A FEATURE GEOMETRY EXEGESIS OF NDAU CONSONANT PHONEME INVENTORY

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Abstract

This research investigates the consonant phoneme inventory of Ndau, a once marginalized language spoken in the Chimanimani and Chipinge districts of the Manicaland province in Zimbabwe. The data for this study were collected mainly through intuition and secondary sources. The research identifies and characterizes the language's distinctive consonant phonemes using the minimal pair and set tests. The study utilises the constriction-based Feature Geometry (Clements & Hume, 1995) model to describe Ndau segment inventory. The study identified Ndau consonants which include aspirated, breathy-voiced, pre-nasalized, labialized, palatalized, and click consonants. The research categorised Ndau consonants into two main categories, namely, simplex, and complex segments. The Ndau simplex consonant phonemes are divided into Labial, Coronal, Dorsal, and Pharyngeal segments. The Ndau complex consonants are sub-categorized into compound place, secondary articulation, manner contour segments, and double complexity. The contribution of this research resides in the mono-segmental analysis of Ndau complex segments from a Feature Geometry perspective. The study has established thirty simplex consonant phonemes and fifty-one complex consonant phonemes. All these phonemes add up to eighty-one. This study contributes to Zimbabwean linguistics since Ndau, which has been closely associated with Shona for 82 years, shows that it differentiates simplex and complex consonant phonemes.

Keywords: Ndau, phonemes, simplex, complex, Feature Geometry

1. Introduction and background

The current study presents a formal analysis of Ndau phoneme inventory from a Feature Geometry perspective (Clements & Hume, 1995). The use of analytical tools from Feature Geometry makes it easy to account for the simplex-complex dichotomy of consonant phonemes. Furthermore, this study determines the articulatory features that are distinctive in this language and demonstrates the ways in which they differ with other dialects of Shona. It further argues for the mono-segmental treatment of Ndau complex consonants.

Ndau is an inter-territorial speech variety that straddles the artificial international boundary of Mozambique and Zimbabwe (Macgonacle, 2007). Ndau was made a dialect of Shona for eighty-two (82) years in Zimbabwe, but was ameliorated into a separate, officially recognised language in 2013 (Constitution of Zimbabwe Amendment (N0.20) Act 2013, p.17). In Mozambique, Ndau has been recognised consistently as a national language without any meaningful formal responsibilities (Sithole, 2017).

Doke (1931a) was the first comprehensive comparative analysis of

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Shona dialects with a view to move towards orthographic unification. The undertaking of bringing Shona dialects under a single orthography has been described as a "model of harmonization" (Msimang, 2000, p.169). Since Doke's official report of 1931, Shona has been considered as comprising five major dialects spoken in Zimbabwe: Zezuru, Karanga, Manyika, Ndau, and Korekore. The major reason why Doke's unification of Shona dialects is very successful is that there is mutual intelligibility between the five dialects. However, in his own admission, Ndau's intelligibility with the other dialects is lower than its counterparts that have over 80% mutual agreement. Also, Doke (1931a) proposes the sparing inclusion of Ndau in Shona grammar which was based on Zezuru and Karanga. Although the unification of Shona dialects is very important, there are, however, phonological differences among the dialects of Shona. This current study explores some of the phonological differences that set Ndau apart from Shona.

Jones (1911) provided some lessons on the pronunciation and orthography of Ndau. He referred to complex segments as 'consonant groups. This description does not clarify whether these segments are consonant clusters or complex segments. Chief among these consonants are affricates such as /pf bv ts dz dg tʃ dʒ/. He aptly concluded that the elements in a consonant group are so closely connected that the groups might almost be considered as simple sounds because they occupy a single C slot on the consonant-vowel (CV) tier in accordance with the syllable structure of Ndau, which is predominantly CV. Although his work was basically for teaching pronunciation, one can conclude that this offers a basis for the treatment of complex consonants in Bantu languages, that is, they should be treated as mono-segments.

Doke (1931b) described velarized consonants as on-homorganic combinations that are due to the action of the labio-velar semi-vowel [w] usually with labials. In describing velarization in Shona consonants, Doke (1931b) used digraphs, trigraphs and tetragraphs, that is, for velaralized bilabials /pk bg mŋ/ and for velarized coronals /tkw tskw ʤg/. Doke functionally regarded each of these as single consonants and not as consonant clusters, despite these multi-letter combinations for their representation (Doke, 1931b). Commenting on Doke's definition of velarization, Mathangwane (1999, p.107) noted that,

> His use of the term velarization for both (labialization and velarization) processes stems from his definition of velarization, given in which the labio-velar glide /w/ is simply referred to as velar semi-vowel instead of a labio-velar glide. Doke's classification which considers both plain velarization and secondary labialization under the same umbrella of velarization can be confusing to the reader. (.....) the labiality in the labio-velar glide is lost, changing the primary place of articulation of the sound into a velar.

What is realized is that there is a difference in the way [w] modifies the sounds. There is the raising of the back of the tongue, resulting in the velarization of some of the sounds whilst there is more latitude for lip rounding with others resulting in labialization. Both processes take place simultaneously with the major articulation. What is important is the degree and extent to which the articulatory organs are moved. As such, it is not possible to discuss one while totally ignoring the other.

As a follow up to Doke's (1931b) study, Maddieson (1989) examined velarization in Zezuru. He audio-recorded three Zezuru speakers at the University of Zimbabwe. Contrary to Doke's (1931b) phonetic analysis, Maddiesen (1989) noted that Shona does not have simultaneous coronal-dorsals. The velar element of velarized consonant is not co-produced with the coronal or labial element but follows without overlap. Furthermore, Maddiesen (1989) argued that post-velarized segments (Cws) should be best analysed as consonant clusters, where each segment enjoys full segmental status. Maddieson (1989) suggested that intrusive velars are complex onsets and not complex segments, because the intrusive velar is released after the preceding consonant, not almost simultaneous with it as Sagey's (1986) representation of intrusive velars suggests.

From a Feature Geometry (Clements & Hume, 1995) perspective, velarized consonants are treated as segments with place features with the non–dorsal component designated as the primary articulation. Therefore, the dorsal component [w] assumes the role of secondary articulation as in the [labial] element which indicates lip rounding. This study argues that complex consonants of this type are blocked from having separate stricture specifications for the places involved because stricture features apply to the primary place only; hence, the secondary articulation has no phonologically relevant stricture features. In this sense, there is a shared substructure in the feature of the velarized consonants. It is against such a background of scholarship on Shona phonology that this current study addresses the issue of simplex and complex segments in Ndau.

A phonological analysis of Ndau is worth pursuing because there is very little that is known about its phonology. Ndau is an under researched language, and descriptions such as this one are needed for posterity. Ndau phonology was partly studied by Mkanganwi (1973), Mutonga (2006), and Mutonga (2017). Mkanganwi (1973) described Ndau phonology from a descriptive perspective. He used the minimal pairs test to identify the Ndau segment inventory. The main difference between Mkanganwi's study and the current study is that the current study is rooted in generative phonology where the use of analytical devices of Feature Geometry (Clements and Hume, 1995) is presumed to present an insightful exploration of Ndau phoneme inventory.

1.1 Problem statement

Doke's (1931a) unification of Shona dialects is largely based on Karanga and

Zezuru phonology, leaving out unique phonetic and phonological features of Ndau. In addition, there is no comprehensive account of Ndau phonology in current descriptions of African (Bantu) studies. The phonological properties of Ndau may eventually get lost if a separate study on Ndau is not conducted. To address this problem, the current research, therefore, presents a detailed descriptive and theoretic account of Ndau consonant phoneme inventory.

2. Theoretical framework

This study utilises Feature Geometry (Clements & Hume, 1995) to describe the Ndau phoneme inventory. Feature Geometry describes the internal dimension of segments, that is, the features or ingredients that make the segments. This tenet of Feature Geometry is used in this study to explain and differentiate simplex segments from complex segments. In Feature Geometry, all phonological features are viewed as auto-segments, and their behaviour and possible interactions are explained and constrained in the model. Features are hierarchically grouped. Class nodes are also auto-segments and act as single units in phonological constraints.

Consonantal places of articulation attach to a C-Place node while vocalic articulations attach to a V-Place node (Green & Abbie, 2019). For consonants, the place features [labial], [coronal], [dorsal], and [pharyngeal] are dependent on the C-place node, whereas vocalic place features are dependent on the V-Place node (Clements & Hume, 1995). The V-Place node is attached to the C-Place node via a vocalic node in secondary articulation. Laryngeal features [voice], [spread glottis], and [constricted glottis] are placed under the Laryngeal node. Clements and Hume's (1995) model does not have the feature [pharyngeal], though they comment on it. Research has incorporated this feature taking into consideration the evidence that shows that the feature is needed to cater for the class of uvulars, pharyngeals, and laryngeals (gutturals), and the low vowel [a] (McCarthy 1994, 1988; Hayward & Hayward, 1989; Mudzingwa, 2010).

The model predicts that consonants and vowels that share place features form natural classes. For example, coronal consonants and front vowels form a natural class and the low vowels and pharyngeal consonants form a natural class (Moren, 2003). This aspect of the model explains the largely predictable vowel-consonant interactions in a straightforward way. The assumed feature geometry model also makes the prediction that the Aperture features and the V-Place features can function together as a single unit in phonological rules (Clements & Hume, 1995, p. 277). V-Place features can function as a unit independent of the Aperture features and vice versa. This is straightforwardly explained as the spreading of the V-Place node. In sum, the Feature Geometry theory is the best tool in capturing the complexity of the segments under investigation.

3. Methodology

The research philosophy that underpins this study is that generative linguistics studies are peculiar by utilising the linguistic intuition of a native speaker as a source of data. The core attribute of generative linguistics relates to methodology. Its methodology is scientific in character in so far as it formulates hypotheses and tests against evidence (Matambirofa, 2017). In practice, generative linguists can use themselves to make conjectures about linguistic facts and test them against the evidence provided by other native speakers of the language. The primary source of data in this research is intuition since the researcher is a native speaker of Ndau. Intuition is the data gathering method that is used widely in generative grammar studies (Haegeman, 1991). This introspective approach where a writer, as in the present case, uses oneself as an informant in the accumulation of data is what Newmeyer (1986) commented upon as follows. "[T]he typical practice of generativists has been to use themselves as informants in collecting data about the acceptability and interpretation of grammatical constructions (p.23)." The linguistic competence of the researcher is a language ability that he shares with other speakers of the Ndau language.

It cannot be expected that the researcher's introspective judgments on Ndau constructions will always be accurate. With this view in mind, the researcher, where he deemed necessary, therefore checked on the grammaticality and/or acceptability of utterances against the collective linguistic and/or grammatical competence of other native speakers of Ndau in Chipinge and Chimanimani Districts. In this regard, the researcher purposively sampled twenty-five native speakers of Ndau in the two districts mentioned above. The data were also verified by ten church members of United Church of Christ in Zimbabwe. The choice of these church members was necessitated by the fact that Ndau is the official language of this church such that all church sermons and hymn books are in Ndau. Hence these members have a higher degree of competence in the language.

The use of multiple informants was done to provide a control against individual idiosyncrasies, whether due to differences in the shape of speech organs, different personal histories, or other factors. This concurs with Kadenge (2008) who noted that to make valid inferences about a particular language, consultation with several informants is to be preferred. The data gathered was recorded in audio form and transcribed in a quiet place to avoid unnecessary noise from people who were not part of this research. All data presented in this study were also verified by Doctor Mlambo, native speaker of Ndau. He is an Executive Director of the *ChiNdau Cultural Association*. He is also a director of *ChiNdau Chemene Project* where he writes textbooks for primary and secondary schools with a view of having Ndau taught as a subject in Chipinge and Chimanimani districts. Some data was also collected from Ndau written materials such as Mkanganwi (1973) and Mutonga (2017).

4. Results and discussion

This section provides a formal analysis of the Ndau consonantal inventory and the features that are assumed for consonants. While Jones (1911) and Mkanganwi (1973) described Ndau complex consonants as 'multi-segment consonants' and 'consonant groups', this study considers them as single, unitary segments for reasons to be outlined in subsequent sections. Based on their articulation, Ndau consonants are divided into two categories: simple and complex segments. According to Clements and Hume (1995), a simple segment consists of a root node characterised by at most one oral articulator feature. A complex segment has a root node characterised by at least two different oral articulator features, representing a segment with two or more simultaneous oral tract constrictions. The next section discusses simplex consonants.

4.1 Ndau simplex consonant phonemes

This section presents the Ndau consonant phoneme inventory, with special reference to simplex consonants.

4.1.1 Simplex labial phonemes

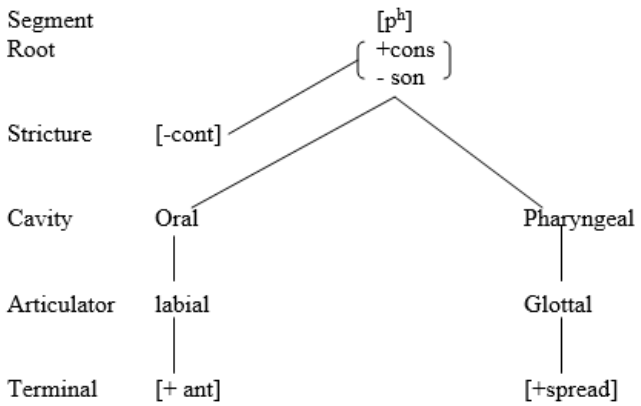
Ndau has nine simplex labial consonants. These labial consonants are distinguished as bilabials and labio-dentals. This gives these sounds the distinctive place feature [+labial]. Ndau consonants with [labial] as their major place articulator feature are /p b̤ pʼ ph m ɓ f v̤ ʊ/. Table 1 presents the simplex labial sounds.

Table 1: Simplex labial sounds

	Bilabial	Labio- dental
plosive	p b̤	
ejected	pʼ	
aspirated plosive	ph	
implosive	ɓ	
fricative		f v̤ ʊ
nasal	m	

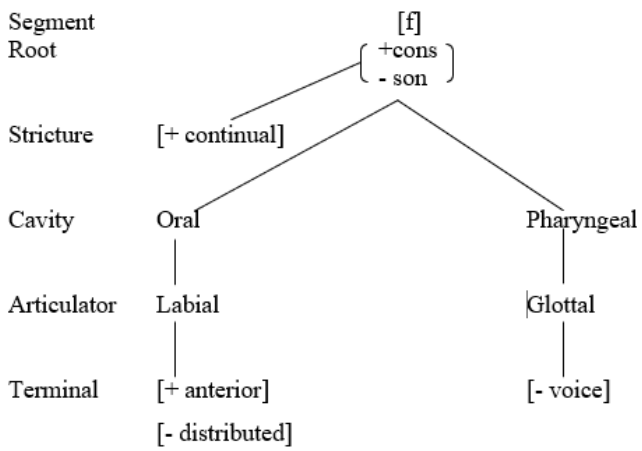
The labial consonants presented above are all simplex consonants because they are characterised by at most one articulator feature which is labial. This is explained by the fact that the feature [labial] designates sounds that are produced with the lip articulator. The feature [+round] is used to describe sounds that are produced with a lower lip as an active articulator. This is demonstrated by Figure 1 below.

Figure 1: /ph/ as a simplex labial consonant



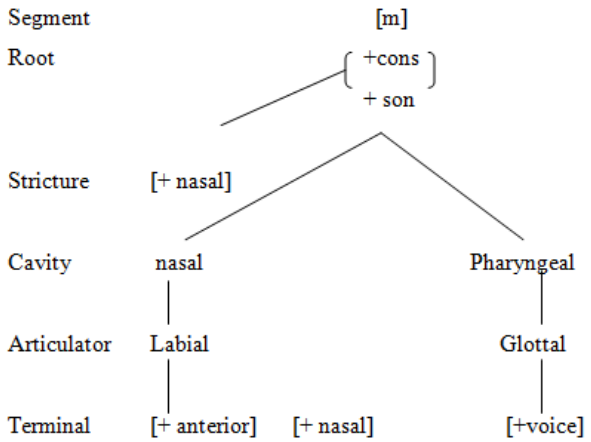
As shown on the feature tree above, the plosive /p/ is a simplex bilabial consonant because it has a root node that is characterised by one oral feature [labial]. The labial fricatives are also simplex because they share the same articulator feature [labial] with their plosive counterparts. The bilabial plosives can be distinguished from the labial fricatives by the feature [-continuant]. This is shown in Figure 2 below, for the voiceless labio-dental fricative /f/.

Figure 2: /f/ as a simplex labial consonant



The plosive /p/ is also different from the labial nasal /m/ because the labial nasal is [+nasal]. This is exemplified by Figure 3 below.

Figure 3: /m/ as a simplex labial consonant



The figures above demonstrate that all Ndau [labial] consonants are simplex. This is accounted for by the fact that they share a similar root node which is characterized by one oral articulator feature [labial]. Moren (2003) argued that the feature that distinguishes bilabials and labiodental /p/ versus /f/, /v̤/, using Clements and Hume's (1995) Feature Geometry, is not clear. He argued that there is a need to have the place feature [labiodental] and therefore, features [labial] and [labiodental] distinguish/p/ from /f/. However, this research argues that this difference is captured by the feature [continuant] because /p/ is [-continuant] and /f/ is [+continuant].

In summation, the simplex [labial] phonemes of Ndau, that is, /p p' ph b̤ ɓ m f v̤ ʊ/ are distinguished by the interaction of the root features [cons] and [son], the laryngeal feature [voice] and the stricture features [continuant] and [nasal] as shown in the above figures. The aspirated labial plosive /ph/ is different from the unaspirated counterpart /p/ in terms of laryngeal features because the aspirated plosive is produced with a spread glottis and the unaspirated counterpart is [+voice].

4.1.2 Simplex coronal phonemes

Coronal consonants can be distinguished as alveolar, alveo-palatal, and palatal consonants. The alveolar consonants/s z t th d̤ n r ɬ ɮ l/ are characterized by the features [+coronal] and [+anterior]. In Feature Geometry, [anterior-coronals] are viewed as segments with a coronal node dominating the feature [+anterior]. The palatal nasal /ɲ/ is characterized as [+coronal] and [-anterior]. Table 2 below presents a simplified list of Ndau coronal consonants.

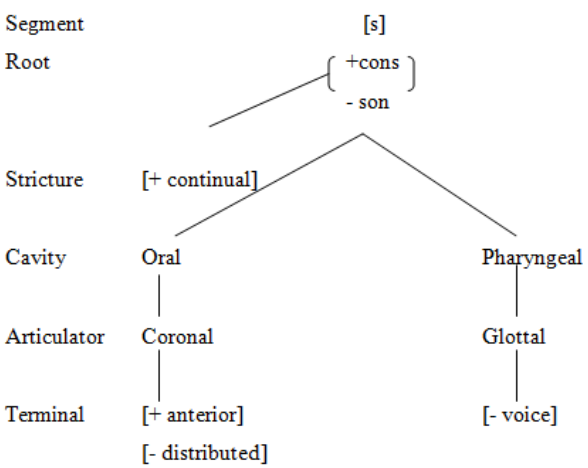
Table 2: Simplex coronal sounds

	alveolar	Palatal
plosive	t d̪	
Implosive	ɗ	
Aspirated plosive	th	
Nasal	n	ɲ
Lateral fricative	ɬ ɮ	
Lateral approximant	l	j
trill	r	

The [+coronal] consonants in Table 2 are divided into plosives, implosives, aspirated plosives, nasals, fricatives, lateral fricatives, lateral approximant, and a trill. The [coronal] consonants in the above table are simplex because they are characterised by one articulatory feature [+coronal].

Figure 4 illustrates the simplex nature of the coronal consonants.

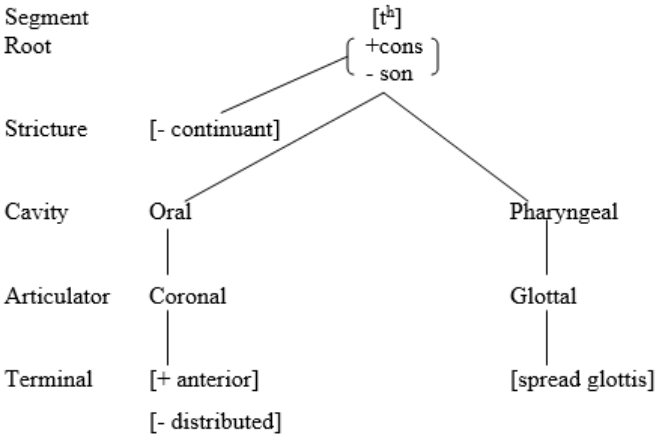
Figure 4: /s/ as a simplex coronal consonant



The above diagram captures the fact that /s/ is a simplex consonant because it is characterized by one articulatory feature, [coronal]. This means that /z̪/ is also simplex because it shares the same place of articulation with /s/. The two simplex coronal fricatives are distinguished from each other in terms of phonation because /s/ is [-voice] and /z̪/ is [+voice].

Figure 5 demonstrates the status of the aspirated voiceless coronal plosive /th/.

Figure 5: /th/ as a simplex coronal consonant



The figure above indicates that /th/ is a simplex segment because it has a root node that is characterised by a single oral articulator feature [coronal]. It differs from /t/ in that /th/ is marked for [+spread glottis] because it is produced with an extra puff of air, whereas in /t/ is unmarked. These two segments /th/ and /t/ are different from /d̰/ because /d̰/ is [+ voice]. This explains the fact that /t/ and /d̰/ are also simplex because they share the same articulatory feature [coronal]. The liquid /l/ is also a simplex coronal segment. It is distinguished from all other consonants by the feature [+lateral]. From the illustrations above, it is clear that the class of Ndau [coronal] phonemes is differentiated by a combination of the root feature [sonorant], the laryngeal feature [voice], the stricture of features [continuant], [nasal], and [lateral].

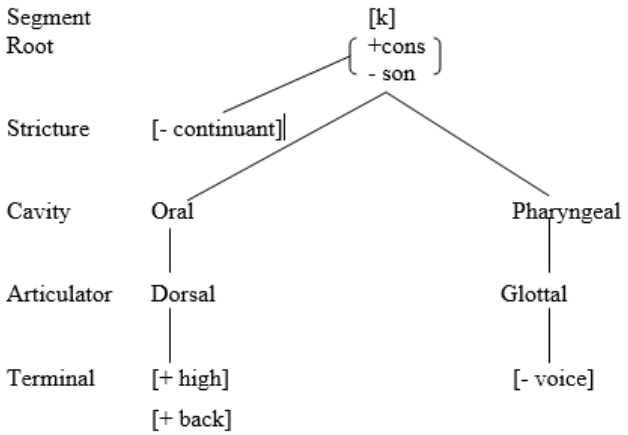
4.1.3 Dorsal simplex phonemes

In Ndau, there are five dorsal simplex segments, namely /k kh k' g̰ ŋ/. All five are velar consonant phonemes. The dorsal segments are presented in Table 3:

Table 3: Dorsal simplex consonants

	velar
plosive	k g̰
nasal	ŋ
Aspirated plosive	kh
ejective	k'

Figure 6: /k/ as a simplex dorsal consonant



The diagram above demonstrates that /k/ is a simplex consonant because it has a root node characterized by a single oral articulatory feature, [dorsal]. The fact that it shares the same place of articulation with /g̈/ shows that the latter is also simplex. The difference is on laryngeal features where /k/ is [-voice] and /g̈/ is [+voice]. Similarly, /ŋ/ is a simplex consonant because it shares the same place of articulation with /k/. The difference is that /k/ is [-continuant] and [-nasal] whereas /ŋ/ is [+ continuant] [+nasal]. However, they are all characterized by one oral articulatory feature which is [dorsal]. The difference between /k/ and the ejected /k'/ is the fact that /k/ is produced by a pulmonic airstream mechanism while the ejected /k'/ is produced by a glottalic airstream mechanism. Furthermore, the laryngeal features for /k/ and /k'/ are different because /k/ is [- constricted glottis] and /k'/ has [+constricted glottis].

The velar nasal /ŋ/ is also a simplex dorsal segment. It is different from other dorsal consonants because it is [+nasal]. Ndau has one velar nasal, a fact that reflects the markedness of this segment type in comparison to alveolar and labial nasals. As Maddieson (1984) reported, the presence of /ŋ/ in a language implies the presence of both /m/ and /n/ but not vice versa.

5.1.4 Glottal simplex consonant

In Ndau, there is one glottal phoneme/ɦ̈/. It is distinguished from other phonemes in Ndau by the place of articulation feature [glottal]. The glottal fricative /ɦ̈/ is an obstruent just like any other fricative in Ndau. However, it is distinguished from other consonants in Ndau by the place of articulation [glottal] as shown below:

Figure 7: /ɦ̪/ as a simplex glottal consonant

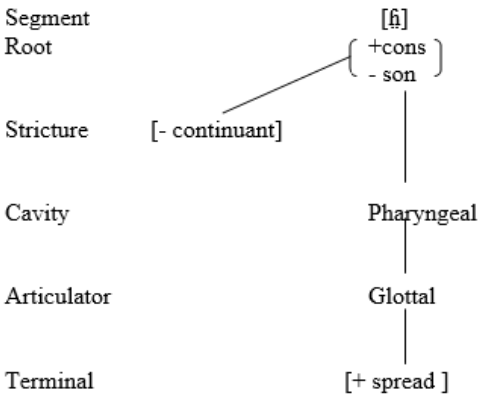


Figure 7 illustrates the fact that /ɦ̪/ is a simplex consonant because it has a root node that is characterised by a single oral articulatory feature, [pharyngeal]. All the consonants discussed in this section are simplex consonants because they have root nodes that are characterized by one oral articulator feature which can be [labial], [coronal], [dorsal] and [pharyngeal].

Table 4 below presents a summary of Ndau simplex consonants.

Table 4: A summary of Ndau simplex consonant phonemes

	bilabial	Labio-dental	dental	alveolar	Alveo-palatal	palatal	velar	glottal
plosives	p b̪			t d̪			k g̪	
Aspirated plosives	ph			th			kh	
ejectives	p’						k’	
implosives	ɓ			ɗ				
nasals	m			n		ɲ	ŋ	
trill				r				
Voiced Lateral				l				
Lateral fricatives				ɬ ɮ				
fricatives		f v̪		s z	ʃ ʒ			ɦ̪
tap		ʋ						
glide						j		

Source: Fieldwork, 2021

4.2 Ndau complex consonants

A complex segment is defined as a segment with two oral articulatory features (Clements &Hume, 1995). Ndau has four types of complex consonants, namely, compound place consonants, manner contour segments, secondary articulation, and double complexity.

4.2.1 Compound place consonants

A compound place consonant is defined as a segment that has more than one articulatory node and more than one articulator, and therefore participates in realising the constriction specified by the manner features in the root (Gussenhoven & Jacobs, 1998). These sounds are also called double –articulated sounds (Gussenhoven & Jacobs, 1998). Sounds that are classified as compound place segments are labio-velar approximants, palatal approximants, palatal fricatives, palatal affricates, alveolar and dorsal clicks.

4.2.2 Labio-dorsal approximants

In Ndau, there are two labio-dorsal approximants, namely /w/ and /w̰2/. These segments are complex place consonants because they are characterised by two oral articulatory features [Labial- Dorsal].

Figure 8: /w/ as a complex place segment

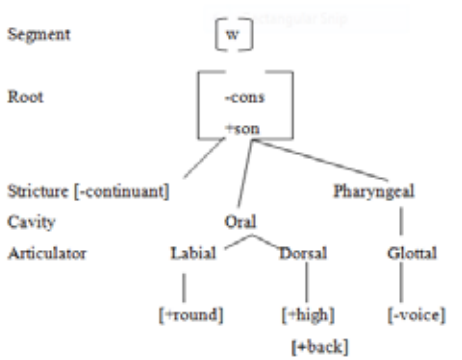


Figure 8 shows the fact that the labio-velar approximant /w/ is a compound place consonant because it has a root node that is characterised by two oral articulatory features [labial-dorsal]. This entails that its breathy-voiced counterpart /w̰/ is also complex because the two consonants share the same place of articulation features. They are distinguished from each other in terms of laryngeal features because /w/ is [+voice, -murmur] and /w̰ / is [+voice, +murmur].

2. /w/ is avoiced labio-velar approximant and /w̰/ is a breathy voiced labio-velar approximant.

4.2.3 Dorsal-coronal click

Ndau has two compound place clicks /g!/ and /!/. This click is both [dorsal] and [coronal]. As Ladefoged and Maddieson (1996, p.247) described, "every click has both a tip or blade action determining the type of click, and also an accompanying velar or uvular articulation." The [dorsal] closure is released to form a "sucking" sound with the other closure, that is, [coronal] or [labial]. The primary motivation for that analysis is that it is phonetically accurate in the sense that the segments in question do have two closures in the places specified by the articulators. The complexity of /g!/ is shown in Figure 9 below.

Figure 9: /g!/ as a compound place consonant

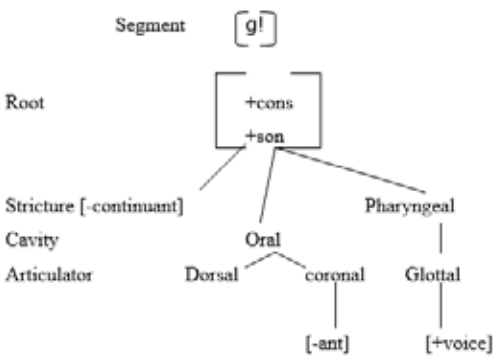


Figure 9 above shows that the dorsal click /g!/ is a complex segment because it is defined by an articulator node with two place features [dorsal-coronal**]**. The coronal-dorsal click is also a compound place click. The only difference is the fact that the coronal click /!/ is a compound place segment because it is defined by the features [coronal] and [dorsal] to indicate velar suction in the production of clicks. No other language has been found with coronal-dorsal segments. "When that happens, the segment is a click" (Howe, 2000, p. 55). Bennett (2014) argues that the featural analysis of clicks in Figure 9 diverges from the earlier view that the dorsal articulation in clicks is just a reflection of the lingual ingressive airstream mechanism (velaric airstream mechanism) and not a genuine consonantal articulation, which Maddieson and Ladefoged (1989, p.134) described as the 'traditional phoneticians' view'.

As opposed to alternative approaches, both traditional and recent, the compound place of analysis of clicks has several merits concerning phonetics, phonology, and typology. First, the cluster analysis and its systemic logic is compatible with major phonetic facts observed in relevant segments across different languages such as recorded and audible second posterior release burst in click clusters with stop offset versus its absence in units, despite the necessary posterior constriction to produce clicks (cf. Ladefoged & Maddieson 1996, p. 335). From a phonological perspective, the compound

place of analysis of clicks explains the language-internal and cross- linguistic structure of phoneme inventories in an elegant way. The advantages of the unit analysis of clicks as complex segments are also not compensated by the novel unit analysis of clicks in terms of "airstream contours" (see Bennett, 2014). Hence, the position that is maintained in this research is that clicks are compound place segments since the nature of the velaric airstream mechanism requires simultaneous closure at two places of articulation.

4.3 Secondary articulations

There are two types of secondary articulation in Ndau. These are post-velarization and post palatalization. It should be noted that all Ndau consonants with secondary articulation are treated as unit phonemes in the present study. In Feature Geometric terms, post-velarized segments have two place features that characterize them, one for the primary articulated segment and the other for the labio-velar approximant articulation [w]. During the articulation of the consonants, the lips are rounded in such a way that "the lips are used to form a vocalic articulation simultaneously with the articulation of these consonants" (Gussenhoven & Jacobs, 1998, p. 15). The featural representation of velarized segments is shown in Figure 10 below.

Figure 10: /pw/ as a complex consonant with secondary articulation

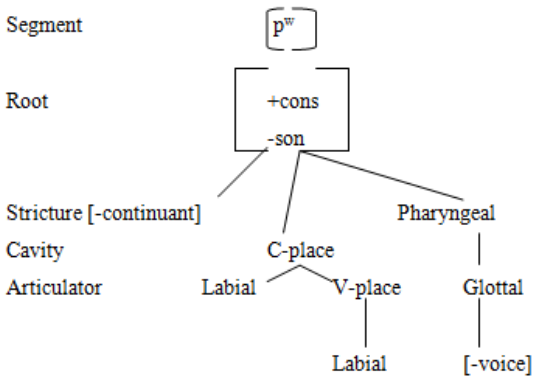


Figure 10 indicates that /pw/ as in /pwáʃà/ 'destroy' has two distinguishable articulations, thus making it a complex consonant. This is neatly accounted for by the fact that /pw/ has a root node that is characterised by two oral articulation features, namely, [labial] [labial]. The first [labial] oral articulator feature specification is for the [p] segment while the second [labial] specification is for the additional component specifying a vowel-like gesture of the lips for the labio-velar approximant (vocalic) element of the /pw/ segment. Therefore, Ndau velarized consonants are classified as complex segments in this study because they are characterized by multiple specifications for place of articulation, with primary and secondary places.

4.3.1 Post-palatalized consonant phonemes

Ndau has two types of post-palatalized consonant phonemes, namely the post-palatalized coronal plosive [tj] and post-palatalized coronal trill [rj]. These post-palatalized consonant phonemes are found in the following minimal pair, /ítjá/ 'be afraid' and /írjá/ 'eat'. These are secondary articulated consonants because they have two places of constriction, that is, for the primary articulation and for the vocalic segment /j/. A Feature Geometry representation of post-palatalized segments is shown in Figure 11 below:

Figure 11: Post-palatalized coronal trill

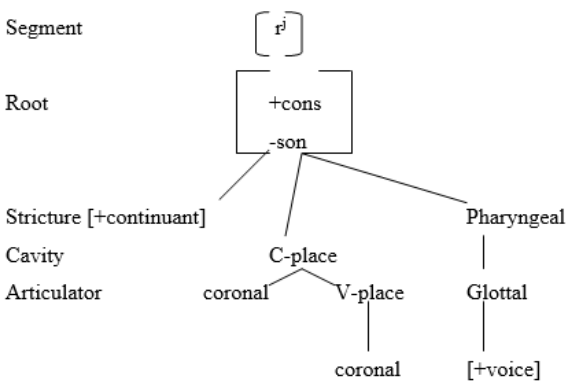


Figure 11 indicates that /rj/ as in /írjà/ 'eat' has two distinguishable articulations, and hence, is a complex consonant. This is in line with Sommerstein's (1977) definition of complexity, which says a complex segment is a segment which, for at least one feature [type], has two or more specifications. This is neatly accounted for by the fact that /rj/ has a root node that is characterized by two oral articulation features, namely, [coronal] coronal]. The first [coronal] oral articulator feature specification is for the [r] segment while the second [coronal] specification is for the additional component specifying a vowel-like gesture of the blade of the tongue for the palatal approximant (vocalic) element of the /rj/ segment.

While in Shona dialects like Zezuru and Karanga (Mutonga, 2017; Mudzingwa, 2010), secondary articulation is restricted to contexts in which consonants are followed by labial vowels, in Ndau, secondary articulation occurs with both labial and coronal vowels to post-velarized and post-palatalized segments respectively. Secondary articulation preserves the [labial] and [coronal] features by passing on the whole V-Place (Vowel Place) node of the vowel onto the preceding consonant, where it is realized as secondary articulation. Hence, this study argues that the secondary place on consonants is dependent on V-Place node which in turn is dependent on a C-Place (Consonant Place) node. Phonetically, that is in terms of their articulation, Cws are complex, hence the term complex segments, but phonologically, the post-velarized segments are simple onsets. That means

in onset position and in combination with a vowel, they make a CV syllable. The labial glide /w/ can combine with most simple and complex segments to form post-velarized segments.

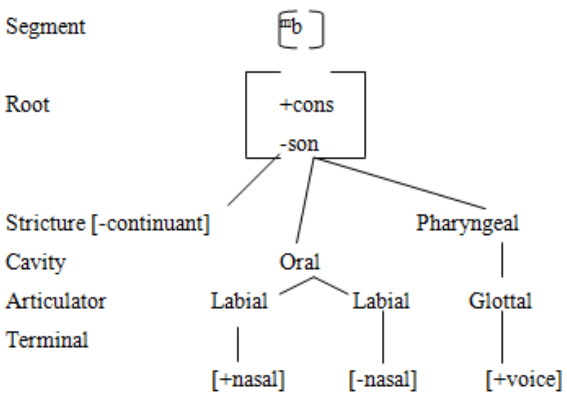
4.3.2 Manner contour consonants

There are two main types of manner contour consonants in Ndau, namely, affricates and prenasalised segments. Both types of consonants have triggered a lively debate on their representation. Manner-contour consonants change their constriction halfway through in such a way that they "have a sequence of differently valued occurrence of one same manner feature" (Gussenhoven& Jacobs, 1998, p. 195). In this study, these segments are treated as unit phonemes to maintain the syllable structure of Ndau as that of consonant-vowel (CV).

4.3.3 Prenasalized consonants

Prenasalized labial consonants are classified as complex consonants because they have a root node characterized by two manner specifications that occur simultaneously in the production of the consonants. The following feature tree shows a feature geometry representation of all prenasalized segments.

Figure 12: /mb/ as a manner-contour consonant



As shown in Figure 12, the features [+nasal] [-nasal] define a feature plane and the two specifications should be arranged in sequence as shown in the figure above. As a result, the feature tree has two manner specifications for a unit phoneme /mb/ such that it clearly resembles a complex consonant in Ndau. As already stressed in this study, such phonemes should not be treated as if they were a combination of [m] and [b]. This rules out the possibility of phoneme clusters in Ndau by restricting the syllable structure of Ndau to CV. Sagey (1986) argued that they can be represented by two ordered [nasal] values. However, this generalization is challenged by many phonologists, notably by Lombardi (1990) who argued that [+nasal] and [-nasal] are not chronologically ordered at all. This present research argues that Ndau

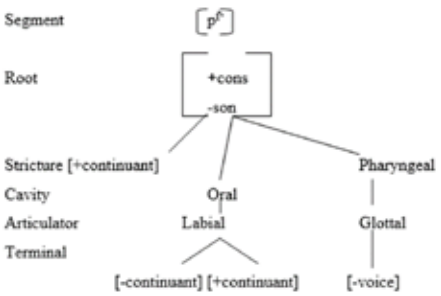
does not have a monovalent feature that is equivalent to [-nasal]. Similarly, Lass (1984) argued against using [-nasal] or the equivalent in underlying representations. The interesting observation here is that if we do not specify [-nasal] in prenasalized consonants, prenasalized sounds with plain voiceless stops are not distinguishable from plain nasals, for example [mb] and [m] have the same feature specification. In the analysis of prenasalized segments, the two 'contour' features [+nasal] and [-nasal] are situated on the same auto-segmental tier and therefore, both display 'edge effects.' This is in line with the tautosyllabic analysis of pre-nasalized segments in Bantu languages, whose first part has the features of a nasal segment and whose second part has those of an oral consonant. Prenasalised segments in Bantu languages such as Sukuma (Maddieson & Ladefoged, 1993), Luganda (Maddieson & Ladefoged, 1993), Kinyarwanda (Sagey, 1986) and Shona (Kadenge, 2010) have been analysed as unit segments. Several arguments have been marshalled in support of this approach which include durational properties, their inability to trigger pre-NC lengthening, and the tendency of native speakers to syllabify the nasal as an onset rather than a coda (i.e., V.NC rather than VN.C) (Casali, 1995; Morrison, 2009).

4.3.4 Affricates

Affricates are represented as internally-sequenced or contour segments whose first part has the features of a stop and whose second part has those of a fricative. Affricates are represented as a root node characterized by the sequence [-continuant] and [+continuant]. This single root node implies a single segment, and the contrasting feature values imply linearity of the dependent stop and fricative features. The two stricture elements are necessarily ordered as it is physiologically impossible to produce a closure and a narrow constriction at the same time. The chronological ordering of two values of a feature in the representation of affricates comes from the fact that affricates act like stops with respect to a preceding segment and like a fricative with respect to a following segment.

Since the major articulator of a segment must execute all its stricture features, then the affricate [-continuant] [+continuant] components cannot be implanted simultaneously since they 'involve the physically incompatible actions of narrowing and widening the vocal tract' (Kenstowicz, 1994). As a result, [-continuant] [+continuant] defines a feature plane and this can only be represented by arranging the two specifications in sequence as shown in the feature tree in Figure 13, which shows the feature specification for the ejected labial affricate /pf'/.

Figure 13: /pf/ as a manner-contour consonant



As shown in Figure 13 above, /pf/ is a complex consonant in Ndau. This also applies to its voiced counterpart /bv/. This observation is explained by the fact that it has a root node characterized by two manner features [-continuant] [+continuant]. This implies that /mv/ as in /mvura/ "water" is also a complex consonant in Ndau. These consonants share the same place of articulation with the same two manner specifications [-continuant] [+continuant] as shown in Figure 13 above. The only difference is that the [-continuant] of the /pf/ element is oral while the [-continuant] element of the /mv/ segment is a nasal. In other words, it is a "nasal affricate" as originally suggested by Mkanganwi (1973). The ordering of the features for the oral affricate is similar to a nasal affricate.

4.4 Double complexity

Some of the sounds that are already complex engage in secondary articulation as they gain more complex characteristics. This phenomenon was originally described by Kadenge (2008) as double complexity. These consonants are a result of both secondary articulations and contoured features. Besides having two place specifications; one to indicate the location of the manner of articulation and one to indicate a simultaneous vocalic articulation, they also change their constriction-type halfway through and consequently also have a sequence of differently valued occurrences of one same manner feature.

4.4.1 Prenasalized labialized consonants

The prenasalized labialized consonants are a result of the superimposition of the vowel quality features of tongue body activity to consonants that have two manner specifications of [+nasal] [-nasal] in sequence. Such consonants are treated as double complex segments because they have secondary articulation and prenasalization at the same time in the same segment. This can be illustrated by Figure 14 which shows the double complexity of /ndw/ as in /ríndwá/ "to be protected":

Figure 14a: /ndw/ as a manner contour segment

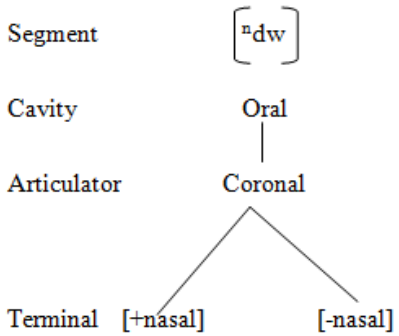
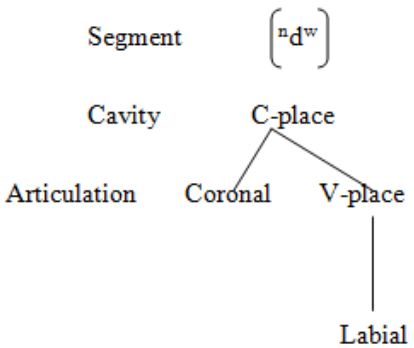


Figure 14b: /ndw/ as a complex consonant with secondary articulation



As shown in Figure 14 (a), /ndw/ can be treated as a prenasalized consonant wherein the [+nasal] specification is for the nasal element [n] of the segment /ndw/ while the [-nasal] specification is for the /dw/ element. Moreover, in Figure 14 (b), /ndw/ is captured as a complex consonant with a secondary articulation of labialization. This implies that /nʐ/ as in / nʐéŋgá/ "dodge, avoid" is also double complex. It has a root node with two manner specification as in Figure 14 (a) [+nasal] [-nasal] while at the same time it is treated as a complex segment with secondary articulation as shown in figure 14 (b) above. The secondary articulation is the labialization of the presenasalised segment /nd/. The only difference is that /nʐ/ is [-anterior] while /ndw/ is [+anterior]. This can further imply that /mbw/ as in /mbwánáná/ "puppy" is also a complex consonant in Ndau. It has a sequence of [+nasal] [-nasal] in time as shown in Figure 14 (a) above while it simultaneously has the addition of a place node to indicate additional lip-rounding. But the only difference is that /mbw/ is [Labial] [Labial] while /ndw/ is [Coronal] [Labial].

4.4.2 post-velarized affricates

Post-velarized affricates are classified as complex because they have a sequence [-continuant] [+continuant] while at the same time they have an additional vowel-like gesture specifying tongue body velarity. This can be shown by the feature trees below, which show the double complexity of /tʃw/ as in /tʃwáɲá/ “chop”:

Figure 15a: /tʃw/ as a manner contour segment

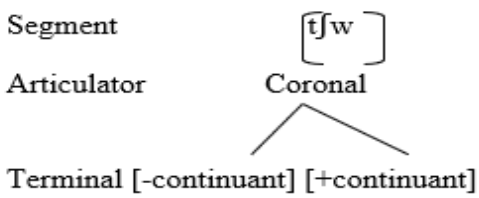
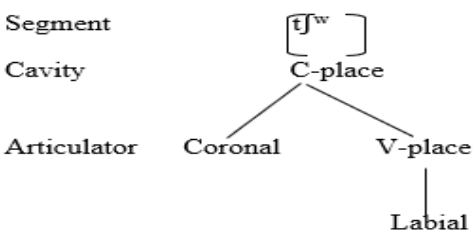


Figure 15b: /tʃw/ as a complex segment with secondary articulation



As shown in Figure 15(a) above, /tʃw/ involves the incompatible actions of narrowing and widening the vocal tract such that the root node in Figure 15 (a) has a sequence of [-continuant] [+continuant]. At the same time, it involves an additional place node to indicate the simultaneous vocalic articulation during the production of the consonant as shown in Figure 15(b) above. This implies that /dʒw/ as in /dʒwáɲá/ “smash with a heavy object” is also a complex consonant in Ndau. It has two manner specifications as shown in Figure 15(a) above and secondary articulation of labialization as shown in Figure 15(b).

Table 5 presents a summary of the Ndau complex consonant phonemes.

Table 5: A summary of Ndau complex consonant phonemes

	Bilabial	Labio-dental	Dental	Alveolar	Alveo-palatal	Palatal	Velar	Glottal
Prenasalized fricative	mv			nz				
Prenasalized lateral fricative				nɮ				
Prenasalized plosives	mp mb			nt nd			ŋk ŋg	
Prenasalized aspirated plosives	mph			nth				
Affricates	pf bv			ts tʂ dz dẓ	ʧ ʤ			
Aspirated affricates	pfh			tsh				
Ejected affricates	pf’			ts’	tʂ’			
Post-velarized affricates					tʃw			
Post-velarized Plosive	pwbw			twdw				
Post-velarized implosive	ɓw			ɗw				
Post-velarized Lateral				rw				
Prenasalized labialized segments				ndʒ	nẓ			
Prenasalized post-velarized segments	mbw			ndw		ŋgw		
Post-velarized Nasal	mw			nw				
click				!			g!	
Post-velarized fricatives		fw vw		sw zw				

Post-palatalized plosive				tj				
Post-palatalized trill				rj				
Labialized fricatives					ʂ ʐ̩			
Labio-velar glide							w w̤	

Source: Field work 2021

5. Conclusion

In summary, this research has presented an analysis of the Ndau phoneme inventory. The research has used Feature Geometry to explain the Ndau phoneme inventory. It has established thirty simplex consonant phonemes and fifty-one complex consonant phonemes. All these phonemes add up to eighty-one. The major advantage of using Feature Geometry is that it organizes features into feature trees, explaining the exact internal structure of the complexity of the phoneme. This method is preferred since it does not explain the complexity of these structures from a mere articulatory perspective but provides their internal make up. Four groups of consonants are analysed as complex consonants. These are compound place, secondary articulation, manner contour consonants and double complexity.

Works Cited

Bennett, W. G. (2014). Some differences between clicks and labio-velars. *South African Journal of African Languages,* 34(2), 115–126.

Casali, R.F. (1995). NCs in Moghamo: Prenasalized onsets or heterosyllabic clusters? *Studies in*African Linguistics,24(2), 151–166.

Clements, G. N. & Hume, E.V. (1995). The Internal Organization of Speech Sounds. In J.A. Goldsmith, (Ed.). *The Handbook of Phonological Theory,* 218-309. Oxford: Blackwell publishers.

Constitution of Zimbabwe Amendment Number 20. (2013).

Doke, C.M. (1931a). *Report on the Unification of Shona Dialects*. Salisbury: Government of Rhodesia.

Doke, C.M. (1931b*). A Comparative Study of Shona Dialects*. Johannesburg: University of Witwatersrand.

Green, C. R. & Abbie, E. H. (2019). A feature geometric approach to Bondu-so vowel harmony. *Glossa: A Journal of General Linguistics,* 4(1), 1–29.

Gussenhoven, J. & Jacobs, H. (1998). *Understanding Phonology*. New York: Oxford University Press, Inc.

Haegeman, L. (1991). Introduction to Government and Binding Theory. Oxford: Blackwell.

Hayward, K. M. & Hayward R. J. (1989). Guttural': Arguments for a new distinctive feature. *Transaction of the Philological Society, 87*(2),179-193.

Howe, D. M. (2000). Oowekyala Segmental Phonology.*Unpublished Phil Dissertation*. Britain: The University of British Columbia.

Jones, D. (1911). *The Pronunciation and Orthography of the Chindau Language*. London: The University of London Press.

Kadenge, M. (2008). The Phonology of Nambya.*UnpublishedDphil Thesis*. Harare: University of Zimbabwe.

Kadenge, M. (2010). Complexity in phonology: The complex consonants of simple CV- syllables in Zezuru. *Southern African Linguistics and Applied Language Studies,*28(4), 393-408.

Kenstowicz, M. (1994). *Phonology in Generative Phonology*. Cambridge MA: Blackwell Publishers.

Ladefoged, P. &Maddieson, I. (1996). *The Sounds of the World's Languages*. Cambridge, MA: Blackwell Publishers Ltd.

Lass, R. (1984). *Phonology:An Introduction to Basic Concepts*. Cambridge, UK: Cambridge University Press.

Lombardi, L. (1990). The nonlinear organization of the affricate.*NLLT, (*8), 375-425.

Maddieson, I. (1984). *Patterns of Sound*. Cambridge: Cambridge University Press.

Maddieson, I. (1989). "Prenasalized Stops and Speech Timing." Journal of the International Phonetic Association,19(2), 57-66.

Maddieson, I. & Ladefoged, P. (1989). Multiply articulated segments and the feature hierarchy. UCLA working papers in Phonetics, 72,116–138.

Maddieson, I. & Ladefoged, P. (1993). Phonetics of partially nasal consonants. In Huffman M.K. &R. Krakow, (Eds.), Nasals, nasalization and the velum, Phonetics and Phonology 5 (pp. 251-301). San Diego: Academic Press.

Matambirofa, F. (2017). The growth and development of Shona Grammar: A tribute to George Fortune. Unpublished Manuscript. Harare: University of Zimbabwe.

Mathangwane, J.T. (1999). Ikalanga Phonetics and Phonology: A Synchronic and Diachronic study. Carlifornia: CSLI Publications.

McCarthy, J. (1988). Unified Feature Geometry and Dependency a Review. Phonetica.

McCarthy, J. (1994). The phonetics and phonology of Semitic pharyngeals. In P.A. Keating, (Ed.), Phonological structure and Phonetic form: Papers in Laboratory Phonology III (pp. 191-233). Cambridge: Cambridge University Press.

Macgonacle, E. (2007). Crafting identity in Zimbabwe and Mozambique.

Rochester, NY: University Rochester Press.

Mkanganwi, K.G. (1973). An outline of the morphology of substantives in Ndau with preliminary note on Ndau phonology. Unpublished M Phil Thesis. London: University of London.

Morén, B. (2003). The Parallel Structures Model of Feature Geometry. Working Papers of the Cornell Phonetics Laboratory, 15,194-270.

Morrison, M. (2009). Homorganic NC sequences in Kibena: Pre-nasalized consonant clusters, or something else? *Rice Working Papers in Linguistics,*1, 223-241.

Msimang, T. (2000). The Nature and History of Harmonization of South African Languages.*Prah*, 165-172.

Mudzingwa, C. (2010). Shona morphophonemics: Repair strategies in Karanga and Zezuru. *Unpublished Dphil Dissertation*. University of British Columbia: Vancouver.

Mutonga, L (2006). Rephonologisation of English Loanwords in Ndau CV Phonology Perspective.*UnpublishedHonours Dissertation*. Harare: University of Zimbabwe.

Mutonga, L. (2017). The segmental phonology of Ndau: A multidimensional approach.*Unpublished Dphil Thesis*. Harare: University of Zimbabwe.

Newmeyer, F. (1986). *Linguistic theory in America*. New York: Academic Books.

Sagey, E. (1986). The Representation of Features and Relations of Features and Relations in Non- Linear Phonology. M. I.T New York: Garland Press.

Sithole, E. (2017). From dialect to 'official' language: The intellectualization of Ndau inZimbabwe.*Unpublished PhD Thesis*. Grahamstown: Rhodes University.

Sommerstein, A. H. (1977). *Modern phonology*. London: Edward Arnold.