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VOICE CONTRAST AND CUMULATIVE FAITHFULNESS IN LUWANGA NOUNS*

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Luwanga has a seemingly allophonic surface distribution of voiced and voiceless obstruents. This commonplace distribution typically requires the proposition that segments are specified as either [±voice] underlyingly, with their counterparts derived via phonological rule. Drawing evidence from consonant alternations in Class 9/10 nouns and their derivatives, obstruents contrast for [voice], at least in stem-initial position. Elsewhere, voice is non-contrastive. The outcome of this alternation, although transparent, cannot be captured in a standard constraint-based optimality theoretic framework and instead requires machinery employed to address surface opacity. This paper illustrates that the result of competing pressures to remain faithful to the underlying segmental structure, as well as to a consonant's specification for [voice], is the seemingly transparent but analytically opaque retention of marked structure. We illustrate that this type of cumulative faithfulness is best addressed via one of two evaluative mechanisms capable of capturing additive effects, namely Local Constraint Conjunction and Harmonic Grammar.

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1. Introduction

Luwanga [lwg] is a language of the Masaba-Luyia cluster (J30) spoken in Western Kenya by an unknown number of individuals, according to the latest Ethnologue (Lewis 2009). It is one of sixteen languages included in this group and has been classified recently by Maho (2008) as JE32A.[1] Luwanga is an underdocumented language with realatively few pre-existing materials, among them a vocabulary list created by an anonymous author (1940) and a more general Luyia vocabulary list and grammar published by Appleby (1943, 1947). Green's (in press) work on Luwanga is a more recent addition to the growing list of publications on this language group that have emerged in the last several years. References to these publications are included in §7.

The current paper explores characteristics of Luwanga's nominal morpho-phonology, particularly the behavior of nouns in classes 9/10 and their diminutive and augmentative derivatives found in classes 12/13 and 20/4, respectively. Collected data show that Class 9/10 nouns surface with one of two different manifestations of their prefixes (*iN*-[2] and *tsiN*-, respectively) depending on the nature of their stem-initial consonant. In certain instances, these prefixes surface faithfully (i.e. *iN*- and *tsiN-)*, while in others, the nasal consonant is removed (i.e. *i*- and *tsi*-). While the removal of a prefix nasal consonant is not an unusual phenomenon in Bantu languages, what is unique in the case of Luwanga is that the removal of this prefix consonant in a particular set of Class 9/10 correlates with the absence of the augment (or pre-prefix) in corresponding diminutive and augmentative nouns. In other instances, the augment in Luwanga is obligatorily present.[3] While the paradigmatic relationship between the prefix and augment in Luwanga is discussed in more descriptive detail in Green (in press), the difficulties that arise in formalizing

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[1] The three-letter code provided in brackets after a language name refers to its assigned ISO code. Other letter + number combinations are used customarily for Bantu languages to refer to their classification within a specific geographic zone. Data were collected by the first author from a 32-year-old male speaker of Luwanga from Musamba, Kenya, over the span of approximately 16 months.

[2] "*N*" indicates an archiphoneme nasal consonant that regressively assimilates to the place of articulation from the consonant that it precedes.

[3] A noted exception to this observation is Class 5 nouns where the prefix varies between [ɛli-] for vowel-initial stems and [li:-] for consonant-initial stems. This variation has no bearing on Class 6 plurals or other derivatives. As discussed in Green (in press), these derivatives are not affected owing to the preservation of mora count in both Class 5 prefix variants.

this phenomenon and its related characteristics in a theoretical framework have not yet been entertained. It is to this task that we turn in the current paper.

Both generative and optimality theoretic frameworks of phonology have little problem providing coherent bases and analytical explanations for a vast number of linguistic attributes, transparent processes, and non-opaque interactions found widely in developing and fully-developed languages. By developing languages, we are referring to the developing phonologies constructed by children at various stages of L1 language acquisition, while fully-developed languages are considered to be end-state adult phonologies. Literature in the field, however, has revealed that other processes and interactions challenge and oftentimes confound a given framework. In these cases, new machinery must be created and/or appended to it in order that it can once again adequately predict attested phonological phenomena. Among the processes that have come to challenge phonological theories are the well-known opacity effects – interactions producing forms that are either non-surface apparent or non-surface true (Baković 2010; Kiparsky 1971; McCarthy 1999). Best known among these effects are instances of underapplication (counterfeeding opacity) and overapplication (counterbleeding opacity) that have been well-attested in both developing and fully-developed languages (e.g. Baković in press, Dinnsen 2008, and references therein). Grandfather effects (McCarthy 2002) are another well-known type of opacity yielding interaction in which phonological processes are blocked from occurring in non-derived environments.

A number of mechanisms have been proposed to address these opacity effects in their various instantiations, among them Comparative Markedness (McCarthy 2002), Local Constraint Conjunction (e.g. Smolensky 1995; Łubowicz 2002; Smolensky 2006), Sympathy (McCarthy 1999), Parallel Optimality Theory (Prince & Smolensky 1993/2004), Optimality Theory with Candidate Chains (McCarthy 2007), and Stratal Optimality Theory (Bermúdez-Otero in press). It is expected that non-opaque or transparent data can be readily derived from a given underlying representation without resorting to this additional machinery. As we illustrate below, this is not always the case. For Luwanga, in the absence of opaque surface forms, machinery developed to address instances of phonological opacity must be invoked to account for the language's seemingly transparent distribution of obstruents that differ only in their specification for the binary feature [voice].

Our analysis proposes that transparent machinery cannot capture satisfactorily what appears to be the transparent and seemingly allophonic distribution of voiced and voiceless stops in the language. We propose that this unusual type of opacity is a manifestation of a particular *cumulative faithfulness effect*. More specifically, it represents an instance where the cumulative violation of multiple constraints on segmental faithfulness has the ability to 'gang up' on a higher-ranked markedness constraint thereby omitting a doubly-unfaithful output in favor of a more marked winner. In terms of cumulative faithfulness effects, the situation found in Luwanga is atypical, as discussed below in §7 and described in more detail in Farris-Trimble (2008). Better known examples of cumulative faithfulness involve instances in which low-level faithfulness constraints gang up on another higher-ranked faithfulness constraint. Given the role that cumulativity of violations plays in Luwanga, we propose that the behavior of obstruents in Luwanga is best captured in either an optimality theoretic framework utilizing the local conjunction of faithfulness constraints or in a harmonic evaluative framework utilizing constraint weighting.

The paper is organized as follows: First, we introduce components of Luwanga nominal morphophonology that bear on our analysis. Next, we consider more specifically data from Luwanga nominal stems and their diminutive and augmentative derivatives and illustrate the challenge that they provide for standard Optimality Theory (Prince & Smolensky 1993/2004). We then consider the adaptations to such an analysis that must be invoked to account for the Luwanga data and illustrate that the unique behavior of the language is accommodated by Local Constraint Conjunction and perhaps more successfully by Harmonic Grammar. Our discussion frames this unusual opacity effect alongside other instances of cumulative faithfulness. We close with a brief conclusion.

2. Luwanga morphophonology

Luwanga shares with its Bantu relatives a number of phonological and morphological characteristics, among them a system of grammatical genders known as noun classes. While the noun classes in many Bantu languages are similar, the number of noun classes present in a given language, the degree of semantic uniformity within a noun class, and the particularities of affixation (e.g. the obligatory use or disuse of certain morphological components) are largely language-specific.

In the case of Luwanga, the language utilizes 23 identifiable noun classes including eight singular/plural pairs, three locative classes (Classes 16-18), sub-classes for kinship terms (Class 1a/2) and uncountables (Class 6a), as well as a class for infinitives or verbal nouns (Class 15), and a singular-only class of abstract nouns (Class 14). A representative list of nouns from these classes follows in (1). A longer list of collected Luwanga nouns from classes 1/2, 1a/2, 3/4, 5/6, 7/8, and 14 is found in Appendix 1. Appendix 2 contains a more detailed list of nouns from Classes 9/10 and 11/10a alongside their corresponding diminutives and augmentatives. Data throughout this paper are presented phonemically, rather than orthographically, unless otherwise stated. Luwanga's sound inventory follows in (2), where allophones are given in parentheses.

(1) Luwanga noun classes[4]

Class	Noun	Gloss	Class	Noun	Gloss
1	omusaatsa	'woman'	2	abasaatsa	'women'
1a	kuka	'grandfather'	2	abakuka	'grandfathers'
3	omusaala	'tree'	4	emisaala	'trees'
5	liibeka	'shoulder'	6	amabeka	'shoulders'
7	eʃitari	'door'	8	efitari	'doors'
9	imbako	'hoe'	10	tsimbako	'hoes'
11	olubafu	'rib'	10a	tsimbafu	'ribs'
12	axatari	'small door'	13	orutari	'small doors'
14	obutʃena	'intelligence'			
15	oxukula	'to buy'			
16	anzu	'near the house'			
17	xuunzu	'on the house'			
18	muunzu	'in the house'			
20	okutari	'big door'	4	emitari	'big doors'

[4] Intervocalically, /b/ → [β], /x/ → [χ], and /ɹ/ → [ɾ]. Word-initially, /e/ → [ɛ], /o/ → [ɔ], and /l/ → [ɺ]. Long vowels are indicated by a double vowel. [ts] is a contrastive alveolar affricate. Classes 14 and 15 do not have plural counterparts. Classes 16, 17, and 18 contain locative nouns formed by replacing the agument of the base noun with the prefix of the locative class. Bantu languages typically have CV syllable structure, although NCV and CVN syllables are common.

(2) Luwanga sound inventory

	Labial	Labio-Dental	Alveolar	Post-Alveolar	Palatal	Velar	Glottal
Nasal	m		n		ɲ	ŋ	
Stop	p b(β)		t d			k g	
Fricative		f v	s z			x(χ) χ	h
Affricate			ts	tʃ dʒ			
Approx.	w		ɹ(ɾ)		j		
Liquid			l (ɺ)				
Vowel	i(iː), e(ɛ,eː), a(aː), u(uː), o(ɔ,oː)						

Of primary interest for this paper are nouns of the Luwanga singular/plural noun class 9/10 and the diminutive and augmentative singular/plural pairs of nouns derived from them found in classes 12/13 and 20/4, respectively. Diminutive and augmentative nouns are best considered derivatives of their counterparts based upon both their patterns of affixation and their paradigmatic relationship to one another, as described in Green (in press). As illustrated in (3), Luwanga nouns are constructed via affixation to the noun stem of the noun class prefix and, in most instances, an augment or pre-prefix. The order of affixation, *augment* + *noun class marker* + *stem*, is invariant, and we refer to the combination of *augment* + *noun class marker* as the *noun prefix* throughout.

(3) Class 1: omusaatsa 'man'

o + mu + saatsa
Augment + Class Prefix + Noun Stem

Noun Prefix

Nouns of Luwanga Class 9/10 are of particular interest to us owing to the segmental content of their respective noun prefixes, *iN*- and *tsiN*-, and the potential for these noun prefixes to be affixed to stems beginning with consonants of various types. The faithful maintenance of the underlying form of these prefixes when affixed to stems beginning with certain consonants, compared to the resolution of resultant impermissible NC̥ (nasal + voiceless consonant) sequences when affixed to other stems, reveals much about the overall phonological inventory of Luwanga and the morphophonological processes active in the language. Expanded study of the intricacies of these components in a lesser-known language like Luwanga is imperative given the spotlight that Bantu languages have occupied in debates and discussion of NC phonology. Bantu languages have been known to showcase the myriad ways that languages resolve varying permissibilities of certain NC combinations and have offered insight into phonological processes acting upon or in conjunction with these sequences. Furthermore, the study of these languages continues to contribute to the state of knowledge on syllable and moraic phonology (e.g. Broselow, Chen & Huffman 1997; Downing 2005, Hubbard 1995; Hyman & Ngunga 1997, Odden 2006), among other important issues in phonology and African linguistics in general (e.g. Hyman 2003, 2008).

The formation of Luwanga Class 9/10 nouns and their derivatives proceeds in much the same way as demonstrated in (3) for other noun classes. The augment, *i*- or *tsi*-, respectively, is affixed to the noun class prefix -*N*-, which is then affixed to the stem. This construction is illustrated in (4) for the Luwanga noun *iŋgato* 'sandal' alongside its singular diminutive and augmentative derivatives. These forms reveal that base nouns differ from their derived counterparts only in their noun prefix and showcase a surface voice alternation in stem-initial stops.[5]

[5] [t] ~ [d] and [k] ~ [g] are typical voiceless/voiced pairs in Luwanga, however the language lacks an alternation between [p] and [b]. Luwanga appears to have an inventory in which *[p] developed into [β], which then alternates with [b] in certain environments, as has been suggested for some other Bantu languages (e.g. Guthrie 1967; Meinhof 1932). Luwanga lacks the phone [p] except in loanwords borrowed from Kiswahili. [β] ~ [b], in Luwanga, alternate analogous to other voiceless/voiced pairs in the language.

(4) a. Voiced stem-initial stops after nasal

i-N-gato	iŋgato	'sandal'	Class 9
tsi-N-gato	tsiŋgato	'sandals'	Class 10

b. Voiceless stem-initial stops after vowel

a-xa-gato	axakato	'small sandal'	Class 12
o-ru-gato	orukato	'small sandals'	Class 13
o-ku-gato	okukato	'large sandal'	Class 20
ɛ-mi-gato	ɛmikato	'large sandals'	Class 4

What makes these particular nouns interesting in Luwanga is the distribution of alternating stops in stem-initial position (compared to elsewhere in the word) taken alongside the assumptions that one must make about their underlying representations. The details of this distribution and the descriptive anomaly that it poses for analyses of Luwanga nouns follow in Section 3. To be clear, our focus in this paper is on the subset of Class 9/10 nouns and their derivatives given that they offer the necessary conditioning environment in which to view the consonant alternations of interest to us. One could argue that the distribution of consonants and related effects discussed for Class 9/10 noun stems can be generalized at least to other noun classes (and perhaps to other lexemes); however, the formation of these other classes does not yield the appropriate conditioning environment within which to view these alternations. This can be seen from the presentation of Luwanga noun classes in (1) where only Class 9/10 (and 10a) contains a prefix nasal that has the potential to be deleted, thus triggering the observed alternation.

3. Distribution of consonants

At first glance, the distribution of Luwanga voiced and voiceless consonants appears to be a simple case of allophony. The consonant distribution of the language is such that [+voice] stops are found only in instances when they are preceded by a nasal segment. Their [-voice] counterparts are found in all other instances, i.e. word-initially and intervocalically. This distribution suggests that Luwanga stops do not underlyingly contrast for the feature [voice]. It would appear, therefore, that stops are specified as [-voice] underlyingly, and, in the presence of a preceding nasal, the [+voice] nasal segment progressively changes a following underlyingly [-voice] stop to its voicing specification. Viewing the distribution of these segments in Luwanga words like those in (5) poses no problem for this generalization, as one observes that [+voice] stops are found only in environments where they are immediately preceded by a nasal segment, while their [-voice] counterparts are found elsewhere; a classic illustration of allophonic complementary distribution.

(5) Typical stop distribution in Luwanga

a.	omukulo	'playmate'	f.	obusaaŋgafo	'happiness'
b.	efitari	'beds'	g.	obutuunduri	'bone marrow'
c.	kuka	'grandfather'	h.	omusuumba	'bachelor'
d.	amatumwa	'corn'	i.	oxulaaŋga	'to call'
e.	liibeka	'shoulder'	j.	oxulooŋga	'to make pottery'

A problem arises with this generalization, however, when confronted with Class 9/10 nouns with stop-initial stems. Consider a comparison between words like (6a-d) and (6e-h).

(6) Class 9/10 Nouns

	Class 9	Gloss	Class 10	Gloss
a.	imbako	'hoe'	tsimbako	'hoes'
b.	imbooŋgo	'bongo'(antelope)	tsimbooŋgo	'bongos'
c.	inda	'belly'	tsinda	'bellies'
d.	iŋgato	'sandal'	tsiŋgato	'sandals'
e.	ikwaaya	'armpit'	tsikwaaya	'armpits'
f.	ikweena	'crocodile'	tsikweena	'crocodiles'
g.	italani	'lion'	tsitalani	'lions'
h.	ibaka	'python'	tsibaka	'pythons'

These nouns may appear, at first, to be analogous to those in (4) and to support the proposal of allophony between voiced and voiceless stops. Once again, in (6), voiced stops are found only in environments following a nasal (i.e. [+voice]) consonant. A closer look at these nouns, however, reveals that positing that stem-initial stops of Luwanga Class 9/10 nouns are derived from underlying segments with an identical specification for the feature [voice] fails to provide motivation for their observed distribution. Let us consider more carefully a comparison between the nouns (6c) and (6g), *inda* 'belly' and *italani* 'lion', in which the nasal class prefix has been either retained or omitted, respectively.

Analysis of such nouns begins with what one assumes to be the underlying form of the constituent morphemes.[6] There are two distinct possibilities that one can propose for the underlying morphological construction of these nouns; however, it can be demonstrated that they both arrive at the same conclusion. On the one hand, one could posit that the Class 9/10 noun prefix consists of the augment, *i*-, and a null noun class prefix, therefore leading to | *i*- + Ø + stem | as the underlying morphological form of such nouns. A more supported assumption, based upon comparison to other Luyia languages and to Bantu languages in general, would be that the Class 9/10 noun prefixes contain the augment plus an underlyingly placeless nasal noun class prefix, -*N*-, that regressively assimilates the place of articulation specification of the consonant it precedes. This yields an underlying morphological form, | *i*- + *N* + stem |, for these nouns.

We begin by adopting the second, better-supported possibility. Because *inda* and *italani* are both Class 9 nouns, we posit that *iN*- is the underlying form of their noun prefix. Moving beyond this point, one would first posit, based solely upon the distribution of voiced and voiceless stops elsewhere in Luwanga, that these two nouns have stems containing the same underlyingly voiceless stem-initial consonant. It is here that the conundrum behind the [voice] specification of Luwanga stem-initial obstruents arises. If one assumes that the underlying form of 'belly' is /iN-ta/ and the underlying form of 'lion' is /iN-talani/, how then can one explain why, in the instance of 'belly', the attested Luwanga word is *inda* (having undergone progressive voicing assimilation, and therefore retaining its prefix nasal), while in the instance of 'lion', the attested Luwanga word is *italani* (having undergone nasal deletion)? If one were to maintain that these words are formed in such a way, one would fail to identify any factor or environment driving the choice of one process versus the other in these words. It would be necessary to assume that, if both contain obstruents with the same underlying specification for the feature [voice], the choice of voicing versus deletion would have to be lexically specified for each stem. As we illustrate next, this is not necessary if one considers a second alternative for the these nouns.

The alternative, although contrary to the seemingly allophonic surface consonant distribution noted elsewhere in the language, is to posit that stops (at least stem-initially, but perhaps in all instances) contrast underlyingly in their specification for

[6] For the sake of clarity, we utilize Class 9 singular nouns unless otherwise noted.

the feature [voice]. We broach this possibility in a more theory-neutral way here but discuss it in the light of the principles of *Richness of the Base* and *Lexicon Optimization* (Prince & Smolensky 1993/2004) below. By adopting this position, the observed distribution is motivated wherein Class 9 nouns with underlyingly voiceless stem-initial stops repair an impermissible morphologically-derived NÇ̥ sequence via nasal deletion (e.g. /iN-talani/ → [italani]), while nouns with underlyingly voiced stem-initial stops are free to maintain their nasal prefix, thereby surfacing faithfully (e.g. /iN-da/ → [inda]). This represents a clear diagnostic for determining the underlying specification of stem-initial stops for the feature [voice]. Furthermore, we now find an environmentally-conditioned motivation for the noted consonant distribution. That is to say, voiced stops are retained when they are preceded by a nasal consonant and devoiced elsewhere, while nasal + voiceless stop sequences are never found.

The situation is somewhat more complicated for stem-internal obstruents. It has been illustrated by the data and distribution above that Luwanga fails to exhibit a surface alternation in the feature [voice] for these segments. This differs from the unique behavior of stem-initial obstruents shown above that clearly indicate that a contrast must be in place in this more prominent stem-initial position.[7] While the Luwanga data illustrate that, in stem-initial position, the underlying [voice] specification for stops can be diagnostically determined; for stem-internal obstruents, however, no evidence can be found allowing one to posit a similar contrast. Then again, no evidence can be found to exclude a contrast either. On the one hand, based upon their seemingly allophonic distribution, one could assume that only voiceless obstruents are found underlyingly in stem-internal positions and are voiced by phonological rule. In such a situation, their distribution would be transparent in its own right. However, one could also posit that the underlying inventory of obstruents is identical in all stem positions and that their surface distribution is analogous to that

[7] This type of split distribution is not entirely uncommon in Bantu, and has been described in Hyman (2008). As Hyman explains, the Bantu stem is, in general, "the unambiguous locus of much phonological or prosodic activity." While he details such phenomena as harmony, assimilation, and reduplication across Bantu, of interest in this study is his discussion of the skewed distribution of consonants within the stem. Specifically in regards to Northwest Bantu languages (e.g. Koyo and Basaa), Hyman explains that "the consonant distribution and realizations point to an important edge-asymmetry in the stem phonology of Northwest Bantu languages. There is a marked decrease in the number of consonantal oppositions as one goes from left to right within the stem." Luwanga is spoken at great distances from these particular languages, however this appears to be a general feature of Bantu stems.

noted for stem-initial position, even though the morphophonology of the language does not permit one to identify a similarly telling alternation. This would also appear to be a transparent outcome, although one unable to be tested. This question is an impossible one to address in the synchronic state of Luwanga, although it could be informed in some respect by ongoing work on Bantu lexical reconstruction (e.g. Bastin & Schadeberg 2010; Bostoen 2008; Schadeberg 2003). Nonetheless, the principle of *lexicon optimization*, as argued for by Prince & Smolensky (1993/2004), states that when a surface form has the potential to result from more than one possible input, the input that would result in the fewest faithfulness violations between the underlying and surface forms is correct. Following from this principle, one would posit that stem-internal obstruents in Luwanga are underlyingly [-voice] and surface as [+voice] only by rule. Analytically, however, one must assume a rich base in which either underlying representation is possible.

To be clear, had we gone in a different direction and chosen the first and less cross-linguistically supported option where the Class 9 noun class prefix is a null morpheme, we would still arrive at the conclusion necessitating that we posit a contrast in stem-initial consonants. If we were to assume that no nasal prefix was involved and no underlying voice contrast exists in the inventory, we would have to explain, once again, the choice between the two surface options from the same underlying representation. In such a situation for the same words discussed above, one would posit the following mappings from the underlying to surface representations: /i + Ø + ta/ → [inda] 'belly' and /i + Ø + talani/ → [italani] 'lion'. In this case, we would be forced to predict the emergence of stem-initial [t] in the latter word versus some type of prenasalized consonant like [^{n}d] in the former, with no motivation or conditioning environment for one choice versus the other. This is certainly a less than satisfactory option. It would therefore be necessary here again to posit an underlying stem-initial contrast.

To conclude our introduction of the observed facts about the behavior of stem-initial stops in Luwanga Class 9/10 nouns, we must consider what becomes of them in instances where the stem-initial consonants are placed in another environment, namely following the VCV- noun prefixes of their diminutive and augmentative derivatives in Classes 12/13 and 20/4, respectively. The construction of these nominal derivatives was presented in (4) and reveals what appears to be intervocalic obstruent *devoicing* (e.g. iŋgato → axakato). While the other processes entertained thus far are common and phonetically-motivated (e.g. progressive post-nasal voicing (e.g. Hajek 1997; Maddieson & Ladefoged 1993) and nasal deletion before voiceless consonants (e.g. Ohala & Busà 1995; Ohala & Ohala 1993), the noted behavior of intervocalic consonants in Luwanga is unusual indeed.[8] One does not expect that a language employs different underlying representations for the same noun stem, and therefore we suggest that something more intricate is at play in Luwanga. It may be the case that a rule is active in the language that requires obstruents to be [+voice] post-nasally and [-voice] otherwise. This follows straightforwardly in stem-internal positions where no voicing contrast is observed for obstruents, and voicing is noted only allophonically after nasals. The situation is analogous in stem-initial positions where underlyingly voiced stem-initial obstruents are compelled to lose their [+voice] specification on the surface if they are not preceded by the Class 9/10 prefix nasal. A difference between the two instances lies in the fact that evidence is present in the form of a voiced/voiceless alternation in stem-initial obstruents. This fact supports the proposition of an underlying voice contrast. In stem-internal positions however, no overt alternation is witnessed, and thus one cannot support the proposition of a contrast, or lack thereof, in these instances.

With all of these seemingly transparent surface forms found in the language, it is surprising from an analytical standpoint that the overall result in the language is an unusual type of opacity, although clearly one that does not match Kiparsky's (1971) description of non-surface-apparent or non-surface-true phenomena. The resultant opacity, if one chooses to call it that, stems from competition in the language between the avoidance of segmental markedness alongside the comparatively less costly but cumulatively fatal accrual of multiple violations of segmental faithfulness. As we shall see below in §5, machinery developed for the purpose of addressing true opacities, in the Kiparskian sense, must be invoked to address this unusual opacity effect in Luwanga. That the data are truly transparent, rather than opaque, is clear in the ability for a non opacity-tolerant framework like Harmonic Grammar to capture these data successfully as well. This is demonstrated in §6.

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[8] This particular outcome can be captured in a rule-based analysis, but not without problems arising. Firstly, one could posit a simple rule of intervocalic devoicing, but as noted, this rule is poorly-motivated typologically and phonetically. Dinnsen (personal communication) has intimated that this outcome could potentially be captured via a disjunctive rule ordering relationship (Chomsky & Halle 1968) supported by the Elsewhere Principle (Kiparsky 1973), although such an analysis makes certain assumptions about the vacuous application of rules so ordered (see Kiparsky 1973 and Hastings 1974 for opposing views on this issue). This possibility is nonetheless entertained briefly in §4.

4. Standard analysis of Luwanga

The data above allow us to make several key observations about the phonology of Luwanga and the phonological processes underway in the language that interact to produce the surface distribution of voiced and voiceless obstruents that we have described. Thus far, we have encountered compelling evidence for the presence of a voicing contrast in stem-initial stops. We have illustrated that one is hard-pressed to predict the surface forms of Luwanga nouns, if one assumes a single underlying specification for the feature [voice] in stem-initial obstruents. Furthermore, we have shown that in stem-internal positions, the distribution of voiced obstruents is transparent. A valid theoretical account of Luwanga's phonology, then, must take into account the surface distribution of obstruents and any processes that affect this distribution.

From a derivational point of view, the Luwanga distribution of voiced and voiceless obstruents is relatively straight-forward and requires only two rules. One rule, Nasal Deletion, deletes a nasal before a voiceless obstruent, while another rule, Devoicing, devoices all obstruents that are not post-nasal. The structural descriptions of the two rules do not overlap, and so they do not interact. The relevant rules are formalized in (7).

(7) Luwanga derivational rules

Nasal deletion (ND):	N → Ø / __ [-voice, -sonorant]
Obstruent devoicing (OD):	[-sonorant] → [-voice] / [-nasal] __

Though these two rules are formally unrelated, they achieve similar results: both rules avoid the sequence of a nasal consonant followed by a voiceless obstruent. ND does this by deleting the nasal when the sequence is underlying, and OD restricts itself from applying only when it would create such a sequence. These rules thus show the hallmarks of a conspiracy (Kisseberth 1970). However, it is important to note that the ND rule resorts to deletion to resolve the prohibited sequence, rather than obstruent voicing, which would seem to be an equally good solution, particularly as such sequences are attested both word-internally and across morpheme boundaries (as in (5) and (6)).

Derivations for three of the most relevant Luwanga patterns are shown in (8). The devoicing process is illustrated in (8a) and nasal deletion in (8b). Neither rule applies to sequences of a nasal followed by a voiced obstruent, and so those sequences remain unchanged, as in (8c).

(8) Derivational account of Luwanga

	a. /axa-duuma/	b. /iN-takata/	c. /iN-duuma/
ND	--	i-takata	--
OD	axa-tuuma	--	--
	[axatuuma]	[itakata]	[induuma]

The rule-based account of Luwanga is somewhat unsatisfying, as mentioned above. While the restriction of voiced obstruents to the post-nasal position is not typologically uncommon, a rule *devoicing* non-nasal obstruents is. A more common rule would be one that actively voices post-nasal obstruents, particularly because we do not typically need rules to create *unmarked* sounds. Likewise, as noted above, the two rules are formally unrelated, but they function in a conspiracy. One solution to both problems is to turn to a constraint-based analysis in which a language's preference to allow or repair a particular marked structure is formally independent of the repair process.

The phonological phenomena in Luwanga discussed above can be formalized to some extent in a standard optimality theoretic framework (Prince & Smolensky 1993/2004), where evaluation of violations of a language-specific ranking of universal constraints can predict the noted consonant distribution in the language. One of the central tenets of Standard Optimality Theory is the principle of *strict domination*, which says that a single violation of a high-ranked constraint is more costly, phonologically speaking, than multiple violations of any single constraint ranked below it, or alternatively any combination of constraint violations assessed below it. In a framework utilizing strict domination, constraints on markedness and faithfulness are ranked hierarchically relative to one another according to the ways in which they interact, i.e. either critically or non-critically, to yield an optimal output candidate for the grammar.

The phonology of Luwanga is such that the phenomena under consideration can be discussed in terms of the relationships between four well-supported constraints: two markedness constraints and two faithfulness constraints. These markedness constraints are introduced in (9) and (10), while the faithfulness constraints are shown in (11) and (12).

(9) *NC̥ – No nasal plus voiceless obstruent sequences (Kager 1999)

(10) *VOIOBS – Voiced obstruent are banned (Ito & Mester 1998)

(11) MAX-IO – Every segment of S_1 has a correspondent in S_2, i.e. no deletion (McCarthy & Prince 1995)

(12) IDENT-IO[voice] – Output correspondents of an input [ɣ voice] segment are also [ɣ voice] (McCarthy & Prince 1995)

We begin by considering the antagonistic relationship between constraints (10) and (12), the first of which is a context-free markedness constraint that militates against voiced obstruents in any environment. The latter is a faithfulness constraint that protects against any change in the specification for the feature [voice] between the underlying and surface correspondents of a segment. The relationship between these two constraints is important in Luwanga, as seen in the formation of diminutive and augmentative derivatives from Class 9/10 nouns. In these forms, underlying stem-initial obstruents lose their [+voice] specification (a violation of ID[voice]) in order to satisfy the higher ranking constraint *VOIOBS. This represents a crucial relationship between these two constraints, as illustrated in (13).[9] (Rather than presuppose a static underlying specification for [voice] in all stem positions, we choose instead to appeal to *Richness of the Base* (Prince & Smolensky 1993/2004) in order to entertain any possible [voice] specification for stem-internal obstruents. The analyses below are shown with underlyingly voiced obstruents when there is no evidence to the contrary, but the analysis does not rely on this assumption.

[9] The criticality of the relationship between these two particular constraints is important here, as there exist other instances in Luwanga where one could argue that a particular candidate potentially violates one or the other of these constraints with the same outcome. A notable example is the possibility of post-nasal voicing in /iN-takata/ → *[indakata]. The attested output candidate is [itakata], which witnesses nasal deletion instead. The avoidance of *[indakata] taken separately could be said to result from a violation of either *VOIOBS or ID[voice]. However, as shown in (13), it is clear that these two constraints are separable, critically ranked in the Luwanga hierarchy, and therefore must be considered in the evaluation of all potential output candidates.

(13) *VOIOBS >> ID[voice][10]

/axa-duuma/ → [axatuuma] 'small yam'

	/axa-duuma/	*VOIOBS	ID[voice]
a.☞	axatuuma		*
b.	axaduuma	*!	

A second instance of competition between a context-free markedness constraint and its antagonistic faithfulness constraint is found in the choice for resolution of an NÇ̥ sequence via deletion of the prefix nasal. In such instances, faithfulness is once again violated in favor of satisfying the higher-ranking markedness constraint. The critical relationship between *NÇ̥ and MAX is illustrated in (14).

(14) *NÇ̥ >> MAX

/iN-takata/ → [itakata] 'chest'

	/iN-takata/	*NÇ̥	MAX
a. ☞	itakata		*
b.	intakata	*!	

The above tableau omits another relevant candidate, namely [inakata], in which the NÇ̥ cluster has been resolved by deletion of the obstruent, rather than the nasal. Such a candidate is a viable alternative but is dispreferred for a number of reasons. It deletes the first segment of the stem, which is a particularly privileged position in Bantu languages (Hyman 2008). Moreover, it deletes an onset segment, a privileged syllabic position, and the resulting nasal is a less satisfactory onset according to the Sonority Sequencing Principle (Clements 1990). Any of these explanations may account for deletion of the nasal rather than the obstruent, but because the stem onset

[10] In a standard optimality theoretic analysis and accompanying violation tableaux, the critical versus non-critical relationship between individual constraints or constraint tiers is indicated by the use of solid versus dashed lines, respectively. Constraint violations are shown by '*', and a fatal violation (i.e. eliminating a potential output candidate from further evaluation) is marked by '!'. A winning candidate is marked by the manual indicator '☞'.

has been shown to be privileged in Bantu, we appeal to a constraint requiring correspondence in the initial stem position: ANCHOR-L, as in (15).

(15) ANCHOR-L_{Stem}: Any elements at the designated periphery of S_1 has an elements in the designated periphery of S_2 (McCarthy & Prince 1995)

If high-ranked in the grammar, as one might expect in Bantu languages, this constraint eliminates the problematic candidate, as in (16).

(16) ANCHOR-L[Stem], *NC̥ >> MAX

/iN-takata/ → [itakata] 'chest'

	/iN-takata/	ANCHOR-L_{Stem}	*NC̥	MAX
a. ☞	itakata			*
b.	inakata	*!		
c.	intakata		*!	

Because it is never violated, the ANCHOR-L constraint and the candidates that it eliminates are omitted from subsequent tableaux.

Along these same lines, one observes that another possible repair for an impermissible NC̥ sequence could be to voice the stem-initial voiceless obstruent progressively. We know, however, that the chosen repair is deletion, as shown above. It is possible in these situations that either the markedness constraint *VOIOBS or the faithfulness constraint ID[voice] could be argued to protect against /iN-takata/ → *[indakata]. However, as we saw in (13), *VOIOBS is critically ranked above ID[voice]. Therefore, in a strict domination analysis, a violation of the higher-ranked *VOIOBS would prove fatal. This relationship is illustrated in (17).

(17) *NÇ̥, *VOIOBS >> ID[voice], MAX

	/iN-takata/	*NÇ̥	*VOIOBS	ID[voice]	MAX
a. ☞	itakata				*
b.	intakata	*!			
c.	indakata		*!	*	

The result of this constraint ranking is striking for voiced obstruent-initial stems. We have seen evidence of alternations above indicating that an underlying [voice] contrast can be posited in these stem-initial positions. We have seen that the outcome in Luwanga is a fully faithful mapping of the input to the surface. Therefore, in such instances, one observes an outcome like /iN-duuma/ → [induuma] 'yam', which is the non-diminutive form of the noun in (13). Given what we already know about the constraints at play in Luwanga and their ranking, it is perhaps surprising that an outcome like /iN-duuma/ → *[ituuma] is ungrammatical. In this potential output candidate, the language would satisfy both high-ranking markedness constraints at the same time by removing a voiced obstruent (i.e. avoiding a *VOIOBS violation) and deleting a nasal (i.e. avoiding an *NÇ̥ violation). In turn, however, this result would necessitate violating both of the lower-ranked faithfulness constraints ID[voice] and MAX by both changing the input specification for [voice] and removing a nasal segment, respectively. As the Luwanga data reveal, however, this is not the outcome. The language instead prefers to violate a single higher-ranked markedness constraint (i.e. *VOIOBS) in order to avoid violating the two lower-ranked faithfulness constraints at the same time. The result is a fully-faithful but more marked output candidate. Consider this outcome as illustrated in (18) where the attested but unpredicted winner is indicated by '☹'.

(18) *NÇ̥, *VOIOBS[11] >> ID[voice], MAX

		/iN-duuma/	*NÇ̥	*VOIOBS	ID[voice]	MAX
a.	☹	induuma		*!		
b.		intuuma	*!		*	
c.		iduuma		*!		*
d.	☞	ituuma			*	*

As tableau (14) indicates, the predicted winner in a strict domination evaluation of these potential output candidates is (14d), wherein both high-ranking markedness constraints are satisfied via the violation of two low-ranking faithfulness constraints. This outcome is clearly problematic given that it is unattested. The attested winning candidate (14a) is not predicted given that it violates the high-ranked *VOIOBS markedness constraint. In this case, then, Luwanga prefers a candidate that violates a higher ranked markedness constraint over one that is doubly unfaithful to the input. It is here that the 'opacity' noted in Luwanga comes into play. While the surface distribution of voiced and voiceless stops is transparent, the phonological grammar so stated overpredicts the desire of the language to avoid marked structures. Thus, a standard optimality theoretic analysis fails to predict the correct transparent output. This is due to the fact that such an analysis cannot capture the *gang effect* of cumulative faithfulness that is now seen to be in play in Luwanga.

In order to compensate analytically for this cumulative faithfulness effect, one must employ supplementary machinery in an optimality theoretic analysis to capture the attested winner. The following sections entertain two distinct possibilities to address this issue. Section 5 proposes that a strict domination account utilizing Local Constraint Conjunction (e.g. Smolensky 1995; Łubowicz 2002, 2003, 2005; Moreton & Smolensky 2002; Smolensky 2006) is one method of addressing this phenomenon in Luwanga. Section 6 next explores an alternative to strict domination that utilizes

[11] A potential solution to this ranking paradox would be to reformulate the constraint *VOIOBS so that it only applied to intervocalic obstruents. This solution parallels the obstruent devoicing rule in the derivational account. Candidate (18a) would not violate the reformulated constraint and would win. This would create a tie between candidates (18a) and (18c), however, making post-nasal voicing and nasal deletion equally good repairs for a nasal+voiceless obstruent sequence. Morever, unlike derivational rules, OT constraints are assumed to be universal, and such a typologically unattested constraint is unlikely to be found in CON.

weighted constraints in a Harmonic Grammar framework (e.g. Farris-Trimble 2008; Legendre, Miyata and Smolensky 1990a, 1990b; Smolensky & Legendre 2006).

5. Cumulative faithfulness in Luwanga

The account above demonstrates that Luwanga has a process of obstruent devoicing, as in (13), and another process of nasal deletion, as in (14). These two repairs are allowed individually, but not together within a single nasal-obstruent sequence; in this case, Luwanga prefers to allow the marked output (i.e. a voiced obstruent), as in (18). This behavior examplifies a cumulative faithfulness effect (CFE; Farris-Trimble 2008). This class of effects results when a language allows multiple individual unfaithful mappings, but does not allow those unfaithful mappings to co-occur within a given domain. CFEs, in general, are unusual from a theoretical standpoint in that they tend to produce transparent outputs but require mechanisms normally suited for opacity effects. As shown above, standard OT cannot account for CFEs, in spite of their transparency, because of the principle of strict domination (Prince & Smolensky 1993/2004). There is no way in classic OT for multiple low-ranked constraints to 'gang up' on a higher ranked constraint, but this seems to be exactly the case in CFEs like Luwanga. It is thus necessary to appeal to an account that can deal with gang effects.

One mechanism that has been developed to address such issues is Local Constraint Conjunction (LCC; e.g. Smolensky 1995; Łubowicz 2002; Smolensky 2006). In an LCC account, two low-ranked constraints are "conjoined" to create a new constraint that is only violated if both its components are violated within a local domain. The conjoined constraint is typically assumed to be in a fixed ranking above either of the individual constraints. LCC is a convenient solution to the cumulativity problem because it essentially overrides strict domination. If the locus of violation of two constraints overlaps, then those constraints may conjoin to eliminate candidates in which the two constraints are violated, even though candidates in which a single constraint is violated are allowed. The tableaux in (19) illustrate a cumulative interaction in LCC. (19a, b) show that the constraint C1 must be ranked above each of the constraints C2 and C3. In (19c), however, the conjoined constraint C2&C3 eliminates the candidate that violates both of the lower-ranked constraints. Note that had the conjoined constraint not been present, Candidate A would have won, even though it violates a greater number of constraints than Candidate B violates.

(19) Cumulativity in LCC

a. C1 >> C2

/input$_1$/	C2&C3	C1	C2	C3
a. ☞ candidate a			*	
b. candidate b		*!		

b. C1 >> C3

/input$_2$/	C2&C3	C1	C2	C3
a. ☞ candidate a				*
b. candidate b		*!		

c. C2&C3 >> C1

/input$_3$/	C2&C3	C1	C2	C3
a. candidate a	*!		*	*
b. ☞ candidate b		*		

LCC has been used to account for other cumulative effects. It can account for chain shifts by conjoining two faithfulness constraints, effectively eliminating a fell-swoop mapping (e.g. Kirchner 1996). LCC has also been used to account for derived environment effects by conjoining a markedness constraint with a faithfulness constraint, such that derived marked segments are penalized while underlying marked segments are not (Łubowicz 2002). LCC can be employed to account for the particular CFE observed in Luwanga via the conjunction of the two low level faithfulness constraints, namely MAX and ID[voice], within the domain of adjacent segments. Such a conjoined constraint MAX&ID[voice]$_{\text{Adj-seg}}$, when ranked above *VOIOBS, is fatally violated by a candidate that violates both relevant faithfulness constraints, i.e. a candidate that has undergone both nasal deletion and obstruent devoicing. This constraint is added in (20), and the new ranking correctly predicts the attested Luwanga data.

(20) MAX&ID[voice]$_{\text{Adj-seg}}$ – incur a violation for every instance where a candidate violates MAX and ID[voice] in adjacent segments

(21) MAX&ID[voice]$_{\text{Adj-seg}}$,*NC̥ >> *VOIOBS >> ID[voice], MAX

	/iN-duuma/	MAX&ID[voice]	*NC̥	*VOIOBS	ID[voice]	MAX
a.☞	induuma			*		
b.	intuuma		*!		*	
c.	iduuma			*		*!
d.	ituuma	*!			*	*

One could argue that this particular account is not intuitive. An evaluation utilizing Local Constraint Conjunction says that the language only wants to avoid deleting a segment in cases where it is adjacent to a segment that has changed in voicing. A change in the specification for the feature [voice] is, in theory, unrelated. As illustrated below in §6, an evaluation utilizing Harmonic Grammar infers that this state of affairs arises, instead, because Luwanga prefers a marked segment over a mapping that is too unfaithful. For these and other reasons discussed below and in Farris-Trimble (2008), a Harmonic Grammar account seems superior.

6. Luwanga in Harmonic Grammar

The LCC account required conjoining specific constraints, resulting in constructions like the one above. Another possibility is an account in which low-ranked constraints still have some power. An alternative to LCC that addresses this problem is Harmonic Grammar (Legendre, Miyata & Smolensky 1990a, 1990b; Smolensky & Legendre 2006). HG was a precursor to OT and was originally intended to model connectionist networks. Each phonological input and output can be thought of as a node in the grammar, with links between them symbolizing input-output pairs. Each link has a weight; the cumulative weight of all the links between an input and an output determines its activation. If heavier weights are given to more likely outputs, or more likely input-output pairs, then the resulting candidates are more likely to be activated in the grammar. HG was originally rejected in favor of OT because HG was argued to predict some grammars that do not seem to occur in the linguistic typology. More recently, though, Pater, Bhatt, and Potts (2007) have shown that HG actually predicts a limited range of languages, particularly if restrictions are placed on the domain of evaluation of certain constraints, and HG has had a resurgence (e.g. Goldrick & Daland, 2007; Jesney & Tessier 2007; Pater, Bhatt & Potts 2007; Pater, Jesney & Tessier 2007). Most importantly, one argument for rejecting HG was that it predicted gang effects, while OT did not. If these gang effects are found to occur, and not infrequently, then this is a strong argument for HG.

HG differs from OT in that constraints are weighted rather than ranked. Constraints with greater weights would translate into higher-ranked constraints in OT, while low-weight constraints are similar to low-ranked constraints. The resulting crucial difference between the two models that strict domination is a key feature of OT but not of HG. Because of the symbolic nature of OT's constraints, a higher-ranked constraint strictly dominates a lower-ranked one—no number of violations of the lower-ranked constraint can overcome the violation of a higher-ranked constraint (McCarthy 2002). On the other hand, in HG, multiple violations of low-weight constraints may, when added together, "gang up" on a higher-weight constraint, thereby allowing low-weight HG constraints to have more power than low-ranked constraints in OT.

The HG tableaux in (22) illustrate the account of a cumulative interaction. In each tableau, the weight of each constraint is listed under the constraint name. Weights are always positive real numbers. Following convention, constraint violations are shown as negative numbers and represent the number of violations that each candidate incurs for each constraint. For each candidate, the relative harmony (H) is calculated as follows: each violation is multiplied by the weight of the constraint violated, and the resulting weighted violations are summed across constraints. The candidate with the highest harmony (the harmony closest to zero, or with the lowest absolute value) wins. Harmony is shown in the rightmost column. In order to produce a cumulative interaction, as in (22c), one constraint (here C1) must have a weight that is greater than either C2 or C3 but less than the sum of C2 and C3. C2 and C3 thus trade off against C1.

(22) Sample HG tableaux (Jesney & Tessier 2007)

a. $W_{C1} > W_{C2}$

/input/	C1 w=3	C2 w=2	C3 w=2	H
a. ☞ candidate a		-1		-1(2) = **-2**
b. candidate b	-1			-1(3) = **-3**

b. $W_{C1} > W_{C3}$

/input/	C1 w=3	C2 w=2	C3 w=2	H
a. ☞ candidate a			-1	-1(2) = **-2**
b. candidate b	-1			-1(3) = **-3**

c. $W_{C2} + W_{C3} > W_{C1}$

/input/	C1 w=3	C2 w=2	C3 w=2	H
a. candidate a		-1	-1	-1(2) + -1(2) = **-4**
b. ☞ candidate b	-1			-1(3) = **-3**

HG has been used to account for the cumulative effects of markedness constraints, in which more marked structures are eliminated while less marked structures are allowed to surface (e.g. Pater, Bhatt and Potts 2007). HG can also account for the Luwanga CFE – a single markedness constraint outweighs either one of the faithfulness constraints, but the combined weight of two faithfulness constraints is sufficient to eliminate a candidate that violates them both.

In Luwanga, all intervocalic obstruents are realized voiceless, even stem-initially when preceded by a vowel-final prefix. This means that faithfulness to the underlying voice specification is not a priority in the language. In the language's grammar, then, *VOIOBS has a weight that is greater than that of ID[voice], as in (23).

(23) $W_{*\text{VOIOBS}} > W_{\text{ID[voice]}}$[12]

/axa-duuma/	*VOIOBS w=2	ID[voice] w =1	H
a. ☞ axatuuma		-1	-1
b. axaduuma	-1		-2

Secondly, we know that underlying NÇ̥ sequences are repaired and that the preferred repair in the language is nasal deletion, rather than obstruent voicing. As

[12] Note that in HG, the actual weights of the constraints matter less than the proportions between them. Here we use small numbers, but the weights could just as easily be 200 vs. 100 or 46 vs. 23.

below in (24), this implies that a violation of MAX (24a) is preferable to a violation of a the high-weight markedness constraint (24b) or a violation of ID[voice] that results in another marked structure (24c).

(24) Decreased weight of MAX allows deletion as a repair

/iN-takata/		*NÇ̥ w=4	MAX w=2	*VOIOBS w=2	ID[voice] w=1	H
a. ☞	itakata		-1			-2
b.	intakata	-1				-4
c.	indakata			-1	-1	-3

Recall that the Standard Optimality Theory account in (18) incorrectly predicted that nasal deletion, combined with obstruent devoicing, would be the optimal repair for a violation of *VOIOBS in an NÇ̥ sequence. The attested output, however, is one that simply retains the marked voiced obstruent. In the HG account, the relatively low weights of the two faithfulness constraints (i.e. MAX and ID[voice]) add up to eliminate the doubly-unfaithful candidate in favor of the marked output. This outcome is illustrated in (25). In this way, two comparatively low-weight constraints can join forces to eliminate only the candidates that violate them both.

(25) Doubly unfaithful output eliminated

/iN-duuma/		*NÇ̥ w=4	MAX w=2	*VOIOBS w=2	ID[voice] w=1	H
a. ☞	induuma			-1		-2
b.	intuuma	-1			-1	-5
c.	iduuma		-1	-1		-4
d.	ituuma		-1		-1	-3

In sum, HG can account for Luwanga's preference for a marked output instead of a doubly-unfaithful repair. The final constraint weighting for the language's grammar is $W_{*NÇ̥} > W_{MAX}, W_{*VOIOBS} > W_{ID[voice]}$. While this outcome is easily handled in this harmonic framework, the result itself is rather unusual compared to other better-known cumulative faithfulness effects. Section 7 discusses this unique situation in more detail.

7. Discussion and concluding thoughts

As discussed in detail in Farris-Trimble (2008), cumulative faithfulness effects (CFE) arise from a variety of interactions. Single violations of multiple faithfulness constraints can gang up on another single faithfulness constraint, multiple violations of a single faithfulness constraints can gang up on another faithfulness constraint or markedness constraint, and, as we have seen in the case of Luwanga, single violations of multiple faithfulness constraints can also gang up on a single markedness constraint. Cumulative markedness interactions are also possible and are somewhat better documented (e.g. Kirchner 1992; Kawahara 2006; Pater, Bhatt & Potts 2007). The Luwanga CFE discussed in this paper does share some similarities to other CFEs in that it results in surface transparency. Where it differs from other CFEs, however, is in the mechanism that it uses to avoid doubly-unfaithful outcomes.

As Farris-Trimble (2008) discusses, most CFEs are resolved by some manifestation of a fell-swoop repair. Taken another way, when a language is faced with an offending sequence, it typically has the option of either repairing the sequence through the change in some feature or via segmental deletion. In most instances, a language will choose deletion, rather than featural repair, given that this second option often involves multiple faithfulness violations. It is here that Luwanga diverges from other languages. It has been illustrated that the Luwanga CFE involves the avoidance of violating two low-level faithfulness constraints, namely MAX and ID[voice]. Simply by considering that one of the two constraints involved in this CFE is MAX (i.e. avoid deletion), one might suppose that a typical fell-swoop repair via segment deletion will likely be problematic. This is precisely what we find in Luwanga, as the language chooses to avoid multiple faithfulness violations neither by deletion, nor by changing some featural specification (e.g. [voice]) which would involve other repairs. Rather than a repair or change of any kind, the language instead chooses simply to remain faithful to the underlying representation, even though it is marked. The transparent retention of a single marked segment in this language is less unfaithful than accumulating two violations of faithfulness – one segmental and one featural – that would result in a doubly unmarked form. It may perhaps appear counterintuitive that remaining faithful to the underlying representation is an unusual 'repair' strategy, but it is, nonetheless, an option seldom chosen by other languages to address such situations.

In sum, the study of Luwanga nominal morphophonology provides contributions on descriptive and theoretical levels in that it documents both an unusual alternation and consonant distribution in a lesser-known language while expanding the typology of possible resolutions to effects of cumulative faithfulness and the challenges that they pose for current and developing phonological frameworks. The seemingly transparent surface distribution of obstruents in this language have been shown to present a problem for standard Optimality Theory, which is otherwise well-suited to capture such surface-true phenomena.

In addition to these theoretical concerns, the noted outcome in Luwanga has interesting descriptive implications to consider, specifically in regards to Bantu NC phonology and the study of nominal derivatives in Luyia. Some but not all of the languages of the Luyia cluster have been studied in more detail, among them Lusaamia [lsm] (e.g. Botne 2006), Lunyala [nle] (e.g. Ebarb & Marlo 2009; Marlo 2007), Lumarachi [lri] (e.g. Marlo 2007), Tura (e.g. Marlo 2008), Bukusu [bxk] (e.g. Austen 1975; Mutonyi 2000), Khayo [lko] (e.g. Marlo 2009a), Lukisa [lks] (e.g. Sample 1976), and Lutsootso [lto] (e.g. Dalgish 1976). For a more extensive set of references, see Marlo (2009b).

These studies can be grouped into two main categories: those focused on a formalization of the verbal tonology of the language or those offering a general descriptive characterization of certain aspects of the language's grammar. While some of the descriptive works discuss nominal phonology to some extent no in depth typological study has been conducted that considers the presence/absence of phenomena such as that identified in the current study for Luwanga and therefore the ways in which offending NÇ sequences are/are not resolved across the Luyia languages. For example, it may be the case that the stem-initial [voice] distinction in these languages is obscured in favor of [+voice] (much as is the case in stem-internal positions in Luwanga) given that many languages choose a post-nasal voicing repair. Prefix nasal deletion, however, is most often seen in voiceless fricative-initial stems.

Luwanga represents an unusual case in this regard, as its [-voice] stops pattern with voiceless fricatives in deleting a prefix nasal. It appears that the chosen repair in Luwanga is based upon the patterning of [-voice] stops with the natural class of [-voice] sounds, given that they pattern with the fricative stems. The voiceless stops of the language therefore do not pattern with the natural class of [-continuant] sounds (i.e. with other stops), as voiceless stops do not undergo a process of post-nasal voicing (at least in stem-initial position) that is observed elsewhere in Bantu languages. It is yet unclear how robust this alternative patterning is, as it is often the case that the works available on these languages have spent considerably little time exploring the phonology of the diminutive and augmentative nominal derivatives which (in some instances) can provide the appropriate environment in which to witness potentially telling alternations in stem-initial sounds. Clearly, additional work is warranted to explore these possibilities, particularly given the typological importance that they may hold for other emerging descriptive and theoretical work on the paradigmatic behavior of nouns and their prefixes in Luwanga, and perhaps in other Bantu languages (Green in press).

What we have done in this paper is to illustrate that both an analysis utilizing Local Constraint Conjunction (as an extension to standard optimality theory) and a Harmonic Grammar analysis utilizing constraint weights can adequately account for the Luwanga cumulative faithfulness effect. We do acknowledge, however, that a body of literature exists calling into question certain issues of overpredictability and the unconstrained nature of local conjunction, as detailed further in the cited works in §5. In light of these arguments, it may ultimately prove that Harmonic Grammar is a better suited analytical means by which to characterize these and similar effects. Indeed, the body of published and unpublished literature on Harmonic Grammar (Albright 2008, 2009) and its extensions, among them the Split-Additive Model (e.g. Albright, Magri & Michaels in press), constraint weight exacerbation (e.g. Khanjian, Sudo & Thomas 2010), and superlinear conjunction (e.g. Green & Davis 2010; Legendre, Sorace & Smolensky 2006), continues to grow.

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Appendices

Appendix A contains Luwanga nouns from singular/plural classes 1/2, 1a/2, 3/4, 5/6, and 7/8. Class 6a contains mass/count nouns with no singular counterpart. Class 14 contains abstract nouns that have no plural counterpart. Class 15 contains the infinitive form of verbs and is not included in this appendix. Nouns from classes 9/10 and 11/10a are found in Appendix 2. The list of nouns in Appendix A is drawn from the first author's field notes are should not be taken to be exhaustive. Some singular or plural forms for these classes were not collected or were not grammatical to the speaker, and in these instances, cells have been left blank. The same transcription conventions used in the above paper are used here. The list of nouns in Appendix B is also drawn from the first author's field notes and contain Class 12 and Class 20 singular diminutive and augmentative derivatives, respectively.

Appendix A

Class 1	Class 2	Gloss
omukuumba	abakuumba	'childless woman'
omulakusi	abalakusi	'witchdoctor'
omulalu	abalalu	'mad person'
omulema	abalema	'lame person'
omuluale	abaluale	'patient'
omunaasi	abanaasi	'nurse'
omusiani	abasiani	'son/daughter'
omusiriʃi	abasiriʃi	'healer'
omusiru	abasiru	'fool'
omusomesi	abasomesi	'teacher'
omusomi	abasomi	'student'
omusuumba	abasuumba	'bachelor'
omutsaatsa	abatsaatsa	'man'
omutsulu	abatsulu	'grandchild'
omutʃeesi	abatʃeesi	'smart person'
omuundu	abaandu	'person'
omuxaase	abaxaase	'woman'
omwaami	abaami	'chief'

omwaana	abaana	'child'
omwibusi	abebusi	'parent'
Class 1a	Class 2	Gloss
koxo	abakoxo	'grandmother'
kuka	abakuka	'grandfather'
maama	abamaama	'mother'
papa	abapaapa	'father'
sendʒe	abasendʒe	'aunt' (father's sister'
xotsa	abaxotsa	'uncle' (mother's brother)
Class 3	Class 4	Gloss
omubiri	amabiri	'body'
omufenesi	emifenesi	'jackfruit'
omukaati	emikaati	'bread'
omukasi	emikasi	'scissors'
omukeeka	emikeeka	'straw mat'
omukoŋgo		'back/spine'
omukooje	emikooje	'rope'
omukuba	emikuba	'bellows'
omukunda	emikunda	'farm'
omunwa	eminwa	'mouth/lips'
omuosi	emiosi	'smoke'
omuriro	emiriro	'fire'
omurjaŋgo	emirjaŋgo	'door'
omurwe	emirwe	'head'
omusaala	emisaala	'tree'
omusi	emisi	'root'
	emisi	'vein'
omuʃeɲe		'mush'
omuʃipi	emiʃipi	'belt'
omuʃira	emiʃira	'tail'
omutʃeere		'rice'
omusomare	emisomare	'nail'
omusomeeno	emisomeeno	'saw'

omuuɲu		'broth'
omuxono	emixono	'arm'
omuja		'air'
omujeeka	emijeeka	'wind'
omujeʃe	emijeʃe	'sand'
omwaaka	emiika	'year'
omwaalo	emjaalo	'river'
omwaambo	emjaambo	'worm'
omwaanda	emjaanda	'road'
omweesi	emjeesi	'moon'
omwixo		'oar'
omwooko	emjooko	'cassava'
Class 5	Class 6	Gloss
eliino	ameeno	'tooth'
eljaro	amaaro	'boat'
eljuuba		'sun'
eljuulu	amoulu	'nostril'
liaro		'boat'
libaatswa	amabaatswa	'shoulder blade'
libeka	amabeka	'shoulder'
liabiakala	amabiakala	'lizard'
liboonda		'butter'
libuuŋgwe	amabuuŋgwe	'chimpanzee'
libwe	amabwe	'jackal'
lidiriʃa	amadiriʃa	'window'
lifumbi		'mist/fog'
lifumo	amafumo	'spear'
likokopiro		'gullet'
likonzo		'wound'
likoondi	amakoondi	'sheep'
likosi		'neck'
likoʃe		'ash'
lilare		'quarry'
liloba		'soil'

limeera		'yeast'
liɲaiɲa		'bat'
lioja	amoija	'feather'
lioni	amajoni	'bird'
	amalaaro	'sole'
liloro		'dream'
lipoŋgopoŋgo	amapoŋgopoŋgo	'gecko'
lipwooni	amapwooni	'sweet potato'
liraaŋgo	amaraaŋgo	'thigh'
lireesi	amareesi	'cloud'
liremwa	amaremwa	'banana'
lirinda	amarinda	'woman's dress'
lisa	amasa	'caterpillar'
lisaafu	amasaafu	'leaf'
lisaka	amasaka	'limb/branch'
liʃaati	amaʃaati	'shirt'
lisibiri	amasibiri	'dung grub'
lisika	amasika	'funeral'
lisikamo	amasikamo	'knee'
lisisi	amasisi	'wall'
liiswa	amaaswa	'bush'
liiswi		'head hair'
litaala		'large house'
litaxo	amataxo	'buttocks'
liteere	amateere	'fingernail'
litisi	amatisi	'pond'
litsoxo	amatsoxo	'lung'
litʃe	amatʃe	'termite'
litʃena	amatʃena	'rock'
litʃitʃi	amatʃitʃi	'owl'
litʃuuŋgwa	amatʃuuŋgwa	'orange'
litooro		'dynasty'
litulo	amatulo	'hill'
litwoma	amatwoma	'valley'
liuguju	amaguju	'egg'

liurwi	amarwi	'ear'
liuto	amawto	'ostrich'
liuuŋgu	amauuŋgu	'eagle'
liuusi	amawsi	'pigeon'
liuwa	amawa	'thorn'
liwaaɲi	amawaaɲi	'crested crane'
lixaaŋga	amaxaaŋga	'guinea fowl'
lixala	amaxala	'crab'
lixaniafu		'chameleon'
lixofi		'navel'
lixumuɲu	amaxumuɲu	'snail'
lixutu	amaxutu	'turtle'
lixwa		'word'
	Class 6a	Gloss
	amaala	'intestines'
	amaaɲi	'urine'
	amaatsi	'water'
	amabere	'millet'
	amabeere	'milk'
	amabibi	'time before dawn'
	amafara	'grease'
	amakata	'reeds'
	amalasire	'blood'
	amaloba	'soil'
	amalua	'alcohol'
	amameera	'phlegm'
	amaɲaasi	'traditional medicine'
	amare	'saliva'
	amaristsatʃe	'fear'
	amaswa	'body hair'
	amatoji	'mud'
	amatumwa	'corn'

Class 7	Class 8	Gloss
eʃiaxodia	efiaxodia	'food'
eʃiini		'liver'
eʃiiro		'market'
eʃikalaba	efikalaba	'palm'
eʃikoro	efikoro	'room'
eʃikoʃe	efikoʃe	'slug'
eʃikulu	efikulu	'mountain'
eʃikuumba	efikuumba	'bone'
eʃilaaro	efilaaro	'shoe'
eʃilikisja		'hiccup'
eʃilindwa	efilindwa	'grave'
eʃilo	efilo	'night'
eʃimiiju		'dry season/drought'
eʃimuru	efimuri	'flower'
eʃinwanwa	efinwanwa	'chin/jaw'
eʃipatupatu	efipatupatu	'sandal'
eʃireendʒe	efireendʒe	'leg'
eʃirikisja	efirikisja	'hiccup'
eʃisaala	efisaala	'chair'
eʃisaanda	efisaanda	'calabash'
	efisitʃe	'eyelash'
	efisoni	'shyness'
eʃisuri	efisuri	'roof'
eʃisuutse	efisuutse	'coyote'
eʃiʃieno	efiʃieno	'ghost'
eʃitaabu	efitaabu	'book'
eʃitari	efitari	'bed'
eʃitaxo	efitaxo	'hen'
eʃiteere	efiteere	'afternoon'
eʃiteeru	efiteeru	'large bowl'
eʃitiiɲiro	efitiiɲiro	'beer sieve'
eʃituju	efituju	'hare'
eʃixoba		'skin'
eʃixuulu	efixuulu	'heel'

eʃjalo	efjalo	'nation'
eʃjaaŋgaaŋga		'skull'
ʃidʒidʒi	fidʒidʒi	'small town'
	Class 14	Gloss
	obuberera	'sadness'
	obubeji	'lie'
	obufiimbe	'swelling'
	obufwiisi	'venom'
	obulafu	'white'
	obulalu	'madness'
	obulalwale	'disease'
	obulamu	'life'
	obulo	'thirst'
	obuluale	'sickness'
	obumari	'black'
	obuɲaasi	'grass'
	obusaŋgafu	'happiness'
	obusije	'flour'
	obusiru	'stupidity'
	obutsuuni	'pain'
	obutʃafu	'dirt'
	obutʃeesi	'intelligence'
	obutunduri	'bone marrow'
	obweeni	'face'
	obwooŋgo	'brain'

Appendix B

Class 9/10 and 11/10a Nouns with Derivatives

Stem	Class 9	Class 10	Class 12	Class 20	Gloss
-baa	imbaa	tsimbaa	axabaa	okubaa	‘clod of earth’
-baala	imbaala	tsimbaala	axabaala	okubaala	‘head wound’
-baalo	imbaalo	tsimbaalo	axabaalo	okubaalo	‘knife’
-bako	imbako	tsimbako	axabako	okubako	‘hoe’
-bale	imbale	tsimbale	axabale	okubale	‘pebble’
-balixa	imbalixa	tsimbalixa	-	-	‘journey’
-bande	imbaande	tsimbaande	axabaande	okubaande	‘sweet nut’
-bandu	imbaandu	tsimbaandu	axabaandu	okubaandu	‘tree shoot’
-baɲa	imbaaɲa	tsimbaaɲa	axabaaɲa	okubaaɲa	‘tooth gap’
-beba	imbeba	tsimbeba	axabeba	okubeba	‘mouse’
-beeko	imbeeko	tsimbeeko	axabeeko	okubeeko	‘eucalyp-tus’
-beete	imbeete	tsimbeete	axabeete	okubeete	‘ring’
-biindi	imbiindi	tsimbiindi	axabiindi	okubiindi	‘pea’
-boko	imboko	tsimboko	axaboko	okuboko	‘buffalo’
-bolo	imbolo	tsimbolo	axabolo	okubolo	‘penis’
-boŋgo	imbooŋgo	tsimbooŋgo	axabooŋgo	okubooŋgo	‘bongo’
-bulu	imbulu	tsimbulu	axabulu	okubulu	‘water monitor’
-bundu	imbuundu	tsimbuundu	axabuundu	okubuundu	‘lump of flour’
-burusi	imburusi	tsimburusi	axaburusi	okuburusi	‘sling’
-bwa	imbwa	tsimbwa	axabwa	okubwa	‘dog’
-βaka	ibaka	tsibaka	xabaka	kubaka	‘python’
-βakuuli	ibakuuli	tsibakuuli	xabakuuli	kubakuuli	‘bowl’
-βirika	ibirika	tsibirika	xabirika	kubirika	‘kettle’

-dá	indá	tsindá	axatá	okutá	'belly'
-dà	indà	tsindà	axatà	okutà	'louse'
-daba	indaba	tsindaba	axataba	okutaba	'tobacco'
-dabuʃi	indabuʃi	tsindabuʃi	axatabuʃi	okutabuʃi	'walking stick'
-dalo	indalo	tsindalo	axatalo	okutalo	'garden'
-daama	indaama	tsindaama	axataama	okutaama	'cheek'
-dasi	indasi	tsindasi	axatasi	okutasi	'arrow'
-debe	indebe	tsindebe	axatebe	okutebe	'stool'
-defu	indefu	tsindefu	-	-	'facial hair'
-dekeyu	indekeyu	tsindekeyu	axatekeyu	okutekeyu	'hoof'
-deŋga	indeeŋga	tsindeeŋga	-	-	'fear'
-dendʒexo	indeendʒexo	tsindeendʒexo	axateendʒexo	okuteendʒexo	'beer pot'
-dukusi	indukusi	tsindukusi	axatukusi	okutukusi	'ant'
-dulaandula	indulaandula	tsindulaandula	axatulaandula	okutulaandula	'wild fruit'
-duli	induli	tsinduli	axatuli	okutuli	'berry'
-dusiye	indusiye	-	-	-	'bile'
-duubi	induubi	tsinduubi	axatuubi	okutuubi	'basket'
-duuma	induuma	tsinduuma	axatuuma	okutuuma	'yam'
-dumbu	induumbu	tsinduumbu	axatuumbu	okutuumbu	'calf'
-faraasi	ifaraasi	tsifaraasi	xafaraasi	kufaraasi	'horse'
-fiiro	ifiiro	tsifiiro	-	-	'soot'
-fisi	ifisi	tsifisi	axafisi	okufisi	'hyena'
-fubu	ifubu	tsifubu	axafubu	okufubu	'hippo'
-fusi	ifusi	tsifusi	axafusi	okufusi	'fist'
-fuuko	ifuuko	tsifuuko	axafuuko	okufuuko	'kidney'
-fuula	ifuula	tsifulla	axafuula	okufuula	'rain'
-fuxo	ifuxo	tsifuxo	axafuxo	okufuxo	'mole'
-gabo	iŋgabo	tsiŋgabo	axakabo	okukabo	'shield'
-gara	iŋgara	tsiŋgara	axakara	okukara	'headpad'
-gasi	iŋgasi	tsiŋgasi	axakasi	okukasi	'ladder'
-gato	iŋgato	tsiŋgato	axakato	okukato	'sandal'
-geke	iŋgeke	tsiŋgeke	axakete	okukete	'tilapia'

-go	iŋgo	tsiŋgo	-	-	'home (abs.)'
-gobi	iŋgobi	tsiŋgobi	-	-	'placenta'
-goloβe	iŋgoloβe	tsiŋgoloβe	-	-	'evening'
-gombe	iŋgoombe	tsiŋgoombe	axakoombe	okukoombe	'cattle'
-gooxo	iŋgooxo	tsiŋgooxo	axakooxo	okukooxo	'chicken'
-gore	iŋgore	tsiŋgore	-	-	'bunch'
-gubo	iŋgubo	tsiŋgubo	axakubo	okukubo	'clothing'
-guuli	iŋguuli	tsiŋguuli	axakuuli	okukuuli	'spirits'
-gwa	iŋgwa	tsiŋgwa	axakwa	okukwa	'tick'
-gwè	iŋgwè	tsiŋgwè	axakwè	okukwè	'ash'
-gwé	iŋgwé	tsiŋgwé	axakwé	okukwé	'leopard'
-dʒiira	indʒiira	tsindʒiira	axatʃiira	okutʃiira	'path'
-dʒiiri	indʒiiri	tsindʒiiri	axatʃiiri	okutʃiiri	'warthog'
-dʒuugu	indʒuugu	tsindʒuugu	axatʃuugu	okutʃuugu	'ground-nut'
-kanzu	ikanzu	tsikanzu	xakanzu	kukanzu	'robe'
-keŋgere	ikeeŋgere	tsikeeŋgere	xakeeŋgere	kukeeŋgere	'bell'
-koofya	ikoofya	tsikoofya	xakoofya	kukoofya	'hat'
-kwaaya	ikwaaya	tsikwaaya	xakwaaya	kukwaaya	'armpit'
-kweena	ikweena	tsikweena	xakweena	kukweena	'crocodile
-laŋgi	ilaaŋgi	tsilaaŋgi	xalaaŋgi	kulaaŋgi	'pants'
-mamba	immaamba	tsimmaamba	axamaamba	okumaamba	'bicep'
-meere	imeere	tsimeere	xameere	kumeere	'grain'
-meesa	imeesa	tsimeesa	xameesa	kumeessa	'table'
-mòndo	immòondo	tsimmòondo	axamòondo	okumòondo	'fat belly'
-móndo	immóondo	tsimmóondo	axamóondo	okumóondo	'ocelot'
-mooni	immooni	tsimmooni	axamooni	okumooni	'eye'
-mwo	immwo	tsimmwo	axamwo	okumwo	'maize seed'
-ndiimu	indiimu	tsindiimu	xandiimu	kundiimu	'lemon'
-ndo	indo	tsindo	xando	kundo	'bucket'
-ŋgamiya	iŋgamiya	tsiŋgamiya	xaŋgamiya	kuŋgamiya	'camel'
-ŋgano	iŋgano	tsiŋgano	xaŋgano	kuŋgano	'wheat'
-ŋguumi	iŋguumi	tsiŋguumi	xaŋguumi	kuŋguumi	'fist'
-ŋgurwe	iŋgurwe	tsiŋgurwe	xaŋgurwe	kuŋgurwe	'pig'

-nuŋgo	innuuŋgo	tsinnuuŋgo	axanuuŋgo	okunuuŋgo	‘mantle’
-nundʒiro	innuundʒiro	tsinnuundʒiro	axanuundʒiro	okunuundʒiro	‘meat pot’
-nuuni	innuuni	tsinnuuni	axanuuni	okunuuni	‘simsim’
-ɲaama	iɲɲaama	tsiɲɲaama	axaɲaama	okuɲaama	‘meat’
-ɲaŋga	iɲɲaaŋga	tsiɲɲaaŋga	axaɲaaŋga	okuɲaaŋga	‘day’
-ɲanza	iɲɲaanza	tsiɲɲaanza	axaɲaanza	okuɲaanza	‘lake’
-ɲanze	iɲɲaanze	tsiɲɲaanze	axaɲaanze	okuɲaanze	‘centipede
-ɲende	iɲɲeende	tsiɲɲeende	axaɲeende	okuɲeende	‘maggot’
-ɲeŋgo	iɲɲeeŋgo	tsiɲɲeeŋgo	axaɲeeŋgo	okuɲeeŋgo	‘rattle’
-ɲeeni	iɲɲeeni	tsiɲɲeeni	axaɲeeni	okuɲeeni	‘fish’
-ɲiimba	iɲɲiimba	tsiɲɲiimba	axaɲiimba	okuɲiimba	‘bell’
-ɲiniɲini	iɲɲiniɲini	tsiɲɲiniɲini	axaɲiniɲini	okuɲiniɲini	‘star’
-ɲundo	iɲɲuundo	tsiɲɲuundo	axaɲuundo	okuɲuundo	‘hammer’
-ɲuŋgu	iɲɲuuŋgu	tsiɲɲuuŋgu	axaɲuuŋgu	okuɲuuŋgu	‘pot’
-ŋani	iŋŋani	tsiŋŋani	axaŋani	okuŋani	‘open grave’
-ŋoma	iŋŋoma	tsiŋŋoma	axaŋoma	okuŋoma	‘drum’
-ŋombe	iŋŋoombe	tsiŋŋoombe	axaŋoombe	okuŋoombe	‘cow’
-pamba	ipaamba	tsipaamba	xapaamba	kupaamba	‘cotton’
-pasi	ipasi	tsipasi	xapasi	kupasi	‘fire iron’
-pataasi	ipataasi	tsipataasi	xapataasi	kupataasi	‘chisel’
-pilipili	ipilipili	-	-	-	‘pepper’
-pumusi	ipumusi	tsipumusi	xapumusi	kupumusi	‘pump’
-puusi	ipuusi	tsipuusi	xapuusi	kupuusi	‘cat’
-randa	iraanda	tsiraanda	xaraanda	kuraanda	‘plane’
-rotso	irotso	tsirotso	-	-	‘planting season’
-saa	isaa	tsisaa	xasaa	kusaa	‘clock’
-saala	isaala	tsisaala	axasaala	okusaala	‘prayer’
-saako	isaako	tsisaako	axasaako	okusaako	‘crook’
-salatʃe	isalatʃe	tsisalatʃe	xasalatʃe	kusalatʃe	‘scar’
-salu	isalu	tsisalu	axasalu	okusalu	‘cyst’
-saxaani	isaxaani	tsisaxaani	xasaxaani	kusaxaani	‘plate’
-sebeere	isebeere	tsisebeere	axasebeere	okusebeere	‘well’
-seefwe	iseefwe	tsiseefwe	xaseefwe	kuseefwe	‘type of bird’

-sekese	isekese	tsisekese	xasekese	kusekese	‘porcu-pine’
-ʃooka	iʃooka	tsiʃooka	xaʃooka	kuʃooka	‘hatchet’
-ʃuuka	iʃuuka	tsiʃuuka	xaʃuuka	kuʃuuka	‘cloth’
-si	isi	tsisi	axasi	okusi	‘sly’
-sitʃe	isitʃe	tsisitʃe	axasitʃe	okusitʃe	‘locust’
-simba	isiimba	tsisiimba	xasiimba	kusiimba	‘lion’
-simbi	isiimbi	tsisiimbu	axasiimbi	okusiimbi	‘cowrie shell’
-sindaani	isindaani	tsisindaani	xasindaani	kusindaani	‘needle’
-sindu	isiindu	tsisiindu	axasiindu	okusiindu	‘quail’
-siʃiiri	isiʃiiri	tsisiʃiiri	xasiʃiiri	kusiʃiiri	‘donkey’
-sooko	isooko	tsisooko	xasooko	kusooko	‘market’
-soolo	isoolo	tsisoolo	xasoolo	kusoolo	‘animal’
-sukare	isukare	tsisukare	-	-	‘sugar’
-sukuti	isukuti	tsisukuti	xasukuti	kusukuti	‘drum
-suli	isuli	tsisuli	axasuli	okusuli	‘bug’
-sumu	isumu	tsisumu	-	-	‘poison’
-suna	isuna	tsisuna	axasuna	okusuna	‘mosquito ’
-sundo	isuundo	tsisuundo	xasuundo	kusuundo	‘wart’
-surusi	isurusi	tsisurusi	xasurusi	kusurusi	‘bull’
-suutsa	isuutsa	tsisuutsa	xasuutsa	kusuutsa	‘wild vegetable’
-swa	iswa	tsiswa	axaswa	okuswa	‘termite’
-swenene	iswenene	tsiswenene	xaswenene	kuswenene	‘mantis’
-syooŋgo	isyooŋgo	tsisyooŋgo	xasyooŋgo	kusyooŋgo	‘water pot’
-takata	itakata	tsitakata	xatakata	kutakata	‘chest’
-talani	italani	tsitalani	xatalani	kutalani	‘lion’
-tawuusi	itawuusi	tsitawuusi	xatawuusi	kutawuusi	‘peacock’
-taywa	itaywa	tsitaywa	xataywa	kutaywa	‘rooster’
-twaasi	itwaasi	tsitwaasi	xatwaasi	kutwaasi	‘cow’
-ula	iula	tsiula	xaula	kuula	‘beeswax’
-unwa	iunwa	tsiunwa	xaunwa	kuunwa	‘bull’
-xafuka	ixafuka	tsixafuka	xaxafuka	kuxafuka	‘pot’

-xokoro	ixokoro	tsixokoro	xaxokoro	kuxokoro	‘scraper’
-xwe	ixwe	tsixwe	-	-	‘dowry’
-yala	inzala	tsinzala	axayala	okuyala	‘famine’
-yayuwa	iyayuwa	tsiyayuwa	xayayuwa	kuyayuwa	‘axe’
-yeyi	iyeyi	tsiyeyi	-	-	‘ox’
-yofu	inzofu	tsinzofu	axayofu	okuyofu	‘elephant’
-yooma	iyooma	-	-	-	‘fever’
-yoxa	inzoxa	tsinzoxa	axayoxa	okuyoxa	‘snake’
-yu	inzu	tsinzu	axayu	okuyu	‘house’

Class 11/10a Nouns, With Class 12/13 Derivatives

Stem	Class 11	Class 10a	Class 12	Class 20	Gloss
-ala	olwaala	tsiinzaala	axaala	okwaala	‘finger’
-anda	olwaanda	tsiiɲaanda	axaanda	okwaanda	‘rock’
-axo	olwaaxo	tsiinzaaxo	axaaxo	okwaaxo	‘boundary’
-baa	olubaa	tsiimbaa	axabaa	okubaa	‘wing’
-bafu	olubafu	tsiimbafu	axabafu	okubafu	‘rib’
-baka	olubaka	tsiimbaka	axabaka	okubaka	‘age group’
-bakaya	olubakaya	tsiimbakaya	axabakaya	okubakaya	‘fishbone’
-baŋga	olubaaŋga	tsiimbaaŋga	axabaaŋga	okubaaŋga	‘machete’
-bao	olupao	tsiimbao	axapao	okupao	‘wood’
-baasi	olubaasi	tsiimbaasi	axabaasi	okubaasi	‘a horse’s kick’
-beere	olubeere	tsiimbeere	axabeere	okubeere	‘breast’
-beka	olubeka	tsiimbeka	-	-	‘side’
-bembe	olubeembe	tsiimbeembe	axabeembe	okubeembe	‘spear grass’
-boolo	oluboolo	tsimboolo	-	-	‘saying’
-bubi	olububi	tsiimbubi	axabubi	okububi	‘spider’
-buutso	olubuutso	-	-	-	‘gathering place’
-tʃembe	olutʃeembe	tsiindʒeembe	-	-	‘circumcision knife’
-tʃenda	olutʃeenda	tsiiɲeenda	axatʃeenda	okutʃeenda	‘journey’

-tʃina	olutʃina	tsiindʒina	axatʃina	okutʃina	'grindstone'
-tʃiŋgo	olutʃiiŋgo	-	-	-	'coast'
-tʃiyo	olutʃiiyo	tsindʒiiyo	-	-	'shard'
-deeru	oluteeru	tsiindeeru	axateeru	okuteeru	'winnow basket'
-fu	olufu	-	-	-	'dust'
-fungwo	olufuuŋgwo	tsiifuuŋgwo	-	-	'key'
-fwa	olufwa	tsiifwa	axafwa	okufwa	'seed'
-fwafwa	olufwaafwa	-	-	-	'soft grass'
-gano	olukano	tsiiŋgano	axakano	okukano	'story'
-goba	olukoba	tsiiŋgoba	axakoba	okukoba	'walled village'
-ibulo	olwiibulo	-	-	-	'childbirth'
-iŋgo	olwiiŋgo	tsiiŋgo	-	-	'bow'
-imbo	olwiimbo	tsiiɲiimbo	axeembo	okwiimbo	'song'
-kaka	olukaka	tsiiŋgaka	axakaka	okukaka	'hedge'
-kata	olukata	tsiikata	-	-	'tobacco pipe'
-koŋgo	olukooŋgo	tsiiŋgooŋgo	axakooŋgo	okukooŋgo	'shore'
-kosi	olukosi	-	-	-	'childishness'
-kuku	olukuku	-	-	-	'shoreline'
-kuma	olukuma	-	-	-	'head wound'
-kuusi	olukuusi	-	-	-	'red soil'
-kuxu	olukuxu	-	-	-	'rust'
-liimi	oluliimi	tsiiniimu	-	-	'language'
-lobo	olulobo	tsiilobo	-	-	'fishing pole'
-mbuku	oluumbuku	-	-	-	'couch grass'
-mbutsu	oluumbutsu	-	-	-	'vertigo'
-me	olume	-	-	-	'dew'
-muli	olumuli	tsiimuli	-	-	'thatch stick'
-mwo	olumwo	tsiimwo	axamwo	okumwo	'razor'
-ɲaaɲiro	oluɲaaɲiro	tsiiɲaaɲiro	-	-	'jaw'
-ɲasi	oluɲaasi	-	-	-	'blade of grass'
-saala	olusaala	tsiisaala	axasaala	okusaala	'stick'
-saatsa	olusaatsa	-	-	-	'manhood'
-saka	olusaka	-	-	-	'long branch'
-sambwa	olusaambwa	tsiisaambwa	-	-	'wilderness'
-saŋgula	olusaaŋgula	tsiisaaŋgula	axasaaŋgula	okusaaŋgula	'a minty fruit'

-saya	olusaya	tsiisaya	-	-	‘cheek’
-si	olusi	-	-	-	‘napier grass’
-swa	oluswa	-	-	-	‘rebelliousness’
-ʃebe	oluʃebe	tsiiʃebe	-	-	‘circumcised penis’
-tende	oluteende	tsiiteende	axateende	okuteende	‘marsh’
-xaana	oluxaana	-	-	-	‘virginity’
-xaasi	oluxaasi	-	-	-	‘womanhood’
-xayiro	oluxayiro	tsiixayiro	axaxayiro	okuxayiro	‘sickle’
-xo	oluxoo	-	-	-	‘type of game’
-xooba	oluxooba	tsiixooba	axaxooba	okuxooba	‘strap’
-xofi	oluxofi	-	-	-	‘slap’
-xwi	oluxi	tsiixwi	-	-	‘firewood’
-ya	oluyaa	-	-	-	‘sweat’
-yoŋgo	oluyooŋgo	-	-	-	‘type of weed’
-zafwa	olwaafwa	tsiinzaafwa	axaafwa	okwaafwa	‘crack’
-zika	olwiika	tsiinziika	axeeka	okwiika	‘horn’

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