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CV Metathesis in Kwara'ae

A thesis submitted in partial satisfaction
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by

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To Emma

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Abstract of the Thesis

CV Metathesis in Kwara’ae

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Master of Arts in Linguistics
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Professor Kie Zuraw, Chair

This thesis examines the phonological process of CV metathesis in Kwara’ae (Austronesian) between the Citation and Normal speech registers in the light of my work with a native speaker. CV metathesis is especially robust in Kwara’ae because it may occur multiple times within a word. For example, the Citation form of ‘bed’ is [ˈʔi.fi.ˌta.ʔi], whereas the Normal form is [ˈʔiˑh.ˌtai̯ʔ]. I show that there is a third form of many words in particular syntactic environments, which I dub the Focus Final form; e.g. the Focus Final form of ‘bed’ is [ˌʔiˑh.ˌtai̯.ˈʔi]. The proposed analysis, in the framework of Optimality Theory, relates the loci of CV metathesis to the stress patterns in the language, which are analyzed without metrical feet (c.f. Gordon (2003)). Specifically, I propose that the language prefers stressed syllables to be heavy (i.e. the language prefers to satisfy the Stress to Weight Principle (Prince 1992, Kager 1999) than to be faithful to underlying linear order. Alternatives to the Stress to Weight Principle are considered, and some of the problems with the correspondance-theoretic notion of linearity (McCarthy and Prince 1995) are exposed.

1 Introduction

1.1 CV Metathesis in Kwara'ae

Kwara'ae is an Austronesian (Eastern Oceanic, Southeastern Solomonic) language spoken on the island of Malaita in the Solomon Islands. There are approximately 30,000 native speakers (Grimes 2003) which makes it the largest indigenous language in the Solomon Islands. Unless otherwise indicated, the data presented here comes from Sophie Streeter, a native speaker of Kwara'ae.[1]

Most words in Kwara'ae have two remarkably different pronunciations.

(1)	Citation	Normal	
	ˈlo.ʔi	ˈloi̯ʔ	'snake'
	ˈbu.ri	ˈbu̯ir	'behind'
	ˈbo.re	ˈbo̯er	'although'

These two allomorphs are related by CV metathesis; a process in which $C_1V_1C_2V_2$ sequences become $C_1V_1V_2C_2$ sequences. In (1) the segments of the final CV syllable of the Citation form have switched positions in the Normal form.

What makes Kwara'ae unique is that CV metathesis may occur in nonwordfinal positions (2) and more than once in a word (3).[2] This is unlike CV metathesis in Rotuman, in which metathesis only occurs at the right word boundary (Churchward 1940, Cairns 1977, McCarthy 2000, Norquest 2001).

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[1] I extend the deepest gratitude to Sophie Streeter for her patience, her teaching, and for her insight.

[2] There is an explanation of morphology in the appendix.

(2)	Citation	Normal	
	ˈʔa.ko.ˌfi.a	ˈʔao̯k.ˌhi̯ɛ	‘to heat it’
	ˈsa.fi.ˌta.na	ˈsai̯h.ˌtaˑn	‘center’
	bo.ˈle.bo.ˌle.a	ˈbo̯el.bo.ˌle̯a	‘crazy’
	ke.ˈba.ke.ˌba.ʔa	ˈke̯ab.ke.ˌbaˑʔ	‘dumbo shaped’ (of ears)

(3)	Citation	Normal	
	ˈke.ta.ˌla.ku	ˈke̯at.ˌlau̯k	‘my height’
	ˈsi.na.ˌfi.da	ˈsi̯ɛn.ˌhi̯ɛd	‘to shine on them’
	da.ˈro.ʔa.ˌni.da	ˈdao̯r.ʔa.ˌŋi̯ɛd	‘to share them’
	ˈra.ʔe.ˌra.ʔe.ˌna.ʔa	ˈrae̯ʔ.ˌrae̯ʔ.ˌnaˑʔ	‘incline, slope’

Finally, many words have a third, previously unreported, allomorph, which I will call the Focus Final form. It occurs as the last word in a focused phrase (as described in section 2.3).

(4)	Citation	Normal	Focus Final	
	ˈle.ʔa	ˈle̯aʔ	ˌle̯a.ˈʔa	‘good’
	ˈsi.na	ˈsi̯ɛn	ˌsi̯ɛ.ˈna	‘sun’
	fi.ˈʔi.ta.ˌta.li	ˈfiˑʔ.ta.ˌtai̯l	ˌfiˑʔ.ta.ˌtai̯.ˈli	‘hibiscus (bush)’

This allomorph can be identified by partial metathesis of the final vowel. Unlike the complete metathesis in the Normal form, partial metathesis spreads the final vowel across the last consonant instead of moving it; i.e., a $C_1V_1C_2V_2$ sequence becomes a $C_1V_1V_2C_2V_2$ sequence.

The goal of this paper is to describe the phonological patterns of the Citation, Normal, and Focus Final forms, and to explain them in synchronic terms.

It remains a challenge for phonology to understand why and how the Citation, Normal and Normal]$_{focus}$ allomorphs are related by CV metathesis synchronically. What are the legal surface forms of the Citation and Normal registers? How can we predict the loci of metathesis? Is CV metathesis a process of copy and deletion or something else? What is the role of stress in this process? How does CV metathesis fit into the broader picture of phonological phenomena? These are some of the questions I try to answer.

1.2 Background

There is no difference in meaning among the three forms in examples (1)-(3). Their only difference, apart from their pronunciation, is their use. Uncontroversially, the Normal form is the speech register used in regular discourse.[3]

The Focus Final form is also part of regular discourse; it will be discussed in section 2.3. Therefore, even though there may be as many as three allomorphs for a particular word, there are only two speech registers: Citation and Normal.

The Citation form is the speech register used in traditional songs and for clarification.[4] Gegeo and Watson-Gegeo (1986, p. 19) write that these forms are also used in calling out routines (a songlike speech style):

> Calling out is used in three main ways in adult Kwara'ae discourse. First people call out for practical reasons in running a household, such as to locate a missing person or to bring a family member home for a meal. Secondly, a Kwara'ae man or woman working in the bush and hearing someone working nearby but out of sight will call out to seek identification of the other person. Thirdly, people call out from house to house, or as someone passes on the path, as a strictly social activity. They ask polite questions, or joke, tease and engage in pleasant banter.

The Citation register is not used exclusively in calling out routines; rather, it is

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[3] The Normal form has also been called has been referred to as the short form (Sohn 1980) and the discourse form (Norquest 2001, 2003).

[4] The Citation form has also been called the long form (Sohn 1980), historical form (Simons 1977, Blevins and Garrett 1998), or underlying form (Sohn 1980, Gegeo and Watson-Gegeo 1986).

often used in alternation with the Normal register. As Gegeo and Watson-Gegeo (1986, p. 24) point out, this is useful for the Kwara'ae learner:

> One question that intrigued us was how children learn to produce alternation of [Citation and Normal] forms and to infer underlying [Citation] forms from metathesized and contracted [Normal] forms. We have found that calling out is an important routine in this regard. In calling out the underlying form of the word is often used in alternation with the metathesized or contracted form, especially if the addressee does not hear the first time.

The examples they provide are one word utterances. Even if entire sentences are not spoken in the Citation form (and my consultant assures me no one does this), a child who is given several examples of two allomorphs may very well develop a mapping between the two forms and later apply it to new vocabulary.

Reasons for a Synchronic Analysis

There are at least three reasons to think that CV metathesis is a synchronic process. First, every word in the language has both a Citation form and a Normal form, including morphologically related words.[5]

(5)

Citation	Normal		Citation	Normal	
ˈsu.li	ˈsu̯il	‘bone’	su.ˈli.ku	ˈsu.li̯uk	‘my bone’
ˈʔo.so	ˈʔɔˑs	‘a lie’	ʔo.ˈso.ʔa	ˈʔo.ˌso̯ʌʔ	‘guile’
ˈfa.ŋa	ˈhaˑŋ	‘to eat’	fa.ˈŋa.ʔa	ˈha.ˌŋaˑʔ	‘feast’
ˈi.hu	ˈi̯uh	‘hair’	i.ˈhu.la	ˈi.ˌhu̯ʌl	‘hairy’

Loanwords also have undergone this transformation, which indicates that CV metathesis is productive.

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[5] An appendix which describes the known morphology is included at the end of this paper.

(6)

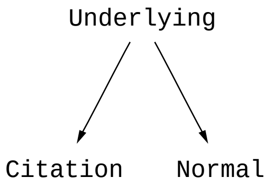
Citation	Normal	
ˈbi.ta	ˈbi̯ɛt	‘Peter’
ˈha.re	ˈhae̯r	‘Harry’
ˈre.sa	ˈre̯as	‘razor’
ˈbe.ba	ˈbe̯ab	‘paper’

Finally, $C_1V_1C_2V_2$ sequences in surface forms are absent in Normal discourse. This fact must be accounted for by the grammar since surface $C_1V_1C_2V_2$ sequences make up well-formed words in most languages. $C_1V_1C_2V_2$ sequences may be eliminated as possible underlying forms stipulatively, but this offers nothing in the way of explanation, and is odd, given the fact that such sequences are abundant in the Citation register, not to mention most other languages. Another way (e.g. Optimality Theory) requires the grammar to derive legal surface forms from any possible underlying form (the principle of a rich base). By admitting underlying forms like $/C_1V_1C_2V_2/$, it must be the grammar which does not allow such underlying representations to surface faithfully. One of the tasks I undertake is to explain how the grammar transforms an underlying representation like $/C_1V_1C_2V_2/$ to $[C_1V_1V_2C_2]$.

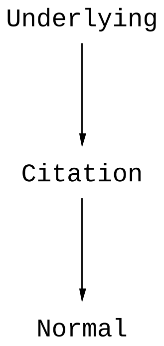
Modeling the Speech Registers

There are at least three ways to set up a model grammar for the two speech registers.

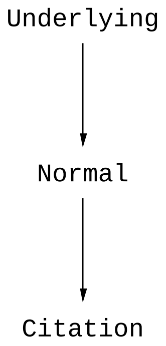
Model I



Model II



Model III



Model I is a branching model; different grammars acting on the same underlying forms produce the surface forms of the two registers. Neither form depends directly on the other. This is not the case in models II and III where one form is derived from the other. Model II is in the spirit of Kiparsky (2000). Model III is non-intuitive, but its premise is the idea that specialized speech is derived from the more commonly used form. Given the study by Gegeo and Watson-Gegeo (1986), model III represents how a child might (at some stage) conceive the grammar.

Although evidence will be presented disfavoring Model III, it is very difficult to find evidence favoring either Model I or II over the others. For concreteness, I will assume Model I throughout. This means that I assume that Normal forms and Citation forms are related because they share a common underlying form; that is, the grammar(s) should be able to derive the surface patterns of the Normal form without directly relying on the observed surface patterns of the Citation form, and vice versa.

What do I consider then to be the underlying form for a word like Normal [ˈdao̯r.ʔa.ˌni̯ɛd] Citation [da.ˈro.ʔa.ˌni.da] ‘to share them’? I have already stated that it it my position that there can be no restrictions on the inputs to the models. There could be many underlying forms that the grammar maps to a single output form. Although I will sometimes point to various possible underlying forms, I will primarily consider /daroʔanida/ as the underlying form for Normal [ˈdao̯r.ʔa.ˌni̯ɛd] and Citation [da.ˈro.ʔa.ˌni.da] ‘to share them’ since this underlying representation cannot surface faithfully in the Normal register.

1.3 Overview

Sections 2.1 and 2.2 describe the legal surface forms of the Citation and Normal forms, respectively. Section 2.3 describes the distribution and surface patterns of the Focus Final forms. Section 2.4 summarizes the main findings of these first three sections. Sections 3.1 and 3.2 show how a moraic analysis of the surface forms leads to a generalization regarding the locations of CV metathesis in the Normal form. Section 3.3 begins the Optimality-theoretic analysis of the Normal form, which culminates in sections 3.4, 3.5, and 3.6 which provide Optimality-theoretic accounts of mora projection and the stress pattern of the Normal form. Finally, implications and alternatives are discussed in section 4.

2 Data

2.1 The Citation Register

This section takes the first step in understanding how the registers are related by laying out in detail what surface forms are allowed in the Normal and Citation forms. The two registers draw from slightly different phonemic inventories, exhibit different syllable structures and have different stress patterns. As we will see, many, but not all, of these differences can be attributed to CV metathesis.

I will describe the surface patterns for each register, beginning with the Citation form. Even though I discuss each register separately, when giving examples I include the related word in the other register for comparison. When discussing the Normal form I assume the underlying form is the Citation form (without stress or syllabification).

2.1.1 Consonants

The following table gives the phonemic inventory for the consonants of the Citation form.

(7)

	labials	coronals	velars	labialized velars	glottal
stops	b	t d	k g	kʷ gʷ	ʔ
fricatives		s			h
nasals	m	n	ŋ	ŋʷ	
liquids		l			
trills		r			

The examples in (8) exhibit the contrast between the velars and labialized velars in the Citation form.[6]

(8)

Citation	Normal	
fu.ˈŋu.a	ˈhu.ŋu̯ʌ	‘to fill it’
ˈŋʷa.ʔi	ˈŋʷai̯ʔ	‘bag’
fi.ˈku.a	ˈhi.ˌku̯ʌ	‘to gather together’
ˈʔa.kʷa	ˈʔa.kʷa	‘to recover’[7]

The [w] cannot be a semivowel formed from the vowel [u] because we would

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[6] It is interesting to note that overwhelmingly in the examples of [w] and [u] in post velar environments, [w] or [u] is followed by [a]. A search through my own word list revealed that out of 92 words with [u] or [w] following a velar, there was only one, *kui* ‘dog’, followed by a vowel other than [a] (1.1%). Similar results are obtained by a search through Ben Burt’s wordlist (2004). Out of 485 words with [u] or [w] post-velarly, only twenty followed these with a vowel other than [a] (4.1%).

[7] There are no labiovelars word-finally in the Normal form. This suggests that metathesis does not occur in this word to avoid a word-final labiovelar.

expect such glide formation in ‘to fill it’ and ‘to gather together’ above. Because the distribution of [w] is limited to post-velar environments previous researchers decided not to treat it as a glide of the vowel [u], but to instead include the class of labialized velars as I have above. I will note, however, that an equally fit description of the facts is to say that a contrast exists between [u] and [w] in only one environment, the post-velar environment.

The semivowel [j] (or [i̯]) does not occur in surface Citation forms.

Finally, glottal stops are contrastive, even initially (word-initial vowels have a breathy quality). They are not voiceless, however; there are no voiceless vowels in the Citation form.

2.1.2 Vowels

There are five vowels in the Citation form: [i,u,e,o,a].

(9)

	front	back
high	i	u
mid	e	o
low	a	

2.1.3 Long Vowels

Simons (1977) claims that there is a surface vowel length difference in Kwara’ae for each of the vowels above. However, the minimal pairs he cites are not true minimal pairs, because the stress pattern is different in the words. Stress usually falls on the penult in the Citation form, but for some words, it falls finally (as described in section 2.1.5). For example, the words ‘father’ and ‘raw’ are two of the words Simons presents as evidence for a long vowel contrast (p. 8).

(10)	Citation	Normal	
	ˈma.ʔa	ˈmaˑʔ	‘father’
	ma.ˈʔa	ma.ˈʔa	‘raw’

Simons proposes that in the Citation form, the final vowel of ‘raw’ is long, but that the final vowel of ’father’ is short. However, although these pairs must have different underlying representations, it is not the case that the only featural difference between the two words is the length of the final vowel since the stress pattern is different. Thus, these pairs are not evidence for a vowel length contrast; since the final syllable of ’raw’ may be lexically stressed.

Simons even writes that “A lengthened vowel may affect the stress pattern and can often be identified in this way” (p. 7). This statement can plausibly be interpreted to mean that it is not easy to hear a durational difference and that Simons employs vowel length to account for aberrant stress patterns. Support for this interpretation comes from the fact that the every pair Simons presents to make his case have stress on different syllables as in (10).

This skepticism may be unwarranted in light of the fact that recent Kwara’ae texts authored by Kwara’ae speakers use a macron to indicate vowel length in some words (Alasa’a et al. 1990, Kwa’ioloa and Burt 2001). The decision to use a macron in Kwara’ae orthography is based on the work in Simons (1977). Ben Burt, an anthropologist at the British Museum, relies on his Kwara’ae co-authors to identify which vowels should have a macron; he says that he is not linguistically trained and does not listen for them (p.c.). Although I very much would like to give the authors of the above texts the benefit of the doubt and say surface long vowels exist, I do not perceive the lengthened vowels, nor does my consultant who uses no macrons or double vowels in her orthography. For all of these reasons, I think it is important to find minimal pairs which could only differ in length, and not stress, to settle the issue.

In order to find them, we should look for a surface length contrast in stressed positions (since underlying long vowels attract stress). A survey of a Kwara'ae word list (Burt 2004) revealed that out of 4679 words, 362 are marked for vowel length (7.7%). 257 of these long vowels are in positions that would otherwise not be stressed; i.e. they are aberrantly stressed words. This leaves 105 words in which a vowel length distinction might be measurable if a minimal pair can be found.

I have not yet found such a minimal pair, but the two words for ‘father’ and ‘raw’ do form a true minimal pair in the Focus Final form where primary stress is final and complete metathesis is blocked (as described in section 2.3). When these words are placed in the Focus Final position, primary stress falls on the final syllable for both words.

(11)	UR	Citation	Normal	Normal]$_{focus}$	
	/maʔa/	ˈma.ʔa	ˈmaʔ	ˌma.ˈʔa	‘father’
	/maʔaa/	ma.ˈʔa	ma.ˈʔa	ˌma.ˈʔa	‘raw’

It is possible now to compare the length of the vowel of the primary stressed syllable [ʔa].

What follows is a brief description and result of a preliminary phonetic study whose goal is to determine if there is surface vowel length contrast in words with underlying long vowels.

To measure the duration of the vowels, I put the words into the sentences below, and recorded seven of them in random order interspersed with filler sentences.

(12) a. [na ma.ʔa]$_{focus}$ neˑʔ ŋʷae̯ ʔi roˑʔ.ki sa.e̯an rɔˑd.
the father that danced to yesterday in night
‘It is the father who danced last night.’

b. [i̯ɛʔ ma.ʔa]$_{focus}$ ne˙ʔ nau̯k ʔei̯n.
fish raw that I ate
‘It is raw fish that I ate.’

The average duration of the final vowel in seven tokens for ‘father’ was 108.16 milliseconds, whereas the average duration of the final vowel in seven tokens for ‘raw’ was 132.44 milliseconds. A t-test made with two groups of seven tokens each shows that this difference is significant (P = 0.0097). In other words, a more accurate transcription of the Final Focus forms for ‘father’ and ‘raw’ is [ˌma.ˈʔa] and [ˌma.ˈʔaː]. It is probably reasonable to extend the surface length facts to their Citation and Normal counterparts.

(13)	UR	Citation	Normal	Normal]$_{focus}$	
	/maʔa/	ˈma.ʔa	ˈmaʔ	ˌma.ˈʔa	‘father’
	/maʔaa/	ma.ˈʔaː	ma.ˈʔaː	ˌma.ˈʔaː	‘raw’

These results are welcome because they suggest that an underlying vowel length contrast is realized as such on the surface. This will play a role later in accounting for cases of so-called aberrant stress.

Although I have not verified a surface long vowel contrast everywhere where one is claimed, I think it is now reasonable to accept Simons’s (1977) claim that there is a long vowel contrast. I will assume that speakers’ use of macrons in Ben Burt’s wordlist correctly identifies long vowels, and I will use the diacritic [˙] to indicate these presumed long vowels in my transcriptions of Citation forms.

2.1.4 Syllable Structure

The syllable structure of the Citation form is straightforward. All syllables are open and consonant clusters are prohibited everywhere. In cases where there are adjacent vowels, they are heterosyllabic.

(14)		Citation	Normal	
	a.	me.ˈa.na	ˈme̯an	‘his, her, or its tongue’
		ˈne.i.ˌri.a	ˈnei̯.ˌri̯ɛ	‘this one’
	b.	fu.ˈi.ni	ˈhu̯in	‘those’
		tu.ˈhu.a	ˈtu.ˌhu̯ʌ	‘to chop it’
	c.	i.ˈo.lo	ˈi̯ɔˑl	‘canoe’
		i.ˈli.a	ˈi.ˌli̯ɛ	‘to try it’
	d.	ˈdo.e	ˈdo̯e	‘great, big’
		ʔo.ˈdo.a	ˈʔo.ˌdo̯a	‘wall’

The sole exception is when the first vowel is [a]. In this case, there is diphthong formation, by which I mean the two vowels are adjacent but not heterosyllabic. They are in the same syllable and the vowel sound consists of a contour from the first vowel to the second vowel.

	Citation	Normal	
	ˈma.na.ˌtai̯.da	ˈman.ta.ˌi̯ɛd	‘to pity them’
(15)	ˈfi.ŋi.ˌfau̯	ˈhiŋ.ˌhau̯	‘skirt’
	ʔa.ˈfae̯	ˈʔa.ˌhae̯	‘sour’
	ˈfao̯.lo	ˈhao̯l	‘new’

2.1.5 The Stress Pattern

Stress in Kwara’ae (both Citation and Normal forms) is indicated by intensity and loudness as opposed to duration. Stress in the Citation form is rhythmic; generally, secondary stress falls on the penultimate and alternating syllables leftward. Main stress falls on the leftmost stressed syllable.[8]

(16)	C. Pattern	Citation	Normal	
	⏑́⏑	ˈka.do	ˈkao̯d	‘thin’
	⏑⏑́⏑	ma.ˈda.mo	ˈma.ˌdao̯m	‘moon, month’
	⏑́⏑⏑̀⏑	ˈke.ta.ˌla.ku	ˈke̯at.ˈlau̯k	‘my height’
	⏑⏑́⏑⏑̀⏑	da.ˈro.ʔa.ˌni.da	ˈdao̯r.ʔa.ˌni̯ɛd	‘to share them’
	⏑́⏑⏑̀⏑⏑̀⏑	ˈra.ʔe.ˌra.ʔe.ˌna.ʔa	ˈrae̯ʔ.ˌrae̯ʔ.ˌnaˑʔ	‘incline, slope’

Syllables with diphthongs are more prominent than others. If the final syllable is CVV (i.e. has a diphthong), it receives stress, as do alternating syllables to its left.

(17)	C. Pattern	Citation	Normal	
	⏑–́	ʔa.ˈfae̯	ˈʔa.ˌhae̯	‘sour’
	⏑́⏑–̀	ˈfi.ŋi.ˌfau̯	ˈhiŋ.ˌhau̯	‘skirt’
	⏑́⏑–̀	ˈta.ʔi.ˌfau̯	ˈtai̯ʔ.ˌhau̯	‘all, every’

If a word is composed of a CVV syllable followed by two CV syllables, or a CVV syllable followed by another CVV syllable, then stress falls on adjacent syllables.

(18)	C. Pattern	Citation	Normal	
	–́⏑̀⏑	ˈmau̯.ˌri.ʔa	ˈmau̯.ˌri̯ɛʔ	‘life’
	–́⏑̀⏑	ˈsae̯.ˌle.ʔa	ˈsae̯.ˌle̯aʔ	‘happy’
	⏑–́⏑̀⏑	li.ˈmau̯.ˌmu.lu	ˈli.mau̯.ˌmul	‘your (pl.) hands’
	–́–̀	ˈkai̯.ˌdai̯	ˈkai̯.ˌdai̯	‘these times’

If, however, a word is composed of a CVV syllable separated from the final word boundary by a single (C)V syllable, secondary stress falls on the penult and alternating syllables to the left, with main stress leftmost.

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[8] Norquest (2001) presents forms with a different stress pattern, for example Citation [ˌŋo.ri.ma.ˈdi.ko] Normal [ˌŋo͡ir.ma.ˈdjok] ‘kind of edible grub’. I observed no forms with this pattern. They might belong to another dialect; Norquest does not say.

(19)	C. Pattern	Citation	Normal	
	◡́◡–̀◡	ˈma.na.ˌtai̯.da	ˈmaˑn.ta.ˌi̯ɛd	‘to pity them’
	◡́◡–̀◡	ˈfa.ʔa.ˌtai̯.na	ˈfaˑʔ.ta.ˌi̯ɛd	‘to show it’

There are no instances where CVV syllables fail to receive primary or secondary stress in the Citation form.

Aberrant Stress Patterns and Long Vowels

There are some words in the Citation form that do not follow the regular stress pattern.

(20)	Citation	Normal	
	ka.ˈfa	ˈka.ˌfa	‘to comb it’

There is another word ‘comb’ pronounced Citation [ˈka.fa] (cf. Normal [ˈkaˑh]), where stress falls on the penultimate syllable. The proposal offered here is that these two forms share the same root /kafa/ ‘comb’, but ‘to comb it’ has the additional third person singular object suffix /-a/. There is a third person singular suffix /-a/, which is clearly present in the word ‘to steal’ below.

(21)	Underlying	Citation	Normal	
	/bili/	ˈbi.li	ˈbiˑl	‘to steal’
	/bili-a/	bi.ˈli.a	ˈbi.ˈli̯ɛ	‘to steal it’

With this knowledge, it is reasonable to say that the Citation form of the verb [ka.ˈfa] ‘to comb it’ is derived from an underlying form /kafa-a/. The stressed [fa] syllable of the Citation surface form [ka.ˈfa] should be identified then as a CVV syllable because it behaves like other CVV syllables with respect to stress; i.e. it should be transcribed [ka.ˈfaˑ]. Of course, the word for ‘comb’ is pronounced [ˈka.fa] in the Citation form because its underlying form is /kafa/.

The broader claim that I making, however, is that underlying vowel length contrasts can be expressed as two identical adjacent vowels. Although it is monomorphemic, the underlying form of [ma.ˈʔaː] (cf. Normal [ˈma.ˌʔa]) ‘raw’ is /maʔaa/. Just as in the case with ‘comb’ above, the grammar distinguishes between this underlying representation and /maʔa/, which surfaces as Citation [ˈma.ʔa] and Normal [ˈmaˑʔ] ‘father’.

That underlying long vowels can be expressed in this way is plausible for another reason. There are no Citation surface forms like [ka.ˈfa.a] or [ma.ˈʔa.a]. Again, according to the principle of a rich base, we must consider what the grammar does with underlying forms like /kafaa/ and /maʔaa/. The claim here is that the grammar does not map them to the same outputs as it maps /kafa/ and /ɱaʔa/, but to [ka.ˈfaˑ] and [ma.ˈʔaː], respectively.

Therefore, identical adjacent underlying vowels (i.e. long vowels) affect stress assignment in the same way non-identical adjacent vowels do. The words with so-called aberrant stress actually follow the normal stress pattern; they just have long vowels in the syllables which attract stress. It is expected then that every aberrantly stressed word should have a measurable long vowel. All the words that are aberrantly stressed that I have come across are in fact marked with a macron in Ben Burt’s word list.

A Minimal Word Condition

There are many [CV] words on the surface, but they are grammatical words that cannot be stressed in Normal speech.

(22)	Citation	Normal		
	/ʔi/	ʔi	ʔi	‘to’
	/na/	na	na	‘the’
	/ta/	ta	ta	‘a’
	/fu/	fu	ma	‘of’

There are no CV content words, however, on the surface. Content words that in my initial consultant work I transcribed as CV in all likelihood have a long vowel. (23) presents some such content words, with longer words in which they occur.

(23)	Citation	Normal	
a.	ˈŋuˑ	ˈŋuˑ	‘to sing’
	ˈŋu.ˌa.ʔa	ˈŋu.ˌu̯ʌʔ	‘singing’
b.	ˈruˑ	ˈruˑ	‘thing’
	ˈu.si.ˌruˑ	ˈwis.ˌruˑ	‘necklace’
c.	ˈʔuˑ	ˈʔuˑ	‘louse’
	ˈʔuˑ.la	ˈʔu.ˌu̯ʌl	‘of, with lice’

A long vowel in the content word accounts for the metathesis pattern in the related words. If the root was CV, we would expect Normal forms *[ˈŋwaʔ], *[ˈu.si̯ur], and *[ʔu̯ʌl] by the grammar given in the sections below. Additional corroboration for the vowel length distinction between content words and grammatical words is that the words in (23) are spelled with a macron by Ben Burt’s Kwara’ae colleagues, whereas the ones in (22) are not.

Thus, content words in the Citation form appear to meet a minimum prosodic requirement (McCarthy and Prince 1986). Since grammatical words do not bear stress, but content words do, I will assume that grammatical words are unable to bear stress because they fail to meet the minimal prosodic standard.[9]

Summary of the Citation Register

The Citation register has five short vowels, five long vowels which can be represented underlyingly as two identical adjacent short vowels, and sixteen consonants which combine to form open syllables. Diphthongs are allowed only if its first

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[9] An alternative explanation is that grammatical words are not required to bear stress, and are therefore allowed to be subminimal.

element is [a]. Stress falls on the penult and alternating syllables to the left unless there is a diphthong, which may change the pattern since CVV syllables attract stress. Vowel length reasonably accounts for aberrantly stressed words.

2.2 The Normal Register

2.2.1 Consonants

Inventory

The consonantal inventory of the Normal form is identical to the one for the Citation register with one change. The labial fricative [f] in the Citation form corresponds to the laryngeal fricative [h] in the Normal form.

(24)	Citation	Normal	
	ˈfo.ga	ˈho̯ag	‘break ’
	ˈka.fo	ˈkao̯h	‘water’
	ˈfa.fa.ˌro.ŋo	ˈhaˑh.ˌroˑŋ	‘to eavesdrop’

Word Final Stops: Aspiration and Voiceless Vowels

Word final stops are often pronounced with quite a bit of aspiration.

(25)	Citation	Normal	
	ˈʔa.ba	ˈʔaˑbʰ	‘arm’
	ˈʔa.to	ʔao̯tʰ	‘difficult’
	ˈro.do	ˈrɔˑdʰ	‘night’
	ˈnau̯.ku	ˈnau̯kʰ	‘I’
	ˈŋʷa.ʔi	ŋʷe̯ˑʔʰ	‘bag’

The aspiration of glottal stops is often realized as a voiceless vowel (see below). However, I do not consider the aspiration following non-laryngeal stops to be voiceless vowels because the qualities of the aspiration are not clear. The transcriptions in this paper will leave out the [^{h}] because they are not phonemic.

Voiceless vowels occur optionally in the Normal form, primarily word finally after the laryngeals [ʔ] and [h], and somewhat less regularly word-finally after the continuants [l] and [s].

(26)		Citation	Normal	
	a.	bi.ˈli.ʔa	ˈbi.ˌli̯ɛʔɛ̥	‘stealing’
		ˈi.du.ˌfa.ʔi	ˈi̯ud.ˌhei̯ʔɪ̥	‘always’
		ˈma.ʔu	ˈmau̯ʔu̥	‘fear’
		ˈu.ʔa	ˈu̯ɛʔɛ̥	‘crab’
	b.	ˈʔa.fe	ˈʔae̯he̥	‘wife’
		ˈka.fo	ˈkao̯ho̥	‘water’
		ka.ˈta.fo	ˈka.ˌtao̯ho̥	‘papaya’
	c.	ˈbu.su	ˈbuˑsu̥	‘to burst’
		li.ˈmau.ˌmu.lu	ˈli.mau.ˌmuˑlu̥	‘your (pl.) hands’

The voiceless vowels are the result of the contour of the tongue and the position of the mouth and lips at the time the laryngeal (or continuant) is pronounced. These vowels are not contrastive; they are optional and the quality of the vowel is always identical to that of the previous vowel, or if the previous vowel was a diphthong, to its second element. Because of this, and since they are invisible to stress, I do not think they make up the nuclei of a syllable. Instead, their characteristics are indicative of what has been called intrusive vowels (Hall 2003).

Blevins and Garrett (1998) present unpublished data circa 1982 attributed to Andrew Pawley showing a similar distribution of voiceless vowels in the Normal form. In this data, voiceless vowels occur in the Normal form following any consonant except nasals, as long as V_2 is higher or the same height as V_1. The data in (27) and (28) comes from Blevins and Garrett (1998, p. 530).

(27)

Citation	Normal	
fusi	huisi̥	‘cat’
kado	kaodo̥	‘thin’
sata	saˑtḁ	‘name’

The examples in (27) differ from my data where the voiceless vowels only occurs after larygneals. In (28), Blevins and Garrett observed that if the diphthong was a rising one, voiceless vowels did not occur.

(28)

Citation	Normal	
lifa	liəh	‘teeth’
uta	wət	‘rain’
ʔasufe	ʔasuəh	‘rat’

This last claim also does not conform exactly to my data. In (27) above, the words [ˈbi.ˌli̯ɛ̥] ‘steal it’ and [ˈu̯ɛʔɛ̥] ‘crab’ are rising diphthongs, but the voiceless vowel still occurs.

The overall picture that emerges, however, is in line with their claim that the voiceless vowels are a residue of the former vowel. The speaker I work with most likely belongs to the next generation of speakers than the ones Pawley worked with over twenty years ago. Because her speech contains optional voiceless vowels in fewer positions overall, its reasonable that her speech pattern reflects another stage of the decline of the final vowel.

As with aspiration, I will not be writing voiceless vowels in my transcriptions.

Labiovelars

Finally, there has been some disagreement about the status of labiovelars in the Normal form. Sohn (1980) claimed that the labiovelars were not contrastive in the Normal form. This is because vowel hiatus is prohibited in the Normal form (see section 2.2.2 below), and [u] occurs in complementary distribution with [w]. In other words, Sohn was claiming that the contrast between [u] and [w] no longer exists because it gets washed out by the fact that /u/ surfaces as [w] whenever its followed by a vowel, post-velar environments notwithstanding. Consequently, the Normal form does not need to distinguish between the hypothetical underlying forms /ŋua/ and /ŋʷa/ since both would surface as [ŋwa].

Under this point of view, the Normal form of 'bag' should be transcribed as [ˈŋwai̯ʔ] instead of the transcription given in (29).

(29)	Citation	Normal	
	fu.ˈŋu.a	ˈhu.ˌŋwʌ	'to fill it'
	ˈŋʷa.ʔi	ˈŋʷai̯ʔ	'bag'

I agree with Sohn that the absence of vowel hiatus in the Normal form calls into question the need to distinguish between velars and labiovelars underlyingly. However, there is some evidence from metathesis patterns that the distinction needs to be maintained. In general, underlying forms like /CVVCVCV$\underline{\text{CV}}$/ surface as [CVVCVCV$\underline{\text{VC}}$], but underlying forms like [CV$\underline{\text{CV}}$CV$\underline{\text{CV}}$] surface as [CV$\underline{\text{VC}}$CV$\underline{\text{VC}}$].

(30)		Citation	Normal	
	a.	ˈmau.ri.ˌla.$\underline{\text{ku}}$	ˈmau.ri.ˌlauk	'my being alive'
		ˈli.a.ta.ˌla.$\underline{\text{na}}$	ˈli̯a.ta.ˌlaˑn	'to look for a person'
	b.	ˈke.$\underline{\text{ta}}$.ˌla.ku	ˈke̯at.ˌlau̯k	'my height'
		ˈsi.$\underline{\text{na}}$.ˌfi.$\underline{\text{da}}$	ˈsi̯ɛn.ˌhi̯ɛd	'to shine on them'

Now consider the word *kwa'iso'i* 'to cut wood'. If this word is underlyingly /kuaʔisoʔi/, we expect that its Normal surface form would not metathesize the first /ʔi/ in the surface form; i.e. Normal [ˈku̯a.ʔi.ˌsoi̯ʔ]. However, if it were underlying /kʷaʔisoʔi/, then we would expect the /ʔi/ to metathesize yielding Normal

[ˈkʷai̯ʔ.ˌsoi̯ʔ]. In fact, the /ʔi/ does metathesize, suggesting that the labiovelar contrast is maintained in the Normal form.

(31)	Citation	Normal	
	ˈkʷa.ʔi.ˌso.ʔi	ˈkʷai̯ʔ.ˌsoi̯ʔ	‘to cut wood’

For this reason, I claim the contrast still exists in the Normal form.

2.2.2 Vowels

Diphthong Formation

Unlike the Citation form, vowel hiatus is prohibited and vowel clusters are common. This section will describe the kinds of vowel clusters present in the Normal form. In the discussion below, V_1 and V_2 refer to a V_1V_2 cluster. These vowel clusters are diphthongs; that is, there are two elements, or targets, in the course of pronouncing the diphthong.

If the adjacent vowels are of different heights, then the higher vowel is realized as a semivowel.

(32)		Citation	Normal	
	a.	ˈga.li	ˈgai̯l	‘around’
		ˈma.ʔu	ˈmau̯ʔ	‘fear’
		ˈʔa.fe	ˈʔae̯h	‘wife’
		ˈsa.lo	ˈsao̯l	‘sky’
	b.	ˈne.i.ˌri.a	ˈnei̯.ˌri̯a	‘this one’
		sa.ˈte.mu	sa.teu̯m	‘your chin’
		ˈke.ta	ˈke̯at	‘tall’
	c.	ˈlo.ʔi	ˈloi̯ʔ	‘snake’
		na.ˈʔo.ku	ˈna.ˌʔou̯k	‘before me’
		ka.ˈfo.la	ˈka.ˌho̯al	‘watery’
	d.	ˈsi.ko	ˈsi̯ok	‘nine’
		a.ˈsi.la	ˈa.ˌsi̯ɛl	‘sweet’
	e.	ˈtu.ke	ˈtu̯ɛk	‘to play about, to mess around’
		fa.ˈʔu.ta	ˈha.ˌʔu̯ʌt	‘which, how, why’

There are some unattested combinations: neither /ie/ nor /uo/ are attested anywhere.

Also notice that when V_1 is high and V_2 is not, the quality of V_2 on the surface may be altered. If V_1 is [i] and V_2 is [a], then V_2 is realized as [ɛ].[10] When V_1 is [u], if V_2 is [a], then V_2 is realized as [ʌ]. If V_1 is [u] and V_2 is [e], then V_2 is realized as [ɛ].

Additionally, there is some free variation: if V_2 = [e], [i] or [u], sometimes the vowel combination can be realized as a single vowel. I have included two normal forms below because I have heard tokens of both kinds, and do not have the sense of which is more frequent (my guess is that it depends on the rate of speech).

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[10] There are some tokens where instead of [ɛ], there is [ə]; i.e. [ˈi.ˌsjəl] and [ˈa.ˌŋjət]. This suggests that there is some free variation between [ɛ] and [ə]. I transcribe these vowels as [ɛ] because in my judgment this realization of the vowel occurs more frequently.

(33)

Citation	Normal (Coalescence)	Normal (Diphthong Formation)	
ˈsa.te	ˈsæˑt	ˈsae̯t	‘chin, beard’
ˈma.ʔi	ˈmeˑʔ	ˈmai̯ʔ	‘come’
li.ˈma.ku	ˈli.ˌmoˑk	ˈli.ˌmau̯k	‘my hand’

If V_1 and V_2 are of the same height, then the first one is realized as a semivowel.

(34)

Citation	Normal	
ˈle.ʔo	ˈle̯oʔ	‘suicide by hanging’
ˈni.u	ˈni̯u	‘coconut’
ˈsu.i	ˈsu̯i	‘to finish’
ˈdo.e	ˈdo̯e	‘great, big’

In general, diphthongs with the low vowel [a] (as either the first or second element) sound the same regardless of whether they occur in open or closed syllables. But other diphthongs sound different in open syllables as compared to closed syllables. For example, the [e̯a] sequence found in [ˈke̯at] ‘tall’ is not the same as in the one in [ˈbo̯el.bo.ˌle̯a] ‘crazy’. In [ke̯at], the [e̯] sound is short and brief, whereas in [e̯], it is more drawn out. Generally, this holds true of other diphthongs with no low vowel.

Adjacent Identical Vowels

When $C_1V_iC_2V_i$ sequences metathesize, do these vowels coalesce to a short vowel yielding $C_1V_iC_2$, or, by virtue of now being adjacent, is their vowel length longer yielding $C_1V_iV_iC_2$? My transcriptions use a [ˑ], presuming a slightly lengthened vowel.

(35)	Citation	Normal	
	ˈki.ni	ˈkiˑn	‘female’
	ˈma.na	ˈmaˑn	‘her, his, or its eye’
	ku.ˈku.du	ˈku.ˌkuˑd	‘basket’
	ˈde.ŋe	ˈdɛˑŋ	‘shrimp’
	ˈmo.ko	ˈmɔˑk	‘smell’

Similar transcriptions to those in (35) are given by Sohn (1980). Simons (1977) and Tryon and Hackman (1983) do not use the diacritic [ˑ] to indicate that these vowels are longer in length. Nobody has justified their use or non-use of the diacritic. The question regarding vowel length is difficult to answer because all closed syllables in the Normal form are derived from a /(C_1)$V_1C_2V_2$/ sequence. We can only find a minimal CVC-CVVC pair if the first C is a actually a semivowel. For example, the Citation form of the word ‘canoe’ is [i.ˈo.lo]. Its Normal pronunciation is [i̯ɔl]. If there were another word whose Citation pronunciation were [ˈi.lo], then we would expect its Normal pronunciation to also be [i̯ɔl]. Measuring the duration of the nuclei of these two Normal form words, one from underlying /iolo/ and one from underlying /ilo/, should tell us whether or not the nuclei in the examples in (35) are long.

I have not found any pairs like the one just described, but I will assume that the vowels are longer because it makes the analysis later more straightforward.

Also note that adjacent identical mid vowels lower slightly. This lowering is likely to be a consequence of the coda, as opposed to them being adjacent. This is because words with long vowels do not lower [e] or [o] in open syllables. For example, [ˈbeˑ.ˌbeˑ] ‘vulva (impolite)’ is spelled *bēbē*, and [ˈkoˑ.ˌŋi̯ɛ] ‘bake it in a stone oven’ is spelled *kōngia* in Ben Burt’s wordlist. Further evidence comes from examples like those in (36) which exhibit lowering, even though there is no reason to believe that there are two identical adjacent vowels making up the nucleus of the Normal form.

(36)

Citation	Normal	
ˈi.ro	ˈjɔr	‘to check out’
ˈo.ne	ˈo̯ɛn	‘sand’
ˈo.re	ˈo̯ɛr	‘to be left out’

There is one lexical exception to this. The complementizer ‘that’ is regularly pronounced [ŋeˑʔ] (cf. Citation [ˈne.ʔe]).

Interim Summary

The following table summarizes the complex nuclei found in the Normal form, indicating the two underlying vowels that surface as the complex form.

(37)

$C_1V_1V_2C_2$		V_2				
		i	u	e	o	a
V_1	i	iˑ	i̯u	⊘	i̯o	i̯ɛ (i̯ə)
	u	u̯i	uˑ	u̯ɛ	⊘	u̯ʌ
	e	ei̯	eu̯	ɛˑ (eˑ)	e̯o	e̯a
	o	oi̯	ou̯	o̯e, u̯e	ɔˑ	o̯a
	a	ai̯, ei̯, eˑ	au̯, oˑ	æ, ae̯	ao̯	aˑ

⊘ = *unattested*
Nuclei in () are underrepresented
Nuclei following a ‘,’ occur in fast speech

The unattested patterns are mysteries. The most represented member of each cell is associated with a unique V_1V_2 pair; however, if we consider the free variation and the lexical exceptions, this is no longer the case. For example an /ai/ combination in fast speech may be pronounced in the same manner as an underlying /ei/ combination, or the same as vowel found in the lexical exception [ˈneˑʔ] ‘that’ (cf. Citation [ˈne.ʔe]).

Triphthongs

In $C_1V_1V_2C_2V_3$ forms, C_3V_3 always metathesizes, potentially yielding a triphthong. However, depending on the quality of the vowels, different strategies are adopted to avoid a triphthong.

If V_1 is not low and V_2=V_3 then V_1 glides, and V_2 and V_3 coalesce.

(38)		Citation	Normal	
	a.	fu.ˈa.da	ˈhu̯ad	‘to her, him, or it’
		fu.ˈa.ra	ˈhu̯ar	‘crocodile’
		fu.ˈi.ri	ˈhu̯ir	‘that’
	b.	bi.ˈa.la	ˈbi̯al	‘smoke’
		ni.ˈa.ʔa	ˈni̯aʔ	‘she, he, or it’
		fi.ˈo.lo	ˈhi̯ol	‘hungry’

Evidence that V_2 and V_3 coalesce into a single vowel comes from the following pair.

(39)	Citation	Normal	
	fi.ˈo.lo	ˈhi̯ol	‘hungry’
	ˈsae.ˌfi.lo	ˈsae.ˌhi̯ol	‘to ask’

The word ‘hungry’ and the second syllable of ‘ask’ have the same pronunciation. If metathesis preserved the length contrast, then we would expect ‘hungry’ to be pronounced *[ˈhi̯oˑl] and not [ˈhi̯ol]. In fact, neither I nor the speaker could identify a length difference between the word ‘hungry’ and the second syllable of ‘ask’.[11]

Also note that under either representation there is nuetralization; e.g. a [$CV_1V_2CV_2$] and [$C_1V_1C_2V_2$] Citation forms share the same [$C_1V_1V_2C_2$] Normal form. This makes it unlikely that the Citation form is derived from the Normal

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[11] This has not been subjected to rigorous phonetic measurement, however. Also, this form appears to be another exception to the proposal that the coda is responsible for mid-vowel lowering because this form is pronounced with an [o], and not a [ɔ].

form (as in Model III in section 1.2) because a single Normal form would have to map to two different Citation forms.

If V_1 is low and V_2=V_3 then V_2 and V_3 coalesce.

(40)	Citation	Normal	
	ˈfau̯.ku	hau̯k	‘to me’
	ˈnau̯.ku	nau̯k	‘I’
	ˈfao̯.lo	hao̯l	‘new’
	ˈkai̯.li	kai̯l	‘you all (excl.)’

All of the above are expected. But interestingly, if V_2 is not low, and $V_2 \neq V_3$ then V_2 glides; i.e. metathesis creates a new syllable.

(41)	Citation	Normal	
	ˈtai̯.da	ˈta.ˌi̯ɛd	‘to sew them’
	ˈma.na.ˌtai̯.da	ˈman.ta.ˌi̯ɛd	‘to pity them’
	ˈmae̯.ʔa	ˈma.ˌe̯ɛʔ	‘death’
	ˈmau̯.ri	ˈma.ˌwir	‘life’
	ˈsae̯.na	ˈsa.ˌe̯ɛn	‘in it’
	ˈuˑ.la	ˈu.ˌu̯ʌl	‘of lice’

This observation is most readily related to the observation that there are no words composed of a heavy syllable followed by a light syllable (see below).

There are some cases where a triphthong is unavoidable. If V_1 is high, V_2 is low and V_3 is high then V_1 and V_3 form glides.

(42)	Citation	Normal	
	fu.ˈa.mu	ˈhu̯au̯m	‘to you’
	fu.ˈa.ku	ˈhu̯au̯k	‘to me’

No other combinations of V_1, V_2, and V_3 are attested.

Summary of the Normal Register Vowels

The surface vowel inventory of the Normal form is much more varied than that of the Citation form. This is because CV metathesis creates vowel clusters, which result in diphthongization, glide formation, height changes, and coalescence. However, we have also seen that the properties of these vowel clusters are predictable from combinations of the five vowels [i,u,e,o,a]. Thus, the phonemic inventory of the Normal form vowels is the same as that of the Citation form.

2.2.3 Syllable Structure

In the Normal form, consonant clusters, vowel clusters, and closed syllables are typical. These are the side effects of CV metathesis. Throughout the discussion I will use the terms V_1 and V_2 to refer to the vowels in a $C_1V_1C_2V_2$ sequence in the Citation form that is $C_1V_1V_2C_2$ in the Normal form. I will also use V to refer to semivowels and vowels within a nucleus. I use G to refer to a semivowel in onset position.

The syllable types found in the Normal form are V, CV, GV, CVV, GVC, CVVC, and CVVVC.

(43)

Citation	Normal		
ˈli.u	li̯u	‘very’	CVV
ˈŋe.la	ŋe͡al	‘child’	CVVC
fu.ˈa.na	ˈhu̯au̯m	‘to her, him or it’	CVVVC
i.ˈfu.da	ˈi.ˌhu̯ad	‘their hair’	V.CVVC
ˈtai̯.a	ˈta.i̯ɛ	‘to sew it’	CV.GV
ˈtai̯.da	ˈta.i̯ɛd	‘to sew them’	CV.GVC
ˈfi.ŋi.ˌfau̯	ˈhiˑŋ.hau̯	‘skirt’	CVVC.CVV

It will be useful to classify the syllable types to expedite discussion. I will call (C)V and GV syllables light, and all other syllable types heavy.

The distribution of light syllables is severely restricted. This follows if CV metathesis prevents underlying $C_1V_1C_2V_2$ sequences from surfacing faithfully. (C)V syllables may occur as the first syllable only if they are followed by a heavy syllable or by a GV syllable (44).

(44)		Citation	Normal	
	a.	si.ˈlo.lo	ˈsi.ˌlɔˑl	‘to be harsh with words, to rouse’
		bo.ˈbe.ʔa	ˈbo.ˌbe̯aʔ	‘fat’
		a.ˈsi.la	ˈa.ˌsi̯ɛl	‘sweet’
	b.	ˈtai̯.a	ˈta.i̯ɛ	‘to sew it’
		su.ˈi.a	ˈsu.i̯ɛ	‘to finish it’
		di.ˈu.a	ˈdi.u̯ʌ	‘to crack it’

Light syllables exist as the second syllable only if they are preceded by a heavy syllable, and followed by a heavy or GV syllable (45).

(45)	Citation	Normal	
	ke.ˈba.ke.ˌba.ʔa	ˈke̯ab.ke.ˌbaʔ	‘dumbo-shaped’ (for ears)
	si.ˈsi.hu.ˌla.ʔa	ˈsiˑs.hu.ˌlaʔ	‘goosebumps’
	ˈma.na.ˌtai̯.a	ˈmaˑn.ˌta.i̯ɛ	‘to pity him, her or it’
	ma.ˌla.ɡa.ˌu.a	ˈmaˑl.ˌɡa.u̯ʌ	‘to ruin it’

GV syllables are attested only word finally (where CV syllables are unattested). Presumably this is because words ending in an underlying sequence of three adjacent vowels can best avoid vowel hiatus if the middle V surfaces as a semivowel. Light syllables have not been found in any other environments, but the analysis presented later predicts that they should be found in certain other locations.

Heavy syllables are found everywhere except in one position. There are no disyllabic words in which the first syllable is heavy and the second syllable is light.[12]

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[12] There are two counterexamples to this: *to'oba* ‘down there’ is pronounced [ˈtoʔ.ba] Citation [to.ˈʔo.ba], and *lo'oba* ‘other side, over there’ is pronounced Normal [ˈloʔ.ba] and Citation

The unusual distribution of light syllables can be understood if there is a process actively preventing them from surfacing faithfully to their underlying positions, such as CV metathesis. Similarly, the relatively free distribution of heavy syllables is also a consequence of this process.

Lastly, onsetless syllables are not allowed except as the initial syllable, owing to the process of hiatus resolution discussed in section 2.2.2.

2.2.4 The Stress Pattern

Unlike the Citation form, in the Normal form, main stress always falls on the initial syllable.

(46)	Citation	N. Pattern	Normal	
	ˈka.do	–́	ˈkao̯d	‘thin’
	ma.ˈda.mo	˘́–̀	ˈma.ˌdao̯m	‘moon, month’
	ˈke.ta.ˌla.ku	–́–̀	ˈke̯at.ˈlau̯k	‘my height’
	da.ˈro.ʔa.ˌni.da	–́˘–̀	ˈdao̯r.ʔa.ˌni̯ɛd	‘to share them’
	li.ˈmau̯.ˌmu.lu	˘́––̀	ˈli.mau̯.ˌmuˑl	‘your (pl.) hands’
	ˈra.ʔe.ˌra.ʔe.ˌna.ʔa	–́–̀–̀	ˈrae̯ʔ.ˌrae̯ʔ.ˌnaʔ	‘incline, slope’

Heavy syllables always bear secondary stress except in one class of words, e.g. ˘́––̀in [ˈli.mau̯.ˌmuˑl] ‘your (pl) hands’. Other words like this one are:

(47)	Citation	N. Pattern	Normal	
	a.ˈŋi.a.ˌŋi.la	˘́––̀	ˈa.ˌŋi̯ɛ.ŋi̯ɛl	‘tearful’
	ʔa.ˈʔai̯.ˌki.na	˘́––̀	ˈʔa.ʔai̯.ˌki̯ɛn	‘aunts (collective)’
	i.ˈli.a.ˌla.na	˘́––̀	ˈi.li̯ɛ.ˌlaˑn	‘his trying’

Light syllables bear stress only if they are in certain positions. For example, in (46) we see they bear stress if they make up an initial (main stressed) syllable. In (48), we see that they can also bear stress in the case where they precede a word final GV syllable.

[lo.ˈʔo.ba]. These are the only two exceptions I am aware of.

(48)	Citation	N. Pattern	Normal	
	ˈma.na.ˌtai̯.a	–́◡̀◡	ˈmaˑn.ˌta.i̯ɛ	‘to pity her, him, or it’
	ˈla.la.ˌgau̯.a	–́◡̀◡	ˈlaˑl.ˌga.wʌ	‘to ruin it’
	ˈfu.li.ˌruˑ.a	–́◡̀◡	ˈhu̯il.ˌru.wʌ	‘to establish something’

CGV syllables also pattern as heavy syllables because they attract stress word-finally.

(49)	Citation	N. Pattern	Normal	
	di.ˈdi.fu.ˌli.a	–́◡–̀	ˈdiˑd.hu.ˌli̯ɛ	‘to replace’
	bo.ˈle.bo.ˌle.a	–́◡–̀	ˈbo̯el.bo.ˌle̯a	‘crazy’
	fa.ˈʔa.fu.ˌŋu.a	–́◡–̀	ˈhaˑʔ.hu.ˌŋwʌ	‘to make full’

Summary of the Normal Register

While words in the Normal form draw from the same phonemic inventory as words in the Citation form, words in the Normal form have more complicated phonotactics. The distribution of light syllables is restricted. Heavy syllables are freely distributed, except that heavy-light words are prohibited. Complex nuclei and consonant clusters are common. Main stress is on the initial syllable, and heavy syllables bear stress, except when following an initial light syllable. These phonotactics follow if CV metathesis is prohibiting underlying /...$C_1V_1C_2V_2$.../ sequences from surfacing faithfully.

2.3 Focus Final Forms

This section describes the third allomorph of the Kwara’ae paradigm found in the focus position of the Normal form. This form, which I call the Focus Final form, is part of the Normal speech register. It is found in regular discourse at the right boundary of the focus position. Focus in Kwara’ae can be likened to clefting in English. Objects and other arguments of the verb which are normally post-verbal move to a pre-subject position in the left periphery. Phonologically, the Focus Final form is distinguished by partial metathesis and primary stress word finally.

2.3.1 Identifying the Focus Final Position

Kwara'ae is a language with SVO basic word order. First, consider where stress falls on the word *'ifita'i* 'bed' (Normal [ˈʔih.ˌtei̯ʔ] Citation [ˈʔi.hi.ˌta.ʔi]) when it is in the usual post-verbal object position.

(50) ki̯ɛr so.ŋei̯ʔ le̯aʔ [na ˈʔiˑh.ˌtei̯ʔ].
they make well the bed
'They skillfully built the bed.'

Objects and other arguments of the verb can precede the verb if they are placed in the focus position. In the examples below, the word [neˑʔ] is a complementizer, which follows the focus position. (51) demonstrates the Focus Final form for the word *'ifita'i* 'bed'.

(51) [na ˌʔiˑh.tei̯.ˈʔi]$_{focus}$ neˑʔ ki̯ɛr so.ŋei̯ʔ le̯aʔ aˑn.
the bed that they make well to
'It is the bed that they skillfully built.'

Notice that the pronunciation of 'bed' is different in the Focus Final position. Primary stress is on the final mora of the allomorph, and the metathesis is only partial. This suggests that the stress pattern and the metathesis pattern are related.

Adjectives typically follow the nouns they modify in Kwara'ae. Therefore, it is possible to see that this Focus Final stress applies only to the syllable immediately preceding the right phrasal boundary of the focused constituent and not to all the content words in the focused constituent. In (52) and (53) below, compare the pronunciations of the adjectives meaning ‘heavy’.

(52) a. ki.ra so.ŋei̯ʔ le̯aʔ [na ˈʔiˑh.ˌtei̯ʔ kul].
3p make well the bed heavy
‘They skillfully built the heavy bed.’

b. [na ʔiˑh.tei̯ʔ ku.ˈlu]$_{focus}$ neˑʔ ki̯ɛr so.ŋei̯ʔ le̯aʔ aˑn.
the bed heavy that they make well to
‘It is the heavy bed that they skillfully built.’

To complete the picture, we will add the adverb ’very’ to the above sentences. In Kwara’ae adverbs follow the adjectives they modify. The Citation form of ‘very’ is [ˈli.u], but its Normal form is [ˈli̯u]. In both of the two sentences below, notice that ‘very’ is pronounced as it is in the Normal form.

(53) a. ki.ra so.ŋei̯ʔ le̯aʔ [na ˈʔiˑh.ˌtei̯ʔ kul li̯u].
3p make well the bed heavy very
‘They skillfully built the heavy bed.’

b. [na ʔiˑh.tei̯ʔ kuˑl ˈli̯u]$_{focus}$ neˑʔ ki̯ɛr so.ŋei̯ʔ le̯aʔ aˑn.
the bed heavy very that they make well to
‘It is the heavy bed that they skillfully built.’

The three allomorphs of the examples above are summarized in the following table.

(54)

Citation	Normal	Normal]$_{focus}$	
ˈʔi.hi.ˌte.ʔi	ˈʔiˑh.ˌtei̯ʔ	ˌʔiˑh.tei̯.ˈʔi	‘bed’
ˈku.lu	ˈkuˑl	ˌku.ˈlu	‘heavy’
ˈli.u	ˈli̯u	li̯u	‘very’

Here are some more examples of words with all three allomorphs.

(55)

Citation	Normal	Normal]$_{focus}$	
ˈle.ʔa	ˈle͜aʔ	ˌle͜a.ˈʔa	‘good’
ˈsi.na	ˈsi͜ɛn	ˌsi͜ɛ.ˈna	‘sun’
fi.ˈʔi.ta.ˌta.li	ˈfiˑʔ.ta.ˌta͜il	ˌfiˑʔ.ta.ˌta͜i.ˈli	‘hibiscus (bush)’
ˈbu.lu.ˌbu.lu	ˈbuˑl.ˌbuˑl	ˌbuˑl.bu.ˈlu	‘star’

Recall that Blevins and Garrett (1998) argue that CV metathesis is actually a diachronic process of copy and deletion.

(56) $C_1V_1C_2V_2 > C_1V_1V_2C_2V_2 > C_1V_1V_2C_2$

If metathesis is a process of copy and deletion, then the Focus Final forms exhibit the copying, but not the deletion.

How can the Final Focus form be derived? I will argue that the same grammar that produces the Normal form will also produce the Normal focus form. I postpone the arguments until the analysis in section 3.6.6.

A tantalizing hypothesis for a synchronic analysis of the Focus Final forms, then, is that the exceptional stress pattern found in the final focus forms interrupts the regular copy and deletion process that makes up CV metathesis. This hypothesis will be pursued in my analysis.

2.3.2 Exceptions to Focus Final Forms

Although many words undergo the Focus Final alternation, there are a number of words that do not. Most of these words can be identified as those taking the possessive suffixes.

(57)	Citation	Normal	Normal]$_{focus}$	
	li.ˈma.ku	ˈli.ˌmau̯k	ˈli.ˌmau̯k	‘my hand’
	ʔa.ˈba.mu	ˈʔa.ˌbau̯m	ˈʔa.ˌbau̯m	‘your arm’
	i.ˈfu.na	ˈi.ˌhu̯ʌn	ˈi.ˌhu̯ʌn	‘her, his, or its hair’
	sa.ˈta.ka	ˈsa.ˌtaˑk	ˈsa.ˌtaˑk	‘our names’
	sa.ˈte.da	ˈsa.ˌte̯ad	ˈsa.ˌte̯ad	‘their chins’

It is not the case that suffixes in general block partial metathesis of these forms because other words that have [-CV] suffixes do exhibit partial metathesis in this position. The following words all take the nominalizing suffix [-ʔa].

(58)	Citation	Normal	Normal$_{focus}$	
	ˈmae.ʔa	ˈma.ˌe̯aʔ	ˌma.e̯a.ˈʔa	‘death’
	ʔo.ˈso.ʔa	ˈʔo.ˌsu̯ʌʔ	ˌʔo.ˌsu̯ʌ.ˈʔa	‘guile’
	bi.ˈli.ʔa	ˈbi.ˌli̯ɛʔ	ˌbi.ˌli̯ɛ.ˈʔa	‘thievery, stealing’

One possibility is that the possessive suffixes are not morphemes, but clitics. Because their junctural properties are more like word boundaries than morpheme boundaries, these suffixes form their own prosodic unit. Because these clitics are [CV], they are smaller than a minimal word, and are therefore unable to bear stress as discussed in section 2.1.5.

Additional words that do not exhibit partial metathesis in Final Focus position are question words and the word meaning ‘instead’.

(59)	Citation	Normal	Normal]$_{focus}$	
	a.ˈŋi.ta	ˈa.ˌŋi̯ɛt	ˈa.ˌŋi̯ɛt	‘when’
	fa.ʔi	ˈheˑʔ	ˈheˑʔ	‘where’
	ˈla.la	ˈlaˑl	ˈlaˑl	‘instead’

It is likely that these words are not in the same syntactic position as the others. It has been argued that question words and focused elements belong to different positions (Lee 2001). The word for ‘instead’ usually expresses contrastive focus, which may be different from the focus expressed above.

2.3.3 Is Partial Metathesis Optional?

Recent inquiries have revealed that partial metathesis may be optional. Some forms may have one of two pronunciations in this position. For example, the word [ˈmau̯ˌri̯ɛʔ] (cf. Citation [ˈmau̯.ˌri.ʔa] ‘life’) may be pronounced in the Final Focus position as [ˌmau̯.ri.ˈʔa], in addition to [ˌmau̯.ˌri̯ɛ.ˈʔa]. In other words, it may be that every Focus Final form may also be pronounced with no metathesis at the right edge, as well as with partial metathesis. I have yet to verify that this is possible for every word looked at already. No matter the distribution of these variants, one thing is clear: Primary stress is at the right edge, and complete metathesis is not allowed.

Summary of the Focus Final Forms

Focus Final forms are the last word in a clefted phrase. In this position primary stress is rightmost, and total metathesis is blocked. Partial metathesis of the final vowel commonly occurs, but appears optional in some cases. Taken as a whole, this is evidence for the position that the stress pattern conditions the loci of CV metathesis. The few exceptions can be explained by other factors.

2.4 The Metathesis Paradigm

There are two speech registers, the Citation and Normal forms. These two registers have the same phonemic inventory, but the legal surface forms of each register allow different syllable structures and stress patterns. The Citation form prohibits consonant clusters and most vowel clusters. All syllables in the Citation form are open, and most consist of a single vowel. n the other hand, the Normal form has both open, closed, light and heavy syllables in unusual distributions.

The distribution of light syllables is restricted, but the distribution of heavy syllables is relatively free with the exception that heavy-light words are absent. The unusual patterns found in the Normal form are understandable if CV metathesis prevents is preventing underlying /...$C_1V_1C_2V_2$.../ sequences from surfacing faithfully.

The following table summarizes the paradigm described in sections 2.1, 2.2, and 2.3. Recall that since sentences are not spoken in the Citation form, there is no Final Focus form in the Citation register.

(60)

	Normal	*Citation*	
Focus Final Position	si̯ɛ.ˈna ˌʔiˑh.tei̯.ˈʔi	NA	‘sun’ ‘bed’
Elsewhere	ˈsi̯ɛn ˈʔiˑh.ˌtei̯ʔ	ˈsi.na ˈʔi.hi.ˌta.ʔi	‘sun’ ‘bed’

The remainder of the paper gives a formal analysis of the Normal form which accounts for its unusual surface patterns by identifying the environment which lead to CV metathesis.

3 Analysis

3.1 A Moraic Analysis of the Citation and Normal forms

3.1.1 The Moraic Grid

This section begins the analysis of CV metathesis in the Normal register. I will set aside the introduction of the phonological constraints until after a discussion of how to represent the surface stress patterns. With the right representations, the analysis is easier to state.

Although I will not formalize a grammar for the Citation register because it is a linguistically familiar object (codas are prohibited, almost every syllable is monomoraic, and stress falls on the penult and alternating syllables leftward), I will use of some of its patterns to facilitate exposition.

As a starting point, I adopt the point of view that stress can determine the loci of CV metathesis (Blevins and Garrett 1998, Norquest 2001, Baird 2002).[13] In order to show that this is the case, the stress patterns will be identified using the moraic grid (Liberman 1975, Prince 1983, Gordon 2003). In its original formulation, the grid is made up of a horizontal axis, which expresses time, and a vertical axis, which expresses degree of stress. The vertical axis typically consists of three levels, zero, one and two, though additional levels may be added (for phrasal stress, for example). Every syllable along the horizontal axis receives a grid mark (X) on the zero level. Syllables receiving stress receive an additional grid mark at level one. Finally, primary stressed syllables receive a gridmark on level two. For example, the Kwara'ae Citation form [ˈke.ta.ˌla.ku] 'my height' has the following representation in the grid.

(61)	2	x			
	1	x		x	
	0	x	x	x	x
		ke	ta	la	ku

An OT grammar reviews all possible competing grids for each candidate and selects the one that best satisfies its constraints. Of course many possible grids are eliminated immediately. A widely accepted inviolable constraint, for example, is the Continuous Column Constraint (Hayes 1994) which prohibits the nth level from being marked with x if the the (n-1)th level is not marked with an x, as is the case for the syllable [la] below.

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[13] The hypothesis that the stress pattern holds the key to identifying the loci of CV metathesis is not recent. To my knowledge, it was originally advanced in an addendum in Laycock (1982), attributed to Gary Simons.

(62)

2	x			
1	x		x	
0	x	x		x
	ke	ta	la	ku

The only change I make to this system is the one explored in Prince (1983): the X_0 level represents moras, not syllables. Heavy syllables have two moras, i.e. two X_0 grid marks, whereas light syllable only get one. Prince (1983, p. 58) contends that the second X0 grid mark attributed to heavy syllables follows from their sonority.

> A heavy syllable encloses significantly more (total) sonority than a light syllable. Stress is a kind of heightening of sonority; heavy syllables are intrinsically heightened; and – in the capitalism of stress assignment – them as has, gets.

That sonority plays a role in syllable weight has been corroborated in phonetic work by Gordon (2002a,b, 2004), where he finds that the total acoustic energy of a syllable is a factor in whether the language treats the syllable as heavy or light. [14]

Heavy syllables then, in both the Citation and Normal forms, are any syllable that is not (C)V or GV, such as CVV, CGV, CVVC, etc.

Prince (1983) makes one additional suggestion. Stressed heavy syllables should always be represented in the grid as $\begin{array}{l}\mathrm{x}\\ \mathrm{xx}\end{array}$, not as $\begin{array}{r}\mathrm{x}\\ \mathrm{xx}\end{array}$ nor as $\begin{array}{c}\mathrm{xx}\\ \mathrm{xx}\end{array}$. He explains (pp. 59-60):

> As a first step, let us ask why a heavy syllable maps into $\begin{array}{l}\mathrm{x}\\ \mathrm{xx}\end{array}$ rather than $\begin{array}{r}\mathrm{x}\\ \mathrm{xx}\end{array}$... We invoke the fundamental law of rhythm mentioned in section

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[14] This also should drive home the need for a phonetic analysis of surface vowel length in Kwara'ae. If the vowels are long, then the two positions at the X_0 are justified by the increase in sonority. If they are not longer on the surface, then there is no perceptual justification for the observed stress patterns.

> 1.2: division of a unit produces the sequential relation s-w [strong-weak] between the subparts. Suppose we wish to map a syllable to two grid positions. This imposes a division on the unit "syllable"; therefore, the two positions must be $\overset{\text{x}}{\text{x}}\text{x}$.

Prince also offers a way to identify which parts of the heavy syllable are represented as moras on the X_0 level of the grid (p. 60):

> Now we ask how syllable contents can be legitimately aligned with the rhythmic template $\overset{\text{x}}{\text{x}}\text{x}$. At this point, considerations of intrinsic sonority-shape come into play. The iambic profile of the onset-rime sequence would be grossly violated if it were to associate with the grid sequence $\overset{\text{x}}{\text{x}}\text{x}$; for this reason, onsets can never be "moras". If sonority is to be respected as a significant kind of intrinsic strength, we must match peak to peak, grid-peak to sonority-peak. Consequently, only the nuclear vowel and material that lies after it can be related to the grid; the "second mora" – the one that makes for heaviness – must follow the peak. On this account..., it is not the internal sonority contrast that ensures a second level of grid representation, but rather the fact of subdivision; sonority comes in to explain the details of alignment.

In this moraic system, the stress pattern for the Citation form [ˈfi.ŋi.ˌfau̯] 'skirt' can be represented as follows.

(63)

2	x			
1	x		x	
0	x	x	x	x
	fi	ni	fa	u

Using this moraic analysis, an alternating stress pattern conveniently derives the tendency for heavy syllables to be stressed cross-linguistically (i.e the Weight to Stress Principle (Prince 1992, Hayes 1994)). As a shorthand, instead of writing the grid out each time as above, I will use the numbers 0,1, and 2 to indicate that heights of the moraic columns of the grid, in order from left to right, along with periods to indicate the syllable boundaries. The examples above could then be written as follows:

(64)	Citation Form	Citation Grid	
	ˈke.ta.ˌla.ku	2.0.1.0	‘my height’
	ˈfi.ni.ˌfau̯	2.0.10	‘skirt’

From this vantage point, we see that, although the syllable structure of the two Citation form words is different, their grid profile is the same.

The next step to understanding how the stress pattern conditions CV metathesis in Kwara’ae is to see how the stress patterns of the two forms can be represented using the moraic grid.

3.1.2 The Citation Stress Pattern and the Moraic Grid

Recall from section 2.1.5 that the stress pattern of words composed solely of (C)V syllables in the Citation form is: main stress falls on the leftmost secondarily stressed syllable, and secondary stress falls on the penultimate and alternating syllables left. The table below is repeated from (16), except now the Citation grid marks have been added.

(65)	Citation	C. Grid	Normal	
◡́◡	ˈka.do	2.0	ˈkao̯d	‘thin’
◡◡́◡	ma.ˈda.mo	0.2.0	ˈma.ˌdo̯m	‘moon, month’
◡́◡◡̀◡	ˈke.ta.ˌla.ku	2.0.1.0	ˈke̯at.ˈlau̯k	‘my height’
◡◡́◡◡̀◡	da.ˈro.ʔa.ˌni.da	0.2.0.1.0	ˈdao̯r.ʔa.ˌni̯ɛd	‘to share them’
◡́◡◡̀◡◡̀◡	ˈra.ʔe.ˌra.ʔe.ˌna.ʔa	2.0.1.0.1.0	ˈrae̯ʔ.ˌrae̯ʔ.ˌnaˑʔ	‘incline, slope’

The fact that heavy syllables project two moras explains why they attract stress word finally because it is still the case that the penultimate mora is receiving stress.

(66)	Citation	C. Grid	Normal	
◡–́	ʔa.ˈfae̯	2.10	ˈʔa.ˌfae̯	‘sour’
◡́◡–̀	ˈfi.ŋi.ˌfau̯	2.0.10	ˈfiˑŋ.ˌfau̯	‘skirt’
◡́◡–̀	ˈta.ʔi.ˌfau̯	2.0.10	ˈtai̯ʔ.ˌfau̯	‘all, every’

It also explains why adjacent syllables are stressed in the case that a heavy syllable is followed by two CV syllables, or is adjacent to another CVV syllable.

(67)	Citation	C. Grid	Normal	
–́◡̀◡	ˈmau̯.ˌri.ʔa	20.1.0	ˈmau̯.ˌri̯aʔ	‘life’
–́◡̀◡	ˈsae̯.ˌle.ʔa	20.1.0	ˈsae̯.ˌle̯aʔ	‘happy’
–́–̀	ˈkai̯.ˌdai̯	20.10	ˈkai̯.ˌdai̯	‘these times’

Each example of the Citation form above exemplifies the alternating stress pattern landing on the penultimate mora. The only mystery in the Citation form regards those words with heavy penultimate syllables. In the moraic analysis presented here, those words have the moraic grid represented below.

(68)	Citation	C. Grid	Normal	
◡́◡–̀◡	ˈma.na.ˌtai.da	2.0.10.0	ˈman.ta.ˌi̯ɛd	‘to pity them’
◡́◡–̀◡	ˈfa.ʔa.ˌtai.na	2.0.10.0	ˈfaʔ.ta.ˌi̯ɛd	‘to show it’

This breaks from the ‘always stress the penultimate mora’ rule that seemed so effective above. The only alternatives to the pattern written above that maintain the right syllable structure are 2.0.01.0 and 2.0.11.0. However, these are excluded by the principle from Prince (1983) that stress cannot fall on the "weak" mora of a syllable. The Citation form prefers to stress the mora closest to the right edge of the word as long as it is not the final mora nor the weak mora of a syllable. As a result, the rightmost stressed syllable will be the one which contains the penultimate mora.

3.1.3 The Normal Stress Pattern and the Moraic Grid

With the assumption that weak moras cannot bear stress, the moraic grid representation of the Normal form can be given as follows:

(69)

Citation		Normal	N. Grid	
ˈka.do	–́	ˈkao̯d	20	‘thin’
ma.ˈda.mo	˘́ –̀	ˈma.ˌdao̯m	2.10	‘moon, month’
ˈke.ta.ˌla.ku	–́ –̀	ˈke̯at.ˈlau̯k	20.10	‘my height’
da.ˈro.ʔa.ˌni.da	–́ ˘ –̀	ˈdao̯r.ʔa.ˌni̯ɛd	20.0.10	‘to share them’
li.ˈmau̯.ˌmu.lu	˘́ – –̀	ˈli.mau̯.ˌmul	2.00.10	‘your (pl.) hands’
ˈra.ʔe.ˌra.ʔe.ˌna.ʔa	–́ –̀ –̀	ˈrae̯ʔ.ˌrae̯ʔ.ˌnaˑʔ	20.10.10	‘incline, slope’

Using the moraic grid, the stress pattern of the Normal form is easy to see. Primary stress falls on the initial mora and secondary stress falls on the penultimate mora in every word. This includes trimoraic words, which then have a moraic clash. Longer words place secondary stress on alternating moras to the left of the penultimate mora, except if the mora immediately follows the primary stress. Thus, longer words like [ˈrae̯ʔ.ˌrae̯ʔ.ˌnaˑʔ] ‘incline, slope’ have 20.10.10 pattern, but words with five moras have a moraic lapse after the initial syllable; i.e. 20010. Thus, words like [ˈli.mau̯.ˌmul 2.00.10] ‘your (pl.) hands’ and [ˈʔa.ʔai̯.ˌki̯ɛn 2.00.10] ‘aunts (collective)’ do not stress their medial heavy syllables after the initial CV.[15]

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[15] This is a slight deviation from a literal reading of Prince (1983), in which he argues that every heavy syllable maps to $\overset{x}{xx}$ (xx not being an option). However, we can see readily that this cannot be true. Some languages have only one stress per word, no matter how many heavy

Based on these examples, I expect even longer words to follow this pattern: main stress on the initial mora, secondary stress on the penultimate mora and alternating moras to the left, with a lapse following the initial syllable in words with an odd number of moras greater than four. Unfortunately previous researchers have not found words with more than three heavy syllables in the Normal form, and neither have I, so it is not possible to verify this prediction at this time. However, this prediction is in line with the cross-linguistic study by Kager (1999), who argued that lapses occur near the rhythmic peak (main stress) in a word.

The pattern established for the Normal form also explains why final heavy syllables bear stress, but final light syllables do not.

(70)

Final Syllable	Normal	Grid	
CV	ˈman.ˌtɛ.i̯ɛ	20.1.0	‘to pity her, him or it’
GVC	ˈman.tɛ.ˌi̯ɛd	20.0.10	‘to pity them’
CVV	ˈbo̯el.bo.ˌlea	20.0.10	‘crazy’
CVV	ˈdid.fu.ˌli̯ɛ	20.0.10	‘to replace’
CVVC	ˈbab.li.ˌljuk	20.0.10	‘my cheek’
CVVC	ˈman.ta.ˌlau̯k	20.0.10	‘my thinking’

Lastly, note that the 210 stress pattern in trimoraic words, combined with the prohibition on stressing the weak mora of a heavy syllable accounts for why there are no disyllabic words with an heavy initial and light final syllables. In other words, the grid profile 21.0 is prohibited; only 2.10 is a possible way to syllabify trimoraic forms, e.g. [ˈhi.ˌku̯ad] ‘to gather together’ and not *[ˈhi̯uk.da] (cf. Citation [fi.ˈku.da]).[16]

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syllables they have.

[16] Some dialects of Fijian also exemplify Prince’s prohibition against stressing the weak mora. Fijian, like the Kwara’ae Normal form also stresses the penultimate mora. But words with underlying forms like /CVVCV/ are syllabified as [CV.V.CV]; e.g. /raiða/ is [ra.i.ða] (Geraghty 1983).

3.2 The Loci Of CV Metathesis

3.2.1 The Stress to Weight Principle

Let us now compare the stress patterns of the Citation and Normal forms using the moraic grid in order to determine the loci of CV metathesis. The stress patterns of representative Normal and Citation forms are given below.

(71)

Citation	C. Grid	Normal	N. Grid	
ˈka.do	2.0	ˈkao̯d	2.0	‘thin’
ma.ˈda.mo	0.2.0	ˈma.ˌdao̯m	2.10	‘moon, month’
ˈke.ta.ˌla.ku	2.0.1.0	ˈke̯at.ˌlau̯k	20.10	‘my height’
da.ˈro.ʔa.ˈni.da	0.2.0.1.0	ˈdao̯r.ʔa.ˌni̯ɛd	20.0.10	‘to share them’
li.ˈmau̯.ˌmu.lu	0.20.1.0	ˈli.mau̯.ˌmuˑl	2.00.10	‘your (pl.) hands’
ˈra.ʔe.ˌra.ʔe.ˌna.ʔa	2.0.1.0.1.0	ˈrae̯ʔ.ˌrae̯ʔ.ˌnaˑʔ	20.10.10	‘incline, slope’

The stress patterns of the Normal and Citation forms are cross-linguistically well-attested,[17] but are recognizably different from each other in words with an odd number of moras. This is important because if the loci of CV metathesis are predictable based on the stress pattern then we must be concerned with the stress pattern of the Normal form, and not the Citation form. The table in (71) is repeated in (72), this time with the loci of metathesis underlined in each column (I do not include the subarches when underlining for readability).

(72)

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[17] The Citation stress pattern is similar to MalakMalak, and the Normal stress pattern is similar to Indonesian (Gordon 2003). See section 3.2.3 for details.

Citation	C. Grid	Normal	N. Grid	
ˈka.$\underline{\text{do}}$	$2.\underline{0}$	ˈka$\underline{\text{od}}$	$2\underline{0}$	‘thin’
ma.ˈda.$\underline{\text{mo}}$	$0.2.\underline{0}$	ˈma.ˌda$\underline{\text{om}}$	$2.1\underline{0}$	‘moon, month’
ˈke.$\underline{\text{ta}}$.ˌla.$\underline{\text{ku}}$	$2.\underline{0}.1.\underline{0}$	ˈke$\underline{\text{at}}$.ˌla$\underline{\text{uk}}$	$2\underline{0}.1\underline{0}$	‘my height’
da.ˈ$\underline{\text{ro}}$.ʔa.ˈni.$\underline{\text{da}}$	$0.\underline{2}.0.1.\underline{0}$	ˈda$\underline{\text{or}}$.ʔa.ˌni$\underline{\text{ɛd}}$	$2\underline{0}.0.1\underline{0}$	‘to share them’
ˈra.$\underline{\text{ʔe}}$.ˌra.$\underline{\text{ʔe}}$.ˌna.$\underline{\text{ʔa}}$	$2.\underline{0}.1.\underline{0}.1.\underline{0}$	ˈra$\underline{\text{eʔ}}$.ˌra$\underline{\text{eʔ}}$.ˌna$\underline{\text{ˑʔ}}$	$2\underline{0}.1\underline{0}.1\underline{0}$	‘incline, slope’

The loci of CV metathesis are not predictable from the stress pattern of the Citation form since both secondary stressed and unstressed CV segments metathesize in words with an odd number of moras, at least five. For example, in the Citation form, [ro] in ‘to share them’ is stressed, though [do] in ‘thin’ is not. But if the stress pattern of the Normal form were laid over the syllable structure of the Citation form, we can see clearly that post-tonic CV sequences are the loci of metathesis.

At first this may seem that deriving the Normal form requires more than one step because we need a representation that resembles the Citation form in its syllable structure, but also resembles the Normal form with respect to the stress pattern. At the very least, this may suggest a dependence between the Citation and Normal forms.

However, there is a way to derive the Normal form primarily from its surface properties. Wherever there is (at least) secondary stress in the Normal form, there is a heavy syllable. There are two regular exceptions: all trimoraic forms and pentamoraic forms which are underlyingly /CVCVV.../. In these two cases, the initial stressed syllable is light. Therefore, for the most part, the Normal form surface pattern can be described as a consequence of stressed syllables preferring to be heavy (Prince 1992, Kager 1999).

(73) **Stress to Weight Principle:** Stressed syllables should be heavy.

As we have seen this principle is obeyed everywhere in the surface Normal form, except in trimoraic words and a class of pentamoraic words. Putting these aside for the moment, underlying forms like /$C_1V_1C_2V_2$/ surface as [ˈ$C_1V_1V_2C_2$] because CV metathesis results in the stressed syllables being heavy whereas a candidate faithful to the linear order like [ˈ$C_1V_1C_2V_2$] has a stressed light syllable. The generalization that identifies the loci of CV metathesis can be given as follows:

(74) Underlying CV sequences metathesize to make stressed syllables heavy (wherever possible).

In other words, /kado/ surfaces as [ˈkao̯d] and not [ˈka.do] because it is more important to satisfy the Stress to Weight Principle than it is to be faithful to the linear order of the input.

There are two cases that do not avoid a stressed light syllable on the surface: words like [ˈhi.ˌku̯ʌd] 'to gather together' and words like [ˈli.mau̯.ˌmuˑl] 'your (pl) hands'. What accounts for these?

In the trimoraic case, the stress pattern requires that the penultimate mora bear stress. At the same time, the prohibition against stressing the weak mora of a syllable prevents a heavy syllable from occurring word initially; if it did, the stress pattern would require its weak mora to bear stress. This is why no trimoraic word in the Normal form begins with a heavy syllable.

In the pentamoraic case, if CV metathesis occurred yielding *[ˈli̯ɛ.mu.ˌmul] from /limaumulu/ for example, and the initial syllable were heavy, we would be disrupting the contiguity of an underlying vowel-vowel sequence (cf. /lim$\underline{\text{au}}$mulu/). Since [ˈli̯ɛ.mu.ˌmul] is a legal surface form in Kwara'ae (presumably derivable from hypothetical /liamumulu/), it is reasonable to assume that vowel-to-vowel contiguity in the input must be preserved wherever possible. In other words, CV metathesis is allowed to create vowel clusters, but it may not destroy them.

We have seen that CVV syllables are places where no metathesis occurs. In the pentamoraic forms like [ˈli.mau.ˌmul], this is because vowel-to-vowel contiguity is respected. In other cases, it is impossible to tell which constraint, the Stress to Weight Principle or faithfulness to underlying vowel-to-vowel contiguity, is responsible. This is because the stressed syllable is heavy without metathesis, so there is no conflict between the Stress to Weight Principle and faithfulness.

	Citation	C. Grid	Normal	N. Grid	
(75)	ˈdao̯	20	ˈdao̯	20	‘arrive’
	ˈsae̯.ˌle.ʔa	20.1.0	ˈsae̯.ˌle̯aʔ	20.10	‘happy’

3.2.2 Focus Final Forms

Recall that Final Focus forms exhibit partial metathesis word-finally, but not total metathesis. Also recall that Final Focus forms exhibit a different stress pattern. Their stress pattern represented on the moraic grid is included below, where 3 represents another level of the moraic grid (phrasal stress for example).

(76)	Citation	Normal	Normal$]_{focus}$	FF Pattern	
	ˈle.ʔa	ˈle̯aʔ	ˌle̯a.ˈʔa	20.3	‘good’
	ˈsi.na	ˈsi̯ɛn	ˌsi̯ɛ.ˈna	20.3	‘sun’
	fi.ˈʔi.ta.ˌta.li	ˈfiˑʔ.ta.ˌtai̯l	ˌfiˑʔ.ta.ˌtai̯.ˈli	20.0.10.3	‘hibiscus bush’

The generalization in (74) does not explain why there is partial metathesis word finally, but it is a first step to understanding why the total metathesis present elsewhere in the Normal register is blocked. Whatever constraint forces stress to fall on the final mora forces a violation of the Stress to Weight Principle.

Since violating faithfulness to the linear order prevents stressed light syllables from occurring on the surface, changing its linear order must fail to accommodate this higher-ranked constraint forcing final stress. A full accounting of these forms will be given in section 3.6.6, after the stress constraints are introduced.

3.2.3 Metrical Feet?

One of the interesting results of applying the moraic grid is that metrical feet are not needed to establish the above stress patterns for the Normal and Citation registers, nor to account for the loci of metathesis. In fact, the patterns described above are in the typology that Gordon (2003) calculated using his non-foot based stress system. The Citation stress pattern in words without diphthongs corresponds to language #26i (MalakMalak) in his appendix, and the Normal stress pattern corresponds to language #41i. While no attested language has exactly the pattern in the Normal form, its stress pattern resembles the one in Indonesian (language #40i); there are only two differences. Indonesian places main stress rightward, whereas Kwara'ae places it leftward. Also, the Normal register of Kwara'ae tolerates a clash in trimoraic forms, which Indonesian does not.

Although Gordon's system was designed and tested against quantity-insensitive languages and the registers of Kwara'ae are quantity-sensitive, I consider it a worthy project to take the constraints of Gordon (2003) and to apply them here, expecting to make some changes to his system to account for issues that arise with quantity-sensitivity. A major addition is to establish how the X_0 level gridmarks are projected onto the grid from the segments that make up a syllable. In Gordon's quantity-insensitive system, this task was easy since every syllable was equally represented at the X_0 level. Furthermore, there is evidence that the acoustic energy of the rime of a syllable is a factor in whether a syllable is counted as heavy or light (Gordon 2004). Once this system has been established with this claim in mind, we will find that there are no changes that need to be made other than the one already discussed: a prohibition on stress on the weak mora of a heavy syllable.

Up until now, this paper has discussed the surface patterns and differences in the syllable structure and stress patterns between the Normal and Citation registers. It has culminated in the generalization in (74) that underlying CV sequences metathesize in the Normal form so that stressed syllables will be heavy. What remains is a formalization of the stress pattern in Optimality Theory, an analysis accounting for the surface pattern of all Normal form words, and a discussion of how this kind of pervasive CV metathesis fits into larger typological patterns.

3.3 Basic OT Analysis of CV Metathesis

Before getting into details of how the grammar determines the optimal stress grid for each underlying form, I will introduce the constraints and their rankings which account for CV metathesis as a solution to the potential violation of the Stress to Weight Principle. I will also analyze the distribution of semivowels in vowel clusters.

To illustrate the basic mechanism of CV metathesis, I will consider the simple case where the underlying form is of the type /(C)VCV/, and the surface form is the [CVVC]. I will assume for now that these forms are bimoraic on the surface with a grid pattern fixed at 20; i.e. the stress pattern of the surface form will be assumed to be fixed on the penultimate mora. I will later introduce the constraints that regulate mora projection and secondary and primary stress, and show how they interact with the constraints presented here.

Here are some examples of the kind of words under consideration.

(77)

Citation	Normal	
ˈa.lo	ˈao̯l	‘taro’
ˈsa.lo	ˈsao̯l	‘sky’
ˈbo.re	ˈbo̯er	‘although’
ˈli.fa	ˈli̯ɛh	‘tooth’
ˈsi.ko	ˈsi̯ok	‘nine’
ˈlo.ʔi	ˈloi̯ʔ	‘snake’

3.3.1 SWP and Linearity

The Stress to Weight Principle (repeated here as a constraint) says that stressed syllables should be heavy.

(78) **SWP** incurs a violation for each stressed light syllable in the output.

In correspondence theory, occurrences of metathesis are violations of the faithfulness constraint Linearity. (See McCarthy and Prince (1995) and Hume (2001) for more details).

(79) **Linearity** incurs a violation for each segment S_1 in the output that precedes a segment S_2 whenever the correspondent of S_1 in the input succeeds the correspondent of S_2 (No metathesis).[18]

The ranking SWP $\gg$ Linearity is the basic ranking, along with the 20 stress pattern, that prevents /$C_1V_1C_2V_2$/ sequences from surfacing faithfully in the Normal form. Consider, for example, the word ‘sky’ /salo/.

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[18] This is the formal definition, but I will score violations by instances of metathesis. As in Hume (2001), if the metathesizing segments are not adjacent, further violations are scored.

(80)

/salo/	SWP	Linearity
☞ ˈsao̯l		*
ˈsa.lo	*!	

As a result, in the Normal form, [ˈ$C_1V_1V_2C_2$] is more harmonic than *[ˈ$C_1V_1C_2V_2$].

Note that if the underlying form were /saol/, the output is the same.[19]

(81)

/saol/	SWP	Linearity
☞ ˈsao̯l		
ˈsa.lo	*!	*

In OT terms, Linearity must be the lowest ranked of all the faithfulness constraints whose violation could allow stressed light syllables to become heavy. Other faithfulness constraints whose violation could satisfy SWP are Max-V and Dep-VMcCarthy and Prince (1995).

(82) **Max-V** incurs a violation for every vowel in the input that has no corresponding segment in the output (no deletion).

Dep-V incurs a violation for every vowel in the output that has no corresponding segment in the input (no insertion).

Violating these constraints is worse than violating Linearity.

(83)

/salo/	SWP	Max-V	Dep-V	Linearity
☞ ˈsao̯l				*
ˈsaa.lo			*!	
ˈsal		*!		
ˈsa.lo	*!			

Similarly, a candidate like [ˈsaʔ.lo] violates a higher-ranked constraint than Linearity (in this case the constraint prohibiting insertion of consonants).

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[19] In the Citation grammar, where surface forms like [ˈsao̯l] are unattested, it is interesting to note that ranking Linearity below a constraint prohibiting codas, for example, ensures the surface Citation form [ˈsa.lo].

Of course there are other candidates. For example, why is *[ˈsa.ˌol] less harmonic that [ˈsao̯l]? Once again, *[ˈsa.ˌol] violates SWP, and [sao̯l] does not.

It should also be recalled that onsetless syllables are prohibited in the Normal Form, except in the first syllable. This fact is captured straightforwardly by the constraints ONSET and ANCHORLEFT (McCarthy and Prince 1993).

(84) **Onset** incurs a violation for every syllable without an onset (syllables have onsets).

AnchorLeft incurs a violation if the first segment in the input does not correspond to the first segment in the output.

The example below with /alo/ 'taro' illustrates that ANCHORLEFT ≫ ONSET.

(85)

/alo/	ANCHORLEFT	ONSET	LINEARITY
☞ ˈao̯l		*	*
ˈlao̯	*!		

Here, we can see that [ˈlao̯] is less harmonic than [ˈao̯l] because ANCHORLEFT is higher ranked than ONSET.

3.3.2 Vowel Clusters

Non-Identical Adjacent Vowels

Turning to vowel quality issues, recall that the higher vowel in a vowel cluster becomes non-syllabic. If the two vowels are of the same height, than the first vowel becomes non-syllabic. I will call the relevant faithfulness constraint IDENT(SYLLABIC) or ID(SYL) for short.

IDent(syllabic) incurs a violation for every segment in the input with aα syllabic feature which corresponds to a feature which is [$-\alpha$ syllabic] in the output.

There are two markedness constraint hierarchies which yield the observed patterns. The first hierarchy is made up of three markedness constraints which capture the pattern for adjacent vowels of the same height. I will assume the first vowel is realized as a semivowel because a segment with the features [-syllabic] which immediately follows a segment with the features [+syllabic] is more marked than if they occurred in the reverse order. In other words, when vowel heights are equal, GV sequences are preferred to VG sequences, which are preferred to VV sequences.

(86) ***[+syl,-cons][+syl,-cons] (*VV)** incurs a violation for every pair of tautosyllabic adjacent segments, both of which have the feature [+syllabic] (No VV sequences within a syllable).

***[+syl,-cons][-syl,-cons] (*VG)** incurs a violation for every pair of tautosyllabic adjacent segments, in which the first segment has the feature [+syllabic] and the second has the feature [-syllabic] (no VG sequences within a syllable) (No VG sequences within a syllable).

***[-syl,-cons][+syl,-cons] (*GV)** incurs a violation for every pair of tautosyllabic adjacent segments, in which the first segment has the feature [-syllabic] and the second has the feature [+syllabic] (no GV sequences within a syllable) (No GV sequences within a syllable).

The ranking *VV $\gg$ *VG $\gg$ *GV, ID(SYL) accounts for the distribution of semivowels when the adjacent vowel are of the same height. In this case, it is the first segment which is realized as a semivowel. Consider the example [ˈbo̯er] ‘although’ (cf. Citation [ˈbo.re]).

(87)

/bore/	SWP	*VV	Linearity	*VG	*GV	ID(syl)
☞ ˈbo̯er			∗		∗	∗
ˈboe̯r			∗	∗!		∗
ˈboer		∗!	∗			
ˈbo.re	∗!					

Also note that since diphthong formation occurs in environments of metathesis, SWP also outranks *VG .

(88)

/salo/	SWP	Linearity	*VG
☞ ˈsao̯l		∗	∗
ˈsa.lo	∗!		

When the two vowels are not of the same height, the other markedness scale enters the picture, since both GV and VG clusters are attested, e.g. [si̯ok] 'nine' and [loi̯ʔ] 'snake'.

This other markedness scale is supposed to capture the idea that the more sonorous the vowel is (and generally lower vowels are more sonorous), the more difficult it is for that vowel to be realized as a semivowel, or glide.

(89) ***High Glide** incurs a violation for every segment in the output with the features [-cons, -syllabic, +high].

***Mid Glide** incurs a violation for every segment in the output with the features [-cons, -syllabic, -high, -low].

***Low Glide** incurs a violation for every segment in the output with the features [-cons, -syllabic, +low].

The idea above can be modeled by fixing the ranking of these constraints as *LowGlide $\gg$ *MidGlide $\gg$ *HighGlide.

With such a scale in place, it is always the case that less sonorous, higher, vowel will be the one that is realized as a semivowel on the surface. Notice also that *MidGlide ≫*VG.

(90)

/loʔi/	SWP	*VV	Linearity	*Mid Glide	*High Glide	*VG	*GV
☞ ˈloi̯ʔ			*		*	*	
ˈlo̯iʔ			*	*!			*
ˈloiʔ		*!	*				
ˈlo.ʔi	*!						

Therefore, the order of the vowels of the cluster is not a factor when elements of the cluster have different heights.

(91)

/siko/	SWP	*VV	Linearity	*Mid Glide	*High Glide	*VG	*GV
☞ ˈsi̯ok			*		*		*
ˈsio̯k			*	*!		*	
ˈsiok		*!	*				
ˈsi.ko	*!						

The low vowel [a] never is realized as a semivowel because if it were, it would violate the highest ranked markedness constraint *LowGlide.

Identical Adjacent Vowels

Finally, we need to deal with long vowels, like those in (92) repeated from (35):

(92)

Citation	Normal	
ˈki.ni	ˈkiˑn	‘female’
ˈma.na	ˈmaˑn	‘her, his, or its eye’
ku.ˈku.du	ˈku.ˌkuˑd	‘basket’
ˈde.ŋe	ˈdɛˑŋ	‘shrimp’
ˈmo.ko	ˈmɔˑk	‘smell’

In section 2.2.2, I stated that without surface forms like [i̯ɔˑl] from underlying

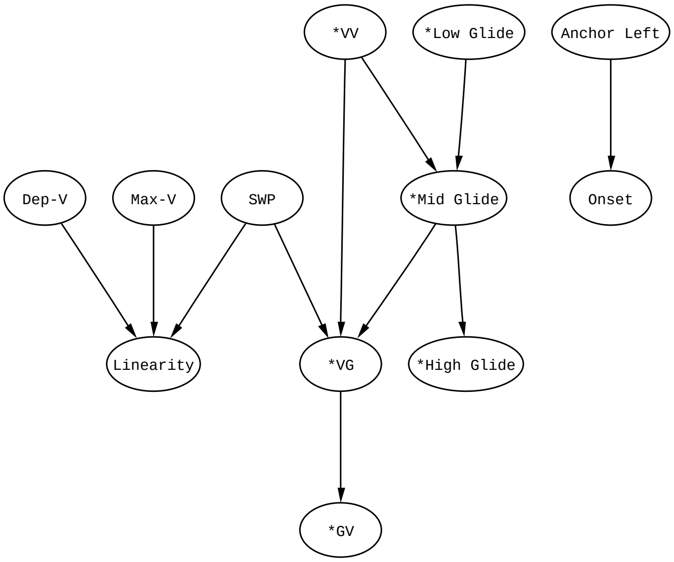
/iolo/ ‘canoe’ and hypothetical [i̯ɔl] from underlying /ilo/, there is no empirical evidence justifying the use of the diacritic in (92). However, if the relevant syllables in the above examples are CVVC, and not CVC, the analysis is simpler because I may omit the mechanism by which a long vowel in syllable with a coda shortens, whereas long vowels in open syllables do not. Thus, the winning candidate [ˈkiˑn] is exactly like [ˈsao̯l] ‘sky’, except that the two vowels which make up the nucleus of the syllable are the same.

The analysis so far predicts that since these adjacent vowels are of equal height, the first element should be realized as a semivowel. Since tautosyllabic sequences like [u̯u] or [e̯e] are unattested, the proposed analysis is still incomplete.

I will just say that homorganic, tautosyllabic GV or VG sequences are prohibited on the surface, but that homorganic, tautosyllabic VV sequences (i.e. long vowels) are not. The distinction can be formalized with the Obligatory Contour Principle (OCP) (see Odden (1986) for an overview). This principle prohibits identical adjacent elements. Therefore, a common approach is to represent identical adjacent elements as single unit at some other level of representation. The surface representation of the long vowel [iˑ] can be given as $\begin{array}{c} V_1V_2 \\ |/ \\ i_{1,2} \end{array}$ instead of $\begin{array}{cc} V_1 & V_2 \\ | & | \\ i_1 & i_2 \end{array}$, which violates the OCP. Since there are no surface sequences like [u̯u] or [i̯i], I will assume that they are prohibited by a markedness constraint such as $*\begin{array}{c} C\ V \\ |/ \\ \alpha \end{array}$.

Summary of the Current Constraint Rankings

The rankings given above are shown below.



The ranking SWP $\gg$ LINEARITY is the basic ranking corresponding to the main generalization in (74), which says that it is more important for a word to have no stressed light syllables on the surface than to be faithful to underlying linear order. LINEARITY is the lowest ranked faithfulness constraint among the faithfulness constraints whose violation avoids a potential violation of SWP. The distribution of semivowels can be modeled by two scales: one based on faithfulness, the other based on markedness. The first (*LOWGLIDE $\gg$ *MIDGLIDE $\gg$ *HIGHGLIDE) captures the observation that the higher, less sonorous, vowel of a cluster is the one realized as a semivowel. The second scale (*VV $\gg$*VG $\gg$ *GV) captures the observation that when the vowel heights are the same, the first of the cluster is realized as a semivowel. I have not analyzed the height changes that occur (e.g. a /ia/ sequence is realized as [i̯ɛ]), and will not, in the interests of space. The ranking SWP $\gg$ LINEARITY is the aspect of the grammar from which it ensures that an underlying sequence /$C_1V_1C_2V_2$/ surfaces as [ˈ$C_1V_1V_2C_2$], and not [ˈ$C_1V_1C_2V_2$].

3.4 Moraic Projection in Optimality Theory

Once the constraints that regulate mora projection are laid out, the constraints that regulate the the placement of secondary and primary stress (which build the first and second levels of the moraic grid) can be presented. Therefore, this section presents an OT account of mora projection in Kwara'ae.

Because of the number of variations of moraic theory, the reader should remember that in this account "mora" and "X0" are synonymous. This is important because in some moraic theories, configurations are allowed where segments share moras and moras share segments. In this analysis, such configurations are not possible because segments do not share X0 grid marks. Rather, following Prince (1983), the sonority of the parts of the syllable determine whether that part projects a X0 grid mark. Segments project X0 grid marks if it is optimal for them to do so. If it is not optimal, no mora is projected. In this context, the more sonorous a segment is, the more optimal it is for it to project a mora.

Projection differs from association; under the concept that moras associate to segments, there is an array of complications: moras are in the input in any number, association lines can be drawn in any manner, etc. Indeed this approach has led to at least two strange predictions that I am aware of: moraic contrasts between coda consonants and unattested syllabification patterns (Campos-Astorkiza 2003). In the grid, we can see that this leads to nightmares: two segments each having their own X0 grid marks, but associating to the same X1 level grid mark, and so on. Under the concept of projection, each segment may project at most one mora.

In OT terms, the grid is not part of the input. This exclusion is no different from excluding syllable boundaries from the input alphabet. Under the projection approach, the number of X0 gridmarks is limited to the number of segments in the output. This is analogous to the standard line on syllabification in OT where the possible syllabifications of an input are limited to the number of segments in the output minus one (Prince and Smolensky 1993). For example, (93) and (94) are candidate outputs of /kado/ but (95) is not (vertical lines are drawn to emphasize the columns of the grid).

(93)

2	x			
1	x		x	
0	x	x	x	x
	k	a	d	o

(94)

2		x		
1		x		
0		x		x
	k	a	d	o

(95)

2		x		
1		x		x
0		x		xx
	k	a	d	o

(95) is not a legal candidate because the short vowel [o] is projecting two X0 grid marks. In this analysis, only a long vowel, by virtue of its representation as adjacent V slots sharing a single feature bundle (e.g. $\overset{\text{VV}}{\overset{|/}{\text{o}}}$), projects two X0 grid marks.

Although the candidate in (93) is a legal candidate, it is not a winning one. This is because other candidates will be more optimal with respect to the constraints. This candidate violates a highly-ranked (as we will see) constraint prohibiting moras from being projected from the onset position.

(96) ***Onset=X0 (*Ons=X0)** incurs a violation if a segment immediately following a syllable boundary projects a X0 grid mark (Onsets do not project moras).

The candidate in (93) has two violations of this constraint.

The fact that vowels are more sonorous than other kinds of segments can be represented with a simple sonority scale is in order from most sonorous to least: V, X where X is a non-vowel. This scale can be derived from two constraints, one for each segment type. Each of these constraints requires its segment type to project a X0 gridmark.[20]

(97) **[-cons,+syl]=X0 (V=X0)** incurs a violation whenever a segment with the features [-consonantal] and [+syllabic] does not project a X0 grid mark (vowels project moras).

Non-vowel=X0 (X=X0) incurs a violation whenever a segment without the features [-consonantal] and [+syllabic] does not project a X0 grid mark (non-vowels project moras).

To reflect the sonority scale given above, these constraints have the following fixed ranking: V=X0 ≫ X=X0.

Under this schema, if every segment in the input could project a mora, it would. However, we have already seen that there is one constraint limiting projection of moras, *Ons=X0. I have already assumed that this constraint is high-ranking, and we can see that it dominates X=X0.

(98)

/GV/	*Ons=X0	X=X0
☞ G$\overset{x}{\text{V}}$		*
$\overset{x}{\text{G}}\overset{x}{\text{V}}$	*!	

However, V=X0 dominates *Ons=X0 because onsetless syllables receive

---

[20] This can be further refined as needed. For example, we can consider a scale where vowels are more sonorous than glides, glides more sonorous than syllabic consonantals, which are more sonorous than non-syllabic consonantals. However, for our purpose, the vowel/non-vowel distinction made above is sufficient.

stress.

(99)

/VCV/	V=X0	*Ons=X0
☞ x x V.CV		*
x V.CV	*!	

We can now see why the candidate in (93) is not optimal; that candidate's X0 profile is less harmonic than (94), which violates the lower-ranked X=X0, but not the higher-ranked *Ons=X0.

(100)

/kado/	*Ons=X0	X=X0
☞ x x x ka.do		**
x x xxxx kado	*!*	

Let us now turn to actual Normal form words, and see how this constraint system works. It should be clear from the above discussion that surface (C)V syllables will project a single mora, whereas CVV and GVC syllables will project two. But what about CVVC (e.g. [ŋe̯al] 'child') and CVVVC (e.g. [hu̯au̯m] 'to you') syllables? Under the current framework, the optimal candidate is the one which projects a mora for each segment not immediately following a syllable boundary, which can be three or four moras for the single syllable. This is why I include a constraint banning such superheavy syllables.

(101) ***SuperHeavy** incurs a violation for every syllable associated to three or more moras (no superheavy syllables).

Every word that might be a superheavy word is a single syllable; e.g. [ˈhu̯au̯m] 'to you'. There is no way to tell if this constraint is undominated or not, but I will assume it is.

With the inclusion *SuperHeavy, the system regulating mora projection is almost complete. In Normal words like [bwir] 'behind', there are two equally optimal outputs: [b$\overset{x}{w}\overset{x}{i}$r] and [bw$\overset{x}{i}\overset{x}{r}$]. Because of the observation that the semivowel in a semivowel-vowel sequence in a closed syllable is shorter than one in an open syllable (see section 2.2.2), I will assume that [bw$\overset{x}{i}\overset{x}{r}$] is the optimal candidate. One way to do this would be make codas privileged positions for bearing weight (i.e. Weight-by-Position). However, since this does not bear on the rest of the analysis, I will leave out this detail.[21]

Lastly, we may ask what the grammar does with inputs like /taaaaa/. Under the constraint rankings given so far, if none of the vowels are deleted or coalesced, this extremely long syllable could only bear two moras. As a result, there would be many equally optimal candidates, each scoring the same number of violations. However, as long V=X0 outranks whatever constraints prohibiting deletion (or coalescence) of segments, the grammar will always produce a real-world type word. For example, ranking Max-V below V=X0 solves the problem.

(102)

/taaaa/	*SuperHeavy	V=X0	Max-V
☞ t$\overset{x}{a}\overset{x}{a}$			**
taa$\overset{x}{a}\overset{x}{a}$		*!*	
t$\overset{x}{a}\overset{x}{a}\overset{x}{a}\overset{x}{a}$	*!*!		

The optimal candidate is now [taa] since deleting vowels is less optimal than having the most sonorous segments without representation at the X0 level.

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[21] One may also wonder under what conditions in the present system a language may treat a CVC syllable as light. An obvious method is to include the constraint *Heavy. If it is ranked above X=X0, then all syllables except CVVs will be treated as light.

The system of mora projection here is straightforward. Every segment prefers to project a mora. However, two constraints in particular, *Ons=X0 and *SuperHeavy, prevent all segments from projecting. Consequently, because of the sonority scale, it is optimal for the more sonorous segments to have representation at the X0 level. The idea is simple and is successful here. Although it would be interesting to see how well this approach would apply to other languages (especially those that would require refining the sonority scale), I will not discuss such matters here.

This analysis given here does not lend itself well to languages with lexicalized stress because the grid is not considered to exist underlyingly. One possible way to extend this system to include such languages might be to encode the various gridmarks as features. Some languages may be more faithful to the [X1] feature underlyingly than they are to [X0]. In such instances, words that are [+X1] underlyingly might surface as [+X0,+X1], whereas in other languages, the [X1] feature may be replaced by [X0], or nothing at all. However, the goal of this system is not to describe lexicalized stress patterns, but instead the predictable ones.

Now that it is clear how the grammar constructs the X0 level of the grid, we turn to the constraints borrowed from Gordon (2003) that regulate placement of stress at the X1 and X2 levels.

3.5 Analysis of the Stress Pattern in the Normal Form

Since Gordon's (2003) constraints are defined on the grid, there is nothing to change in the constraints themselves. The unit of time on the grid (from syllables to moras) is all that has changed. I do replace two of his constraints with ones from Kager (1999). The reasons for this change will be discussed when the relevant constraints are introduced. I also formalize the notion that was mentioned earlier, that the weak mora of a syllable cannot bear stress.

Gordon (2003) uses twelve constraints to construct his typology. Instead of presenting them all at once, I will introduce them as needed.

3.5.1 Alignment Constraints

The following two constraints account for positioning primary stress closer to one edge of the word than the other.

(103) **AlignX2Left** incurs n violations for each mora with stress level 2, where n is the number of moras of stress level 1 which separate it from the **left** edge of the word.

AlignX2Right incurs n violations for each mora with stress level 2, where n is the number of moras of stress level 1 which separate it from the **right** edge of the word.

Since primary stress is leftmost in Kwara'ae, ALIGN-X2-LEFT $\gg$ ALIGN-X2-RIGHT.

Gordon employs the following two constraints to regulate placement of secondary stress closer to one edge or the other.

(104) **AlignX1Left** incurs n violations for each mora with stress level 1, where n is the number of moras of stress level 0 which separate it from the **left** edge of the word.

AlignX1Right For each mora with stress level of at least 1, assign a violation for each mora of stress level of at least 0 which separate it from the **right** edge of the word.

I will replace these constraints with ones recommended by Kager (1999) that will be introduced below. The reason for the change is twofold. There are multiple counting dependencies in the course of the evaluation of these constraint; a property which cannot be represented in finite state terms (Eisner 1997). There has been an effort to replace constraints of this type with categorical constraints that are representable in finite state terms (McCarthy 2003). ALIGN-X1-LEFT and ALIGN-X1-RIGHT also overgenerate the kinds of languages that are attested by regulating the position of lapses and clashes towards the edges, independent of the other factors. This is contrary to Kager's (1999) observation that, cross-linguistically, lapses occur in one of two places – the right edge of the word, or near the rhythmic peak (the primary stressed mora).

3.5.2 Clash/Lapse Constraints

Kager (1999) proposes to replace constraints like ALIGN X1LEFT/RIGHT with the following constraints.[22]

(105) **Lapse-at-Peak** incurs a violation if there is a lapse and the lapse is not adjacent to a peak; e.g. 2001 and 1002 do not violate this constraint, but 201001 does.

Lapse-at-Right incurs a violation if there is a lapse and the lapse is not adjacent to the right edge of the word boundary; e.g. $100]_{wd}$ does not violate this constraint but 2001 does.

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[22] Kager (1999) actually introduced his constraints within a foot-based framework. The arguments made there though still apply straightforwardly here to ALIGN X1LEFT/RIGHT.

In the stress system utilized here, I will use these rhythmic constraints from Kager (1999) in place of Align X1Left/Right.

There are three other constraints that Gordon employs to regulate clashes and lapses. These are:

(106) ***Clash** incurs a violation for each pair of adjacent moras where both have a stress level greater than 0 (No clash).

***Lapse** incurs a violation for each pair of adjacent moras where both have a stress level 0 (No lapse).

***LapseRight** incurs a violation if the ultimate and penultimate moras both have a stress level 0 (Stress one of the final two moras).

When we consider the positions of clashes and lapses in the Normal register, we see that clashes only occur in trimoriac words, and lapses occur in words with an odd number of moras, at least five.

(107)

Citation	Normal	N. Grid	
ipafi.”ku.da	ˈfi.ˌku̯ʌd	2.10	‘to gather them together’
ta.ˈi.a	ˈta.ˌi̯ɛd	2.10	‘to sew them’
da.ˈro.ʔa.ˌni.da	ˈdao̯r.ʔa.ˌni̯ɛd	20.0.10	‘to share them’
li.ˈmau.ˌmu.lu	ˈli.mau.ˌmuˑl	2.00.10	‘your (pl) hands’

To account for the placement of clashes and lapses in the Normal form, I will briefly consider the case of ‘your (pl) hands’ below. We can see from that in order for the surface form to have its attested stress pattern, *Clash must outrank *Lapse and Lapse-at-Peak.

(108)

/lima-umulu/	*Clash	*Lapse	Lapse-at-Peak
☞ ˈli.mau̯.ˌmuˑl 2.00.10		*	*
ˈli.ˌmau̯.ˌmuˑl 2.10.10	*!		

Since the candidates above have equal violations of SWP and Linearity, these columns were omitted from the tableaux. The ranking *Clash ≫ *Lapse is what forces a lapse in longer words. With this piece of the puzzle in place, I turn to presenting an explanation of why clashes are tolerated in trimoraic forms.

3.5.3 Trimoraic Words: 210

Trimoraic words are unique because they are the only words which tolerate a clash. The reason for this is that Kwara'ae requires stress on the penult and initial moras, and heavy syllables can only form around certain stress peaks. To see how the initial and penultimate moras always receive stress, consider first that the ranking *LapseRight ≫ *Clash ≫ SWP ensures that trimoraic words do not have a lapse at the right word edge.

(109)

	/fikuda/	*LapseRight	SWP	*Clash	*Lapse
☞	ˈhi.ˌku͜ʌd 2.10		∗	∗	
	ˈhi.ˌku.da 2.10		∗∗!	∗	
	ˈhi͜uk.da 20.0	∗!			∗
	ˈhi.ku.da 2.0.0	∗!	∗		∗

Also note that the losing candidate above [ˈhi.ku.da] 2.0.0 does not violate Linearity though the winning candidate does. The faithful candidate [ˈhi.ˌku.da] 2.1.0 is eliminated because it violates SWP once more than the winner, which has fewer violations of SWP, because it is less faithful to the linear order of the input.

Since *LapseRight is actually undominated, stress must fall on one of the two final moras. Another one of Gordon's constraints requires the first and final moras of a word to bear stress, whereas another prohibits stress from falling on the final mora.

(110) **AlignEdges** incurs a violation if either the initial or final mora has a stress level 0; if both, assign two (stress initial and final moras).

Nonfinality incurs a violation if the final mora has a stress level greater than 0. (do not stress final mora)

AlignEdges is the constraint that ensures the initial mora is always stressed. In fact, it rules out candidate [hi.ˈku̯ʌd] 0.20 because it outranks *Clash and SWP.

(111)

/fikuda/	AlignEdges	*Clash	SWP
☞ ˈhi.ˌku̯ʌd 2.10	*	*	*
hi.ˈku̯ʌd 0.20	**!		

The ranking NonFinality ≫ AlignEdges ensures that stress always falls on the penultimate mora.

(112)

/fikuda/	Non Finality	Align Edges	*Clash	SWP
☞ ˈhi.ˌku̯ʌd 2.10		*	*	*
ˈhi̯uk.ˌda 20.1	*!			*

The constraints *LapseRight, NonFinality and AlignEdges are responsible for fixing stress on the penultimate and initial moras. Since these constraints are ranked higher than *Clash, a clash in trimoraic words is unavoidable.

Now we can ask about a candidate like [ˈhi̯uk.da] 21.0. Recognize that this candidate violates the prohibition against stress falling on the weak mora of a stressed heavy syllable. Like the Continuous Column Constraint, this is presumed to be a universally undominated constraint. I will formalize it as follows.

(113) ***WeakMora=X1** incurs a violation if the second mora of a heavy

syllable has a stress level greater than 0. (do not stress weak mora of a heavy syllable)

Since [ˈhi̯uk.da] 21.0 violates *WEAKMORA=X1, it must outrank SWP; thus, [hi.ˈku̯ʌd 2.10] is the optimal output form.

(114)

/fikuda/	*WEAKMORA=X1	SWP
☞ ˈhi.ˌku̯ʌd 2.10		*
hi̯uk.da 21.0	*!	

We may also wonder why CV metathesis is not a solution to SWP in the first syllable, yielding [ˈih.ˌkuʌ̯d]. In this case, violating LINEARITY also results in a violation of ANCHORLEFT. Thus ANCHORLEFT also outranks *CLASH and SWP.

(115)

/fikuda/	ANCHORLEFT	*CLASH	SWP
☞ ˈhi.ˌku̯ʌd 2.10		*	*
ˈih.ˌku̯ʌd 20.10	*!		

Another candidate to consider is *[ˈhik.ˈdu̯a] 20.10. This candidate violates LINEARITY only once (the [u] metathesizes rightward), and avoids a clash because it has created two heavy syllables. There are at least two generalizations about this language that this candidate betrays. The first is that every instance of metathesis claimed to occur between an underlying form and its surface form is leftward; that is, the vowel moves to the left of the consonant which preceded it. This directionality can be encoded into two constraints which take the place of LINEARITY in this analysis.

(116) **V-C Precedence** incurs a violation if a vowel preceding a consonant in the input does not have a corresponding segment in the output which precedes a segment corresponding to the consonant (No

rightward metathesis).

C-V Precedence incurs a violation if a consonant preceding a vowel in the input does not have a corresponding segment in the output which precedes a segment corresponding to the vowel (No leftward metathesis).

By ranking V-C Precedence above C-V Precedence and *Clash, it captures the fact that rightward metathesis is not allowed to occur. Splitting Linearity in this way also obviates the need for some of the rankings already established. For example, the ranking AnchorLeft ≫ Onset was established to deal with cases like /alo/ which surface as [ao̯l], and not *[lao̯] (see section 3.3.1). However, as long as V-C Precedence is undominated, this ranking is no longer needed.

The second way a candidate like *[ˈhik.ˈdu̯a] 20.10 could be eliminated is to take advantage of the fact that this candidate has more moras than the faithfully parsed *[ˈfi.ˌku.da 2.1.0]. In other words, CV metathesis in Kwara'ae is compensatory: it aims to preserve mora count (Hayes 1989). Increasing the number of moras, as this candidate has done, is prohibited. Because there is a pronounced Citation form with only three moras, it is sufficient to have an output to output correspondence constraint between the Citation and Normal forms.

(117) **OO Dep X0** incurs a violation for every segment projecting an X0 gridmark in the Normal form whose corresponding segment in the Citation form does not project an X0 gridmark.

The candidate *[ˈhik.ˈdu̯a] 20.10 violates this constraint because the [k] projects an X0 gridmark in the Normal form, but the [k] in the Citation form [fi.ˈku.da]

0.2.0 does not.

At this time, I do not think that either approach is any more or less desirable in eliminating candidates like *[ˈhik.ˈdu̯a] 20.10. I will not incorporate either of them further into the analysis presented here, and will return the significance of these generalizations in section 4.

3.5.4 Other Trimoraic Patterns

Turning now to underlying forms such as /CVVCV/, recall the patterns from section 36, a sampling of which is repeated below.

(118)

Citation	Normal	
ˈtai̯.da	ˈta.ˌi̯ɛd	‘to sew them’
fi.ˈo.lo	ˈhi̯ol	‘hungry’
fu.ˈa.mu	ˈhu̯au̯m	‘to you’

In the examples above, the faithful candidates, [ˈhi̯o.lo] 21.0, [ˈtai̯.da] 21.0 and [ˈhu̯a.mu] 21.0 lose because they violate the *WeakMora=X1. Again, the initial and penultimate moras must bear stress because of the ranking NonFinality ≫AlignEdges ≫ *Clash, and the ranking *LapseRight ≫ *Clash. Candidates with a different syllabification pattern such as [ˈhi.ˌo.lo] 2.1.0, [ˈta.ˌi.da] 2.1.0 and [ˈhu.ˌa.mu] 2.1.0, will violate high-ranking Onset.

Therefore, as in the other cases above, the winning candidates will violate low ranked Linearity.

However, the output forms of the words above are different because there is another markedness constraint in play, *Triphthong.

(119) **[-cons][-cons][-cons] (*Triphthong)** incurs a violation for each tautosyllabic sequence of three segments that each have the feature

[-cons] (No triphthongs).

Crucially, *TRIPHTHONG is ranked below ONSET, but above SWP. Thus, in the case of 'to sew it', the middle vowel glides to avoid the diphthong.

(120)

	/taida/	ONSET	*TRIPH THONG	SWP	LINEA RITY	*HIGH GLIDE
☞	ˈta.ˌi̯ɛd 2.10			∗	∗	∗
	ˈtai̯ɛd 20		∗!		∗	∗
	ˈhu.ˌau̯m 2.10	∗!		∗	∗	∗
	ˈhu.ˌa.mu 2.1.0	∗!		∗∗		

For words like *fiolo* 'hungry', where the final two vowels are identical, gliding the middle vowel would result in a violation of the OCP-companion constraint, $*\begin{array}{c}\text{C V}\\ |/\\ \alpha\end{array}$. Thus, a candidate like [ˈhi.ˌo̯ol], unlike the winner in (120), is not optimal. In the case when the final two vowels are identical, the winning strategy to avoid a triphthong appears to be coalescence, in violation of UNIFORMITY.

(121) **Uniformity** incurs a violation for each segment in the output which corresponds to more than one segment in the input (No coalescence) (McCarthy and Prince 1995).

This can be modeled by ranking *TRIPHTHONG above UNIFORMITY.[23]

(122)

	/fio$_1$lo$_2$/	*WEAK MORA=X1	*TRIPH THONG	UNIFO RMITY	LINEA ITY	*HIGH GLIDE
☞	ˈhi̯o$_{1,2}$l 20			∗	∗	∗
	ˈhi̯o$_1$o$_2$l 20		∗!		∗	∗
	ˈhi̯o.$_1$lo$_2$ 21.0	∗!				∗

---

[23] In the event that future phonetic work reveals that [o] is actually long, then its just the case that this ranking is reversed, and words like *fiolo* 'hungry' behave just like words like *fuamu* 'to you'.

In *fuamu* ‘to you’, the middle vowel is too sonorous (or low) to glide. In these cases, a triphthong results. Candidates that do realize the middle vowel as a semivowel are losers because they violate *LowGlide, an undominated constraint; in particular, *LowGlide ≫ *Triphthong.

(123)

/fuamu/	On set	*Weak Mora=X1	*Low Glide	*Trip *thong	Linea rity
☞ ˈhu̯au̯m 20				*	*
ˈhu.a̯um 2.10			*!		*
ˈhu̯a.mu 21.0		*!			
ˈhu.ˌa.mu 2.1.0	*!				

We may wonder why the final two vowels /a/ and /u/ do not coalesce to [o], especially since it has been observed in section 36 that /au/ sequences surface as [o] in faster speech. In fact, *fuamu* is sometimes pronounced [hu̯om] (again I think primarily in faster speech), though my consultant in slow, careful speech clearly produces the triphthong [hu̯au̯m].

The ranking *Triphthong ≫ SWP ≫Linearity means that a candidate not faithful to underlying linear order with fewer stressed light syllables is more harmonic than a candidate not faithful to linear order with at least one triphthong. This is illustrated with words like *korea* ‘to marry him or her’, Normal [ˈko.ˌre̯a] Citation [ko.ˈre.a]. The winning candidate [ˈko.ˌre̯a] has one violation of the SWP, and one violation of Linearity. Candidates like *[ˈkoe̯ar] lose because they violates *Triphthong, even though it has no stressed light syllables (at the cost of two violations of Linearity).

(124)

/korea/	*Triph thong	SWP	Linea ity	*Mid Glide
☞ ˈko.ˌre̯a 2.10		*		*
ˈko.e̯ar 2.10		*	*!*	*
ˈkoe̯ar 20	*!		**	*

Also note that candidates like *[ˈko.ˌe̯ar] have one stressed light syllable, the same as the winning candidate; however, such candidates are eliminated because they have two violations of Linearity, unlike the winning candidate which has none.

Similarly, words like *'afae* 'sour' are pronounced [ˈʔa.hae̯] in the Normal form, and not *[ʔae̯h] because Uniformity also outranks SWP.

(125)

/ʔa$_1$fa$_2$e/	*Triphthong	Uniformity	SWP	Lineaity	*Mid Glide
☞ ˈʔa$_1$.ˌha$_2$e̯ 2.10			*		*
ˈʔa$_{1,2}$eh 2.10		*!	*	**	*
ˈʔa$_1$a$_2$e̯h 20	*!			**	*

3.5.5 Underlying /CVVV/ Forms

Now consider a word like Normal [ˈsu.i̯ɛ] 'to finish it' (cf. Citation [su.ˈi.a]). The candidate *[ˈsu̯i.a] 21.0 is less harmonic than [ˈsu.i̯ɛ] 2.0 because *[ˈsu̯i.a] 21.0 violates *WeakMora=X1 and Onset. But why not *[su̯əi̯] 20?[24]

The idea presented earlier was that underlying adjacent vowel clusters must be preserved on the surface. Metathesis may create new vowel clusters on the surface, but it cannot destroy ones that exist in the underlying form. This idea can be encoded into the following constraint.

V-V Contiguity incurs a violation if a V$_1$ immediately precedes V$_2$ in the input, but the vowel corresponding to V$_1$ in the output does not immediately precede the vowel corresponding to V$_2$ in the output. Here, vowels

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[24] It is likely that the /a/ would raise to [ə] in this instance since it is in between two high vowels.

are understood to be [-consonantal]. (Underlying vowel sequences must be present on the surface)

Ranking SWP below VV-Contig guarantees the winner.

(126)

/sui-a/	VV-Contig	SWP
☞ ˈsu.i̯ɛ		*
ˈsu̯əi̯	*!	

It is interesting to note that candidates like *[su̯əi̯] also do not meet another generalization about metathesis in Kwara'ae. This generalization is that the vowels themselves never change order. In other words, a vowel in the ouput which corresponds to a vowel V_1 in the input that precedes another vowel V_2 in the input always precedes the correspondant of V_2 in the output. The losing candidate above violates this generalization[25], which I will call V-V Precedence, as well as VV-Contig, so it is not possible to distinguish them at this point, though later we will be able to.

Interim Summary of the Stress xConstraint Rankings

The discussion above establishes the stress constraints adopted here and how they are ranked in the Normal register in Kwara'ae. They are summarized in the Hasse diagram below.[26]

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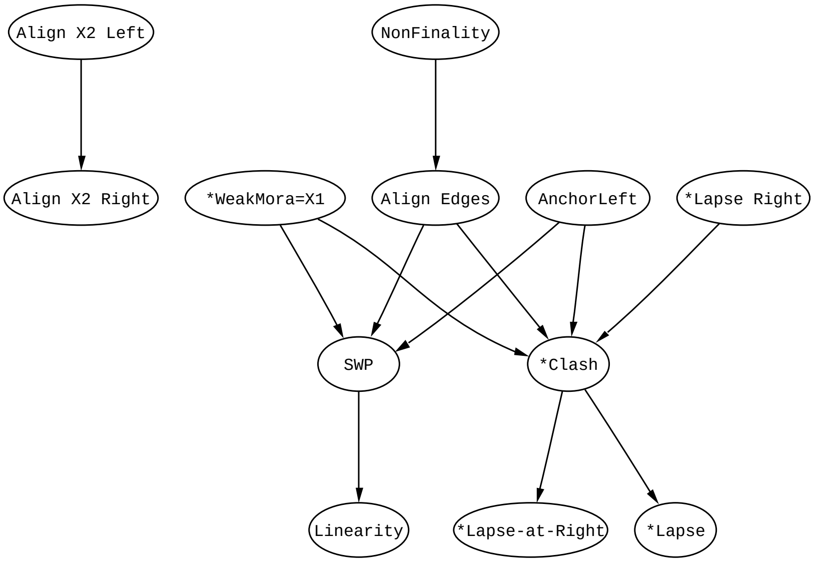
[25] This is encoded as a constraint in section 3.6.3.

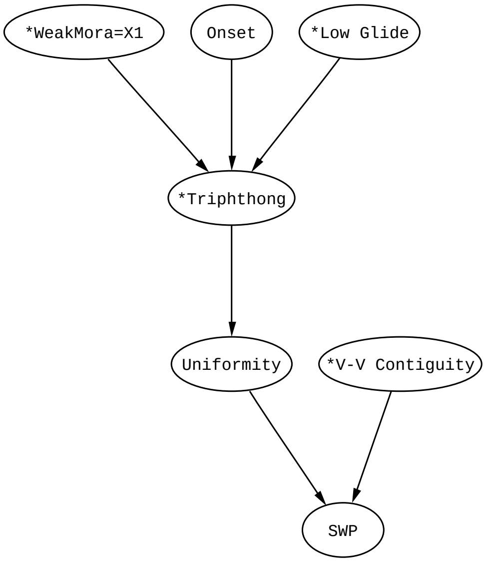
[26] Gordon uses three other constraints in his typology. However, they are never violated in the Normal form in Kwara'ae and so I include them here only for completeness. *LapseLeft incurs a violation if the initial and peninitial moras both have stress level 0. *ExtendedLapse incurs a violation for every consecutive sequence of three moras with stress level 0. *ExtendedLapseRight incurs a violation if there is an extended lapse at the right word boundary.



The ranking NonFinality ≫ AlignEdges ensures that the first mora is always stressed and that the final mora is never stressed. Undominated *Lapse-Right then ensures that the stress falls on the penultimate mora. These constraints also are the ones that ensure trimoraic forms have clashes, despite the ranking *Clash ≫ *Lapse. This ranking's effects matter in words with an odd-number of moras greater than five as we will see below.

Notice that since *WeakMora=X1, AlignEdges, and *LapseRight outrank SWP, a heavy syllable is not allowed word-initially in trimoraic forms.

Finally, in order to account for certain trimoraic forms, I introduced constraints against triphthongs, and other faithfulness constraints such as VV-Contig and Uniformity; their rankings are summarized below.



3.6 Extending and Refining the Analysis

This section shows how the system accounts for patterns present in longer words and Focus Final forms. A few more rankings will be introduced, adding further detail to the system.

3.6.1 Quadrimoraic Words: 2010

It is easy to see that the main ranking SWP ≫ Linearityaccounts for multiple metathesis in quadrimoraic words.

(127)

/ketalaku/	SWP	Linearity
☞ ˈke̯at.lau̯k 20.10		∗∗
ˈke.ta.lau̯k 20.10	∗!	∗
ˈke̯at.la.ku 20.10	∗!	∗
ˈke.ta.ˌla.ku 20.10	∗∗!	

Note that the optimal candidate of the underlying forms /ke̯atlauk/, /ketalauk/, or /keatlaku/ is the same as the winning candidate in the tableaux above;

in other words, the grammar does not distinguish between these underlying forms because they are mapped to the same output.

Also we can expect that any deviation in the grid profile of the above candidates will either add clashes, lapses, or take away initial and penultimate stress. As we have seen, the initial and penultimate moras must be stressed, and that the constraints responsible trump other factors.

3.6.2 Underlying /CVCVCVVV/ Forms

These forms behave just like the underlying /CVVV/ forms discussed above. Recall Normal forms like the following.

(128)

Citation	Normal	N. Grid	
ˈma.na.ˌtai̯.a	ˈmaˑn.ˌta.jɛ	20.1.0	‘to pity’
ˈla.la.ˌgau̯.a	ˈlaˑl.ˌga.u̯ʌ	20.1.0	‘to ruin it’
ˈfu.li.ˌruˑ.a	ˈhu̯il.ˌru.u̯ʌ	20.1.0	‘to establish it’

There are two candidates that challenge the winning form [ˈman.ˌta.jɛ 20.1.0] The first, [ˈman.ta.ˌjɛ 20.0.1], is eliminated by NonFinality, which outranks AlignEdges.

(129)

	/manataia/	NonFinality	AlignEdges	*Lapse
☞	ˈmaˑn.ˌta.jɛ 20.1.0		∗	
	ˈmaˑn.ta.ˌjɛ 20.0.1	∗!		∗

Another problem candidate is [ˈmaˑn.ˌtaˑi̯ 20.10], where the vowels have metathesized. However, VV-Contig prohibits underlying vowel sequences from being absent on the surface; therefore, this candidate loses as well.

3.6.3 Pentamoraic forms

The ranking NonFinality ≫ AlignEdges places stress on the final and initial moras. Since *Clash ≫ *Lapse, lapses are preferred to clashes in longer words. Thus, surface forms like ‘to share them’ [ˈdao̯r.ʔa.ˌni̯ɛd] have a grid profile 20.0.10. The tableaux below shows that the grid profile cannot be adjusted, even if the metathesis patterns change accordingly.

(130)

	/daroʔanida/		Align Edges	*Lapse Right	SWP	Linearity
☞	ˈdao̯r.ʔa.ˌni̯ɛd	20.0.10				∗∗
	ˈda.ro.ʔa.ˌni.da	20.0.1.0			∗!∗	
	ˈdao̯r.ʔa.ni.da	20.0.0.0		∗!		∗
	da.ˈro̯aʔ.ˌni̯ɛd	0.20.10	∗!			∗∗

Of course, if the stress pattern is fixed, then SWP and Linearity choose the winner.

(131)

	/daroʔanida/		SWP	Linearity
☞	ˈdao̯r.ʔa.ˌni̯ɛd	20.0.10		∗∗
	ˈda.ro̯aʔ.ˌni̯ɛd	2.00.10	∗!	
	ˈdao̯r.ʔa.ˈni.da	20.0.1.0	∗!	
	ˈda.ro.ʔa.ˌni.da	20.0.10	∗!∗	

Note how the stress pattern determines the loci of metathesis. To illustrate, the surface form [ˈdao̯r.ʔa.ˌni̯ɛd] ‘to share them’ is more harmonic than candidates like *[ˈda.ro̯aʔ.ˌni̯ɛd 2.00.10] because metathesizing the [ʔa] syllable does not improve this candidate; it does not remove the stressed light syllable.

Also consider why [ˈdao̯r.ʔa.ˌni̯ɛd 20.0.10] ‘to share them’ is the optimal candidate for the input /daroʔanida/, as opposed to [ˈdao̯.ˌraʔ.ˌni̯ɛd]. This latter candidate is less harmonic because it has an extra violation of *Lapse; therefore, Linearity must outrank *Lapse. In other words, CV metathesis cannot be employed to avoid a lapse (as in [ˈdao̯.ˌraʔ.ˌni̯ɛd]).

(132)

/daroʔanida/	SWP	Linearity	*Lapse
☞ ˈdao̯r.ʔa.ˌni̯ɛd 20.0.10		**	*
ˈdao̯.ˈraʔˈ.ˌni̯ɛd 20.10.10		***!	

Turning now to pentamoraic forms that are underlyingly like /(C)VCVV.../, the above constraints would deliver an incorrect optimal candidate if not for VV-Contig. Here are some examples of these words.

(133)

Citation	N. Pattern	Normal
li.ˈmau.ˌmu.lu	ˈli.mau.ˌmul	‘your (pl) hands’
a.ˈŋi.a.ˌŋi.la	ˈa.ŋi̯ɛ.ŋi̯ɛl	‘tearful’
ʔa.ˈʔai̯.ˌki.na	ˈʔa.ʔai̯.ki̯ɛn	‘aunts (collective)’
i.ˈli.a.ˌla.na	ˈi.li̯ɛ.ˌlaˑn	‘his trying’

Without VV-Contig, the constraints and their rankings would not distinguish between the underlying forms /limaumul/ and /liamumulu/, which the grammar surely does.[27] This is because *[ˈli̯ɛ.mu.ˌmul] is more harmonic than [ˈli.mau̯.ˌmul] since although the former candidate metathesizes a vowel, it has no stressed light syllables. The ranking VV-Contig ≫ SWP enables the grammar to eliminate this candidate and distinguish between the underlying forms like /limaumulu/ shown in (134), and /liamumulu/ given in (135).

(134)

/limaumulu/	VV-Contig	SWP	Linearity
☞ ˈli.mau̯.mul		*	*
ˈli̯ɛ.mu.ˌmul	*!		*

(135)

/liamumulu/[28]	VV-Contig	SWP	Linearity
☞ ˈli̯ɛ.mu.ˌmul			*
ˈli.mau̯.ˌmul	*!	*	*

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[27] I know of no word [ˈli̯ɛ.mu.ˌmul], but words of this type are not uncommon: *liatalana* ‘to find someone suitable’ Normal [ˈli̯ɛ.ta.ˌlaˑn] Citation [li.ˈa.ta.ˌla.na] and *maurilaku* ‘my being alive’ Normal [ˈmau̯.ri.ˌlau̯k] Citation [ˈmau̯.ri.ˌla.ku] are two examples.

Candidates like *[ˈli̯au̯m.ˌmuˑl], which violate Linearity twice, lose because they also violate *Triphthong, which outranks SWP.

Notice that VV Precedence, as a constraint, is insufficient in the above cases because the precedence relations among the vowels are not themselves altered.

(136) **V-V Precedence** incurs a violation if the ouput correspondant of vowel V_1 in the input which precedes vowel V_2 in the input does not precedes the correspondant of V_2 in the output (No VV metathesis).

Therefore, VV-Contig is the crucial faithfulness constraint that distinguishes between inputs /limaumulu/ and hypothetical /liamumulu/. VV-Contig is necessary to restrict where CV metathesis is allowed to occur because the stress pattern by itself overestimates the loci of CV metathesis.

On the other hand, however, there is another class of words which needs a constraint like V-V Precedence. Consider words with underlying forms like /$CV_1CV_2V_3CV_4$/, such as *fikua'a* 'gathering together of it' Normal [ˈhi.ˌku̯aʔ] Citation [ˈfi.ku.ˌa.ʔa]. Since Linearity is ranked below SWP, we expect that Linearity may be violated any number of times in order to avoid the initial stressed light syllable; i.e. without a constraint like V-V Precedence, *[ˈCV_1V_4.ˌCV_2V_3C] is more harmonic than winning [ˈCV_1.ˌ$CV_2V_3V_4C$] (c.f.ˈhi.ˌku̯aʔ). The problem generalizes to words with underlying forms /$CV_1(CVV)^nCV_4$/. This problem is solved however, by the observation that the process of CV metathesis never changes the precedence relations of elements on the vocalic tier; i.e. V-V Precedence is undominated.

There is another way to solve this problem, and that is to recognize that the problem is basically one of unbounded metathesis. To my knowledge, there are

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[28] Again this is a hypothetical input/output pair.

no cases of unbounded metathesis in languages with metathesis. Furthermore, like the Align All-X Left/Right constraints, there is no way to encode unbounded metathesis as a finite state machine. These facts suggest that Correspondance Theory, which admits unbounded metathesis with a constraint like LINEARITY, may need to be constrained. Doing so eliminates the problem class of words described above.

3.6.4 Even Longer Words

Hexamoraic words, and other longer words with an even number of moras, will have strict alternating stress patterns. As we have seen in bimoraic and quadramoraic forms, the optimal candidates will have a heavy syllable at each stress peak.

As mentioned earlier, I expect that heptamoraic words would have a 2001010 grid profile. Longer words with an odd number of moras would also have a grid profile beginning 20010... Like pentamoraic words, I expect the grammar to distinguish between underlying forms that begin /(C)VCV.../ and those that begin /CVCVV.../. The grammar presented here does this for these forms in the same way as we saw with the pentamoraic forms above.

3.6.5 /CVVCV/ and /CVVCVCVCV/ Forms

*WEAKMORA=X1 prohibits weak moras of syllables from bearing stress. It is especially successful capturing the behavior of word-final and non-word-final CVVCV sequences. Recall that word finally, the final syllable of CVVCV words metathesizes.

(137)

Citation	C. Grid	Normal	N. Grid	
fu.ˈa.mu	210	ˈhu̯au̯m	20	‘to you’
fa.ˈo.lo	210	ˈhao̯l	20	‘new’
ˈmau̯.ri	200	ˈma.ˌu̯ir	210	‘life’

However, CVVCV sequences that occur word initially in longer words do not metathesize as they do in (137).

(138)

Citation	C. Grid	Normal	N. Grid	
ˈmau̯.ri.ˌla.ku	20010	ˈmau̯.ri.ˌlau̯k	20010	‘my being alive’
ˈfai̯.ri.ˌri.di	20010	ˈfai̯.ri.ˌriˑd	20010	‘to slip’
ˈsae̯.fi.ˌlo.da	20010	ˈsae̯.hi.ˌlu̯ad	20010	‘to ask them’
ˈtai̯.fi.ˌla.ku	20010	ˈtai̯.hi.ˌlau̯k	20010	‘myself’

The explanation is as follows. In trimoraic words, the stress pattern forces a clash in the initial and penultimate moras. By *WeakMora=X1, those two moras cannot belong to the same syllable. Linearity is the lowest ranked faithfulness constraint whose violation can solve this problem. By metathesizing the final CV, we either get a single syllable (as in [ˈhu̯au̯m]) or the mora bearing units are separated into different syllables (as in [ˈma.ˌu̯ir]). On the other hand, in words where there are five moras, there is no clash, and therefore *WeakMora=X1 is not violated.

Consider the case of /mauri/ ‘to live’.

(139)

/mauri/		*Weak Mora=X1	SWP	Linearity
☞	ˈma.ˌu̯ir 2.10		*	*
	ˈmau̯.ri 21.0	*!		

A candidate like [ˈmau̯.ir] which has a 2010 grid profile violates high ranking Onset and is eliminated.

In the case of /maurilaku/ ‘my being alive’, neither *Clash nor *WeakMora= X1 can be violated by the candidates below because the stress constraints fix the pattern to 20010.

(140)

	ipa/maurilaku/	*WEAK MORA=X1	SWP	LINEARITY
☞	ˈmau̯.ri.lau̯k 20.0.10			*
	ˈma.u̯ir.lau̯k 2.00.10		*!	**

3.6.6 Focus Final Form Analysis

Recall the data and observations given in chapter 2.3. The examples below are repeated from (55).

(141)

Citation	Normal	Normal]$_{focus}$	
ˈle.ʔa	ˈle̯aʔ	ˌle̯a.ˈʔa	'good'
ˈsi.na	ˈsi̯ɛn	ˌsi̯ɛ.ˈna	'sun'
fi.ˈʔi.ta.ˌta.li	ˈfiˑʔ.ta.ˌtai̯l	ˌfiˑʔ.ta.ˌtai̯.ˈli	'hibiscus (bush)'
ˈbu.lu.ˌbu.lu	ˈbuˑl.ˌbuˑl	ˌbuˑl.bu.ˈlu	'star'

The constraint below is intended to capture the fact that main stress falls on the final syllable.

(142) **Focus-Stress** incurs a violation for every X0 grid mark between the right focus boundary and an X3 grid mark, or, if there are no X3 gridmarks, then every X0 grid mark incurs a violation (place X3 level stress as close to the right edge as possible).

Phrasal stress can be considered a third level of the grid so this constraint requires that third level stress be placed as far to the right as possible. Note that as long as this constraint is ranked high enough, the Continuous Column Constraint forces the second and first levels of stress to be applied as well.

For example, the candidate [ˌsjɛ.ˈna 20.3]$_{focus}$ has zero violations of FOCUS-

STRESS, but the candidate [ˈsjɛ.na 30.0]$_{focus}$ has two. If a candidate has no X3 grid mark, then the number of violations is the same as the number of X0 grid marks in the word. Because the winning candidate violates NONFINALITY, FOCUS-STRESS outranks NONFINALITY.

Because of the properties of the vowel in the nucleus of the penultimate syllable, we never expect to find a form like [ˌsi̯ɛ.ˈni] in the Final Focus position. In other words the second element of the diphthong is largely predictable – it is the second element of a vowel cluster formed by the last two vowels. This is why I will assume that the winner violates INTEGRITY rather than DEP-V .

(143) **Integrity** incurs a violation for every pair of segments in the output which correspond to the same segment in the input.

Partial metathesis occurs because of an Output-Output correspondence constraint which requires words in the Final Focus position to sound somewhat similar to their Normal counterparts. In other words the candidate [ˌsi.ˈna] loses because it violates OO VV-CONTIG.

(144) **OO V-V Contiguity** incurs a violation if a V_1 immediately precedes V_2 in the Normal form, but the segment corresponding to V_1 in the Focus Final form does not immediately precede the segment corresponding to V_2 in the Focus Final form.

We see how this works in the table below.

(145)

	si$_1$na$_2$]$_f$	Focus Stress	*Weak Mora=X1	OO VV Contig	Integrity	Linearity
☞	si̯$_1$ε$_2$.na$_2$ 20.3				*	*
	si$_1$.na$_2$ 2.3			*!		
	si̯$_1$ε$_2$n 23		*!			*
	si̯$_1$ε$_2$.na$_2$ 31.0	*!*	*	*		*

Also, [ˈli̯u]$_{focus}$ 'very' must have a 30 grid profile because I assume that *WeakMora=X1 is undominated (i.e. it outranks Focus-Stress). I will assume it is more harmonic than [ˌli.ˈu]$_{focus}$ with a 23 grid profile because Onset outranks Focus-Stress.

(146)

	liu]$_f$	*WeakMora=X1	Onset	Focus-Stress
☞	li̯u 30			*
	li.u 2.3		*!	*
	li̯u 23	*!		

Likewise, consider the case of /maPaa/ 'raw' also shows why it is necessary for Focus-Stress to be violable.

(147)

	/maʔaa]$_f$/	*Weak Mora=X1	Focus Stress	Integrity	Linearity
☞	ma.ʔaː 2.30		*		
	ma.ʔaː 2.03	*!			*

The analysis can be summarized as follows. Complete metathesis is blocked in the final focus forms because Focus-Stress requires phrasal stress to fall as far to the right as possible. Partial metathesis occurs because the Normal form serves as a base form – and vowel clusters in the base must be realized in the derived form, i.e. the Focus Final form.

Note that it cannot be the case that partial metathesis occurs because Integrity is ranked below SWP. At first glance, it seems like this would account for the case above without OO VV-Contig.

(148)

/si$_1$na$_2$]$_f$/	Focus Stress	*Weak Mora=X1	SWP	Integrity	Linearity
☞ si̯$_1$ε$_2$.na$_2$ 203			∗	∗	∗
si$_1$.na$_2$ 23			∗∗!		
si̯$_1$ε$_2$n 23		∗!			∗
si̯$_1$ε$_2$.na$_2$ 310	∗!		∗		∗

However, ranking Integrity below SWP predicts that duplicating vowels on the surface should be a good solution to SWP. This however is not the case as we can see from the [ko.re̯a] 'to marry her or him'.

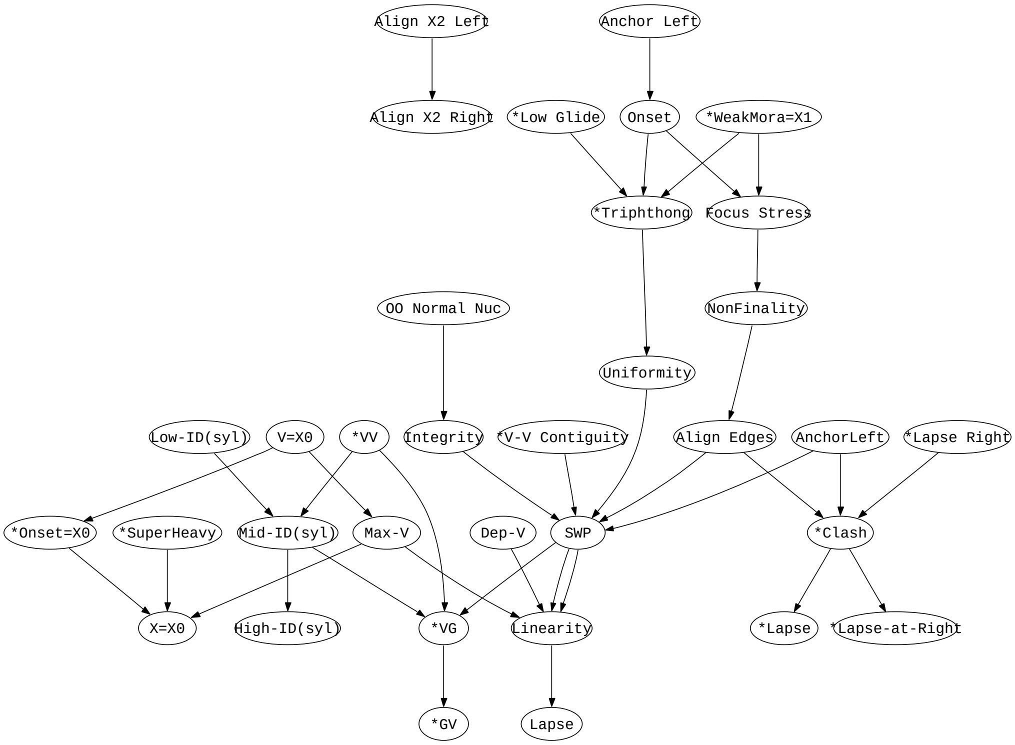
(149)

/korea/	Integrity	SWP
☞ ˈko.ˌre̯a		∗
ˈkoe.ˌre̯a	∗!	

The Output to Output constraint is appropriate, especially since some Focus Final forms are actually in free variation with the form with no partial metathesis as described in section 2.3.3. If it turns out that this free variation is universal among all Final Focus forms, then either by optional application of OO VV-Contig or by stochastic ranking (Boersma and Hayes 2001), the variation is accounted for.

Final Hasse Diagram

Here is the final Hasse diagram, summarizing all of the rankings given in this analysis.



4 Implications and Alternatives

4.1 Linearity

This analysis has raised some questions about the constraint Linearity. At least four other faithfulness constraints regarding linear order have been introduced VV-Contig, V-V Precedence, V-C Precedence, and C-V Precedence. Whether or not Linearity can ultimately be replaced by these constraints and others is an interesting question that will not be answered here. However, I will point out that with respect to CV metathesis, the V-V constraints are more desirable than the constraints that regulate the direction of the metathesis. This is because to my knowledge no case of CV metathesis violates either VV-Contig or V-V Precedence. Thus, they appear to capture true gueneralizations regarding this phonological process.

On the other hand, the constraints V-C Precedence and C-V Precedence, which have been proposed to regulate the direction of metathesis miss the fact that the direction of metathesis always seems to be from the unstressed syllable to the stressed syllable (Blevins and Garrett 1998). CV metathesis in Kwara'ae is leftward, and the stressed syllables always stand to the left of the unstressed syllables whose vowels metathesize. To demonstrate the reverse pattern, I present data from the Northern Paman language group, which have been described as iambic (Hale 1964).

In the following words from Awŋt̪im (Hale 1964), the first consonant was lost historically, and the short vowel immediately following it metathesized with the subsequent consonant.

(150)	*nʲiŋku-	>	ŋkyu	'2nd sg oblique'
	tʲuma	>	mwa	'fire'
	mulir	>	lwiθ	'tooth'
	ŋali	>	laj	'we, dual inclusive'
	ŋatʲu-	>	t̪aw	'1st singular oblique'

Hale also writes that this process was associated with a stress shift from the initial to the second syllable. This is important because we can infer from it, for example, that [ˈlaj]'s nonmetathesized competitor is *[a.ˈli], which violated the Stress to Weight Principle.[29]

It is interesting to observe that in Awŋt̪im, as well as in Kwara'ae, it is the case that an unstressed vowel is moving into the nucleus of its stressed neighbor. The fact that the direction of the metathesis (rightward in Awŋt̪im, but leftward in Kwara'ae) appears to be tied to the stress pattern is troubling for the directional

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[29] We can only guess that a competitor like *[ˈajl] loses because it violates Onset (≫ AnchorLeft). Also, Hale does not say whether CVC syllables count as heavy or light, so we can only guess that they count as light (cf. mulir > lwiθ).

metathesis constraints mentioned above since those constraints are independent of stress. There should be no reason why one applies instead of the other, and it remains a challenge for Optimality Theory to encode this generalization into constraints.

4.2 The Stress to Weight Principle

In the analysis presented here, the Stress to Weight Principle motivates CV metathesis. Whenever possible, stressed light syllables are avoided on the surface, even at the expense of maintaining underlying linear order.

I chose to use the Stress to Weight Principle in this analysis because it highlights the similarities between CV metathesis in Kwara'ae and phonological processes in other languages. For example, syncope in Tonkawa has been argued to be a process where underlying /...$C_1V_1C_2V_2$.../ sequences surface as [...ˈCV_1C...] because the faithful surface form [...ˈ$C_1V_1C_2V_2$...] would have a stressed light syllable (Gouskova 2003). Likewise, Kager (1999) invoked the Stress to Weight Principle to account for vowel lengthening in stressed syllables in Icelandic. Other languages such as the Argyllshire dialects of Scots Gaelic insert glottal stops in stressed syllables (unless the glottals would be followed by an obstruent) that would otherwise be light (Hall 2003).

In Optimality Theory, it is straightforward to see how these different phonological processes are related by the Stress to Weight Principle – it is the result of having different lowest-ranked faithfulness constraints ranked below SWP. Syncope in Tonkawa is given by the ranking SWP $\gg$ MAX-V, whereas vowel lengthening in stressed syllables is given by the ranking SWP $\gg$ DEP-V, and glottal insertion can be modeled by the ranking SWP $\gg$ DEP-C (with the other faithfulness constraints ranked high in each case). Indeed, one of the central claims of Optimality Theory is that languages only differ according to how they rank universal constraints. I will illustrate this with the case of Tonkawa.

Syncope in Tonkawa

The surface patterns in Tonkawa parallel the surface patterns of the Normal register in Kwara'ae. Almost every syllable is stressed Tonkawa, and [CVCV] sequences are uncommon in surface forms. Gouskova (2003) shows that in this language, the Stress to Weight Principle can be satisfied by violating other faithfulness constraints. In particular, the syncope pattern in Tonkawa is a case where SWP $\gg$ Max-V. In Gouskova's examples below, the underlined underlying vowels are absent in the surface form (the italicized vowels are also absent, but they are deleted because of hiatus).

(151)	/nes-yama̲x*a*-o/	ˌnes.ˈyam.xo	‘he causes him to paint his face’
	/ke-ya̲kapa-nes-o/	ˌkey.ˌka.pa.ˈnes.o	‘they two strike me’
	/ke-we̲-yama̲x*a*-oo-ka/	ˌkew.ˌyam.ˈxoo.ka	‘you paint our faces’
	/ke-ta̲s-eca̲n*e*-oʔs/	ˌket.ˌsec.ˈnoʔs	‘you paint our faces’

The syncope of the underlined vowels, according to Gouskova, is a result of a constraint prohibiting stressed light syllables on the surface. There is only one regular class of exceptions– unstressed root final vowels, as exemplified by [pa] in ‘they two strike me’.

In Gouskova's analysis, a [ˈCVCV] is less harmonic than a [ˈCVC] sequence because faithfulness to underlying vowels is not as important as ensuring that stressed syllables are heavy.

In both Tonkawa and Kwara'ae, we see that an underlying CVCV sequence surfaces as a single stressed heavy syllable. Also in Tonkawa and Kwara'ae, if the CVCV sequence were to surface faithfully, the first CV would bear stress.

The languages take different approaches to resolving this marked form, however. Tonkawa deletes the vowel, which results in a heavy, stressed CVC syllable. Kwara'ae metathesizes the vowel with the preceding consonant, which also results in a stressed heavy surface syllable. In this sense, CV metathesis in Kwara'ae is a kind of vowel-preserving syncope: although underlying linear order is disturbed, at least underlying vowel quality is preserved.

Predictions and Consequences

The predictions that follow from this line of inquiry are not inconsequential. Recall that there is a divorce between the markedness condition that motivates some phenomena (such as CV metathesis), and the stress pattern, which determines the loci of such phenomena. In Kwara'ae, for example, the Normal stress pattern is crucial because it determines the rhythmic peaks of the words that the syllables organize around.

In other words, for each attested stress pattern in the world, we should expect to find a set of languages with that stress pattern, but in which the Stress to Weight Principle is obeyed. Some, like Kwara'ae, metathesize; some, like Tonkawa, syncopate; some, like Icelandic, lengthen the vowel; some, like Scots Gaelic, insert consonantal material.

For the case of CV metathesis, this does appear to be the case. In Kwara'ae alone, the Focus Final forms exhibit a different stress pattern and a different metathesis pattern. When we look to other languages with CV metathesis, we also see that this is the case. It was in this way that Norquest (2001) was able to provide a unified analysis of CV metathesis in Rotuman and CV metathesis in Kwara'ae. The data from Awŋt̪im above is also predicted by the divorce between the stress pattern fixing the stress on the one hand, and the markedness of stressed light syllables on the other.

However, there are some well known reasons to think the predictions here do not match well with what is known about the world's languages. Namely, some trochaic systems shorten vowels in stressed syllables (including Tonkawa), whereas no known iambic system does. Also, iambic systems regularly lengthen all of their stressed syllables, whereas the only known trochaic lengthening systems only lengthen the main stressed-syllables. I refer the reader to Hayes (1994, pp. 79-84) for a thorough review of these asymmetries.

It was largely because of trochaic shortening that Prince (1992) argued against giving the Stress to Weight Principle special status; instead, he argued that stress patterns influenced syllable structure only to optimize foot types. For trochaic systems, LL formed a better foot than HL. The limited extent to which trochaic lengthening is attested, on the other hand,is accounted by other factors. However, if LL is an optimal trochaic foot, then there must be some other (so far unstated) reason why LL sequences in Kwara'ae and Tonkawa are less preferred than H sequences. On the other hand, if, as I am suggesting, that the Stress to Weight Principle does account for the range of cases discussed here, then it is trochaic shortening that must be accounted for by other means (especially in the non-foot based approach adopted here). Similarly, if trochaic lengthining really is limited, then this fact must also be accounted for by other factors.

4.3 Alternatives to the Stress to Weight Principle

There are mechanisms other than the Stress to Weight Principle that have been proposed to motivate CV metathesis. Simons (1977) suggested that syllable economy is what motivates metathesis in Kwara'ae, because metathesis reduces the total number of syllables. This position was adopted by Sohn (1980) in his

SPE-style analysis. Blevins and Garrett (1998) hypothesized that diachronically CV metathesis results from extreme vowel to vowel coarticulation, followed by lenition of the unstressed vowel; in a synchronic analysis, this can be translated into a principle of economy of unstressed syllables.

I will note, however, that the historical story is more complex than Blevins and Garrett suggest. They imply that unstressed syllables in the Citation form metathesize to produce the Normal form. However, words like Citation [da.ˈro.ʔa.ˌni.da] ‘to share them’ have three unstressed syllables [da], [ʔa], and [da], but in the Normal form only one of these metathesizes, Normal [ˈdao̯r.ʔa.ˌni̯ɛd]. The two syllables that actually metathesize are [ro], which is stressed in the Citation form, and the second one is unstressed (word-final) [da]. If unstressed syllables in the Citation form metathesize to yield the Normal form, we expect Normal *[ˈad.ˌro̯aʔ.ˌni̯ɛd], or assuming that the initial syllable is prohibited from metathesizing, Normal *[da.ˈro̯aʔ.ˌni̯ɛd]. This does not mean that their general proposal is wrong; it only means because that the Normal form stress pattern is different from the Citation form stress pattern, and that therefore, for their analysis to hold, the Normal form must have been derived historically from something other than the Citation form.

It may true that syllable economy or unstressed syllable economy may be made to work for synchronic analyses of Kwara’ae CV metathesis (or Tonkawa syncope for that matter). For example, since surface [ˈ$C_1V_1V_2C_2$] is more harmonic than [ˈ$C_1V_1C_2V_2$], it is clear that both principles account for this simple case. Under syllable economy, it has fewer syllables, and under unstressed syllable economy, it has fewer unstressed syllables. Of course, under SWP, the more harmonic form has fewer stressed light syllables.

In the more complicated cases, specifically the pentamoraic forms, each principle requires additional measures. The Stress to Weight Principle analysis must be restricted by a constraint demanding faithfulness to vowel-to-vowel contiguity, as seen in section 3.2. Syllable economy fails to explain which pentamoraic form is better– *[ˈda.ro̯aʔ.ˌni̯ɛd] or [ˈdaor.ʔa.ˌni̯ɛd] (cf. Citation [da.ˈro.ʔa.ˌni.da]) since each has three syllables, and the same stress pattern. (A candidate like *[ˈda.ˌro̯aʔ.ni̯ɛd] would fatally violate *CLASH.) Unstressed syllable economy wrongly predicts *[ˈda̯o.ˌraʔ.ˌni̯ɛd] instead of [ˈda̯or.ʔa.ˌni̯ɛd] because the former has no unstressed syllables, whereas the latter has one. The candidate *[ˈda̯o.ˌraʔ.ˌni̯ɛd] cannot be ruled out by markedness since it is a legal surface form (cf. hypothetical /daoraʔanida/). It can only be ruled out by failing to be faithful in some way to the input /daroʔanida/. It may be possible to rule this candidate out by appealing to stress (X1) economy. Such an additional constraint may work, and eliminates the need for constraints like VV-CONTIG.

However, although the relative merits of the other kinds of constraints that may be necessary is a legitimate topic when comparing analyses, it not the main issue here. This is because the main point is that neither of the economy accounts relate CV metathesis to the the full range of other stress phenomena mentioned above. There is no way that syllable economy, nor unstressed syllable economy, can account for the lengthening processes mentioned above which add material to the stressed syllable. CV metathesis and syncope also add material to the stressed syllable by rearranging the vowel in the former case, and by eliminating the vowel in the latter, so that a consonant becomes a coda instead of an onset.

4.4 Conclusion

I have made three contributions in this research. The first is empirical. In sections 2.1 and 2.2, I have tried to clarify some of the issues raised by previous researchers. Furthermore, there are word types presented in this paper that went previously unnoticed. In particular, the Focus Final forms discussed in section 2.3 are further evidence that the stress pattern determines the loci of CV metathesis because changing the stress pattern also requires changing the metathesis pattern. Secondly, I have shown in section 3.2 that CV metathesis can be motivated by the Stress to Weight Principle. By using the moraic grid and establishing the grid profiles of the words in a principled fashion in section 3.1, the stress pattern transparently reveals the locations of CV metathesis.

The advantage to this approach is that it relates CV metathesis to other stress-related phenomena in phonology, in particular syncope, and other processes which increase the sonority of stressed syllables. Finally, it has been shown that the stress system and the metathesis patterns can be analyzed without metrical feet (sections 3.5 and 3.6). I presented constraints regulating mora projection in section 3.4 in order to apply the constraints developed in Gordon (2003). By including the prohibition of secondary stress on the weak mora of heavy syllable (Prince 1983), I was able to capture the quantitive-sensitive patterns of the Normal form stress system.

There are further empirical and theoretical questions to pursue. On the empirical side, there are plenty of factual issues in Kwara'ae that still need to be settled. Further phonetic evidence for a surface vowel length contrast would be welcome. It would also be fruitful to investigate any productive processes of reduplication and compounding to see how they fit into this system.

On the theoretical side, this work points out some avenues for future research. How successful is a non-foot based system of stress constraints in accounting for the world's typology of quantity-sensitive patterns? Also, if the Stress to Weight Principle is on the right track, then what accounts for the asymmetries attributed to the Iambic/Trochaic law? Finally, this paper has elucidated some of the issues in CV metathesis. The roles of vowel contiguity and directionality in this process need to be better understood. Ultimately, the data and analysis here allows us to better understand CV metathesis in Kwara'ae, and relate it to other, more familiar, phonological phenomena.

Appendix: A Brief Overview of Morphology

1.1 Nominal Morphology

Possessive Suffixes

There are six suffixes in common use which mark possession on certain nouns.

(152)

	singular	plural
1st	-ku	-ka
2nd	-mu	-(u)mulu
3rd	-na	-da

The suffixes in (152) only attach to a class of body-part nouns.

(153)

Underlying	Citation	Normal	
/suli/	ˈsu.li	ˈsu̯il	‘bone’
/suli-ku/	ˈsu.li.ku	ˈsu.ˌli̯uk	‘my bone’
/suli-mu/	su.ˈli.mu	ˈsu.ˌli̯um	‘your bone’
/suli-na/	su.ˈli.na	ˈsu.ˌli̯ɛn	‘its bone’
/suli-ka/	su.ˈli.ka	ˈsu.ˌli̯ɛk	‘our bones’
/suli-umulu/	su.ˈli.u.ˌmu.lu	ˈsu.li̯u.ˌmuˑl	‘your (pl.) bones’
/suli-da/	su.ˈli.da	ˈsu.ˌli̯ud	‘their bones’

The same suffixes are also used with prepositions

(154)

Underlying	Citation	Normal	
/naʔo/	ˈna.ʔo	ˈnao̯ʔ	‘before’
/naʔo-ku/	na.ˈʔo.ku	ˈna.ˌʔou̯k	‘before me’
/naʔo-mu/	na.ˈʔo.mu	ˈna.ˌʔou̯m	‘before you’
/naʔo-na/	na.ˈʔo.na	ˈna.ˌʔo̯an	‘before it’
/naʔo-ka/	na.ˈʔo.ka	ˈna.ˌʔo̯ak	‘before us’
/naʔo-umulu/	na.ˈʔo.u.ˌmu.lu	ˈna.ʔou̯.ˌmuˑl	‘before you (pl.)’
/naʔo-da/	na.ˈʔo.da	ˈna.ˌʔo̯ad	‘before them’

Adjectival Suffixes

Some nouns become adjectives with addition of /-la/.

(155)	Underlying	Citation	Normal	
	/kafo/	ˈka.fo	ˈkao̯h	‘water’
	/kafo-la/	ka.ˈfo.la	ˈka.ˌfo̯al	‘watery’
	/ʔuu/	ˈʔuˑ	ˈʔuˑ	‘lice, louse’
	/ʔuu-la/	ˈʔuˑ.la	ˈʔu.ˌu̯ʌl	‘of lice, lousy’

1.2 Verbal Morphology

Transitive suffixes

Many nouns, adjectives, and intransitive verbs become transitive verbs by adding the appropiate transitive suffix. These suffixes are usually of the form [-Ci]. Some examples are given below (the /-a/ is the object suffix, see 1.2 below).

(156)		Underlying	Citation	Normal	
	a.	/iru/	ˈi.ru	jur	‘wind’
		/iru-fi-a/	ˈi.ru.ˌfi.a	ˈjur.ˌhi̯ɛ	‘to blow it’
	b.	/tala/	ˈta.la	ˈtaˑl	‘road’
		/tala-ʔi-a/	ˈta.la.ˌʔi.a	tal.ʔi̯ɛ	‘to lead it’
	c.	/ʔako/	ˈʔa.ko	ˈʔao̯k	‘hot’
		/ʔako-fi-a/	ˈʔa.ko.ˌfi.a	ˈʔao̯k.ˌhi̯ɛ	‘to heat it’
	d.	/doʔo/	ˈdo.ʔo	ˈdɔˑʔ	‘to burn’
		/doʔo-fi-a/	ˈdo.ʔo.ˈfi.a	ˈdɔp.ˌhi̯ɛ	‘to burn it’

However, these suffixes may be inappropiately named since at least one may attach to a verb which is already transitive because it takes the object suffix.

(157)	Underlying	Citation	Normal	
	/li-a/	ˈli.a	ˈli̯ɛ	‘to look at it’
	/li-si-a/	li.ˈsi.a	ˈli.ˌsi̯ɛ	‘to see it’

Also, sometimes, there appears to be a transitive suffix, though it is not clear if there is an independent root, or if there is one, the semantic connection is tenuous. For example, Normal *salofia* 'to sweep it', may have an underlying form /salo-fi-a/. However, the only root I am aware of with the underlying form /salo/ is *salo* 'sky'.

Object Suffixes

Transitive verbs are required to take an object suffix. The 3rd singular object suffix is [-a]. The third person plural suffixes are [-da] and [-ʔi].

(158)		Underlying	Citation	Normal	
	a.	/salo-fi-a/	ˈsa.lo.ˌfi.a	sao̯l.hi̯ɛ	'to sweep it'
		/salo-fi-da/	ˈsa.lo.ˌfi.da	sao̯l.hi̯ɛd	'to sweep them'
	b.	/olo-mi-a/	ˈo.lo.ˌmi.a	ˈɔˑl.mi̯ɛ	'to swallow it'
		/olo-mi-da/	ˈo.lo.ˌmi.da	ˈɔˑl.mi̯ɛd	'to swallow them'
	d.	/doʔo/	ˈdo.ʔo	ˈdɔˑʔ	'to burn'
		/doʔo-fi-a/	ˈdo.ʔo.ˈfi.a	ˈdɔˑp.ˌhi̯ɛ	'to burn it'
		/doʔo-fi-da/	ˈdo.ʔo.ˈfi.da	ˈdɔˑp.ˌhi̯ɛd	'to burn them'
		/doʔo-fi-ʔi/	ˈdo.ʔo.ˈfi.ʔi	ˈdɔˑp.ˌhiˑʔ	'to burn them'

If the third person singular object suffix is used, an overt object is optional. On the other hand, if either of the third person plurals is used, then can be no overt object.

Almost all transitive verbs can only take the third person suffixes above; a few such as *to'o* 'to get, have, try' can take the possesive suffixes as object suffixes .[30] In the following examples, this verb means 'to meet' because of the previous word *dao* 'arrive'.[31]

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[30] This word may have a variety of meanings. Ben Burt's word list (2004) defines it as follows: 'get, have, possess, hit the mark, attempt, succeed; deliberate, strong, still, sharp (of knife); belong (of objects), related (of people); exact, proper, ... ; normal, quiet, regular'.

[31] The word *saka* 'emerge, come out of' may also precede *to'o* with the resulting verbal

(159) ’I Bioro dao to’oku.
the Bioro arrive have-me
Bioro met me.

Here are the possible object suffixes for *to’o*.

(160)

Underlying	Citation	Normal	
/toʔo-ku/	to.ˈʔo.ku	ˈto.ˌʔou̯k	‘to meet me’
/toʔo-mu/	to.ˈʔo.mu	ˈto.ˌʔou̯m	‘to meet you’
/toʔo-na/	to.ˈʔo.na	ˈto.ˌʔo̯an	‘to meet it’
/toʔo-ka/	to.ˈʔo.ka	ˈto.ˌʔo̯ak	‘to meet us all (incl.)’
/toʔo-mulu/	ˈto.ʔo.ˌmu.lu	ˈtɔˑʔ.ˌmuˑl	‘to meet you all (excl.)’
/toʔo-da/	to.ˈʔo.da	ˈto.ˌʔo̯ad	‘to meet them’

Nominalizing suffixes

There are three nominalizing suffixes, /ʔa/, /aʔa/, and /la/. The first of these is the most common and shown below.

(161)

	Underlying	Citation	Normal	
a.	/masa/	ˈma.sa	ˈmaˑs	‘to play’
	/masa-ʔa/	ma.ˈsa.ʔa	ˈma.ˌsaʔ	‘game, playing’
b.	/ago/	ˈa.go	ˈao̯g	‘to hide’
	/ago/	a.ˈgo.ʔa	ˈa.go̯aʔ	‘hiding’
c.	/rao/	ˈrao̯	ˈrao̯	‘to work’
	/rao-ʔa/	ˈrao̯.ʔa	ˈra.ˌo̯aʔ	‘work, job’

The suffix /aʔa/ only seems to occur after minimal words ending in [u].

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complex also meaning ‘meet’.

(162)		Underlying	Citation	Normal	
	a.	/ŋuu/	ˈŋu	ˈŋu	‘to sing’
		/ŋuu-aʔa/	ˈŋu.ˌa.ʔa	ˈŋu.wʌʔ	‘singing’
	b.	/muu/	ˈmu	ˈmu	‘to break (snap)’
		/muu-aʔa/	ˈmu.ˌa.ʔa	ˈmu.wʌʔ	‘snapping’
	c.	/siu/	ˈsi.u	ˈsju	‘to wash, to take a bath’
		/siu-aʔa/	ˈsi.u.ˌa.ʔa	ˈsi.ˌwʌʔ	‘washing, bathing’

Although it is tempting to analyze this morpheme into two parts, i.e /-a-ʔa/, where the first /-a/ is the object suffix, there are two reasons not to. First, the meanings of the above word do not contain the ‘it’; i.e. *ngua’a* does not mean ‘singing of it’ or ’singing of something’. Secondly, there is no suffix /-daʔa/, which takes the plural object suffix.

The suffix /-la/ is always accompanied by one of the possessive suffixes.

(163)		Underlying	Citation	Normal	
	a.	/manata/	ma.ˈna.ta	ˈma.ˌnaˑt	‘to think’
		/manata-la-ku/	ma.ˈna.ta.ˌla.ku	ˈman.ta.ˌlau̯k	‘my thoughts’
	b.	/tai-a/	ta.ˈi.a	ˈta.i̯ɛ	‘to sew it’
		/tai-a-la-na/	ta.ˈi.a.ˌla.na	ˈta.i̯ɛ.ˌlaˑn	‘his sewing of it’
	c.	/ili-a/	i.ˈli.a	ˈi.ˌli̯ɛ	‘to try it’
		/ili-a-la-na/	i.ˈli.a.ˌla.na	ˈi.li̯ɛ.ˌlaˑn	‘his trying of it’

Causative prefix

The causative prefix is /faʔa-/. It can attach to verbs and some nouns.

(164)		Underlying	Citation	Normal	
	a.	/lebe/	ˈle.be	ˈlɛˑb	‘to startle’
		/faʔa-lebe-a/	fa.ˈʔa.le.ˌbe.a	ˈhaʔ.le.ˌbe̯a	‘to surprise’
	b.	/futa/	ˈfu.ta	ˈhwʌt	‘to be born’
		/faʔa-futa/	ˈfa.ʔa.ˌfu.ta	ˈhaʔ.hwʌt	‘to give birth’
	c.	/loko/	ˈlo.ko	ˈlɔˑk	‘mess’
		/faʔa-loko/	ˈfa.ʔa.ˌlo.ko	ˈhaˑʔ.ˌlɔˑk	‘to make a mess’

The ‘Not’ Prefix

Some verbs may take the prefix /abu-/; words with the adjective have a meaning opposite to the root.

(165)	Underlying	Citation	Normal	
	/fanga/	ˈfa.ŋa	haŋ	‘to eat’
	/abu-fanga/	ˈa.bu.ˌfa.ŋa	ˈau̯b.ˌhaŋ	‘to fast’

1.3 Reduplication and Compounding

Reduplication

There are many words that inherently reduplicated in Kwara’ae. That is, there are words that appear to have the form XX, but there is no independent root X. Some examples are *’ali’ali* ‘fast’, *ti’iti’i*, ‘small’, and *lo’ulo’u*, ‘straight (through)’.

Other words are related semantically.

(166)		Underlying	Citation	Normal	
	a.	/nau/	ˈnau̯	ˈnau̯	‘I, me’
		/nau-nau/	ˈnau̯.ˌnau̯	ˈnau̯.ˌnau̯	‘arrogant’
	b.	/ʔaba/	ˈʔa.ba	ˈʔaˑb	‘hand’
		/ʔabaʔaba/	ˈʔa.ba.ˌʔa.ba	ˈʔaˑb.ˌʔaˑb	‘shoulder

Other words have reduplicated forms, which may change the meaning way in some subtle way that has not been apparant to me.

(167)		Underlying	Citation	Normal	
	a.	/bali/	ˈba.li	ˈba͡il	‘side’
		/bali-bali/	ˈba.li.ˌba.li	ˈba͡il.ˌba͡il	‘side’
	b.	/laŋa/	ˈla.ŋa	ˈlaŋ	‘dry’
		/laŋa-laŋa/	ˈla.ŋa.ˌla.ŋɑ	ˈlaŋ.ˌlaŋ	‘dry’

There is some productive partial reduplication in Kwara’ae, but this is an area of ongoing research. For example, the first syllable of a verb can be reduplicated to give a kind of perfective sense.

(168)	Underlying	Citation	Normal
	/daroʔa-ni-da/	da.ˈro.ʔa.ˌni.da	dao̯r.ʔa.ˌni̯ɛd ‘to share them’
	/da-daroʔa-ni-da/	da.da.ˈro.ʔa.ˌni.da	da.ˈdao̯r.ʔa.ˌni̯ɛd ‘to have shared them’

Notice that these words do not follow the regular stress pattern, nor the regular metathesis pattern. Obviously, more research is needed in this area.

Compounding

I do not know how compounds are formed productively. Here are two compounds I know, which indicate that the head occurs as the first element of the compound.

		Underlying	Citation	Normal	
(169)	a.	/faka/	ˈfa.ka	ˈhaˑk	‘ship’
		/lofo/	ˈlo.fo	ˈloˑh	‘fly’
		/faka-lofo/	ˈfa.ka.ˌlo.fo	ˈhaˑk.ˌloˑh	‘airplane’
	b.	/ʔai/	ˈʔai̯	ˈʔai̯	‘tree’
		/takalo/	ta.ˈka.lo	ˈta.ˌkao̯l	‘to scatter’
		/ʔai-takalo/	ˈʔai̯.ta.ˌka.lo	ˈʔai̯.ta.ˌkao̯l	‘a scatter-tree’
				(a tree that sheds its leaves seasonally)	

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