

[A version of this paper also appeared in Graham Horwood and Se-Kyung Kim (eds.) 2001. *RuLing Papers 2: Working Papers of Rutgers University*. New Brunswick: Department of Linguistics, Rutgers University. p. 1-20.]

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2001

Nasal-only syllables in Tswana¹

*In Tswana parsing of nasals in syllabic peak position is avoided by deletion. This implies the general ranking *P/NAS >> MAX. However, there are three distinct environments where faithfulness is respected and the marked nasal peaks are preserved onto the surface. These three environments are when the non-parsing of the nasal will result in: (i) a word below the minimal word length requirement of two syllables; (ii) contiguity violations in the head foot of the prosodic word; (iii) total loss of a morpheme. The constraint interaction that is responsible for blocking nasal deletion and forcing the marked nasal peak to emerge are discussed in this paper.*

1. Introduction

The phonology of Tswana has never been analysed in detail within modern phonological theory. The classical grammars of Tswana contain good general discussions of the phonological processes of this language (cf. Cole, 1955:1-56), and there are also a few good, shorter monographs dedicated specifically to the description of the phonology of Tswana (Krüger, 1998; Krüger & Snyman, s.a.). We therefore have all the data, already organized and ready for an analysis within modern linguistic theory. And yet, aside from a few side comments Tswana (cf. Hyman, 1998) data do not feature prominently in any current phonological literature. This is a pity. Both the study of Tswana per se, and general linguistic theory stand to gain much from a more in depth treatment of Tswana phonology within modern linguistic theory.

This paper presents an initial investigation into one aspect of the segmental phonology of Tswana, namely the phenomenon of syllables with nasal peaks. Tswana has a relatively simple syllable structure, with most syllables having one of the following two structures: CV or V.² However, there is a class of systematic exceptions to this generalization. There are certain environments in which syllables that consist of only consonants (specifically nasals) occur. This phenomenon is usually discussed as part of the morphology in descriptive grammars of Tswana. The reason for this is that these

¹ I am thankful to John McCarthy, Paul de Lacy and Joe Pater for their input into this paper. I also want to extend my appreciation to the audience at HUMDRUM 2000, Rutgers University, New Jersey. An earlier version of this paper was presented there, and I have gained much from the suggestions and questions of the audience. All shortcomings are, of course, my own.

² This is actually not completely true. Clusters consisting of a consonant followed by a glide are tolerated in Tswana, as in *mo^hwana*. This complication is conveniently ignored in this paper as it has no bearing on the issues addressed here.

nasal only syllables typically occur in the class prefixes of certain noun and adjective classes. It is therefore mostly treated as part of the morphology of these noun and adjective classes.

However, listing the morphological environments in which these nasal only syllables occur is only descriptively adequate. It can tell us very accurately where these syllables occur, but it does not tell us anything about why they are encountered specifically there and only there. In this paper I argue that the why of this phenomenon has nothing to do with morphology. The occurrence of these syllables is governed by ordinary phonological principles. The fact that they occur only in specific morphological environments, is an accident of the grammar. It is through the concatenation of different morphemes that the phonological environment is created in which these nasal only syllables are tolerated. These syllables are therefore not part of the morphology of certain noun and adjective classes. Rather, the morphology of these noun and adjective classes creates the phonological contexts in which these syllables are tolerated.

Instead of scattering the explanation for these syllables throughout diverse parts of the morphology of Tswana, the OT analysis presented in this paper unifies the explanation for these syllables by proposing that they are the result of general phonological principles. The phonological principles used in the explanation, are based on universal constraints (a hallmark of OT). It therefore also draws the phonology of Tswana into the arena of Universal Grammar. These nasal only syllables are not idiosyncrasies of Tswana morphology, but follow from general, universal phonological principles.

In the rest of this paper an OT analysis of the nasal only syllables of Tswana is developed step by step. The discussion is structured by morphological environments in which the nasal-only syllables occur, following the traditional descriptive grammars of Tswana. I first establish the fact that Tswana in general does not allow nasal-only syllables (§2). Then I consider each of the morphological environments that present as exceptions to this generalization in turn. First, I consider the simplest case, the singular of Class 5 nouns (§3). The bulk of the paper is dedicated to the more complex data of the adjectives of Classes 4, 5 and 6, and the plural of Class 5 and 6 nouns (§4). Section §5 contains discussion on two minor patterns, the reflexive verb and the first person object agreement marker. Finally, in §6 the paper is summarized. A basic familiarity with OT is assumed in this paper. To aid the flow of the paper constraints that are well known and generally accepted in the OT literature are not explained in the body of the paper. However, since I accept that the readership of this paper might include Tswana students who are not conversant with the technicalities of OT, I include in an appendix a list of definitions for all the constraints used in this paper.

2. The general pattern – no consonantal syllabic peaks

Tswana has a simple syllable structure – all syllables are open and no tautosyllabic consonant clusters are tolerated. As a consequence an underlying consonant is often unparsed in output structure, if its parsing would result in either a coda or tautosyllabic consonant cluster (all Tswana data in this paper are from Cole, 1995; Krüger, 1998; Krüger & Snyman, s.a):

3. Nasal-only syllables in singular nouns

The singular prefix of Class 5 nouns is an underlying nasal. This nasal is usually not parsed into the surface form because of the constraint hierarchy established above. However, when the nominal root to which it is to be prefixed is monosyllabic, the nasal is parsed as a syllabic peak.⁴

(4) Nasal deletion: Root_{σσ}			
/N + peo/	→	{{(pe.o)}}	<i>seed</i>
/N + tl ^h ase/	→	{{(tl ^h a.se)}}	<i>spark</i>
/N + ts ^h ipi/	→	{{(ts ^h i.pi)}}	<i>iron/metal</i>
 Nasal peaks: Root_σ			
/N + pa/	→	{{(m.pa)}}	<i>stomach</i>
/N + ku/	→	{{(ŋ.ku)}}	<i>sheep</i>
/N + tlo/	→	{{(n.tlo)}}	<i>house</i>

This effect can be explained by invoking the word minimality requirement that has been called upon in the analysis of many languages.⁵ There is a strong universal tendency for especially lexical words to be of a certain minimal prosodic size (see Selkirk, 1986 & 1995 on the special prosodic status of lexical words.) Lexical words usually bear stress, and stress is assigned to feet. Feet, again, are typically either bimoraic or disyllabic. The drive to foot lexical words therefore indirectly imposes a minimality requirement on words. This minimality requirement can result in augmentation of underlying material by epenthesis, or in non-deletion of marked structures that are otherwise deleted (which is what we see in Tswana).

The prosodic word in Tswana must be minimally disyllabic. This requirement is more important than the constraint against having nasal peaks. So, when non-parsing of a nasal will result in a word minimality violation, the nasal is parsed into a syllabic peak position. This gives evidence for the ranking of the two constraints responsible for enforcing word minimality effects (FTBIN and LX≈PRWD) and *P/NAS.⁶

⁴ Braces indicate prosodic words, parentheses feet, and periods syllables.

⁵ A sample of languages in which word minimality effects have been claimed to play an active role is Lardil, Choctaw, Kameyama, Axininca Campa, Estonian, Japanese, Yupik, Warlpiri (Wilkinson, 1988; Prince & Smolensky, 1993, McCarthy & Prince, 1986, 1990, 1991; Piggott, 1992).

⁶ Crucially, this does not say anything about the ranking between the FTBIN, LX≈PRWD and the other two markedness constraints *COMPLEX and NOCODA. However, since only liquids and nasals ever appear in peak position and since codas and tautosyllabic consonant clusters never appear, it would be possible to claim that these two markedness constraints are not dominated by FTBIN or LX≈PRWD. This is of course also required by richness of the base.

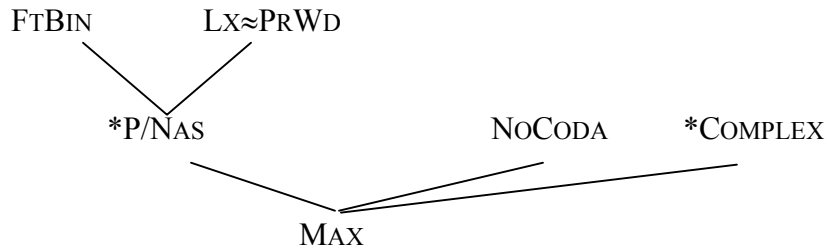
(5) Evidence for ranking FTBIN, LXPRWD >> *P/NAS⁷

N + ku	FTBIN	LX≈PRWD	*P/NAS	MAX
a. {(ku)}	*!			*
b. ku		*!		*
c. {ŋ.ku}			*	

This tableau shows that parsing the nasal into syllabic peak position, candidate (c), is preferred over either having a monosyllabic foot, candidate (a), or having a lexical word with no prosodic structure, candidate (b).

We here have the ordering for a classic blocking situation. A nasal peak is marked and is under usual circumstances prevented by non-parsing of the peak. For this we have markedness (*P/NAS) outranking faithfulness (MAX). However, we have another markedness constraint (here actually two, FTBIN and LX≈PRWD) outranking the first one, and sometimes forcing a violation of the first one. The ranking established up to this point is:

(6) Preliminary ranking for Tswana



What this ranking shows is that under normal circumstances, segments are deleted to avoid marked structures (because the constraint against deletion, MAX, is lowest ranked). There are three circumstances in which an segments can be deleted, namely when parsing of that segment will result in a syllable with a coda (a NOCODA violation), in a tautosyllabic consonant cluster (a *COMPLEX violation), or a nasal only syllable (a *P/NAS violation). However, deletion of the segment is blocked even at the expense of creating the marked nasal-only syllable, if its deletion will result in a lexical word that is either unfooted (a LX≈PRWD violation), or in a word whose only foot is monosyllabic (a FTBIN violation). This much is still easy. Things get more complicated and interesting once we consider more data.

⁷ Brackets indicate feet and curly brackets prosodic words, and periods syllables.

4. A complication: Noun plurals and adjectives

In the previous section we have simplified the situation considerably by considering only singular nouns. The pattern found in the plurals of the noun Classes 5 and 6 complicates the matter somewhat. Here the nasal is still parsed into peak position when the nominal root is monosyllabic, but we can no longer rely on word minimality to enforce this. This nasal is parsed into peak position even though the plural prefix has enough segmental material to supply a second vowel peak. The prefixes for Classes 5 and 6 are given below, and then the singular examples from Class 5 are repeated with their plural forms. Some examples of singulars and plurals from Class 6 are also presented.

(7) Tswana noun Classes 5 and 6

	Singular prefix	Plural prefix
Class 5	N-	diN-
Class 6	lo-	diN-

(8) Examples from noun Classes 5 and 6

Class 5	Root	Sg (N-)	Pl (diN-)	
Root_{σσ}	peo	pe.o	di.pe.o	<i>seed</i>
(Nasal deletion)	tl ^h ase	tl ^h a.se	di.tl ^h a.se	<i>spark</i>
	ts ^h ipi	ts ^h i.pi	di.ts ^h i.pi	<i>iron/metal</i>
Root_σ	pa	m.pa	di.m.pa	<i>tummy</i>
(Nasal preserved)	ku	ŋ.ku	di.ŋ.ku	<i>sheep</i>
	tlo	n.tlo	di.n.tlo	<i>house</i>
Class 6	Root	Sg (lo-)	Pl (diN-)	
Root_{σσ}	baka	lo.ba.ka	di.pa.ka	<i>time</i>
(Nasal deletion)	leme	lo.le.me	di.te.me	<i>tongue</i>
	mao	lo.ma.o	di.ma.o	<i>needle</i>
Root_σ	di	lo.di	di.n.ti	<i>twine</i>
(Nasal preserved)	bu	lo.bu	di.m.pu	<i>brack soil</i>

Some of the agreement prefixes of the Tswana adjectives show nasal deletion similar to the nouns. The relevant agreement prefixes are the singular of Class 5, and the plural of the Classes 4, 5 and 6. Below these prefixes are listed, and then some examples to exemplify the pattern.

(9) Tswana Adjective Classes 4, 5 and 6



	Singular prefix	Plural prefix
Class 4	sese-	tsediN-
Class 5	eN-	tsediN-
Class 6	lolo-	tsediN-

(10) Examples from Adjective Classes 4, 5 and 6

	Prefix	Root	Surface	
Root_{>σ} (no nasal)	eN-	lelele	e.te.le.le	<i>long</i> (sg)
	tsediN-	lelele	tse.di.te.le.le	<i>long</i> (pl)
	eN-	tona	e.to.na	<i>big</i> (sg)
	tsediN-	tona	tse.di.to.na	<i>big</i> (pl)
Root_σ (nasal)	eN-	ba	e.m.pa	<i>bad</i> (sg)
	tsediN-	ba	tse.di.m.pa	<i>bad</i> (pl)
	eN-	ša	e.n.tš ^h a	<i>new</i> (sg)
	tsediN-	ša	tse.di.n.tš ^h a	<i>new</i> (pl)

Our present constraint set cannot account for these facts. Under the present ranking the nasal will only be parsed when its non-parsing will result in a word minimality violation. Our present ranking therefore predicts that the nasal should never be parsed in the plural nouns or in the adjectives. This is indicated in a tableau below. This tableau may also help us to see where we will have to look for a solution to this problem.

(11) Plural of monosyllabic noun root under current ranking

diN + ku	FTBIN	LX≈PRWD	*P/NAS	MAX
a.  {(di.ku)}				*
b.  {di.(ŋ.ku)}			*!	

Candidate (b) that should be the winner has a seemingly fatal violation of *P/NAS. We are yet again dealing with a blocking relationship here. Under normal circumstances the marked structure (a nasal peak) is avoided by non-parsing (markedness outranking faithfulness, *P/NAS >> MAX). What we are in need of is another markedness or faithfulness constraint outranking *P/NAS to block the nasal deletion. Unlike with the singular nouns we cannot invoke word minimality here – the plural prefix always contains a vowel that can serve as a more harmonic peak and still satisfy word minimality requirements. So we should look for another constraint violated by candidate (a) {(di.ku)} and obeyed by candidate (b) {di.(ŋ.ku)}. In order to be able to formulate this constraint correctly, it is necessary to consider stress assignment in Tswana.

Tswana stresses lexical words consistently on the penultimate syllable. This pattern can easily be achieved by invoking two top-ranked constraints. One that specifies feet in

Tswana to be trochaic (FT=TROCH)⁸ and another that requires the head foot to be aligned with the right edge of the prosodic word (ALIGN(Head foot, R, PrWd, R) – this will be referred to as ALIGNR in the rest of this paper).⁹ Having established that the final two syllables of every prosodic word form its head foot, we can propose the following to account for the pattern exemplified above: Tswana has a positional faithfulness constraint (Beckman 1998) that requires the head foot to be faithful to underlying contiguity, i.e. CONTIG(Head foot). This constraint will be violated only when the head foot (i.e. the final two syllables) corresponds to a non-contiguous string in the input. The tableau below illustrates how all of this comes together by evaluating the same two candidates as in (11) above. The constraints responsible for getting the head foot on the final two syllables are not considered here.

(12) Plural of monosyllabic noun root under new ranking

diN + ku	CONTIG (Head foot)	CONTIG	*P/NAS	MAX
a. {(di.ku)}	*!	*		*
b. $\text{di} \cdot \text{ku}$ {di.(ŋ.ku)}			*	

Because the sequence [diku] is not a contiguous string in the input, candidate (a) violates both CONTIG(Head foot) and CONTIG. Candidate (b) avoids both these violations at the expense of a *P/NAS violation.

This results in the choice of the correct optimal candidate in plural nouns and adjectives of monosyllabic roots. Non-parsing of the nasal in these roots results in a contiguity violation within the main foot. Such a violation is of course not encountered in noun and adjective roots that are longer than monosyllabic. Here the head foot will consist solely of root material. Non-parsing of a prefixal element therefore has no influence on the head foot. In order to account for the longer roots, we do need to rank CONTIG and *P/NAS, however. In tableau (12) they are not ranked relative to each other. The tableau below shows that we need CONTIG to be outranked by *P/NAS.

(13) Plural of disyllabic noun root

diN + podi	CONTIG(Head foot)	*P/NAS	CONTIG	MAX
a. $\text{di} \cdot \text{po} \cdot \text{di}$ {di.(po.di)}			*	*
b. {(di.m)(po.di)}		*!		

When the positional CONTIG(Head foot) is equally satisfied, the decision is passed down to *P/NAS again. Here no blocking applies. Both forms comply with word minimality requirements (the first set of constraints that can block nasal deletion) and

⁸ RHTYPE=T in Prince & Smolensky, 1993:53 ff. FTFORM:Iamb/Troch in Ellenbaas & Kager, 1996.

⁹ The literature on Tswana grammar makes no comment on secondary stress. This may mean that PARSE-σ is dominated by a constraint requiring all feet to be right (ALLFEETR). However, the literature also does not state that secondary stress is absent. It is therefore equally possible that PARSE-σ may dominate the constraint on the alignment of feet.

with CONTIG(Head foot) (the second blocking constraint). Therefore the usual unmarked form with nasal deletion is optimal.

The explanation offered here crucially depends on the constraints on word minimality (FTBIN and LX \approx PRWD) and on CONTIG(Head foot). The existence of and need for the word minimality constraints are well established. However, a positional contiguity constraint does not have such a secure place in the theory. Is there any evidence for the need of such a constraint aside from the Tswana examples discussed here?

Lamontagne (s.a.) has proposed a relativized contiguity account that distinguishes two classes of contiguity constraints. One class requires contiguity between segments at the junctures of (prosodic) domains – this is called J(uncture)-CONTIG. The second class requires contiguity within prosodic domains, i.e. D(omain)-CONTIG. The idea of relativizing contiguity to prosodic domains is therefore not novel. However, Lamontagne’s proposal is different from the one made in this paper. For one thing he works (primarily) with the syllable as the domain to which contiguity can be relativized – although he does mention that other domains are also in principle possible. Most importantly, however, he formulates the two classes of contiguity constraints such that a form violates the one or the other, never both. I.e. the relation between J-CONTIG and D-CONTIG in his theory is not one of general faithfulness to special faithfulness, but of two special faithfulness constraints to each other. The explanation of the Tswana data above is such that all cases of deletion violate general CONTIG, while cases with deletion in the head foot also violate special CONTIG. Lamontagne’s theory and the explanation offered here are therefore not equivalent, but the idea of relativizing contiguity constraints to prosodic domains does at least get some support from Lamontagne. There are also other examples in the literature of faithfulness constraints that are relativized to prosodic domains (see *inter alia* Beckman, 1998; Kager, 1999; Carpenter, *in progress*). There is thus some support for the analysis presented here from the OT literature.

The best support for the proposal offered in this paper, comes from comparison with alternatives. Below the most obvious alternatives to the CONTIGUITY account offered here are discussed. It is shown with each why they are problematic, and why the analysis of this paper is preferred over them.

4.1 *Initial extrametricality*

It seems plausible to claim that Tswana tries to avoid stressing initial syllables. A comparison of the following forms will make this clear (bold face indicates stress in these examples):

(14)	Input	Initial stress	Non-initial stress	
	/diN + ku/	*{(di.ku)}	{di.(ŋ .ku)}	<i>sheep</i> (pl.)
	/diN + bu/	*{(di.bu)}	{di.(m .pu)}	<i>soil</i> (pl.)
	/eN + ba/	*{(e.ba)}	{e.(m .pa)}	<i>bad</i> (sg.)
	/eN + ša/	*{(e.ša)}	{e.(n .tš ^h a)}	<i>new</i> (sg.)


It is very tempting to invoke a constraint militating against placing stress on an initial syllable, something akin to Prince and Smolensky’s (1993) NON-FINALITY, only now specifying it for initiality.

(15) **NON-INITIALITY**


The head foot of a prosodic word is never the initial syllable.

Hayes (1995:57) claims that extrametricality can occur at both the left and right edges of phonological constituents, even though the right edge is the unmarked option. Left edge oriented extrametricality has been argued for in Winnebago (Halle & Vergnaud, 1987:31; Hayes, 1995:352) and Western Aranda (Halle & Vergnaud, 1987:49; Hayes, 1995:306). It would therefore not be totally unmotivated to claim that initial syllables in Tswana are extrametrical. With this constraint ranked above *P/NAS it seems to be a rather straightforward matter to account for the plural nouns and the adjectives, as well as for singular adjectives:

(16) **Singular nouns**

diN + ku	NON-INITIALITY	*P/NAS	MAX
a.  {di.(ŋ.ku)}		*	
b. {(di.ku)}	*!		*



(17) **Singular adjectives**

eN + pa	NON-INITIALITY	*P/NAS	MAX
a.  {e.(m.pa)}		*	
b. {(e.pa)}	*!		*

In both of these tableaux, candidate (b) with nasal deletion violates the constraint against placing stress on an initial syllable. Therefore, candidate (a) is chosen as optimal even though it has a nasal-only syllable.

However, this will not be able to account for the parsing of the nasal in the plural adjectives. The plural prefixes of the adjective forms contain two vowels that can form syllabic nuclei. It is therefore possible to not parse the nasal and still have stress on a non-initial syllable. NON-INITIALITY will therefore make the wrong choice in these words:

(18) **Plural adjectives**

tsediN + pa	NON-INITIALITY	*P/NAS	MAX
a.  {(tse.di).(m.pa)}		*!	
b.  {tse.(di.pa)}			*

It is of course possible that yet another constraint is responsible for blocking nasal deletion in the plural adjective. However, we can capture the noun plurals, adjective plurals and adjective singulars with a singular constraint, CONTIG(Head foot). This constraint also seems to have support from other areas in phonology. Compare this to the initial extra-metricality account. It is highly controversial to claim initial extrametricality. And added to that is the fact that we will need yet another constraint to explain the adjective plurals.

4.2 Lexical roots attracting stress

Another way in which we can get stress to decide between the two candidates (the one with nasal deletion and the one without), is to formulate a constraint that will require stress to fall on (or as close as possible to) the lexical root. Do we have any motivation for such a constraint? It is possible to argue for special prominence of the root morpheme as the carrier of lexical information. This prominence will then result in attracting stress – i.e. stress wants to be assigned to the prominent morphological element, the root. Even though stress assignment rules are often blind to morphology, the idea that affixes avoid stress or that the stem/root attracts stress, is not novel (Hayes, 1995:32; Halle & Vergnaud, 1987:54). It has also been argued that lexical roots attract stress away from affixes in Tahltan (Alderete, 1999) and Tuyuca (Barnes, 1996 & Smith, 1998). It is possible to deal with the Tswana data in this manner

In disyllabic or longer roots, this constraint will of course be obeyed fully. In monosyllabic roots it will necessarily be violated due to the high ranking of the constraint responsible for setting foot structure to trochees. But, if we can in some way get the constraint that evaluates forms for the placement of stress on the root, to be violated gradiently and to see unparsed segmental material, we may be able to use it.

(19) STRRT

Stress goes to a syllabic peak in the root.

This constraint will be violated once for every potential stress-bearing unit (i.e. every potential peak) between the root and the peak that actually carries the stress including the stress-bearing peak itself. Let us first see to what extent such a constraint can account for the data if it is ranked above *P/NAS. Below are examples of a plural noun from a monosyllabic root, and then of the singular and plural form of a monosyllabic adjective:

(20) Monosyllabic noun

diN + ku	STRRT	*P/NAS	MAX
a. $\{di.(ŋ.ku)\}$	*	*	
b. $\{(di.ku)\}$	**!		*

(21) Monosyllabic adjective (singular)

eN + pa	STRRT	*P/NAS	MAX
a. $\{e.(m.pa)\}$	*	*	
b. $\{(e.pa)\}$	**!		*

(22) **Monosyllabic adjective (plural)**

tsediN + pa	STRRT	*P/NAS	MAX
a. ^{טְסֵדִי} {(tse.di).(m.pa)}	*	*	
b. {(tse.(di).pa)}	**!		*

In all three tableaux, candidate (b) earns two violations of the new constraint STRRT. This is because stress is assigned two potential syllables away from the root. The first is the root syllable itself, and the second is the deleted nasal. Candidate (a), on the other hand, earns only one violation in terms of STRRT – because stress is assigned to the first potential syllable next to the root.¹⁰

On descriptive grounds this idea is superior to the initial extrametricality account above (cf. §4.1). Here one constraint is able to account for noun plurals, adjectives singulars and adjective plurals. However, there are serious questions about the acceptability of a constraint such as STRRT.

Stress assignment is a prosodic phenomenon and should in general not be sensitive to morphological domains. This is only to some extent a worry. Stress is sometimes sensitive to morphology. There are several languages with different stress patterns for different lexical categories (e.g. English nouns and verbs, Tiberian Hebrew nouns and verbs). The distinction between root and affixes is also quite often relevant (cf. the different suffixes of English, so-called heavy/light distinction in Tiberian Hebrew suffixes). A stress assignment system that disregards morphology is decidedly simpler and the preferred option, but it is not in principle better than one that is sensitive to morphology.

More serious is the question about the visibility of unparsed segments. This constraint must crucially be able to see whether any potential stress-bearing unit has been deleted from the input. This goes counter to the correspondence idea of input-output mapping (McCarthy & Prince, 1995). If we could still claim containment of the input in the output *a la* Prince and Smolensky (1993) and McCarthy and Prince (1993b), then it would be easier to think of this constraint in this way. This is quite problematic however. There are many arguments in favour of correspondence rather than containment.¹¹

4.3 *Stacked prosodic words*

The prosodic hierarchy is usually envisaged as a strict hierarchy – i.e. every level is allowed to dominate only elements of the level lower than itself (Selkirk 1986). This means that a foot can dominate only syllables, not other feet. And likewise, the prosodic word can dominate only feet, not other prosodic words. However, it has been argued that

¹⁰ Full satisfaction of STRRT will have stress assigned to the final syllable, violating higher ranked constraints on foot (FT=TROCH) structure and locus of stress assignment (ALIGN(Head foot, R, PrWd, R)). Such a candidate is therefore not considered here.

¹¹ For recent argument in favour of containment, see the theory of opacity formulated by Goldrick and Smolensky (1999).

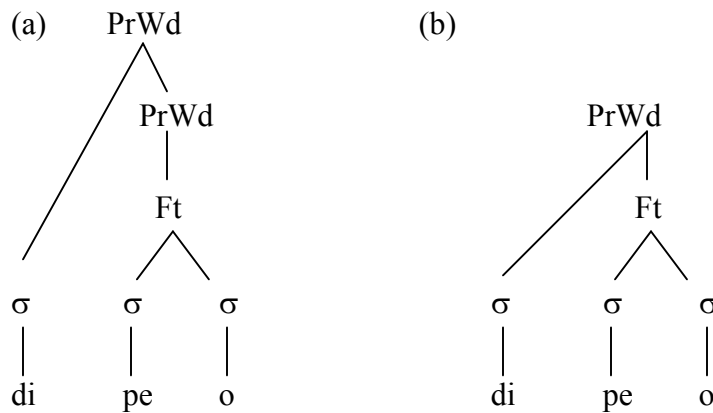
the prosodic word may be an exception to this general rule. McCarthy and Prince mention the possibility of having stacked prosodic words, or recursion of prosodic words (1993a:84-5). This is also argued for by Selkirk (1995) and Truckenbrodt (1999). If we can call on this idea for Tswana, there may be yet another way to deal with problems associated with noun plurals and adjectives. The idea of stacked prosodic words will then interact with the following alignment constraint for Tswana (cf. McCarthy & Prince 1993a: 113 for an identical constraint for Dakota):

(23) **ALIGN-ROOT (Root, L, PrWd, L)**

The left edge of every root must be aligned to the left edge of some prosodic word.

To see how this constraint will interact with multiple prosodic words, consider the following structures:

(24) /diN + peo/ → **di.pe.o seeds**



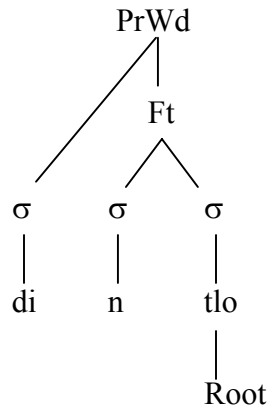
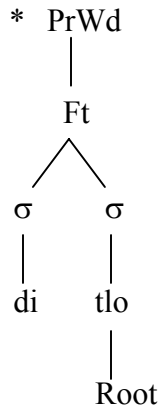
The structure in (24b) will violate ALIGN-ROOT, while that in (24a) will not. So, let us for the sake of the argument accept that there is a constraint against recursive prosodic words,¹² but that this constraint is outranked by ALIGN-ROOT in Tswana – i.e. stacked prosodic words are allowed in Tswana.

Now that we have some idea of how stacked prosodic words may possibly be represented and how this can interact with ALIGN-ROOT, consider how this may bear on the Tswana data above. The problematic words here are of course not the words with disyllabic roots, but the monosyllabic roots. Consider the possible representation for the plural of the root /tlo/ in (25).

¹² NONREC of Truckenbrodt (1999).

(25) /diN + tlo/ → di.n.tlo
 (a)

houses
 (b) PrWd



On a first look, it seems that the root is equally misaligned in both (a) and (b) – that is if violations are counted in terms of syllables. If we count violations in terms of segments then (b) fares better than (a) and we have the result that we want. But, the prosodic word being a prosodic constituent, it seems more natural to count violations of this constraint in terms of a prosodic unit (syllables). So, how can we get (b) to do better in terms of ALIGN-ROOT if we count violations in syllables? If we once again invoke the idea that this constraint can see the input when it counts violations, we can get this effect. If we count every potential syllable in the input between the root and the prosodic word boundary, then (a) has two violations of this constraint and (b) only one. So, if we accept that Tswana allows stacked prosodic words, that there is a constraint ALIGN-ROOT active in Tswana, and this constraint is gradiently violable in terms of potential syllables in the input, then we can account for the Tswana data by ranking ALIGN-ROOT above *P/NAS. This is shown below for the plural of monosyllabic noun roots, and the singular and plural of monosyllabic adjective roots. (A vertical line | is used to indicate the root boundary.)¹³

(26) **Monosyllabic noun**

diN + ku	ALIGN-ROOT	*P/NAS	MAX
a. {di η ku}}	*	*	
b. {di ku}}	**!		*

¹³ A vertical line (|) is used to indicate the root boundary.

(27) **Monosyllabic adjective (singular)**

eN + pa	ALIGN-ROOT	*P/NAS	MAX
a. $\{e\{m pa\}\}$	*	*	
b. $\{e pa\}$	**!		*

(28) **Monosyllabic adjective (plural)**

tse diN + pa	ALIGN-ROOT	*P/NAS	MAX
a. $\{tse\{di\{m pa\}\}\}$	*	*	
b. $\{tse\{di pa\}\}$	**!		*

In all three tableaux, candidate (b) violates ALIGN-ROOT twice, because the root is misaligned with the prosodic word with two potential syllables. Candidate (a) violates this constraint only once, and is therefore correctly chosen as optimal.¹⁴

This idea is empirically equal to the STRRT account above (cf. §4.2) – it also includes the plural adjectives in its account. In this respect both of these accounts seem to be better than the initial extrametricality account (cf. §4.1) that needed a separate account of these words. However, the ALIGN-ROOT account also shares with the STRRT account the necessity to call on containment. Consequently, both of these explanations, has far reaching theoretical implications especially with regard to the difference between correspondence and containment. Therefore the less problematic explanation, CONTIG(Head Foot), is preferred in this paper.

4.4 Output-Output correspondence

A comparison between the singular and plural forms of Class 5 monosyllabic nouns suggests that another possibility might be output-output correspondence (Benua, 1997). It might be that the plural parses the nasal and earns the *P/NAS violation not under duress from any special markedness constraint, but because it wants to agree maximally with the singular form where the nasal is parsed to satisfy word-minimality requirements.

(29) **Class 5 monosyllabic noun**

Singular: /N + pa/ → $\{(m.pa)\}$
 Plural /diN + pa/ → $\{di(m.pa)\}$ * $\{(di.pa)\}$

This option is alluring, but unfortunately it will not solve all the problems. The plural of monosyllabic Class 6 nouns also parses the nasal, and the singular prefix of these

¹⁴ Candidates with perfect alignment of root and prosodic word are not considered. An example of such a candidate for input /diN + ku/ is $\{di.\eta\{ku\}\}$. The root is here a prosodic word on its own. A prosodic word must dominate a foot, and feet are minimally disyllabic in Tswana. This candidate will therefore fatally violate FTBIN.

nouns contains no nasal. For this group of nouns the output-output correspondence relation, will not work.

(30) **Class 6 monosyllabic noun**

Singular: /lo + bu/ → {(lo.bu)}
 Plural: /diN + bu/ → {di(m.pu)} *{(di.bu)}

4.5 *A summary of where we are*

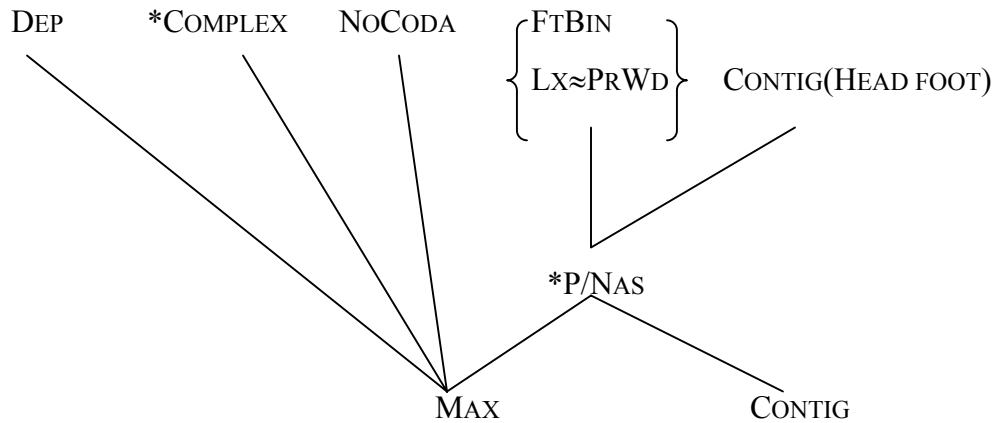
Below is a summary of the constraint rankings that we have argued for up to this point as well as an indication of the motivation for the rankings.

(31) **Rankings argued for thus far**

Ranking	Motivation
{DEP, *P/NAS, *COMPLEX, NOCODA} >> MAX	Nasal deletion in long nouns (2)
{FTBIN, LX≈PRWD} >> *P/NAS	Blocking of nasal deletion in singular of short nouns (5)
CONTIG(Head foot) >> *P/NAS	Blocking of nasal deletion in the plural of short nouns, and in adjectives (12)
*P/NAS >> CONTIG	Nasal deletion in the plural of long nouns (13)

These different rankings can be collapsed by transitivity as follows:

(32) **Tswana constraint hierarchy**



Considering this ranking in more detail reveals much of the underlying pattern. We observe that DEP outranks MAX. This is crucial – it means that marked structure will be avoided by deletion rather than epenthesis. Then there are three markedness constraints that outrank MAX. There are thus three marked structures that will in general be avoided by deletion. These three markedness constraints are *COMPLEX, NOCODA and *P/NAS. In general, tautosyllabic consonant clusters, codas and nasal peaks are avoided by deletion. However, *P/NAS is dominated twice. First by the markedness constraints against sub-minimal words (FTBIN and LX≈PRWD), and secondly by the special faithfulness

constraint CONTIG(Head foot). This signals the two contexts in which the marked nasal peak (usually avoided by deletion of the nasal) is tolerated – when its non-parsing will result in a prosodic word that is not minimally disyllabic, or in a head foot with a CONTIG violation. Crucially, however, the other two markedness constraints (*COMPLEX and NOCODA) are not dominated. The marked structures against which they militate are always avoided by deletion.

This accounts for the basic facts of nasal peaks and nasal deletion in Tswana. There are two minor complications to this pattern that are dealt with in the next section.

5. Two minor patterns

5.1 Nasal deletion in the reflexive verb

Tswana expresses reflexive verbal meaning by adding the prefix **iN-** to the verbal root. The vowel is the only part of this prefix that is ever actually visible on the surface, but the nasal exerts an influence on the first segment of the verbal root – which points to its presence on underlying level. The changes caused by this nasal are usually referred to as “occlusivation” by Tswana grammarians.¹⁵ The following table contains a few examples to illustrate this process:

(33)	Reflexive	Root		
	iN	bolaya	ipolaya	<i>kill oneself</i>
	iN	tl ^h aba	it ^h laba	<i>stab oneself</i>
	iN	dumela	itumela	<i>agree with oneself</i>
	iN	rekela	it ^h ekela	<i>buy for oneself</i>

All the examples of reflexive verbs that I could find in the Tswana grammars at my disposal were of verbs that had more than one syllable in their root form. It will therefore follow straightforwardly from the hierarchy established above for nouns that the nasal will not be parsed on the surface. This will be exactly similar to the syllabification of a noun like **dipodi** in (2) above. There are a few verbal roots in Tswana that are monosyllabic (e.g. **ja** *eat*). Unfortunately the grammars do not mention the reflexive form of any of the monosyllabic verbal roots. It is the prediction of the analysis presented here that these forms (if they ever occur) will parse the nasal in order to avoid in CONTIG(Head Foot) violation.

5.2 The first person object agreement marker

In accordance with general Bantu tendencies, Tswana has an elaborate object agreement system. The first person singular agreement marker is a clitic that has the underlying form **N-**. As a clitic, this morpheme never occurs on its own, but is always cliticized to

¹⁵ This occlusivation phenomenon is very interesting in itself. A very basic description of this phenomenon is that a consonant preceded by a nasal in the input decreases in sonority by at least one level, i.e. a voiced consonant becomes voiceless, a continuant becomes a stop or affricate, etc. This goes counter to Pater’s (1996, 1999) constraint *N_C that specifically requires a voiced (high sonority) consonant to follow a nasal. See Hyman (1998) for a discussion of this and similar phenomena in Tswana and other languages.

the verb and forms a prosodic unit with the verb. It therefore acts very much like the plural/singular prefixes discussed above in §3 – these prefixes were also incorporated into the prosodic domain of the nominal/adjectival roots. It is therefore expected that this object agreement morpheme should also only be parsed when necessary for either word minimality or avoiding a CONTIG(Head Foot) violation. But this prediction is not borne out by the data. In fact, this agreement marker is always parsed on the surface, irrespective of the length of the prosodic word in which it occurs.

(34)

Inf	1 sg OBJ	Root		
go	N	sega	gonts ^h ega	<i>to cut me</i>
go	N	direla	gontirela	<i>to do for me</i>
go	N	fenya	gomp ^h enya	<i>to conquer me</i>
go	N	loma	gontoma	<i>to bite me</i>

Here we need yet another constraint to outrank *P/NAS that will block nasal deletion. I propose that the constraint that blocks nasal deletion in these instances is MORPHREAL (Samek-Lodovici, 1992 and Gnanadesikan, 1997). This constraint forces morphemes to have surface exponents even at the expense of markedness violations. This can explain the parsing of the this nasal despite the fact that its non-parsing does not cause either a word minimality violation or a CONTIG violation in the head foot. There is one problem with this explanation, however. The singular prefix of Class 5 nouns also consists only of a nasal N-, and this morpheme is deleted except for minimality and CONTIG reasons. We can therefore not rely on a general MORPHREAL constraint. We will have to index this constraint to refer to only the object agreement marker, i.e. MORPHREAL (1st sg AgrO). If we rank this constraint above *P/NAS, we get the correct result.

(35) **First person object agreement**

/go + N + direla/	MORPHREAL(1 st sg AgrO)	*P/NAS	MAX
a. ^h go.n.ti.re.la.		*	
b. .go.di.re.la.	*!		*

Is there any way that we can account for the difference between this agreement marker and the singular prefix of Class 5 nouns? If the nasal in the agreement morpheme is deleted, there will be no segment on the surface that represents this morpheme and recoverability will be extremely difficult. The same is true of the nasal in the singular noun prefix. However, there is a difference between the singular morpheme with nouns and the first person object agreement marker. The singular morpheme does not refer to anything, while the object agreement marker is a referring expression. Non-parsing of the agreement marker will therefore result in greater semantic loss than non-parsing of singular prefix. To this can also be added that non-parsing of the singular prefix does not create any ambiguity – the plural and singular will still be distinct in form. By non-parsing of the object agreement, a verb’s meaning becomes ambiguous at least and even possibly uninterpretable. I therefore suggest a constraint like the following:

(36) **MAXREF**

A referring expression may not be unparsed completely.

A constraint like this is of course problematic for theories of grammar in which phonological interpretation and semantic interpretation occur in two distinct branches of the grammar and can have no influence on each other. The argumentation behind a constraint like MAXREF crucially relies on the meaning of morphemes. If the formulation of this constraint is indeed correct, this may be an argument against the strict separation of the phonological and semantic components of the grammar.

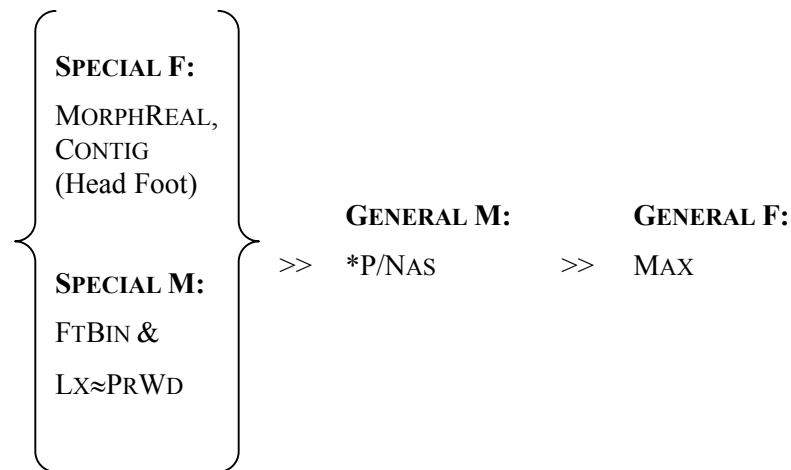
6. Final summary and conclusion

I have argued above that a constraint against parsing a nasal into peak position (*P/NAS) is responsible for the non-parsing of the nasal that occurs in several Tswana morphemes. This is achieved by ranking this constraint higher than the segmental faithfulness constraint MAX. However, the deletion of this nasal can be blocked in three distinct environments:

- ⇒ In words that are too short, the nasal is parsed. This translates into *P/NAS being dominated by the constraints on word minimality, i.e. {LX≈PRWD, FTBIN} >> *P/NAS.
- ⇒ If non-parsing of the nasal will result in a CONTIG violation in the head foot, the nasal is also parsed, i.e. CONTIG(Head foot) >> *P/NAS.
- ⇒ When non-parsing of the nasal will result in total loss of the first person object agreement morpheme, the nasal is also parsed, i.e. MORPHREAL >> *P/NAS.

For any process to be activated in an OT grammar, the ranking of markedness over faithfulness is required. Without this ranking, the input will simply be mapped unchanged unto itself. This is evidenced in the discussion above. The basic ranking is markedness (*P/NAS) over faithfulness (MAX). This triggers the process of nasal deletion. Blocking of a process in OT is achieved by ranking either a special faithfulness or special markedness constraint above the basic markedness over faithfulness pair. Both special faithfulness and special markedness is active as blockers in Tswana.

(37) **Blocking of nasal deletion in Tswana**



The analysis presented in this paper argues that the occurrence of nasal-only syllables in Tswana is governed by general phonological constraints, and is not a feature of the morphology of certain noun and adjective classes. This results in a more unified, consistent explanation of this phenomenon. It also shows that this phenomenon is not an idiosyncrasy of Tswana. It results from the interaction of universal constraints.

References

Alderete, J. 1999. Root-controlled accent in Cupenõ. Ms. University of Massachusetts, Amherst. [ROA #253.]

Barnes, Janet. 1996. Autosegments with three-way lexical contrasts in Tuyuca. *IJAL*, 62:31-58.

Beckman, Jill. 1998. Positional faithfulness. Ph.D. dissertation, University of Massachusetts, Amherst.

Benua, Laura. 1997. Transderivational identity: phonological relations between words. Ph.D. dissertation, University of Massachusetts, Amherst.

Carpenter, Angela C. In preparation. Non-contiguous Metathesis. Ms. University of Massachusetts, Amherst.

Chomsky, N. 1995. *The Minimalist Program*. Cambridge, MA: MIT Press.

Cole, D.T. 1955. *An introduction to Tswana grammar*. London: Longmans, Green and Co.

Ellenbaas, Nine. & René Kager. 1996. Ternary rhythm and the lapse constraint. Ms. (To appear in *Phonology*).

Gnanadesikan, Amalia. 1997. Phonology with ternary scales. Ph.D. dissertation, University of Massachusetts.

- Goldrick, Matt & Paul Smolensky. 1999. Opacity, turbid representations, and output-based explanation. Talk given at a Colloquium in Department of Linguistics, University of Massachusetts, Amherst. September 17th, 1999.
- Halle, M. & J-R. Vergnaud. 1987. An essay on stress. Cambridge: MIT Press.
- Hayes, B. 1995. Metrical stress theory. Chicago: University of Chicago Press.
- Hyman, Larry M. 1998. The limits of phonetic determinism in phonology: *NC revisited. Ms. University of California, Berkeley.
- Kager, René. 1999. Surface opacity of metrical structure in Optimality Theory. (In Hermans, Ben & Van Oostendorp, Marc., eds. *The Derivational Residue in Phonological Optimality Theory*. Amsterdam: John Benjamins. p. 207-245.)
- Krüger, C.J.H. 1998. Afrikatale woordfonologie. Studiegids vir Tswana III. Potchefstroom: Potchefstroom University for Christian Higher Education. (Title in English: African languages word level phonology. Study guide for Tswana III.)
- Kruger, C.J.H. & J.W. Snyman. s.a. The sound system of Setswana. Goodwood: Via Afrika.
- Lamontagne, Greg. s.a. Contiguity and syllabic prosody. Ms. University of British Columbia.
- McCarthy, John J. & Alan S. Prince. 1986. Prosodic Morphology. Ms. University of Massachusetts, Amherst and Brandeis University.
- McCarthy, John J. & Alan S. Prince. 1990. Foot and word in prosodic morphology: The Arabic broken plural. *NLLT*, 8:209-283.
- McCarthy, John J. & Alan S. Prince. 1993a. Generalized alignment. *Yearbook of Morphology*, 79-153.
- McCarthy, John J. & Alan S. Prince. 1993b. Prosodic Morphology I: constraint interaction and satisfaction. Ms. University of Massachusetts, Amherst and Rutgers University, New Brunswick.
- McCarthy, J.J. & Prince, A.S. 1995. Faithfulness and Identity in Prosodic Morphology. (In Kager, R., Van der Hulst, H. & Zonneveld, W., eds. *The Prosody-Morphology Interface*. Cambridge: Cambridge University Press. pp. 218-309.)
- Pater, Joe. 1996. *NC̥. *Proceedings of the North East Linguistics Society* 26, 227-239.
- Pater, Joe. 1999. Austronesian nasal substitution and other NC̥ effects. (In René Kager, Harry van der Hulst & Wim Zonneveld, eds., *The prosody-morphology interface*. Cambridge: Cambridge University Press, 310-343.
- Piggott, G.L. 1992. Satisfying the minimal word. Ms. McGill University.
- Prince, Alan S. & Paul Smolensky. 1993. Optimality Theory: constraint interaction in generative grammar. Ms. Rutgers University, New Brunswick, NJ, and University of Colorado, Boulder, CO.

- Samek-Lodovici, Vieri, 1992. A unified analysis of crosslinguistic morphological gemination. (*In Proceedings of CONSOLE-1 Utrecht, The Netherlands, 1992.*) [ROA#149-1096.]
- Selkirk, Elisabeth. 1986. On derived domains in sentence phonology. *Phonology Yearbook*, 3:371-405.
- Selkirk, Elisabeth. 1995. The prosodic structure of function words. (*In University of Massachusetts Occasional papers 18: Papers in Optimality Theory.* Amherst: GLSA. p. 439-469.)
- Smith, Jennifer L. 1998. Noun faithfulness and word stress in Tuyuca. (*In Jennifer Austin and Aaron Lawson, eds. Proceedings of ESCOL 97.* Ithaca: CLC Publications, 180-191.)
- Truckenbrodt, Herbert. 1999. On the relation between syntactic phrases and phonological phrases. *Linguistic Inquiry*, 30(2):219-255.
- Wilkinson, Karina. 1988. Prosodic structure and Lardil phonology. *Linguistic Inquiry*, 19:325-334.

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