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An Optimality Theoretic Analysis of the Mid Tone in Ịṣẹ́kírì

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Abstract: The asymmetric behaviour of the mid tone has been reported in the Yoruboid literature and previous accounts of tone behaviour in Ịṣẹ́kírì suggest that a low tone is always deleted in favour of others at word boundary. However, synchronic data have shown that this is not the case. This paper investigates tonal asymmetry and the non-participation of the mid tone in some phonological processes in Ịṣẹ́kírì. The study adopts an Optimality Theory (OT) version that incorporates the grounding conditions to develop constraints of implicational statements into faithfulness constraints. Data are elicited from eight speakers of the language, recordings are with the aid of a digital audio device and the tool used for our acoustic measurement is Praat 6.0.30. The analysis reveals that tonal asymmetry in this language always deletes the Mid-tone at word boundary and not the Low tone, also noting that the Low tone may be deleted in some cases. The lack of participation of the M tone in some phonological processes such as vowel elision, glide formation and vowel assimilation reveals the unstable nature of this tone in Ịṣẹ́kírì. This paper concludes that the M tone is in asymmetry to the H and L tones in Ịṣẹ́kírì and demonstrates the need for more perceptual and acoustic studies of tonal behaviour in Ịṣẹ́kírì.

Keywords: tone, asymmetry, vowel elision, vowel assimilation, tone behaviour

1. Introduction

Ịṣẹ́kírì is a Yoruboid language, a member of the Benue-Congo family (Williamson, 1989), spoken in Warri and Sapele areas of Delta State, Nigeria (Lloyd, 1957:172; Sagey, 1981:10; Eyeoyibo, 2008:1; Ogharaerumi, 2010:1). The language is an example of a tone language (Yip, 2002:1; Yul-Ifode, 2008). Omamor (1979:26) claims in Ịṣẹ́kírì that "in any sequence of vowels involving two different tones, the lower tone usually gets elided… [which]

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means that L is always elided no matter what it combines with." Contrarily, synchronic Iṣẹ́kírì data suggest otherwise and this paper examines this phenomenon in the language within the Optimality Theory (OT).

Omamor (1979), Otokunefor (2002), Samuel (2011), Ijama (2014), Inoniyegha (2014), and Osewa (2016) examine the aspects of Iṣẹ́kírì phonology and establish its sound inventory and processes. On the prosodic level, Omamor (1979) and Osewa (2016) identify three level tones, H, M and L. They also identify the LL, MM and MH patterns for disyllabic nouns and H, M and L for monosyllabic verbs. Omamor (1979) notes that the L is the most unstable tone and usually deleted when in contact with the H or M. This L tone deletion claim contradicts the behaviour of Iṣẹ́kírì tones, as revealed in this study.

1.1 Literature review

Different accounts exist on tonal asymmetry: Contrastive Specification (Steriade, 1987; Mester & Itô, 1989), Underspecification (Akinlabi, 1985; Pulleyblank, 1986; Odden, 1995; Meyers, 1998), Tone Fusion Analysis (Turner, 2006), and Markedness as Faithfulness Encoding (Pulleyblank, 2004).

In Contrastive Specification (henceforth, CS), contrastive properties must be specified underlyingly (Peng, 2013). Tone asymmetry is thus the result of phonological rules and not of representation. Hence, all features are present underlyingly. Therefore, the representation of the lexical tones in a language like Iṣẹ́kírì with three contrastive tones will be:

Figure 1. A phonological representation of tones in contrastive specification

A CS account of tonal asymmetry will take the form below.

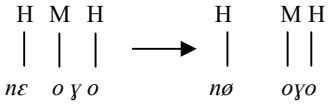

Figure 2. An illustration of the input and output to vowel elision in *nɛ́ ōɣó* 'to have money'

The floating H is linked to the next TBU after the vowel /ɛ/ is deleted, as in Figure 3.

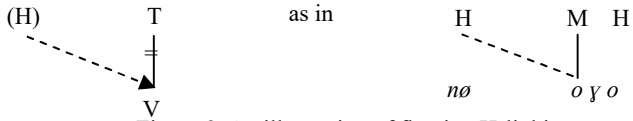

Figure 3. An illustration of floating H-linking

Figure 3 shows the surface deletion of M but not why M is asymmetric to the others.

In Underspecification, not all contrastive properties are specified underlyingly. Thus, tone asymmetry is a product of phonological representation as shown in Figure 4 below.

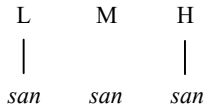

Figure 4. A phonological representation of tone in the underspecification account

This account sees the retention of H and L tones over the M as the specification of the H and L against the non-specification of the M. In a three-tone language, M will be deleted in the neutralization of tonal contrasts (Odden, 1995), therefore M lacks tonal specification in such a tone system. The Underspecification theory appears to be more attractive in accounting for tone asymmetry because it specifies the reason for deleting the M tone.

Tone Fusion Analysis questions the delinking of the L, citing cases of vowel elision where both the H and L are delinked from the hiatus vowel. Akinlabi (1985) offered that L spreads unto a following mora and no longer needs its original mora as host. However, the spread of L onto a following H does not usually require it to be delinked as the spread applies across board. In the Tone Fusion Analysis, Turner (2006) argues that two tones are underlyingly associated with two vowels but compete for one vowel on the surface. Snider's 4-tier geometry is used in tone fusion. The register and tonal tier contain features which specify the quality of a tone. "h" is a higher register than the previous one while "H" is a lower register. The tonal tier defines the pitch of a tone relative to its register. Thus, in vowel elision, the root nodes of the two tones on both vowels are fused, resulting in a mid tone. This is illustrated by Turner (2006) as shown in the figure below where a higher register tone "h" and a lower tone "H" (which may be a low tone or a mid as in the case of the phenomenon under investigation) are fused into one on the "Tonal Root Node Tier". The result of the fusion, which is usually an M in the case of Isẹkiri, is the tone borne by the TBU "μ" in the final utterance.

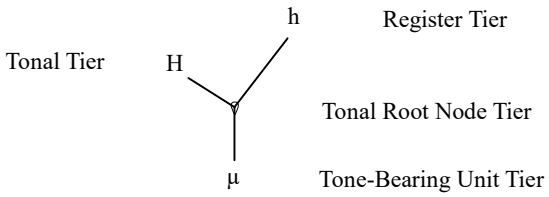

Figure 5. Features of tone in tone fusion analysis

In Markedness as Faithfulness Encoding, tonal markedness is directly encoded into faithfulness constraints, thus M is present but unmarked. A markedness constraint such as *H is incorporated into a featural MAX constraint MAX (T) to give MAX [H]. Thus for Isẹkírì, the encoded markedness is scaled into the faithfulness constraints with the hierarchy MAX [H] >>MAX [L] >>MAX [M] to account for the stability of the low tone in vowel elision in the verb noun construction *jẹ ọ̀jẹ̀ /dʒɛ̄ ɔ̀dʒɛ́/*, as shown below.

Table 1. Constraint table for /*dʒɛ̄ ɔ̀dʒɛ̀*/ 'eat food'

/*dʒɛ̄ ɔ̀dʒɛ̀*/	MAX [H]	MAX [L]	MAX [M]
a. [*dʒɔ̄dʒɛ̀*]		*!	
☞b. [*dʒɔ̀dʒɛ̀*]			*

Two challenges confront this analysis: (1) L is not deleted when in contact with H but both result in a rising contour. Thus, the ranking of MAX [H] over MAX [L] is unaccounted for, and (2) the frequency effects that prefer H over L, and L over M are unpredictable.

1.2 Methodology

Data were drawn from two speakers of Iṣẹ́kírì in a preliminary experiment. 20 lexical items (10 from Omamor, 1976:39, 1979:193, 1982:105-106 and 10 from Osewa, 2016) with the H, M and L tones, and collocating in V-V sequences with H#M, H#L, M#L, L#M and M#M tones, and as well combined into phrases resulting in vowel elision were produced by each speaker before identifying the tones in the individual words and phrases after elision. The results provided the motivation for the present study. The data for this study were elicited from 8 respondents. Phrases with different tonal patterns in different contexts were put together to show different tonal behaviors. The study derives acoustic measurements with Praat 6.0.30 and adopts the Optimality Theory (OT) of Prince and Smolensky (1993). In OT, Universal Grammar (UG) has violable constraints in two sets – Faithfulness and Markedness (McCarthy & Prince, 1993; McCarthy, 2007:265-266) – from which individual grammars are constructed with differently ranked constraints. OT has three components – GEN (the candidate generator), CON (the constraints), and EVAL (the evaluator). Generally, an input receives a set of candidates which are evaluated against the constraint hierarchy (Dekkers, Leeuw & Weijer, 2000:2). The form that least violates higher–ranked constraints is optimal. Evaluation is shown on a table. Our constraints are drawn from the Iṣẹ́kírì tonal phenomena. The H is least marked in all alternations, most stable in vowel elision, and its feature is the least malleable. The M is the most unstable. In vowel contact position, M is deleted and not the H or L. MAX constraints account for these tonal descriptions in line with Pulleyblank (2004) and Peng (2013). Our analysis differs from Pulleyblank (2004) in that markedness constraints are not incorporated into faithfulness in this study. Rather, the markedness constraints are required for an exhaustive analysis. Peng (2013) proposed MAX and others that are different from those here. Our analysis differs in that MAX [H] ranks higher than MAX [L] because in H-L tonal sequences, the L is deleted, whereas both are ranked equally in Peng (2013). The following constraints are relevant to our analysis.

(1) MAX-IO (T) constraints:

a. MAX[H]: A high tone in the input has an output correspondent.

b. MAX[M]: A mid tone in the input has an output correspondent.

c. MAX[L]: A low tone in the input has an output correspondent.

(2) *MULTIPLE (T): No more than one tone is associated to each TBU (Peng, 2013).

The tonal outcome after vowel elision is expressed as negative implicational statements as in "if a, then not b" (Heiberg, 1999). These constraints are based on the possible tonal sequences after vowel elision. The constraints formed thereby are stated below.

(3) Implicational constraints

(i) If H then not M:

a. *H↔M: A high tone- mid tone sequence is prohibited.

b. *M↔H: A mid tone- high tone sequence is not allowed.

c. *L↔H: A low tone- high tone sequence is not permitted.

(ii) If L then not M:

d. *M↔L: A mid tone- low tone sequence is not allowed.

A ranking of all the tonal constraints is given below:

MAX[H]>> *H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>>*MULTIPLE>>MAX[M]

Since the concern of this study is on the tonal outcome of phonological alternations, tonal candidates are analyzed. Although tone alternation occurs in many phonological processes in tone languages (Yul-Ifode, 2007:144), vowel elision serves as a fruitful domain for analyzing Ịṣẹ́kírì tone behavior.

2. Vowel elision and the morphotonology of Ịṣẹ́kírì

One common strategy of vowel hiatus resolution in many languages is vowel elision (Orie & Pulleyblank, 2002:101). It involves the deletion of one of two vowels in a sequence as a result of the concatenation of morphemes across boundaries. Vowel elision (VE) as a phonological operation has received a lot of attention in the literature, however an identification of which of the vowel in a V + V sequence gets deleted and an adequate explanation for the selection of the vowel to be deleted is still a matter of interest. Also, there are a number of analytical challenges with VE but the interest of this paper as regards vowel elision is in the resultant tonal alternation. Data on vowel sequences with the H # LL, H # MM, H # MH, M # LL, M # MM and M # MH tone pattern for monosyllabic and disyllabic combinations and MH # LL, MH # MM, MH # MH, MM # LL, MM # MM and MM # MH tone pattern for disyllabic and disyllabic sequences will be used to illustrate vowel elision in Ịṣẹ́kírì. The L # MM, L # MH, LL # MM, and LL # MH patterns are exempted because of low toned monosyllabic verbs followed by a complement present tonal outlay that is incongruous with the observed tone behaviour in other tonal inputs.

These patterns represent all the possible tonal combinations of verb + noun and noun + noun structures in Iṣẹ́kírì bearing in mind that while the vowel of the verb which is V_1 can bear any of the H, M or L tone, the tone on V_2 which is the initial syllable of the noun structure can only bear the M or L tone following the tonotactic restrictions in the language.

A schema of the tonal inputs relevant to the examination of tonal alternation in vowel elision and their outputs is presented in Table 2 and illustrated in examples (4)-(14).

Table 2. Tonal input and output

Input		Output
a) Monosyllabic (Verb) + disyllabic (Noun)		
H	LL	HL
H	MM	HM
H	MH	HH
M	LL	LL
M	MM	MM
M	MH	MH
b) Disyllabic (Noun) + disyllabic (Noun)		
MH	LL	MHL
MH	MM	MHM
MH	MH	MHH
MM	LL	MLL
MM	MH	MMH

(4)	H	LL	HL
a.	*g͡bá*	*àlɛ̀*	*g͡bálɛ̀*
	sweep	ground	to sweep
b.	*dʒɛ́*	*ɛ̀bɛ̀*	*dʒɛ́bɛ̀*
	agree	beg	acceptance of begging
c.	*né*	*ɔ̀jɔ̀*	*nɔ́jɔ̀*
	have	joy	to have joy
d.	*né*	*òwṵ̀*	*nówṵ̀*
	have	voice	to have a voice
e.	*wó*	*ùɣà*	*wúɣà*
	destroy	compound	to destroy acompound

Example (4) shows the H and L tones of two vowels in contact at the word boundary. The H-L vowel sequences in the example show that V_1 is deleted but the H tone on the deleted vowel is preserved due to tone stability. The H tone re-associates to the TBU on its

right, while the L tone of V_2 is deleted, changing the tonal pattern from H LL tonal input to HL output.

(5)	H	M M	HM
a.	*lá*	*ēk͡pō*	*lék͡pō*
	lick	oil	to lick oil
b.	*ʃɛ́*	*ēgī̃*	*ʃégī̃*
	split	wood	break wood
c.	*g͡bé*	*ūlɔ̄*	*g͡búlɔ̄*
	carry	grinding stone	to carry a grinding stone
d.	*wɔ́*	*ɔ̄mā*	*wɔ́mā*
	hit	child	hit a child
e.	*sɛ́*	*āʃɔ̄*	*sáʃɔ̄*
	sew	cloth	sew cloth

In example (5), two vowels bearing the H and M tones abut at the word boundary and vowel elision is applied on V_1 in (a) and (b) and on V_2 in (c), (d) and (e). The H tone is preserved irrespective of the vowel that is deleted while the M tone is deleted. The M tone is lost and the H MM tonal input becomes an HM output.

(6)	H	M H	HH
a.	*nɛ́*	*ōɣó*	*nóɣó*
	have	money	to have money
b.	*lá*	*ōwó*	*lówó*
	lick	soup	to lick owo soup
c.	*g͡bɛ́*	*ēré*	*g͡bɛ́ré*
	tear	mat	to tear a mat
d.	*dɛ́*	*īk͡pá*	*díḱpá*
	fry	prawn	to fry prawn
e.	*nɛ́*	*ɔ̄sá*	*nɔ́sá*
	have	father	to have a father

The examples in (6) show a similar process of the deletion of the M tone in preference of the H tone when vowel elision occurs. In this example, the tonal input is the H MH tonal pattern which results in the HH tonal pattern after elision.

(7)	M	LL	LL
a.	*dʒɛ̄*	*ɔ̀dʒɛ̀*	*dʒɔ̀dʒɛ̀*
	eat	food	to eat food
b.	*k͡pā*	*ɔ̀lɔ̀lɔ̀*	*k͡pɔ̀lɔ̀lɔ̀*
	kill	bottle	to break bottle

c.	*bɛ̄*	*ɔ̀sà*	*bɔ̀sà*
	peel	orange	to peel orange
d.	*rɛ̄*	*èwò*	*rèwò*
	wet	clay pot	to treat a clay pot
e.	*rɔ̄*	*ìbù*	*rìbù*
	pour	sand	to pour sand

Vowel hiatus is resolved in example (7) through the deletion of V_1. Here, the M tone is in contact with the L tone, and the M tone is deleted revealing the asymmetric behaviour of the M tone in Iṣẹ̀kìrí.

(8)	M	MM	MM
a.	*rɔ̄*	*ōmī*	*rōmī*
	pour	water	to pour water
b.	*jā*	*īrɔ̄̃*	*jīrɔ̄̃*
	comb	hair	comb hair
c.	*ʃɛ̃*	*ūrũ̄*	*ʃūrũ̄*
	do	something	to do something
d.	*k͡pā*	*ɔ̄mā*	*k͡pɔ̄̃mā*
	beat	child	to beat a child
e.	*bã̄*	*īrɔ̄̃*	*bĩ̄rɔ̄̃*
	plait	hair	plait hair

The M MM tonal formation becomes an MM tonal output. This example illustrates the possible tonal pattern that the language attests. The MM tonal output is predictable given the fact that no other tone is contending with the M tone.

(9)	M	MH	MH
a.	*jā*	*ējí*	*jējí*
	write	this	write this
b.	*k͡pā*	*ārɔ́*	*k͡pārɔ́*
	kill	story	tell a story
c.	*jɔ̄*	*īká*	*jīká*
	pull	feather	remove feather
e.	*sɔ̄*	*akṹ*	*sɔ̄kṹ*
	throw	cry	to cry
e.	*jɔ̄*	*ēdʒū*	*jēdʒú*
	pull	face	to show up briefly

In example (9), like the observation in (8), the two vowels in contact have the M tone and thus have predictable outcome of surface M tones. In this instance, the M MH tonal input derives MH output after deletion.

(10)	MH	LL	MHL
a.	*ɔ̄k͡pá*	*ɔ̀kɔ̀̃*	*ɔ̄k͡pɔ́kɔ̀̃*
	walking stick	one	one walking stick
b.	*ūʃɛ́*	*èʃù*	*ūʃɛ́ʃù*
	work	devil	devil's work
c.	*ōɣó*	*ɛ̀̀jì̃*	*ōɣɛ́jì̃*
	money	back	secret money
d.	*ōɣó*	*àdʒà*	*ōɣádʒà*
	money	town	community fund
e.	*ūdʒó*	*èkù̃*	*ūdʒwɛ́kù̃*
	dance	door	dance of the shrine

The data in (10) have the H and L tones coming in contact at word boundary positions. V_1 is deleted in (a), (b), and (e) while V_2 is deleted in (c) and (d). In all instances, the L tone is deleted while the H tone is retained.

(11)	MH	MM	MHM
a.	*ɔ̄sɔ́*	*ērɛ̃́*	*ɔ̄sɛ́́rɛ̃́*
	flesh	meat/animal	beef
b.	*ōɣó*	*ēnē*	*ōɣénē*
	money	we	our money
c.	*ūk͡pá*	*ārṹ*	*ūk͡párṹ*
	covering	mouth	lips
d.	*ūkó*	*āɣɛ̃́*	*ūkáɣɛ̃́*
	cup	their	their cup
e.	*īnɔ́*	*ēdʒā*	*īnédʒā*
	stomach	fish	the stomach of a fish

The V + V sequences in example (11) have the H and M tones abutting at the word boundary. The first of the two vowels in contact bearing the H tone is deleted in all instances. However, the H tones on the deleted vowels are preserved in all cases while the M tone on the second in the contact is lost. The MH MM tonal formation therefore becomes the MHM pattern after deletion.

(12)	MH	MH	MHH
a.	*ūʃɛ́*	*īwé*	*ūʃíwé*
	work	book	book work
b.	*ūʃɛ́*	*ōɣó*	*ūʃóɣó*
	work	money	profitable labour
c.	*ɔ̄dɔ́*	*ɔ̄rú*	*ɔ̄dɔ́́rú*
	year	hundred	hundred years

d.	*īwé*	*ɛ̄kɔ́*	*īwɛ́kɔ́*
	book	lesson	textbook
e.	*ūʃɛ́*	*ɛ̄wɔ́*	*ūʃɛ́wɔ́*
	work	hand	handwork

As in example (11), the H tone occurring with the M tone is retained in the examples presented in (12) thus resulting in MHH tonal output.

(13)	MM	LL	MLL
a.	*ɔ̄nɛ̄*	*ìrɛ̀*	*ɔ̄nìrɛ̀*
	person	wisdom	a wise person
b.	*āʃɔ̄*	*ɔ̀kà*	*āʃɔ̀kà*
	cloth	one	one cloth
c.	*ɔ̄mā*	*ɛ̀dɔ̀*	*ɔ̄mɛ̀dɔ̀*
	child	heart	house help
d.	*ārɔ̄*	*ɔ̀kà*	*ārɔ̀kà*
	cripple	one	one cripple
e.	*āgā*	*ɔ̀kà*	*āgɔ̀kà*
	chair	one	one chair

The M tone in example (13) is deleted in favour of the L tone. This attests to the malleable nature of the M tone. V1 is deleted in (a), (b), (c), (d), and (e) and the M tone on the deleted vowel is also lost in all cases.

(14)	MM	MH	MMH
a.	*āʃɔ̄*	*ūʃɛ́*	*āʃūʃɛ́*
	cloth	work	work clothes
b.	*ɛ̄ɣɛ̃̄*	*īdé*	*ɛ̄ɣɛ̃̄dé*
	egg	crayfish	egg of crayfish
c.	*ɛ̄tū*	*ɔ̄rú*	*ɛ̄twɔ̄rú*
	antelope	hundred	one hundred antelopes
d.	*ɛ̄rɛ̄*	*ūʃɛ́*	*ɛ̄rūʃɛ́*
	effort	work	well done
e.	*ɔ̄bɛ̄*	*ōgṹ*	*ɔ̄bōgṹ*
	knife	twenty	twenty knives

The MM tonal output in these examples is predictable as earlier noted in examples (8) and (9). This is because no other tone is in contact with the M tone. The MM MH tonal input, therefore gives us the MMH output.

The examples in (4)-(14) illustrate tone behaviours in vowel contact situations. In examples (4) and (10), the H and L tones of the vowels at word boundary positions concatenate. The H-L vowel sequences in these examples show that V_1 is deleted and the H

tone of the deleted vowel is retained owing to tone stability. The H tone re-associates to the TBU on its right, while the L tone of V_2 is deleted changing the tonal pattern from H LL tonal input to HL output in (4) and MH LL tonal input to MHL tonal output in (10). In Yoruba, it has been held that the L tone delinked by the H tone is not deleted but rather re-attaches to the H tone on its right to derive a rising tone. Evidence of this is provided in sequences where H + L H → H L H (Akinlabi, 1985).

(15) a. *wa* (H) + *ẹkọ* (LH) → *wẹ́kọ* (H L H)
look (for) education look for education
b. *mu* (H) + *iwe* (L H) → *muwe* (H L H)
take book take a book

Iṣẹ́kírì data account for the deletion of the L tone as a re-attachment of a delinked L tone cannot be affirmed because the H #LH formation across the word boundary is absent.

In examples (5), (6), (7), (11), (12), (13) and (14), the M tone is deleted in vowel contact with both the H and L tones. This is contrary to what is reported in Omamor (1979) for Iṣẹ́kírì where the L tone is said to be deleted. Instrumental evidence points to the fact that in M # LL tonal combination where vowels abut, the mid-tone is deleted. Figure 6 illustrates this for the Iṣẹ́kírì phrase *jẹ ọ̀jẹ̀* which becomes *jọ̀jẹ̀* 'eat food' after the elision process.

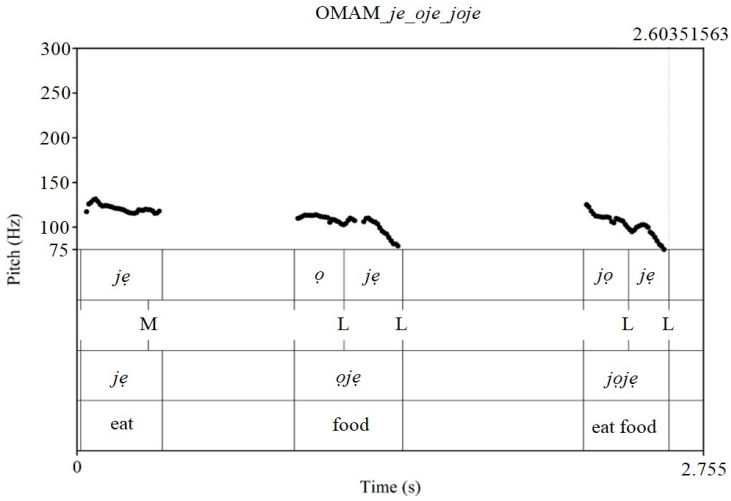

Figure 6. Pitch tracks of *jẹ*, *ọ̀jẹ̀* and *jọ̀jẹ̀*

Perceptually and acoustically, the tone on *jọ* (which is the resultant syllable after vowel elision) is a low tone. A comparison of the F_0 values of the M tone on *jẹ* and the resultant syllable *jọ* after the deletion of the vowel *ẹ* shows that the tone on *jọ* is a low tone. These values are presented in Table 3.

Table 3. F_0 values for *jẹ* 'eat', *ọ̀jẹ̀* 'food' and *jọ̀jẹ̀* 'eat food' for the speaker OMAM

Syllable	F_0 (mean values in Hz)	F_0 (absolute values in Hz)
Jẹ	120.88	124.07
Ọ	110.19	102.48
Jẹ	93.08	79.11
Jọ	111.05	99.44
Jẹ	93.29	75.22

The M tone is thus the tone deleted in vowel contact situations with the H or L tone. Tonal alternations that result from vowel contact in Iṣẹ́kírì reveal that the mid tone is most likely to lose out when in contact with the high or low tone. While this asymmetric behaviour of the mid tone has been confirmed in Iṣẹ́kírì in this study and in the Yoruba literature, there remains the issue of analysis. Efforts of analyzing the asymmetric behaviour of tones have been varied and these include accounts in terms of underspecification (Akinlabi, 1985; Pulleyblank, 1986; Odden, 1995; Meyers, 1998), analysis based on the incorporation of tonal markedness into the formulation of faithfulness constraints Pulleyblank (2004), and the fusion analysis Turner (2006). These earlier attempts at analyzing the asymmetric behaviour of tones have engendered disagreements with regard to the underlying status of the M tone described in Akinlabi (2000:8) as "… the modal tone, which represents the absence of L or H". This study suggests that the mid tone is not underlyingly inert. Although it is the most malleable of the three tones (High, Mid and Low tones), it is underlyingly extant. Its malleable nature can be accounted for through its position in a ranking hierarchy.

3. OT analysis

3.1 Evaluation of candidates

Any OT analysis must identify the candidate set to be evaluated from the GEN component, select the constraints for evaluation and most importantly determine the constraint ranking. These aspects are discussed in this section. An OT analysis of tone asymmetry in Iṣẹ́kírì is given in Tables 4-12.

3.1.1 Emergence of *g͡bálɛ̀* 'to sweep'

Table 4. Input /*g͡bá àlɛ̀*/ → Output [*g͡bálɛ̀*]

/*g͡bá àlɛ̀*/	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
a. [*g͡bàlɛ̀*]	*!							*
☞b. [*g͡bálɛ̀*]						*		*
c. [*g͡bálɛ*]		*!				*		
d. [*g͡bá̰lɛ́*]				*!			*	

Table 4. (Continued)

/g͡bá àlè/	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
e. [g͡bālé]	*!		*!			*		
f. [g͡bálé]	*!			*!			*	*
g. [g͡bàlé]	*!			*!				*

Constraint ranking: MAX[H]>>*H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>>*MULTIPLE>>MAX[M]

Eight constraints are involved in the ranking for our analysis of tone asymmetry in Iṣẹkírì and they are MAX[H]>>*H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>> *MULTIPLE>>MAX[M]. MAX[H] is the topmost ranked constraint and it dominates the other constraints. There are seven output candidates for the input /g͡bá àlè/, a. [g͡bàlè], b. [g͡bálè], c. [g͡bálɛ] d. [g͡bálé], e. [g͡bálé], f. [g͡bàlé] and g. [g͡bàlé]. Candidate (b) [g͡bálè] emerges as the optimal candidate because it satisfies the highest ranking constraint MAX[H]. Other candidates, (c), and (d) also satisfy the highest-ranked MAX[H] but are knocked out of the competition because they violate another high–ranking constraint *L↔H which is relevant to the analysis in Table 4 and defines the co-occurrence of H LL tone sequence after deletion. Therefore, the acceptable form in the language is [g͡bálè] as this satisfies the relevant constraints and represents a well-formed tonal output in the language.

3.1.2 Emergence of *lékp͡ō* 'to lick oil'

Table 5. Input /*lá ēk͡pō*/ → Output [*lékp͡ō*]

/lá ēk͡pō/	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
a. [lēk͡pō]	*!					*		
b. [lēk͡pó]	*!		*!			*		
c. [lèk͡pó]	*!			*				
d. [lēk͡pǒ]	*!		*!			*	*	
☞e. [lék͡pō]		*				*		*
f. [lēk͡pò]	*!				*			

Constraint ranking: MAX[H]>>*H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>>*MULTIPLE>>MAX[M]

In Table 5, the tonal output form selected from the candidate forms presented for analysis is (e) [*lékpō*]. The other candidates, (a) [lēk͡pō], (b) [lēk͡pó] and (c) [lēk͡pǒ] violate the top-ranking constraint MAX[H] and are therefore disqualified from the competition. A candidate that violates the topmost ranking constraint is naturally knocked out of the competition for further evaluation in OT. The import of this in the analysis in Table 5 is that all candidates except Candidate (e) [*lékpō*] are eliminated. This candidate violates another high–ranking constraint *H↔M but this is insignificant in this analysis since all other candidates cannot participate in any further evaluation for the other constraints. The

violation of the highly ranked *H↔M constraint by Candidate (e) is not fatal because it is the only candidate that satisfies the highest-ranked constraints MAX[H] and therefore emerges as the optimal form.

3.1.3 Emergence of *nóɣó* 'to have money'

Table 6. Input /*né ōɣó*/ → Output [*nóɣó*]

/*né ōɣó* /	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
☞a. [*nóɣó*]						*		*
b. [*nòɣó*]	*!			*!				*
c. [*nóɣō*]		*!						
d. [*nōɣṓ*]	*!		*!			*	*	
e. [*nōɣò*]	*!				*	*		
f. [*nōɣó*]	*!		*!			*		

Constraint ranking: MAX[H]>>*H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>>*MULTIPLE>>MAX[M]

Table 6 shows the emergence of Candidate (a) [*nóɣó*] as the optimal candidate for the input /*né ōɣó*/. A violation of the constraint MAX[H] by candidates (b), (d), (e) and (f) is considered fatal.

3.1.4 Emergence of *ʤɔ̀ʤɛ̀* 'to eat food'

Table 7. Input /*ʤɛ̄ ɔ̀ʤɛ̀*/ → Output [*ʤɔ̀ʤɛ̀*]

/*ʤɛ̄ ɔ̀ʤɛ̀*/	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
a. [*ʤɔ̄ʤɛ̀*]					*!	*!		
b. [*ʤɔ̄ʤɛ́*]			*!			*!		
☞c. [*ʤɔ̀ʤɛ̀*]								*
d. [*ʤɔ̀ʒɛ́*]				*!				*
e. [*ʤɔ̄ʒɛ̀*]					*!		*	

Constraint ranking: MAX[H]>>*H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>>*MULTIPLE>>MAX[M]

It is evident from Table 7 that the first two constraints involved in the ranking for tone asymmetry analysis in this study are inconsequential. This is because the input /*ʤɛ̄ ɔ̀ʤɛ̀*/ from which the output candidates are generated excludes a high tone in the Iṣẹ́kírì word *ʤɛ̄* 'eat'. The optimal and attested form from the analysis in Table 7 is candidate (c) [*ʤɔ̀ʤɛ̀*]. Candidate (c) [*ʤɔ̀ʤɛ̀*] emerges as the optimal candidate because it satisfies the high-ranking constraints. Candidates (a), (b), (d) and (e) violate this constraint which incurs a fatal violation and they lose out of the competition.

3.1.5 Emergence of *ɔ̄k͡pɔ́kà̋* 'one walking stick'

Table 8 reveals that, Candidates (a) [*ɔ̄k͡pɔ̄kà̋*], (c) [*ɔ̄k͡pɔ̀kà̋*], (d) [*ɔ̄k͡pɔ̄ká̋*] and (f) [*ɔ́k͡pɔ̀ká̋*] violate the highly ranked constraint MAX[H] and are automatically knocked out of the competition. Other constraints are rendered irrelevant in their evaluation. Candidates (b)

[ɔ̄k͡pɔ́kà] and (e) [ɔ̄k͡pɔ́kã̄] are considered for further evaluation and Candidate (e) [ɔ̄k͡pɔ́kã̄] is knocked out while Candidate (b) [ɔ̄k͡pɔ́kà] emerges as the optimal candidate for the input /ɔ̄k͡pá ɔ̀kà/. This is the attested form in Iṣẹ́kírì of the H LL tone sequence after vowel elision as it satisfies the relevant constraints and represents a well-formed tonal output in the language.

Table 8. Input /ɔ̄k͡pá ɔ̀kà/ → Output [ɔ̄k͡pɔ́kà]

/ɔ̄k͡pá ɔ̀kà/	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
a. [ɔ̄k͡pɔ̄kà]	*!				*!	*		
☞b. [ɔ̄k͡pɔ́kà]								*
c. [ɔ̄k͡pɔ̀kà]	*!							*
d. [ɔ̄k͡pɔ̄ká]	*!		*!			*		
e. [ɔ̄k͡pɔ́kã̄]		*!				*		
f. [ɔ̄k͡pɔ̀ká]	*!			*!				*

Constraint ranking: MAX[H]>>*H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>>*MULTIPLE>>MAX[M]

3.1.6 Emergence of *ɔ̄sɛ́rã̄* 'beef'

Table 9. Input /ɔ̄sɔ́ ɛ̄rã̄/ → Output [ɔ̄sɛ́rã̄]

/ɔ̄sɔ́ ɛ̄rã̄/	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
a. [ɔ̄sɛ̃̄rã̄]	*!							
b. [ɔ̄sɛ̃̄rà]	*!				*			
c. [ɔ̄sɛ̃̄rá]	*!		*					
d. [ɔ̄sɛ̀rá]	*!			*				*
☞e. [ɔ̄sɛ́rã̄]		*						*
f. [ɔ̄sɛ̃̄rá]	*!		*				*	

Constraint ranking: MAX[H]>>*H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>>*MULTIPLE>>MAX[M]

All candidates except Candidate (e) [ɔ̄sɛ́rã̄] are eliminated. The violation of the highly ranked *H↔M constraint by Candidate (e) is not fatal because it is the only candidate that satisfies the highest-ranked constraints MAX[H] and therefore emerges as the optimal form. As earlier mentioned, a candidate that violates the topmost ranking constraint is automatically knocked out of the competition for further evaluation in OT. Therefore, all other candidates in Table 9 cannot participate in any further evaluation for the other constraints. This is like the analysis in Table 5.

3.1.7 Emergence of *ū∫íwé* 'book work'

Table 10 reveals that, for the input /ū∫ɛ́ īwé/, Candidate (a) [ū∫íwé] emerges as the optimal candidate because it does not violate any of the high-ranking constraints. Candidate (b) [ū∫íwē] does not violate the high-ranking constraint MAX[H] but violates the next top ranking constraint *H↔M. The H↔M co-occurrence is not permitted for the H

MH tonal formation after deletion. Candidates (c) [*ūfǐwé*], (d) [*ūfǐwē̄*] and (e) [*ūfìwé*] fatally violate the constraint MAX[H] and are not allowed to partake in further analysis.

Table 10. Input /*ūfɛ́ īwé*/ → Output [*ūfǐwé*]

/*ūfɛ́ īwé*/	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
☞a. [*ūfǐwé*]								*
b. [*ūfǐwē̄*]		*!						*
c. [*ūfīwé*]	*!		*!					
d. [*ūfǐwē̄*]	*!				*!		*	
e. [*ūfìwé*]	*!			*!				*

Constraint ranking: MAX[H]>>*H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>>*MULTIPLE>>MAX[M]

3.1.8 Emergence of *ɔ̄nìrɛ̀* 'a wise person'

Table 11. Input /*ɔ̄nɛ̄ ìrɛ̀*/ → Output [*ɔ̄nìrɛ̀*]

/*ɔ̄nɛ̄ ìrɛ̀*/	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
a. [*ɔ̄nīrɛ̀*]					*!	*!		*
b. [*ɔ̄nìrɛ́*]				*!				*
c. [*ɔ̄nīrɛ́*]			*!			*!		
☞d. [*ɔ̄nìrɛ̀*]								*
e. [*ɔ̄nīrɛ̄̀*]					*!	*!	*	

Constraint ranking: MAX[H]>>*H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>>*MULTIPLE>>MAX[M]

There are five output candidates for the input /*ɔ̄nɛ̄ ìrɛ̀*/ in Table 11. The first two constraints in our constraint ranking are irrelevant in the analysis of M LL sequence as earlier noted. Candidate (d) [*ɔ̄nìrɛ̀*] satisfies the high ranked constraints and violates only the lowest ranked constraint MAX[M] to prevail and win over the other four candidates.

The Yoruba data presented earlier to argue for an OT analysis as proposed in this analysis are evaluated in Table 12 to provide evidence that the theoretical approach recommended and applied in this study can adequately take care of tone asymmetry in any language. This, we hope, will put to rest the challenge of tone asymmetry analysis.

3.1.9 Emergence of *rɔ́b!ɛ̄* 'to see a knife'

Table 12. Input /*rí ɔ̀bɛ̄*/ → Output [*rɔ́b!ɛ̄*]

/*rí ɔ̀bɛ̄*/	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
a. [*rɔ́bɛ̄*]		*!				*		
b. [*rɔ̀bɛ̄*]	*!							
☞c. [*rɔ́b!ɛ̄*]						*		*
d. [*rɔ́bɛ́*]		*!				*	*	*
e. [*rɔ̄bɛ̀*]	*!				*!	*		

Table 12. (Continued)

/rí ɔ̀bɛ̄/	MAX[H]	*H↔M	*M↔H	*L↔H	*M↔L	MAX[L]	*MULTIPLE	MAX[M]
f. [*rɔ̀bɛ́*]	*!							*
g. [*rɔ̄bɛ́*]	*!		*!			*		
h. [*rɔ̀bɛ́*]	*!			*!				*

Constraint ranking: MAX[H]>>*H↔M, *M↔H, *L↔H, *M↔L>>MAX[L]>>*MULTIPLE>>MAX[M]

Table 12 reveals that, Eight constraints are involved in the analysis of the Yoruba utterance */rí ɔ̀bɛ̄/*. Candidate (c) [*rɔ́b!ɛ̄*] emerges as the optimal candidate because it satisfies the highest-ranked constraint MAX[H]. This candidate violates two constraints but emerges as the optimal form because the two constraints MAX[L] and MAX[M] are lowly-ranked and are therefore not relevant to the analysis.

3.2 Discussion

An examination of the behaviour of mid tones within an Optimality Theory (OT) version which this study proposes shows that tone asymmetry can be properly and simplistically accounted for by constraint ranking. Pulleyblank (2004) and Peng (2013) also recognized the explanatory ability of OT in analyzing tone asymmetry by constraint ranking, but our analysis has incorporated constraints, by way of implicational statements as markedness constraints which insightfully reveal why and how the mid tone behaves differently from the high and low tones.

The appeal of the grounding principles to this study is on the tonal outcome expressed as negative implicational statements. That is, "if a then not b" (Heiberg, 1999). The relevance of this is in the possible tonal output after vowel elision in Isẹ́kírì. For example, the presence of a high tone in a V-V sequence implies that the mid tone is neutralized, thus one can assert that 'if a high tone then not a mid-tone'. The interesting contribution of such a statement is that, it handles data from both Isẹ́kírì and Yoruba where the low tone is not deleted. This also resolves the problem associated with the underspecification analysis in the data like *rí ọ̀bẹ* 'see knife', where the attested form after vowel elision is [*rɔ́b!ɛ̄*], even though going by the underspecification approach, [*rɔ́bɛ̀*] which is not attested in the language should be the resultant form.

4. Conclusion

The paper presents an analysis of the non-participation of the mid tone in the vowel elision process in Isẹ́kírì language, in the light of acoustic-phonetic analysis. Data in Isẹ́kírì vowel elision process reveal that when H or L tone meets M tone, it is the M tone that usually gets deleted as seen in *jẹ* 'eat' and *ọ̀jẹ̀* 'food' */dʒɛ # ɔ̀dʒɛ̀/* which becomes [*dʒɔ̀dʒɛ̀*]. This observation is contrary to earlier assumption in the Isekiri literature that the L tone is

elided in that context. It reveals that the lack of participation of the M tone in vowel deletion, glide formation and vowel assimilation show the unstable nature of this M tone in Iṣẹ́kírì language. This paper concludes that the M tone is in asymmetry to the H and L tones in the language. This study, therefore, brings the need for more acoustic investigations in Isekiri phonology to fore, to help expand the understanding of tone and tonal system in the language.

Abbreviations and symbols

#	Word Boundary	h	A Higher Tonal Tier in Tone Fusion Analysis
*!	Fatal Violation		
>>	Much Greater than	IO (T)	Tonal Output/Input
↔	Segment Sequence	L	Low Tone
μ	Tone Bearing Unit in Tone Fusion Analysis	M	Mid Tone
		OT	Optimality Theory
CON	The Constraints	T	Tone
CS	Contrastive Specification	TBU	Tone Bearing Unit
EVAL	The Evaluator	UG	Universal Grammar
GEN	The Candidate Generator	V_1	First Occurring Vowel in a Sequence
H	(1) High Tone, (2) A Lower Tonal Tier in Tone Fusion Analysis	V_2	Second Occurring Vowel in a Sequence
		VE	Vowel Elision

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