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Gemination and Morphophonological Organisation in Kisa

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Abstract: *Gemination is a linguistic property that abounds in the phonology of natural langauges as a language universal property. All language, however, do not display this phonological aspect in the same way. Language specific variations exist, in which case, languages of the world uniquely exhibit gemination. Though a phonological phenomenon, gemination, in natural langauges, could be seen to interact with morphological aspects of language in the Phonology-Morphology interface. Kisa, a Bantu language spoken in western Kenya and one of the seventeen Luhya languages, exhibits phonemic geminates, albeit very few. Cases of two adjacent identical consonants word internally as a result of affixation and vowel syncope are common in this language, and vary depending on the type of the consonants in question. Nonetheless, empirical studies on such language specific unique behaviour of geminates in Kisa and evidence of the morphology – phonology interface are rare. The study to which this paper is based investigated the behaviour of derived geminates in Kisa basing on natural speech data generated by native speakers of Kisa and adopting a descriptive analytic research desingn. The study looked into how morpho-phonological variability and phonetic detail relate to gemination in Kisa. The results show that gemination occurs tautomorphemically and heteromorphemically and that not all consonants geminate. Gemination depends, on the one hand, the type of consonant in question and, on the other hand, the type of affix in question and segmentability of the affix. Kisa, is shown to have morphological geminates, discerned from their morphological properties. Kisa morphological geminates, however, behave like phonological geminates based on the phonological properties they portray. The analysis shows a distinction between phonological rules and phonetic implementation rules and that the strength of*

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morphological boundaries impacts the gemination properties of certain affixes and sounds, providing evidence of the morphoplogy - phonology interface in Kisa.

Keywords: *Affixation, Bantu Languages, Geminates, Kisa, Morpho-phonology, Segmentability*

1. Introduction

It can be argued that there are both underlying and derived geminates, in Kisa as is in other languages [1, 2, 3, 4, 5, 50, 51, 57]. The supposed underlying geminates are found word initially and are distinctive. Derived geminates, which may or may not be distinctive, on the other hand, result from two situations in Kisa. First, from the syncopation of vowels between identical consonants and second, from the assimilation of unlike consonants after the syncope of a vowel between them. Geminates resulting from these two situations can be tautomorphemic or heteromorphemic. Accordingly, Kisa has underlying, concatenated and assimilated geminates. Kisa can therefore, be argued to have both pure/true geminates and geminate clusters. The study on which this paper is based looked at both types of geminates, in Kisa. The paper begins by highlighting the theories on the representation and analysis of geminates and then explaining the methodology used in the study, followed by a description of the geminates in Kisa. An analysis and representation of Kisa geminates is then presented followed by a discussion on how gemination relates to morphological organisation. Finally, a conclusion to the paper is provided.

2. Literature Review: Representation and Analysis of Geminates

Representation of geminates has been a long-standing problem in Phonology [6, 7, 52]. In autosegmental terms, geminate consonants are represented as one root node that is linked to two timing slots [8, 9, 10, 52]. This type of representation makes no specific claim about the weight of geminates. It simply captures their quantity, that is the fact that geminates are longer than single consonants. Further, by linking the timing slots to one root node, the 'inalterability of geminates,' that is the fact that they behave as a single unit is also explained [11].

To capture the weight of geminates, moraic representations [12, 13, 52] comes into play. Moraic theory is primarily a theory of syllable weight; but since weight is directly linked to quantity, moraic theory also deals with the representation of contrastive segment length. The proponents of this theory [1, 3, 14, 15, 16, 52], argue that moraic structure can adequately represent both weight and quantity, and thus that there is no need for the skeleton. They further argue that moraic structure and related phenomena such as compensatory lengthening and mora-sharing are

directly reflected in the phonetic duration of segments. Therefore, a fundamental tenet of moraic theory is that geminates are inherently moraic, that is they have weight [12].

Thus, in moraic theory the representation of geminates shows that a geminate consonant has its own mora and is ambisyllabic, since it is linked to two syllables, a preceding and a following syllable. A direct phonological consequence of this representation is that geminates affect the weight of the first syllable they are attached to: they make it bimoraic, therefore heavy. From the phonetic point of view, the fact that a geminate consonant is moraic means that it is longer than a singleton since moraic structure is meant to represent not only weight, but quantity as well. The moraic representation captures the facts about geminates in several languages, in which weight and quantity go hand in hand. But this only applies perfectly to geminates in word-medial position meaning that the assumption of ambisyllabicity poses no problems.

How then do we explain word initial geminates in moraic theory? True geminates (that is not sequences of identical consonants), that are found word initially have been conceived to be non-moraic [4, 17]. To represent them as such and at the same time represent word-medial true geminates, Hume et al and Tranel argue that there is need for phonology to allude to both a skeletal tier and moraic structure, if it is to adequately represent both quantity and weight.

[1] propose that although all geminates are inherently moraic they may not necessarily head a mora at the surface. Such geminates are underlyingly moraic, but do not make the syllable to their left heavy. This type of analysis can account for non-moraic geminates, but it still does not solve the problem of how to represent word-initial geminates within the moraic framework.

[2] and [12] suggest a representation for word-initial geminates as two separate root nodes linked directly to the syllable node once syllabification has taken place. [3], [5], [18], [19] and [20] agree with this representation and suggest that languages that do not have real geminates but "double consonants," should represent such geminates as two separate root nodes with identical content.

3. Methodology

The study used purposive sampling to select 1 female and 1 male informant based on their availability for data collection. Two informants were considered appropriate for the study given that every native speaker has the same linguistic competence about the language in question [21, 22, 23, 24]. Although, working with one native speaker would yield the same results as working with more than one native speaker, and that consulting a range of speakers about the same phenomenon would lead to replications of information and eventually superfluous information

[21, 22, 22], the use of two native speakers both male and female in this study was to help guard against representing the speech characteristics of one individual and gender.

3.1 Research Design

The study used a descriptive analytic research design. Descriptive analytic design describes a phenomenon and explains why and how a phenomenon exhibits particular characteristics with a view of identifying and establishing trends, relationships and patterns in the data collected. [25, 26], The study described and analysed the different types of geminates that occur in Kisa, how they are represenetd and how gemination relates to morphological orgnaisation.

3.2 Research Instrument

Data in this study was collected through elicitation method using an elicitation frame as the instrument. An elicitation frame is a fixed environment that is used for discovering or testing particular linguistic phenomenon and its patterns in various appropriate paradigms [27] Elicitation method was deemed appropriate for the study because the data required was concerned with the linguistic competence of the informants in the form in which it occurs in their minds. Given that the researcher and the informants have no control about such information, the most appropriate way to get it was to make the informants produce it involuntarily.

3.3 Data Collection and Analysis

Data for the study was collected from the two informants using elicitation frames. The informants were asked to articulate words with different consonant sequences at morphological boundaries involving different affixes as was presented in the elicitation frames. The elicitation frames contained words with all possible consonant sequences at all possible morphological boundaries involving all possible affixes in Kisa. Data analysis, on the other hand, involved organizing, describing, explaining and discussing the data collected according to the consonant sequences and geminates that emerged and with regard to which affixes as well as the motivating factors. The data analysed was presented in descriptive write-ups in which examples alluded to were represented in a three or four tier format where appropriate and given morpheme by morpheme glossing

4. Results and Discussion

Geminates in Kisa result from the syncopation of a vowel between like consonants concatenating two identical consonants or from the syncopation of a vowel between unlike consonants, which then undergo assimilation resulting in a

sequence of two identical consonants. Kisa has both underlying and derived geminates. Underlying geminates in Kisa are tautomorphemic, while derived geminates in Kisa can be tautomorphemic or heteromorphemic.

4.1 Underlying Geminates

In Kisa, underlying geminates are rare. There were only six words with underlying geminates in the data as presented in (1) and notably, they are entirely tautomorphemic. Underlying geminates are distinctive in Kisa as seen from the minimal and subminimal pairs in the data in (1).

(1)

i.	*jjaakal-a*	*jaal-a*	*iii.*	*llala*	*lal-a*
	sharpen- sgS	spread- sgS		once	burn- sgS
	‘sharpen’	‘spread’		‘once’	‘burn’
ii.	*wwoor-a*	*woowe*	*iv.*	*mmoni*	*mot-a*
	begreedy- sgS	exclamation		face	bite- sgS
	‘be greedy’	‘dismay’		‘face’	‘bite’

v.	*jj-a*	*jaβ-a*
	be hot- sgS	dig- sgS
	‘be hot/cooked’	‘dig’
vi.	*ww-a*	*wa*
	getfinished-sgS	exclamation
	‘get finished’	‘exclamation of surprise’

Though the geminates in (1) are underlying, it can be argued that they originated from the syncopation of vowels present in the initial syllable of these forms, as shown in (2).

(2)

	UR	SR			
i.	*jijaakal-a*	*jjaakala*	*iv.*	*mumoni*	*mmoni*
	sharpen- sgS			face	
	‘sharpen’			‘face’	
ii.	*wuwoor-a*	*wwoora*	*v.*	*wuw-a*	*wwa*
	be greedy- sgS			get finished- sgS	
	‘be greedy’			‘get finished’	
iii.	*lulala*	*llala*	*vi.*	*jij-a*	*jja*
	once			be hot- sgS	
	‘once’			‘be hot/cooked’	

The syncopation of the vowel in the initial syllable, in these examples would imply that these are concatenated geminates. However, given that there are no forms with the underlying vowel existing in the current synchronic state of Kisa, as is the case with derived geminates in Kisa as discussed in the following section, these geminates can be argued to have been lexicalised in the language. As a result, they are treated as true or underlying geminates in this paper.

4.2 Derived Geminates

Derived geminates in Kisa can be tautomorphemic or heteromorphemic. They can be, concatenated or assimilated.

4.2.1. Concatenated Tautomorphemic Geminates

Concatenated tautomorphemic geminates in Kisa result when a vowel is deleted between like tautomorphemic consonants. They are found in different word classes in Kisa. There are those that do not involve reduplication (3) and those that involve partial reduplication (5-6).

(3)	UR	SR	
i.	*βeerer-a*	*βeerra*	*βeer-a*
	be sad-sgS		forgive-sgS
	‘be sad’		‘forgive’
ii.	*βolol-a*	*βolla*	*βol-a*
	untie-sgS		rot-sgS
	‘untie’		‘rot’
iii.	*iβirir-a*	*iβirra*	*jiβir-a*
	forget-sgS		immerse-sgS
	‘forget’		‘immerse’
iv.	*xulul-a*	*xulla*	*xul-a*
	drag down-sgS		grow-sgS
	‘drag down’		‘grow’
v.	*o-lu-βuβi*	*oluββi*	*o-lu- βi*
	AUG-11-spider		AUG-11-bad
	‘spider’		‘a bad one’
vi.	*e-ʃi-fwaanani*	*eʃifwaanni*	*e-ʃi-fwaani*
	AUG-7-image		AUG-7-likeness
	‘image’		‘likeness
vii.	*o-mu-luujija*	*omuluujja*	
	AUG-1-luhyia		
	‘a Luhya’		

viii.	i-Ø-taakika	itaakka	
	AUG-9a-minute		
	‘minute’		
ix.	lol-a	lla	
	see-sgS		
	‘see’		
x.	lul-a	lla	
	be bitter-sgS		
	‘be bitter’		
xi.	ŋaŋaal-a	ŋŋaala	ŋaala
	be dumbfounded-sgS		take long strides
	‘be dumbfounded’		‘take long strides’

Note that the geminates in these examples are distinctive, given the provided minimal and sub-minimal pairs. The form in (3xi) above does not involve partial reduplication because the second syllable of this form has a long vowel, while the initial syllable has a short vowel. If it were a case of reduplication, we would expect a long vowel both in the initial and second syllable. In this case syncope would not take place because long vowels are not syncopated in Kisa. This argument is supported by the fact that syncope and gemination does not occur in the data in (4) due to the long vowel between the like consonants.

(4)

i.	*laal-a*	*iii.*	*jaaj-a*
	spread everywhere-sgS		take greedily-sgS
	‘spread everywhere’		‘take greedily’
ii.	*maam-a*	*iv.*	*ɲaaɲ-a*
	cover everywhere-sgS		chew-sgS
	‘cover everywhere’		‘chew’

The fact that syncope and gemination do not occur when long vowels are involved implies that long vowels in Kisa are bimoraic. This lends to the fact that syllables with long vowels in Kisa are heavy as in other languages [28, 29].

The forms in (5) involve duplication of the second syllable of the root, while those in (6) involve duplication of the third syllable of the root.

(5)	UR	SR	
i.	*nener-a*	*nnera*	*ner-a*
	economise-sgS		blossom-sgS
	‘economise’		‘blossom’

ii.	*rerem-a*	*rrema*	*rem-a*
	stagnate-sgS		chop-sgS
	'stagnate'		'chop'
iii.	*lulum-a*	*lluma*	*lum-a*
	be fierce-sgS		bite-sgS
	'be fierce'		'bite'
iv.	*seser-a*	*ssera*	*ser-a*
	choke-sgS		crowd/swarm-sgS
	'choke'		'crowd/swarm'
v.	*kukun-a*	*kkuna*	*kuno*
	gnaw-sgS		this one
	'gnaw at something'		'this one'
vi.	*tetej-a*	*tteja*	*tet-a*
	defend-sgS		cut-sgS
	'defend someone'		'cut'
vii.	*ʦeʦem-a*	*ʦʦema*	*ʦex-a*
	pretend	-sgS	laugh-sgS
	'pretend'		'laugh'
viii.	*e-ʃi-riri*	*eʃirri*	*e-ʃi-ri*
	AUG-7-fiddle		AUG-7-fear
	'single-stringed fiddle'		'something full of fear'
ix.	*i Ø-ʃiʃiri*	*iʃʃiri*	*e-mi-ʃira*
	AUG-9a-donkey		AUG-4-tail
	'donkey'		'tails'

(6)	UR	SR	
i.	*e-ʃi-terere*	*eʃiterre*	*e-ʃi-tere*
	AUG-7-rabbit		AUG-7-finger
	'rabbit'		'finger'
ii.	*e-ʃi-ɲololo*	*eʃiɲollo*	*e-ʃi-ɲolo*
	AUG-7-urine stench		AUG-7-luo
	'urine stench'		'in a Luo manner'
iii.	*ɲalal-a*	*ɲalla*	*ɲal-a*
	diarrhoea-sgS		manage-sgS
	'diarrhoea'		'manage a task'
iv.	*alal-a*	*alla*	*al-a*
	together-sgS		spread-sgS
	'lend a hand'		'spread'

Reduplication in Kisa can be argued to be prefixal, given the syllables that are duplicated and the vowels that are syncopated in the data in (5-6). The vowel that is syncopated is that of the reduplicant and not the base due to morpheme integrity. This, however, needs further investigation but in a different paper as it is beyond the scope of this paper.

The data in (7) shows forms with more than two identical syllables. In these examples, it is the vowel in the penultimate syllable that is deleted.

(7)

i.	*ʦererere*	*ʦererre*	*iii.*	*tatatata*	*tatatta*
	extrenmy clean/white			extremely hard	
	‘extremely clean/white’			‘extremely hard’	
ii.	*papapapa*	*papappa*	*iv.*	*tutututu*	*tututtu*
	extremely hot			extremely full	
	‘extremely hot’			‘full to the brim’	

Given that these forms can occur in the non-reduplicated form in the language as ‘ʦere’, ‘pa’, ‘ta’ and ‘tu’ respectively, then this supports further the argument that reduplication is prefixal in Kisa. Though, as stated above, this needs further investigation with more examples and discussion of reduplication as a morphological process in Kisa.

4.2.2. Assimilated Tautomorphemic Geminates

Assimilated tautomorphemic geminates result when a vowel is syncopated between unlike consonants. In this case one of the consonants totally assimilates to the other resulting in a geminate. Consider the data in (8).

(8)

	UR	SR	
i.	*funir-a*	*funna*	*funak-a*
	tie the roof-sgS		break-sgS
	‘tie the roof together’		‘break’
ii.	*hulir-a*	*hurra*	*tur-a*
	listen-sgS		assist-sgS
	‘listen’		‘assist’
iii.	*e-ʃi-ilolero*	*eʃiilorro*	
	AUG-7-mirror		
	‘mirror’		
iv.	*o-mu-futiro*	*omufutto*	*o-mu-futu*
	AUG-3-erasure		AUG-3-tree
	‘erasure’		‘tree species’
v.	*Ø-lii-ŋwaatiro*	*liiŋwaatto*	*Ø-lii-ŋwaato*

AUG-5a-bwteen the legs	AUG-5a-hoof
'between the legs'	'hoof'

4.2.3. Concatenated Heteromorphemic Geminates

Concatenated heteromorphemic geminates in Kisa result when a vowel is deleted between like heteromorphemic consonants. This is seen in noun roots and noun class prefixes, in verbal prefixes and in verb roots and verbal suffixes.

In noun roots and noun class prefixes, if the consonant preceding the final vowel of the prefix is identical to the initial consonant of the noun root, the final vowel in the prefix is syncopated resulting in the juxtaposition of two identical consonants. This results in concatenated geminates and the obliteration of the morpheme boundary. Consider the data in (9).

(9)	UR	SR
i.	*o-βu-βaatsi*	*oββaatsi*
	AUG-14-carpentry	
	'carpentry'	
ii.	o-βu-βasi	oββasi
	AUG-14-account	
	'accounting'	
iii.	*o-lu-limi*	*ollimi*
	AUG-11-tongue	
	'tongue'	
iv.	*o-mu-mali*	*ommali*
	AUG-1-dark	
	'an African'	
v.	*a-ma-mira*	*ammira*
	AUG-3 mucus	
	'mucus'	
vi.	*a-ma-misu*	*ammisu*
	AUG-3-dirt	
	'adhering dirt'	
vii.	*e-ʃi-ʃeβo*	*eʃʃeβo*
	AUG-7-circumsize	
	'circumcision'	
viii.	*o-xu-xupa*	*o-xxupa*
	AUG-15-beat	
	'beating style'	

In verbal prefixes, if the consonant preceding the final vowel of the first prefix is identical to the initial consonant of the second prefix, the final vowel in the first prefix is syncopated resulting in the juxtaposition of two identical consonants. This results in concatenated geminates and the obliteration of the morpheme boundary. Consider the data in (10).

(10)	UR	SR
i.	*mu-mu-xup-e*	*mmuxupe*
	2plS-3sgO-beat- SUBJ	
	'You (pl) beat him/her'	
ii.	*mu-mu-ßal-e*	*mmußale*
	2plS-3sgO-count- SUBJ	
	'You (pl) count him/her'	
iii.	*mu-mu-ßukul-e*	*mmußukule*
	2plS-3sgO-take- SUBJ	
	'You (pl) take him/her'	

In verb roots and verbal suffixes, syncope and gemination involves the final consonant of the root and the first consonant of the suffix. When the final consonant of the verb root and the first consonant in the verbal suffix are identical, the vowel that occurs between the final consonant of the verb root and the first consonant of the suffix is syncopated and the final consonant of the root and the first consonant of the suffix are concatenated resulting in a geminate. This occurs with the hesternal/hodiernal past suffix (11), the applicative suffix (12), the reversive, iterative suffix (13) and the reciprocal suffix (14).

The hesternal/hodiernal past suffix is /-ire/. When it is affixed to a root that ends in /r/ the vowel /i/ in this suffix is syncopated concatenating the final consonant of the root and the consonant /r/ of the suffix giving rise to a geminate as shown in (11).

(11)	UR	SR
i.	*a-sir-ire*	*asirre*
	3sgS-fence-HODP	
	'She/he fenced'	
ii.	*a-jir-ire*	*ajirre*
	3sgS-take to-HODP	
	'She/he took to'	
iii.	*a-kor-ere*	*akorre*
	3sgS-get lost-HODP	
	'She/he got lost'	
iv.	*a-siir-ire*	*asiirre*

3sgS-jump over-HODP
'She/he jumped over'

The applicative suffix, in Kisa, is /-ir/. When it is affixed to a root ending in the consonant /r/ the vowel of the suffix vowel syncopates leading to the concatenation of two identical consonants which result in a geminate. See the data in (12).

(12) UR SR

i. *sir-ir-a* *sirra*
fence- APPL-sgS
'fence for'

ii. *jir-ir-a* *jirra*
take to- APPL-sgS
'take to for'

iii. *imir-ir-a* *imirra*
lead- APPL-sgS
'lead for'

iv. *iɲʤir-ir-a* *iɲʤirra*
enter- APPL-sgS
'enter for'

With the reversive, iterative suffix, gemination takes place when the final consonant of the root is /l/. The reversive suffix, in Kisa, is /-ul/. Here the vowel of the reversive suffix is syncopated, and the final consonant /l/ of the verb root is concatenated with the consonant /l/ of the reversive suffix. The two then result in the geminate /ll/. Consider the data in (13).

(13) UR SR

i. *fwaal-ul-a* *fwaalla*
dress-RVS-sgS
'undress'

ii. *taabuul-ul-a* *taabuulla*
widen-IT -sgS
'widen further'

iii. *lik-ul-ul-a* *likulla*
strengthen-RVS-IT -sgS
'unstrengthen repeatedly'

iv. *fuuts-ul-ul-a* *fuutsulla*
spit-RVS-IT -sgS
'spit repeatedly'

With the reciprocal suffix, gemination takes place when the final consonant of the root is /n/. The reciprocal suffix, in Kisa, is /-an/. Here the vowel of the reciprocal suffix is syncopated, and the final consonant /n/ in the root is concatenated with the consonant /n/ of the reciprocal suffix. The two then result in the geminate /nn/. Consider the data in (14).

(14)	UR	SR
i.	*fwaan-an-e*	*fwaanna*
	look like-REC-plS	
	'look a like'	
ii.	*nuun-an-e*	*nuunanne*
	suckle-REC-plS	
	'suckle for each other'	
iii.	*kon-an-e*	*konanne*
	sleep-REC-plS	
	'sleep for each other	

4.2.4. Assimilated Heteromorphemic Geminates

Assimilated heteromorphemic geminates also occur in Kisa. They result when a vowel is deleted between unlike heteromorphemic consonants. They occur both in nouns and verbs. In nouns, they occur between prefixes and roots, while in verbs they occur between roots and suffixes.

With nouns, assimilated geminates occur when the final vowel of the prefix is syncopated and the consonant of the prefix is concatenated with the initial consonant of the root. In this case the consonant in the prefix and the initial consonant of the root are not identical. Therefore, the consonant in the prefix assimilates completely to the initial consonant of the root. Consider the data in (15).

(15)	UR	SR
i.	*o-βu-fiisi*	*offiisa*
	AUG-14- venom	
	'venom'	
ii.	*o-βu-fwa*	*offwa*
	AUG-14- seed	
	'seeds'	
iii.	*e-ʃi-saala*	*essaala*
	AUG-7- stick	
	'stick'	
iv.	*e-ʃi-suli*	*essuli*

AUG-7- apex
'apex of the house'

v. *o-βu-paaki* *oppaaki*
AUG-14- praise
'praise'

vi. *o-βu-pata* *oppata*
AUG-14- hinge
'door hinge'

In verbs assimilated geminates occur with the hesternal/hodiernal past suffix /-ire/ and the applicative suffix /-ir/. Here, when the vowel /i/ in the suffix is syncopated, the consonant /r/ in the suffix totally assimilates to the final consonant of the root resulting into a geminate. Consider the examples in (16). These examples only involve the applicative suffix. The process is the same with the hesternal/hodiernal past suffix.

(16)	UR	SR
i.	*xup-ir-a*	*xuppa*
	beat-APPL-sgS	
	'beat for'	
ii.	*fut-ir-a*	*futta*
	erase-APPL-sgS	
	'erase for'	
iii.	*kok-er-a*	*kokka*
	make to fall-APPL-sgS	
	'make to fall for'	
iv.	*fun-ir-a*	*funna*
	harvest-APPL-sgS	
	'harvest for'	
v.	*laam-ir-a*	*laamma*
	wail-APPL-sgS	
	'wail for'	
vi.	*mweeɲ-er-a*	*mweeɲɲa*
	smile-APPL-sgS	
	'smile for'	
vii.	*tooŋ-er-a*	*tooŋŋa*
	remain-APPL-sgS	
	'be left behind for'	
viii.	*fuutʂ-ir-a*	*fuutʂtʂa*

	spit-APPL-sgS	
	'spit for'	
ix.	*six-ir-a*	*sixxa*
	die out-APPL-sgS	
	'die out for'	

The data in the preceding discussion demonstrates that in Kisa geminates involve a variety of consonants. There are geminate liquids /rr/ and /ll/. We also have geminate nasals : /mm/, /nn/, /ɲɲ/ and /ŋŋ/. There are also geminate stops : /pp/, /tt/ and /kk/. Similarly, a geminate affricate also occurs that is /ʦʦ/. Geminate fricatives also occur such as /ββ/, /ff/, /ss/, /ʃʃ/and /xx/. There are also geminate glides, that is, /jj/ and /ww/. This demonstrates that all consonants in Kisa are able to geminate except for the palato-alveolar affricate /ʧ/ and the glottal fricative /h/. There were no words in the data with geminates involving these two sounds.

4.2.5. Geminates Involving Nasal Consonant (NC) Sequences

Other than the geminates occurring in the environments seen in the preceding discussion, geminates, in Kisa, also occur in the environment of nasal consonant sequences. When the prefix /ma-/ or /mu-/ is juxtaposed with a root whose initial consonant is the bilabial fricative /β/, the vowel in the prefix is deleted, leading to the concatenation of the nasal /m/ and the fricative /β/. The fricative /β/ hardens to the stop /b/ resulting in a nasal-consonant sequence /mb/. The mora of the syncopated vowel is compensated for by lengthening the nasal /m/. What surfaces then is /mmb/, that is a geminate nasal /mm/ followed by a voiced bilabial stop /b/. Consider the data in (17).

(17)	UR	SR
i.	*a-ma-βaaŋga*	*ammbaaŋga*
	AUG-3-blood	
	'blood'	
ii.	*a-ma-βeere*	*ammbeere*
	AUG-3-milk	
	'milk'	
iii.	*a-ma-βere*	*ammbere*
	AUG-3-millet	
	'millet'	
iv.	*o-mu-βano*	*ommbano*
	AUG-3-knife	
	'knife'	

v.	*o-mu-βasu*	*ommbasu*
	AUG-3-sunshine	
	'sunshine'	
vi.	*o-mu-βajo*	*ommbajo*
	AUG-3-game	
	'game'	
vii.	*mu-βal-e*	*mmbale*
	3sgO-count-plS	
	You (pl) count him/her	

This also occurs between prefixes as the data in (18) shows.

(18)	*mu-βu-limo*	*mmbulimo*
	in-14-bush	
	'in the bush'	

In suffixation, geminates in the environment of NC sequences occur with the applicative suffix /-ir/ when the final consonant of the root is a nasal consonant sequence. Consider the data in (19).

(19)	UR	SR
	roomb-er-a	*roommba*
	spout-APPL-sgS	
	'sprout for'	
	βaamb-ir-a	*βaammba*
	stretch out-APPL-sgS	
	'stretch out for'	
	heend-er-a	*heennda*
	worry-APPL-sgS	
	'be worried about'	
	haand-ir-a	*haannda*
	stick-APPL-sgS	
	'stick for'	
	jaandʑ-ir-a	*jaanndʑa*
	be happy-APPL-sgS	
	'be happy for'	
	xoondʑ-er-a	*xoonndʑa*
	amass-APPL-sgS	
	'amass for'	

kuu ɲʤ-ir-a	*kuuɲɲʤa*
fold-APPL-sgS	
'fold for'	
ʃiiŋg-ir-a	*ʃiiŋŋga*
bet-APPL-sgS	
'bet for'	
ʧooŋg-er-a	*chooŋŋga*
prune-APPL-sgS	
'prune for'	

The examples in (17-19) involve affixation. However, there were two examples in the data involving gemination in the environment of NC sequences that did not involve affixation. Consider the data in (20 and 21).

(20)

nende	*nnde*
and	
'and/with'	

Here, the vowel /e/ is syncopated between the initial nasal consonant /n/ and the nasal consonant /n/ preceding the stop /d/ resulting in the cluster /nnd/.

(21)

ʦii-ndeendere ʦiindeennde
10b-elephantiasis
'elephantiasis'

In the example in (21), the vowel /e/ in the penultimate syllable is deleted. This concatenates the NC sequence /nd/ and the trill /r/. Assimilation takes place resulting in the cluster /nnd/, a geminate nasal followed by the voiced stop /d/.

4.3 Analysis and Representation of Kisa Geminates

The analysis and representation of Kisa geminates follows both the moraic theory and the skeletal theory. In this way, Kisa geminates are best analysed as moraic and as two separate root nodes linked directly to the syllable.

In Kisa, derived heteromorphemic geminates are clusters because the two consonants that form these geminates belong to different morphemes. They are also moraic because they result from the syncopation of a vowel, whose mora is compensated for in gemination. Therefore, following [30], the first consonant in

these geminates is syllabified in the coda of the preceding syllable and the second in the onset of the following syllable, as shown in the data in (22).

(22)	UR	SR
i.	*sir-ir-a*	*sir.ra*
	hate-APPL-sgS	
	'hate for'	
ii.	*fut-ir-a*	*fut.ta*
	erase-APPL-sgS	
	'erase for'	
iii.	*o-βu-pata*	*op.pata*
	AUG-14- hinge	
	'door hinge'	

Derived tautomorphemic geminates are also analysed in the same way. Because they result from the syncopation of a vowel whose mora is compensated for in gemination, they are clusters, moraic and are syllabified in separate syllables, as shown in the data in (23).

(23)	UR	SR	
i.	*βolol-a*	*βol.la*	*βol-a*
	untie-sgS		rot-sgS
	'untie'		'rot'
ii.	*funir-a*	*fun.na*	
	tie the roof together- sgS		
	'tie the roof together'		

This is also the case with derived geminates involving NC sequences. The geminate nasal [mm] in the data presented in (24) and (25) is a cluster because it spans two morphemes.

(24)

o-mu-βano *om.mba.no*
AUG-3-knife
'knife'

The geminate results from the syncopation of the vowel /u/ in the prefix, whose mora is compensated for in gemination lending to the fact that this geminate is moraic. Given that this geminate is moraic, in its syllabification, the first nasal in

the cluster is syllabified in the coda of the preceding syllable and the second nasal in the onset of the following syllable.

In the data in (25), the nasal geminate is word initial.

(25) *mu-βu-limo* *m.mbu.li.mo*
in-14-bush
'in the bush'

Here, given that the geminate is word initial but moraic, the first nasal forms a syllable on its own as a syllabic consonant, while the second nasal is syllabified in the onset of the following syllable. This is also the case with derived heteromorphemic geminates (26) and derived tautomorphemic geminates (27) that occur word initially.

(26) UR SR
i. *mu-mu-lol-e* *m.mu.lo.le*
2plS-3sgO-see-SUBJ
'You (pl) see him/her'
ii. *mu-mu-bale* *m.mu.ba.le*
2plS-3sgO-count-SUBJ
'You (pl) count him/her'

(27) *seser-a* *s.sera*
choke-sgS
'choke'

The clusters in (24-25) involve derived NC sequences. However, there were words in the data with underlying NC sequences as discussed in section 4 and as seen in the data in (28).

(28)
nende *n.nde*
and
'and/with'

In the data in (28), the vowel /e/ is syncopated between the word initial nasal consonant /n/ and the nasal consonant /n/ preceding the stop /d/. Given that the resulting geminate is the nasal /nn/, the underlying NC sequence /nd/ is analysed as a cluster as opposed to a prenasalised consonant. This agrees with the analysis of NC sequences in Kisa as clusters provided in [31]. If the underlying NC sequence

/nd/ in (28) was a prenasalised consonant, analysed as a single segment, gemination would not take place because there would be no trigger. This then supports the analysis of the nasal geminate /nn/ in this example as a cluster and hence moraic ; where the first nasal in the geminate is syllabified in its own syllable, hence syllabic and the second nasal in the onset of the following syllable. The second nasal in the cluster /nn/ cannot be syllabified in the preceding syllable as in /nn.de/ due to the maximal onset principle that requires the onset to be made as maximum as possible at the expense of the coda, following language specific phonotactic requirements. Also, given the open nature of syllables in Kisa [32], the second nasal in this example is better syllabified in the onset of the following syllable.

This is also the case with the underlying geminate in the data in (29).

(29)
ʦii-ndeendere ʦiindeennde
10b-elephantiasis
'elephantiasis'

Here, the vowel /e/ in the penultimate syllable is deleted. This concatenates the consonant /d/ and /r/ which then assimilate giving rise to a moraic geminate compensating for the lost mora of the vowel that is syncopated. Note, however, that it is not the stop part of the NC sequence that geminates but the nasal part. This is motivated by both phonetic and phonological factors.

Though cross linguistically, geminates of lower sonority are preferred over those of higher sonority [33, 53, 56, 58], high sonority consonants are prone to occur as syllable nucleus as opposed low sonority consonants [34] This motivates the realisation and syllabification of the word in (28) above as /ʦii.ndee.n.nde/. The first nasal /n/ in the geminate nasal /nn/ is syllabified in its own syllable as a syllabic consonant to avoid losing the mora of the syncopated vowel. It cannot be syllabified as a coda in the preceding syllable because the preceding syllable is bimoraic. As an onset in the following syllable, it will not preserve the mora it is intended to preserve.

Geminating the stop part of the NC sequence as in /tsiindeendde/ is plausible. However, a problem arises with its syllabification. If this word is syllabified as /tsii.ndee.ndde/, the geminate /dd/ occurs in the onset of the following syllable rendering it non-moraic. In this way, the mora of the vowel that was syncopated is not compensated for as is the case with the other geminates in the language. And if we syllabify the first consonant of the geminate /dd/ in the preceding syllable as in /tsii.ndee.nd.de/, then the resultant syllable /nd/ sees a stop as a syllabic consonant as opposed to the nasal which is more sonorant and widely

attested as a syllabic consonant [34, 53, 56, 58] compared to the stop. And when we syllabify the nasal in the cluster /ndd/ in its own syllable as in /tsii.ndee.n.dde/, then we cannot justify the origin of the mora it carries in this case.

The explanation given above suffices for heteromorphemic geminates in the context of NC sequences, as seen in the data in (30).

(30)

i.	*roomb-er-a*	*roo.m.mba*
	spout-APPL-sgS	
	'sprout for'	
ii.	*heend-er-a*	*hee.n.nda*
	worry-APPL-sgS	
	'be worried about'	

As clusters, heteromorphemic geminates in Kisa cannot be argued to violate the Obligatory Contour Principle (OCP) because as [35] and [36] argue, OCP does not apply to cross morpheme-boundary geminates since different morphemes are represented on different tiers. This then supports the analysis of these geminates as moraic and as two separate root nodes linked directly to different syllables. But given the fact that tautomorphemic geminates in Kisa involve the concatenation of identical consonants after the syncopation of an intervening vowel, are moraic, and are analysed as two separate root nodes, the OCP principle ranks low in Kisa. The same observation and analysis is levelled on the Kisa underlying geminates discussed in section three. Though underlying, as lexicalised forms, they originated from non-geminated forms after the syncope of an intervening vowel.

[36] and [56] observe that in the analysis of geminates a distinction is made between phonological rules and phonetic implementation rules. [36] asserts that the latter are distinguished from the former by their gradient effect, their variability, their dependence on speech rate, and their lack of interaction with the phonology. These facts lend to the analysis of Kisa geminates.

The geminates in Kisa, can be attributed to speech rate. Synchronically, they occur mostly in fast, normal rate, and casual speech as opposed to slow, clear enunciation and careful speech. That is the reason why the derived geminates are not found in the underlying representation. And the supposed underlying geminates are seen to have been lexicalised in the language having originated from non-geminated forms as discussed in section three. This is supported by the observation that the forms with the geminate are rampant in Kisa synchronically and among younger speakers, while the forms without the geminate are not and are used more often by older speakers. Another supporting factor is the fact that there are indeed

many differences between careful and casual speech, some of them expected, some of them less expected that make research on casual speech necessary to show the validity of conclusions based on careful speech in order to provide information that cannot be revealed by studies on careful speech and in order to raise new and important questions about the phenomenon in question [37, 54, 55, 57].

The phonetic motivations that lead to the creation of geminates in Kisa apply variably. Not all consonants in Kisa are a trigger for gemination. This is seen clearly in assimilated heteromorphemic geminates involving verbal suffixes. The trigger for all the geminates in the data in this environment, is the consonant /r/ in the suffix. Similarly, the deletion of vowels that occur between like consonants to create geminates only applies to short but not long vowels. This is because, long vowels are bimoraic, and so resist syncopation.

Derived geminates in Kisa, which are the majority, come by as a result of the syncopation of a short vowel, predominantly between like consonants to reduce the number of syllables induced by gradient as observed in other languages [38]. This however, does not consider the phonological requirements of the language. Syncope leads to the loss of a mora. The mora is compensated for in gemination. In cases where the first part of the resulting geminate cannot be syllabified in the coda of a preceding syllable, it is syllabified in its syllable to preserve the lost mora.

Though [36], [54], [55] and [57] argue that phonetic implementation rules may create what appear to be geminates, but are not, at least of the phonological sort, the Kisa geminate data and analysis contradicts this and shows that phonetic implementation rules can also create phonological geminates. This is because the Kisa geminates as analysed in this section are moraic, and ambisyllabic and link to the syllable as two separate root nodes.

4.4 Gemination and Morphological Organisation in Kisa

The geminates that occur in Kisa as discussed in the preceding discussion can be said to be both of the phonological and morphological type. In languages with phonological geminates, a geminate is taken to be a double consonant which is articulated with a particularly long duration [39, 40, 41, 42, 43]. This is seen with all the Kisa geminates discussed in section three. In such languages, there is a phonemic difference between a geminate and the corresponding single consonant. This is the case with the underlying geminates in Kisa as discussed in section three.

In Kisa all the heteromorphemic geminates can be argued to be morphological geminates because they result from affixation and the two consonants in question are preserved, hence morphological gemination [44]. Given that these geminates arise from the syncope of a vowel and concatenation or assimilation of consonants, the discussion in section three shows that there is a

significant durational difference between such double consonants and a single consonant, with the double consonant being longer as in other languages [44, 52, 53]. Of interest in this section are the morphological geminates. This is because morphological gemination may have important implications for the organization of morphological information in the lexicon [44, 45].

Following [44] and [45] this paper argues that the phonetic properties of Kisa heteromorphemic geminates are determined by the word specific morphological segmentability of the affixes. [46] argues that words with a weaker boundary are more likely to be processed as whole words while words with a strong boundary are more likely to be decomposed. In this approach, boundary strength is taken to be gradient and to be influenced by parameters such as semantic transparency and phonological transparency. Phonetically, words with weaker boundaries are expected to show more phonetic reduction across the morpheme boundary than words that have a strong boundary. Under this view, gemination can be seen as a reduction phenomenon that is predicted to be dependent on the decomposability of the words in question.

Segmentability of the affix had an influence on the ability of the affix to trigger gemination in Kisa. After syncope, in cases where two like consonants were concatenated, the morpheme boundary was obliterated, triggering gemination. Similarly, in cases where two unlike consonants were concatenated after the syncope of a vowel, assimilation took place, also obliterating the morpheme boundary, resulting into a geminate. Again, the gemination results show that the phonetic properties of the consonants concatenated after syncope determine gemination. Gemination was predominant in cases of the concatenation of like consonants, consonants with similar or closer to similar places of articulation and predominantly with the alveolar trill /r/. The latter saw the suffixes /-ir and -ire/ triggering gemination the most. These properties explain the obscurity of semantic and phonological transparency in the resultant forms, hence the gemination. The results suggest that ability to geminate is dependent on the segmentability of the affix. Therefore, in Kisa as in other languages [47], the strength of morphological boundaries impacts the gemination properties of certain affixes and sounds. Affixes with a weak morphological boundary go a long with greater phonological integration with their base through assimilation and gemination [47, 48, 49]. Heteromorphemic gemination, in Kisa is therefore a result of the obliteration of the morpheme boundaries obscuring segmentation.

5. Conclusion

Kisa has both underlying and derived geminates. Underlying geminates are found word initially and they are distinctive. Derived geminates, are not

distinctive and result from the syncopation of vowels between identical consonants or from the assimilation of unlike consonants after the syncope of a vowel between them. Derived geminates, in Kisa, can be tautomorphemic or heteromorphemic. Given that Kisa has underlying, concatenated and assimilated geminates, Kisa can be argued to have both pure geminates and geminate clusters.

The analysis and representation of Kisa geminates lends to the distinction between phonological rules and phonetic implementation rules. Phonetic implementation rules in Kisa with regard to gemination differ from phonological rules in terms of their gradient effect, variability, dependence on speech rate, and lack of interaction with the phonology. The geminates in Kisa, can be attributed to speech rate occurring mostly in fast, normal rate, and casual speech as opposed to slow, clear enunciation and careful speech. The phonetic motivations that lead to the creation of geminates in Kisa apply variably. Not all consonants in Kisa are a trigger for gemination and the deletion of vowels that occur between like consonants to create geminates only applies to short but not long vowels. Kisa derived geminates result from the syncopation of a short vowel to reduce the number of syllables induced by gradient without considering the phonological requirements of the language. Syncope leads to the loss of a mora, which is then compensated for in gemination, showing that phonetic implementation rules can also create phonological geminates.

In Kisa, the strength of morphological boundaries impacts the gemination properties of certain affixes and sounds. The phonetic properties of Kisa heteromorphemic geminates are determined by the word specific morphological segmentability of the affixes. Affixes with a weak morphological boundary are prone to phonological integration with their base through assimilation and gemination after syncope obliterates the morpheme boundary and obscurity of semantic and phonological transparency in the resultant forms. Heteromorphemic gemination, in Kisa is therefore a result of the obliteration of the morpheme boundaries obscuring segmentation.

The geminates that occur in Kisa can, therefore, be said to be both of the phonological and morphological type. Kisa has morphological geminates that behave like phonological geminates, seen from the behaviour of the phonological geminates in the language. Though the Kisa geminates are derived, given their, phonetic and morphological properties, their phonological properties warrant them to be analysed as phonological geminates. This shows the interplay between phonetics and morphology in determining and shaping phonological systems.

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This article does not contain any studies with human participants performed by any of the authors.