

<https://dx.doi.org/10.4314/gjl.v14i1.3>

A PHONOLOGICAL APPRAISAL OF HIATUS IN NZEMA SYLLABIC SYSTEM

John Nyame

Abstract

Hiatus is a phonological phenomenon in which two different vowels occur in a juxtaposition without an intervening consonant. This configuration is unacceptable in several languages, therefore, specific phonological strategies are required to break the cluster. Nzema does not readily permit adjacent hetero-syllabic vowels and thus employs strategies to resolve them. This paper examines how Nzema resolves vowel hiatus through epenthesis and coalescence. Data for the study were collected from four native speakers through interviews. The study dwells on Optimality Theory for the analysis. It finds that, in Nzema, coalesced vowels always preserve their [-high] and [-round] features in the resultant vowel. With respect to epenthesis, a consonant is triggered by an adjacent high vowel, which in turn spreads its feature to harmonise with the consonant, be it coronal or labial. This, however, occurs within individual words and not at the word boundary. This paper therefore, contributes to the limited existing literature on Nzema phonology and expands the discussion of unacceptable v-v sequences in general.

Keywords: Nzema, Hiatus, Coalescence, Epenthesis, Optimality Theory

1. Introduction

The paper is both descriptive and theoretical in nature. The descriptive part discusses how Nzema repairs unacceptable vowel sequence. The theoretical part argues for a formal analysis of the repair strategies within the purview of Optimality Theory (Prince & Smolensky 1993). In this paper, two of the several possible mechanisms Nzema uses to resolve vowel-vowel sequence in the language are discussed: glide epenthesis and vowel coalescence.

Hiatus is a hetero-syllabic sequence of adjacent vowels which constitutes a dispreferred configuration in many languages (Siptár 2005). Some languages prohibit hiatus altogether; others prevent some instances from arising by various means but let others surface or resolve them in some surface-phonological manner (Siptár 2005). The various ways by which hiatuses are avoided include elision of one or the other vowel, diphthong formation, glide formation, vowel coalescence, assimilation as well as epenthesis of a default consonant, capturing a 'floating' consonantal melody or the spread

of some (consonantal) melody from one of the vowel positions flanking the empty onset position (Siptár 2005).

Nzema, like some other languages, disallows vowel hiatus and naturally employs a number of strategies to avoid it. This is in connection with what Harris (2011:1600-1601) posits that, “vowel sequences lacking an intervening consonant are cross-linguistically dispreferred, and wherever morphemes concatenation threatens to create a hiatus configuration of this sort, languages can take various measures to resolve it.” The current paper discusses consonant epenthesis and vowel coalescence as hiatus interrupters in Nzema.

1.1 The Nzema Language and its Speakers

Nzema is a Volta-Comoe (or Southern Bia) language of the Niger-Congo language Phylum within the Kwa language family spoken mainly in the southwestern part of Ghana and some parts of the La Côte d’Ivoire both in West Africa. It consists of five main dialects namely; Dwɔmɔlɔ (Nzema West), ɛlɛmgbɛlɛ (Nzema Central), ɛvalɔɛ, Egila and Adwɔmɔlɔ (Nzema East). The language, the people and the place are called Nzema (Annan 1980a; Nyame 2019). Nzema is also categorized under Atlantic-Congo, Nyo, Potou-Tano, Tano and Central Bia language groups (Eberhard, Gary & Charles 2018).

Nzema is located at the southwestern part of Ghana. It is bordered to the West by La Côte d’Ivoire (also known as the Ivory Coast), to the East by the Ahanta, to the North by Aowin (or Anyi) and Wassa and to the South by the Gulf of Guinea. Some of the Nzema speaking communities in Ivory Coast include: Apolonu, Maama, Agyekɛ, Mouah (Mowa), Ngyeme, Noi (Noe), Akpanye, Anzeasawu, Manvea (Mafia), Bassam, Kakusuazo, Kpɔkɛti, Poso (Border town), Asue, Nzɔbɛnu, Mgbɔsɛya and Eboko, and Bassam (also known as Grand Bassam) (Nyame 2019).

According to the Ghana Statistical Service (2021), the population of Nzema speakers (in Ghana) totaled 342, 090. The language is studied as a subject at all levels of education in Ghana, including the tertiary level. Nzema is also used for radio and TV broadcasting programmes, particularly on the radio stations of Nzema. It is also used in adult education programmes and as a result, has caused an increase in the number of publications in the language. Nzema, as it is called today, was not called Nzema (Annan 1980a; Aboagye 1992). The historical account of the origin of the Nzema people dates back to the early 2000 BC. The people (Nzema) initially, were called ‘Kɔtɔkɔ’ as they are affectionately called Nzema Kɔtɔkɔ today. The ‘Kɔtɔkɔ’ of Nzema is not however the same as that of the Asante of the Akan. The porcupine represents the Nzema ‘Kɔtɔkɔ’ while hedgehog is for the Akan (Annan 1980a).

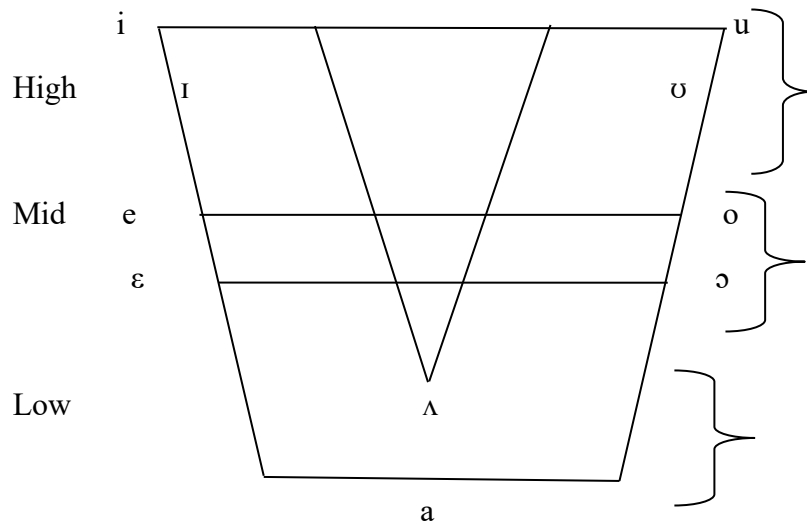
Traditionally, Nzema is divided into five states; Dwɔmɔlɔ, ɛlɛmgbɛlɛ, ɛvalɔɛ, Egila and Adwɔmɔlɔ (Aboagye 1992). Annan (1980) reports that, the Ahanta were part of Nzema and so were called Nzema-Ahanta. This is not surprising as languages that share borders with Nzema are mostly Volta-Comoe languages; Eboloza, Wasa, Aowin, Ahanta, Sehwi and Anyi of the La Côte d’Ivoire.

1.2 The sound system of Nzema

Scholars of Nzema phonology such as Essuah (1965) and Annan (1980b) both report that there are seven (7) vowel symbols, namely a, ɛ, e, i, ɔ, o and u which are used for writing. Nyame (2019) posits that Nzema has ten (10) oral vowels and six (6) nasal vowels

making it a total of sixteen (16) vowels in the language. The nasal vowels are; [ã, ã̃, ã̄, ã̅, ã̆]. The oral vowels are; [a, ɛ, e, ɪ, i, ɔ, o, ʊ, ʌ, u]. Among the ten oral vowels, with the exception of [ʌ] which is only phonetic, the remaining nine are both phonetic and phonemic. Nine of these oral vowels, [a, ɛ, ɪ, i, ɔ, ʊ, ʌ, u], can be nasalized while one [o] cannot be nasalized in any environment. The figure below shows the ten oral vowels of Nzema.

Figure 1: Nzema Vowel Chart



Nyame (2019)

The rest of the paper is structured as follows. Section 2 surveys some hiatus resolution strategies discussed in the literature. Section 3 is the methodology. Section 4 provides a brief review of Optimality Theory. Section 5 provides generalizations as to how vowel hiatus is repaired through epenthesis and coalescence and then analyses the observed generalizations within the purview of Optimality Theory (Prince and Smolensky 1993).

2. Literature Review

There are several strategies by which languages deal with sequences of vowels that arise through morphological or syntactic concatenation. According to Casali (1996, 1997), one such strategy is to leave the sequence unchanged and syllabify the two vowels into separate syllables, a process he refers to as hetero-syllabification. Indeed, many languages do not readily tolerate adjacent hetero-syllabic vowels; for instance, Ndebele (Sabao, 2015), Igbo (Mba 2011), and others such as Nguni (Sibanda 2009) and Ganda (Haris 2011) strongly disprefer them. Languages which do tolerate vowel sequence may subject it to any one of the several possible hiatus resolution strategies which include syllabifying the two vowels into the nucleus of a single syllable (Diphthong Formation), Epenthesis of a default consonant sharing common feature(s) in place or manner with the vowels it is going to interrupt, Vowel Elision, Glide Formation (a process in which the first of two adjacent vowels surfaces as a semivowel), and Coalescence (a process in which an underlying V_1 and V_2 sequence is realized as a third vowel, V_3 sharing features of both V_1 and V_2). It is also referred to technically as Fusion (Hout 2015). Some languages also resort to

assimilation; Igbo (Mba 2011), secondary articulation; Ndau (Mutonga 2017), etc. Some of these hiatus resolution strategies are discussed as follows.

2.1 Hetero-syllabification

Hetero-syllabification means vowels that are in sequence should be syllabified into their respective, independent syllables. Casali (1996) explains that most languages in which vowel sequences are tolerated do so by means of segmenting the vowels into separate syllables. With this, though the vowels are in sequence, they are independent. Casali (1996:1) provides the examples in (1) below as the process of hetero-syllabification and uses data from the English language to illustrate.

Hetero-syllabification: $CV_1+V_2 > .CV_1 .V_2$

1

UR		SR	Gloss
a. ple insaid	→	[.ple.in.said.]	‘play inside’
b. go əwe	→	[.go.ə.we.]	‘go away’

Casali (1996: 1)

In the English example (1) above, we observe that whenever there is a vowel sequence at word boundary, the vowels are put into separate syllables. This situation may not hold cross-linguistically, as some languages consistently syllabify word-internal vowels into respective syllables. Eegimaa (Bassene 2012), Nzema (Annan 1980b) and Akan (Dolphyne 2006) are just a few examples of such languages. Let us consider the examples below.

2 Eegimaa

UR		SR	Gloss
a. /ε- <i>ap</i> /	→	[ε. <i>aφ</i>]	‘forge (iron)’
b. /ε- <i>at</i> /	→	[ε. <i>at</i>]	‘type of shrine’
c. /fi- <i>εp</i> /	→	[fi. <i>εp</i>]	‘month, moon’

3 Nzema

a. / <i>deb</i> <i>ie</i> /	→	[<i>de.bi.e</i>]	‘something’
b. / <i>dua</i> /	→	[<i>du.ɿ</i>]	‘to plant’
c. / <i>aleεabo</i> /	→	[<i>a.li.ε.a.bv</i>]	‘universe’

4 Akan

a. / <i>abaa</i> /	→	[<i>a.ba.a</i>]	‘a stick’
b. / <i>abɔa</i> /	→	[<i>a.bɔ.a</i>]	‘an animal’
c. / <i>owuo</i> /	→	[<i>o.wu.o</i>]	‘death’

Comparing examples (1), (2), (3) and (4), we see that in (1), vowels at word boundaries are usually syllabified into separate syllables. In (2), (3) and (4), however, syllabification does not occur at word boundaries but word-internally. This is because in many languages just as in Nzema, vowels that are in sequence in words are independent and as such are separate syllables within the words.

In Nyame (2017), the author indicated that hetero-syllabification is an active discourse or vocalic hiatus resolution strategy in Nzema. This strategy is, however, neither a vocalic nor a consonantal hiatus resolution strategy in Nzema as was asserted in Nyame (2017). The present knowledge of hetero-syllabification, therefore, contradicts Nyame's (2017) assertion. Nyame (2017) only focuses on vowel elision and glide epenthesis and emphasises that these are the only mechanisms for breaking unacceptable vowel-vowel clusters in the language. Furthermore, epenthesis of the labial-velar glide /w/, is also discussed in Nyame (2017) that it is as a result of the sequence of /uʌ/. Another sequence, which also triggers epenthesis of /w/, which is /ua/, is, however, not mentioned. Clear explanations are also not given to account for epenthesis of the consonants, /w/ and /j/ that are used for epenthetic purposes in the language. This, perhaps, may be a result of wrong constraints used. For instance, *DIPH, a faithfulness constraint which penalises diphthongs, is ranked over all other constraints in Nyame (2017). Additionally, ONSET, which is a mild requirement for consonant epenthesis in the language, particularly in slow and emphatic speeches, is ranked high in Nyame (2017) to imply that ONSET is a strict requirement. These and other observations provide a good reason for a second look into how Nzema resolves sequence of vowels in the language. The present study draws on enough data to provide a detailed theoretical account of glide epenthesis and also examines other means through which Nzema resolves hiatus.

2.2 Diphthong Formation (Diphthongization)

Some sequences of vowels (usually two) function as a single sound. Such a combination of vowels that yields a single sound is what is technically referred to as a diphthong (Yule 2010, Hayes 2009). Diphthong formation is one of the means for resolving hiatus in many languages.

Casali (1996) presents the following as the basic form diphthong formation takes universally:

$CV_1 + V_2 > .CV_1 V_2$.

He explains that some languages avoid hiatus by retaining both vowels and syllabify them into the nucleus of a single syllable. A language like Ngiti resolves hiatus via diphthong formation (Kutsch Lojenda 1994: 90-91). Consider the example in (5) below.

5 Diphthong Formation in Ngiti (Kutsch Lojenda 1994)

UR	SR	Gloss
a. /abvo àji/	→ [a.bvoà.ji]	'window'
b. /opi àji/	→ [o.pià.ji]	'Lendu woman'
c. /indrí akpà/	→ [in.drí.a.kpà]	'male goat'

Kutsch Lojenga (1994) states that, "both vowels must be realised as a short complex vowel nucleus on one V timing slot." She, however, admits that the first vowel in every sequence is shorter in duration than the second vowel. It appears, therefore, that for every possible resolution strategy to work in a particular language as far as vowels are concerned, the

featural properties of the vowels also count. Diphthong formation is not yet attested in Nzema as far as the current literature on Nzema is concerned. This is because in Nzema every vowel is a syllable on its own (see example 3).

2.3 Consonant Epenthesis

Languages that resolve hiatus through consonant epenthesis differ in the kind of consonants that function epenthetically as hiatus interrupters. According to Casali (2011:3), three possibilities that are well attested include; a semivowel, usually one that is homorganic with (that is, one that shares the same frontness or roundness as) the first or the second vowel, a glottal stop ([ʔ]) or fricative ([h]) or coronal consonant, generally [t] or a rhotic. Vaux (2001), however, thinks otherwise. Vaux (ibid) explains that epenthesis of a default consonant is language specific. I agree with Vaux's (2001) submission in that, though languages in the world draw their grammar from one major source (Universal Grammar) (Kager 1999), the type of consonant that a language will select may be different from another. An example is the (isi)Ndebele language in which labial consonant, /b/ epenthesis is regular at preposition – noun boundary (Sabao 2015), as shown in (6).

6 Epenthesis in Ndebele (Sabao, 2015)

UR	SR	Gloss
a. /la-o-mama/	→ [labomama]	‘with mothers’
b. /la-o-mangoye/	→ [labomangoye]	‘with cats’

Sabao (2015) explains that, the trigger for /b/ epenthesis is the back mid vowel [o] which is also a plural affix. Sabao (ibid), however, does not explain in detail the reason for the labial /b/ epenthesis and not any other consonant. As already mentioned, epenthesis of a consonant of any kind must share common feature(s) either in frontness or roundness with the first vowel (Casali 1996). From the Ndebele example in (6) however, the vowel that shares feature with /b/ is /o/ which is the second vowel and not /a/, the first vowel. Even though /o/ and /b/ differ in roundness, they are both [labial]. It is this feature that makes it possible for /b/ to interrupt between /a/ and /o/ to resolve the hiatus created. This also suggests that it is not always the case that an epenthetic consonant will necessarily have to agree in feature with the first vowel and that the feature should be either frontness or roundness as Casali (1996) posited.

In Nzema, the consonants that are used as hiatus interrupters do actually share same frontness and roundness as the vowels (usually the first vowel as stated in (Casali, 1996)). If the first vowel is either of the specifications [+round] or [-round], the consonant to epenthesize assumes same feature. Thus, [j], which is a front high unrounded approximant, is the consonant counterpart of [i], a front high unrounded vowel. Likewise, [w], a labial-velar central approximant which is also a back high rounded glide, the counterpart is [u]. Moreover, in Nzema, it is not only [i] and [u] that trigger epenthesis of [j] and [w] but also [ɪ] and [ʊ], respectively, as in example (7) below.

7 Nzema (Environment for epenthesis of [j] and [w])

UR	SR	Gloss
a. /sua/	→ [suwʌ]	‘house’
b. /soa/	→ [sowa]	‘carry’
c. /tia/	→ [tijʌ]	‘walk’
d. /tea/	→ [tja]	‘shout’

In (7), we observe that both [u] and [ʊ] which are back high vowels trigger [w] epenthesis and not only [u] as asserted earlier in Nyame (2017). The same way [i] and [ɪ] trigger epenthesis of [j] as both are front unrounded high vowels.

2.4 Vowel Elision

Elision or deletion is basically a situation where sounds disappear or are not articulated in certain contexts (Celce-Murcia, Brinton & Goodwin 1996). This suggests that a sound that is present in its underlying form can be removed in the surface form in certain environments.

Matthews (1997) defines vowel elision as the process by which a vowel at the end of a word is lost, or elided before another vowel at the beginning of a word that follows. This definition agrees with that given by Casali (1997) and Rosenthal (1997). However, it appears to exclude other instances of elision by focusing solely on first vowel that is, (V₁) elision. Indeed, there are languages in which elision always targets the leftmost vowel. Nguni (Sibanda 2009) is one of these languages, as shown in (8).

8 Vowel elision as hiatus resolution in Nguni (Sibanda 2009)

UR	SR	Gloss
a. /ba-onke/	→ [bonke]	‘all’
b. /ba-odwa/	→ [bodwa]	‘only them, alone’
c. /ibe-ihamba/	→ [ibihamba]	‘it was going’
d. /ube-uhamba/	→ [ubuhamba]	‘you were going’

In (8) above, we see that the target of elision is not subject to whether the vowel is low or high. The target is always the leftmost of the two vowels, V₁. In Akan for instance, leftmost and rightmost vowel elision occur (Amoh 2017). Consider the example in (9) below.

9 Vowel elision as hiatus resolution in Akan (Amoh 2017)

	UR		SR		Gloss	
a.	<i>/efie/</i>	+	<i>/owura/</i>	→	<i>/efiewura/</i>	‘landlord/landlady’
	house/home		owner			
b.	<i>/aboa/</i>	+	<i>/efunu/</i>	→	<i>/aboæfunu/</i>	‘dead animal’
	animal		carcass			

The Akan examples in (9) above demonstrate that vowel elision is not always in the prerogative of V₁ as Rosenthal (1997), Mathews (1997) and Casali (1997) posit but also V₂. In examples (8) and (9), the environment for elision is between morpheme and word boundaries. Elision, however, occurs word-internally too and as such, does not only affect vowels but also syllables. The Nzema examples in (10) and Ganda in (11) are presented below to demonstrate this assertion.

10 Syllable elision in Nzema

	UR	SR	Gloss
a.	<i>/abɛbɛ/</i>	<i>[a:bɛ]</i>	'locust'
b.	<i>/abubura/</i>	<i>[a:bura]</i>	'a lame person'
c.	<i>/awuko/</i>	<i>[a:ko]</i>	'abode'

In (10), a whole syllable is deleted and it is compensated by lengthening the initial vowel. With this, pronunciation is made easy for the Nzema native speakers. This is in line with Harris's (2011) argument that, the phenomenon is language specific and that some of the lost morphemes are compensated with a lengthening as also in Ganda below.

11 Vowel elision as hiatus resolution in Ganda (Harris 2011)

	UR	SR	Gloss
a.	<i>/Ba-ezi/</i>	<i>[be:zi]</i>	'sweepers'
b.	<i>/Ba-ogezi/</i>	<i>[bo:gezi]</i>	'speakers'

In (11), the lost sounds involve low vowels, but in Nzema (10), it involves syllables with non-low vowels.

Gimson (1970) explains that, apart from word-internal elisions, sounds may be elided in rapid colloquial speech, especially at or in the vicinity of word boundaries. This also suggests that languages in which elision is frequent, the phenomenon is unavoidable particularly for native speakers. In normal speech, speakers tend to leave some sounds unpronounced which is neither as a result of laziness nor a form of sloppiness. Thus, deliberately avoiding the regular patterns of elision in discourse usually results in artificial talk (Yule 2010). In this sense, elision can be seen as a linguistic criterion that distinguishes a native speaker from a non-native speaker.

2.5 Coalescence

Another attested hiatus resolution strategy is coalescence. Some scholars refer to it as fusion (Hout 2015). That is, the merger of two sounds to yield a third sound that shares feature(s) of both sounds. Casali (1996) explains coalescence with the following structure:

$$CV_1 + V_2 > V_3.$$

Based on Casali's (1996) description, the resulting sound of coalesced underlying sounds should surface as a different sound, but one that shares similar features with those sounds. For example, in Ciyao, where V_1 is low and V_2 is mid or high, the resulting vowel is always mid, with backness and roundness of the resulting vowel agreeing with those features of V_2 (Ngunga 2000; cited in Tanner 2007).

12 Coalescence as hiatus resolution in Ciyao (Ngunga 2000)

	UR	SR	Gloss
a	/a + i/ → [e:]		
	/ma-ísó/ → [mé:só]		'eyes'
b	/a + u/ → [o:]		
	/ma-úngu/ → [mó:ngu]		'pumpkins'
	/ma-úvǎ/ → [mó:vǎ]		'days'
c	/a + e/ → [e:]		
	/ga-éswé:lǎ/ → [gé:swé:lǎ]		'white'
d	/a + o/ → [o:]		
	/ma-óla/ → [mó:la]		'frogs'

From (12), it is observe that both [+low] and [+high] and [+low] and [-high] merger respectively result in a [-high] vowel. Though the resulting (third) vowel is a mid-vowel, it shares features with the first and second vowels. That is to say, in examples (12a) and (12c), the third vowel shares the feature [-high] with the first vowel. It also shares [-round] feature with the first and second vowels. In (12b) and (12d), however, the third vowel shares the feature [-high] with the first vowel and shares the feature [+round] with the second vowel. This is in line with what Casali (1996) describes as height coalescence. He explains that /a+i/ coalesce to /e/, and /a+u/ to /o/. In Ciyao, as we can see from the examples in (12), it is not only /a+i/ and /a+u/ coalescence that result in /e/ and /o/ respectively, but also /a+e/ and /a+o/. This is because /i/ and /e/ share same frontness while /o/ and /u/ share same backness and roundness. Notwithstanding, (12c) and (12d) clearly display V_1 elision more than classical coalescence. The examples from Nguni (Sibanda 2009) shown in (13) display a true instance of coalescence.

13 Coalescence in Nguni

	UR	SR	Gloss
a.	/a+isi/	→ [esi]	‘the big chair’
b.	/a+ulu/	→ [olu]	‘the long stick’
c.	/la+inja/	→ [lenja]	‘and/with the dog’
d.	/la+umuntu/	[lomuntu]	‘and/with the person’

As can be seen in (13), coalescence occurs in Nguni when the vowel /a/ is followed by /i/ or /u/ resulting in /e/ or /o/, respectively. The resulting vowel [e] shares the feature [-round] with the underlying vowels /a/ and /i/. The reverse is what we see in (13b) and (13d). An important observation is that the resultant vowels which are both [-high] are however [+ATR]. Examples (13a) and (13c) fit Casali’s (1996) description of a canonical height coalescence of the type belonging to e-Coalescence.

2.6 Assimilation

Assimilation as a hiatus resolution strategy is not well examined cross-linguistically; however, it occurs in some languages. Among the ninety-two (92) languages surveyed by Casali (1996) in respect of hiatus resolution strategies, assimilation was not reported on.

Mba (2011) explains the phenomenon as a phonological process by which one sound becomes more like a nearby sound. She adds that this occurs regularly in rapid speech either at word boundary or word-internally. In vowel assimilation, one vowel sound becomes more like the other or assumes some feature of an adjacent vowel. In Igbo, apart from vowel elision which is a major hiatus resolution strategy, vowel assimilation is another means of resolving hiatus in the language (Mba 2011). Consider the examples in (14).

14 Assimilation as hiatus resolution in Igbo (Mba 2011)

	UR	SR	Gloss
a.	<i>ulo + elu</i>	= <i>uleelu</i>	‘storey building’
b.	<i>ùdé + ísí</i>	= <i>údíísí</i>	‘hair pomade’
c.	<i>ódụ + águ</i>	= <i>ódáágu</i>	‘tiger’s tail’
d.	<i>àkpà + égó</i>	= <i>àkpéégó</i>	‘bag of money’

The examples in (14) show a regressive assimilation in which V₁ is influenced to take features of V₂. In this respect, V₂ becomes long which is taken as a single vowel and not two vowels in sequence. There are also instances of progressive assimilation in Igbo (Mba 2011). Both progressive and regressive assimilation also occur in Hiroshima Japanese as hiatus resolution strategies (Shigeto & Yurie 2008).

3. Methodology

Data for the study were collected from ten native speakers; five males and five females who are also teachers of the Nzema language. Their ages range between forty and sixty. The data were gathered from three towns; Half Assini, Tikobo 1 and Menzezo in the Western and Central Nzema, where the consultants live and teach. Semi-structured interviews were used to illicit responses from them. The interviews were audio-recorded and later transferred onto a computer. The recordings were then transcribed. Concatenations involving vowel-vowel sequence that showed were selected and assigned their various glosses and translations. The analysis is carried out within Optimality Theory.

4. Theoretical Framework

4.1 Optimality Theory

This study is analysed within Optimality Theory (henceforth OT). OT, which was first proposed by Prince & Smolensky (1993), is a constraint-based linguistic theory and has mainly developed in the field of generative phonology. It is a theory of the grammar of human language, which holds that every grammar is a system of conflicting forces. These ‘forces’ are represented by constraints, each of which makes a requirement about some aspect of grammatical output forms (Kager 1999). In other words, OT defines and shows how unique the grammar of one language is from another. It does this through ranking of constraints that are said to be in conflicts. Whereas the set of constraints is universal, their hierarchies are different across languages. These OT constraints are not inviolable: a violation of a constraint is tolerated if it is necessary to satisfy another constraint that is ranked higher. Any systematic variation in human language is derived from the interaction among universal constraints.

OT is different from earlier generative models such as the Declarative Phonology which posits that constraints are ‘hard’ and inviolable (Bird 1990, Scobbie 1991). OT on the other hand assumes constraints to be violable and it is a theory of constraint interaction independent of what the constraints are (Dresher 1996). According to Kager (1999:18-19), “It is an input-output mechanism that pairs an output form to an input form (such that each input has precisely one output)”.

In OT, optimal candidates are not necessarily flawless as they may incur at least the least costly violations in a given language. Kager (1999) notes that violation of a constraint is not a direct cause of ungrammaticality, nor is absolute dissatisfaction of all constraints essential to the grammar’s outputs. Instead, what determines the best output of a grammar is the least costly violation of the constraints. Constraints though universal, may be ranked differently from one language to the other. That is to say, ranking of constraints is subject to language specific grammar and it is this hierarchical way of looking at the constraints that finally produce the desired optimal candidate. The study adopts this framework because of its many advantages for morphophonological analysis.

5. Data presentation and discussion

This section discusses the repair strategies that speakers employ for hiatus resolution in Nzema. In his previous study, Nyame (2017) briefly discussed vowel elision, consonant epenthesis and hetero-syllabification. In the present study, an alternative analysis to hetero-syllabification as a hiatus resolution strategy in Nzema is provided. Moreover, coalescence and epenthesis are discussed in detail. Therefore, the mechanisms for hiatus resolution that would be discussed in this paper include consonant epenthesis and vowel coalescence. The available data for the Optimality analysis are based on these strategies as they are frequently used for resolving hiatus in Nzema. This section, therefore, explores these strategies by bringing to light how sequences of vowels are resolved in Nzema through consonant epenthesis and vowel coalescence.

5.1 Consonant epenthesis in Nzema

Hayes (2009:14) argues, “It is fairly common for languages to resolve high-vowel hiatus by inserting a glide that is homorganic (shares the same place of articulation) with one of the two adjacent vowels”. Epenthesis of the palatal [j] and labial-velar [w] glides is discussed in this subsection.

5.1.1 Epenthesis of [w]

Epenthesis of [w] is realised in the environment where a vowel following a consonant in a word (or syllable) has the feature [labial] and [+high]. Example (15) demonstrates epenthesis of the labial-velar [w].

15

	UR	SR	Gloss
a.	/sòà/	[sʷòwà]	‘send’
b.	/mòà/	[mʷòwà]	‘far place’
c.	/súà/	[sʷúwà]	‘house’
d.	/bòàni/	[bʷòwàni]	‘sheep’
e.	/túà/	[tʷúwà]	‘pay’
f.	/kúà/	[kʷúwà]	‘gather’

Example (15) shows instances of consonant epenthesis. Although [w] has been inserted, the meanings of the lexical items remain unchanged. This is because the insertion of the glide has a discourse function, which is emphasis. This means that a true epenthesis will not render an item a different realization in Nzema. This phenomenon is also different from the canonical labialization where vowels that possess [labial] feature when preceded by consonants, influence the consonants that are originally non-labials to behave as labials.

Thus, in (15), /k/, /s/ and /t/ which are not labials gain the feature labial, [w]. Therefore, as can be seen in the examples above, the consonants on the left are usually affected, yet glide (semi-vowel) is inserted in that same word. What accounts for this is that the vowel which is the trigger for the epenthesis spreads its labial feature to the epenthetic site. Thus, the spreading is always from left to right as in the examples.

Moreover, the insertion of the epenthetic glide [w] enables onsetless syllables to have onsets, even though this is not a strict requirement in Nzema. This usually occurs (in the case of Nzema) when the initial vowel of two or more vowels in sequence has the feature [labial] and [+high]. In the environments discussed above, inserting a different segment other than [w] would render the lexical items meaningless. Consider example (16).

16	UR	SR
a.	/sòà/ ‘carry’	*[sʷ`oǰà]
b.	/mòà/ ‘to fold’	*[mʷ`oǰà]
c.	/súà/ ‘house’	*[sʷ`úǰà]

It is observed from (16a-c) that the meanings of the items are distorted. This means that inserting a segment in the wrong environment will create a distortion in meaning. It is seen that the initial vowels, V₁ are all [labial] and so do not share same feature with [j] in spite of the fact that they are both [+high].

5.1.2 Epenthesis of [j]

Epenthesis of [j] is realised in the environment where a vowel following a consonant in a word (or syllable) has the feature [cor] and [+high]. Consider the examples in (17).

17	UR	SR	Gloss
a.	/ʌzǐé/	[ʌzǐjé]	‘sepulcher’
b.	/bíʌ/	[bíjʌ]	‘to bathe’
c.	/teǐà/	[teǐjà]	‘to bend’
d.	/bíé/	[bíjé]	‘to urinate’
e.	/nǐà/	[nǐjà]	‘to look’
f.	/tǐé/	[tǐjé]	‘to listen’
g.	/àmgbǐě/	[àmgbǐjě]	‘a shell fish, mussel’

In contexts like example (16) and (17), Nzema epenthesize rather than syllabifying the vowel sequence into separate syllables. When this occurs, it satisfies a constraint in OT called ‘onset’. It can also be observed that, the epenthetic segment which is a semi-vowel is harmonic with V₁ (that is, it shares the same feature of frontness with V₁). However, this is a technique of breaking the cluster of vowels to avoid hiatus. The strategy of [w] and [j] epenthesis facilitates easy articulation in the Nzema language. It is also utilized for the purpose of emphasis.

5.2 Vowel coalescence in Nzema

Vowel coalescence is another strategy through which sequences of vowels are resolved in Nzema. Cross-linguistically, a true coalescence is either ε -coalescence or e-coalescence (Casali 1996). Casali (ibid) explains ε -coalescence as the merger of two different vowels which usually surface as / ε / and the contrary for e-coalescence. The examples in (18) show e-coalescence.

18

UR		SR	Gloss
a. / <i>bàkà</i> /	+ / <i>ébú</i> /	→ [<i>bàkébú</i>]	‘a stick has broken’
‘stick’	‘has broken’		
b. / <i>àwà</i> /	+ / <i>éfítí</i> /	→ [<i>àwéfítí</i>]	‘a bottle gourd has cracked open’
‘bottle gourd’	‘has cracked open’		
c. / <i>ànì ò mà</i> /	+ / <i>édú</i> /	→ [<i>ànì ò médú</i>]	‘a bird has flown’
‘bird’	‘has flown’		
d. / <i>bànà</i> /	+ / <i>éwíé</i> /	→ [<i>bànéwíé</i>]	‘plantain has finished’
‘plantain’	‘has finished’		

In (18), underlying /a+ ε / coalesce into /e/. This form of coalescence is e-Coalescence, which is usually uncommon. What we observe is that, both V₁ and V₂ that are [-ATR] coalesce into a [+ATR].

An alternative analysis can also account for the result in (18) where elision of V₁ feeds raising of V₂. Examples (18a) and (18b) are repeated in example (19) to show the alternative analysis.

19	UR		SR	Gloss
a.	/ <i>bàkà</i> /	+ / <i>ébú</i> /	→ [<i>bakɛbu</i>] → [<i>bàkébú</i>]	‘a stick has broken’
	‘stick’	‘has broken’		
b.	/ <i>àwà</i> /	+ / <i>éfítí</i> /	→ [<i>awɛfítí</i>] → [<i>àwéfítí</i>]	‘a bottle gourd has cracked open’
	‘bottle gourd’	‘has cracked open’		

In (19), it is observed that V₁ elision first apply before raising of V₂ to realize the output, V₃. Notwithstanding, the resultant [-high] vowel shares both [-high] and [-round] features with its V₁ and V₂. Observe also, the example (20) where a +ATR low vowel and a -ATR mid vowel coalesce into a +ATR mid vowel.

20	UR	SR	Gloss
a.	/èbí ʌ/ + /ɛwú/	→ [èbí.é.wú]	‘Ebia has died’
	‘name’	‘has died’	
b.	/sú ʌ/ + /ɛbú/	→ [sú.é.bú]	‘a building has collapsed’
	‘house’	‘has collapsed’	
c.	/gú ʌ/ + /ɛdú/	→ [gú.é.dú]	‘the market is closed’
	‘market’	‘has closed’	

From (20), it is seen that underlying /ʌ+ɛ/ merges into /e/. What is observed is that, both V₁ and V₂ which are [+ATR] and [-ATR], respectively coalesce into a [+ATR]. The resultant vowel thus shares the feature [+spread] of both V₁ and V₂.

It must be noted that in Nzema, coalescence of [+ATR] and [-ATR] low vowels, [ʌ, a], with [-ATR] mid vowel, [ɛ] respectively, always results into a [+ATR] mid vowel, [e]. As also noted by Casali (1996), the feature that is preserved in height coalescence generally is [-high]. However, e-coalescence, in which two [-ATR] vowels coalesce into a [+ATR] is not discussed in Casali (1996), and which is unique to Nzema.

An important observation made during the interviews with my consultants, which manifests in (20b) and (20c) is the fact that glide formation precedes coalescence. That is to say, the actual realizations appear to be [swebu] and [gwedu], respectively. In this case, multi-hiatus resolution which involves glide formation of the final vowel /u/ and coalescence of /ʌ+ɛ/ are seen to have taken place at the same time. This is not surprising as some languages in which the phenomenon is very frequent exhibit complex patterns of resolution (Casali 1996).

A question which may need a swift answer is whether or not the phonotactics of Nzema permit sequences such as /sw/ and /gw/. This question will require another study to answer it. However, since growth is a major feature of every language, this can be investigated in another study. Our interest for now is in the merger as a single pattern.

5.3 Consonant epenthesis in OT

As noted earlier, when it comes to which consonant can act as a hiatus interrupter, the choice is triggered by an adjacent high vowel. This adjacent high vowel then spreads its features (be it [cor] or [labial]) to the epenthetic site. In optimality-theoretic terms, epenthesis involves a violation of the faithfulness constraint, which is a result of the non-existence of the epenthetic segment in the input counterpart. This violation of the faithfulness constraint is mostly due to dominant syllable well-formedness constraints, such as Onset and No-Coda. In languages where there is constant epenthesis in output forms, because the input did not stay loyal or faithful to the output, it breaches the contract with the faithful constraint. However, if it is a strict requirement for syllables to have onsets, Faithfulness constraint will necessarily be dominated by Onset to enable onsetless syllables to have onsets.

In initial vowel utilizing languages such as Nzema, Onset may not be a strict requirement; the Onset First Principle in this regard will be a ‘weak’ one (Itô 1989). For instance, [àlɪ́-éàbɔ́] ‘universe’ will become [à.lɪ.ʔé.à.bɔ]; [éwɔ́lɛ́] ‘snake’, [é.wɔ.lɛ́]; [ʔlókó] ‘ripe plantain’, [ʔ.lókó]. In the examples given, we see that epenthesis of [j] occurs to break the cluster, [ɪ́] and [é], in the first example. However, the first and fourth syllables still do not have onsets. In the other examples, we see the initial onsetless syllables, ‘é’ and ‘ʔ’, surfacing in the outputs. This implies that in Nzema, both initial and medial onsetless syllables exist. Thus, syllables that may necessarily require onsets may not be as a result of imperfect matching as may be the case for some other languages. Consequently, Selkirk (1981) and Itô (1989) explain epenthetic segment as an empty structural position whose presence is required by a language-specific ‘syllable template’. This template defines whether or not an onset is obligatory, whether or not a coda is allowed.

In this model, epenthesis is driven by an imperfect match between input segments and the syllable template. An imperfect match may arise, for example, when the input contains a sequence of two vowels, without an intervening consonant, whereas the syllable template requires an obligatory onset. Syllabification then enforces the template by providing an empty onset position: one that is not filled by an input consonant. In the case of Nzema, however, as we saw from the discussions above, epenthesis of a segment is not always to address onsetless syllables, but also to fulfill a major speech function: emphasis. Thus, during slow and emphatic speeches, epenthesis becomes regular. This will therefore rule out Onset as an important constraint in the present analysis. The following constraints as used in Uffmann (2006) and Motte (2013) would be used in tableaux 1 and 2.

20 Constraints ranking: *VV >> *MULT(Dor) >> *MULT(Cor) >> *MULT(Lab) >> DEP(F)

The constraints are explained below:

*VV – there should not be vowel-vowel clusters

*MULT(Dor) – there should be no multiple dorsals

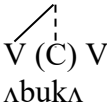
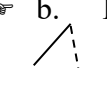
*MULT(Cor) – there should be no multiple coronals

*MULT(Lab) – there should be no multiple labials

DEP(F) – features in the output must have input correspondence (no insertion of a feature)

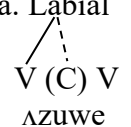
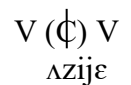
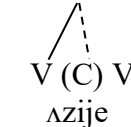
These constraints penalise any candidate that inserts unacceptable feature. This in effect, leads us to the very consonant that should be inserted. Consider the analysis in tableaux 1 and 2.

Tableau 1: Glide, [w] epenthesis

ΛbuΛ	*VV	*MULT (Dor)	*MULT (Cor)	*MULT (Lab)	DEP(F)
a. Dor  V (C) V ΛbukΛ		*!			*
b. Lab  V (C) V ΛbuwΛ				*	*
c. Cor  V (C) V ΛbujΛ				*	*
d. ΛbuΛ	*!				

As can be seen from tableau (1), candidates (a) and (d) are eliminated at an early stage of the competition due to the highly ranked constraints each violates. Candidate (a) violates a second highest-ranked constraint by inserting multiple dorsal /u, k/, which is fatal. Candidate (d) violates the first and most highly-ranked constraint by presenting vowel clusters /u, Λ/, which is also fatal. Candidates (b) and (c) survive at this stage. There are however other constraints to be satisfied or violated by candidates (b) and (c). Candidate (b) and candidate (c) violates two constraints each. However, candidate (b) performs better on the hierarchy than (c) in the sense that (c) inserts a dispreferred sound. At last, the competition is over and candidate (b) emerges the optimal because it has the best performance on the entire hierarchy, notwithstanding its violation of the lowest ranked constraints in the given hierarchy which is insignificant to the outcome.

Tableau 2: Glide, [j] epenthesis

Λzie	*VV	*MULT (Lab)	*MULTI (Dor)	DEP(F)	*MULT (Cor)
a. Labial 		*!		**	
b. Dor 				**	*
c. Cor 				*	*
d. Λzie	*!				

From tableau (2), candidates (a) and (d) are eliminated at an early stage of the competition as they could not satisfy higher-ranked constraints on the hierarchy. Candidate (b) performs better than candidates (a) and (d). Candidate (b) incurs three violations and it is equally kicked out of the competition. Candidate (c) incurs two violations as opposed to candidate (b) which incurred three violations. Candidate (c) therefore emerges the winner of the competition.

5.4 Coalescence in OT

In the context of hiatus in the Nzema language, coalescence occurs mostly at the boundary of words. Determining the directionality of each context in this regard however needs investigation. In doing this, faithfulness constraints are used. Thus, the position-sensitive faithfulness approach is adopted to account for vowel coalescence in resolving hiatus in Nzema. As the name implies, Positional faithfulness has to do with loyalty in some specific positions. Loyalty in the sense that segments do not lose their features, they rather preserve feature values of segments and these segments occupying the positions try as much as possible not to shed any of their features. In other words, they are phonological positions that maintain their original form thus resisting any pressure that could cause them change. According to Kager (1999) these positions are salient or prominent because they are positions where contrasts are best realised. Some of these positions include: in word-initial, in a lexical word or morpheme, in stressed syllable and geminate segment (see Casali 1996). For the purpose of this study, the contexts which are most relevant are the initial two contexts that is, in word initial and in lexical word or morpheme. Regarding salient positions in respect of lexical words, nouns have been widely attested that they do

everything possible to safeguard the whole of the category. This implies that in contrast, they tend to resist any phonological process or processes that may affect them negatively than do other categories such as verbs, adjectives, etc. Nouns are known to occupy a strong position in grammars.

21 Constraint ranking: *V#V >> PARSE(-high) >> PARSE(+high), PARSE(F)-lex >> PARSE (F)

*V#V is a markedness constraint which bans vowel sequence at the boundary of words. The remaining are faithfulness constraints. PARSE(-high) requires that a feature that is specified for [-high] in the input root word be preserved in the output. PARSE(+high) on the other hand, requires that a feature that is specified for [+high] in the input root word be preserved in the output. PARSE(F)-Lex requires that a feature (F) in a root (Lexical word) is parsed, and PARSE (F) requires that all features in the input are preserved in the output. The constraints ranked above will help determine the output form from coalesced vowels in Nzema as illustrated in the tableau below.

Tableau 3: Vowel coalescence preferred to vowel elision when V₂ is /ɛ/

bàkà+`ébú	*V#V	PARSE(-high)	PARSE(+high)	PARSE(F)-lex	PARSE (F)
a. bàkíbú		*!			
☞ b. bàkébú				*	*
c. bàk`ɛ`ébú	*!				
d. bàkà`ébú	*!				

From tableau (3) above, candidates (c) and (d) violated the highest ranked constraint hence eliminated. Candidate (a) satisfies the highest ranked constraint, *V#V. However, candidate (a) violates a second higher-ranked constraint, PARSE(-high) by shedding a [-high] feature in its root, which is fatal. Consequently, candidate (b) which also has a violation of a high-ranked constraint emerges the winner as there is no other candidate that can fare better.

6. Conclusion

In this paper, an alternative analysis to hetero-syllabification as a hiatus resolution strategy in Nzema is provided. We have also discussed consonant epenthesis in detail with vowel coalescence as hiatus interrupters in Nzema. The discussion and the Optimality analysis are based on these strategies as they are frequently used for resolving hiatus in Nzema. The consonants that are epenthesized as hiatus interrupters in Nzema are the labial-velar glide, [w] and palatal glide, [j]. Vowel sequences usually occur at word boundaries and within words. For every resolution, the strategy to employ is usually subject to the environment in which the sequences occur. When vowel sequences occur word-internally, Nzema

resolves it by inserting an epenthetic consonant, and when it occurs at word boundary, coalescence occurs. It is worth mentioning that the present study provides a more detailed analysis of the phenomenon of hiatus resolution in Nzema. The discussion has shown that epenthesis of either of the consonants has to do with the vowel that shares feature either in frontness or backness with the consonant in question. That is to say, if the first vowel is a [lab] with a [+high] feature, [w] is inserted between the serial vowels. However, if the first vowel is a coronal [cor], and high for that matter, [j] is inserted between the vowels. The optimality analysis has also revealed that in Nzema, the markedness constraints, *VV and *V#V, which respectively ban vowel-vowel sequence in word internal and at word boundaries, and the faithfulness constraint, PARSE(-high) which requires output-input similarity, are the most highly ranked constraints as far as hiatus resolution in Nzema is concerned. Coalescence of vowels and insertion of a consonant in the output renders it unfaithful to the input. Feature preservation for coalescence is [-high]. Finally, the two hiatus resolution mechanisms; consonant epenthesis and vowel coalescence all violate faithfulness constraint.

References

- Aboagye, Kwesi P. A. (1992). *Nzema anee ne anwo mgbanyidweke*. Accra: Bureau of Ghana Languages
- Amoh, Samuel. (2017). *Vaworo ntoatoasoo anosie wo Akan mu*. [Master's thesis]. University of Education, Winneba.
- Annan, Joseph Crosby. (1980a). *Nzema kotoko*. (Unpublished manuscript). School of Ghana Languages, Ajumako.
- Annan, Joseph Crosby. (1980b). *Nzema Fonology*. (Unpublished manuscript). School of Ghana Languages, Ajumako.
- Bassene, Mamadou. (2012). *Morphophonology of Joola Eegimaa*. [Doctoral dissertation]. The University of Minnesota.
- Bird, Steven. (1990). *Constraint-based phonology*. [Doctoral dissertation]. University of Edinburgh.
- Casali, Roderic F. (1996). *Resolving Hiatus*. [Doctoral dissertation]. University of California.
- Casali, Roderic F. (1997). Vowel elision in hiatus contexts: Which vowel goes? *Language*, 73(3), 493-533. <http://doi.org/10.2307/415882>
- Casali, Roderic F. (2011). Hiatus resolution. In Marc van Oosterndorp, Colin, J. Ewen, Elizabeth Hume & Keren Rice (Eds.), *The Blackwell companion to phonology* (pp. 1434-1460). Malden, MA and Oxford: Wiley Blackwell Publishers.
- Celce-Murcia, C. Marianne., Brinton, Donna M., & Goodwin, Janet M. (1996). *Teaching pronunciation*. Cambridge: Cambridge University Press.
- Dolphyne, Florence Abena. (2006). *The Akan (Twi-Fante) language: Its sound system and tonal structure (2nd ed.)*. Accra: Woeli Publishing Services.
- Dresher, B. Elan. (1996). The rise of optimality theory in first century Palestine. *GLOT International*, 2(1), 8.
- Eberhard, David M., Gary, F. Simons., & Charles, D. Fennig (Eds.) (2022). *Ethnologue*:

- Languages of the world, twenty-fifth edition*. Dallas, Texas: SIL International.
Retrieve: <http://www.ethnologue.com>nzi>
- Ekanjume, Beatrice. (2010). Hiatus resolution in Akóóse: An OT approach. *Lagos Papers in English Studies*, 15, 158-167.
- Essuah, Amihere Joseph. (1965). *Nzema grammar*. Ibadan: Claverianum Press.
- Ghana Statistical Service. 2021. *The 2021 population and housing census*. Retrieved from census2021.statsghana.gov.gh
- Gimson, A. C. (1970). *An Introduction to the pronunciation of English*. London: Edward Arnold Publishers Ltd.
- Harris, John. (2011). *Deletion*. In: Marc van Oostendorp, Colin J. Ewen, Elizabeth Hume & Keren Rice (Eds.), *The Blackwell Companion to Phonology* (pp. 1597-1621). Wiley- Blackwell.
- Hayes, Bruce. (2009). *Introductory Phonology*. Oxford: Blackwell Publishing.
- Hout, Katherine. (2015). A lexical indexation account of exceptions to hiatus resolution in Mushunguli. *San Diego Linguistic Papers*, 5, 30-70.
- Itô, Junko. (1989). A prosodic theory of epenthesis. *Natural Language and Linguistic Theory*, 7, 217-259.
- Kager, Rene. (1999). *Optimality Theory*. Cambridge: Cambridge University Press.
- Kutsch Lojenga, Constance. (1994). *Ngiti: A Central-Sudanic language of Zaire*. Cologne: Rüdiger Köppe Verlag.
- McCarthy, John & Prince, Alan. (1995). Faithfulness and reduplicative identity. *Papers in Optimality Theory. University of Massachusetts Occasional Papers*, 18, 249-384.
- Matthews, Peter H. (1997). *Oxford concise dictionary of Linguistics*. Oxford: Oxford University Press.
- Mba, Rita O. (2011). *Hiatus resolution strategies in Igbo*. [Master's thesis]. University of Nigeria, Nsukka.
- Motte, Mercy. (2013). *Vowel Hiatus Resolution in Ewe*. Master's thesis, Norwegian University of Science and Technology.
- Mutonga, Lovemore. (2017). Hiatus resolution in Ndau. Marang: *Journal of Language and Literature*, 28(1), 1-20.
- Ngunga, Armindo. (2000). *Phonology and morphology of the Ciyao verb*. Stanford: CSLI Publications.
- Nyame, John. (2017). *Hiatus resolution in Nzema*. Munich, Germany: Grin Publishing.
- Nyame, John. (2019). *Hiatus resolution in Nzema*. [Master's thesis]. University of Education, Winneba.
- Prince, Alan & Smolensky, Paul. (1993). Optimality theory: Constraint interaction in generative grammar. <http://roa.rutgers.edu>files>537-...>
- Rosenthal, Sam. (1997). The distribution of prevocalic vowels. *Natural Language and Linguistic Theory*, 15(1), 139-180. <http://doi.org/10.1023/A:1005717617507>
- Sabao, Collen. (2015). Resolving hiatus in (isi) Ndebele: An optimality theoretic account. *Ampersand*, 2(3), 122-135.
- Selkirk, Elizabeth. (1981). Epenthesis and degenerate syllables in Cairene Arabic. In: Hagit Borer and Youssef Aoun (Eds.), *Theoretical issues in the grammar of Semitic languages. MIT Working Papers in Linguistics*, 3.

- Scobbie, James M. (1991). *Attribute-value phonology*. [Doctoral dissertation]. University of Edinburgh.
- Sibanda, Galen. (2009). Vowel processes in Nguni: Resolving the problem of unacceptable VV sequences. *Selected Proceedings of the 38th Annual Conference on African Linguistics*, 35–55.
- Shigeto, Kawahara & Yurie, Hara. (2008). Hiatus resolution in Hiroshima Japanese. *Phonetics and Phonology, CIL 18*, Seoul, Korea.
- Siptár, Peter. (2005). *Hiatus resolution in Hungarian: An optimality theoretic account*. Abstract submitted for ICSH. Retrieved from <https://nanopdf.com/download/hiatus...>
- Tanner, Darren Scott. (2007). *Context insensitive vowel hiatus resolution in Ciyao*. Rutgers Optimality Archive (ROA 458). Retrieved from <http://roa.rutgers.edu/files/903-0307/903-TANNER-0-0.PDF>
- Uffmann, Christian. (2006). *Epenthetic vowel quality in loanwords*: Empirical and formal issues. *Lingua*, 116 (7), 1079-1111.
- Vaux, Bert. 2001. *Consonant epenthesis and hypercorrection*. LSA, Harvard University, Washington, DC.
- Yule, George. (2010). *The study of language (4th edition)*. Cambridge: Cambridge University Press.