Vowel Hiatus Resolution in Kikuyu Short Vowels: An Optimality Theory Analysis

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Abstract

Vowel hiatus is a sequence of two vowels in adjacent syllables with no intervening consonant, taking the form .CV.V where periods mark syllable boundaries. Some languages, like Hawaiian, allow vowel hiatus to surface freely without restriction (i.e. without the need to *resolve* vowel hiatus); other languages employ a series of resolution techniques to restrict hiatus sequences from surfacing (Casali 1996). The goal of this paper is to examine vowel hiatus sequences in Kikuyu, a Bantu language spoken primarily in Central Kenya, looking first at which resolution techniques Kikuyu employs and then using Optimality Theory (OT) to analyze the specifics of how underlying hiatus sequences surface in the language. Specifically, this paper looked at all 49 possible combinations of Kikuyu's seven phonemic short vowels (however, each of Kikuyu's vowels contrasts with its long counterpart, meaning there are 14 phonemic vowels in the language and 196 possible underlying sequences). It was concluded that Kikuyu employs four resolution techniques: heterosyllabification (i.e. the ability for hiatus sequences to surface as hiatus), vowel elision, glide formation, and diphthong formation, with heterosyllabification the most common technique, meaning Kikuyu generally allows hiatus to surface. OT was then used to analyze the specific changes. For example, when Kikuyu employs vowel elision and glide formation to stop hiatus from surfacing, there is always compensatory lengthening, suggesting that Kikuyu is maximally faithful with respect to syllable weight, prompting the introduction of a high ranking MAX-IO(μ) constraint. Further, OT was used to identify marked forms that drive certain resolution techniques. For example, the underlying sequence /i + u/ is marked when preceeded by a voiceless stop; the specific relationship of $*\begin{bmatrix} -voice \\ +del.release \end{bmatrix}$IU >> IDENT(SYLLABIC) captured the marked form's desire to resolve with glide formation. In the end, this paper accounted for all 49 underlying combinations it sought to analyze, with much room for further study and refinement.

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1 Introduction

1.1 Introduction to vowel hiatus and hiatus resolution

Vowel hiatus is defined by Casali (1996) as a sequence of two vowels that occur in adjacent syllables with no intervening consonant, taking the structure CV.V. Some languages allow hiatus sequences to surface freely, such as in Hawaiian (Senturia 1998: 26):

(1)	a.	[ko.a.na]	'space'
	b.	[ku.a]	'back'
	c.	[hu.i.na]	'sum'
	d.	[ko.e.na]	'remainder'

However, many languages do not allow hiatus sequences to surface and instead seek to *resolve* underlying vowel hiatus sequences. Casali (1996: 1) schematizes the ways in which languages resolve hiatus[1]:

(2)	a. Heterosyllabification:	$CV_1 + V_2 \rightarrow .CV_1.V_2.$
	b. Diphthong Formation:	$CV_1 + V_2 \rightarrow .CV_1V_2.$
	c. Epenthesis:	$CV_1 + V_2 \rightarrow .CV_1.CV_2.$
	d. Vowel Elision:	$CV_1 + V_2 \rightarrow .CV_1(:).$ or $.CV_2(:).$
	e. Glide Formation:	$CV_1 + V_2 \rightarrow .CGV_2(:).$
	f. Coalescence:	$CV_1 + V_2 \rightarrow .CV_3(:).$

Under Casali's schema, the Hawaiian vowel hiatus examples in (1) therefore undergo heterosyllabification. Following Casali's analysis, the resolution of (1a) is as follows:

(3) $/ko_1a_2na/ \rightarrow ko_1.a_2.na$

As it turns out, heterosyllabification is the most common form of "resolution" in Kikuyu and follows the same form as (3).

It is worth noting that it might be more accurate not to classify heterosyllabification as resolution at all; rather, some languages just allow underlying hiatus sequences to surface without needing to resolve them. However, Casali's classification of (3) as heterosyllabification is worthwhile as it provides clarification between the surfacing of an underlying $/V_1 + V_2/$ sequence as a heterosyllabic sequence versus as a diphthong, which would see both V_1 and V_2

[1] The schema presented in (2) shows parenthesized (:) indicating that certain resolution techniques may occur with or without compensatory lengthening depending on the language (and, as we will see later, Kikuyu universally applies compensatory lengthening after employing certain hiatus resolution techniques)..

surfacing in the same syllable. This contrast is seen when comparing (2a) and (2b). Therefore, henceforth I will be adopting Casali's "heterosyllabification resolution" for this paper whenever hiatus can surface.

Finally, Casali notes that the specifics of these resolutions will depend on the vowel inventory of the language and language-specific constraints and constraint rankings, and that this is best analyzed in Optimality Theory (henceforth OT; McCarthy & Prince (1995)). This is the primary goal of this paper and will be the bulk of content beyond §1.

1.2 Introduction to Kikuyu and Kikuyu vowel hiatus

Kikuyu, or Gĩkũyũ (IPA: ɣēkōjó), is a Bantu language spoken by the Kikuyu people (*Agĩkũyũ*) of Kenya from the mountain ranges surrounding the Central Kenya province (Mugane 1997). Kikuyu has seven phonemic vowels[2]:

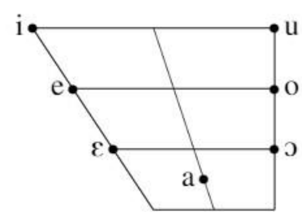

Fig. 1: Kikuyu vowel inventory

However, each Kikuyu vowel contrasts with its long (ː) counterpart. This means that there are technically 14 phonemic vowels in Kikuyu. As a result, there are 196 possible /V_1(ː) + V_2(ː)/ hiatus sequences. The scope of this paper is purposefully limited to analyzing underlying sequences of only short vowels, meaning 49 /$V_1 + V_2$/ sequences are attested for.

To obtain this data, elictations with a native speaker of Kikuyu were conducted over the course of several months in Fall 2020 with the goal of recording as many vowel hiatus sequences as possible in as many phonological and syntactic contexts as possible. In the end, all 49 possible combinations are attested for, with incredibly rich variation with regards to resolution techniques Kikuyu employs, and the Kikuyu-specific ways in which hiatus resolution changes the underlying form.

[2] While phonetic data from past elicitations suggests /a/ to be in the position represented in fig. 1, this paper assumes /a/ to still be [+ LOW].

As a note, from this point on, long vowels will not be shown as Vː. Instead, long vowels will be shown in the form VV. This is to better represent Kikuyu's compensatory lengthening and the fact that the syllable "weight" of all underyling forms is two mora (μ), and that the resulting surface form is always equal to two mora (it is broadly accepted that a short vowel bears a syllable weight of 1μ, and a long vowel 2μ, as per Hayes et. al (2008)). It is therefore more visually intuitive to think of a lengthening process in Kikuyu as V + V → VV rather than V + V → Vː.

Figure 2 below shows a chart of every short vowel combination in Kikuyu and their surface forms after going through various resolution techniques and after the language parses various marked forms.[3]

V1 V2	i$_1$	e$_1$	ɛ$_1$	a$_1$	ɔ$_1$	o$_1$	u$_1$
i$_2$	ii$_{1,2}$	e$_1$i$_2$	ɛi	a$_1$i$_2$	ɔ$_1$i$_2$	o$_1$i$_2$ (→w $_1$ii$_2$)	ui (→wii)
e$_2$	i$_1$e$_2$	ee$_{1,2}$	ɛɛ$_1$	ɛɛ$_2$	o$_1$ɛ$_2$	oe (→wee)	ue
ɛ$_2$	i$_1$ɛ$_2$	e$_1$ɛ$_2$	ɛɛ$_{1,2}$	ɛɛ$_2$	ɔ$_1$ɛ$_2$ (→w$_1$ɛɛ$_2$)	oɛ (→wɛɛ)	uɛ
a$_2$	i$_1$a$_2$	e$_1$a$_2$	ea	aa$_{1,2}$	ɔ$_1$a$_2$	oa (→waa)	ua
ɔ$_2$	i$_1$ɔ$_2$	e$_1$ɔ$_2$	eɔ	ɔɔ$_2$	ɔɔ$_{1,2}$	uɔ/oɔ (→wɔɔ)[4]	uɔ
o$_2$	i$_1$o$_2$	i$_1$o$_2$	eo	ɔɔ$_2$	ɔɔ$_1$	oo$_{1,2}$	uo
u$_2$	i$_1$u$_2$ (→y$_1$uu$_2$)	i$_1$u$_2$ (→y$_1$uu$_2$)	ɛ$_1$u$_2$ ~ e$_1$ɔi$_2$	ɔi$_{1,2}$	ɔ$_1$u$_2$ ~ ɔi$_{1,2}$	uu$_2$/ou[5]	uu$_{1,2}$

Fig. 2: Vowel hiatus in Kikuyu short vowels.

[3] Unlike in Casali's schema in (2), syllable boundaries are not marked in figure 2 or in most of this paper. This is because we can broadly assume that each surface form (that isn't simply a long vowel) is heterosyllabic. There is evidence of diphthong formation as a hiatus resolution technique in Kikuyu, in which case the surface form is not heterosyllabic, but that will be evident through vowel indices. Therefore, syllable boundaries are mostly omitted.

[4] [uɔ] within words across morpheme boundary; [oɔ] ~ [wɔɔ] across word boundary

[5] [uu] within words across morpheme boundary; [ou] across word boundary

Using the data that was used to construct fig. 2, the goal of this paper, first, is to draw conclusions about hiatus resolution methods Kikuyu employs using Casali's framework. Second, this paper seeks to construct an OT analysis that captures the ways in which the forms that surface as a result of hiatus resolution stay faithful to their underlying /$V_1 + V_2$/ sequences, as well as the marked forms that account for Kikuyu's idiosyncracies (for example the reasons why only certain underlying forms are resolved with glide formation, and only in certain phonological contexts).

1.3 Observed hiatus resolution patterns in Kikuyu

As shown in fig. 2, underlying vowel hiatus sequences in Kikuyu yield rich and diverse surface forms; this diversity of surface forms are driven by a) Casali's resolution techniques, many of which Kikuyu employs, and b) marked forms unique to the language that drive further changes.

Kikuyu is shown to employ four resolution techniques: heterosyllabification, diphthong formation, vowel elision, and glide formation.

Heterosyllabification, i.e. the surfacing of underlying hiatus sequences, is the most common resolution technique. A large amount of underlying hiatus sequences surface as hiatus with no other changes as seen in (4) below.[6] Please note that every unglossed noun in this paper, such as *Kagoci* in (4b), are common first names in Kikuyu. Further, indexing is shown only in (4a); each subsequent datum in (4) follows the same indexing pattern. Kikuyu is also a tonal language and tone has been marked accordingly; but, instances where tone itself affects hiatus resolution have not been observed. Finally, in this paper, /j/ represents the affricate /d͡ʒ/, and /y/ is a high glide; there are also other hopefully intuitive combinations of IPA and Kikuyu orthography.

(4)

Hiatus sequence	Careful speech		Fast speech	Gloss
a. $i_1 + e_2 \rightarrow i_1e_2$	kàɣɔ̀ʃí étèkà	→	kàɣɔ̀ʃíétèkà	*'Kagoci, answer!'*
b. i + ɛ → iɛ	kàɣɔ̀ʃí ɛ́hɛ́rà	→	kàɣɔ̀ʃíɛ́hɛ́rà	*'Kagoci, stand aside!'*
c. i + a → ia	àðùùrì áyá	→	àðùùrìàyá	*'these seniors'*
d. i + ɔ → iɔ	mòðúúrí ɔ́nà	→	mòðúúrìɔ̀nà	*'elder, see!'*
e. i + o → io	mòðúúrì óyó	→	mòðúúrìòyó	*'this elder'*

[6] Every hiatus example in this paper will follow the same format: the hiatus resolution pattern, the underlying form as is pronounced in careful speech, the surface form as is pronounced in fast/conversational speech, and the gloss.

f. e + i → ei	gèʃóhè íkòmí	→	gèʃóhè íkòmì	*'ten Gĩcũhĩs'*
g. e + ɛ → eɛ	kèvàkè ɛ́hɛ̀rà	→	kèvàkè ɛ́hɛ̀rà	*'Kĩbakĩ, stand aside!'*
h. e + a → ea	né áðɛ́kàɣà	→	néáðɛ́kàɣà	's/he laughs (hab.)'
i. e + ɔ → eɔ	mòtè ɔ́nà	→	mòtéɔ́nà	*'tree, look [at that]!'*
j. ɛ + i → ɛi	hɔ̀ɔ̀gɛ̀ ìgèrè	→	hɔ̀ɔ̀gèìgèrè	*'two branches'*
k. ɛ + u → ɛu	jɔ̀rɔ̀gɛ́ úgà	→	jɔ̀rɔ̀gɛ́ꜜúgà	*'Njoroge, speak!'*
l. a + i → ai	mèðènya íkòmí	→	mèðɛ́nyáíkòmí	*'ten days'*
m. ɔ + i → ɔi	hùkɔ̀ ìɣɛ́rɛ́	→	hùkɔ̀ìɣɛ̀rɛ̀	*'two moles'*
n. ɔ + ɛ → ɔɛ	gèkɔ̀nyɔ́ ɛ́hɛ́rà	→	gèkɔ̀nyɔ́ɛ́hɛ́rà	*'Gĩkonyo, go away!'*
o. ɔ + a → ɔa	mòɣɔ̀ áyá	→	mòɣɔ̀àyá	*'these Mũgos'*
p. ɔ + u → ɔu	húkɔ́ úgà	→	húkɔ̀úgà	*'mole, speak!'*
q. o + i → oi	íráátò íʃí	→	íráátòìʃí	*'these shoes'*
r. o + e → oe	gèʃòrò étékà	→	gèʃòròètékà	*'Gĩcũrũ, answer!'*
s. o + ɛ → oɛ	gɛ̀ʃó ɛ́hɛ́rà	→	gɛ̀ʃóɛ́hɛ́rà	*'Ngecũ, stand aside!'*
t. o + a → oa	gɛ̀ʃó áyá	→	gɛ̀ʃòáyá	*'these Ngecũs'*
u. o + ɔ → oɔ	gèʃòrò ɔ́nà	→	gèʃòròɔ́nà	*'Gĩcũrũ, see!'*
v. o + u → ou	wàjìkó úɣà	→	wàjíkóúgà	*'Wanjikũ, speak!*
w. u + i → ui	gàðù íkòmí	→	gàðùíkòmí	*'ten Gathus'*
x. u + e → ue	gàðú étèkà	→	gàðùétèkà	*'Gathu, answer!'*
y. u + ɛ → uɛ	màtù ɛ̀hɛ́rà	→	màtùɛ́ꜜhɛ́rà	*'Matu, stand aside!'*
z. u + a → ua	ìvúkú àrìyá	→	ìvúkúárìyà	*'book, speak!'*
aa. u + ɔ → uɔ	ìvúkú ɔ́nà	→	ìvúkùɔ́nà	*'book, see!'*
bb. u + o → uo	mátú ókà	→	mátùókà	*'Matu, come!'*

However, some sequences that are analyzed as heterosyllabification see their forms changing (generalizations and analyses of the changes seen will be explained as this paper continues). The following examples are analyzed the exact same as in (4), with respect to indexing and resolution; however, you'll notice that qualities of V_1 change (or, in the case of (5a) and (5b), both V_1 and V_2 changes).

(5) a. ɔ$_1$ + e$_2$ → o$_1$ɛ$_2$	mèrɔ̀ɔ̀gɔ̀ ètàtó	→	mèrɔ̀ɔ̀gòɛ̀tàtó	*'thirty'*
b. a + u → ɔi	tààtà úgà	→	tààtɔ̀ígà	*'Aunt, say something!'*
c. ɛ + o → eo	ɔ̀ʃɔ̀ɔ̀kɛ̀ ótòɛ̀jɛ̀	→	ɔ̀ʃɔ́ɔ́kèòtòɛ̀jɛ̀	*'then shave us'*
d. ɛ + a → ea	dɔ̀ɔ̀nìrɛ́ áðùùrì	→	dɔ̀ɔ̀nìréáðúúrì	*'I saw the seniors'*
e. e + u → iu	gɛ̀ʃóhè úgà	→	gɛ̀ʃóhìúgà	*'Gĩcũhĩ, say something!'*
f. ɛ + ɔ → eɔ	kàmààdɛ́ ɔ́nà	→	kàmààdéɔ́nà	*'Kamande, see!'*

Vowel elision is another resolution technique that has been observed in Kikuyu. As mentioned previously (and will be analyzed and explained further in §2), there is compensatory lengthening when a vowel is elided, likely to preserve syllable weight, something attested for cross-linguistically (Hayes et. al 2008). Instances of elision as a resolution technique are shown below in (6).

(6)	a. $a_1 + e_2 \rightarrow ɛɛ_2$	mɛ̀kààdá énà	→	mɛ̀kààdɛ́ɛ̀nà	*'four ropes'*
	b. $a_1 + ɛ_2 \rightarrow ɛɛ_2$	mèðɛ̀nyà ɛ́ꜜnɔ́	→	mèðɛ́nyɛ̀ɛ̀nɔ́	*'these days'*
	c. $a_1 + ɔ_2 \rightarrow ɔɔ_2$	tààtà ɔ́nà	→	tààtɔ́ɔ́nà	*'Aunt, see!'*
	d. $a_1 + o_2 \rightarrow ɔɔ_2$	tààtà óyó	→	tààtɔ̀ɔ̀yó	*'this aunt'*

There is some contentious data here; for example, (6a) and (6d) are both considered to be vowel elision here, despite the surface form not being either V_1 or V_2. Casali might classify this as coalescence, not elision. However, as we will soon discuss, tense vowels are marked relative to most other vowels, and there is a host of evidence suggesting there is a mechanism in Kikuyu that sees tense vowels like /e/ and /o/ to de-tense and drop to the nearest non-tense vowel, i.e. [ɛ] and [ɔ] respectively. Thus, in (6d) for example, the resulting [ɔɔ] is more likely indexed as a de-tensed "anaphor" of the underlying /o/, and not as a coalescence of both V_1 and V_2.

Continuing, glide formation is also a valid resolution technique in Kikuyu and employed often. However, glide formation is licensed by certain phonological contexts. In certain underlying (marked) combinations, such as /i + u/, and many other combinations when V_2 is [+BACK], the preceeding consonant in the underlying /CV_1.V2/ sequence licenses glide formation. It appears as though there might be a gradient of preceeding Cs that license glide formation. Preceeding consonants that license glide formation are presented in (7) below; (7) shows a gradient in which glide formation is least likely to be licit to most likely to be licit, based on observed data.

(7) d → g → t → k

Per (7), a preceeding /k/ makes glide formation very licit. This is true. There is also seemingly a gradient of underlying hiatus combinations that like to resolve using glide formation, regardless of which consonant from (7) preceeds the hiatus sequence; this will all be discussed later as the OT analysis of hiatus resolution unfolds, and this paper will certainly not resolve the nuances of these possible gradients. Examples of every underlying form that surfaces as licit after underoging glide formation are below.

(8) a. i$_1$ + u$_2$ → y$_1$uu$_2$ mwààgì úmà → mwààgyúúmà *'Mwangi, come out!'*

b. ɔ$_1$ + ɛ$_2$ → w$_1$ɛɛ$_2$ húkɔ́ ɛ́hɛ́rà → húkwɛ́ɛ́hɛ́rà *'mole, go away!*

c. o$_1$ + i$_2$ → w$_1$ii$_2$(~oi[7])wàjìkó íkòmí → wàjìkwííkòmí *'10 Wanjikũs'*

d. o$_1$ + e$_2$ → w$_1$ee$_2$ wàjìkó étékà → wàjìkwéétékà *'Wanjikũ, answer!'*

e. o$_1$ + ɛ$_2$ → w$_1$ɛɛ$_2$ wàjìkó ɛ́hɛ́rà → wàjìkwɛ́ɛ́hɛ́rà *'Wanjikũ, stand aside!'*

f. o$_1$ + a$_1$→ w$_1$aa$_2$(~oa)wàjìkó áyá → wàjìkwááyá *'these Wanjikũs'*

g. o$_1$ + ɔ$_2$ → w$_1$ɔɔ$_2$ wàjíkó ɔ́nà → wàjíkwɔ́ɔ́nà *'Wanjikũ, see!'*

h. u$_1$ + i$_2$ → w$_1$ii$_2$ màfùkù ìkòmí → màfùkwììkòmí *'ten books'*

Finally, if you will recall earlier, it was mentioned that diphthong formation is another vowel hiatus resolution technique. This paper will not account for that resolution technique as there are multiple mysteries surrounding it; an acoustic study will need to be conducted to capture all the facts of diphthong formation in Kikuyu. Preliminary thoughts on how this analysis will go, building off previous diphthong studies, will be discussed in the conclusion.

With this empirical foundation, we can soon begin to analyze the specificities of Kikuyu vowel hiatus using OT.

1.4 Roadmap

Thus far, we have discussed vowel hiatus and Casali's hiatus resolution classifications, and have introduced the puzzle of Kikuyu vowel hiatus. We have also discussed the conclusions we can draw from the findings presented in fig. 2; specifically, the hiatus resolutions Kikuyu employs and the separate puzzles they all present have been introduced.

§2 will continue by discussing generalizations from Kikuyu vowel hiatus data and how those generalizations inform our understanding of how Kikuyu surface-forms stay faithful to their underlying vowel hiatus sequences; we've already discussed, for example, how Kikuyu likes to stay faithful with regard to retaining the syllable weight (mora) of underlying forms in their outputs.

§3-6 will use the findings from §2 as well as diagnose marked forms in the language to construct OT tableau for each vowel hiatus resolution technique Kikuyu employs and whenever a crucial constraint ordering presents itself.

§7 Discusses the shortcomings of the analysis this paper argues, as well as various possible future directions of study (for example, diphthong formation).

[7] The ~ here indicates that /o + i/ can optionally surface as [oi] regardless of the preceeding /k/.

2 Faithfulness

This short section deals with faithfulness in Kikuyu; that is, what aspects of the input (underlying hiatus sequence) the language prefers to retain in the output. This section will see a shift into OT, and relevant constraints will be introduced. Following this section, markedness constraints will be proposed and tableau to show the crucial constraint orderings to account for the various Kikuyu resolution techniques.

The first constraint proposed is actually a markedness constraint, included here because it is the driving force behind all resolution techniques besides heterosyllabification; i.e. whenever hiatus sequences are not allowed to surface, and because it is dominated by the many ways in which Kikuyu stays faithful to underlying hiatus sequences.

(9) NOHIATUS/*VV
Don't allow hiatus sequences.

Again, this constraint is ranked relatively low: You can see in section 1.3 that heterosyllabification—i.e. the ability for hiatus sequences to surface—is the preferred resolution technique. This is similar to Hawaiian, which would rank this constraint even lower (or perhaps not at all), as Hawaiian essentially freely allows for hiatus sequences to surface.

Continuing, we have already mentioned previously Kikuyu's need for compensatory lengthening when a mora-bearing segment is deleted. This is captured by the following faithfulness constraint, which is ranked high in Kikuyu.

(10) MAX-IO(μ)
Preserve the syllable weight of the input.

This constraint has importance in almost every part of the OT analysis of Kikuyu vowel hiatus resolution.

Further, there is also a strong desire in Kikuyu to retain the identity of underlying high vowels (or consonants, in the case of glide formation) in the output, captured in (11).

(11) IDENT(+HIGH)
Retain the height of high vowels and consonants in the output.

In a similar vein, backness also has a special status in Kikuyu.

(12) IDENT(BACK)
Preserve the backness of a vowel across the input/output.

Continuing, there are some crucial faithfulness constraint rankings that are key to accounting for the Kikuyu facts. For example, Kikuyu prefers to retain the identity of V_2 (easily accessible evidence of this is seen in (6) and (8)).

(13) IDENT(V_2) >> IDENT(V_1)

Preserve the identity of V_2. >> *Preserve the identity of* V_1.

The ordering in (13) importantly overshadows Kikuyu's tendency to preserve the backness of back vowels more stringently than non-back values. This relationship is captured in (14). Note that this differs from just preserving the backness of a vowel, which is accounted for in (12).

(14) (IDENT(V_2)) >> IDENT(+BACK) >> IDENT(-BACK)
Preserve the backness of [+back] vowels. >> Preserve the backness of [-back] vowels.

Finally, there are three remaining faithfulness constraints that will be utilized throughout the analysis that Kikuyu employs. These remaining three are not necessarily highly ranked, but important for capturing the facts.

(15) IDENT(LOW)
Preserve lowness.

(16) IDENT(SYLLABIC)
Don't change a vowel into a consonant (this is low ranked and used to show licit glide formation).

(17) *IDENT(LONG)*
Preserve vowel length.

With that, we have accounted for most of the ways in which the surface forms of underlying vowel hiatus stay faithful to those underlying forms. The crucial orderings of faithfulness constraints will be continuously updated as the analysis progresses, and more facts reveal themselves. More low-ranking faithfulness constraints will be introduced to contrast certain marked forms, but the constraints presented here are most important to the analysis.

3 Hiatus /$V_1 + V_2$/ sequences when $V_1 = V_2$

Before getting into the other resolution techniques discussed in §1, there is one type of "hiatus resolution" that we haven't discussed, and that is when the underlying vowels are the same. This technically meets the definition of vowel hiatus, because underlyingly, they are two heterosyllabic vowels with no intervening consonant. In every instance where the two underlying vowels are the same, they surface as a long vowel, as shown below.

(18)	a. $i_1 + i_2 \rightarrow ii_{1,2}$	dìgí íɣɛ́rɛ̀ → dìgííɣɛ́rɛ̀	*'two strings'*
	b. e + e → ee	gèʃóhè étékà → gèʃóhèètékà	*'Gĩcũhĩ, answer!'*
	c. ɛ + ɛ → ɛɛ	ŋɔ̀ɔ̀bɛ̀ ɛ̀hɛ́rà → ŋɔ̀ɔ̀bɛ́ɛ́hɛ̀rà	*'cow, stand aside!'*
	d. a + a → aa	wáʃíírá àrìà → wáʃííráárìà	*'Wacira, speak!'*
	e. ɔ + ɔ → ɔɔ	gèkɔ̀nyɔ́ ɔ́nà → gèkɔ̀nyɔ́ɔ̀nà	*'Gĩkonyo, see!'*
	f. o + o → oo	wàjìkó òyò → wàjìkóóyó	*'this Wanjikũ'*

You could analyze these examples in (18) as vowel elision. But that would require to think of an example such as $i_1 + i_2 \rightarrow ii_1$ *or* ii_2 which would be odd seeing as it implies only the nature of V_1 or V_2 is driving the surface forms, when it is of course due to both V_1 and V_2 being equal to each other. Thus, I believe it deserves its own section.

The analysis of this is fairly simple and, in a way, just captures that the output is maximally faithful to the input. Tableau 1 below captures this.

/i_1 + i_2/	MAX-IO(μ)	MAX-IO	IDENT(LONG)	*VV/NOHIATUS	IDENT(SHORT)
ii_1		*!			*
☞ $ii_{1,2}$ ($i\!:_{1,2}$)					*
i_1i_2			*!	*	
i_1	*!	*	*		

Tableau 1. Hiatus resolution when $V_1 = V_2$

One may have noticed that the constraint ranking in tableau shows the first two Max constraints dominating Ident(long) and NoHiatus despite the fact that any ranking of all four of those first constraints can theoretically yield the correct surface form as long as they all dominate Ident(short). However, we will see evidence to suggest that both Max constraints are ranked equally high, with Ident(long) also dominating NoHiatus, which is ranked arbitrarily low, as is Ident(short). Thus, the final orderdering I propose is as follows, with potential for evolution as this paper continues.

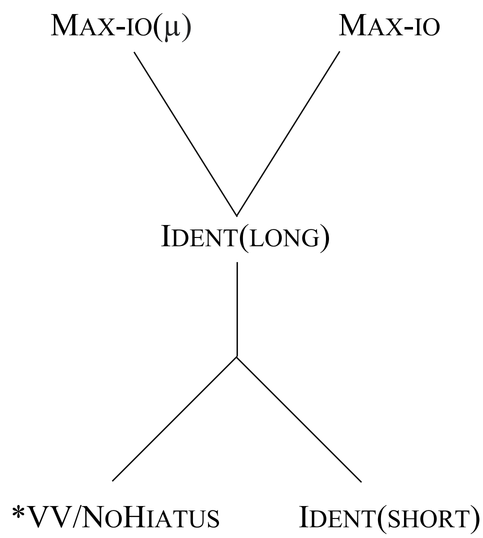

Fig. 3: Constraint ordering for sequences where $V_1 = V_2$

Continuing, there are, however, some fringe cases which I believe follow somewhat the same process; at least, cases where V_1 and V_2 are nearly identical, and analyzing them as vowel elision would de-emphasize that similarity. These examples are below.

(19) a. $\varepsilon_1 + e_2 \rightarrow \varepsilon\varepsilon_{1,2}$ ŋɔ̀ɔ̀bɛ̀ èɣɛ́ðìɛ́ → ŋɔ̀ɔ̀bɛ́ɛ́ɣɛ̀ðìɛ̀ *'the cow went'*

b. $ɔ_1 + o_2 \rightarrow ɔɔ_{1,2}$ òhɔ́rɔ́ ómùɛ̀ → òhɔ́rɔ́ɔ́mwɛ̀ *'one issue'*

Analyzing (19a) and (19b) as vowel elision would also yield some other issues. For example, in all other instances of vowel elision, we see V_2 being retained. But for these examples, it would be odd tosuggest that V_2 is being retained when it is a lengthened V_1 that actually surfaces; but, suggesting the result of $\varepsilon_1 + e_2$ is $\varepsilon\varepsilon_1$ not only breaks the vowel elision pattern of retaining V_2, but also doesn't capture the fact that V_1 and V_2 are as similar as two distinct vowels can be in Kikuyu, articulatorily. Hence, I include them in this section. However, analyzing them in this section also creates a degree of arbitrariness, as I have to introduce *Eɛ and *ɔo markedness constraints that dominate another low ranking $*\begin{bmatrix}+long\\+tense\end{bmatrix}$ constraint which is also arbitrary but necessary in order not to break the importance of IDENT(V_2) which will come up later. Further, if you include these markedness constraints as very low ranked, no ranking paradoxes come up later. The tableau showing these cases from (19) is below, assuming all other constraint relationships from Tableau 1. The markedness constraints just introduced are assumed to be ranked below the already low-ranking NOHIATUS to avoid future paradoxes.

/$ɛ_1$ + e_2/	MAX-IO(μ)	MAX-IO	NOHIATUS	*Eɛ	$*\begin{bmatrix}+long\\+tense\end{bmatrix}$	IDENT(+TENSE)
$ɛ_1e_2$				*!		
☞ $ɛɛ_{1,2}$						*
$ee_{1,2}$					*!	

Tableau 2. /ɛ + e/ derivation.

The same analysis can be considered for /ɔ + o/. While, again, this analysis uses somewhat arbitrary markedness constraints, analyzing these examples as if V_1 and V_2 are equal probably captures more the articulatory processes that lead to the observed surface forms.

4 Glide formation

Glide formation as a resolution technique is licit for multiple underlying forms in Kikuyu; however, each underlying form that can undergo glide formation can also undergo heterosyllabification and surface as a hiatus sequence. It has been observed that the consonant that preceeds the hiatus sequence in certain underlying forms. As a reminder, here are the preceeding consonants that license glide formation as hiatus resolution, in the gradient from least licit to most licit, followed again by the observed underlying forms that undergo glide formation.

(20) d → g → t → k

(21) a. $i_1 + u_2$ → y_1uu_2 mwààgì úmà → mwààgyúúmà *'Mwangi, come out!'*

b. $ɔ_1 + ɛ_2$ → $w_1ɛɛ_2$ húkɔ́ ɛ́hɛ́rà → húkwɛ́ɛ́hɛ́rà *'mole, go away!*

c. $o_1 + i_2$ → w_1ii_2 wàjìkó íkòmí → wàjìkwííkòmí *'10 Wanjikũs'*

d. $o_1 + e_2$ → w_1ee_2 wàjìkó étékà → wàjìkwéétékà *'Wanjikũ, answer!'*

e. $o_1 + ɛ_2 \rightarrow w_1ɛɛ_2$	wàjìkó ɛ́hɛ́rà → wàjìkwɛ́ɛ́hɛ́rà	*'Wanjikũ, stand aside!'*
f. $o_1 + a_2 \rightarrow w_1aa_2$	wàjìkó áyá → wàjìkwááyá	*'these Wanjikũs'*
g. $o_1 + ɔ_2 \rightarrow w_1ɔɔ_2$	wàjíkó ɔ́nà → wàjíkwɔ́ɔ́nà	*'Wanjikũ, see!'*
h. $u_1 + i_2 \rightarrow w_1ii_2$	màfùkù ìkòmí → màfùkwììkòmí	*'ten books'*

Based off of current data, it looks like there are two distinct glide formation processes occuring, which will be discussed below.

4.1 /i + u/ glide formation

First, the underlying /i+u/ combination seems to particularly favor undergoing glide formation; with /i+u/, glide formation is more likely to be licit for each of the consonants listed in (20). It must be stressed that more data incorporating more phonological environments will give us clues as to what actually licenses glide formation, and why we see data patterns such as in (22) below, where two very similar names with the same preceeding /g/ differ in the acceptability of glide formation (tone has not been checked for these examples).

(22)	a. /motugi uɣa/ → mo.tu.gi.u.ɣa, #yuu	'*Mũtungi, say something!'*
	b. /motigi uɣa/ → mo.ti.gyuu.ɣa, #iu	*'Mũtingi, say something!*

Similar puzzling data is found with all of the glide formation-licensing preceeding consonants listed in (20), suggesting the need for a study focusing on the greater phonological context in which /i+u/ is resolved through glide formation. But for the purposes of this analysis I have to work with existing data to create a markedness constraint that drives glide formation in /i+u/ sequences. Based on what consistenly licenses glide formation for this vowel combination, I propose the following constraint.

(23) $*\begin{bmatrix} -voice \\ +del.release \end{bmatrix}_{IU}$

Disallow /i+u/ hiatus sequences to surface when preceeded by a voiceless stop.

I have chosen to indicate that a voiceless stop preceeding /i+u/ as my markedness constraint because preceeding voiceless stops most consistently feed glide formation (even though stops in general do feed glide formation, especially when the underlying sequence is /i+u/. But seeing as more research needs to be done on glide formation specifically, there will always be a degree of arbitrariness in the markedness constraints that drive glide formation, so I've opted for the most consistently marked form). The following is an example of such a marked form.

(24) /$ki_1 + u_2$/ → ky_1uu_2; /murioki uɣa/ → muriokyuuɣa; *'Muriũki, say something!'*

The primary glide formation mechanism here is driven by the crucial ordering of $*\begin{bmatrix} -voice \\ +del.release \end{bmatrix}$IU >> IDENT(SYLLABIC) which allows /i/ → [y]. Combine this with a high-ranking MAX-IO(μ) that drives compensatory lengthening, IDENT(+HIGH) preferring to retain the high status of /i/ by choosing the high glide [y] over the non-high [w], and IDENT(BACK) choosing to retain /u/ in the output rather than /i/, we see the appropriate output. Tableau 3 shows this analysis in action.

Note that the available voiceless stops in Kikuyu are /k,t/ which are both attested for in the tableau below.

/(k,t)i_1 + u_2/	MAX-IO(μ)	IDENT(BACK)	IDENT(+HIGH)	MAX-IO	$*\begin{bmatrix}-voice\\+del.release\end{bmatrix}$IU	IDENT(SYLLABIC)	*VV/NOHIATUS
i_1u_2					*!		*
☞ y_1uu_2						*	
y_1ii_2		*!				*	
w_1uu_2			*!				
uu_1		*!		*			
i_1o_2			*!				*
ii_1		*!		*			
u_1	*!			*			

Tableau 3: Glide formation of underlying /i + u/ sequences when preceeded by a voiceless stop.

The primary mechanism at play here, again, is the $*\left[\begin{smallmatrix}-voice\\+del.release\end{smallmatrix}\right]$IU ranking above Kikuyu's desire to preserve vowels as vowels, captured with the IDENT(SYLLABIC) faithfulness constraint. But other faithfulness constraints that we discussed in §2 also of course play an important role in showcasing which form is allowed to surface. The entirety of this constraint ranking is captured in Fig. 4 below.

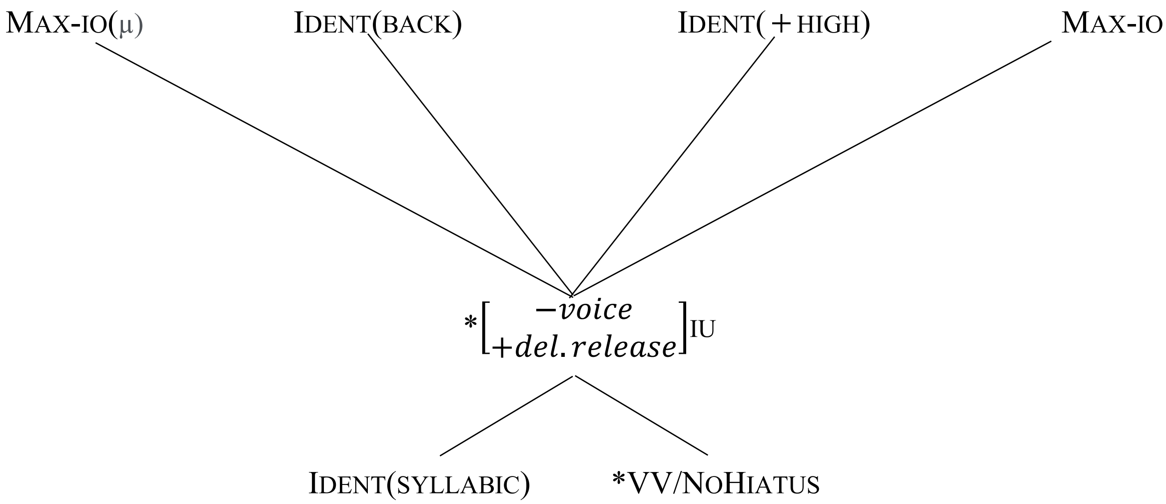

Fig 4. /(k,t)i + u/ glide formation constraint rankings

4.2 Glide formation in hiatus sequences where V_1 is [+BACK]

I propose a second glide-formation mechanism in Kikuyu that occurs when V_1 is a back vowel. Referring to the examples of glide formation in (21b) through (21h), we see this to be the case. However, now another element of arbitrariness is introduced, as there isn't a natural class that accurately captures the environments of (21b) and (21h). While it is true that V_1 are all back vowels, not *all* back vowels are present in that data. For example, when V_1 is /o/, glide formation (with the addition of those preceeding stops) is almost always licit, but not every possible combination when V_1 is /u/ or /ɔ/ is licit/attested for. In short, more data is needed. With that arbitrariness acknowledged, I introduce another markedness constraint constructed similarly to that of the previous one introduced in (23).

(25) $*\begin{bmatrix} -voice \\ +del.release \end{bmatrix} \begin{bmatrix} +syllabic \\ +back \\ -low \end{bmatrix} [+syllabic]$

Disallow sequences of voiceless stops follow by a hiatus sequence where V_1 is a non-low back vowel.

I suggest referring back to the data overview presented in Fig. 2 to get a sense of the natural class that I have chosen for this markedness constraint and its shortcomings, as it is an overgeneralization.

The mechanism for glide formation here is roughly the same as in §4.1; the markedness constraint in (25) dominates IDENT(SYLLABIC). However, a new crucial ordering also emerges here which would see an amendment to the ordering shown in Fig. 4. Referring again to the glide formation data in (21), it's clear that, after glide formation occurs, it is V_2 that is uniformly preserved. This suggests that there is a crucial ordering of IDENT(V_2) $>>$ IDENT(BACK), suggesting that both of these constraints sit on a separate plain from the universally high-ranking constraints such as MAX-IO(μ). Further, an IDENT(HIGH) constraint must be introduced (instead of IDENT(+HIGH) in this case) to capture why the combinations attested for in this section choose /w/ as the glide here (as V_1 in these examples are not high and therefore choose the appropriate non-high glide /w/); but there is no evidence that both of these ident constraints have a crucial ordering with respect to one another.

A full tableau showing this second glide-formation mechanism along with an updated ordering of some faithfulness constraints is found on the next page, after which we can continue onto an analysis of another resolution method.

/(k,t)o_1 + e_2/	MAX-IO(μ)	MAX-IO	IDENT(V_2)	IDENT(HIGH)	$*\begin{bmatrix}-voice\\+del.release\end{bmatrix}\begin{bmatrix}+syllabic\\+back\\-low\end{bmatrix}[+syllabic]$	IDENT(BACK)	IDENT(SYLLABIC)	*VV/NOHIATUS
o_1e_2					*!			*
☞ w_1ee_2						*	*	
w_1oo_2			*!				*	
y_1ee_2				*!		*	*	
y_1oo_2			*!				*	
ee_2		*!				*		
w_1e_2	*!							
e_2	*!	*				*		

Tableau 4: /o + e/ hiatus resolution via glide formation when preceeded by a voiceless stop

It should be noted that, even though the ordering of IDENT(BACK) does not matter with respect to IDENT(SYLLABIC) in Tableau 4, Tableau 3 shows that the former must rank above the latter. This then suggests the following markedness ranking:

(26) $$*\begin{bmatrix}-voice\\+del.release\end{bmatrix}\text{IU} \quad >> \quad *\begin{bmatrix}-voice\\+del.release\end{bmatrix}\begin{bmatrix}+syllabic\\+back\\-low\end{bmatrix}[+syllabic]$$

This is exactly what you would expect given our data and preliminary understanding that /i + u/ is more prone to resolve through glide formation than any other underlying sequence, and therefore more marked.

5 Vowel elision

Vowel elision is another hiatus resolution technique that Kikuyu employs, and rather straightforwardly. As a reminder, Casali's interpretation of vowel elision, along with examples showing the underlying forms that undergo vowel elision, are shown below.

(27)	Vowel Elision:	$CV_1 + V_2$	→	$.CV_1(ː).$ or $.CV_2(ː).$	
(28)	a. $a_1 + e_2 \rightarrow ɛɛ_2$	mɛ̀kààdá énà	→	mɛ̀kààdɛ́ɛ̀nà	*'four ropes'*
	b. $a_1 + ɛ_2 \rightarrow ɛɛ_2$	mèðɛ̀nyà ɛ́ˈnɔ́	→	mèðɛ́nyɛ̀ɛ̀nɔ́	*'these days'*
	c. $a_1 + ɔ_2 \rightarrow ɔɔ_2$	tààtà ɔ́nà	→	tààtɔ́ɔ́nà	*'Aunt, see!'*
	d. $a_1 + o_2 \rightarrow ɔɔ_2$	tààtà óyó	→	tààtɔ̀ɔ̀yó	*'this aunt'*

These cases suggest that it is marked in Kikuyu to raise from a low vowel to a mid vowel (notice that /a + i/ and /a + u/ do not feed vowel elision). The driving force behind the data in (28) can then be captured with the following markedness constraint.

(29) $*[+low]\begin{bmatrix}-high\\-low\end{bmatrix}$

Don't allow a sequence of a low vowel plus a mid vowel.

In conjunction with the ways we know Kikuyu to remain faithful to its underlying sequences of vowel hiatus, the following ranking, then, is what more fully captures the use of vowel elision as hiatus resolution in Kikuyu.

(30) $*[+low]\begin{bmatrix}-high\\-low\end{bmatrix} >>$ IDENT(LOW)

However, a paradox still remains, and that is the fact that vowel elision sees tense vowels becoming lax. You can resolve this here by introducing a markedness constraint that penalizes long, tense vowels; however, you would have to then rank this above IDENT(V_2) for the derivation to yield the correct surface form. Thus, a paradox exists, because that would suggest long, tense vowels cannot surface in examples such as /(k,t)o + e/, shown in Tableau 4.

Instead, I propose the following markedness constraint.

(31) $*[+low][+tense]$

This markedness constraint allows for a two-tiered approach to solving vowel elision. First, this constraint will allow sequences such as /a + e/ to "surface", intermediately, as [aɛ], which still feeds vowel elision by the constraint given in (30) and will then feed vowel elision. Tableaus showing the derivation of vowel elision is below (Tableau 5a will be truncated for expository purposes, showing the most faithful result driven by the constraint (31)).

/a_1 + e_2/	*[+*low*][+*tense*]	IDENT(V_2)
a_1e_2	*!	
☞ $a_1ɛ_2$		*

Tableau 5a: /a + e/ markedness yielding a lax V_2

feeds

/a_1 + $ɛ_2$/	MAX-IO(μ)	IDENT(V_2)	$*[+low]\begin{bmatrix}-high\\-low\end{bmatrix}$	IDENT(SYLLABIC)	MAX-IO	IDENT(LOW)	*VV/NOHIATUS
$a_1ɛ_2$			*!				*
☞ $ɛɛ_2$					*	*	
aa_1		*!			*		
$w_1ɛɛ_2$				*!		*	

Tableau 5b: vowel elision as hiatus resolution

Constraint rankings in Tableau 5b are based off previous rankings, with one exception. Our faithfulness rankings update again, with the crucial ordering of IDENT(SYLLABIC) > > MAX-IO. This comes at no cost to past derivations.

The analysis given here involving an intermediate stage is, while attested for in OT, not an incredibly sound analysis, in my opinion. Usually, it is opacity that requires the use of strata; however, in this case, it is a feeding relationship that requires an intermediate form to act as a marked input that feeds vowel elision. The facts of this feeding relationship, however, do seem to plausibly account for the data. It just manifests itself in OT in a way that I think requires a second look.

6 Heterosyllabification

Heterosyllabification, i.e. the ability for underlying hiatus sequences to surface as hiatus sequences, is the most common form of "resolution" in Kikuyu. As a reminder, Casali's heterosyllabification structure is as follows.

(32) Heterosyllabification: $CV_1 + V_2 \rightarrow .CV_1.V_2.$

Continuing, there are two "types" of heterosyllabifaction: faithful heterosyllabification, and unfaithful heterosyllabification, both of which we will handle in this section. The following is an example of one of many faithful hiatus sequences that surfaces through hetero-syllabification, taken from (4).

(33) $i_1 + e_2 \rightarrow i_1e_2$ kàɣɔ̀ʃí étèkà → kàɣɔ̀ʃíétèkà *'Kagoci, answer!'*

It is fairly easy to account for faithful heterosyllabification given what we know thus far. The sequences that surface as hiatus, faithful to their input, make up a majority of the 49 possible sequences this paper accounts for. What is occuring here is that none of these faithful sequences are marked; that is to say, there are no markedness constraints that drive any changes. Coupled with the fact that NoHiatus/*VV is ranked quite low in Kikuyu, all other faithfulness constraints that we've introduced thus far would rule out any other candidate besides the faithful one in these non-marked underlying sequences.

However, there is still the puzzle of unfaithful heterosyllabification, in which case forms are marked but do not feed mechanisms that disallow hiatus to surface. The following sequences fit this description:

(34)	a. $ɔ_1 + e_2 \rightarrow o_1ɛ_2$	mèrɔ̀ɔ̀gɔ̀ ètàtó → mèrɔ̀ɔ̀gòètàtó	*'thirty'*
	b. a + u → ɔi	tààtà úgà → tààtɔ̀ígà	*'Aunt, say something!'*
	c. ɛ + o → eo	ɔ̀ʃɔ̀ɔ̀kɛ̀ ótòɛ̀jɛ̀ → ɔ̀ʃɔ́ɔ́kèòtòɛ̀jɛ̀	*'then shave us'*
	d. ɛ + a → ea	dɔ̀ɔ̀nìrɛ́ áðùùrì → dɔ̀ɔ̀nìréáðúúrì	*'I saw the seniors'*
	e. e + u → iu	gèʃóhè úgà → gèʃóhìúgà	*'Gĩcũhĩ, say something!'*
	f. ɛ + ɔ → eɔ	kàmààdɛ́ ɔ́nà → kàmààdéɔ́nà	*'Kamande, see!'*

This data is quite puzzling and is where my analysis requires somewhat arbitrary markedness constraints. For example, my analysis of (34e) is merely that a markedness constraint, $*\begin{bmatrix}-high\\+tense\\-back\end{bmatrix}\begin{bmatrix}+tense\\+back\end{bmatrix}$, when dominated by IDENT(+HIGH) and dominates IDENT(V_1), yields the surface form [iu]. This can be seen in tableau 6 below.

$/e_1 + u_2/$	MAX-IO(μ)	IDENT(BACK)	IDENT(+HIGH)	MAX-IO	$*\begin{bmatrix}-high\\+tense\\-back\end{bmatrix}\begin{bmatrix}+tense\\+back\end{bmatrix}$	IDENT(V_1)	*VV/NOHIATUS
e_1u_2					*!		*
☞ i_1u_2						*	*
ee_1		*!	*	*		*	
uu_2				*!			
u_1u_2		*!				*	
$εε_1$		*!	*	*		*	
e_1	*!	*		*		*	

Tableau 6: Heterosyllabification of /e + u/

In tableau 6, the marked form /e + u/, in conjunction with Kikuyu's preference for high vowels and somewhat expendable V_1 (as opposed to V_2), makes the heterosyllabic [i.u] the favorable output (which of course is itself resolved with glide formation depending on the preceeding consonant; see tableau 3).

The following three sequences seen in (34) are also generalizable with a single markedness constraint. That data, repeated in (35), is represented by the constraint (36).

(35) a. $ε_1 + o_2 \rightarrow e_1o_2$
b. ε + a → ea
c. ε + ɔ → eɔ

(36) $*[+tense]\begin{bmatrix}-high\\-front\end{bmatrix}$

All else remaining faithful, the crucial ordering of $*[+tense]\begin{bmatrix}-high\\-front\end{bmatrix}$ >> IDENT(TENSE), where the latter is ranked relatively low, like IDENT(V_1) in tableau 6, allows for the observed outputs to surface.

The remaining two datum, (34a) and (34b) can be solved with a similar technique of using somewhat arbitrary marked forms (i.e. *ƆE and *AU) which then dominate the relative contrastive faithfulness constraints that yield the outputs. However, the arbitrariness of this analysis makes it less central to the overall puzzle of Kikuyu vowel hiatus resolution.

7 Conclusion

7.1 Faithfulness revisted

Over the course of this paper, there has been an evolution of the crucial orderings of faithfulness as they reveal themselves through our exploration of Kikuyu vowel hiatus resolution. Kikuyu values multiple facets of faithfulness—for example, mora preservation, retaining the quality of high vowels, the identity of V_2 in underlying /$V_1 + V_2$/ hiatus sequences, etcetera. The following diagram represents the final ranking of the most crucial ways in which surfacing Kikuyu hiatus sequences, post-resolution, stay faithful to their underlying forms. It also shows the NoHiatus markedness constraint as a reference.

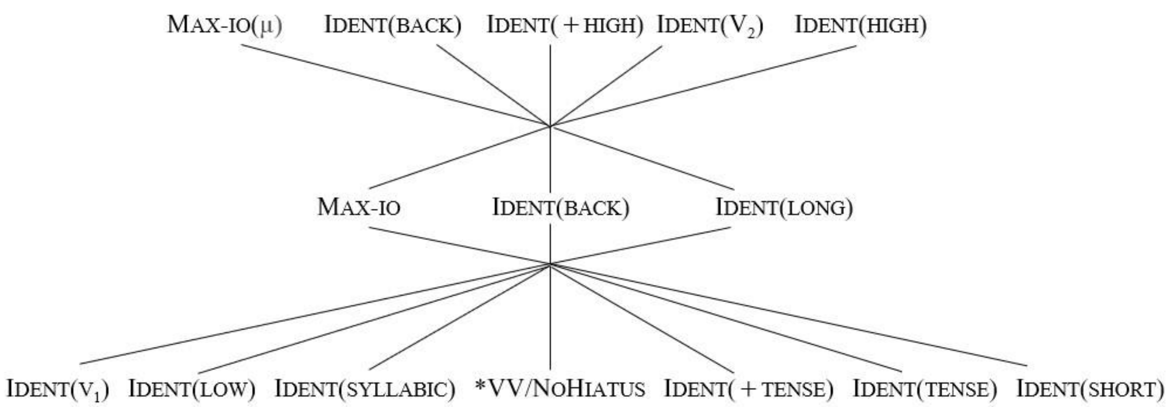

Fig 5: Faithfulness in Kikuyu hiatus resolution

7.2 Diphthongs

There is one more hiatus resolution technique that I hypothesize that Kikuyu employs but I have not yet analyzed—diphthong formation. There are certain surface forms that appear as diphthongs, or at least have potential to surface as diphthongs. Two of these examples are below, with the latter representing a more clear-cut diphthong.

(37)	a. $a_1 + u_2 \rightarrow$? ɔ$i_{1,2}$	bùrá úrà → bùrɔ́ìrà	*'rain, come down!'*
	b. ɛ$_1 + u_2 \rightarrow e_1$ɔi_2	jɔ̀rɔ̀gɛ́ úgà → jɔ̀rɔ̀géɔ́ìgà	*'Njoroge, say something!'*

Peterson's (2018) dissertation discusses the differences between a diphthong and a heterosyllabic hiatus sequence, saying, "the main difference between a diphthong and hiatus is that hiatus is a sequence of two phonemes in separate syllables, while a diphthong consists of two targets in a single monophonemic syllable" (pp. 44). However, Peterson notes that this distinction itself, one which I hypothesize as the case for the data in (37), is *not* a diagnostic for hiatus vs. diphthong formation. Instead, an acoustic study should be conducted looking for differences in duration and F2 trajectory. The duration of hiatus, for example, has been attested to be longer than the duration of diphthongs. Peterson's diagnostics are absolutely a possible point of further study.

Further, Peterson's dissertation has interesting implications for the phonological structure of Kikuyu as a whole. Almost central to the hiatus resolution techniques observed is Kikuyu's compensatory lengthening in order to preserve moraicity, using the broadly accepted distinction between short vowels (which bear 1 mora) versus long vowels (which bear 2 mora) (Hayes et. al 2008). Peterson (2018) highlights that, in a similar vein, some languages have contrastive diphthong length—short diphthongs and long diphthongs—which similarly bear 1 and 2 mora, respectively. What I propose as the second syllable in (37b), *ɔi*, is likely to be a 1-mora (short) diphthong, based off of personal observation of the extreme quickness in which the segment is pronounced, as well as considering mora preservation (i.e. MAX-IO(μ)) is ranked so highly in Kikuyu. If (37a) also turns out to be a diphthong, then we have an extremely unique three-way distinction between hiatus, short diphthongs, and long diphthongs in Kikuyu. An acoustic study in Peterson's (2018) framework for diagnosing diphthongs is a logical next step.

7.3 Shortcomings and directions of future study

Beyond studying diphthongs in Kikuyu, there are numerous directions of future study on Kikuyu vowel hiatus. As mentioned previously, there are technically 14 phonemic vowels in Kikuyu, given that each vowel contrasts with its long counterpart. While this paper attested for 49 potential combinations of /short vowel + short vowel/ hiatus sequences, there are 196 possible underlying hiatus sequences in Kikuyu. An empirical study of these combinations involving long vowels is underway with Professor Mary Paster and language consultant Kimani Mbũgua; many of these remaining possible sequences have not been attested for in the literature, and preliminarily seem to display unique characteristics. Syntactic environment, for example, seems to play a large role that was absent in this paper.

And finally, the many shortcomings of this paper have been discussed along the way. There are concerns with arbitrary markedness constraints that sometimes employ over-generalized natural classes to shoehorn my analysis. With glide formation, there is some preliminary evidence of the need for a gradient study of what preceeding consonants license glide formation; controlling for speech rate/register and broader phonological contexts could solve the complete puzzle of glide formation as hiatus resolution.

This paper has also some data that is completely unattested for. For example, while minimal, there are instances where syntactic environment affects resolution. Note the difference in (38) when the same sequence is underlyingly within a word versus across a word boundary (this data is replicable).

(38)	a. o + u → ou	wàjìkó úɣà→wàjíkóúgà	*'Wanjikũ, say something!'*
	b. o + u → uu	/to-ug-ir-ɛ/→tùùgírɛ́	*'we said (today)'*

In summation, there are seemingly endless future directions of study on this topic, which is beautifully rich and complex. This paper addressed resolution techniques found in underlying sequences of short vowel hiatus; namely, heterosyllabification, vowel elision, glide formation, and possibly diphthong formation. An OT analysis was conducted to analyze the idiosyncracies of Kikuyu phonology and markedness that yields wildly diverse surface forms, as well as the ways in which the ways these surface forms tend to stay faithful to their underlying sequences of vowel hiatus.

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