form

In these derivations, the morphological rules attaching suffixes must be applied in the order shown. Infinitive Formation could apply anywhere, since just a single prefix is involved. The crucial point for phonological purposes is that when the morphology adds enough material following the root /re:b/, then the long vowel of this root gets phonologically shortened.

Preantepenultimate Shortening does not depend on any particular suffixes being present, but applies quite generally to vowels more than three syllables from the end, irrespective of what morphological processes cause these syllables to be present. The following examples illustrate this point.

[bo:z-e.l-e]	‘he stole’	[boz-e.l-en-i]	‘what did he steal?’
[dʒo:hari]	‘jewel’	[dʒohari-je]	‘her jewel’
[x-fa:n-a]	‘to do’	[x-fa:n-iliz-a]	‘to do with’
[x-sa:meh-a]	‘to forgive’	[x-sameh-an-a]	‘to forgive one another’

7.2.3 *Justifying underlying forms*

The original researchers cited here, Kisseberth and Abasheikh, when presenting the evidence for Preantepenultimate Shortening, take care to *justify their underlying forms*. For Preantepenultimate Shortening, it is not sufficient merely to note that vowels are always short when more than three from the end. One must show further, if possible, that vowels that one would expect on other grounds to be

long show up as short. It is for this reason that the authors give not just forms like [kurebe.lana], but also [ku-re:b-a] and [ku-re:b-e.l-a]. Under the assumption that a morpheme normally has a single representation throughout its paradigm,⁵ the latter two forms show that [kurebe.lana] must be underlyingly /ku-re:b-e.l-an-a/. Were it not for the existence of these paradigmatically related forms, we could take the path of least resistance and assume that [kurebe.lana] is simply underlyingly /kurebe.lana/.

Careful authors justify their underlying forms whenever they are different from the surface forms. The two kinds of justification that are most commonly given are as follows:

- The underlying form is needed to account for other forms in the paradigm ([kurebe.lana] must be /ku-re:b-e.l-an-a/ because of forms like [kure:ba]).
- The underlying form is needed to unify a group of allophones into a single phoneme (see chapters 2 and 3).

Occasionally, one finds analyses in which the author appeals to spelling to justify the underlying form, or to historically earlier stages of the language. Such forms of evidence are generally considered not legitimate. In the case of spelling, we can note that not all speakers of a language are necessarily literate, particularly at the age when the phonological system is acquired. And children certainly do not have access to historical data about their language. Assuming that the goal of analysis is to describe the system of rules that develops in children on exposure to language data, the analysis must be based on the same kind of data that children get. For further discussion, see chapter 10.

7.2.4 *Phrase-Final Shortening and Word-Final Lengthening*

We can now continue the analysis with an additional shortening rule. To express this rule, we must briefly cover the idea of **phrases** in phonology. A phrase is, informally, a phonologically cohering sequences of words. The exact nature of the phrases of Chimwiini will be explored in chapter 10; for the moment we will assume that every utterance given in this chapter (for the moment we will be considering only very short ones) consists of one single phrase. Therefore, “at the end of a phrase” is for present purposes the same as “before a pause.”

With this in mind, we can note that every phrase-final vowel in Chimwiini is short. The relevant shortening rule can be expressed as follows:

⁵ For the exceptions to this principle, see §3.5 and §9.9.

Phrase-Final Shortening

[+syllabic] → [-long] / ____]_{Phrase}

Vowels become short at the end of a phrase.

There is also an environment in which Chimwiini vowels show up as long: whenever they are final in a word, but *not* final in the phrase. This can be seen in the following forms:

[na]	‘by’	[na: noka]	‘by a snake’
[kolkɔ]	‘than’	[kolkɔ: mi]	‘than me’
[kama]	‘like’	[kama: mp ^h aka]	‘like a cat’
[hudʒɔ]	‘the one who eats’	[hudʒɔ: mbele]	‘the one who eats first’

There are various ways to capture this pattern. The analysis here assumes a very simple rule that requires all vowels to be long at the end of a word:

Word-Final Lengthening

[+syllabic] → [+long] / ____]_{word}

We will order this rule before Phrase-Final Shortening, which means that its effects get undone in phrase-final position. Therefore, only the non-final words of a phrase will show the effect of the rule in surface forms.

Here is a representative derivation. It assumes that the syntax has formed a complete phrase, /kama mp^haka/ ‘like’ + ‘cat’, that is, ‘like a cat’.

/kama mp ^h aka/	output of syntax = underlying form of phonology
a: a:	Word-Final Lengthening
a	Phrase-Final Shortening
—	Preantepenultimate Shortening
[kama: mp ^h aka]	surface form

If Phrase-Final Shortening were (wrongly) ordered before Word-Final Lengthening, the derivation would give the wrong output, as follows:

/kama mp ^h aka/	output of syntax = underlying form of phonology
—	Phrase-Final Shortening
a: a:	Word-Final Lengthening
—	Preantepenultimate Shortening
*[kama: mp ^h aka:]	surface form

Indeed, under this ordering there would be no evidence that Phrase-Final Shortening even existed.

7.2.5 Ordering Word-Final Lengthening and Preantepenultimate Shortening

Here is another ordering: Word-Final Lengthening can be shown to precede Preantepenultimate Shortening. The crucial cases arise when we have a two-word phrase, with the second word trisyllabic or longer. Here is an example of the relevant type:

[kuna]	‘to drink’
[kahawa]	‘coffee’
[kuna kahawa]	‘to drink coffee’

Here, even though [kuna] is a word that is non-final in its phrase, its final vowel does not surface as lengthened. The reason is that the word [kahawa] has three syllables. Therefore, the last vowel of [kuna] is more than three syllables from the end, and is eligible for Preantepenultimate Shortening – which, as it turns out, counts the syllables of the whole phrase, and not just of single words.

The following derivation, with Preantepenultimate Shortening ordered after Word-Final Lengthening, produces the correct output:

/kuna kahawa/	underlying form
a: a:	Word-Final Lengthening
a	Preantepenultimate Shortening
a	Phrase-Final Shortening
[kuna kahawa]	surface form

If Word-Final Lengthening were ordered after Preantepenultimate Shortening, we would get the wrong result, as follows:

/kuna kahawa/	underlying form
—	Preantepenultimate Shortening
a: a:	Word-Final Lengthening
a	Phrase-Final Shortening
*[kuna: kahawa]	predicted surface form

The form [kuna kahawa] is just one of a large number of similar examples, which according to Kisseberth and Abasheikh work in just the same way. Here are three further cases.

[maji malaḍa]	‘water’ + ‘fresh’	= ‘fresh water’
[tʃisu tʃihaba]	‘knife’ + ‘small’	= ‘small knife’
[kubola tʃiwovu]	‘to steal’ + ‘wallet’	= ‘to steal a wallet’ ⁶

⁶ The words for ‘water’ and ‘to steal’ have underlying long vowels, as their isolation forms show us: [ma:ji], [kubo:lɑ]. In the examples above, these long vowels are shortened, just as we would expect, by Preantepenultimate Shortening.

These may be compared to the forms [na: noka], [kolko: mi], [kama: mp^haka], and [hudzo: mbele], given earlier. In these forms, the fact that the second word has only two vowels means that the effect of Word-Final Lengthening survives intact, as it is not overridden by the subsequent application of Preantepenultimate Shortening.

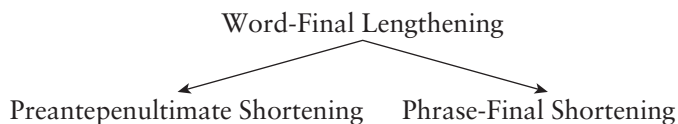
Kisseberth and Abasheikh give a number of phrases containing the verb [ku-big-a] ‘hit’, which is found in many idiomatic expressions in Chimwiini:

[kubiga: luti]	‘to hit with a stick’
[kubiga: ngoma]	‘to strike a drum’
[kubiga: zita]	‘to make war’
[kubiga ŋk ^h engele]	‘to ring a bell’
[kubiga maʔipi]	‘to slap’
[kubiga rasa:si]	‘to pull the trigger of a gun’

As expected, the length of its final vowel depends on the number of syllables in the following word. Other words alternate similarly.

7.2.6 *Illustrating rule order with Hasse diagrams*

As we accumulate data and rule orderings, it is useful to keep track of the orderings, in part to make sure that they are mutually consistent. A method commonly used is to lay out the rule names and connect with arrows the rule pairs for which there is ordering evidence. The resulting graph is sometimes called a **Hasse diagram**. For the analysis so far, with just three rules and two orderings, the Hasse diagram is very simple:



Where there is no evidence concerning ordering, as with Preantepenultimate Shortening and Phrase-Final Shortening, no arrow is drawn.

7.2.7 *Pre-Long Shortening*

There is one more rule of Chimwiini to be discussed here. Its basic pattern is this: whenever morphology or syntax sets up two long vowels in consecutive syllables, the first of them is shortened. Here are some representative alternations:

[x-si:b-a]	‘to afflict’
[x-sib-o:ɪw-a]	‘to be afflicted’
[sib-i:ɪ-l-e]	‘afflicted’
[x-tu:f-a]	‘to go around the <i>ka’aba</i> ’
[x-tuf-o:ɪw-a]	‘to be gone around’
[tuf-i:ɪ-l-e]	‘went around the <i>ka’aba</i> ’
[x-sa:jɖ-a]	‘to help’
[x-sajɖ-o:ɪw-a]	‘to be helped’
[sajɖ-i:ɪ-l-e]	‘helped’

The rule that is needed can be stated as follows:

Pre-Long Shortening

$$[+\text{syllabic}] \rightarrow [-\text{long}] / \text{--- } C_0 \begin{bmatrix} +\text{syllabic} \\ +\text{long} \end{bmatrix}$$

Shorten a vowel if the next vowel is long.

Here, C_0 is a conventional notation that means “any number of consonants.” When it appears in a rule, it can be matched to a consonant string of any length, including no consonants at all. C_0 is one way of writing rules in which vowels influence vowels in neighboring syllables.⁷ The following is a representative derivation involving Pre-Long Shortening.

/si:b/	lexical entry for ‘afflict’
	Morphological component:
/si:b-o:ɪw/	Passive Formation (p. 148)
/si:b-o:ɪw-a/	Final Vowel Attachment (p. 147)
/x-si:b-o:ɪw-a/	Infinitive Formation (/ku/ → [x] by phonological rules not covered here)
	Phonological component:
/x-si:b-o:ɪw-a/	underlying form
a:	Word-Final Lengthening
—	Preantepenultimate Shortening
a	Phrase-Final Shortening
i	Pre-Long Shortening
[xsibo:ɪwə]	surface form

Pre-Long Shortening, like Preantepenultimate Shortening, is a neutralizing rule. This is illustrated by a case in which it creates an ambiguous form (§6.2.1): the

⁷ In the original proposal for the C_0 notation, the notation was specified as C_n^m , meaning “at least n consonants and at most m .” Other than C_0 , the C_n^m scheme is seldom employed today in phonological rule writing.

verbs [x-kul-a] ‘to grow’ and [x-ku:l-a] ‘to extract’, cited earlier as a minimal pair, have identical passive forms (both [xkulo:wa]),⁸ due to the effect of Pre-Long Shortening on underlying /x-ku:l-o:w-a/.

The ordering of Pre-Long Shortening with respect to the other rules must be established. The following forms suffice to show that Pre-Long Shortening must follow Word-Final Lengthening. The derivations are given as exercise 1 below.

[kubiga pa:si]	‘to iron clothes’
[kuɖara le:mbe]	‘to sharpen a razor’
[x-tʃimbil-a si:m̩ba]	‘to run from a lion’

Pre-Long Shortening must also be ordered after Phrase-Final Shortening, as can be determined from the following data. The derivations are left as exercise 2.

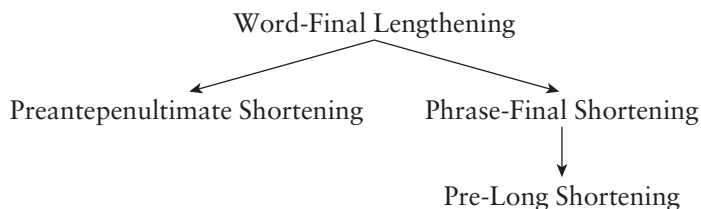
[kolko]	‘than’	[mi]	‘me’	[kolko: mi]	‘than me’
[kama]	‘if’	[we]	‘you’	[kama: we]	‘if you’

The following forms will be derived differently, depending on how the shortening rules are ordered with respect to one another. All orderings that put Word-Final Lengthening first will work for these forms, but you might want to try out the various possibilities to make sure you have a solid understanding of the system.

[nu:m̩ba]	‘house’	[numba: nkulu]	‘large house’
[sanɖu:xu]	‘box’	[sanɖuxu: nzito]	‘heavy box’
[miɕa:na]	‘rooms’	[miɕana miwili]	‘two rooms’
[zi.la:tu]	‘shoes’	[zi.latu zizito]	‘heavy shoes’

7.2.8 Chimwiini summary

In Chimwiini, alternations between long and short vowels are numerous. But the system they follow is regular, being reducible to phonological rules. For the part of the Chimwiini system we have covered here, the four rules must be ordered according to the following Hasse diagram:



⁸ More precisely, [xkulo:wa], due to a minor phonological rule not discussed here; see Kisseberth and Abasheikh (2004, p. xxix). The point about neutralization is not affected.

The alternations follow from these four rules as applied to the output of Chimwiini syntax and morphology.

Exercises

1 *Chimwiini rule ordering I*

Justify the Chimwiini rule order of Word-Final Lengthening before Pre-Long Shortening (p. 155) with two derivations, one correct and one incorrect.

2 *Chimwiini rule ordering II*

Same as above, except for Phrase-Final Shortening preceding Pre-Long Shortening (p. 155).

3 *Chimwiini rule ordering III*

Provide all derivations of /nu:mba nkulu/ → [numba: nkulu] ‘large house’ that are compatible with the Hasse diagram on p. 155.

4 *Displaced contrast and pseudo-minimal pairs*

On p. 93 are given some “pseudo-minimal pairs” similar to the [ˈɹaɪtə]/[ˈɹaɪtə̃] pair discussed in §7.1. Reread the discussion on p. 00 and consider the examples *safe* [sæɪf] vs. *save* [sæɪv] (the latter can also surface as [sɛɪv], which you may ignore). Produce the rules that are needed to cover these cases, state the ordering needed, and give derivations for both *safe* and *save*. Then explain why they are not a true minimal pair for vowel length.

5 *Rule ordering in Vancouver*

In the speech of many English speakers there is an allophonic rule whereby the phoneme /æ/ is diphthongized to [æ̃t̃] before /ŋ/

/æ/ Diphthongization

/æ/ → [æ̃t̃] / ___ ŋ

The effects of the rule can be seen in pairs such as the following:

<i>pan</i>	/pæn/	[pæn]	<i>pang</i>	/pæŋ/	[pæ̃ŋ]
<i>fan</i>	/fæn/	[fæn]	<i>fang</i>	/fæŋ/	[fæ̃ŋ]
<i>gander</i>	/'gændə/	['gændə]	<i>anger</i>	/'æŋgə/	['æ̃ŋgə]

In the same dialect there is an optional rule of /n/ Assimilation, as given below (for the notation [place_i] see p. 89).

/n/ Assimilation:

n → [place_i] / ___ [$\left[\begin{array}{c} \text{-syllabic} \\ \text{place}_i \end{array} \right]$ (in casual speech)

Assimilate /n/ in place of articulation to a following consonant.

Among the effects of this rule is the shifting of /n/ to [ŋ], as seen in the last four items below.

<i>input</i>	['ɪn,pʊt] or ['ɪm,pʊt]
<i>unprepared</i>	[,ʌnpɹə'peɪd] or [,ʌmpɹə'peɪd]
<i>unbelievable</i>	[,ʌnbə'livəbəl] or [,ʌmbə'livəbəl]
<i>I live in Minnesota</i>	[aɪ 'lɪv ɪn ,mɪnə'soũrə] or [aɪ 'lɪv ɪm ,mɪnə'soũrə]
<i>phone call</i>	['foũn ,kɔl] or ['foũŋ ,kɔl]
<i>concourse</i>	['kɑn,kɔɪs] or ['kɑŋ,kɔɪs]
<i>con game</i>	['kɑn,gēɪm] or ['kɑŋ,gēɪm]
<i>in college</i>	[ɪn 'kɑlɪdʒ] or [ɪŋ 'kɑlɪdʒ]

- a. Assess the implications of the following forms for the relative ordering of /æ/ Diphthongization and /n/ Assimilation. Pick a representative form from each of the two groups below, and work out the predictions of *both* orderings.

Word	Phonemic Form
<i>pancake</i>	/'pæn,kēɪk/
<i>Vancouver</i>	/væn'kuvə/
<i>Dan Gurney</i>	/'dæn 'gəni/
<i>sank</i>	/'sæŋk/
<i>anchor</i>	/'æŋkə/
<i>Rangoon</i>	/ɹæŋ'gun/
<i>pancake</i>	/'pæŋ,kēɪk/ 'cake eaten to assuage pangs of hunger'

- b. Assess your own English concerning these forms (possible answers: "I have both rules, with X ordered before Y," "I only have Rule X," "I have neither rule," etc.). Justify your answer with data from your own speech.

For reference, it can be noted that the author of this book says the seven words under (a) as ['pæŋ,kēɪk], [væŋ'kuvə], ['dæŋ 'gəni], ['sæ̃ŋk], ['æ̃ŋkə], [ɹæ̃ŋ'gun], and ['pæ̃ŋ'kēɪk]. I'm not sure what dialect variation occurs here.

6 *Toba Batak consonant alternations*

Toba Batak is an Austronesian language spoken in northern Sumatra (Indonesia). This language has several processes which modify consonants in various contexts. Here is an example:

Ex. 1.	[halak]	‘person’	Ex. 2.	[tuak]	‘palm wine’
	[an]	‘that’		[i]	‘the’
	[halah an]	‘that person’		[tuah i]	‘the palm wine’

These forms illustrate a rule of /k/ Weakening, which requires that whenever /k/ is placed before a vowel, it becomes [h]. (This process will not, however, be crucial for this rest of the problem.)

Here are some other data illustrating additional rules. These rules apply to the consonant clusters that arise when words are combined into phrases or sentences.

1.	[maŋan]	‘is eating’	2.	[baoa an]	‘that man’
	[baoa an]	‘that man’		[peddek]	‘short’
	[maŋab baoa an]	‘that man is eating’		[baoa ap peddek]	‘that man is short’
3.	[lean]	‘give’	4.	[soŋon]	‘as’
	[lali]	‘hen-harrier’		[gottina]	‘replacement’
	[leal lali]	‘give a hen-harrier’		[soŋog gottina]	‘in exchange’
5.	[maŋinum]	‘drink’	6.	[holom]	‘somewhat’
	[tuak]	‘palm wine’		[saetik]	‘dark’
	[maŋinup tuak]	‘drink palm wine’		[holop saetik]	‘somewhat dark’
7.	[mananɔm]	‘bury’	8.	[manan]	‘or’
	[piciŋ]	‘dish’		[pulpen]	‘pen’
	[mananɔp piciŋ]	‘bury a dish’		[manak pulpen]	‘or a pen’
9.	[dan]	‘not’	10.	[marisap]	‘smoke’
	[tibbo]	‘tall’		[hita]	‘we’
	[dak tibbo]	‘not tall’		[marisap p ^h ita]	‘let us smoke’
11.	[dɔhɔt]	‘and’	12.	[manipak]	‘kick’
	[halak]	‘person’		[haraŋan i]	‘the basket’
	[dɔhɔt t ^h alak]	‘and a person’		[manipak k ^h araŋan i]	‘kick the basket’

13. [modom] [halah i] [modop p ^h alah i]	‘sleeping’ ‘the man’ ‘the man is sleeping’	14. [ibereŋ] [halah i] [ibereŋ k ^h alah i]	‘saw’ ‘the man’ ‘the man saw’
15. [ganup] [taon] [ganu? taon]	‘every’ ‘year’ ‘every year’	16. [dohot] [lali i] [dohot? lali i]	‘and’ ‘the hen-harrier’ ‘and the hen-harrier’
17. [halak] [batak] [hala? batak]	‘person’ ‘Batak’ ‘Batak person’	18. [lap] [piŋgol] [la? piŋgol]	‘wipe off’ ‘ear’ ‘wipe off an ear’
19. [maŋihut] [taon] [maŋihu? taon]	‘following’ ‘year’ ‘according to the year’	20. [maŋan] [halah i] [maŋak k ^h alah i]	‘is eating’ ‘the person’ ‘the person is eating’

Rather than give examples for all of the logical possibilities, this problem simply expresses them in table 7.1, which works as follows. To find out what happens when you put a /p/-initial word after an /n/-final word, you examine where the row for /n/ intersects the column for /p/; thus phonemic /np/ sequence appears phonetically as [pp]. (There is an actual example of this change under (2) above.)

Gray cells are the ones that involve no change. The overlapping outlines are meant to help: look inside them to see the rules that are applying.

Table 7.1 Toba Batak consonant alternations

Rows: last sound of first word.

Columns: first sound of second word.

	p	t	h	s	b	d	ʃ	g	m	n	ŋ	r	l	Vowel
p	ʔp	ʔt	pp ^h	ʔs	ʔb	ʔd	ʔʃ	ʔg	ʔm	ʔn	ʔŋ	ʔr	ʔl	pV
t	ʔp	ʔt	tt ^h	ʔs	ʔb	ʔd	ʔʃ	ʔg	ʔm	ʔn	ʔŋ	ʔr	ʔl	tV
k	ʔp	ʔt	kk ^h	ʔs	ʔb	ʔd	ʔʃ	ʔg	ʔm	ʔn	ʔŋ	ʔr	ʔl	hV
s	sp	st	ss ^h	ss	sb	sd	sʃ	sg	sm	sn	sŋ	sr	sl	sV
n	pp	tt	kk ^h	ss	bb	dd	ʃʃ	gg	mm	nn	ŋŋ	rr	ll	nV
ŋ	kp	kt	kk ^h	ks	ŋb	ŋd	ŋʃ	ŋg	ŋm	ŋn	ŋŋ	ŋr	ŋl	ŋV
m	pp	pt	pp ^h	ps	mb	md	mʃ	mg	mm	mn	mŋ	mr	ml	mV
r	rp	rt	rh	rs	rb	rd	rʃ	rg	rm	rn	rŋ	rr	rl	rV
l	lp	lt	lh	ls	lb	ld	lʃ	lg	lm	ln	lŋ	lr	ll	lV

Determine what rules, other than /k/ Weakening, are applying in the Batak data. How must the rules be ordered with respect to each other? For each case of ordering, provide a derivation to illustrate it. Show both correct and incorrect orders, indicating how only the correct order will work.

Further reading

The rule-ordered analysis of ['ɹɑɪɪŋ] vs. ['ɹɑɪŋ] given in §7.1 was first proposed in Morris Halle (1962) "Phonology in generative grammar," *Word* 18: 54–72. It is not clear that the analysis works for all dialects that have ['ɹɑɪɪŋ] vs. ['ɹɑɪŋ]. Subsequent research has located dialects in which [ɑɪ] and [ɹɪ] have evolved into two separate phonemes, which can be diagnosed by straightforward, monomorphemic minimal pairs. See Timothy Vance (1987) "'Canadian Raising' in some dialects of the Northern United States," *American Speech* 62: 195–210. An interesting question that this work raises is just how diachronically stable cases of displaced contrast are – does the displaced contrast tend to be reanalyzed by new learners as a straight phonemic contrast?

Chimwiini phonology: Morris Goodman (1967) "Prosodic features of Bravanese, a Swahili dialect," *Journal of African Languages* 6: 278–84; Charles W. Kisseberth and Mohammad Imam Abasheikh "Vowel length in Chi-Mwi:ni: A case study of the role of grammar in phonology," in Anthony Bruce, Robert A. Fox, and Michael L. LaGaly, eds., *Papers from the Parasession on Natural Phonology* (1974, Chicago Linguistic Society); Michael Kenstowicz and Charles Kisseberth, *Topics in Phonological Theory* (1977, Academic Press); Kisseberth and Abasheikh's *The Chimwiini Lexicon Exemplified* (2004, Tokyo University of Foreign Studies).