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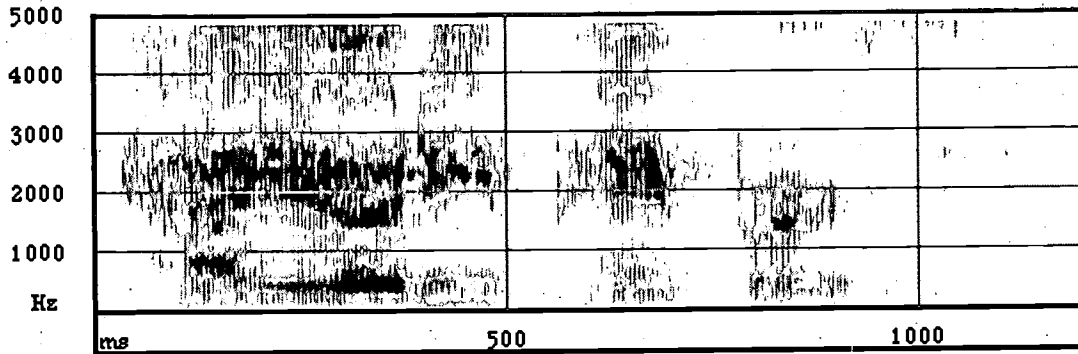
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## ABSTRACT

The papers in this volume are all phonological in nature, and all but one of them are written within the framework of Optimality Theory. This volume includes work on a variety of languages: American Indian (Kiowa, Koasati, Shoshoni), Austronesian (Muna and Nancowry), Bantu (Tsonga), and Indo European (English and Spanish). The following articles are included: "Featural Morphology: Evidence from Muna Irrealis Affixation" (Allyson Carter); "Sound Symbolism as a Purposive Function of Culturally Situated Speech: A Look at the Use of Ideophones in Tsonga" (Deborah Cole); "Fronting and Palatization in Two Dialects of Shoshoni" (Dirk Elzinga); "There Is No Lexicon!" (Michael Hammond); "Trisyllabic Shortening and Two Affix Classes" (Jessica Maye); "Augmentation and Correspondence: A Reanalysis of Nancowry Reduplication" (B. A. Meek); "Anchoring and Reduplicative Identity: Cases From Nancowry and Koasati" (Barbara Meek, Sean Hendricks); "Sequential Grounding and Consonant-Vowel Interaction" (Mizuki Miyashita). (KFT)

# Coyote Papers:

## Working Papers in Linguistics from A-Z



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## Preface

The Linguistics Circle at the University of Arizona is pleased to present Volume 10 of the continuing series of the Coyote Papers, our working papers in Linguistics. These papers were originally selected in 1996 by Amy Fountain, Sean Hendricks, and Sachiko Ohno, who completed much of the editing of this volume. The papers in this volume are all phonological in nature, and all but one of them are written within the framework of Optimality Theory. This volume includes work on a variety of languages: Native American (Kiowa, Koasati, Shoshoni), Austronesian (Muna and Nancowry) Bantu (Tsongan) and Indo-European (English and Spanish).

We would like to thank our fellow students in the Linguistics department for their encouragement and support. Thanks also to all the contributors who made this volume possible and to the original editors for their hard work.

Mizuki Miyashita  
Debbie Cole

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# Featural Morphology: Evidence from Muna Irrealis Affixation<sup>1</sup>

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## 1. Introduction

Affixation has been extensively analyzed within Optimality Theory as a phenomenon relating two domains of linguistics, morphology and phonology. McCarthy and Prince (1993a, b) have developed a theory of prosodic morphology in which prosodic criteria delimit where an affix may be placed in a word. McCarthy (1995) and McCarthy and Prince (1995) have also examined this phenomenon in light of Correspondence Theory, looking at faithfulness relations between strings of phonological elements. Correspondence Theory was originally conceived to explain reduplicative copying (McCarthy and Prince 1993a), but has since been developed into a general theory of faithfulness relationships between lexical-surface forms, base-reduplicant forms and other analogous relations (McCarthy 1995, McCarthy and Prince 1995). In each of these cases, affixation is limited by the interaction of prosodic constraints and/or other phonological constraints with these correspondence relations.

In this paper I examine one such affixation process in Muna, an Indonesian language spoken on the island of Muna, southeast of Sulawesi and Indonesia (van den Berg, 1989). This affix takes four different forms: prefixation, substitution of the root initial segment, apparent deletion of the affix, and infixation. First, I argue that this affixation system cannot be determined solely on the language's prosodic criteria, but that any analysis of this data must also hinge on *featural morphology*, in which featural criteria are necessary to delimit the shape and position of this affix. A three-way interaction between syllable structure, input-output featural correspondence relations, and alignment accounts for the four distinct positions and shapes of this particular affix. Second, I argue that Correspondence can explain two different data patterns, resembling substitution and deletion, as one: coalescence. The substitution of the root initial segment is a case of overt coalescence, and the apparent deletion of the affix is a case of covert coalescence. The analysis presented here is similar to that of McCarthy and Prince (1993a) and Pater (1995), in which one constraint is able to

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account for a conspiracy of phenomena. My analysis is more complicated in that it employs a set of related identity constraints to decide if and how coalescence will occur, and it also relies on the interaction of two alignment constraints with these correspondence relations to allow for infixation. Finally, I show that these data provide one more piece of evidence for OT over a serial, rule-based approach.

In section 2 of this paper I give a description of the affixation paradigm. Sections 3.1 through 3.3 give the analysis of each related phenomenon. In section 4 I motivate an Optimality Theoretic analysis over a rule-based approach. Finally, I conclude in section 5.

## 2. The Affix

In Muna, the irrealis form of the verb has three purposes: one, to depict future tense, conditional tense, or a wish; two, to help form the negative; and three, to form special adjective forms (van den Berg, 1989). This affix is manifested in four different ways depending on the phonological features of the root initial segments in relation to the affix. The four manifestations are prefixation, nasal substitution, prefix deletion, and infixation.

Prefixation of /m-/ occurs when the root initial segment is a vowel:

(1)	<b>Root</b>	<b>Irr. + Root</b>	<b>Gloss</b>
(a)	ala	mala	'take, irr.'
(b)	ere	mere	'stand up, irr.'
(c)	uta	muta	'pick fruit, irr.'
(d)	o <sup>m</sup> ba	mo <sup>m</sup> ba	'appear, irr.'
(e)	a <sup>ɟ</sup> kafi	ma <sup>ɟ</sup> kafi	'follow, irr.'

The second pattern, nasal substitution of the affix /m-/ for the root initial segment, occurs when the root initial segment is voiceless and labial:

(2)	<b>Root</b>	<b>Irr. + Root</b>	<b>Gloss</b>
(a)	pili	mili	'choose, irr.'
(b)	po <sup>ɟ</sup> ko	mo <sup>ɟ</sup> ko	'kill, irr.'
(c)	fonɪ	moni	'climb, go up, irr.'
(d)	fekiri	mekiri	'think, irr.'

The third pattern, an apparent deletion of the prefix, occurs when the root initial segment is voiced and either labial, nasal, or prenasalized:

(3)	<b>Root</b>	<b>Irr. + Root</b>	<b>Gloss</b>
(a)	baru	baru	'happy'
(b)	bala	bala	'big'
(c)	ma <sup>n</sup> da	ma <sup>n</sup> da	'repent, irr.'
(d)	nale	nale	'soft, weak'
(e)	<sup>m</sup> bolaku	<sup>m</sup> bolaku	'steal, irr.'
(f)	<sup>n</sup> diwawa	<sup>n</sup> diwawa	'yawn, irr.'

Notice that in the cases in (2), the feature [labial] is common to the root onsets and the affix, and in the cases in (3), the feature [voice] and either of the features [labial] or [nasal] (or both) are common to the root onsets and the affix. Compare these cases to those in which infixation occurs (in (4)): if the root initial segment is a consonant that is neither labial nor nasal, infixation of /m-/ occurs, along with epenthesis of the vowel /u/.<sup>2</sup>

(4)	<b>Root</b>	<b>Irr. + Root</b>	<b>Gloss</b>
(a)	туру	t-um-uru	'sleepy'
(b)	dadi	d-um-adi	'live, irr.'
(c)	ɸuɸu	ɸ-um-uɸu	'push, irr.'
(d)	kala	k-um-ala	'go, irr.'
(e)	gaa	g-um-aa	'marry, irr.'
(f)	yuse	y-um-use	'rain, irr.'
(g)	suli	s-um-uli	'return, irr.'
(h)	re <sup>n</sup> de	r-um-e <sup>n</sup> de	'alight, irr.'
(i)	li <sup>m</sup> ba	l-um-i <sup>m</sup> ba	'go out, irr.'
(j)	horo	h-um-oro	'fly, irr.'

We see in (1) that in the case of an onsetless root, the form of the affix is a single consonant prefix that precedes the onsetless vowel. In the case of a root with an onset, three allomorphs surface: with voiceless labial root onsets, the form that the affix takes is substitution of the onset; with voiced labial, nasal, and prenasalized root onsets, the affix appears to be hidden; and with onsets that lack both the labial and nasal features, the form of the affix is VC, infixed directly after the onset. The important generalizations to make from these alternations are that the shape and location of the affix change in order to be consistent with the unmarkedness of open syllables that contain an onset, and specifically a single onset (i.e., no consonant clusters are allowed):

<sup>2</sup> I will discuss a possibility why specifically this vowel is the epenthetic one, in section 3.4.

(5)

	ROOT	ROOT + AFFIX
V-initial root	a.la	<u>ma</u> .la
C-initial root a)	fo.ni, pi.li	<u>mo</u> .ni, <u>mi</u> .li
b)	ba.ru, na.le	ba.ru, na.le
c)	da.di	du.ma.di

These generalizations are consistent with van den Berg's (1989) account of syllable structure in the language.

### 3. The Analysis

In this section, I first posit the underlying form of the affix (3.1.). In 3.2.-3.4. I show the constraints necessary to determine the surface forms of each of the four affix patterns. I maintain that one constraint ranking is able to account for all four patterns. This ranking capitalizes on syllable structure of the language, featural correspondence between the root initial segment and the affix, and the relative alignment of the affix and root initial segment. Finally, in sections 3.3.1.-3.3.2. I argue that the nasal substitution case and the prefix deletion case are actually two types of coalescence: overt and covert.

#### 3.1. The Input Form of the Affix

From the data and generalizations above, I posit that the underlying form of the affix is /m-/, a consonantal prefix with the features [voice], [nasal], and [labial].<sup>3</sup> Evidence for this form is as follows. First, it surfaces as a prefix in the vowel-initial root form when no other consonants are root initial to create a conflict (1). Second, the application of the affix lacks consistency with consonant initial roots (2-4). One of its forms is an infixal /-um-/ (4), identical in shape and position to an infix in the related Austronesian language, Tagalog. It could be argued that the underlying form of the affix under scrutiny in this research is /-um-/, as it is in Tagalog (McCarthy and Prince 1993a, b). If this were the case, then the affix would be expected to surface in all environments as /-um-/, regardless of the shape of the root. However, this is not the case (2-3). Third, in Muna there exist no other infixes and no other prefixes of the form VC, which

<sup>3</sup> Throughout this paper, I use the privative feature [voice] to distinguish between the presence of voice and the absence of voice. I have posited that the affix /m-/ is specified for the privative feature [voice], but this may not be the case. Underspecification would have different implications, but not different enough to unravel my analysis. Therefore, I leave this for another paper.



would have given support for a VC affix.<sup>4</sup> In my analysis I will explain exactly how each of the surface forms occur.

### 3.2. Prefixation

In cases of vowel-initial roots ((1) above), the affix is simply prefixed to the root initial vowel in the output:

(6) m-ala mala 'take, irr.'

These prefixed forms obey both optimal syllable structure and prefix alignment constraints, as well as general input-output faithfulness constraints. The constraints relevant to the prefix allomorph of the irrealis affix are:

- (7) NOCODA  
Syllables are open.
- (8) MAX-IO  
Every segment of the input has a correspondent in the output.
- (9) ALIGN-AFFIX  
Align the left edge of every affix with the left edge of some prosodic word.

NOCODA states that open syllables are preferred. Since this is a universal fact in Muna, we know this constraint must be undominated. MAX-IO assesses the completeness of mapping from the input to output, and states that every segment that is present in the input must also be realized in the output. The alignment constraint states that the affix should be leftmost in the output form. The interaction of these constraints is shown in the following tableau. (For all of the tableaux in this paper, subscripted numerals are used for purposes of evaluation by Max-IO).

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<sup>4</sup> Going into more depth on this issue is possible, but not in the scope of this paper. I have addressed this issue already as the focus of a previous paper (Carter, 1995). The implication for positing /m-/ as the underlying form is that perhaps McCarthy and Prince's (1993a, b) examination of languages whose affixes change shape and form (e.g., Tagalog, Dakota) could be re-analyzed more cohesively under an analysis similar to the one presented here. More investigation is of course necessary to come to a resolution of this issue.

(10) /m - ala/

	NOCODA	MAX-IO	ALIGN-AFFIX
☞ (a) m <sub>1</sub> a <sub>2</sub> la			
(b) a <sub>2</sub> m <sub>1</sub> la	*!		*
(c) a <sub>2</sub> la		*!	
(d) Ca <sub>2</sub> m <sub>1</sub> la	*!		*

Simply, the syllable structure constraint dictates where this prefix will be located, and MAX-IO will dictate that it be realized at all. The correct output form, *mala*, does not violate any of the three constraints. Candidate (c) violates MAX-IO, because /m-/ is not realized in the output. Candidates (b) and (d) violate NOCODA and ALIGN-AFFIX, because in both forms the affix is realized as the coda of the first syllable. Note that at this point, since the correct surface form does not violate any of the three constraints, MAX-IO and ALIGN-AFFIX have no ranking hierarchy with regard to each other. However, an argument for their respective rankings will be given later.

In summary, I have shown that /m-/ surfaces as a prefix when combined with vowel-initial roots. Syllable structure requirements and constraints governing the mapping of input to output delimit the position of the affix. The next three sections deal with more complicated issues in which the features of the root initial elements determine the outcome of the affixation phenomenon.

### 3.3. Coalescence

In this section I will try to convince the reader that there is a better analysis of the substitution and deletion cases, namely that they are both types of coalescence, one overt and one covert. Let us look at the generalizations to be made about the two patterns first. The data in (2), shown again in brief in (11), show us that being prefixal, alignment requires that /m-/ be leftmost in the word:

(11) m-pili            mili            'choose, irr.'

However, recall that Muna does not allow complex onsets. In these cases, the affix /m-/ does not appear in combination with labial or nasal root initial consonants; this resembles Russell's (1995) description of Nisgha coalescence.<sup>5</sup> Instead, compensatory measures are taken. Remember from the data that some or all of the features [labial], [nasal], and [voice] are what appear to be in common between the affix and root onsets in the cases of substitution and deletion,

<sup>5</sup> Russell points out that the coronal consonants /s/, /t/, and /ʃ/ do not occur in the presence of one another. Since /t/ shares features with /s/ and /ʃ/, he claims that it is contained in these other segments, allowing coalescence.

whereas they are not common between the affix and root onsets in the cases of infixation. With that in mind, with regard to roots that contain voiceless labial onsets (e.g., *pili, foni*), if the feature [labial] is common to both the affix and root initial consonant, but not [voice] or [nasal], then the combination of the affix and root onset resembles nasal substitution. However, I posit that this process illustrated in (2) and here again in (11) is actually a case of overt coalescence, as in Nisgha (Russel, 1995). The feature [labial] is shared between the affix and root onset, and that shared feature forms the basis of the coalescence. I will flesh out this analysis in section 3.3.1. below, but first let us turn to the data in (3), those forms that resemble prefix deletion.

In the cases of apparent prefixal deletion in (3) above, given again in part in (12) for the reader's ease, one will notice that the features [voice] and either [labial] or [nasal] (or both) are common to the affix and the root initial consonant:

(12a)	m-baru	baru	'happy'
(b)	m-nale	nale	'soft, weak'

In these cases, it appears that the prefix is not realized. However, it could be the case that this is also a type of covert coalescence, in which the affix and the root onset coalesce since they share two of the three features that make up the affix. On this analysis, it would seem that if the onset of the root shares two of the appropriate features with the affix, then this is a sufficient portion of the featural matrix of the affix to be realized, and the third feature is unnecessary. Again, I will elaborate on this analysis in 3.3.2.

### 3.3.1. Overt Coalescence

In the case of the voiceless labial root initial forms, coalescence seems to be dictated by a combination of constraints. The first is the constraint on syllable structure which prohibits tautosyllabic clusters (from Prince and Smolensky 1993):

- (13) \*COMPLEX  
 No more than one C or V may associate to any syllable position node.

This constraint is inviolable in Muna, and is therefore ranked at the top with NOCODA (7). Second, the correspondence constraint MAX-IO, defined in (8) assesses the faithfulness between input and output crucially of the affix and the root initial segment. This constraint must be satisfied in order to allow coalescence, which means that the affix and root initial segments will both be

realized in the output forms. Third, we need an alignment constraint on the root onset, that states that the root be leftmost in the prosodic word:

(14) ALIGN-ROOT

Align the left edge of a every root with the left edge of some prosodic word.

Satisfying both this constraint and the alignment constraint on the affix (9) are necessary to allow coalescence in forms with root initial voiceless labial consonants (whereas we will see in the case of infixation that there is an interaction between the two). Finally, a set of constraints that assesses featural identity between the input and output forms of each morpheme is necessary to explain this case of overt coalescence. The two constraints on featural identity for voiceless labial root onsets are:

(15) IDENTITY-AFFIX, VOICE (IDENT-AF(V))

Correspondent elements of an affix are identical for [voice] in input and output forms.

(16) IDENTITY-ROOT, NASAL (IDENT-RT(N))

Correspondent elements of a root are identical for [nasal] in input and output forms.

We have established that the shared [labial] feature of the affix and root onset is maintained in the output of these forms. It is also important that the voice specification of the affix /m-/ be realized, since there are no voiceless nasal consonants in Muna. Finally, for these forms, it is an important property of the root to maintain the [nasal] specification or lack thereof between the input and output; if it is present in one, it should be present in the other, and likewise if it is not present in the input, it should not be present in the output.

Therefore, a surface form such as *mili* (*m-pili*) requires satisfaction of each of the above constraints at the expense of IDENT-RT(N):

(17) \*COMPLEX >> IDENT-RT(N)

	*COMPLEX	IDENT- RT(N)
☞ (a) m <sub>1</sub> ili		*
(b) m <sub>1</sub> p <sub>2</sub> ili	*!	
(c) p <sub>2</sub> m <sub>1</sub> ili	*!	

In this case, the inviolable constraint \*COMPLEX rules out any surface forms with consonant clusters (17b-c). The winning surface candidate obeys this constraint at the expense of failing to be faithful in root nasality to the input.

## (18) MAX-IO &gt;&gt; IDENT-Rt(N)

	MAX-IO	IDENT- RT(N)
☞ (a) m <sub>12</sub> ili		*
(b) m <sub>1</sub> ili	*!	
(c) p <sub>2</sub> ili	*!	

MAX-IO rules out forms such as (18b-c), which truly delete a segment, in favor of a coalesced segment such as in (18a). The winning candidate, (18a) *m<sub>12</sub>ili*, satisfies MAX-IO because both the affix and root initial segment are represented in the output form (this is possible because they share the feature [labial]).

## (19) ALIGN-AFFIX &gt;&gt; IDENT-Rt(N)

	ALIGN-AFFIX	IDENT- RT(N)
☞ (a) m <sub>12</sub> ili		*
(b) p <sub>2</sub> um <sub>1</sub> ili	**!	

## (20) ALIGN-ROOT &gt;&gt; IDENT-Rt(N)

	ALIGN- ROOT	IDENT- RT(N)
☞ (a) m <sub>12</sub> ili		*
(b) m <sub>1</sub> up <sub>2</sub> ili	**!	

The candidates *pumili* (19b) and *mupili* (20b) fatally violate ALIGN-AFFIX and ALIGN-ROOT, respectively. Again, these are ruled out in favor of the correct surface candidate in which the indices corresponding to both the affix and the root onset are leftmost in the prosodic word. However, this optimal candidate lacks nasal identity between root input and output forms.

## (21) IDENT-Af(V) &gt;&gt; IDENT-Rt(N)

	IDENT-Af(V)	IDENT- RT(N)
☞ (a) m <sub>12</sub> ili		*
(b) p <sub>12</sub> ili	*!	

The candidate *p<sub>12</sub>ili* (21b) crucially violates IDENT-Af(V), because it lacks the important [voice] quality of the affix. This is a worse violation than that of the optimal candidate (21a). The pairwise evaluations above are shown together in (22):

(22) /m - pili/<sup>6</sup>

	*COMPLEX	MAX-IO	ALIGN-AFFIX	ALIGN-ROOT	IDENT-AF(V)	IDENT-RT(N)
(a) m <sub>1</sub> 2ili						*
(b) m <sub>1</sub> p <sub>2</sub> ili	*!			*		
(c) p <sub>2</sub> m <sub>1</sub> ili	*!		*			
(d) m <sub>1</sub> ili		*!				
(e) p <sub>2</sub> ili		*!				
(f) p <sub>1</sub> 2ili					*!	
(g) m <sub>1</sub> up <sub>2</sub> ili				*!*		
(h) p <sub>2</sub> um <sub>1</sub> ili			*!*			

The hierarchy of constraints so far in the analysis is:

(23) NoCODA, \*COMPLEX, MAX-IO, ALIGN-AFFIX, ALIGN-ROOT, IDENT-AF(V) >> IDENT-RT(N).

The cases involving root initial [f] also follow this tableau.<sup>7</sup> (Note that since \*Complex is inviolable, I will henceforth leave it out of the subsequent tableaux. The analogous forms to *m<sub>1</sub>p<sub>2</sub>ili* and *p<sub>2</sub>m<sub>1</sub>ili* in the other tableaux, which are always ruled out by this constraint, will also be left out of the tableaux (for space reasons)).

### 3.3.2. Covert Coalescence

In 3.3.1. I examined a case that involves coalescence in which the affix and root onsets shared one of the features ([labial]) that satisfies coalescence; this was a case of overt coalescence, because one can see that the surface form has changed. The next case is also a type of coalescence because the relevant segments share the features that allow coalescence ([voice], [labial], and/or [nasal]). However, it is covert in that the change does not surface (see (12) above). No new constraints are needed to show the analysis of consonant-initial forms with voiced labial consonants:

<sup>6</sup> In the language there are many prenasalized segments, so forms like *mpili* and *mbaru* should not be a problem to derive and would satisfy the MAX-IO constraint necessary for coalescence. However, it seems that inherent prenasalized segments are allowed, but those derived (from morphemic processes) are not. This would need some extra constraint (like \*derived prenasals).

<sup>7</sup> Cases like *m-foni* also require an IDENT-ROOT (+cont) constraint that is low-ranked and therefore violable.

## (24) /m - baru/

	MAX-IO	ALIGN-AFFIX	ALIGN-ROOT	IDENT-RT(N)
☞ (a) b <sub>12</sub> aru				
(b) m <sub>1</sub> aru	*!			
(c) b <sub>2</sub> aru	*!			
(d) m <sub>12</sub> aru				*!
(e) m <sub>1</sub> ub <sub>2</sub> aru			*!*	
(f) b <sub>2</sub> um <sub>1</sub> aru		*!*		

In this tableau, both candidates (24b-c) *m<sub>1</sub>aru* and *b<sub>2</sub>aru* fatally violate the high-ranked MAX-IO, since each candidate lacks one of the elements in the output that was present in the input. Candidate (24d), *m<sub>12</sub>aru*, is ruled out because its root nasality is not identical in the input and output. The fifth candidate, *mubar<sub>u</sub>*, fatally violates ALIGN-ROOT, because the root initial segment is not next to the prosodic word edge. (24f), *bumaru*, incurs a similar violation for ALIGN-AFFIX. The correct form, (24a) *b<sub>12</sub>aru*, does not incur any violations, and therefore is the clear winner.

For consonant-initial forms with nasal onsets such as *nale* (12b), there is one new constraint to consider:

## (25) IDENTITY-ROOT, PLACE (IDENT-RT(PL))

Correspondent elements of the root are identical for (place) in input and output forms.

This constraint is needed to ensure that the place specification of the root element in the input is identical to that of the output. If it is not, the form will be ruled out. IDENT-RT(PL) at this point has no relative ranking order with regard to the other constraints, since the optimal candidate does not violate any of the constraints. The tableau for these consonant-initial forms with nasal consonants is:

## (26) /m - nale/

	MAX-IO	ALIGN-AFFIX	ALIGN-ROOT	IDENT-RT(PL)
☞ (a) n <sub>12</sub> ale				
(b) m <sub>1</sub> ale	*!			
(c) n <sub>2</sub> ale	*!			
(d) m <sub>12</sub> ale				*!
(e) m <sub>1</sub> un <sub>2</sub> ale			*!*	
(f) n <sub>2</sub> um <sub>1</sub> ale		*!*		

This tableau mirrors that of (24) *baru*, except that the form in (26d), *m<sub>1</sub>zale*, crucially violates IDENT-RT(PL) now because the input and output correspondents of the root initial segment are not identical in place.

To summarize this section, coalescence can only occur if one or both of the features [nasal] and [labial] are common to the relevant segments. If [voice] is also a feature of the root initial segment, then it seems that [voice] and either [labial] or [nasal] are sufficient to surface, and covert coalescence occurs. However, if [voice] is not present, then [labial] on its own is not sufficient to surface, and it is best if all the necessary features of the affix surface, giving way to overt coalescence.

### 3.4. Infixation

In consonant-initial roots where the initial consonant shares neither a [labial] nor a [nasal] feature with the affix, coalescence cannot occur. In this case, /m-/ surfaces as an infix. In order to obey the syllable structure of the language, a vowel (/u/) must be epenthesized (see (4), shown in brief in (27)):

(27a)	m-dadi	dumadi	'live, irr.'
(b)	m-suli	sumuli	'return, irr.'

According to van den Berg (1989), the three main epenthetic vowels of Muna are /i/, /a/, and /u/. I argue that /u/ is the designated vowel in this case of irrealis infixation, because it is the only labial vowel of the three, and this seems to be an important feature to maintain in the affix.

In order to capture the generalization that either [labial] or [nasal] must be shared by the affix and root initial consonant for coalescence to occur, or else irrealis affixation results in an infix, one new constraint must be added to the analysis. This constraint is a locally conjoined constraint, based on the idea introduced by Smolensky (1995), in which either one or both constraints must be true to be satisfied, but both must be false to be violated:

(28) IDENTITY-AFFIX, LABIAL OR NASAL (IDENT-AF{L,N})

Correspondent elements of the affix are identical for one or both of the features  
[labial] or [nasal] in input and output forms.

In the case of (27a) *dadi* and (27b) *suli*, neither share [labial] nor [nasal] with /m-/, whereas *baru* and *pili* share [labial], *nale* shares [nasal], and *ma<sup>n</sup>da* (3c) shares both. Therefore, *dadi* and *suli* must violate this constraint, whereas the others do



not. It stands to reason that if the necessary features are not present to share, there is no way the morphemes can combine, or coalesce.

Because *dumadi* is a case of infixation, ALIGN-AFFIX must necessarily be low in the hierarchy to allow it. Pairwise rankings between the crucial constraints for infixation, showing the crucial dominance of ALIGN-AFFIX, are in (29-31).

## (29) ALIGN-ROOT &gt;&gt; ALIGN-AFFIX

	ALIGN-ROOT	ALIGN-AFFIX
☞ (a) d <sub>2</sub> um <sub>1</sub> adi		**
(b) m <sub>1</sub> ud <sub>2</sub> adi	*!*	

In this tableau, ALIGN-ROOT must outrank ALIGN-AFFIX in order for the correct form to surface. The violation of Align-Root that the form *mudadi* incurs is more fatal than the violation of ALIGN-AFFIX that the optimal form *dumadi* incurs.

## (30) IDENT-AF{L,N} &gt;&gt; ALIGN-AFFIX

	IDENT-AF{L,N}	ALIGN-AFFIX
☞ (a) d <sub>2</sub> um <sub>1</sub> adi		**
(b) d <sub>12</sub> adi	*!	

In (30), the nonoptimal form *d<sub>12</sub>adi* fatally incurs a violation of IDENT-AF{L,N}, because it shares neither feature with the affix, whereas both the features [labial] and [nasal] of the affix are present in the optimal form.

## (31) IDENT-RT(PL) &gt;&gt; ALIGN-AFFIX

	IDENT-RT(PL)	ALIGN-AFFIX
☞ (a) d <sub>2</sub> um <sub>1</sub> adi		**
(b) m <sub>12</sub> adi	*!*	

In (31), *m<sub>12</sub>adi* violates IDENT-RT(PL) because the place specification of the root has not been maintained between the input and the output. The optimal and correct candidate, (31a) *dumadi*, only incurs a violation of the now necessarily low-ranking ALIGN-AFFIX. The full tableau for *dumadi* is in (32):

(32) /m-dadi/

	ALIGN-ROOT	IDENT-AF{L,N}	IDENT-Rt(PL)	ALIGN-AFFIX
☞ (a) d <sub>2</sub> um <sub>1</sub> adi				**
(b) d <sub>12</sub> adi		*!		
(c) m <sub>12</sub> adi			*!	
(d) m <sub>1</sub> ud <sub>2</sub> adi	*!*			

A form like *suli* will also follow this pattern. (33) shows the tableau for *sumuli*.

(33) /m-suli/

	ALIGN-ROOT	IDENT-AF(V)	IDENT-AF{L,N}	IDENT-Rt(PL)	ALIGN-AFFIX
☞ (a) s <sub>2</sub> um <sub>1</sub> uli					**
(b) s <sub>12</sub> uli		*!	*		
(c) m <sub>12</sub> uli				*!	
(d) m <sub>1</sub> us <sub>2</sub> uli	*!*				

The only difference between *dumadi* and *sumuli* is that in *sumuli*, IDENT-AF(V) is at work again. (33b) *s<sub>12</sub>uli* is therefore ruled out either by this constraint, because the identity of [voice] is not identical in the affix between input and output, or by the equal-level constraint IDENT-AF {L,N}. The optimal candidate (33a) does not violate IDENT-AF(V) because the [voice] of the affix is identical in input and output. This allows us to reach the final ranking step of IDENT-AF(V) >> ALIGN-AFFIX. Therefore, the entire hierarchy is:

(34) NoCODA, \*COMPLEX, MAX-IO, ALIGN-ROOT, IDENT-AF(V), IDENT-AF{L,N}, IDENT-Rt(PL) >> ALIGN-AFFIX >> IDENT-Rt(N).

In summary, this analysis has attempted to bring to light the necessity of featural constraints to determine the prosodic shape and position of the irrealis affix in Muna. In doing so, I have argued for the necessity of covert coalescence, in addition to the more firmly accepted overt coalescence.<sup>8</sup> I have also made an argument for local conjunction constraints, in that they are necessary in order to allow coalescence in some cases but ban it in others.

<sup>8</sup> There are interesting data in Muna branching out from the irrealis affixation, in which reduplication is combined with irrealis affixation and results in the phenomenon of overcopying (van den Berg, 1989, McCarthy and Prince, 1995). See Carter and Suzuki (1997) for an analysis of these data.

#### 4. The Benefit of Optimality Theory

In the past, a serial approach based on rules would have been used to analyze complicated affixation paradigms, such as those in Muna. However, a serial approach does not account for this data alternation as well as Correspondence Theory does under OT, for several reasons. With a rule-based approach, for example, we would have to list many different rules for deletion, insertion, and movement:

(35) deletion:

(a) baru:  
 $m \rightarrow 0 / \_ \begin{bmatrix} \text{NAS} \\ \text{VOI} \end{bmatrix} ; \begin{bmatrix} \text{LAB} \\ \text{VOI} \end{bmatrix}$

(b) mili:  
 $\{\text{LAB}\} \rightarrow 0 / m \_$

(36) infixation:

(a) movement of /m/ to the right of any other initial consonant

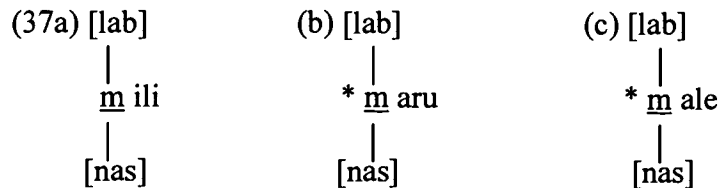
(b) insertion (ordered after (36a)):

$0 \rightarrow u / C \_ m$

$\begin{bmatrix} \text{-LAB} \\ \text{-NAS} \end{bmatrix}$

Also, with this serial approach, it is hard to specify exactly what the environment for the rules is.

Another possible way to look at this is in light of floating features. For example, due to syllable structure, there is only one slot for the initial consonant of the word that both the affix and root initial consonant compete for. The floating features try to attach to this slot. However, this analysis yields a handful of paradoxes. For example, in looking at the roots *pili*, *baru*, and *nale*, if both [labial] and [nasal] attach (which would give identical outcomes as attaching [labial], [nasal], and [voice]), we get the correct form in (37a) but the incorrect forms in (37 b-c).



Similarly, if [labial] and [voice] attach, we get the correct outcome for (38b) but not for (a):



Attaching [nasal] and [voice] would have the same outcome as attaching [nasal], which would give a placeless nasal segment. Attaching only [voice] obviously would not give enough information to identify the segment, and attaching only [labial] would yield either a voiced or voiceless segment, which would only hold true for the *baru* input. Any way this could be examined will not give the correct results.

Optimality Theory and Correspondence are able to explain the different manifestations of the affix. Constraints on syllable structure determine the prefix in vowel-initial forms and demand an alternative to the co-occurrence of the affix and root initial consonant. Input-output constraints demand the realization of every segment. Featural correspondence demands a relation between what can and can't be coalesced together: identity constraints state that the root must share [labial] or [nasal] with the affix in order to coalesce, and that it must keep its place feature. Correspondence also decides how coalescence will surface: overtly or covertly depending on the identity of [voice] in the root initial consonant. Finally, if coalescence is not a viable option because identity does not hold, the interaction of Correspondence with Align constraints determines a fate of infixation.

## 5. Conclusion

In this paper I examine an affixation phenomenon in Muna that manifests itself in four distinct ways, depending on the features of the root initial segment. I argue for an Optimality Theoretic approach to account for the alternation, using Correspondence Theory to examine the relations between input and output, both on a general segmental level as well as a featural level. I demonstrate how these featural identity constraints interact with alignment and syllable structure constraints to establish the correct shape and position of each affix form. I also argue that coalescence can account for two of the four patterns (resembling onset

substitution and affix deletion), if one accepts an analysis of both overt and covert types of coalescence, depending upon the features of the root initial consonant. Finally, I show that an Optimality Theoretic approach is better than a serial, rule-based analysis because one constraint ranking can account for the specific alternations, how the affix manifests itself, and why.

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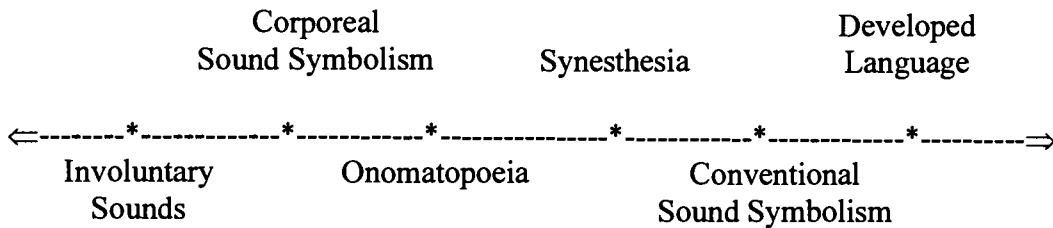
**Sound Symbolism as a Purposive Function  
of Culturally Situated Speech:  
A look at the use of ideophones in Tsonga**

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**1. Introduction**

The relationship between sound and meaning has interested scholars since the time of Plato. Saussure said that language may have some pre-linguistic and pre-cultural relationship to sound, but that by the time we call the sound "Language", that relationship is so arbitrary that iconicity is no longer important or motivating (Saussure 1916:97-192). A system of classifying the degree of linkage between sound and meaning is laid out in a recent volume on sound symbolism (Hinton, et al. 1994:1-6). The continuum of linkage between sound and meaning is represented in (1a) below where the left side of the line represents a completely linked relationship between sound and meaning, and the right side represents a completely arbitrary relationship between sound and meaning,

**(1a) Continuum of linkage between sound and meaning**



The table in (1b) gives examples of the different kinds sounds represented in the continuum in (1a).

**(1b) Examples of types of sounds (Based on Hinton, et al. 1994:1-6)**

Involuntary Sounds	Corporeal Sound Symbolism	Onomato-poeia	Synesthesia	Conventional Sound Symbolism	Developed Language
hiccuping sneezing	purposefully clearing one's throat	swish bang smack	low voice and vowel lengthening to represent large objects	'gl' in glitter glisten glow glimmer	most words in Language. Ex. dog, in, up, sit, ect.

Even though everything from hiccups to phonemes can now be classified by how the sound is related to the meaning, Silverstein points out that linguists have not gone much farther than Saussure in our understanding of sound on the denotational plane. He says that we are still "operating along the single dimension of signs as being denotationally iconic or denotationally arbitrary and, as it were, equating specific-system determination with arbitrariness." Which is to say that we are operating as though the linear representation in (1a) is correct. This, he says, is "not really making use of the distinction between absolute and relative arbitrariness/motivation, even on the denotational plane" (Silverstein 1994:41). Ideophones seem to give us a way to make *real* use of the distinction between direct linkage between sound and meaning and indirect linkage between sound meaning.

Silverstein goes on to say that in sound symbolism, sound is functioning outside of the usual ways it functions in language, and is thus transmitting meaning on another level. The challenge is to "view denotational iconism as one of the 'breakthrough' modes of semiosis, in which a system of sound structure,...normally subordinated to virtual zero autonomous power with respect to reference-and-predication in the doubly articulated structure of language, undergoes a functional rank-shifting...into the plane of referential-and-predicated-function" (Silverstein 1994:42). Silverstein challenges us to consider the possibility that a sound symbolic utterance, i.e. one where there is an iconic relationship between the sound and the meaning expressed, is not at the level of a grunt or a moan that communicates nothing more than a person's physical state, but is at some level that breaks through the usual high level of meaning conveyed in Language and adds another layer of expression. This is to say that we must revise the representation given in (1a) to one that is multi-layered or multi-dimensional instead of simply linear.

This paper accepts Silverstein's challenge by showing that ideophones rightfully belong within the realm of true Language where sound is arbitrarily related to meaning. Once this is established, we can look at the extra-linguistic, but sound oriented, qualities that are exploited by speakers when they use these

forms, and maybe come closer to understanding how sound as sign can be used to mean. The examination of ideophones allows us to tease apart the distinction between the indirect linkage between sound and meaning, which is a result of ideophones being highly conventionalized forms of language, and direct linkage between sound and meaning, which is a result of the fact that people use ideophones in a sound symbolic way to represent other sounds or movements in nature. This paper further suggests that a possible method for understanding the function of sound on an extra-linguistic plane is to look at the usage of ideophones in social contexts that allow for the exploitation of a non-arbitrary relationship between sound and meaning.

## 2. Ideophones Defined

In this section, ideophones are situated within the study of sound symbolism. Sound symbolism is defined as “the direct linkage between sound and meaning” (Hinton, et al. 1994:1). Ideophones can draw on elements from onomatopoeic, synesthetic, and conventional sound symbolism. If an ideophone is onomatopoeic, it represents environmental sounds in an imitative way. (Animal sounds like “oink” and “meow” are examples of onomatopoeia in English.) If an ideophone is synesthetic, it will be an acoustic symbolization of non-acoustic phenomena. (An example of synesthesia in English is the use of the high front vowel ‘i’ and high pitch and to represent small size as in “It was an itty bitty puppy”.) If an ideophone can be described as conventional sound symbolism, there will be an analogical relationship between language specific phoneme clusters and meaning. (An example of this is the use of the cluster ‘sl’ in English to represent things that are wet or do not have much friction as in ‘slippery’, ‘slick’, ‘slide’ and ‘slimy’.) Alpher (Alpher 1994:161) says that “Ideophones are word-like elements that suggest the *sound*, in a highly conventionalized sense, that accompanies an action”. Sometimes they convey the feel of an action as much as the sound. Childs, in his discussion of African ideophones (Childs 1994:180), suggests that ideophones are more non-arbitrary than most forms of language and that their understanding should be “grounded in a theory of expressiveness”.

Childs’ treatment of Bantu ideophones is a good description of how ideophones draw on different aspects of sound symbolism. However, it is not the purpose of this paper to analyze the ideophones in Tsonga according to these categories of iconicity. The Tsonga ideophones collected for this paper can easily be categorized this way, and more extensive categorization may yield some interesting information about the range of possible relationships sound can have to meaning in different contexts. Further categorization might also reveal ways that sounds can come to convey meanings about “colour, taste, smell, silence, action, condition, texture, gait, posture, or intensity” (Finnegan 1970:64). In



partial response to a statement made by Childs that the way “ideophones are learned and transmitted has not been studied” (Childs 1994:198), this paper examines when and how ideophones are used in social contexts, and how their meanings are transmitted and understood by the user.

### 3. Ideophones Elicited

The writer of this paper had the opportunity in the fall of 1995 to work with a consultant from South Africa whose native language was Tsonga. The consultant, hereafter referred to as Thomas, shared several Tsonga stories that contained ideophones. Although extremely interested in the ideophones, the writer found that consultation of the dictionary was of little help in determining what the ideophones might mean. During a personal interview with Thomas, he read ideophones from the dictionary so the writer could hear what they sounded like. In that we were not in South Africa using ideophones in everyday contexts, the setting for hearing these ideophones was not completely ‘natural’. However, what emerged in the writer’s mind from both Thomas’s demonstration and explanation of Tsongan ideophones is that ideophones have a particularly social dimension. Below are two excerpts from stories that Thomas told that include the use of ideophones.

One of the stories Thomas told was about the trickster Hare who outsmarts the other animals in order to gain admission to the Elephant’s beer bash, to which he was not invited. When Hare is found out by Lion and Hyena, Hare has to come up with a quick plan of escape. Just as Hare sees his chance to get away, Thomas used two ideophones back-to-back to communicate Hare’s actions (ideophones are underlined throughout):

- (3a) **Tsonga:** Xikan’we-kan’we a tlula: Gedle-gedle psiii.  
**IPA:** /fikan we kan we a ʔula: gedle gedle pfii/  
**Gloss:** Suddenly he jumped: Gedle-gedle psiii.

Thomas told another story about a girl named Nyeleti who was given to a barren mother on the condition that Nyeleti never do any hard work. Later, while Nyeleti was living at her husband’s home, he had to go far away to find work. Conditions went from bad to worse, and one day the mother-in-law, who was very old, was forced to ask Nyeleti to pound some corn so they could eat. Thomas vocalized the sound of the pestle hitting the mortar several times with the words

- (3b)  
“Gi.....Gi.....Gi.....”.

The striking thing about these words was not so much the form of them, but the way Thomas vocalized them to give them meaning. The sound of them was so different than the sounds of the other words in the story that they stood out

in the flowing sounds of the narration. Seeing these ideophones on the pages of the dictionary offered hardly any idea of how these words should sound, even though the phonetic system employed in Tsonga was fairly straightforward, and the phonetic transcriptions of the ideophones were included. During the interview, Thomas looked at pages of the dictionary on where ideophones had been marked. Many of them he did not know, and he said they were used regionally. These he would skip over or read without any exaggerated inflection at all, but the ones he did know, he pronounced in a sound symbolic way. The meanings and the relationships between the words and the sounds became much clearer. It was like seeing the word “boing” on a page without ever hearing it, then having someone say,

(3c)

G”

I N

“BO

imitating a spring, starting the ‘b’ in a low voice and making the sound rise higher and higher in pitch as the mouth forms the rest of the phonemes.

#### 4. Ideophones Voiced

To better understand how sound is at work in the usage of ideophones, we have to be able to share the sound. A phonetic transcription is not enough to convey what is being done by the speaker. In order to talk about them, we all have to be able to hear them, and since we communicate in the academic world through writing, an attempt has been made here to convey more directly what the ideophones sounded like. Below is a list of several of the ideophones Thomas used in the interview or in his stories. If the Tsonga/English dictionary (Cuenod 1991) had an entry for the ideophone being described, it is included. Otherwise, a definition given by the consultant is included. Falling and rising tones are indicated on the orthographic representation of the ideophones. Where possible, the sound of the Tsonga ideophone is related to sounds used sound symbolically in English. It is hoped that knowing the English iconic usage provided will help make the sound of the Tsonga ideophone more clear, and that the process of sounding out similar and familiar sounds in English will give the reader the experience of discovering the sound meaning of the Tsonga ideophones.

(4a) **gèdlè-gèdlè**: /gedle gedle/ “flutter, palpitate, as heart in sudden fright” (Cuenod 1991). This is the word Thomas used to show “getting ready to take off”. It sounds like ‘giddy up giddy up’ in English, but there is a definite break between the reduplication. Thomas would sometimes

use his hands for this one. He would plant his hands in front of him, slightly to one side, on the first “gedle” then quickly move them and plant them again in a different position on the second “gedle”. According to Thomas, it represents an evasive tactic of an animal whose trail has been picked up by a hunter.

**(4b) psii:** /pʃii/ To disappear quickly. The /ʃ/ sound is sustained. It sounds like our ‘Shhhhh’ for ‘quiet’, except with an explosive ‘p’ at the beginning. The sound is made quickly and with rising intonation. Thomas would point his finger and move his hand quickly across his body and away. Something Americans do that has a similar effect is when we say, ‘It disappeared, *just* like that!’ where the ‘just’ is devoiced, said quickly, and accompanied by a snap of the fingers.

**(4c) gi-gi-gi:** /gi gi gi/ “Produce brief crisp thud” (Cuenod 1991). Notice the English sound symbolic words used in the definition. This ideophone is said in about as low a pitch as one can manage comfortably at intervals of about one second apart. The ‘g’ and the ‘i’ are both heavily voiced, and the ‘i’ is allowed to ring a little. A ghost story told by children in American culture might include a ‘bad guy’ coming up the stairs as in ‘You could hear his footsteps getting closer and closer: thump, thump, thump’. The slow deliberate quality of these ‘thumps’ are similar in rhythm and pitch to the ‘gi’ sounds of Nyeleti pounding the corn in Thomas’s story.

**(4d) dlòmú:** /dlomu/ “Plump into deep water, as big stone” (Cuenod 1991). This is said with a very iconic intonation. The “dlo” is started in the lower part of one’s pitch range, and the vowel is lowered even more. As one begins to pronounce the ‘m’, the tone is on the rise, and by the time the ‘u’ is said, one is at the higher middle part of one’s range. The ‘o’ is longer than the ‘u’. English does not have a conventionalized form of this sound. However, the writer is well acquainted with people who can reproduce the sound of water dripping from a faucet by tapping a finger on the side one’s cheek as while forcing air out of a small rounded opening in the lips as the lower jaw is raised up to meet the upper jaw. This is the same sound represented by this Tsonga ideophone.

**(4e) mpfèká-mpfèká:** /mpfeka mpfeka/ “Something badly made, rickety, not firm, as basket, chair” (Cuenod 1991). This is actually pronounced in a repetition of three syllables. The ‘m’ is a quick, low hum, followed by the

falling ‘pfè’ and then the rising ‘ká’. This is the sound that Thomas says the “Tsongas think they hear” springs make when one jumps on the bed or bounces on a bicycle seat. The triple rhythm of this ideophone can be seen in an English nursery rhyme that has nothing to do with beds or springs. The rhythm of mpfeka-mpfeka-mpfeka sounds like the rhythm of “To market---To market---to buy a---fat pig. Home again---Home again---jiggity---jig.”

**(4f) féhlè-féhlè:** / feθle feθle / Something soft and bouncy. This one is related to ‘mpfeka’ in that it also describes a bouncing motion, but it is used for bouncing on something soft and yielding like a fat couch. The ‘h’ becomes a /θ/ as the tongue approaches the ‘l’ position, and the word is said with a definite ‘up-down, up-down’ intonation reminiscent of rhythmic bouncing.

## 5. Ideophones contextualized

Caught up in the different sounds of Thomas’s pronunciation of the ideophones, the writer began to wonder about the notion that sound symbolism is the precursor to fully formed human language (Hinton 1994:11). While describing the ideophones in written English and repeating them aloud, it became clear that English speakers have at their disposal the same use of sound symbolism in certain forms of speech. A couple of times, Thomas read the ideophones he recognized without the iconic sound representation, driving home the fact that these ideophones are in fact highly conventionalized lexical forms whose inherent relationship to the sound is pretty far removed. This contradicts the possibility that ideophones are reminiscent of early forms of language. What Thomas was doing was infusing a particular lexical item with sound symbolic properties, not showing the word’s inherent sound symbolic characteristics. He was performing, in the same way that an English speaker would be performing if she were trying to explain “boing” to a non-English speaker by exaggerating the inflection in her voice (as in 3c). The difference between Tsonga ideophones and English sound symbolic words seems to be the degree to which sound symbolic items have become codified in Tsonga as lexical items.

So the question then is why do some languages use sound symbolism more than others, and why do some people feel more comfortable than others in exploiting sound iconicity to convey meaning? This is a cultural question, not a linguistic one, and the answers Thomas provided were cultural answers. When asked about the contexts in which ideophones were used, Thomas said ideophones often showed up in stories. He said that adults tell stories, usually a grandma or a

grandpa, and if neither of these are present, then one's mother will tell them. "That's how family values are transmitted from one generation to another," Thomas said, because stories all have at least one moral lesson to share. Stories are told, at least they were a few years ago, around the fireplace after supper, while eating roasted peanuts, corn on the cob, and jago beans. Different stories are told to children of different ages so that the moral lesson will be relevant to the child's experience.

When asked if ideophones were used in other contexts besides storytelling, Thomas said, "Oh, yes. We use them all the time." Finnegan comments on this everyday usage of ideophones when she writes, "the picturesque and imaginative forms of expression of many Bantu languages are particularly noticeable. These are often applied to even the commonest actions, objects, and descriptions" (Finnegan 1970:58). When asked, "When and how are ideophones used?" Thomas proceeded to tell more stories. Almost every ideophone discussed had a personal, contextualizing story to go with it to explain how and when these words infused with sound were used to mean. Below is a list of ideophones accompanied by the social contexts in which Thomas placed them to show how and when they would be used.

**(5a) bì:** /bi/ Said in very low pitch with a little bit of aspiration at the end. "Me and my younger brother used to go hunting, and we would take a big bag full of peanuts. Once we got there, we roasted them in dry leaves. We lived with my grandmother for a while, because my mother had gone to stay with my father who was working far away. When she would come home once a month to see us, she would say, "When I left there was a bag full of peanuts, and within a month, they are all gone, bì!"

**(5b) chòlá-chòlá:** /çola çola/ Said with much the same break between the reduplication as gedle-gedle. This is the sound of a big animal making noises in the bush while walking. "When my brother and I would go hunting, he would tell me, 'Don't just come along and chola-chola. You'll scare all the animals away!"

**(5c) dlidlirita:** /dlidlirita/ Said with a push from the diaphragm on the first two syllables to make a sound almost like a car engine trying to start. "If I push Debbie, and she lands in the corner, dlidlirita."

**(5d) dlòrí-dlòrí:** /dlori dlori/ Said while swaying a little from side to side with the intonation much like the one used for dlomu (above) although in an overall higher pitch and in a fast, repetitive rhythm to imitate the

pace of walking. “I know this one too. Among the Tsongas where there is no basketball, height is not a good thing, it’s not an asset. So...everybody looks at you this way and they say you go dlori-dlori-dlori because you are taller than everybody else...the seven guys are rare. I remember, I used to have this classmate of mine when I was a second grader. She was tall! She was tall. Well, you can imagine I was six then, and we had somebody about as tall as you are, and we called her dlori-dlori.”

(5e) **mbòò**: /mboo/ Said in a very low voice with a falling tone that is sustained until it fades away. “This would mean usually you are sad...Like, say for instance my parents married a girl for me and then two months later she disappeared. And then they say, ‘Mboo, mali ya tata’/mboo mali ya tata/ (*Mboo* , money of Dad)...Something is lost for good.”

(5f) **phyáphyàrhà**: /pfyapfyarha/ The ‘phy’ is devoiced but explosive. The first ‘phyá’ rises and the vowel is cut short. The second ‘phyà’ is longer and falling. “Have you evermade cornmeal? Well, you have boiling water, then you put corn meal and then you start mixing. Then you see air coming out, the kind of bubbles phyá phyaphya phyá. And then somebody will say, it used to be me in my family, my mom would be doing something else and she’d say to me, ‘Check and let me know when the porridge starts to phyaphyarha.’”

(5g) **bvanyangeta** and **yandlamela**: /bvanyangeta/ /yandlamela/ Thomas said these two words without any sound symbolism at first, but he said that ‘bvanyangeta’ was to pounce and ‘yandlamela’ was to sneak. When I asked him how he would use them, he said, “How would I say it? Well, I’ll say it in Tsonga...ximanga /fimaŋa/ (cat) xiyandlamela, xiyandlamela (said in a whisper) kondlo /kondlo/, kondlo is the mouse,(this phrase was spoken in a normal voice) xiyandlamela, xiyandlamela, xiyandlamela, xi**BVANYANGETA!**” The three xiyandlamela’s were whispered and as he said them he picked up speed until he exploded into full voice on the bvanyangeta.

In each of these little stories, Thomas used the ideophones in a sound symbolic way, either varying the volume of his voice, or the pitch, or the length of the sounds. By reporting actual speech, he showed that this exploitation of the sounds when speaking words is used in everyday situations like cooking, and in normal conversations between family members. These anecdotes were offered

almost as a definition of what the words meant. The fact that Tsongas use these sounds in stories is not different from the use of sound symbolic words in English stories, but the freedom to use them so often in everyday speech is not something usually taken advantage of by English speakers. Thomas offered a bit of insight into why this might be true when he said, “People usually like to exaggerate, Tsongas at least, like to exaggerate...These (ideophones) are kind of like hyperboles. It’s gross exaggeration. It’s like *mbvéé /mbvee/*, you die from the stink! People like to use them.” When Finnegan writes about ideophones in Bantu languages she says, “the acoustic impression often conveys aspects which, in English culture at least, are not normally associated with sound at all” (Finnegan 1970:64). It is not that English speakers cannot imagine an abstract relationship between things that can be expressed iconically in sound, they can and do, it is just that the Tsongas seem to do this more often because of their love for exaggeration, and because of the way they use stories and storytelling to transmit cultural ideas. By repeated usage, sound symbolic forms become codified into lexical items linguists call ideophones. At this point, the relationship between the sound and the meaning of the ideophone is arbitrary as it is in Language.

## 6. Ideophones redefined

The proliferation of ideophones in the Tsonga language can be explained by looking at Tsonga culture or even Tsonga language ideology. The fact that Tsongas have words they use sound symbolically for many specific and unrelated things points to a repeated choice made by speakers to use sound to convey meaning. The words themselves have a definite arbitrary relationship between sound and meaning which is manifested in Thomas’s ability to pronounce them without the sound symbolism, and in his concern that some ideophones may not be transmitted to the next generation. This places ideophones in the realm of Language where the relationship between sound and meaning is arbitrary (the far right on the continuum in 1a). When asked how children learn to use ideophones, Thomas said that the ones used for hunting might not be learned by children today because hunting has become prohibited by “conservationists and preservationists”. If the relationship between the sound of an ideophone and its meaning was inherent, it seems that its perception would be almost intuitive. The sound of a person walking through a bush would still sound like ‘chola-chola’ to a native Tsongan whether or not he was initiated into the native hunting traditions. In fact, a person walking through the bush should sound like ‘chola-chola’ to any non-Tsongan as well. The fact is that these ideophones are highly conventionalized lexical items like the other words in Language, but that a sound relationship is imposed on them to convey meaning on a level not usually

exploited by regular language usage. It is as if we are working on a continuum that may be parallel or tangential to the one described above, but we are no longer working only within it.

Now that we have established that we are no longer trying to understand how language may have evolved from a non-arbitrary relationship between sounds and things in nature (this is not to say that this is not in fact true, or that continued research in this area might not provide insights, but only to say that manifestations of sound symbolism in ideophones is a purposeful application of newly conceptualized relationships between sound and meaning imposed onto an arbitrary lexical form), we are free to look deeper at the sound meaning relationship of ideophones. One direction to look for a deeper understanding of the purpose of ideophones would be to look at the “poetics of linguistic expression as a functional plane distinct from denotation as such, to determine the contribution of (broadly speaking) ‘metrically’ organized form as one of the determinants of at least the native speaker’s feeling of sound symbolism attached to certain expressions” (Silverstein 1994:41). Silverstein suggests that there is a poetic function of language that is distinct from the usual denotation function of language, and that to explore the poetic function of language is to explore at the very least the feeling of a speaker that is attached to the use of the sound symbolic expression. How is it that when we use sound-as-iconic-manifestation of things that “sensation is immediate and is immediately translated into a word or a sound, a sound which is so appropriate, so fitting, that one sees the animal moving, hears the sound produced, or feels oneself the very sensation expressed” (Junod 1936:30-31)? Why is it that “to be used skillfully,...they (ideophones) must correspond to one’s inner feeling” (Fortune 1962:6)? These are questions that must seek answers in the behaviors and ideas of people as well as in the description of the linguistic forms used by them.

In the presentation of the above data, this paper has emphasized the similarities between common English sound symbolic utterances and Tsonga ideophones even though English cannot be said to contain proper ideophones in its vocabulary. The question raised by the difference in frequency of usage of sound symbolic items in Tsonga and English is, “What is it about our cultures that make us as individuals more or less likely to attempt to communicate with sound on an extra-linguistic plane?” Attempts to answer this question may lead to a better understanding of the human capacity to use and develop ways to communicate on multiple sensory and semantic levels, which will in turn lead to a multi-dimensional model of the relationship between sound and meaning in human language.



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# Fronting and Palatalization in Two Dialects of Shoshoni\*

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## 1. Introduction

In Western Shoshoni, a Uto-Aztecan language spoken in northern Nevada, coronal obstruents are found in distributional patterns which depend on the presence or absence of a preceding front vowel ([i] or [e]). In the pattern I refer to as FRONTING, alveolar stops alternate with dental stops—dental stops occur following front vowels (1a), while alveolar stops occur elsewhere (1b); this pattern is common to all dialects:

### (1) Western Shoshoni Fronting

- a. dental: [sittu] ‘here’ (*si-* ‘PROXIMAL’ –*ttu* ‘LOCATIVE STEM’)
- b. alveolar: [sattu] ‘here’ (*sa-* ‘DISTAL’ –*ttu* ‘LOCATIVE STEM’)

In the pattern I refer to as PALATALIZATION, coronal affricates alternate with palato-alveolar affricates—palato-alveolar affricates occur following front vowels (2a), while alveolar affricates occur elsewhere (2b):

### (2) Western Shoshoni Palatalization

- a. palato-alveolar: [moyittʃi] ‘bag’ (*moyi* ‘bag’ –*tʃi* ‘ABSOLUTE’)
- b. alveolar: [poniattʃi] ‘skunk’ (*ponia* ‘skunk’ –*tʃi* ‘ABSOLUTE’)

This distribution of coronals in Western Shoshoni is completely predictable and also occurs morpheme-internally (3-4):

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- (3) Morpheme-internal Fronting in Western Shoshoni
- dental: [hi<sup>̣</sup>tt<sup>̣</sup>o:] ‘meadowlark’
  - alveolar: [p<sup>̣</sup>otto] ‘grinding stone’
- (4) Morpheme-internal Palatalization in Western Shoshoni
- palato-alveolar: [h<sup>̣</sup>uitt<sup>̣</sup>ʃu] ‘small bird’
  - alveolar: [h<sup>̣</sup>uttsi] ‘grandmother (FaMo)’

These distributional patterns are not unusual when taken separately. However, finding both of them together is curious, since coronal obstruents move in two different directions in exactly the same environment—towards the front of the mouth in the case of Fronting (5a), and towards the back of the mouth in the case of Palatalization (5b).

- (5) Western Shoshoni coronals following front vowels
- Fronting 

[t]	←	/t/
-----	---	-----
  - Palatalization 

/ts/	→	[tʃ]
------	---	------
- (dental)                      (alveolar)      (palato-alveolar)

Palatalization in Gosiute, a dialect of Shoshoni spoken in Western and Central Utah, differs from that in Western Shoshoni in that a palato-alveolar affricate alternates with an interdental affricate; palato-alveolar affricates occur following front vowels (6a), while alveolar affricates occur elsewhere (6b):

- (6) Gosiute Palatalization
- palato-alveolar: [moyitt<sup>̣</sup>ʃi] ‘bag’ (*moyi* ‘bag’ -<sup>̣</sup>tt<sup>̣</sup>θ<sup>̣</sup>i ‘ABSOLUTE’)
  - interdental: [poniatt<sup>̣</sup>θ<sup>̣</sup>i] ‘skunk’ (*ponia* ‘skunk’ -<sup>̣</sup>tt<sup>̣</sup>θ<sup>̣</sup>i ‘ABSOLUTE’)

Just as in Western Shoshoni, Fronting and Palatalization in Gosiute are fully regular and occur within morphemes (7-8):

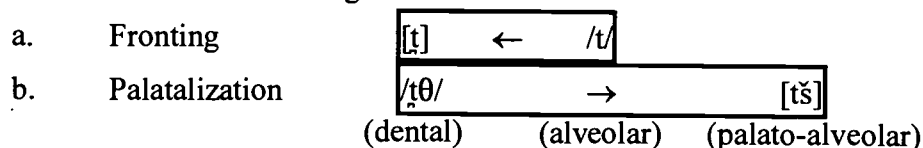
- (7) Morpheme-internal Fronting in Gosiute
- dental: [ni<sup>̣</sup>tt<sup>̣</sup>oi] ‘sing’
  - alveolar: [p<sup>̣</sup>otto] ‘grinding stone’

(8) Morpheme-internal Palatalization in Gosiute

- a. palato-alveolar: [huittʃu] ‘small bird’
- b. interdental: [huttθi] ‘grandmother (FaMo)’

In Gosiute, not only do coronals move in opposite directions following front vowels, but they actually cross, as is apparent from figure (9):

(9) Gosiute coronals following front vowels



Previous descriptions of the phonology of Western Shoshoni and Panamint (a closely related language with similar alternation patterns) have treated Fronting and Palatalization separately in spite of the identity of the triggering environments (Crum and Dayley 1993 and Miller 1996 for Western Shoshoni;<sup>1</sup> McLaughlin 1987 and Dayley 1989 for Panamint); no analysis of the Gosiute pattern itself has yet been proposed. McLaughlin (1987) provides the rationale:

“Even though these two sets of rules [i.e. Fronting and Palatalization] are clearly related in having the same environment and the same class of sounds that they operate on [i.e. coronals], there is no way to collapse these two rules in generative phonology without increasing the amount of obfuscation and decreasing the amount of explanation.” (McLaughlin 1987: 73 fn.)

In this paper I provide an analysis of Fronting and Palatalization in western Shoshoni and Gosiute within the framework of Optimality Theory (Prince and Smolensky 1993; McCarthy and Prince 1993, 1995). This analysis accomplishes two things. First, it provides a unified solution to Fronting and Palatalization in both dialects. By providing a unified analysis, I show that the intuition that these two alternations are related is in fact correct. This analysis relies on the feature [distributed], which describes the active articulators in the alternations, the tongue tip ([-distributed]) or tongue blade ([+distributed]).

<sup>1</sup> The data in Miller (1996) is from a speaker of Gosiute, but the transcription has been normalized to conform to a more general Western Shoshoni pattern. For instance, Miller restores all instances of [h] which are absent from his consultant’s speech based on comparative data from other dialects, and the interdental affricate [tθ] and its reflexes are consistently transcribed as alveolar [c], although he does mention their dental articulation the text.

Second, the analysis of the Gosiute patterns provides additional support for the formal device of Local Conjunction within Optimality Theory (Smolensky 1995; see also Kirchner 1996). I show that any Optimality Theoretic analysis of Gosiute Fronting and Palatalization which does not make use of Local Conjunction will not be able to provide a coherent account of these alternation patterns.

The rest of the paper is organized as follows. I begin in section 2 with an analysis of Fronting and Palatalization in Western Shoshoni. In this analysis, I show that both patterns involve the conditioned distribution of apicals and laminals: laminals follow front vowels, and apicals occur elsewhere. In section 3, I provide an analysis of Gosiute Fronting and Palatalization which builds on the results in section 2, showing that the analysis of Western Shoshoni Fronting can be adopted *in toto* for the Gosiute data. The extension of this analysis to Gosiute Palatalization requires the formal device of Local Conjunction of constraints; this formal move does not change the basic insight concerning the distribution of apicals and laminals, however. This paper concludes in section 4.

## **2. Fronting and Palatalization in Western Shoshoni**

In this section I present an analysis of Western Shoshoni Fronting and Palatalization. I show that these alternations in Western Shoshoni are easily explained as the alternation of apical and laminal coronals, with laminals occurring after front vowels and apicals occurring elsewhere. In 2.1, I present the data for Fronting in Western Shoshoni. Based on the articulatory properties of the coronal consonants involved in Fronting, I show that Fronting can be expressed as a requirement on coronals following front vowels to bear the feature [+distributed]. Although this requirement is expressed in Optimality Theoretic terms, the analytical insight behind it is independent of this framework.

In 2.2 I provide data for Palatalization in Western Shoshoni. Again, based on the articulatory properties of the consonants involved in the alternations and distributional patterns, I show that Palatalization is the result of the requirement of coronals following front vowels to bear the feature [+distributed]. Palatalization thus has the same analysis as Fronting, and the unification of these two patterns is achieved. In 2.3 I summarize the results of this section.

### **2.1. Western Shoshoni Fronting and [+distributed]**

I turn first to Fronting in Western Shoshoni. In this distributional pattern, plain alveolar obstruents are in complementary distribution with dental

obstruents; the data in (10) illustrate this pattern.<sup>2</sup> In (10a), voiced alveolar taps and voiced dental fricatives occur between vowels; dental fricatives follow [i] or [e], and alveolar taps occur elsewhere. In (10b), voiced alveolar and dental stops occur following homorganic nasals; dental nasal-stop clusters follow [i], and alveolar nasal-stop clusters occur elsewhere. In (10c), voiceless alveolar taps and voiceless dental fricatives occur between vowels; dental fricatives follow [i] and [e], and alveolar taps occur elsewhere. Finally, in (10d), voiceless geminate alveolar stops and voiceless geminate dental stops occur between vowels; geminate dental stops follow [i] and [e], and geminate alveolar stops occur elsewhere.

(10) Western Shoshoni Fronting: morpheme-internal complementary distribution of dental and alveolar obstruents

a.	[pira]	‘arm’	[pið̥i]	‘to arrive’
	[ara]	‘uncle(MoBr)	[peð̥i]	‘daughter, niece
	(SiDa)’			
	[poro]	‘cane’		
	[nura:]	‘run-pl.subj.’		
b.	[kindu]	‘yesterday’	[taiŋ̥ði]	‘hole’
	[pand̥i]	‘killdeer’		
	[ondi]	‘brown’		
	[nasundaŋ̥a]	‘to remember’		
c.	[towiria]	‘to pour’	[piθ̥u:]	‘to be stung by a bee’
	[aɾaϕ̥i]	‘jaw’	[pa:ŋ̥neθ̥i]	‘Northern
	Paiute, Bannock’			
d.	[k <sup>w</sup> itti]	‘to shoot’	[hit̥to:]	‘meadowlark’
	[pattu]	‘dead-fall trap’		
	[potto]	‘grinding stone’		
	[uttapp̥i]	‘fine dust’		

In (11), I provide examples of the conditioned alternation of dental and alveolar consonants in suffixes following a stem-final front vowel.

<sup>2</sup> In addition to Fronting, the data in (6) and (7) show the effects of consonant gradation. The details of Shoshoni consonant gradation are not relevant to the problem at hand, and will not enter into the analysis presented here.

## (11) Western Shoshoni Fronting: alternation of dental and alveolar obstruents at morpheme boundaries

a.	-(n)tuʔi 'future'	
	[na:ria-ruʔi] 'will race'	[nukki-ṅduʔi] 'will run'
		[hanni-ðuʔi] 'will use'
b.	-ti 'generic aspect'	
	[kari-ri] 'sitting'	[hiβi-ði] 'drinking'
	[tikka-ri] 'eating'	[pekkai-ði] 'killing'
c.	-ti 'demonstrative stem'	
	[sa-ri] 'that'	[si-ði] 'this'
	[su-ri] 'that'	[se-ði] 'this'
d.	-ti 'participle'	
	[si:ma:-ɾi] 'ten'	[wattsiwi-θi] 'four'
		[maneyi-θi] 'five'
		[na:ɸai-θi] 'six'
e.	-ttu 'locative stem'	
	[sa-ttu] 'there'	[si-ttu] 'here'
		[se-ttu] 'here'

The alveolar obstruents in the first column of both (10) and (11) are produced with the tip of the tongue at the alveolar ridge, an *apical* articulation. The dental obstruents in the second column are produced with the blade of the tongue at the alveolar ridge and behind the upper teeth, which is a *laminal* articulation.<sup>3</sup> The alternation of Fronting thus reduces to an alternation between laminals and apicals; laminals follow front vowels and apicals occur elsewhere.

<sup>3</sup> These articulatory observations were made by speakers of the language reporting and commenting on their own pronunciation of the sounds under investigation.

Using [t̟] and [t] as cover symbols for the dental and alveolar consonants under discussion here, the figure in (12) summarizes their distribution.

(12) Distribution of dental and alveolar consonants:

i,e ____	elsewhere
laminal [t̟]	apical [t]

This kind of alternation is supported on articulatory grounds. In the articulation of a front vowel, the blade of the tongue is close to the roof of the mouth, facilitating a laminal articulation in a neighboring consonant. In Chomsky and Halle (1968), the feature [distributed] is described as controlling the length of constriction along the direction of air flow: “Distributed sounds are produced with a constriction that extends for a considerable distance along the direction of the air flow; nondistributed sounds are produced with a constriction that extends only for a short distance in this direction.” (Chomsky and Halle 1968:312) Since then it has been common to describe dentals and palato-alveolars as [+distributed], and alveolars and retroflexes as [-distributed]. Assigning the feature [distributed] to the coronals involved in Western Shoshoni Fronting entails the equation of [+distributed] and laminal (=dental), and [-distributed] and apical (=alveolar).<sup>4</sup> Figure (13) shows the feature matrix for the consonants involved in Western Shoshoni Fronting:

(13) Feature matrix for dental and alveolar consonants

	t	t̟
anterior	+	+
strident	-	-
distributed	-	+

In featural terms, Fronting is merely the addition of [+distributed] to an alveolar consonant (14).

(14) Fronting

t	→	t̟
[COR]		[COR +dist]

<sup>4</sup> Keating (1991) points out that there may actually be less correlation between a long constriction, which is definitional for [+distributed], and laminal articulation than has previously been assumed. I will continue to use the feature [distributed] for convenience, while recognizing that it is actually the apical-laminal distinction which is at work in Gosiute and Shoshoni.



It is important to note that this analysis of Fronting is independent of Optimality Theory; that is, the success or failure of Optimality Theory as a theoretical framework will have no bearing on the validity of the proposal made here that Fronting can be analyzed as the addition of [+distributed] to the feature set of a coronal consonant. That said, the Optimality Theoretic constraint in (15) captures this generalization:

- (15) FR...DIST: A consonant following a [-back] vowel is [+distributed].

The constraint in (15) evaluates a *sequence* of features. In Suzuki (1995, 1997) and Archangeli and Suzuki (1995) the notion of *sequential grounding* is introduced and defended. Briefly, for any grounded condition X/Y prohibiting or requiring the cooccurrence of features X and Y in a path, there is a *sequential* constraint which prohibits or requires X and Y in adjacent paths. This constraint is abbreviated X...Y, and is universally lower-ranked than the constraint X/Y. This means that for the sequential constraint FR...DIST there is also a related, superordinate constraint FR/DIST which requires the features [-back] and [+distributed] to cooccur on a single segment. It is the sequential constraint FR...DIST which is active in the analysis of Fronting in Western Shoshoni.

Satisfaction of FR...DIST comes potentially at the expense of changing the value of the feature [distributed] which is present in underlying representation. The pressure to preserve underlying features and their values is expressed by constraints on faithfulness of corresponding elements (McCarthy & Prince 1995). In this case the constraint is MAX[-dist], defined in (16):

- (16) MAX[-dist]: An input [-distributed] has a corresponding output [-distributed].<sup>5</sup>

Ranking of FR...DIST above MAX[-dist] ensures that its requirements are met at the expense of the preservation of the underlying value of [distributed]; this is illustrated in the tableaux in (17).

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<sup>5</sup> It should be noted that the usage of the constraint family MAX proposed here differs from that introduced in McCarthy and Prince (1995). Their definition of MAX states only that "Every element of S<sub>1</sub> has a correspondent in S<sub>2</sub>." (p122) and makes no requirement on identity or similarity between corresponding elements.

(17) Ranking of FR...DIST >> MAX[-dist]

	/hitto/ [-dist]	FR...DIST	MAX[-dist]
a. $\wp$	hitto: [+dist]		*
b.	hitto: [-dist]	*!	

In the tableau in (17) candidate b. preserves an underlying [-distributed] at the cost of violating the higher ranked FR...DIST; candidate a. on the other hand fails to preserve underlying [-distributed] but satisfies FR...DIST and is therefore chosen by the constraint hierarchy as optimal.

Summarizing the results so far, Fronting in Western Shoshoni has been analyzed as the conditioned distribution of laminals and apicals; laminals occur following front vowels, and apicals occur elsewhere. This is expressed in featural terms by equating laminal with [+distributed] and apical with [-distributed] and requiring front vowels to be followed by a [+distributed] consonant. This requirement takes priority over the preservation of the underlying feature value for [distributed]. In the next section, I extend this analysis to Western Shoshoni Palatalization.

## 2.2. Western Shoshoni Palatalization and [+distributed]

In the distributional pattern of Palatalization in Western Shoshoni, alveolar sibilants are in complementary distribution with palato-alveolar sibilants; the data in (18) illustrates this pattern. In (18a), voiced alveolar fricatives and voiced palato-alveolar fricatives occur between vowels; palato-alveolar fricatives follow [i] and [e], and alveolar fricatives occur elsewhere. In (18b), voiced alveolar affricates and voiced palato-alveolar affricates occur following homorganic nasals; palato-alveolar nasal-affricate clusters follow [i], and alveolar nasal-affricate clusters occur elsewhere. In (18c), geminate alveolar affricates and geminate palato-alveolar affricates occur between vowels; geminate palato-alveolar affricates follow [i] and [e], and geminate alveolar affricates occur elsewhere. Finally, in (18d), voiceless alveolar fricatives and voiceless palato-alveolar fricatives occur between vowels; palato-alveolar fricatives follow [i] and [e], and alveolar fricatives occur elsewhere.

## (18) Western Shoshoni Palatalization: morpheme-internal complementary distribution of alveolar and palato-alveolar sibilants

a.	[izi]	‘to stink’	[ižappi]	‘coyote’
	[pazi]	‘older sister’	[ežikko]	‘sling shot’
	[mozo]	‘beard, whiskers’		
	[huziðo:]	‘shin’		
b.	[tindzo:]	‘hand game bones’	[mawiñdža]	‘wrist’
	[wandzi]	‘buck antelope’		
	[warondzipp̥i]	‘wild rye’		
	[k <sup>w</sup> iβundzi]	‘scorpion’		
c.	[hittsipp̥i]	‘saliva’	[huittšu:]	‘small bird’
	[wattsiwiθ̥i]	‘four’	[pettši]	‘holler-DUR’
	[pottsi]	‘hop, jump’		
	[huttsi]	‘grandmother (FaMo)’		
d.	[p̥i:si]	‘body hair, fur’	[išaβaipp̥i]	‘Coyote’
	[kasa]	‘wing’	[k <sup>w</sup> eši]	‘tail’
	[tosa]	‘white’		
	[usi]	‘that’		

In (19), I provide examples of the conditioned alternation of palato-alveolar and alveolar sibilants in suffixes following a stem-final front vowel.

## (19) Western Shoshoni Palatalization: alternation between alveolar and palato-alveolar sibilants at morpheme boundaries

a.	-ttsi	‘absolute’		
	[araŋgu-ttsi]	‘red ant’	[moyi-ttši]	‘bag’
	[ponia-ttsi]	‘skunk’		
b.	-ttsi	‘diminutive’		

- |    |                          |               |  |              |                |
|----|--------------------------|---------------|--|--------------|----------------|
|    | [appi-ttsi]              | ‘dear father’ |  | [kahni-ttši] | ‘little house’ |
| c. | -sɪ ‘demonstrative stem’ |               |  |              |                |
|    | [u-sɪ]                   | ‘that’        |  | [i-ši]       | ‘this’         |
|    | [a-sɪ]                   | ‘that’        |  | [e-ši]       | ‘this’         |
| d. | -sɪ ‘emphatic’           |               |  |              |                |
|    | [oyi-sɪ]                 | ‘always’      |  | [pie-ši]     | ‘already’      |

The alveolar obstruents in the first column of (18) and (19) are produced with the tongue tip at the alveolar ridge; they are thus apical. The palato-alveolar obstruents in the second column of (18) and (19) are produced with the tongue blade rounding the corner of the alveolar ridge—a laminal articulation. As with Fronting, the laminal consonants follow front vowels, and the apical consonants occur elsewhere. I use [tš] and [ts] as cover symbols for the dental and alveolar sibilants discussed here; the figure in (20) summarizes their distribution.

(20) Distribution of palato-alveolar and alveolar sibilants:

i,e	___	elsewhere
laminal	[tš]	apical [ts]

Since both alternants in Palatalization are sibilants, I assign the feature [+strident] to them; this distinguishes the underlying plain coronal /t/ ([-strident]) from the sibilant /ts/ ([+strident]). In 2.2 I discussed the assignment of [+distributed] to laminals and [-distributed] to apicals and demonstrated that Fronting is thus the addition of [+distributed] to the feature matrix of a coronal following a front vowel. Just as dentals are assigned [+distributed], it has been common to assign this feature value to palato-alveolars as well. Making these feature assignments to the coronals involved in Palatalization yields the feature matrix in (21).

## (21) Feature matrix for Western Shoshoni sibilants

	ts	tš
anterior	+	-
strident	+	+
distributed	-	+

From the distributional statements summarized in (20) and the feature matrix for Western Shoshoni sibilants in (21), it is clear that Palatalization has the same analysis as Fronting; Fronting is the addition of [+distributed] to a coronal consonant (22). The tableau in (23) provides an example of the interaction of the constraints FR...DIST and MAX[-dist] in Western Shoshoni Palatalization.

## (22) Palatalization

ts	→	tš
$\begin{bmatrix} \text{COR} \\ +\text{str} \end{bmatrix}$		$\begin{bmatrix} \text{COR} \\ +\text{str} \\ +\text{dist} \end{bmatrix}$

## (23) FR...DIST &gt;&gt; MAX[-dist]

	/huittsu:/ [-dist]	FR...DIST	MAX[-dist]
a. $\text{☞}$	huittš̥u: [+dist]		*
b.	huittsu: [-dist]	*!	

In the tableau in (23), candidate b. violates high ranking FR...DIST; candidate a. satisfies this constraint at the expense of violating MAX[-dist]. Since FR...DIST is top-ranked, candidate a. is selected as optimal.

## 2.3. Summary

In this section, I have shown that the alternation patterns of Fronting and Palatalization in Western Shoshoni involve the conditioned distribution of apical and laminal coronals; laminals occur following front vowels, while apicals occur elsewhere. This is represented in an Optimality Theoretic grammar by ranking

the constraint FR...DIST, which requires the feature [+distributed] to follow a segment specified [-back], above a constraint requiring preservation of underlying [-distributed]. In the next section, I use these results as the foundation for the analysis of the Gosiute patterns of Fronting and Palatalization.

### 3. Gosiute Fronting and Palatalization

Gosiute shows alternation patterns similar to the ones found in Western Shoshoni. As in Western Shoshoni, Fronting is the complementary distribution of laminal and apical coronal consonants before a front vowel (1,7; repeated below for convenience).

- (1) Western Shoshoni Fronting
  - a. dental: [sittu] ‘here’ (*si-* ‘PROXIMAL’ –*ttu* ‘LOCATIVE STEM’)
  - b. alveolar: [sattu] ‘here’ (*sa-* ‘DISTAL’ –*ttu* ‘LOCATIVE STEM’)
  
- (7) Morpheme-internal Fronting in Gosiute
  - a. dental: [nittoi] ‘sing’
  - b. alveolar: [potto] ‘grinding stone’

Gosiute Palatalization, however, is an alternation between two laminal consonants before a front vowel (6,8; repeated below for convenience).

- (6) Gosiute Palatalization
  - a. palato-alveolar: [moyittši] ‘bag’ (*moyi* ‘bag’ –*ttθi* ‘ABSOLUTE’)
    - b. interdental: [poniattθi] ‘skunk’ (*ponia* ‘skunk’ –*ttθi* ‘ABSOLUTE’)
  
- (8) Morpheme-internal Palatalization in Gosiute
  - a. palato-alveolar: [huittšu] ‘small bird’
  - b. interdental: [huttθi] ‘grandmother (FaMo)’

If Fronting is the alternation of alveolars and dentals following front vowels, and Palatalization is the alternation of dentals and palato-alveolars in the same environment, a two-step *chain shift* can be set up which extends from alveolars on one end to palato-alveolars on the other: ALVEOLAR > DENTAL > PALATO-ALVEOLAR. Fronting is the first step in this chain and Palatalization is the second (24).

## (24) Fronting and Palatalization as a two-step chain shift

- a. Fronting: alveolar > dental
- b. Palatalization: dental > palato-alveolar

Viewing Fronting and Palatalization as two steps in a chain shift provides unity to these alternations—unity suggested by the identity of their triggering environments. the traditional, rule-based approach to chain shifts is to formulate a rule for each step in the chain and place them in a counter-feeding order. In the informal analysis of Fronting and Palatalization given in (25), Palatalization is ordered before Fronting:

## (25) Rule-based approach to Fronting and Palatalization

- a. Palatalization: dental → palato-alveolar / [i]\_\_\_\_
- b. Fronting: alveolar → dental / [i]\_\_\_\_

While a rule-based approach accounts for the facts, it splits up a unified phenomenon into a set of formally unrelated rules; this type of analysis is therefore not as highly favored as one which views the steps in the chain shift as being part of a single alternation pattern.

A different problem posed by chain shifts arises in non-derivational theories such as Optimality Theory. In a rule-based approach, it is possible for rules to refer to intermediate levels of representation; in fact, reference to intermediate levels is necessary in order to provide a workable analysis of chain shifts. In Optimality Theory, however, these intermediate levels are unavailable; an Optimality Theoretic grammar is usually seen as a mapping of an underlying form directly to a surface representation, mediated only by constraints on well-formedness and faithfulness. In Kirchner (1996), a general solution to the problem posed by chain shifts was provided. His solution involves the *Local Conjunction* (Smolensky 1995) of faithfulness constraints, which effectively limits the “distance” between an underlying form and a surface form along a phonetic or phonological scale, such as that described above for Fronting and Palatalization. It is this kind of solution which proves successful in the analysis of the Gosiute alternation patterns.

In 3.1 I show that the analysis of Fronting in Gosiute is the same as that for Fronting in Western Shoshoni. In 3.2, I show that the Gosiute Palatalization needs a slightly different account than that provided for Western Shoshoni Palatalization, since Gosiute Palatalization is the alternation of two laminal coronals, while in Western Shoshoni, Palatalization, like Fronting, is the alternation of laminals and apicals. I then show that the analyses provided in 3.1 and 3.2 lead to an unattested “all-or-nothing” pattern which apparently requires *all* coronals following front vowels to be realized as palato-alveolar. In 3.3 I show how Local Conjunction in the Gosiute constraint set provides a unified and

restrictive account of both Fronting and Palatalization, sidestepping the “all-or-nothing” problem.

### 3.1. Gosiute Fronting = Western Shoshoni Fronting

As in Western Shoshoni, Fronting in Gosiute is the complementary distribution of laminal and apical coronal obstruents before a front vowel. In (26a), voiced alveolar taps and voiced dental fricatives occur between vowels; dental fricatives follow [i] or [e], and alveolar taps occur elsewhere. In (26b), voiced alveolar and dental stops occur following homorganic nasals; dental nasal-stop clusters follow [i], and alveolar nasal-stop clusters occur elsewhere. In (26c), voiceless alveolar taps and voiceless dental fricatives occur between vowels; dental fricatives follow [i] and [e], and alveolar taps occur elsewhere. Finally, in (26d), voiceless geminate alveolar stops and voiceless geminate dental stops occur between vowels; geminate dental stops follow [i] and [e], and geminate alveolar stops occur elsewhere.

#### (26) Gosiute Fronting

a.	[pira]	‘arm’	[pið̥i]	‘to arrive’
	[ara]	‘uncle (MoBr)’	[peð̥i]	‘daughter, niece
	(SiDa)’			
	[poro]	‘stick’		
	[nura:]	‘to run-PL.SUBJ’		
b.	[kindu]	‘yesterday’	[taiŋ̥di]	‘hole’
	[pand̥i]	‘killdeer’		
	[ond̥i]	‘brown’		
	[nasundaw̥a]	‘to remember’		
c.	[tow̥iç̥ia]	‘to pour’	[piθ̥u:]	‘to be stung by
	a bee’			
	[aç̥aθ̥i]	‘jaw’		



d.	[k <sup>w</sup> itti]	‘to shoot’	[ni <sup>ʔ</sup> toi]	‘to sing’
	[pattu]	‘dead-fall trap’		
	[potto]	‘grinding stone’		
	[utappi]	‘fine dust’		

In (27), I provide examples of the conditioned alternation of dental and alveolar consonants in suffixes following a stem-final front vowel.

(27) Gosiute Fronting: alternation of dental and alveolar obstruents at morpheme boundaries

a. *-(n)tui* ‘future’

[na:ria-ru <sup>i</sup> ]	‘will race’	[nukki- <sup>n</sup> ɽui]	‘will run’
		[hanni- <sup>ð</sup> ui]	‘will use’

b. *-ti* ‘generic aspect’

[kari-ri]	‘sitting’	[hiβi- <sup>ð</sup> i]	‘drinking’
[tikka-ri]	‘eating’	[pekkai- <sup>ð</sup> i]	‘killing’

c. *-ti* ‘demonstrative stem’

[sa-ri]	‘that’	[si- <sup>ð</sup> i]	‘this’
[su-ri]	‘that’	[se- <sup>ð</sup> i]	‘this’

d. *-ti* ‘numeral’


[si:ma:-ri]	‘ten’	[wattsiwi- <sup>θ</sup> i]	‘four’
		[maneyi- <sup>θ</sup> i]	‘five’
		[na:φai- <sup>θ</sup> i]	‘six’

e. *-ttu* ‘locative stem’

[sa-ttu]	‘there’	[si- <sup>ʔ</sup> tu]	‘here’
		[se- <sup>ʔ</sup> tu]	‘here’

This distribution can be analyzed in the same way as Western Shoshoni; namely by ranking the constraint FR...DIST, which expresses a preference for front vowels to be followed by [+distributed] obstruents, above MAX[-dist], which requires outputs to retain a [-distributed] feature from the input. The tableau in (28) illustrates:

(28) FR...DIST >> MAX[-dist]

	/nittoi/ [-dist]	FR...DIST	MAX[-dist]
a. 	n <sup>u</sup> tt <sup>u</sup> oi [+dist]		*
b.	n <sup>u</sup> tt <sup>u</sup> oi [-dist]	*!	

In this tableau, candidate b., which fails to specify [+distributed] in its feature set is ruled out by FR...DIST, in spite of pressure exerted by MAX[-dist] to preserve the input [-distributed] intact.

### 3.2. Gosiute Palatalization ≠ Western Shoshoni Palatalization

Palatalization in Gosiute is a distributional pattern involving two laminal obstruents; palato-alveolar obstruents follow front vowels while interdental obstruents occur elsewhere. In (29a), voiced interdental fricatives and voiced palato-alveolar fricatives occur between vowels; palato-alveolar fricatives follow [i] and [e], and interdental fricatives occur elsewhere. In (29b), voiced interdental affricates and voiced palato-alveolar affricates occur following homorganic nasals; palato-alveolar nasal-affricate clusters follow [i], and interdental nasal-affricate clusters occur elsewhere. In (29c), geminate interdental affricates and geminate palato-alveolar affricates occur between vowels; geminate palato-alveolar affricates follow [i] and [e], and geminate interdental affricates occur elsewhere. Finally, in (29d), alveolar [s] is in complementary distribution with palato-alveolar [š].

## (29) Gosiute Palatalization

- |    |               |                      |                      |              |
|----|---------------|----------------------|----------------------|--------------|
| a. | [ið̥i]        | ‘to stink’           | [ižappi]             | ‘coyote’     |
|    | [paði]        | ‘older sister’       | [ežikko]             | ‘sling shot’ |
|    | [moðo]        | ‘beard, whiskers’    |                      |              |
|    | [huðiðo:]     | ‘shin’               |                      |              |
| b. | [tiŋd̥ðo:]    | ‘hand game bones’    | [mawiŋd̥ðo:yo]       |              |
|    |               | ‘bracelet’           |                      |              |
|    | [waŋd̥ði]     | ‘buck antelope’      |                      |              |
|    | [mo:ŋd̥ði]    | ‘domesticated onion’ |                      |              |
|    | [tuyuŋd̥ðia]  | ‘raspberry’          |                      |              |
| c. | [hiŋt̥θiɪp̥i] | ‘saliva’             | [hiŋt̥ʃu:]           | ‘small bird’ |
|    | [waŋt̥θiwiθi] | ‘four’               | [pet̥ʃi]             | ‘holler-DUR’ |
|    | [poŋt̥θi]     | ‘hop, jump’          |                      |              |
|    | [huŋt̥θi]     | ‘grandmother (FaMo)’ |                      |              |
| d. | [pi:si]       | ‘body hair, fur’     | [iʃaβaiɪp̥i]         | ‘Coyote’     |
|    | [kasa]        | ‘wing’               | [k <sup>w</sup> eʃi] | ‘tail’       |
|    | [tosa]        | ‘white’              |                      |              |
|    | [kusipp̥i]    | ‘ashes’              |                      |              |

The data in (30) provide examples of the conditioned alternation of dental and palato-alveolar obstruents in suffixes following a stem-final front vowel.

## (30) Gosiute Palatalization: alternation between dental and palato-alveolar obstruents at morpheme boundaries

- |    |                |               |             |                |
|----|----------------|---------------|-------------|----------------|
| a. | -ŋt̥θi         | ‘absolute’    |             |                |
|    | [araŋgu-ŋt̥θi] | ‘red ant’     | [moyi-t̥ʃi] | ‘bag’          |
|    | [ponia-ŋt̥θi]  | ‘skunk’       |             |                |
| b. | -ŋt̥θi         | ‘diminutive’  |             |                |
|    | [appi-ŋt̥θi]   | ‘dear father’ | [kahŋt̥ʃi]  | ‘little house’ |

In addition to the Palatalization data in (30), there are also alternations between [s] and [š]; [š] follows a front vowel, and [s] occurs elsewhere (31):

(31) Gosiute Palatalization: alternation between [s] and [š]

a. -si ‘demonstrative stem’

[u-si]	‘that’	[i-ši]	‘this’
[a-si]	‘that’	[e-ši]	‘this’

b. -si ‘emphatic’

[oyi-si]	‘always’	[pie-ši]	‘already’
----------	----------	----------	-----------

Figure (32) summarizes the distributional patterns in (29) and the alternations in (30-31).

(32)	i,e ____	elsewhere
Palatalization:	laminal [tš]	laminal [tθ]
	laminal [š]	apical [s]

In (33) I give the feature matrix for the segments involved in Gosiute Palatalization:

(33) Feature matrix for Gosiute Palatalization

	tθ	tš, š	s
strident	-	+	+
distributed	+	+	-

The analysis of the [s] ~ [š] alternation shown in (31) is the same as that for Western Shoshoni Palatalization; in both cases an apical alveolar sibilant alternates with a laminal palato-alveolar sibilant. In constraint terms, FR...DIST is ranked above MAX[-dist] (34):

(34) FR...DIST &gt;&gt; MAX[-dist]

	/pie-si/ [-dist]	FR...DIST	MAX[-dist]
a. $\wp$	pieši [+dist]		*
b.	piesi [-dist]	*!	

In (34), the candidate which satisfies high-ranking fr...dist is selected over the candidate which preserves an underlying [-distributed], a pattern familiar from Western Shoshoni Palatalization.

The distributional pattern involving dentals and palato-alveolars shown in (29) and (30) is not governed by the constraint FR...DIST, since both dentals and palato-alveolars are already specified [+distributed]; in Gosiute Palatalization it is the value for [strident] which is conditioned by a following front vowel. This generalization is captured in the constraint given in (35):

(35) FR...STR: A consonant following a [-back] vowel is [+strident].

Satisfaction of this constraint comes at the expense of changing the value of the feature [strident] which is present in underlying representation. This expense is represented by the constraint MAX[-str], defined in (36):

(36) MAX[-str]: An input [-strident] has a corresponding output [-strident].

For the effects of FR...STR to be seen, it must be ranked above MAX[-str]. These constraints are added to the constraints already existing; their intersection is illustrated in the tableau in (37).

(37) FR...STR &gt;&gt; MAX[-str]:

/huittθu:/	FR...DIST	FR...STR	MAX[-str]	MAX[-dist]
a. <sup>Ⓢ</sup> huitt <u>š</u> u:			*	*
b. huitt <u>θ</u> u:		*!	*	*
c. huitt <u>s</u> u:	*!	*!	*	*
d. huitt <u>u</u> :	*!		*	*

In this tableau, any candidate which fails to satisfy either of the constraints on the distribution of [distributed] or [strident] is eliminated in favor of the candidate which satisfies both of them (*huittšu:*).

To summarize, I have given an account of Gosiute Palatalization which relies on the constraint FR...STR, requiring front vowels to be followed by a [+strident] consonant. In the next section I show that the ranking as it stands is insufficient to capture Fronting as well as Palatalization in Gosiute; however, the intermediate result in (37) is still instructive.

### 3.3. Local Conjunction in the Gosiute Constraint Set

In the previous sections I have shown that both FR...DIST and FR...STR are necessary to account for the range of Fronting and Palatalization facts in Gosiute. For the effects of the distributional constraint FR...STR to be seen, it must be ranked above MAX[-str]; this was demonstrated in (37). However, the effects of this same ranking are disastrous for simple Fronting (38) (I use “<sup>Ⓢ</sup>” to indicate an unattested form which is nevertheless chosen by the constraint hierarchy as optimal):

(38) Disaster:

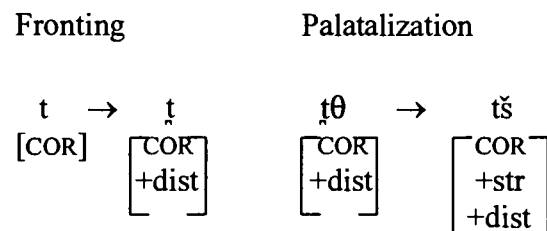
/nittoi/	FR...DIST	FR...STR	MAX[-str]	MAX[-dist]
a. <sup>Ⓢ</sup> nitt <u>š</u> oi			*	*
b. ( <sup>Ⓢ</sup> ) nitt <u>θ</u> oi		*!	*	*
c. nitt <u>s</u> oi	*!	*!	*	*
d. nitt <u>o</u> i	*!	*!	*	*

In (38) any candidate which violates either FR...DIST or FR...STR is bested by the candidate which violates neither. Attempting to resolve this problem by varying the ranking of the constraints will have no effect, since the palatalized candidate bests any other candidate which violates even one of the distributional constraints.

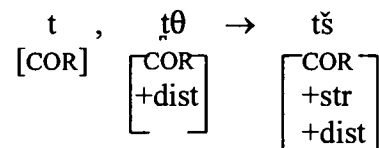
In fact, there is no possible ranking of these four constraints which will yield correct results for both Palatalization and Fronting. This has the effect of palatalizing every coronal obstruent, regardless of its underlying specifications for [strident] and [distributed]. This is an unfortunate result.

The Gosiute alternations display a stepwise change between pairs of coronal obstruents. In Fronting a plain apical alveolar becomes laminal, adding [+distributed]; and in Palatalization a laminal dental affricate becomes a laminal palato-alveolar affricate, adding [+strident] (39a). The constraint hierarchy in (37) and (38) cannot capture this stepwise alternation pattern; it requires an “all-or-nothing” change, so that both plain apical [t] and interdental [tʰ] both become [tʃ] following front vowels (39b).

(39) a. Attested stepwise pattern:



b. Unattested “all-or-nothing” pattern:



The problem is that adding one feature of [distributed] or [strident] is allowed, but adding both of them at once is not. This is a familiar pattern and is typical of chain shifts, where segments advance along a phonological dimension (such as height) one step at a time. Following Kirchner (1996), I adopt the use of a formal device, the Local Conjunction of constraints (Smolensky 1995), to escape the all-or-nothing character of the distributional constraints FR...DIST and FR...STR.

Local Conjunction creates a new constraint by conjoining two other constraints. This conjoined constraint is ranked above both of its constituent constraints and is violated only in the case where both of its lower ranked constituent constraints are violated within the same domain (see Smolensky 1995 for the initial statement of and for arguments supporting the local conjunction of

constraints). In Gosiute, the two MAX constraints, MAX[-str] and MAX[-dist], are conjoined into a single constraint MAX[-str] &<sub>loc</sub> MAX[-dist], which I will abbreviate as MAX(S&D). The conjoined constraint MAX(S&D) is violated only in the case where both MAX[-str] and MAX[-dist] are violated on the same segment. Ranking this conjoined constraint above the markedness constraint FR...STR will give the desired stepwise effect of Fronting and Palatalization (40).

(40) Gosiute Palatalization: MAX(S&D) >> FR...STR

/huittθu:/	MAX(S&D)	FR...DIST	FR...STR	MAX[-str]	MAX[-dist]
a. $\text{huitt}\check{\text{s}}\text{u}$ :				*	*
b. $\text{huitt}\theta\text{u}$ :			*!		
c. $\text{huittsu}$ :	*!	*!		*	*
d. $\text{huittu}$ :		*!	*		*

In (40), any violation of FR...DIST or FR...STR will eliminate a candidate from competition; in this respect it is identical to the tableau in (37). Additionally, since candidate c. violates both MAX[-str] and MAX[-dist] on the same segment it receives a violation mark for the conjoined constraint MAX(S&D). However, since either ranking of MAX(S&D) and FR...DIST is equally successful in eliminating candidate c., it is not necessarily the conjoined constraint which removes candidate c. from evaluation.

(41) Gosiute Fronting: MAX(S&D) >> FR...STR

/nittoi/	MAX(S&D)	FR...DIST	FR...STR	MAX[-str]	MAX[-dist]
a. $\text{nitt}\check{\text{s}}\text{oi}$	*!			*	*
b. $\text{nitt}\theta\text{oi}$			*		*
c. $\text{nittsoi}$		*!			
d. $\text{nittoi}$		*!	*		

In contrast to (40), the constraint competition illustrated in (41) is clear in demonstrating the role played by the conjoined constraint in the selection of the correct output. Candidates c. and d. both violate high-ranking FR...DIST; these violations remove them from competition. Because candidate a. violates both MAX[-str] and MAX[-dist] on the same segment, it also violates high-ranking MAX(S&D). It is this violation which eliminates candidate a. from competition, leaving candidate b. the winner in spite of its violation of FR...STR.

The final ranking for Gosiute Fronting and Palatalization is given in (42).



## (42) Final Ranking

$$\begin{array}{l} \text{MAX(S\&D), } \gg \text{ FR...STR } \gg \text{ MAX[-str],} \\ \text{FR...DIST} \qquad \qquad \text{MAX[-dist]} \end{array}$$
**3.4. Summary of Gosiute Fronting and Palatalization**

In this section, I have provided an analysis of Fronting and Palatalization in Gosiute which capitalizes on the similarity between these alternations in Gosiute and their counterparts in Western Shoshoni. Fronting receives the same analysis as in Western Shoshoni—the alternation of apicals and laminals following front vowels. This is expressed in constraint terms by ranking FR...DIST above MAX[-dist]. Palatalization on the other hand, is analyzed as the alternation of sibilants and non-sibilants following front vowels—sibilants follow front vowels, non-sibilants occur elsewhere. In constraint terms, this is expressed by ranking FR...STR above MAX[-dist]. Adding these constraints to the existing ranking for Fronting produces the unwelcome result of requiring all coronals following front vowels to be palato-alveolar. This problem disappears when the two MAX constraints are locally conjoined and the resulting constraint is ranked above FR...STR; this has the effect of making a violation of both constraints on the same segment worse than violations of either constraint by itself. This allows a stepwise alternation among coronals which is characteristic of chain shifts.

**4. Conclusion**

In this paper I have provided an analysis of Fronting and Palatalization in two dialects of Shoshoni. There are at least two lessons to be learned. First, the intuition that Fronting and Palatalization are related was confirmed. Both alternations in Western Shoshoni involved the alternation of apicals and laminals, and it is not necessary to further specify place of articulation. Second, Fronting and Palatalization in Gosiute are analyzable as two steps in a chain shift. Viewing the alternations in a way confirms their relationship to each other—a relationship suggested by the identity of their triggering environments and provides another argument in favor of the Local Conjunction of constraints as part of the toolbox of UG.

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## There is no lexicon!\*

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### Abstract

Exceptional stress in Spanish nouns and verbs is best treated in terms of "parochial constraints", rather than altered lexical representations. This suggests that lexical representations may be entirely superfluous. The argument is based on the distribution of exceptional stresses. Regular stresses fall on the penult, exceptional stresses on the antepenult or ultima. Within Optimality Theory, this limited distribution for exceptional stress can be captured if the machinery for exceptional stress is very specific constraints ranked below the constraint that limits stress to the final three syllables, but above the constraint forcing stress on the penult.

### 1. Introduction

Within generative linguistics, underlying representations have been a sine qua non. Such representations have been thought to encode what is unpredictable or not governed by rules. Within Optimality Theory (henceforth OT), even though the rules are virtually gone, this view continues. The function GEN and EVAL pair an underlying representation with an optimal output. I argue against this entrenched view here.

Specifically, I show that within the general paradigm of OT, exceptional and morphological stress in Spanish can be treated in terms of Generalized Alignment. There is no need to alter underlying representations to account for the exceptionality of a particular word or

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morphological category. This raises the question of whether underlying representations are necessary for anything.

This paper is organized as follows. First, I sketch out the problem of exceptional stress in Spanish nouns and verbs. Exceptions of both sorts fall into a narrow range of possibilities. I then show how normal stress and exceptional stress can be treated in terms of OT. Next, I show how a treatment in terms of parochial constraints is superior to a treatment in terms of enriched lexical representations. This raises the possibility that there are, in fact, no lexical representations to enrich.

## 2. The problem

The problem for OT posed by exceptional stress is that there are a number of possible analyses. In this section, I review the relevant facts and briefly sketch out the proposed analysis.

### 2.1. Unmarked stress in Spanish

Normal stress in Spanish falls on the penult.

- |     |         |        |         |           |
|-----|---------|--------|---------|-----------|
| (1) | monéda  | 'coin' | Granáda | 'Granada' |
|     | trabájo | 'work' | Tolédo  | 'Toledo'  |

There are a number of ways this can be analyzed in terms of metrical theory. One possibility would be to build a trochaic foot on the right edge of the word.

- (2)
- |  |         |
|--|---------|
|  | x       |
|  | x (x x) |
|  | monéda  |

Another possibility would be to exclude the final syllable via extrametricality and construct some sort of right-headed structure.

- (3)
- |  |           |
|--|-----------|
|  | x         |
|  | (x x) <x> |
|  | moné da   |

Given only the distribution of primary stress, both analyses are possible.

## 2.2. Exceptional stress in Spanish

Halle & Vergnaud (1987), when faced with a similar indeterminacy in the analysis of Polish, resolve it by consideration of exceptionally stressed words.<sup>1</sup>

The best analysis of Spanish can also be elucidated by considering exceptional words. However, unlike in Polish, in Spanish there is also morphologically conditioned verbal stress which sheds light on the unmarked stress pattern as well.

For nouns, there are two kinds of exceptional stress patterns. First, there are words that have antepenult stress.<sup>2</sup>

- (4) pájaro      'bird'      estómago      'stomach'  
       médico      'doctor'      América      'America'

There are also nouns with exceptional final stress.

- (5) Panamá      'Panama'      sofá      'sofa'  
       café      'coffee'

There are no words with exceptional stress further to the left than the antepenult.<sup>3</sup>

- (6) \*Cónstantino      \*éstomago

That the exceptional stresses are confined to a three-syllable window on the right edge of the word would seem to confirm aspects of both analyses presented above. Forms with antepenult stress can only be treated with a trochaic foot and extrametricality.

- (7)      x  
       (x x) <x>  
       pája ro

---

<sup>1</sup>See also Hammond (1989b).

<sup>2</sup>Harris (1982, et seq.) has argued that this pattern is restricted to words with light penults. However, there are exceptions to this pattern, e.g. *alíquota* 'aliquot'. See Lemus (in prep.) for discussion.

<sup>3</sup>This analysis was extensively discussed in seminar meetings at the University of Arizona and I thank Constantino Martínez Fabian for his good humor in allowing us to mispronounce his name for science....

However, forms with normal penult stress are subject to at least three possible analyses. One possibility is that normal footing is iambic with extrametricality (8a). A second possibility is to build some sort of unary foot (or unbounded foot) with extrametricality (8b). A final possibility is to build a trochaic foot with no extrametricality.

- (8)
- |   |   |   |
|---|---|---|
| $\begin{array}{c} x \\ (x \ x) <x> \end{array}$ | $\begin{array}{c} x \\ x (x) <x> \end{array}$ | $\begin{array}{c} x \\ x (x \ x) \end{array}$ |
| a. moné da                                      | b. moné da                                    | c. monéda                                     |

There are then two possibilities for words with final stress. One possibility involves a single iambic foot (9a), while the other relies on a unary or unbounded foot (9b).

- (9)
- |   |   |
|---|---|
| $\begin{array}{c} x \\ x (x \ x) \end{array}$ | $\begin{array}{c} x \\ x \ x (x) \end{array}$ |
| a. Panamá                                     | b. Panamá                                     |

In Polish, there are morphological patterns that resolve these ambiguities. In Spanish, nominal morphology provides no help.

Verbal stress is somewhat different though and provides some clues. Individual lexical items all receive the same stress, but specific morphological paradigms exhibit the same three possibilities. Most verbal forms receive penult stress.

- (10) término 'I finish'

Some verbal forms end up with final stress.

- (11) terminé 'he finished'

Others surface with antepenult stress.

- (12) terminábamos 'we would finish'

Again, there are no verbal forms that exhibit preantepenult stress.

- (13) \*terminábamos

So far, the verbal stress system is analogous to the nominal stress system. However, Harris (1987) maintains that these three syllabic patterns are distributed across four basic morphological types.<sup>4</sup> Pattern 1 exhibits penult stress.

- (14) Pattern 1 (e.g. present)
- |                        |                          |
|------------------------|--------------------------|
| ter <sup>o</sup> mino  | terminá <sup>o</sup> mos |
| terminá <sup>o</sup> s | terminá <sup>o</sup> is  |
| terminá <sup>o</sup>   | terminán                 |

Pattern 2 exhibits antepenult stress in the first and second person plural forms and penult stress otherwise.

- (15) Pattern 2 (e.g. imperfect)
- |                         |              |
|-------------------------|--------------|
| terminá <sup>o</sup> ba | terminábamos |
| termináb <sup>o</sup> s | terminábais  |
| terminá <sup>o</sup> ba | terminában   |

A fairly obvious generalization for these cases is that stress always falls on the vowel following the root.

Pattern 3 exhibits ultima stress in the first and third person singular, antepenult stress in the second person plural, and penult stress otherwise.

- (16) Pattern 3 (e.g. preterit)
- |                          |                            |
|--------------------------|----------------------------|
| terminé                  | terminá <sup>o</sup> mos   |
| terminá <sup>o</sup> ste | terminá <sup>o</sup> steis |
| terminó                  | terminá <sup>o</sup> ron   |

Again, stress falls on the vowel following the root. This observation allows us to conflate patterns 2 and 3.

Finally, in pattern 4, there is penult stress in the first and second person plural, ultima stress otherwise.

- (17) Pattern 4 (e.g. future)
- |            |                           |
|------------|---------------------------|
| terminaré  | terminaré <sup>o</sup> s  |
| terminarás | terminaré <sup>o</sup> is |
| terminará  | terminarán                |

---

<sup>4</sup>There is a certain amount of irrelevant dialect variation which Harris discusses and which is ignored here.

If we take certain tense/mood suffixes like *-ar-* as redefining the stem, then we can say that stress falls on the vowel following the extended root. This allows us to conflate patterns 2, 3, and 4 into a single category where stress falls on the vowel following the (extended) stem.

### 2.3. The basic idea

Intuitively, what we have for the verbs is a stress system where normal penult stress is overridden by a constraint aligning stress with the first post-root vowel. This morphological constraint is, in turn, limited by the same restriction that limits exceptional nominal stress: stress must fall in the final trisyllabic window.

- (18) Trisyllabicity  
Stress must fall on one of the last three syllables.
- (19) Lexical Exceptions  
Certain nouns exhibit exceptional stress.
- (20) Morphological Stress  
Certain paradigms align stress with the first post-root vowel.
- (21) Penult Default  
Stress must fall on the penult.

In this intuitive statement of the problem, the critical observation is that morphological stress and lexical stress can BOTH override the normal penultimate stress pattern and can both be suppressed by the trisyllabic window constraint. This will be the basis of the argument against a lexicon distinct from the constraint component.

In the following, I outline the essential components of Optimality Theory. I show how the analysis above can be formalized, how it does away with a separate lexicon, and how it resolves the indeterminacy above.

### 3. Optimality Theory

Standard generative phonology posits a set of lexical items and a finite set of language-specific ordered rules. The rules apply to lexical



forms to produce surface forms. If some candidate surface form is a possible output of the ordered rule set applied to some real (or potential) lexical item, the form is grammatical in the language in question.

We can characterize classical generative phonological rules as effecting some change in some context. Using SPE formalism:

(22)  $\sigma \rightarrow \acute{\sigma} / [ \_ ]$

This rule assigns stress to the first syllable of some domain, say word. Such a rule would supply stress to the first syllable of underlying representations and capture the (presumed) generalization that all initial syllables are stressed.

Optimality Theory (Prince & Smolensky, 1993; McCarthy & Prince, 1993a; et seq.) can be seen as a decomposition of this process. The change performed by rules is factored out into a single operation, termed GEN. The function GEN operates freely producing a number of candidate surface forms which are winnowed through by the residue of the now passive/change-free rules. This residue is recast as a set of constraints and termed CON.

Consider how this would work in the case of a rule like (22) above. We can represent the formal decomposition from rule to GEN as in (23).

(23) a. Rule:  $\sigma \rightarrow \acute{\sigma} / [ \_ ]$   
 b. GEN:  $\sigma \rightarrow \acute{\sigma}$

The function GEN must (at least) be able to make syllables stressed. The constraint system must force the assignment of stress to initial syllables. The constraint system would only need one constraint which could be expressed positively (24a) or negatively (24b).

(24) CON: a.  $[\acute{\sigma}]$  or: b.  $*[\acute{\sigma}]$

Consider how GEN and CON would then produce the correct output for some monosyllabic lexical item /pa/. The function GEN either adds stress or not producing two candidates for a surface form: [pa] and [pá]. Constraint (24a) or (24b) would then select [pá] over [pa].

Notice that if stress is assigned freely by GEN, many more candidate forms are generated for polysyllabic inputs. Thus an input

/pata/ would have four candidate outputs: [pátá], [páta], [patá], and [pata]. While CON as formulated here forces stress on the initial syllable, it doesn't limit it to initial syllables. What this means formally is that, while CON excludes [patá] and [pata], it would allow two surface forms for /pata/: [páta] and [pátá].

This leads to two possibilities. First, this allows for surface variability in some languages (Hammond, 1994). Second, additional constraints may adjudicate between the remaining candidates, forcing a single best candidate for any input.

Let us assume the latter is the case in this hypothetical language: the generalization will be that there are no noninitial stresses and that there is a constraint to this effect. Again, such a constraint can be expressed positively (25a) or negatively (25b).

(25) a.  $\sigma \tilde{\sigma}$                       b.  $*\sigma \acute{\sigma}$

In the example above, either (25a) or (25b) would exclude [pátá] as a candidate, leaving only [páta].

Consider now how multiple constraints are combined into CON. First, the positive and negative constraints in (24) and (25) can be combined freely, giving four possible choices for CON.

(26) a.  $[\sigma \quad \sigma \tilde{\sigma}]$                       c.  $*[\tilde{\sigma} \quad \sigma \tilde{\sigma}]$   
       b.  $[\sigma \quad *\sigma \acute{\sigma}]$                       d.  $*[\tilde{\sigma} \quad *\sigma \acute{\sigma}]$


Second, note that each of these systems is somewhat redundant in that there is no overlap in the environments of the two constraints: one applies to all initial syllables and the other to all noninitial syllables. This strict partitioning forces the constraints to be more complex than they need to be.

Within OT, this complexity is eliminated by use of strict ranking and violability. Strict ranking establishes a priority among constraints in the set CON. Violability allows lower ranked constraints to be violated if higher ranked constraints are unviolated.

Consider (26a). If we rank the first constraint higher than the second, then violations of the second can be overridden by satisfaction of the first and the second can be simplified to:  $\tilde{\sigma}$ . This is shown in the


following tableaux. In (27), the two original constraints are unranked. The input is indicated in the upper left corner, candidate forms are given along the left, and constraints are presented along the top. The absence of ranking is denoted with the comma and dotted line. Constraint violations are indicated with asterisks and the optimal candidate with the pointing finger.

(27) {[ $\sigma$ ,  $\sigma\bar{\sigma}$ ]

	/pata/	[ $\sigma$	$\sigma\bar{\sigma}$
a	 páta		
b	pátá		*!
c	patá	*!	*!
d	pata	*!	

In (28), the ranked alternative constraints are presented. Ranking is indicated with ">>", and a solid line.

(28) [ $\sigma$  >>  $\sigma\bar{\sigma}$ ]


	/pata/	[ $\sigma$	$\bar{\sigma}$
a	 páta		*
b	pátá		**!
c	patá	*!	*!
d	pata	*!	*!

Strict ranking ensures that candidate (28a) is selected over (28d).

Violability allows (28a) to be selected even though it violates the second constraint, because it is the best candidate of the lot. (In this case, no other candidate is possible because of the limitations we have imposed on GEN.)

These constraints can actually be ranked the other way as well, with the effect that the other constraint can be simplified instead. This is shown in (29).

(29)  $\sigma\bar{\sigma}$  >>  $\sigma$

	/pata/	$\sigma\bar{\sigma}$	$\sigma$
a	 páta		*
b	pátá	*!	*!
c	patá	*!	*!
d	pata		**!

This is true for all the options in (26).

(30            unranked                            ranked                            reversed

[ó	σ ǒ	[ó	ǒ	σ ǒ	ó
* [ǒ	σ ǒ	* [ǒ	ǒ	σ ǒ	*ǒ
[ó	*σ ó	[ó	*ó	*σ ó	ó
* [ǒ	*σ ó	* [ǒ	*ó	*σ ó	*ǒ

Nothing we have said so far chooses among the eight ranked options for CON. In richer constraint systems where GEN can do more, the options are reduced.<sup>5</sup>

#### 4. Stress in Optimality Theory

In the analysis that follows, we will draw on certain constraints and constraint schemata that have been established in the OT literature (cited above). These are reviewed in this section.

First, we have several constraints on feet.

(31) FOOT-BINARITY (FTBIN)  
Feet are binary.

(32) PARSE-σ  
Syllables are footed.

These are self-explanatory.

There are also constraints on stress per se.

(33) WEIGHT-TO-STRESS (WSP)  
Heavy syllables are stressed.

The theory of Generalized Alignment (McCarthy & Prince, 1993b) will be extremely important in what follows.

(34) GENERALIZED ALIGNMENT (GA)

---

<sup>5</sup>It would be real interesting to establish this formally, but this is not germane here.

Align(Cat1, Edge1, Cat2, Edge2) =def  
 $\forall$  Cat1  $\exists$  Cat2 such that Edge1 of Cat1  
and Edge2 of Cat2 coincide,  
where  
Cat1, Cat2  $\in$  PCat  $\cup$  GCat (Prosodic and  
Grammatical categories)  
Edge1, Edge2  $\in$  {Right, Left}

GA provides a schema for capturing, e.g. the headedness of feet. Note that the head of a foot is formalized as: H( $\Sigma$ ).

- (35) a. left-headed: ALIGN( $\Sigma$ , L, H( $\Sigma$ ), L)  
(A(H( $\Sigma$ )))  
Align a head with the left edge of a  
foot.  
b. right-headed: ALIGN( $\Sigma$ , R, H( $\Sigma$ ), R) (A(H( $\Sigma$ )))  
Align a head with the right edge of a  
foot.

GA can also be used to account for directionality.

- (36) a. left-to-right: ALIGN( $\Sigma$ , L, Word, L) (A( $\Sigma$ ))  
Align all feet with the left edge of a  
word.  
b. right-to-left: ALIGN( $\Sigma$ , R, Word, R) (A( $\Sigma$ ))  
Align all feet with the right edge of a  
word.

Iterativity results from the ranking of these with respect to PARSE- $\sigma$ .

There is a constraint that is the functional equivalent of extrametricality.

- (37) NONFINALITY  
The final syllable is unfooted.

This can be recast in GA terms by requiring that words end in an unparsed syllable.<sup>6</sup>

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<sup>6</sup>Note that this constraint could also be characterized as a negative alignment constraint, if the theory of GA is extended to permit negative restrictions (Smolensky, 1995).

- (38) ALIGN(Word, R, <σ>, R) (A(<σ>))  
 Align the right edge of all words with an unparsed syllable.

Finally, we must require that words get at least one stress. In OT terms, this is usually done with LXWD=PRWD, which requires that content words be prosodic words, where prosodic words must include at least one foot. We adopt an earlier formulation (Hammond, 1984).

- (39) ROOTING  
 Content words must be stressed.

### 5. Spanish analysis

Let us now return to the analysis of Spanish. Recall that we were left with an indeterminacy in analyzing forms with normal penult stress and forms with exceptional final stress. These indeterminacies disappear under the OT-based analysis. In this section, we show how both of the exceptional cases – ultima and antepenult – can be treated by aligning the heads of feet on a lexical or morphological basis. This restricts the set of possible exceptional patterns in the world and limits exceptions in Spanish to the reported positions.

There are, however, two ways in which exceptional stress can be encoded: altering lexical representations or parochial constraints. We will argue for the latter (contra Inkelas, 1994).

Normal stress can be treated in two ways. One possibility would be to build an iambic foot with extrametricality. This can be done by invoking the following constraints. First, ROOTING forces words to be stressed. Second, ALIGN(Word, R, Σ, R) forces right-to-left footing. Third, ALIGN(Word, R, <σ>, R) over the preceding constraint provides for extrametricality. Finally, ALIGN(Σ, R, H(Σ), R) forces iambic feet. These are exemplified in the following tableau.

(40)

	/moneda/	ROOTING	A(<σ>)	A(H(Σ))	A(Σ)
a	moneda	*!			
b	mo(néda)		*!	*!	
c	mo(nedá)		*!		
d	☞ (moné)da				*

e (móne)da      \*!      \*

On this analysis, antepenult stress is achieved by forcing the head of the foot to occur on the left of the foot. Let us assume that this is accomplished with parochial constraints aligning the head of the foot with the left edge of specific words, e.g.

- (41)  $\text{ALIGN}(\text{pájaro}, L, H(\Sigma), L) \quad (A(\text{pajaro}))$   
Align a head with the left edge of *pajaro*.

This constraint must outrank the general iambic constraint.

- (42)  $\text{ALIGN}(\text{pájaro}, L, H(\Sigma), L) \gg \text{ALIGN}(\Sigma, R, H(\Sigma), R)$

Since there are words longer than trisyllables that exhibit antepenult stress, such constraints cannot outrank the directionality constraint.<sup>7</sup>

- (43)  $\text{ALIGN}(\text{Word}, R, \Sigma, R) \gg \text{ALIGN}(\text{América}, L, H(\Sigma), L)$

The opposite ranking would allow for \**Ámerica*. Such forms are unattested. The incorrect ranking and results are shown in (44); the correct ranking and results are shown in (45).<sup>8</sup>

(44) Incorrect ranking

	/America/	ROOTING	A(Amer )	A( $\Sigma$ )	A(H( $\Sigma$ ))
a	america	*!		*	
b	a(merí)ca		*!*	*	
c	a(méri)ca		*!	*	*
d	(amé)rica		*!	*	
e	☞ (áme)rica			*	*

<sup>7</sup>We assume GEN cannot place the head of a foot outside a foot, but see Hagberg (1993).

<sup>8</sup>Not all candidates or constraints, e.g.  $A(\langle\sigma\rangle)$ , are shown in (44) and (45) because of issues to be discussed immediately below.

## (45) Correct ranking

	/America/	ROOTING	A( $\Sigma$ )	A(Amer )	A(H( $\Sigma$ ))
a	america	*!	*		
b	a(merí)ca		*	**!	
c	a(méri)ca		*	*	*
d	(amé)rica		**!	*	
e	(áme)rica		**!		*

The full ranking so far is as follows. (The dots indicate that other parochial alignment constraints could also occur in this position in the ranking.)

- (46) ALIGN(Word, R,  $\langle\sigma\rangle$ , R)  
 ALIGN(Word, R,  $\Sigma$ , R)  
 ALIGN(*pájaro*, L, H( $\Sigma$ ), L), ....  
 ALIGN( $\Sigma$ , R, H( $\Sigma$ ), R)

Final stress can be treated with a parochial constraint forcing the H( $\Sigma$ ) to the right edge of the word.

- (47) ALIGN(*Panamá*, R, H( $\Sigma$ ), R) (A(*panama*))  
 Align a head with the right edge of *panama*.

Such a constraint must outrank the positioning of the  $\langle\sigma\rangle$  on the right edge.

- (48) ALIGN(*Panamá*, R, H( $\Sigma$ ), R) >> ALIGN(Word, R,  $\langle\sigma\rangle$ , R)

This ranking is shown in (49) and exemplified in (50).

- (49) ALIGN(*Panamá*, R, H( $\Sigma$ ), R), ....  
 ALIGN(Word, R,  $\langle\sigma\rangle$ , R)  
 ALIGN(Word, R,  $\Sigma$ , R)  
 ALIGN(*pájaro*, L, H( $\Sigma$ ), L), ....  
 ALIGN( $\Sigma$ , R, H( $\Sigma$ ), R)



(50)	/panama/	A(Pan)	A(< $\sigma$ >)	A( $\Sigma$ )	A(H( $\Sigma$ ))
a	(pána)ma	*!		*	*
b	(paná)ma	*!		*	
c	pa(náma)	*!	*		*
d	$\mathcal{P}$ pa(namá)		*		

The problem with this system so far is that nothing prevents a constraint of the *pájaro*-type from occurring with the same ranking as a constraint of the *panamá*-type. In a quadrisyllabic word or longer, such a ranking would predict incorrect/impossible initial stress.

(51)	/america/	A(Amer)	A(< $\sigma$ >)	A( $\Sigma$ )	A(H( $\Sigma$ ))
a	ame(ricá)	***!	*		
b	ame(ríca)	**!	*		*
c	a(merí)ca	**!		*	
d	a(méri)ca	*!		*	*
e	(amé)rica	*!		**	
f	$\mathcal{P}$ (áme)rica			**	*

There are three ways of avoiding this. One possibility is to maintain that only instances of constraints like *ALIGN(Panamá)* may outrank extrametricality. This solution is rather stipulatory though.

A second possibility is to split extrametricality into two separate constraints, say, *NOCLOSER* and *NOFURTHER*. All parochial constraints would go below *NOFURTHER*, but above *NOCLOSER*. *NOFURTHER* would guarantee that stress appears within the final three syllables, and would be inviolable; *NOCLOSER* would guarantee that stress not occur on the ultima, but would be violable.

(52) *NOFURTHER*

The rightmost foot can occur no further than a single syllable from the right edge of the word.

(53) *NOCLOSER*

The rightmost foot can occur no closer than a single syllable to the right edge of the word.

The ranking this entails is as follows.

(54) NOFURTHER >> A(*all exceptional words*) >> NOCLOSER

The absence of forms like \**Ámerica* would follow from the fact that A(*America*) is ranked below NOFURTHER.

(55)	/america/	NOFURTH	A(Amer)	NOCLOS	A( $\Sigma$ )	A(H( $\Sigma$ ))
a	ame(ricá)		***!	*		
b	ame(ríca)		**!	*		*
c	a(merí)ca		**!		*	
d	☞ a(méri)ca		*		*	*
e	(amé)rica	*!	*		**	
f	(áme)rica	*!			**	*

The possibility of forms like *Panamá* follows from the fact that A(*Panama*) is ranked above NOCLOSER.

(56)	/panama/	NOFURTH	A(Pan)	NOCLOS	A( $\Sigma$ )	A(H( $\Sigma$ ))
a	(pána)ma		*!		*	*
b	(paná)ma		*!		*	
c	pa(ná)ma		*!	*		*
d	☞ pa(namá)			*		

The third possibility holds that NOFURTHER, in fact, is directionality if we assume that extrametrical syllables don't count in determining violations of directionality. In other words, when the rightmost foot is separated from the right edge of the word, there is no violation of A( $\Sigma$ ). On this view, directionality outranks any parochial constraint and limits exceptional stress to the antepenult and ultima. Extrametricality is outranked by the parochial constraints, allowing for final stress.

(57) ALIGN(Word, R,  $\Sigma$ , R)  
*parochial constraints....*  
 ALIGN(Word, R, < $\sigma$ >, R)  
 ALIGN( $\Sigma$ , R, H( $\Sigma$ ), R)

This analysis thus restricts stress to the final three syllables by ranking the exceptional patterns in the middle of a more general hierarchy.<sup>9</sup>

(58)	/america/	A( $\Sigma$ )	A(Amer)	A(< $\sigma$ >)	A(H( $\Sigma$ ))
a	ame(ricá)		**!*	*	
b	ame(ríca)		**!	*	*
c	a(merí)ca		**!		
d	a(méri)ca		*		*
e	(amé)rica	*!	*		
f	(áme)rica	*!			*

Notice that this would NOT be possible if exceptions were represented in lexical representations. Such representations are, definitionally, outside the hierarchy, and thus not subject to it.<sup>10</sup>

Consider now the treatment of exceptional verbal stress. Recall that certain paradigms stress the first poststem syllable. Under the alignment approach, this is treated by aligning the head of a foot with the end of certain stems.

- (59) ALIGN(preterit, R, H( $\Sigma$ ), L) (A(preterit))  
Align a head immediately to the right of a preterit stem.

The fact that there are no cases like (13) follows from the fact that constraints like (59) would also be ranked below directionality.

Verbs provide two arguments against lexical marking. First, as with the nouns, one would have to come up with some way to prevent preantepenult stress. In addition, note that the morphemes that ultimately bear stress in the exceptional paradigms are not THEMSELVES exceptional: the very same verbal desinences can occur with regular stress and irregular stress. Lexical marking would result in gross redundancies. For example:

<sup>9</sup>See Inkelas (1994) for a different proposal for Turkish.

<sup>10</sup>In classic derivational stress theory, this was dealt with by positing more abstract representations requiring conflation (Halle & Vergnaud, 1987) or lexical diacritics (Hammond, 1989a, 1989b).

(60)	-amos		
	stressed		
		present indicative	termin-ámos
		weak preterit	termin-ámos
	stressless		
		imperfect	termináb-amos
		past subjunctive I	terminár-amos
		conditional	terminarí-amos
	-emos		
	stressed		
		future	terminar-émos
	stressless		
		past subjunctive II	terminás-emos
		present subjunctive	termin-emos

We conclude then that lexical stress in Spanish should be encoded with parochial constraints aligning heads of feet. All such constraints are placed in the constraint hierarchy at the same point, as shown in (57) above.<sup>11</sup>

Notice that this position is distinct from Idsardi (1992). Idsardi allows – in a derivational framework – parochial alignment of either side of a foot: his ‘edge marking’ thus allows one to manipulate lexically the position of foot heads and nonheads. This allows for more options and is not required in the treatment of Spanish.

## 6. Against a trochaic analysis

Consider now how a trochaic analysis might fare. In (61), I diagram how the iambic analysis above would differ from a trochaic analysis for critical cases.

(61)	a.	iambic:			
			x	x	x
			x(x x)	(x x)x	x(x x)x
			Panamá	monéda	América
	b.	trochaic:			
			x	x	x
			x(x x)	x(x x)	x(x x)x
			Panamá	monéda	América

---

<sup>11</sup>See Tsay (1991) for a notionally similar but derivational proposal.

The basic system would be guaranteed by the following constraints. First, ROOTING would force words to be stressed. Second, ALIGN(Word, R,  $\Sigma$ , R) forces right-to-left footing. Third, ALIGN( $\Sigma$ , L, H( $\Sigma$ ), L) forces trochaic feet. For words with penult stress, no ranking is necessary. This is exemplified in the following tableau.

(62)	/moneda/	ROOTING	A(H( $\Sigma$ ))	A( $\Sigma$ )
a	moneda	*!		*!
b	☞ mo(néda)			
c	mo(nedá)		*!	
d	(moné)da		*!	*!
e	(móne)da			*!

Exceptional final stress would be easily obtainable with parochial constraints that would override the general trochaic pattern. The full hierarchy is given in (63) and a sample tableau for *Panamá* in (64).

- (63) Constraints:    ROOTING  
                           ALIGN(Word, R,  $\Sigma$ , R)  
                           ALIGN( $\Sigma$ , L, H( $\Sigma$ ), L)  
                           ALIGN(*Panamá*, R, H( $\Sigma$ ), R), etc.

Ranking:

- ALIGN(*Panamá*, R, H( $\Sigma$ ), R), etc. >>  
 ALIGN( $\Sigma$ , L, H( $\Sigma$ ), L)

(64)	/panama/	A( <i>Pan</i> )	ROOTING	A( $\Sigma$ )	A(H( $\Sigma$ ))
a	panama	*!	*	*	*
b	(pána)ma	*!	*	*	*
c	(paná)ma	*!	*	*	*
d	pa(náma)	*!	*	*	*
e	☞ pa(namá)		*	*	*

Exceptional antepenult stress is more problematic, however. The problem is that such cases must be treated by invoking exceptional extrametricality. For example, a word like *pájaro* would be subject to a

parochial constraint  $\text{ALIGN}(\text{pájaro}, R, \langle \sigma \rangle, R)$ . This is exemplified in the tableau below.<sup>12</sup>

(65)	/pajaro/	A(Paj)	ROOTING	A( $\Sigma$ )	A(H( $\Sigma$ ))
a	pajaro		*!	*!	
b	$\sigma$ (pája)ro			(*)	
c	(pajá)ro			(*)	*!
d	pa(járo)	*!			
e	pa(jaró)	*!			*!

There are two problems with the trochaic approach. First, it must countenance several different ways to encode exceptional items: parochial constraints governing the alignment of heads and parochial constraints governing the alignment of unparsed syllables. On the iambic view, there is only one way to encode exceptional stress: parochial constraints governing the alignment of heads.

The second problem is that the treatment of antepenultimate nominal stress under the trochaic analysis does not generalize to verbs. Recall that verbs also exhibit antepenultimate stress, e.g. *terminá**b**amos*. Such forms cannot be treated with a GA constraint of the form (66).

(66)  $\text{ALIGN}(\text{terminá**b**amos}, R, \langle \sigma \rangle, R)$   
Align an unparsed syllable at the right edge of *terminabamos*.

The problem is that, as discussed above, verbal inflectional paradigms are organized so that the overriding generalization is not that certain paradigms exhibit antepenultimate stress or not, but that certain paradigms align stress with the edge of the stem, occasionally producing antepenultimate stress. Under the trochaic analysis, this generalization cannot be captured without allowing for the possibility of generating unattested preantepenultimate stress.

<sup>12</sup>Notice that we have no evidence for the ranking of  $\text{ALIGN}(\text{pájaro})$  on this view. If we adopt the same convention as in the preceding section where extrametricality does not induce a violation of directionality, then  $\text{ALIGN}(\text{pájaro})$  can occur anywhere in the constraint hierarchy. The relevant violations are indicated with parentheses in (65).

The argument goes as follows. To capture the generalization that certain verbal paradigms exhibit occasional antepenultimate stress when the poststem syllable is the antepenult, we would need to say that the alignment of stress with verbal stems outranks the alignment of the foot with the right edge of the word. This indeed allows antepenult stress, but once this ranking is established, it would also allow preantepenult stress, e.g. \**terminabamos*.

Under the iambic analysis, this problem does not arise. Antepenult stress for nouns and verbs is guaranteed by the same machinery: parochial constraints governing the alignment of heads. Moreover, by virtue of the ranking of such constraints, the iambic analysis guarantees that preantepenult stress is impossible for both nouns and verbs.

Summarizing, the OT analysis eliminates the indeterminacy in the unmarked headedness of feet in Spanish: feet are iambic.

## 7. Conclusion

I have argued that exceptional nominal and verbal stress in Spanish should be treated in terms of parochial constraints governing the alignment of the heads of feet. This result leads to an interesting hypothesis. If the lexical positioning of stress can be treated with specific constraints, perhaps other aspects of lexical form can be treated in terms of constraints, or even all aspects of lexical form can be treated as constraints.<sup>13</sup>

Demonstrating the empirical need for this would demand far more space, but let us outline what this would entail and some potential benefits.

Consider, for example, the fact that CAT is pronounced [kæt]. This sort of fact can be removed from the lexicon and reformalized as a constraint.

(67) CAT = [kæt]

There are at least two immediate advantages of this proposal.

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<sup>13</sup>See Russell (1995) for a similar proposal in OT terms. See Kiparsky (1982) for a similar proposal in pre-OT terms.

First, PARSE and FILL become unnecessary. The fact that CAT is pronounced [kæt] and not \*[Akæt] or \* [<k>æt] emerges from the pressure on the system from (67).

A second advantage of constraints like (67) is that they can be ranked with other constraints. Fitzgerald (1994) argues that this must be true at least for affixes. She argues that while reduplication in Tohono O'odham (Papago) is normally restricted to plurals, RED=PLURAL, this constraint is outranked by constraints of the metrical system. This allows reduplication to occur in other contexts under metrical pressure.

Notice that while this proposal entails an increase in the number of constraints, this increase is matched by a corresponding decrease (and elimination?) of the lexicon. Thus there is no argument for or against this proposal in terms of crude economy.

In summary, I have argued that exceptional stress in Spanish can be treated in terms of OT. This analysis argues for the lexical placing of foot heads and that this placement be by ranked violable constraints, rather than by lexical representations. This result suggests that we should entertain the possibility that there may be very little – if anything – left for the lexicon.



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# Trisyllabic Shortening and Two Affix Classes\*

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## 1. Introduction

Trisyllabic Shortening is a phenomenon in English prosody which has received much attention within the theoretical framework of Lexical Phonology (Kiparsky (1982)). Trisyllabic Shortening occurs when a word containing a long vowel, such as *nation*, takes a suffix from a particular class called the ‘Level 1’ affixes, such as *-al*, placing the long vowel in a position three or more syllables from the right edge of the word. In this position, the initially long vowel shortens: *national*.

Lexical Phonology is a derivational theory which posits various strata in which morphemes are concatenated and phonological rules may apply. Morphemes subcategorize for the stratum in which they will be added to a word, and many phonological rules are dependent on morpheme concatenation before they are able to apply. Since the derivation is serial, rules from a later level do not apply until previous levels are finished. In Lexical Phonology, Trisyllabic Shortening has been characterized by the application of a rule within the first stratum, or ‘Level 1’, of English phonology. This rule applies only within Level 1, to words which contain Level 1 affixes. A word which doesn’t concatenate morphemes at Level 1 misses its chance for the application of Trisyllabic Shortening, so shortening doesn’t occur in these words.

In contrast, mainstream Optimality Theory (Prince and Smolensky (1993)) does not posit multiple levels of derivation. In this constraint-based system all morphemes of a word are present in the input, and possible output candidates are evaluated in one step. Because of this, Optimality Theory (OT) cannot treat morphologically-sensitive alternations such as Trisyllabic Shortening via level-ordering in which some phonological constraints are only applied to certain inputs. However, such phenomena can be analyzed within OT by multiplying constraints, such as FOOTBINARITY (Prince and Smolensky (1993)), into parochial constraints whose effects are visible only with inputs of a certain morphological type, such as FOOTBINARITY<sub>Class 1</sub>, and general constraints which affect all inputs,

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such as FOOTBINARITY. Since these constraints are separately rankable, the result is that although a constraint such as FOOTBINARITY applies to all inputs, for certain inputs (e.g. words with Class 1 affixes) it may be given a higher priority via a higher ranking of FOOTBINARITY<sub>Class 1</sub>. In this paper I account for Trisyllabic Shortening within OT by presenting just such an analysis. I argue that in English FOOTBINARITY is given higher priority for words which contain affixes from one particular group (Class 1) than it is for words with other affixes and unaffixed words. This analysis accounts for the vowel length alternations of Trisyllabic Shortening by appealing to the well-attested cross-linguistic tendency for stress feet to be moraicly binary, without positing multiple levels or rankings.

The organization of this paper is as follows. First, I review a Lexical Phonological analysis of Trisyllabic Shortening, as given in Kiparsky (1982) and Borowsky (1990). I then present an OT analysis of the data, and motivate the need for a division of FOOTBINARITY into FOOTBINARITY<sub>Class 1</sub> and FOOTBINARITY. This is followed by an alternate analysis, based on output-output correspondence, which fails to account for the data.

Throughout this paper I make a number of assumptions regarding underlying representations. This paper focuses on the length alternations associated with Trisyllabic Shortening. In English, however, length alternations also result in vowel quality alternations. Since I wish to focus only on vowel length, not vowel quality, I will assume throughout the paper that all underlying vowels are lax, and that long lax vowels are pronounced as tense. The richness of the base within OT prevents such constraints on input structure, but I make them in order to limit the scope of this paper to vowel length only. I assume that other constraints, not discussed here, will force long vowels in English to surface as tense, and short vowels to surface as lax, regardless of underlying vowel quality (cf. Hammond (1997)). The assumed vowel inventory of English, as based on a standard American West Coast dialect, is given in (1):

(1) English Vowels

/ɪ/ [ɪ]	/ɛ/ [ɛ]	/æ/ [æ]	/ɑ/ [ɑ]	/ʌ/ [ʌ]
/ɪ:/ [ɪː]	/ɛ:/ [ɛː]	/æ:/ [æː]	/ɑ:/ [ɑː]	/ʌ:/ [ʌː]

## 2. Trisyllabic Shortening

Kiparsky (1982) gives an extensive account of Trisyllabic Shortening. In Kiparsky's analysis, Trisyllabic Shortening follows from the rule given in (2), which shortens a vowel when it is followed by two or more vowels, the first of which is unstressed.

(2) *Trisyllabic Shortening*

$V \rightarrow [-\text{long}] / \_ \_ C_0 V_i C_0 V_j$  where  $V_i$  is not metrically strong (Kiparsky (1982), p. 35).

The effect of this rule is to cause the alternations shown in (3). Alternating vowels are underlined>.

(3) m <u>i</u> tər ~ m <u>ɛ</u> trɪkəl	/ɛ:/ ~ /ɛ/	ko <sup>w</sup> n ~ k <u>ɑ</u> nəkəl	/ɑ:/ ~ /ɑ/
əb <u>s</u> ɪn ~ əb <u>s</u> ɛnəti		ko <sup>w</sup> d ~ k <u>ɑ</u> dəfə <sup>j</sup>	
dəskr <u>i</u> t ~ dəskr <u>ɛ</u> fən		o <sup>w</sup> mən <u>ɑ</u> mənəs	
s <u>e</u> n ~ s <u>æ</u> nəti	/æ:/ ~ /æ/	dəv <u>a</u> n ~ dəv <u>ɪ</u> nəti	/ɪ:/ ~ /ɪ/
n <u>e</u> fən ~ n <u>æ</u> fənəl		b <u>a</u> bəl ~ b <u>ɪ</u> bləkəl	
pr <u>æ</u> fən ~ pr <u>æ</u> fənəti		f <u>a</u> nə <sup>t</sup> ~ inf <u>ɪ</u> nəti	

Trisyllabic Shortening only operates in certain morphological environments, however. It does not apply to morphologically simple words (4a), nor does it apply in environments created by the addition of certain affixes (4b).

- (4) a. natɪŋɡel (\*nɪtɪŋɡel)  
 aɪvəri (\*ɪvəri)  
 o<sup>w</sup>vɜrtʃər (\*ɑvɜrtʃər)  
 ɪnɡrɪdɪənt (\*ɪnɡrɛdɪənt)
- b. ʃɪpɪʃ ~ ʃɪpɪʃli (\*ʃɛpɪʃli)  
 feθfəl ~ feθfələnəs (\*fæθfələnəs)  
 o<sup>w</sup>pən ~ o<sup>w</sup>pənɪŋ (\*ɑpənɪŋ)  
 saɪnəs ~ saɪnəs<sup>ɔ</sup>d (\*sɪnəs<sup>ɔ</sup>d)

In *Lexical Phonology*, the fact that Trisyllabic Shortening does not apply to monomorphemic words (4a) is accounted for by the Strict Cycle Condition, which states that cyclic rules which are structure-changing apply only in derived environments.<sup>1</sup> Under Kiparsky's analysis, Trisyllabic Shortening is a cyclic rule which applies at Level 1. A derived environment is created by the addition of a morpheme or the application of a structure-changing phonological rule within the

<sup>1</sup> Non-structure-changing phonological rules include syllabification, stress assignment, and feature-filling rules, which are structure-adding. These rules are exempt from the Strict Cycle Condition, as formulated in Kiparsky (1985).

same cycle. Since in monomorphemic words no additional morphemes are attached at Level 1 (or at any level), such words can only undergo cyclic rules after the application of a non-cyclic structure-changing rule (such as Schwa Insertion and the vowel shifting rule which changes the quality of long vowels, shown in (5) below). However, all Level 1 structure-changing rules are cyclic, resulting in the fact that monomorphemic words cannot undergo any cyclic rules (such as Trisyllabic Shortening (TRI)) at Level 1. A simplified derivation of the monomorphemic word *ivory* is shown in (5). Underlines indicate vowel changes.

(5) Underlying Representation:	/i:vɑrɛ:/
Level 1 Morphemes added:	-----
Stress Assignment:	(i:·vɑ) rɛ:
TRI:	----- (cannot apply)
Level 2 Morphemes added:	-----
Schwa Insertion:	(i:·və) rɛ:
Vowel Shift:	(a <sup>i</sup> ·və) ri <sup>j</sup>
Surface Representation:	[a <sup>i</sup> vəri <sup>j</sup> ]

Because no morphemes have been concatenated at Level 1, Trisyllabic Shortening cannot be applied. Since Schwa Insertion and the Vowel Shift rule are non-cyclic, they can apply at Level 2, despite the lack of morpheme concatenation.

The polymorphemic words which do not undergo Trisyllabic Shortening (4b) are accounted for by the fact that the suffixes which create the trisyllabic environment (e.g. *-y*, *-ness*, *-ing*, *-oid*) are applied at Level 2. Because at Level 1 these words have not yet undergone any morpheme concatenation, these words, like monomorphemic words, cannot undergo any cyclic rules at Level 1. This is illustrated in (6) with a simplified derivation of the words *national*, which has a Level 1 suffix, and *opening*, which has a Level 2 suffix. *National* is polymorphemic at Level 1, and undergoes Trisyllabic Shortening, while *opening* is still monomorphemic at Level 1 and Trisyllabic Shortening fails to apply.

(6) Underlying Representation:	/næ:ʃɑn/	/ɑ:pɛn/
<i>Level 1</i> Morphemes added:	næ:ʃɑn + æl	-----
Stress Assignment:	(næ:ʃɑ) næl	(ɑ:pɛn)
TRI:	(næ:ʃɑ) væl	-----
(cannot apply)		
<i>Level 2</i> Morphemes added:	-----	(ɑ:pɛn) + ɪŋ
Schwa Insertion:	(næ:ʃə) nəl	(ɑ:pɛn) ɪŋ
Vowel Shift:	-----	(ɑ <sup>w</sup> :pɛn) ɪŋ
Surface Representation:	[næ:ʃənəl]	[ɑ <sup>w</sup> pɛnɪŋ]

Because Trisyllabic Shortening applies only to words which have undergone morpheme concatenation at Level 1, it cannot apply to words which are monomorphemic (e.g. *ivory*) or which contain only Level 2 affixes (e.g. *opening*).

Borowsky (1990) provides a more natural account of Trisyllabic Shortening within Lexical Phonology, by appealing to more general principles of English syllable structure in order to explain the effect. Arguing that stressed syllables attract coda consonants, she provides the following Level 1 resyllabification rule:

$$(7) \quad \acute{V}.CV \rightarrow \acute{V}.C.\check{V}$$

The rule in (7) forces all stressed vowels followed by consonants to be parsed into closed syllables. Once this has occurred, the syllable well-formedness constraint in (8) applies, which bans superheavy syllables.

$$(8) \quad \sigma \rightarrow C^0V(X) \text{ (where } C^0 \text{ is zero or more consonants, and } X \text{ is a consonant or vowel)}$$

The rule in (8) allows syllables to contain at most two segments (i.e. VV or VC) following an onset. Once the resyllabification rule (7) has applied, stressed syllables are closed (if there is an available coda consonant), so any long stressed vowels will be forced to shorten in order to maintain the well-formedness imposed by (8). Since the resyllabification rule in (7) only operates at Level 1, it feeds Trisyllabic Shortening in words with Level 1 affixes without causing shortening at Level 2.

### 3. OT Analysis

The division between Level 1 and Level 2 affixes in Lexical Phonology is motivated by such things as differences in stress assignment (*párent/paréntal* (Level 1) vs. *párenthood* (Level 2)), the need to block regular affixes from applying to irregular forms (*mouse/mice*, \**mouses*), and the ordering of affixes in cases of multiple affixation (*nonillegible*, \**innonlegible*; from Kiparsky (1982)). How these phenomena should be treated within OT is a question for further research, but it appears that at least some irregular or morpheme-specific phenomena will require a treatment that appeals to lexically specified information. For example, the irregular pluralization of *mouse* cannot be said to occur for purely phonological reasons (cf. *blouses*, *spouses*); it must be the case that *mouse* is lexically specified as having an irregular plural. In the case of Trisyllabic Shortening, only certain affixes induce shortening, and there is no clear phonological distinction between those that do and those that do not. For example, although many Level 1 suffixes are vowel-initial (e.g. *-al* in *nátion/náational*, and *-ual* in *gráde/gráduál*) and many Level 2 affixes are consonant-initial (e.g. *-hood* in *nátion/náationhood* and *-less* in *gráde/grádeless*), there are exceptions on both levels. Level 1 affixes such as *-tive* (*describe/descriptive*) and *-tion* (*induce/induction*) cause Trisyllabic Shortening, yet are consonant-initial. And Level 2 affixes such as *-ing* (*describe/describing*) and *-able* (*gráde/grádeable*) do not cause Trisyllabic Shortening, and yet are vowel-initial. These examples also demonstrate that the two affix classes do not divide along the lines of syllable number. Affixes from both classes can be either one or two syllables long. Instead, it appears that there must be a purely morphological distinction between the two groups. In order to account for this, I assume that affixes are lexically marked as belonging to one of two types, which I will call Class 1 and Class 2, corresponding to Levels 1 and 2 of Lexical Phonology.<sup>2</sup> The proposed analysis for treating Trisyllabic Shortening within OT distinguishes these two affix classes by imposing a stricter requirement on words containing Class 1 affixes that they maintain binary foot structure.

### 4. FOOTBINARITY and MAX $\mu$

Prince and Smolensky (1993) point out the preference for languages to have moraicly binary stress feet (citing examples from Estonian, Latin, Lardil, and English). In subsequent analyses, this preference has been illustrated in languages such as Axininca Campa (McCarthy and Prince (1993)), Indonesian

<sup>2</sup> See Benua (1997) for a full account of these two affix classes in English.

(Cohn and McCarthy (1994)), Tohono O'dham (Fitzgerald (1996)), Yupik (Bacović (1996)), and further analyses of English (Hammond (1995), Pater (1995)). This cross-linguistic preference is formalized in the constraint FOOTBINARITY, defined in (9):

- (9) FOOTBINARITY (FTBIN): Feet are binary (bimoraic).<sup>3</sup>

FOOTBINARITY interacts with MAX $\mu$ , which requires all moras from the input to be faithfully maintained in output forms.

- (10) MAX $\mu$ : Input moras have output correspondents (i.e., don't delete moras).<sup>4</sup>

The respective ranking of these two constraints determines whether or not vowel shortening is an option, when a language is faced with an input whose moraicallly faithful output would result in a nonbinary foot. This interaction is shown in tableaux (11) and (12).

- (11) Input: /CVVCV/

		FTBIN	MAX $\mu$
a.	(CV.V)(CV)	*!	
b.	(CVV)(CV)	*!	
c.	(CV.CV)		*
d.	(CVV.CV)	*!	

The input in (11) contains a long vowel (represented by "VV"). The ranking of FTBIN above MAX $\mu$  results in the choice of candidate c, which has a shortened vowel. Candidates a and b both violate FTBIN by having final, monomoraic feet. Candidate d violates FTBIN with its single, trimoraic foot. In (12) the ranking of these two constraints is reversed.

<sup>3</sup> The original definition for FOOTBINARITY, as given in Prince and Smolensky (1993) is "Feet are binary at some level of analysis ( $\mu$ ,  $\sigma$ )" (p.47). The result of this constraint is to require feet that are *minimally* bimoraic, as opposed to the current definition which requires feet to be *exactly* bimoraic. The present definition of FOOTBINARITY is taken from Hammond (1995).

<sup>4</sup> MAX $\mu$  is a moraic correspondence constraint, following McCarthy and Prince (1995). The wording of the constraint is borrowed from Baković (1996).



(12) Input: /CVVCV/

		MAX $\mu$	FTBIN
a.	(CV.V)(CV)		*
b.	(CVV)(CV)		*
*c.	(CV.CV)	*!	
d.	(CVV.CV)		*

When MAX $\mu$  outranks FTBIN, candidate c is ruled out for deleting a mora, while the other candidates all faithfully maintain the input moras. This faithfulness, however, is at the expense of FTBIN, which is violated by all three. With this ranking, other constraints would be necessary to determine which candidate is chosen, but any candidate which has shortened vowels (in this case, candidate c) will be ruled out. In this analysis, I assume that long vowels are specified as bimoraic in the input. I do not treat short vowels as having underlying moras, although it makes no difference to the analysis.

### 5. Nonfinality and ParseSyllable

Nouns and suffixed forms in English are generally analyzed as having unfooted final syllables (e.g. Hayes (1982), Hammond (1995)). In OT this can be characterized by the interaction of NONFINALITY (Prince and Smolensky (1993)), with several other constraints (see Pater (1995) for a full analysis). As originally formulated, NONFINALITY prevents the prosodic head of a word from falling on the final syllable. However, to simplify the interaction of several constraints for our purposes, I follow Hammond (1995) in redefining NONFINALITY as in (13):

(13) NONFINALITY (NONFIN): The final syllable is not footed.

This modified version of NONFINALITY prevents final syllables from being footed. In order to allow the existence of final extrametrical syllables, this constraint must outrank PARSESYLLABLE.

(14) PARSESYLLABLE (PARSE $\sigma$ ): All syllables must be parsed into feet.

The interaction of NONFINALITY and PARSESYLLABLE is shown in the following two tableaux.

(15) Input: /CVVCV/

		NONFIN	PARSE $\sigma$
a.	(CVV) CV		*
b.	(CVV.CV)	*!	

In (15), NONFINALITY outranks PARSESYLLABLE. Candidate a leaves the final syllable unparsed, and consequently satisfies the higher ranked constraint, NONFINALITY. Candidate b, which is exhaustively parsed into a single foot satisfies PARSESYLLABLE, but thus violates NONFINALITY which requires a final, extrametrical syllable.

(16) Input: /CVVCV/

		PARSE $\sigma$	NONFIN
a.	(CVV) CV	*!	
b.	(CVV.CV)		*

In (16) PARSESYLLABLE is ranked above NONFINALITY, and the candidate with exhaustive parsing is chosen. A comparison of (15) and (16) shows that these two constraints are in direct opposition: no candidate which satisfies NONFINALITY can also satisfy PARSESYLLABLE, and vice versa. Since we know that NONFINALITY does play a role in English (at least in nouns and suffixed forms), this constraint must outrank PARSESYLLABLE.

(17) *Ranking of NONFINALITY and PARSESYLLABLE in English*  
NONFINALITY >> PARSESYLLABLE

## 6. Class 1 Affixes vs. Other Forms

Having discussed the interaction of FTBIN with MAX $\mu$ , and NONFINALITY with PARSESYLLABLE, a few more constraints will be necessary in order to analyze the vowel shortening data. The constraint STRESSWELL (Pater (1995)), prevents stress clash between primary and secondary stresses.

(18) STRESSWELL: No stressed syllable may be adjacent to the head syllable of the Prosodic Word.<sup>5</sup>

<sup>5</sup> The constraint STRESSWELL, as discussed in Pater (1995), prevents adjacent primary and secondary stresses. As Pater points out, stress clash between non-primary stress heads is tolerated in English to a greater degree than clash between primary and non-primary heads. The constraint \*CLASH, which prevents any adjacent stresses, is lower ranked. In this paper, however, I do not mark the distinction between primary and secondary stress, but violations of STRESSWELL are only marked in cases where one stress is primary.

The constraints  $\text{MAX}_{\text{segment}}$  and  $\text{DEP}_{\text{segment}}$ , which prevent outright deletion or insertion of segments are for our purposes undominated. A summary of the constraints and rankings given so far is shown in (19).

- (19)  $\text{MAX}_{\text{segment}}, \text{DEP}_{\text{segment}}$  (undominated)  
 NONFINALITY >> PARSESYLLABLE  
 FTBIN,  $\text{MAX}_{\mu}$ , STRESSWELL (not yet ranked)

Since  $\text{MAX}_{\text{segment}}$  and  $\text{DEP}_{\text{segment}}$  are for our purposes undominated, no violations of these constraints will be considered, and the segment faithfulness constraints will be left out of subsequent tableaux.

We now turn to the evaluation of a word such as *national*, which contains a Class 1 affix. Evaluation of Class 1 affixed forms demonstrates the need to rank STRESSWELL and FTBIN above  $\text{MAX}_{\mu}$ . Crucial rankings are marked by a double line.

(20) Input: /næ:ʃən + æl/

	NONFIN	PARSE $\sigma$	STRESSWELL	FTBIN	$\text{MAX}_{\mu}$
a. (næ.ʃə) nəl		*			*
b. (né:.ʃə) nəl		*		*!	
c. (né:)(ʃán) əl		*	*!		
d. (næ.ʃə)(nǽl)	*!				*
e. (né:.ʃə)(nǽl)	*!				*

Since NONFINALITY outranks PARSE $\sigma$ , candidates d and e are ruled out, leaving only a, b, and c. We know that the correct candidate is a -- [(næ.ʃə) nəl] -- so candidates b and c must be ruled out. This is done by ranking STRESSWELL and FTBIN above  $\text{MAX}_{\mu}$ . Since candidate c violates STRESSWELL by having adjacent stresses, and candidate b violates FTBIN by virtue of its trimoraic foot, candidate a correctly emerges as the winner, although it violates  $\text{MAX}_{\mu}$  by deleting a mora and thus shortening the initial vowel. This indicates that both STRESSWELL and FTBIN must outrank  $\text{MAX}_{\mu}$ . There is not yet any evidence for the ranking of PARSE $\sigma$ , so long as it is dominated by NONFINALITY. Likewise, there is no evidence for the ranking between STRESSWELL, PARSE $\sigma$ , and FTBIN, so long as both STRESSWELL and FTBIN dominate  $\text{MAX}_{\mu}$ .

The evaluation of *national* in (20) demonstrates the need to rank FTBIN above  $\text{MAX}_{\mu}$  for forms with Class 1 affixes. This interaction is highlighted in (20) by the bold double line. However, this ranking must be reversed for forms with Class 2 affixes and monomorphemic forms. The evaluation of a word with a Class 2 affix, *opening*, is given in (21).

(21) Input: /ɑ:pɛn + ɪŋ/

	NONFIN	PARSE $\sigma$	STRESSWELL	MAX $\mu$	FTBIN
a. (ó:pə) nɪŋ		*			*
b. (á:pə) nɪŋ		*		*!	
c. (ó:)(pɛ̀n) ɪŋ		*	*!		
d. (ó:pə)(nìŋ)	*!				*
e. (á:pə)(nìŋ)	*!			*	

As in (20), candidates d and e are ruled out by NONFINALITY. Since we know that candidate a -- [(ó:pə) nɪŋ] -- is the correct output, STRESSWELL and MAX $\mu$  must outrank FTBIN. Candidate c violates STRESSWELL with its adjacent stresses, and candidate b violates MAX $\mu$  by shortening its initial long vowel, and so with this ranking candidate a is correctly chosen.

The ranking in (21) of MAX $\mu$  above FTBIN, however, is the converse of the ranking established in (20). But by comparing the outlined sections of (20) and (21), it is clear that a reversal of the ranking between these two constraints would in both cases result in an incorrect choice. In (20), if MAX $\mu$  were to outrank FTBIN, candidate b -- [(né:fə) nəl] -- which has no vowel shortening, would be incorrectly chosen. In (21), if FTBIN were to outrank MAX $\mu$ , candidate b -- [(á:pə) nɪŋ] -- which has a shortened initial vowel, would be incorrectly chosen. From this comparison, it is evident that the distinction between Class 1 affixed forms (e.g. *national*) and Class 2 affixed forms (e.g. *opening*) lies in the ranking between FTBIN and MAX $\mu$ . Class 1 affixed forms violate MAX $\mu$  by shortening long vowels, in order to satisfy FTBIN and maintain better-formed feet. Class 2 affixed forms have the opposite preference: they sacrifice well-formedness by creating trimoraic feet, in order to faithfully maintain input moras.

We would not, however, want to say that the ranking between FOOTBINARITY and MAX $\mu$  changes depending on the morphology of the input. If this were true, there would be two different phonologies of English: one operating whenever an input had a Class 1 affix, the other operating for words with Class 2 affixes. Since this solution seems a bit extreme, we can instead characterize the difference between these two affix classes by means of a parochial constraint. Because words with Class 1 affixes differ from words with Class 2 affixes and unaffixed words by their stricter obedience to FOOTBINARITY, we can characterize this by ranking a parochial constraint FOOTBINARITY<sub>Class 1</sub> above the general FOOTBINARITY constraint. FOOTBINARITY<sub>Class 1</sub> requires that words containing Class 1 affixes maintain binary feet.

- (22) FOOTBINARITY<sub>Class 1</sub>: In words with Class 1 affixes, feet are binary (bimoraic).

Since words with Class 1 affixes would rather maintain good foot form than preserve input moras, as demonstrated in (20), FTBIN<sub>Class 1</sub> must dominate MAX $\mu$ . Words with Class 2 affixes, however, preserve input moras at the expense of foot form, as demonstrated in (21), and therefore MAX $\mu$  must dominate FTBIN. The resulting ranking between these three constraints is given in (23):

- (23) FOOTBINARITY<sub>Class 1</sub> >> MAX $\mu$  >> FOOTBINARITY

With this ranking, we re-evaluate *national* (Class 1) and *opening* (Class 2). As the interaction between NONFINALITY and PARSE $\sigma$  has already been demonstrated, and the higher ranking of NONFINALITY forces all winning candidates to include a final extrametrical syllable, these two constraints are left out of subsequent tableaux.

- (24) Input: /næ:ʒɑn + æl/

	STRESSWELL	FTBIN <sub>CLASS 1</sub>	MAX $\mu$	FTBIN
a. (nǽ.ʒə) nəl			*	
b. (né:.ʒə) nəl		*!		*
c. (né:)(ʒɑ̀n) əl	*!			

Candidate c is ruled out by STRESSWELL for having adjacent stresses. The crucial interaction is between FTBIN<sub>CLASS 1</sub> and MAX $\mu$ . Since this word contains a Class 1 affix, FTBIN<sub>CLASS 1</sub> applies and rules out candidate b, correctly choosing candidate a as the winner.

- (25) Input: /ɑ:pən + ɪŋ/

	STRESSWELL	FTBIN <sub>CLASS 1</sub>	MAX $\mu$	FTBIN
a. (ɑ́:pə) ɪŋ				*
b. (ɑ́.pə) ɪŋ			*!	
c. (ɑ́:)(pə̀n) ɪŋ	*!			

Tableau (25) shows the evaluation of a word with a Class 2 affix. Since all candidates vacuously satisfy FTBIN<sub>CLASS 1</sub> (because the word does not contain any Class 1 affixes), the crucial ranking is between MAX $\mu$  and the general constraint

FTBIN. Candidate b is ruled out for deletion of a mora, and candidate a is correctly chosen as the winner.

The tableau in (26) shows that this ranking will result in the correct candidate being chosen for monomorphemic words, such as *ivory*, as well.

(26) Input: /I:vɑrɛ:/

		STRESSWELL	FTBIN <sub>CLASS 1</sub>	MAX $\mu$	FTBIN
☞ a.	(á <sup>j</sup> .və) ri:				*
b.	(í.və) ri:			*!	
c.	(á <sup>j</sup> )(vár) i:	*!			

STRESSWELL rules out candidate c, which has adjacent stresses. FTBIN<sub>CLASS 1</sub> is vacuously satisfied by all candidates because there are no Level 1 affixes in this form. As with the Class 2 affixed form, the candidate which faithfully preserves all input moras (candidate a) is chosen over the one which maintains bimoraic feet (candidate b). This ranking of constraints correctly chooses candidate a -- [(á<sup>j</sup>.və) ri:] -- as the output form.

The final ranking of constraints is summarized in (27).

(27) *Final Rankings*

FAITH (undominated)

NONFIN >> PARSE $\sigma$

NONFIN >> STRESSWELL, FTBIN<sub>CLASS 1</sub> >> MAX $\mu$  >> FTBIN

## 7. Alternate Analysis

An alternate analysis of these two affix classes is given by Benua (1997), who appeals to output-output correspondence constraints. Benua's analysis rests on a family of constraints requiring correspondence between output forms containing the same root. For example, the constraint OO-ANCHOR requires words containing the same root, such as *párent/párenthood* to have stress assigned to the same syllable of the root. In Benua's analysis, the difference between words with Class 1 affixes and other words is that words with Class 1 affixes violate output-output correspondence more than words with Class 2 affixes; that is, the roots of Class 1 affixed forms are less similar to their isolation forms than the roots of Class 2 affixed forms are. For example, with respect to stress assignment, a Class 2 affixed form (e.g. *párenthood*) has stress on the same

syllable as the isolation form of the root (e.g. *párent*). The same is not true for Class 1 affixed forms (e.g. *paréntal*).

From data such as these, Benua concludes that Class 2 affixes require words to be more faithful to their inputs. This is characterized by ranking the parochial constraint OO<sub>2</sub>-ANCHOR above the general OO-ANCHOR constraint, mediated by a constraint ALIGN-R, which requires stress to be aligned at the rightmost syllable of a word.

(28) OO-ANCHOR: In an affixed word, stress falls on the same syllable of the root as in the isolation form of the root.

(29) ALIGN-R: Main stress is on the rightmost syllable of a word.

This analysis is illustrated in the following two tableaux, which evaluate *párenthood* and, *paréntal* respectively.

(30) Input: /pɛ:rɛnt + hud/

	NONFIN	STRESSWELL	OO <sub>2</sub> -ANCHOR	ALIGN-R	OO-ANCHOR
a. (pɛ:rɛnt)hud				*	
b. pə(rɛnt)hud			*!		*
c. (pɛ:)(rɛnt)hud		*!			
d. (pɛ:)rɛnt(húd)	*!				

As in all previous tableaux, NONFINALITY is highly ranked, and here it rules out candidate d for parsing a final syllable. Candidate c is ruled out by STRESSWELL for its two adjacent stresses. Because this word contains a Class 2 affix, OO<sub>2</sub>-ANCHOR is active and rules out candidate b for failing to place stress on the initial syllable of the root, where it is located in the isolation form *párent*. Candidate a is correctly chosen as the output.

For words which do not contain Class 2 affixes, OO<sub>2</sub>-ANCHOR has no effect, allowing ALIGN-R to determine the output. This is illustrated in (31) in the evaluation of a Class 1 affixed form, *parental*.

(31) Input: /pɛ:rɛnt + æl/

	NONFIN	STRESSWELL	OO <sub>2</sub> -ANCHOR	ALIGN-R	OO-ANCHOR
a. pɛ:(rɛnt)əl					*
b. (pɛ:.rɛnt)əl				*!	
c. (pɛ:)(rɛnt)əl		*!			
d. (pɛ:)rɛnt(æɫ)	*!				

Once again, candidates c and d are ruled out by STRESSWELL and NONFINALITY, respectively. OO<sub>2</sub>-ANCHOR is vacuously satisfied, and ALIGN-R rules out candidate b. The remaining candidate is a, which is chosen as the output form although it violates OO-ANCHOR by failing to stress the same root syllable as in the isolation form *párent*.

From these data, it appears that Benua's generalization is correct: that is, that the difference between Class 1 and Class 2 affixes is that Class 2 affixed words are more faithful to their roots' isolation forms than are Class 1 affixed words. However, if we apply the same reasoning to the vowel shortening data, we see that this is not the case.<sup>6</sup> In order to demonstrate, let us consider an output-output correspondence analysis of the Trisyllabic Shortening data.

Since it is Class 1 affixed forms which undergo vowel shortening, while Class 2 affixed forms do not, Benua's generalization appears at least initially to be correct: Class 2 affixed forms are moraicly more faithful to their isolated roots (e.g. [(ó:)pən]/[(ó:.pə) nɪŋ] -- same number of moras in root) than are Class 1 forms (e.g. [(né:)ʃən]/[(næ:.ʃə) nəl] -- fewer moras in root of affixed form). Since this is true, it appears that Class 2 affixed forms require a stricter moraic faithfulness to their roots than do Class 1 affixed forms. We can characterize this with the constraints OO-IDENT<sub>μ</sub> and OO<sub>2</sub>-IDENT<sub>μ</sub>, as defined below.

(32) OO-IDENT<sub>μ</sub>: The roots of affixed forms are moraicly identical to their isolation forms.

(33) OO<sub>2</sub>-IDENT<sub>μ</sub>: The roots of Class 2 affixed forms are moraicly identical to their isolation forms.

In order to have an effect, the parochial constraint OO<sub>2</sub>-IDENT<sub>μ</sub> must be the higher ranked of the two. As in the proposed analysis, the crucially conflicting constraint

<sup>6</sup> Benua (1997) does not provide an analysis of the vowel shortening data. The analysis given here is my own interpretation of her analysis, as applied to the present data.



is FOOTBINARITY, because the contrast between these two affix classes is between faithfulness (as represented by MAX $\mu$  in the proposed analysis, or by OO-IDENT $\mu$  in the output-output correspondence analysis) and well-formedness (FTBIN in both analyses). If FTBIN intervenes between the two output-output constraints, the evaluation of a Class 2 affixed word, such as *opening* is as shown in (34).

(34) Input: /ɑ:pən + ɪŋ/

		STRESSWELL	OO <sub>2</sub> -IDENT $\mu$	FTBIN	OO-IDENT $\mu$
☞ a.	(ó:pə) nɪŋ			*	
b.	(á:pə) nɪŋ		*!		*
c.	(ò:)(pən) ɪŋ	*!			

Candidate c is ruled out by STRESSWELL, leaving only a and b. Since candidate b has fewer moras in its root than the root isolation form -- [(ó:pən)]-- it is ruled out by OO<sub>2</sub>-IDENT $\mu$ , resulting in candidate a as the correct output.

For Class 1 affixed forms, such as *national*, OO<sub>2</sub>-IDENT $\mu$  has no effect, as shown in (35).

(35) Input: /næ:ʃən + əl/

		STRESSWELL	OO <sub>2</sub> -IDENT $\mu$	FTBIN	OO-IDENT $\mu$
☞ a.	(næ:ʃə) nəl				*
b.	(né:ʃə) nəl			*!	
c.	(nè:)(ʃən) əl	*!			

Since this word contains no Class 2 affixes, OO<sub>2</sub>-IDENT $\mu$  is vacuously satisfied. Because of this, the decision is made by FTBIN, which rules out candidate b for its trimoraic foot. The resulting winner is candidate a, although it does not have the same number of moras in its root as the isolation form -- [(né:ʃən)].

Thus far, the output-output analysis appears to correctly account for the data. However, the evaluation of a monomorphemic word, such as *ivory*, demonstrates the inadequacy of this analysis.

(36) Input: /ɪ:vəɪ:/

		STRESSWELL	OO <sub>2</sub> -IDENT $\mu$	FTBIN	OO-IDENT $\mu$
a.	(á:və) ri:			*!	
ⓑ b.	(í:və) ri:				
c.	(à')(vǎr) i:	*!			

Since this is a root word in isolation (i.e. a monomorphemic word), neither of the output-output constraints apply. The final decision is thus made by FTBIN, which

rules out candidate a for having a trimoraic foot, incorrectly choosing candidate b as the winner.

The problem with this analysis is that by making the generalization that Class 2 affixed words are more *faithful* than other words (via the higher ranking of parochial Class 2 output-output constraints), the analysis also predicts that monomorphemic words will behave like Class 1 affixed forms (i.e. by being less faithful and more well-formed). Any analysis which appeals to *Class 2* parochial constraints cannot account for the fact that monomorphemic words group together with Class 2 affixed words, rather than Class 1. For this reason, the data require an analysis which appeals instead to *Class 1* parochial constraints, and thus sets the Class 1 affixed words off as different from Class 2 affixed and monomorphemic words.

In fact, an output-output correspondence analysis cannot account for these data, because the difference between Class 1 and Class 2 affixes is not a question of faithfulness, but rather of well-formedness. As illustrated by the fact that monomorphemic words group with Class 2 affixed words, it is Class 1 affixed words which are different. Class 1 affixed words are unique in their stricter maintenance of well-formed (i.e. moraicly binary) feet. Since output-output correspondence imposes faithfulness, rather than well-formedness, requirements, such an analysis cannot account for an alternation which is fundamentally a question of well-formedness.

## 8. Conclusion

In this paper I have given an OT analysis of Trisyllabic Shortening, a phenomenon analyzed within Lexical Phonology as being the result of a very serial derivation. Within OT such morphologically-sensitive alternations are characterized well through the use of parochial constraints, such as  $\text{FOOTBINARITY}_{\text{CLASS 1}}$ . The crucial point to my analysis is that there is a sub-group of affixes in English (the Class 1 affixes) which impose upon words a stricter requirement for stress feet to be moraicly binary than is observed by words not containing such affixes. I have shown that output-output correspondence cannot account for the difference between Class 1 and Class 2 affixes, because the difference between the groups is one of well-formedness, rather than of faithfulness. Although for most words of English, faithfulness to underlying moraic structure is more important than having perfect trochees, words which include a Class 1 affix prefer to maintain good foot form, at the expense of moraic faithfulness.

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# Augmentation and Correspondence: A Reanalysis of Nancowry Reduplication

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## 1. Introduction

The goal of this paper is to provide an account for what appears to be reduplication in Nancowry, a Nicobarese language (Radhakrishnan 1981). Some examples of ‘reduplication’ are the following:

(1)	Augmented form <sup>1</sup>	Input form	Gloss
	?it.cat	-cat	‘to jump or bounce’
	?uk.yak	-yak	‘to conceive a child’

In these two examples, the only segments that are identical between the input form and the initial syllable of the augmented form are the final consonants of the augmented forms and the final consonants of the input forms. Typically, in reduplication, the copied segment corresponds with the edge that the reduplicant attaches to. Nancowry presents two problems for this general conception of reduplication. First, reduplicants are at least a syllable, a prosodic unit. Second, reduplication is a morphological process that alters the meaning of forms. In Nancowry, the reduplicated element appears to be only a single segment (the final consonant). Also, this process does not alter the meaning of the initial form. Thus, what has been labeled reduplication in Nancowry appears to be more analogous to augmentation. These problems can be circumvented by using Optimality Theory (henceforth OT) in conjunction with Correspondence Theory, a sub-branch of OT (McCarthy and Prince 1993, 1995; McCarthy 1995).

In section 2, I show that augmentation affects only monosyllabic forms without affecting any meaningful changes in the forms. I argue more fully that what has been called reduplication is actually augmentation. Following McCarthy and Prince’s analysis of Axininca Campa, I provide an account for the augmentation process itself. Section two describes the augmented form. Section three compares that augmented form with the input form. This shows the

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<sup>1</sup> I use these headings (Augmented form, Input form) because I argue that even though there are correspondences between the augmented form and the input form, it is not reduplication. In order to remain consistent throughout the paper, then, I used these headings here.

correspondence(s) between the vowel and the final consonant of the augmented form and the final consonant of the input form. Section four sums up the analysis and offers suggestions for future research. In particular, the analysis shows that the base-reduplicant, input-output, lexical-surface distinctions are not necessary. In fact, the whole notion of reduplication may be analyzable as an augmentation process.

## 2. Augmentation

The primary reasons for considering Nancowry reduplication to be augmentation are the following. First, most cases of reduplication are associated with meaningful differences in the lexical form, usually marking either repetition or plurality (Marantz 1982, Moravcsik 1978). Nancowry reduplication never alters the meaning of the form. The only alternation is with respect to the phonological form itself (2).

- (2) Monosyllabic augmenting forms: CVC → CVC.CVC
- |                   |                       |
|-------------------|-----------------------|
| /pok/ → [ʔuk.pok] | ‘to tether an animal’ |
| /ʔep/ → [ʔup.ʔep] | ‘to plan’             |
| /lop/ → [ʔup.lop] | ‘to cover one’s self’ |
| /lom/ → [ʔum.lom] | ‘to fold’             |
| /sa/ → [ʔu.sa]    | ‘to visit a boat’     |
| /ʔet/ → [ʔit.ʔet] | ‘to write’            |
| /tot/ → [ʔit.tot] | ‘to lend’             |
| /run/ → [ʔin.run] | ‘to paint a picture’  |
| /tin/ → [ʔin.tin] | ‘to push’             |
| /cat/ → [ʔit.cat] | ‘to jump or bounce’   |

Second, disyllabic forms do not reduplicate/augment (2’). Only monosyllabic verb forms undergo this process.<sup>2</sup>

- (2’) Disyllabic forms: CV(C).CV(C) → CV(C).CV(C)
- |        |                  |
|--------|------------------|
| ti.moʔ | ‘to give a blow’ |
| ku.lay | ‘to make curry’  |
| ki.lk  | ‘to shake’       |
| si.ʔun | ‘to bow’         |
| ku.yo  | ‘to thrash’      |

<sup>2</sup> Monosyllabic and disyllabic forms do not reduplicate (see Radhakrishnan 1981 for a discussion)

ka.ʔep	‘to carve’
cac.i	‘to gossip’
hat.ruk	‘to abstain’
kap.mat	‘to imagine’
kin.ʔc	‘to squeeze’
lin.rok	‘to shoot with fingers’
ka.mu	‘to frighten children’

CV(C).CV(C) -> \*CV(C).CV(C).CV(C)

Third, when a prefix is attached, monosyllabic forms do not reduplicate.  
Consider the following:

(3) /ha-/: causative prefix

ʔum.cim	‘to cry with tears’	ha.cim	‘to make someone cry’
ʔu.miʔ	‘to be soaked’	ha.miʔ	‘to cause to get soaked’
ʔin.tin	‘to push’	ha.tin	‘to make someone push’
ʔit.ʔet	‘to write’	ha.ʔet	‘to make someone write’
ʔip.ʔep	‘to plant’	ha.ʔep	‘to make someone plant’
ʔup.lop	‘to cover one’s self’	ha.lop	‘to cover someone’
ʔuk.lak	‘to avoid’		
ʔuk.lak.hala	‘to wait for’	ha.lak.hala	‘to ask someone to wait’

Thus, I conclude from the alternations that only monosyllabic verb forms augment. I posit, then, that reduplication in Nancowry is an augmentation process. Also, monosyllabic forms augment in order to become disyllabic. In other words, verb stems want to be disyllabic. The evidence for this is in (3) which shows that when a prefix attaches to the monosyllabic verb stem, no augmentation occurs. However, when the stem is bare, augmentation occurs. The constraint that captures this in OT is DISYLL (following McCarthy and Prince 1993: 79).

(4) DISYLL-vb  
Verb stems are minimally disyllabic.

In order to account for the exact position and mode of the augmentation, other constraints are needed. First, I need to spell out when this augmentation occurs.

Identical to Axininca Campa, augmentation occurs when the following properties hold.

- (5) Bareness:
- only a bare root is augmented
  - when a prefix is present, nothing happens

A second property of augmentation is syllabicity. McCarthy and Prince state this as follows:

- (6) Syllabicity
- roots /CVC/ augment to disyllabic CVC.CVC

This captures the observation that the augmentation is to the left, the right-side of the root never augments in Nancowry (see 2 & 3 above). In Axininca Campa, augmentation is restricted to the right-side of the root.

- (7) Nancowry augmentation  
/cim/: ?um.cim  
\*cim.?um

Axininca Campa augmentation  
/t<sup>h</sup>o/: t<sup>h</sup>o.ta  
\*ta.t<sup>h</sup>o

In order to capture Axininca Campa augmentation, McCarthy and Prince use the constraints ALIGN and ALIGN-L.

- (8) ALIGN  
Every right stem-edge coincides with the right edge of a syllable  
ALIGN-L  
Every left stem-edge coincides with the left edge of a prosodic word

This restricts the augmentation to the right side of the root (Align-L; position) and requires that the stem-final element be syllable-final (Align; mode). For Nancowry, augmentation needs to be restricted to the left side of the root (Align-R). With respect to the relation between stem edges and syllable edges, both the right and the left edges of the stem should coincide with a syllable edge. Thus, the constraints for Nancowry are:

- (9) ALIGN (revised)  
 Every stem edge coincides with an edge of a syllable  
 ALIGN-R  
 Every right stem-edge coincides with the right edge of a prosodic word

Consider the following tableau:

(10)

/tin/	DISYLL	ALIGN-R	ALIGN	ALIGN-L
☞ a. [ʔin.  tin  ]				*
b. [  tin  .ʔin ]		*!		
→ c. [n.  tin  ]				*
→ d. [in.  tin  ]				*
e. [n  tin  ]	*!		*	*
→ f. [ʔi.  tin  ]				*
g. [  ti.n  i ]		*!	*	

[ ] = PrWd, || = stem-edge

Here, DISYLL, ALIGN-R and ALIGN need to be ranked above ALIGN-L in order for augmentation to take place at the beginning of the input form. Whereas for Axininca Campa, ALIGN-L must be ranked above ALIGN-R. Note that four candidates remain, {a, c, d, f}. In order to tease these apart, two more constraints are needed.

- (11) \*C  
 Consonants are not syllabic  
 ONSET  
 All syllables have onsets.

The first constraint is given by default. There is no evidence in Nancowry to suggest that consonants may be syllabic. Syllables are either CVC or CV (see 2). They are never V, C, or VC. This leads to the second constraint, ONSET. Since only CVC and CV syllables are possible in Nancowry, onsetless syllables never appear. Thus, syllables always have onsets and always have a vowel; they are minimally CV. Consider this next tableau which eliminates candidates (c) and (d) in (10).



(12)

/tin/	*C	ONSET	ALIGN-R	ALIGN	ALIGN-L
☞ a. [ <u>?in</u> .  tin  ]					*
c. [ <u>n</u> .  tin  ]	*!				*
d. [ <u>in</u> .  tin  ]		*!			*
→ f. [ <u>?i</u> .  tin  ]					*

Since ONSET and \*C are never violated in Nancowry, they are undominated. It remains to be seen whether or not this holds true for ALIGN and/or ALIGN-R. However, all four constraints are ranked above ALIGN-L.

In (12), two candidates remain standing. In order to force a selection between these (since they do not freely vary), the form of the augment itself needs to be examined. The next two sections address this. They look at the properties of the augmented syllable itself and its relation to the input form.

### 3. The Form of the Augmented Syllable

So far, I have shown that augmentation occurs in order for monosyllabic stems to become like their disyllabic counterparts; optimal stems are disyllabic. However, the augmented syllable may surface as either a CV or CVC syllable. The goal of this section is to find out when these two different forms surface. In (13) I give examples of both types of augmentation and their illicit counterparts.

(13) CVC augmentation (see (2) above also)

a.	[?in.tin]	/tin/	'to push'	a'	*?i.tin	tin
b.	[?uk.yak]	/yak/	'to conceive'	b'	*?u.yak	yak
c.	[?um.cim]	/cim/	'to mourn'	c'	*?u.cim	cim

CV augmentation<sup>3</sup>

d.	[?i.?as]	/?as/	'to sneeze'	d'	*?is.?as	?as
e.	[?i.tus]	/tus/	'to weed'	e'	*?is.tus	tus
f.	[?i.tiy]	/tiy/	'to laugh'	f'	*?is.tiy	tiy

<sup>3</sup> There are other CV forms ending in [?] which surface as CV.CVC when augmented. Some examples are the following:

?u.ki?	ki?	'to tempt'
?u.ya?	ya?	'to hatch an egg'
?u.mi?	mi?	'to be soaked'

I do not deal with these here. I leave them for future investigation.

g.	[?i.cej]	/cej/	'to twinkle'	g'	*?iy.cej	cej
h.	[?u.tow]	/tow/	'to brood'	h'	*?uw.tow	tow
i.	[?u.kew]	/kew/	'to take'	i'	*?uw.kew	kew

From this, it is evident that all augmented syllables begin with a [?] where the [?] surfaces in order to satisfy the constraint, ONSET.<sup>4</sup> Also, the vowel of the augmented syllable is always a high vowel, either [i] or [u]. For this paper, I will simply stipulate that there is a constraint that states that all vowels are high.

- (14) V=HI  
All vowels are [+high]

Since not all vowels surface as high vowels, this is an obviously violable constraint and not highly ranked. In order to maintain the non-highness of other vowels, the constraint, MAX, is needed.

- (15) MAX (from McCarthy and Prince 1995)  
Every element of S1 has a correspondent in S2.  
(every input segment has a corresponding segment in the output)

It is ranked above V=HI. This allows the vowel of the augmented form to always surface as a high vowel while preserving the features of the input vowels. Consider the next tableau:

- (16) /-ht/ 'to be hunchback'

/ht/	ONSET	MAX	V=HI
a. ?it.ht			
b. ?it.hit		*!	
c. ?t.ht			*!
d. it.ht	*!		

The only definitive ranking is MAX >> V=HI; ONSET and MAX are unranked with respect to each other.

Another pattern appearing within the augmented syllable itself is the similarity between the place features of the vowel and the final consonant. Consider these forms:

<sup>4</sup> I do not address the issue of why the default consonant is [?].

- (17) Place-feature correspondence
- |            |                       |              |                       |
|------------|-----------------------|--------------|-----------------------|
| ? i t. h t | 'to be hunchback'     | ? i n. t i n | 'to push'             |
|            |                       |              |                       |
| cor cor    |                       | cor cor      |                       |
| <br>       |                       |              |                       |
| ? u k.yak  | 'to conceive a child' | ? u k.pok    | 'to tether an animal' |
|            |                       |              |                       |
| dor dor    |                       | dor dor      |                       |
| <br>       |                       |              |                       |
| ? u m.cim  | 'to mourn'            | ? u p.lop    | 'to cover one's self' |
|            |                       |              |                       |
| lab lab    |                       | lab lab      |                       |

This shows that the place features of the vowel and the final consonant match in the augmented form. This potentially explains the variation between [i] and [u] in the augmented form. That is, the place feature of the vowel varies depending on the place feature of the final consonant. However, this raises the original question: (i) how to get the appropriate final consonant for the augment and (ii) how to predict when there is no final consonant in the augment. The forms given in (13) above provide the contrasting forms. For ease of accessibility, I repeat a few of them in (18).

(18) CVC augmentation

- a. [ʔin.tin] /tin/ 'to push'
- b. [ʔuk.yak] /yak/ 'to conceive a child'
- c. [ʔum.cim] /cim/ 'to mourn'

CV augmentation

- d. [ʔi.ʔas] /ʔas/ 'to sneeze'
- e. [ʔi.cey] /cey/ 'to twinkle'
- f. [ʔu.kew] /kew/ 'to take'

With respect to the augmented syllable alone, the only generalization which appears is that the final consonants which surface in augmented forms are all stops (see 18a-c). Forms (d-f) have no final consonants in the augmented form. It would seem, then, that only stops can surface as final consonants in the augmented syllable. Note that this restriction applies to augmented forms only.

## (19) Disyllabic forms with medial non-stop segments

- a. hew.ca? 'to meet someone'
- b. muy.yuah 'to quarrel'
- c. i.mu .san 'kitchen'
- d. i.rew.si 'temple'

The constraint which captures this generalization is the CODA CONDITION following Ito 1986.

(20) CODA CONDITION<sup>5</sup>

All codas are stops.

Obviously, there are disyllabic forms which violate this in Nancowry. In order to prevent the coda constraint from affecting these forms, MAX must be ranked above CODA CONDITION.

## (21) /tow/ 'to brood'

/tow/	ONSET	MAX	CODA-COND
a. ?u.tow			*
b. ?uw.tow			**!
c. ?u.to		*!	
d. u.tow	*!		

Thus, ranking MAX above CODA CONDITION keeps the input form from altering at the surface while preventing a final consonant from surfacing in the augmented form. The remaining question, though, is why a final consonant ever surfaces in the augmented syllable in the first place. Once this is resolved, then the vowel alternation can be neatly accounted for. However, in order to do this, the relationship between the input form and the augment needs to be addressed.

<sup>5</sup> This is a stipulative constraint. The only motivation for it at this time is the fact that only stops surface as codas in the augment. Future research will hopefully use correspondence constraints to account for this.

#### 4. Augmentation and Correspondence

This section focuses on the similarities between the input form and the augmented form. The first observation is that there exists exact correspondence between the final consonants of the input and the augmented syllable (when the final consonant is a stop). For example:

- (22)    ?um.cim        ‘to mourn’  
          ?in.run        ‘to paint a picture’  
          ?uk.pok        ‘to tether an animal’  
          ?VC<sub>2</sub>.C<sub>1</sub>V<sub>X</sub>C<sub>2</sub>

In order to capture this relation in OT, I use the constraint, R-ANCHOR.

- (23)    R-ANCHOR

Any element at the designated periphery of the input has a correspondent at the designated periphery of the augment.

I have altered this definition slightly from McCarthy & Prince’s original definition. I have substituted ‘input’ for ‘base’ and ‘augment’ for ‘reduplicant.’ What this does is it defines the correspondence between the edge of the augmented syllable and the edge of the input form. It requires the segments at these edges to be identical and helps choose the optimal candidate.

- (24)    /pok/    ‘to tether an animal’

/pok/	MAX	R-ANCHOR	CODA-COND
☞ a. ?uk.pok			
b. ?u.pok		*!	

Tableau (24), then, illustrates the applicability of R-ANCHOR. Now consider the forms which do not surface with a coda in the augmented syllable (as in 12 & 17). In order to be able to select a candidate with no coda in the augment, the CODA CONDITION needs to be ranked above R-Anchor, as in tableau (25).

(25) /tow/ 'to brood'

/tow/	MAX	CODA-COND	R-ANCHOR
☞ a. ?uw.tow		*!	
b. ?u.tow			*

This shows that Coda Condition must be ranked above R-Anchor in order to get an augmented syllable without a final consonant.

The final question remaining deals with the relationship between the place features of the augmented vowel and the final consonant of the input form. I noted earlier the relationship between the final consonant and the vowel of the augmented form. As I have shown, though, a final consonant does not always appear in the augmented syllable, but an alternation in the vowel still occurs. Thus, the actual relationship is between the place features of the input's final consonant and the place features of both the augment's final consonant and vowel.

(26) Correspondence of place

? u k – p o k	‘to tether an animal’	? u – t o w	‘to brood’
dor		lab	
dor		lab	

As (26) shows, the correspondence can be reinterpreted as one between the mora of the augmented syllable and the final consonant of the input.<sup>6</sup> This allows the generalization to be captured by using a single constraint, R-ANCHOR(place).

(27) R-ANCHOR(PL)

The rightmost place feature of the input corresponds to the leftmost mora of the output.

This constraint must be ranked below MAX, otherwise the alternation which appears in the augmented syllable would appear elsewhere, and it does not.

<sup>6</sup> I would like to thank Diana Archangeli for this suggestion.

(28) /pok/ 'to tether an animal'

/pok/	MAX	CODA-COND	R-ANCHOR	R-ANCHOR(PL)
☞ a. ?uk.pok				
b. ?ik.pok				*!
c. ?u.pok			*!	
d. ?u.po	*!			

So, Max dominates all three constraints. Coda Condition dominates R-Anchor (as shown in (25)). Finally, R-Anchor(PL) is unranked with respect to R-Anchor and Coda Condition because the optimal candidate (28a) does not violate any of these constraints. Subsequently, a ranking cannot be determined.

## 5. Conclusion

In sum, I have given an account of Nancowry augmentation by using the mechanics of OT and Correspondence Theory. It has provided an analysis for the augmentation, for the form of the augment and for the correspondence between the input and the output without having to call upon the problematic notion of reduplication or the derivational-like domains posited by McCarthy and Prince 1995. This analysis has avoided all of the theoretical entanglements. Instead of redefining reduplication to accommodate a single segment, I have instead argued for a reanalysis of Nancowry reduplication as an augmentation process and have shown this above. Also, with respect to the domain distinctions implemented by McCarthy and Prince, I have circumvented these issues by (1) analyzing Nancowry reduplication as augmentation and (2) reducing the domains to one between input and output only. This removes the need to consider what RED might be in Nancowry as well as allowing a more general analysis, one which may apply to other phenomena including reduplication. An interesting question for future deliberations is whether or not reduplication in general can be reanalyzed as augmentation.

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## Anchoring and Reduplicative Identity: Cases from Nancowry and Koasati

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### 1. Introduction

This paper problematizes the concept of Anchoring as defined in both Containment Theory (Prince and Smolensky 1993, McCarthy and Prince 1993) and Correspondence Theory (McCarthy and Prince 1995, McCarthy 1995). Specifically, McCarthy and Prince (henceforth M&P) state that Anchoring “should subsume Generalized Alignment” (1995:123). That is, Anchoring should stipulate both the matching between the edges of a reduplicant and its base as well as the positioning of a reduplicant with respect to its base. This suggests that there is a direct correlation between reduplicative identity and Generalized Alignment with respect to Anchoring. In particular, M&P claim that all suffixal reduplicants match the right edges of the related bases, and all prefixal reduplicants match the left edges of the related bases. However, evidence from two unrelated languages, Nancowry (a Nicobarese language; Radhakrishnan 1981), and Koasati (a Muskogean language; Kimball 1991), does not support this correlation.

In Nancowry, the right edge of the reduplicant matches the right edge of the base (in bold) and is prefixal, as shown in (1) below.

- (1) Nancowry:  
BASE: -**yak** ‘to conceive’  
R+B: ?u**k** - **yak** ‘to conceive’

In contrast, the beginning of the Koasati reduplicant matches the beginning of the base and is suffixal, as shown in (2) below.

- (2) Koasati:  
BASE: **tahas-** ‘to be light in weight’  
B+R: **tahas** - **to:** ‘to be light many times’

Since the generalization which Anchoring captures does not hold for these two patterns, we argue that Generalized Alignment is separate from Anchoring. We also show that we can account for Semai prefixal reduplication where both the

right and left edges are copied. Thus, we show that Anchoring (a la McCarthy & Prince 1993, 1995) cannot deal with these cases. Both Alignment constraints in conjunction with a modified Anchoring constraint are necessary to account for the cases shown above.

The first section of this paper presents reduplication data from Nancowry, spelling out the patterns shown in (1). The second section introduces the relevant constraints, defines these constraints for Nancowry and gives our analysis of the Nancowry data. The third section presents reduplication data from Koasati, spelling out the patterns shown in (2). The fourth section uses similar constraints introduced in section 2, redefining them for Koasati, and gives our analysis of the Koasati data. The fifth section shows how Anchoring alone fails to account for these patterns. In addition, we further support our point by extending our analysis to a case of reduplication from Semai (a Mon-Khmer language; Diffloth 1976). The last section summarizes our findings.

## 2. Nancowry Reduplication

This section illustrates and discusses the patterns that appear in Nancowry reduplication. This reduplication is semantically vacuous. We present general observations regarding the overall reduplicative form itself, but we are focussing primarily on the identity and positioning of the reduplicant in relation to the base form (for discussion of the overall form see Meek 1995, Alderete et. al. 1996).

As noted above, Nancowry contains forms in which the last segment of the prefixal reduplicant matches the last segment of the base. The matching segments are bolded and underlined in (3).

- (3) Nancowry Data
- |                                    |                       |
|------------------------------------|-----------------------|
| a. ? <u>uk</u> - <u>yak</u>        | 'to conceive'         |
| b. ? <u>it</u> - <u>cat</u>        | 'to jump'             |
| c. ? <u>um</u> - <u>ci<u>m</u></u> | 'to mourn'            |
| d. ? <u>uk</u> - <u>pok</u>        | 'to tether an animal' |
| e. ? <u>up</u> -? <u>ep</u>        | 'to plan'             |
| f. ? <u>up</u> - <u>lop</u>        | 'to cover one's self' |
| g. ? <u>um</u> - <u>lom</u>        | 'to fold'             |
| h. ? <u>it</u> -? <u>et</u>        | 'to write'            |
| i. ? <u>it</u> - <u>tot</u>        | 'to lend'             |
| j. ? <u>in</u> - <u>tin</u>        | 'to push'             |

A number of patterns can be observed here. The first three observations pertain to general facts about the reduplicant which are not integral to our point. First, the

reduplicant always begins with a glottal, [ʔ]. Second, the vowel of the reduplicant is always a high vowel. Third, the vowel of the reduplicant alternates between [i] and [u] depending on the place feature of the final consonant (Meek 1995). The diagram in (4) illustrates these observations.

- (4) Diagram:
- |      |               |
|------|---------------|
| Base | Red +Base     |
| yak  | ʔ u k - yak   |
|      | dorsal dorsal |
|      | * yak - yak   |
|      | * yuk - yak   |
|      | * yik - yak   |
|      | * ʔik - yak   |

This diagram reemphasizes that the only matching segments between the base and the reduplicant are the last segments in each form. Vowels may or may not match as in (3i,j).

The final two observations that can be gleaned from this data that are integral to our focus are the following. First, the reduplicant attaches to the left edge of the base, as illustrated in (5).

- (5) Positioning of Nancowry reduplicant
- $$C_1V_1C_2 \Rightarrow \begin{array}{ccc} \text{ʔ} & C_2 & - C_1V_1C_2 \\ \underline{\text{R}} & & \underline{\text{B}} \end{array} \quad * \begin{array}{ccc} C_1V_1C_2 & - & \text{ʔ}C_2 \\ \underline{\text{B}} & & \underline{\text{R}} \end{array}$$

Second, the coda of the reduplicant matches the coda of the base, as illustrated in (6).

- (6) Identity of Nancowry reduplicant: last segment
- $$C_1V_1C_2 \Rightarrow \begin{array}{ccc} \text{ʔ} & C_2 & - C_1V_1C_2 \\ & \uparrow & \uparrow \end{array}$$

In sum, the relevant observations, illustrated in (5) and (6) above, are summarized below in (7).

- (7) Relevant observations: Nancowry
- a. The reduplicant is attached to the left of the base.
  - b. The coda of the reduplicant matches the coda of the base.

These two observations motivate the constraints defined in the next section.

### 3. Analysis of Nancowry Data

In this section, we analyze the Nancowry data within an Optimality Theoretic framework. We use a Generalized Alignment constraint and an Anchoring constraint, defined according to the observations made in section 1. We show that both Alignment and Anchoring are satisfied in optimal forms.

The first constraint that we consider positions the reduplicant at the beginning of the base. This constraint is formulated under Generalized Alignment (cf. McCarthy & Prince 1994) and is defined in (9).

- (9) ALIGN-L  
ALIGN(RED, R, Base, L)  
The right edge of a reduplicant is aligned with the left edge of its base.

This is motivated by the observation stated in (7a). The constraint itself is schematically represented below in (10).

- (10) Input: /yak/

	Candidates	ALIGN-L
a.	?uk <sub>R</sub> ][ <sub>B</sub> yak	
b.	yak <sub>B</sub> ][ <sub>R</sub> ?uk	*!

This shows that the winning candidate for Nancowry must look like the example in (10a) and not (10b).

The second constraint matches the coda of the reduplicant with the coda of the base. The constraint that has been designed to capture this relationship is R/L-ANCHOR (cf. McCarthy & Prince 1995). This is defined in (11).

- (11) R-ANCHOR  
Any element at the right edge of the base has a correspondent at the right edge of the reduplicant.

This is motivated by the observation in (7b). The constraint itself is schematically represented below in (12).

(12) Input: /yak/

	Candidates	R-ANCHOR
☞ a.	?uk <sub>2</sub> ] <sub>R</sub> , y <sub>1</sub> ak <sub>2</sub> ] <sub>B</sub>	
b.	<sub>R</sub> [y <sub>1</sub> u?, <sub>B</sub> [y <sub>1</sub> ak <sub>2</sub>	*!

( Subscripts denote corresponding segments; positioning of affixes is not illustrated.)

This shows that the winning candidate for Nancowry must look like the example in (12a) and not (12b).

The final step is to show how these constraints choose the correct candidate for Nancowry. Below we focus only on candidates which are relevant to the above constraints.

(13) Nancowry: ?ukyak 'to conceive'

Input: /yak/

	Candidates	ALIGN-L	R-ANCHOR
☞ a.	?uk <sub>R</sub> ] <sub>B</sub> yak		
b.	yak <sub>B</sub> ] <sub>R</sub> ?uk	*!	
c.	yu? <sub>R</sub> ] <sub>B</sub> yak		*!
d.	yak <sub>B</sub> ] <sub>R</sub> yu?	*!	*

In the above tableau, candidates (b) and (d) violate ALIGN-L because the reduplicant is attached to the right of the base. Candidates (c) and (d) violate R-ANCHOR because the right-edge segments are not identical. Thus, candidate (a) is the winner because it doesn't violate any of the constraints. Because of this, we have no motivation for ranking the constraints with respect to each other.

#### 4. Koasati Reduplication

This section illustrates and discusses the patterns that appear in Koasati reduplication. This pattern of reduplication, known as punctual reduplication (Kimball 1991), is used to indicate plurality of the subject in stative verbs and to indicate repetition of the action in active verbs. We again present general observations regarding the overall reduplicative form itself, continuing to focus primarily on the identity and positioning of the reduplicant in relation to the base form.

As noted in the introduction, Koasati contains forms in which the first segment of the suffixal reduplicant matches the first segment of the base. The

matching segments are bolded and underlined in (14). The suffixes, *-pin*, *-kin*, and *-nan* indicate a citation form and denote classes of verbs.

- (14) Koasati Data
- |    |                                  |                                    |
|----|----------------------------------|------------------------------------|
| a. | <u>tahas</u> - <u>to</u> : - pin | ‘to be light in weight many times’ |
| b. | <u>lapat</u> - <u>lo</u> : - kin | ‘to be narrow many times’          |
| c. | <u>cofok</u> - <u>co</u> : - nan | ‘to be angled many times’          |
| d. | <u>copok</u> - <u>co</u> :-sin   | ‘to be a hill many times’          |
| e. | <u>limih</u> - <u>lo</u> :-kin   | ‘to be smooth many times’          |
| f. | <u>poloh</u> - <u>po</u> :-kin   | ‘to be circular many times’        |
| g. | <u>talas</u> - <u>to</u> :-ban   | ‘to be thin many times’            |
| h. | <u>tonoh</u> - <u>to</u> :-kin   | ‘to be round many times’           |

A number of patterns can be observed here. First, the vowel of the reduplicant is always [o:]. Second, the reduplicant attaches to the right edge of the base. Third, the onset of the reduplicant matches the onset of the base. These last two observations motivate the constraints below.

## 5. Analysis of Koasati Reduplication

In this section, we analyze the Koasati data within an Optimality Theoretic framework. Again we use a Generalized Alignment constraint and an Anchoring constraint, defined according to the observations made in section 3. As before, we do not motivate a particular ranking with respect to the relevant constraints because they must both be satisfied.

The first constraint to consider places the reduplicant to the right of the base. Again, this constraint is formulated according to Generalized Alignment (cf. McCarthy & Prince 1993) and is defined below.

- (15) ALIGN-R  
 Align(RED, L, Base, R)  
 The left edge of a reduplicant is aligned with the right edge of the base.

This constraint is schematized below in (16).

(16) Input: /tahas/

	Candidates	ALIGN-R
☞ a.	tahas <sub>B</sub> ][ <sub>R</sub> to:	
b.	to: <sub>R</sub> ][ <sub>B</sub> tahas	*!

This shows that the winning candidate for Koasati must look like the example in (16a) and not (16b).

The second constraint matches the onset of the reduplicant with the onset of the base. Again, an ANCHORing constraint is used (cf. M&P 1995), as defined below in (17).

(17) L-ANCHOR

Any element at the left edge of the base has a correspondent at the left edge of the reduplicant.

This is schematically represented in (18).

(18) Input: /tahas/

	Candidates	L-ANCHOR
☞ a.	<sub>R</sub> [t <sub>1</sub> o:, <sub>B</sub> [t <sub>1</sub> ahas <sub>2</sub>	
b.	<sub>R</sub> [o:s <sub>2</sub> , <sub>B</sub> [t <sub>1</sub> ahas <sub>2</sub>	*!

This shows that the winning candidate for Koasati must look like the form in (18a) and not (18b).

As in section 2, the final step is to show how these constraints choose the correct candidate for Koasati. Note that the final suffixes are not included in the following candidates because they are not relevant to the case at hand.

(19) Koasati: tahasto:pin 'to be light in weight many times'

Input: /tahas/

	Candidates	ALIGN-R	L-ANCHOR
☞ a.	tahas <sub>B</sub> ][ <sub>R</sub> to:		
b.	to: <sub>R</sub> ][ <sub>B</sub> tahas	*!	
c.	tahas <sub>B</sub> ][ <sub>R</sub> o:s		*!
d.	so: <sub>R</sub> ][ <sub>B</sub> tahas	*!	*

Candidates (b) and (d) violate ALIGN-R because the reduplicant is attached to the left of the base. Candidates (c) and (d) violate L-ANCHOR because the left-edge segments are not identical. Thus, candidate (a) is the winner because it doesn't

violate any of the constraints. As in section 2, we have no motivation for ranking the constraints with respect to each other.

## 6. Anchoring and Alignment

This next section addresses the question of whether or not we need both anchoring and alignment. As noted in the introduction, McCarthy and Prince (1995: 123) argue against the need for both, stating that “it is clear that ANCHORING should subsume Generalized Alignment; as formulated, it captures the effects of Align(MCat, E1, PCat, E2); for E1 = E2 in McCarthy and Prince (1994).” M&P provide two different, but related, definitions for capturing the base/reduplicant edge relationship. We begin with these two definition and show that they cannot account for the above data.

The first definition from which they were working is given below in (20).

- (20) ANCHORING (M&P, 1993: 63)  
 In R + B, the initial element in R is identical to the initial element in B.  
 In B + R, the final element in R is identical to the final element in B.

This stipulates that the edge of the base where the affix is attached is necessarily the same edge that has the copied segment. For example, this would mean that if a reduplicant attaches to the right edge (i.e., prefix), then the matching segments between the base and reduplicant must also be at that same right edge. However, we have seen that this is not always true (Nancowry reduplication). There is greater variability in base/reduplicant relations than this definition allows.

The second definition captures the alignment effects within a Correspondence framework. We provide the following definitions of Anchoring, based on M&P (1995):

- (21) ANCHOR-L  
 Any element at the left edge of the base has a correspondent at the left edge of the reduplicant.
- (22) ANCHOR-R  
 Any element at the right edge of the base has a correspondent at the right edge of the reduplicant.



In (21) and (22), the definitions given do not overtly spell out the edge relationship between the placement of the reduplicant and the edge-matched segments as in (20) above. However, given the quote in the introduction to this section, it is clear that M&P are assuming this relationship. Therefore, in order to satisfy ANCHOR-L/R, the reduplicant must not only match the base at the L/R edge, but must be attached there as well.

To illustrate the ineffectualness of these definitions with respect to our data, consider the tableaux (23) and (24) which evaluate the same candidates as in (13) and (19) above. Note that we do not include ALIGN- $\{R, L\}$  in these tableaux because according to M&P (1995:123), ANCHOR-L and ANCHOR-R alone should be able to choose the correct optimal forms based on their respective rankings. We are using  $\textcircled{B}$  to represent a candidate that is chosen as optimal but is not the correct surface form; the true optimal form is still marked with  $\textcircled{A}$ .

- (23) Nancowry  
Input: /yak/

	Candidates	ANCHOR-R	ANCHOR-L
$\textcircled{A}$ a.	?uk <sub>R</sub> ][ <sub>B</sub> yak		*!
$\textcircled{B}$ b.	yak <sub>B</sub> ][ <sub>R</sub> ?uk		
$\textcircled{B}$ c.	x yu? <sub>R</sub> ][ <sub>B</sub> yak		
d.	yak <sub>B</sub> ][ <sub>R</sub> yu?	*!	

In tableau (23), candidate (d) is eliminated because it violates ANCHOR-R, i.e., the reduplicant is attached to the wrong (non-corresponding) edge of the base. Candidate (a) (the actual surface form) is eliminated because it violates ANCHOR-L, i.e., the reduplicant is copying the wrong edge of the base in relation to where it's attaching to the base. Candidates (b) and (c) do not violate either constraint, tying as the optimal candidates. For this case, M&P's Anchoring constraints do not work, choosing anything but the correct candidate.

The same holds true for Koasati, as shown in (24).

- (24) Koasati  
Input: /tahas/

	Candidates	ANCHOR-L	ANCHOR-R
$\textcircled{A}$ a.	tahas <sub>B</sub> ][ <sub>R</sub> to:		*!
$\textcircled{B}$ b.	to: <sub>R</sub> ][ <sub>B</sub> tahas		
$\textcircled{B}$ c.	tahas <sub>B</sub> ][ <sub>R</sub> o:s		
d.	o:s <sub>R</sub> ][ <sub>B</sub> tahas	*!	

In (24), we get the same result as in (23). Candidate (a) and (d) are eliminated because the reduplicant is attaching to the wrong edge in relation to the base/reduplicant edges where the segments correspond. Candidates (b) and (c) are the chosen, tied forms, but neither one is the actual surface form (candidate (a)). Thus, these definitions of Anchoring (21, 22) choose the incorrect forms as optimal.

In order to get the right candidate as optimal, it would be necessary to posit a higher ranked constraint, such as RED=AFX ('The reduplicant is a prefix'). However, this would be a stipulation, analogous to the one found in M&P's original definition of Anchoring. On the other hand, Generalized Alignment has been used to position affixes in general (see M&P 1994). Since reduplication is a form of affixation, we conclude that it is more consistent and economical to use Alignment in these cases, rather than stipulating a reduplicative-specific constraint. Thus, this means that Alignment must be conceptualized and implemented separately from Anchoring.

Finally, we provide further evidence for the separation of Alignment from Anchoring by testing our analysis with a language that has base/reduplicant correspondence between both edges, yet attaches to only one edge. This case arises in Semai, a Mon-Khmer language (Diffloth, 1976). In Semai reduplication, both the coda and the onset of the reduplicant match the coda and the onset of the base, as in (25).

(25)	dŋɔh	<b><u>dh</u>-dŋɔh</b>	'appearance of nodding constantly'
	cʔɛ:t	<b><u>ct</u>-cʔɛ:t</b>	'sweet'
	cfa:l	<b><u>cl</u>-cfa:l</b>	'appearance of flickering red object'
	bʔəl	<b><u>bl</u>-bʔəl</b>	'painful embarrassment'
	ghu:p	<b><u>gp</u>-ghu:p</b>	'irritation on skin (e.g. from bamboo hair)'
	taʔəh	<b><u>th</u>-taʔəh</b>	'appearance of large stomach constantly bulging out'

Note that this also shows that the reduplicant is prefixal. To account for this pattern, we use an analysis parallel to those given above for Nancowry and Koasati. The relevant constraints are the following: ALIGN-L for a prefixal reduplicant, L-ANCHOR for corresponding left edges and R-ANCHOR for corresponding right edges. This is shown below in (26).

## (26) L-ANCHOR, R-ANCHOR

Input: / c?ɛ:t/

	Candidates	ALIGN-L	L-ANCHOR	R-ANCHOR
☞ a.	ct <sub>R</sub> ][ <sub>B</sub> c?ɛ:t			
b.	c?ɛ:t <sub>B</sub> ][ <sub>R</sub> ct	*!		
c.	c? <sub>R</sub> ][ <sub>B</sub> c?ɛt			*!
d.	?t <sub>R</sub> ][ <sub>B</sub> c?ɛt		*!	

In the above tableau, candidate (b) violates ALIGN-L because the reduplicant is attached to the right of the base. Candidate (c) violates R-ANCHOR because the right-edge segments are not identical. Candidate (d) violates L-ANCHOR because the left-edge segments are not identical. Thus, candidate (a) is the winner because it satisfies all of the given constraints. Note again that we have no motivation for ranking the constraints with respect to each other<sup>1</sup>.

## 7. Conclusion

In this paper, we have shown that conceptions of Anchoring that subsume Generalized Alignment (21-22) cannot choose the correct forms for Nancowry, Koasati, and Semai reduplication. By keeping Alignment and ANCHORing as mutually distinct constraints, we achieve the following. First, both reduplicant placement and segment matching in Nancowry and Koasati reduplication are straightforwardly accounted for by our analysis. Second, it is not necessary to create ‘exceptional’ constraints, i.e., RED=PFX, to incorporate the phenomena shown above. Third, this analysis can be extended to other types of reduplication, such as Semai. In sum, we can account for reduplication patterns that previous analyses ignored/overlooked.

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<sup>1</sup> The reduplicants in (31c & d) include a glottal in order to maintain a two-segment reduplicant, consistent with the rest of the candidate set.

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# Sequential Grounding and Consonant-Vowel Interaction\*

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## 1. Introduction

Interactions between consonants and vowels are common cross-linguistic phenomena (e.g. Japanese palatalization (Shibatani 1990), Acadian French palatalization and coronalization (Hume 1992)). If the surface form of a consonant changes to another surface form by the influence of the neighboring vowel, there must be a significant relation between the two consonants which alternate with each other.

Kiowa has alternation of consonants [d] and [g] due to the interaction with a following vowel based on its quality.

In this paper, Kiowa [d]-[g] alternation is analyzed in the framework of Optimality Theory (McCarthy and Prince 1993, Prince and Smolensky 1993) and based on the notion of Sequential Grounding (Suzuki 1995), which is developed from Grounded Phonology (Archangeli and Pulleyblank 1994). In accounting for the Kiowa consonant alternation, I propose that Sequential Grounding must be realized as implicational. This paper contributes to the phonological theory proving that Grounded Phonology can be utilized as universal constraints in Optimality Theory.

In this paper, I focus on data from Kiowa (Watkins 1984), in which the [d]-[g] consonant alternation is influenced by the quality of an adjacent vowel. I argue that Sequential Grounding (SG), proposed by Suzuki (1995), accounts for the interaction between a consonant and an adjacent vowel. I propose that SG must be realized as implicational. Also, I show that SG is easily represented in Optimality Theory (McCarthy and Prince 1993, Prince and Smolensky 1993).

## 2. Kiowa Sound Inventories

Kiowa is a Tanoan language spoken in southwestern Oklahoma. In this section, vowel and consonant inventories are given as background to the discussion in the following sections.

### 2.1. Kiowa Vowel Inventory

The vowel inventory in Kiowa is shown in (1) below. There are six basic vowels. At each of the three heights, there is a front/back pair.<sup>1</sup>

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## (1) Kiowa Vowel Inventory

	Front	Back
High	i	u
Mid	e	o
Low	a	ɔ

## 2.2. Kiowa Consonant inventory

The consonant inventory is shown in (2) below. The alternation discussed in this paper involves the segments in the shaded boxes: [d] vs. [g], and [t] vs. [k].

## (2) Kiowa Consonant Inventory

	Labial		Dental		Alveolar		Palatal		Velar		Laryngeal	
	-vc	+vc	-vc	+vc	-vc	+vc	-vc	+vc	-vc	+vc	-vc	+vc
Stop <sup>2</sup>	p	b	t	d					k	g	ʔ	
Affricate					t							
Fricatives					s	z					h	
Nasal		m		n								
Liquid				l								
Glide								y				

The data analyzed in this paper is introduced in the following section.

## 3. Data

In this section, the sound alternation between [d] and [g] in Kiowa is introduced. The alternation between voiceless consonants [t] and [k] is found in only one case in Watkins (1984). Although I focus on the voiced segments for the analysis, it also accounts for alternations in the voiceless consonants.

## 3.1. [d]-[g] alternation in Kiowa

In Kiowa, velar [g] is coronalized to dental [d] when it is followed by [e]. In the same way, the dental [d] is velarized before [i]. As shown in the data (3) below, both [d] and [g] can occur when followed by [ɔ]. This shows that [d] and [g] are not allophones because the environment in the perfective overlaps. The perfectives have either [d] or [g] depending on the ideosyncratic stem form. However, in imperfective hearsay (ipf/hsy), the second consonants in any words are always [d] followed by the vowel [e]. Also, imperfective imperatives

<sup>1</sup> In addition to the vowels shown in the data, each of the six vowels has a nasal counterpart. There are also diphthongs. Furthermore, Kiowa is a tone language, but I do not discuss tone in this work, since it is irrelevant to the consonant alternation.

<sup>2</sup> There are also dental and velar ejective and aspirated stops. In this paper, I discuss only alternations involving the plain stops.

(ipf/imp) always have [g] for the second consonant followed by the suffix [i]. Other combinations such as [di] and [ge] do not appear.

(3)	<u>perfective</u>	<u>ipf/hearsay</u>	<u>ipf/imperative</u>	<u>gloss.</u>	
a.	magɔ	made	magi	'feed'	*mage
b.	hadɔ	hade	hagi	'shout'	*hadi
c.	sɔdɔ	sɔde	sɔgi	'lower/tr'	*sɔdi

(Watkins 1984)

### 3.2. Feature Matrices

The significant features in terms of the Grounding condition in vowels are shown in figure (4). The shaded vowels are not considered in this paper since they play no role in consonant alternation. The vowels [e] and [i] share the feature [front]. The vowel [i] has additional feature [high]. The vowel [ɔ] has the additional feature [low].

#### (4) Vowel Feature Matrix

a	e	i	ɔ	o	u
+lo		+hi			+hi
			+lo		
	+fr	+fr			

The figure (5) below only shows the significant features of consonants discussed in this paper. All four share the same feature [-cont]. [t] and [d] are [+cor], and [k] and [g] are [+dorsal]. Voicing difference is indicated by the feature [+voice]. The relevance will be discussed later.

#### (5) Consonant Feature Matrix

t	d	k	g
	+vc		+vc
+cor	+cor		
		+dor	+dor
-cont	-cont	-cont	-cont

Having introduced the data, the analysis of the consonant alternation in Kiowa is presented in the following sections.

## 4. Sequential Grounding

In this section, the consonant-vowel interaction is explained by Sequential Grounding, developed by Suzuki (1995) based on Grounded phonology (Archangeli and Pulleyblank 1994). In this section, the analysis of the consonant-vowel interaction is discussed.

#### 4.1. Consonant-Vowel Interaction

The two consonants [g] and [d] share the several features: [+voice], [-cont], etc. The difference is in their place of articulation; either [coronal] or [dorsal]. The two share the same surface form when they are followed by [i] or [e]. The selection of the surface representation between the two is always [g] when it is followed by [i] and [d] when followed by [e]. Sagey (1986: in Hume 1992) claims that coronals and dorsals are close to each other and an alternation between them is not a surprising phenomenon. I follow Sagey, and assume that the features coronal and dorsal are unstable or unspecified, and the surface form of a consonant changes under the influence of a strong feature of the following vowel. A strong feature is defined in this paper as a feature of a segment which motivates the alternation of a feature of a neighboring segment. In Kiowa, a high vowel is preceded by a dorsal [g], and a mid front vowel [e] is preceded by a coronal [d]. The feature in [coronal] or [dorsal] is not specified, but the vowels [i] and [e] carry a strong feature which determines the surface form of the preceding consonant. In addition, the [d] vs. [g] before [ɔ] is ideosyncratic.

In the following sections, I analyze the relationship between [d] and [e], and [g] and [i]

#### 4.2. Sequential Grounding

Sequential Grounding (Suzuki 1995) claims that grounding conditions apply to the conditions on sound alternation in sequences. The Kiowa sound alternation outlined above is analyzed in terms of Sequential Grounding. The analyses of the two conditions ([gi] sequence and [de] sequence) are presented separately.

##### 4.2.1. 1DOR...HI: [g] Before [i]

When a [-cont] consonant either [d] or [g] is followed by a high front vowel [i], the consonant always surfaces as [g]. The feature shared by both [g] and [i] is [+high]<sup>3</sup>. When the consonant [g] is followed by [i], the [+high] of the vowel agrees with that of the consonant, and the surface form of the consonant does not change. On the other hand, when the consonant [d] is followed by [i], then the sequence can not hold as [di], because [d] is not [+high] and the agreement on the feature [+high] cannot be established. For this reason, [d] is dorsalized to [g]. When [d] receives [+high] from the following vowel [i], the segment which was originally [d] changes to [g] the form which possesses the feature [+high]. Therefore, [d] alternates with [g] followed by [i], and [g] stays the same in the environment. The consonant alternation is determined due to the vowel feature. Hence the vowel feature is strong in terms of consonant alternation. This phenomenon is determined by the Sequential Grounding constraint below:

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<sup>3</sup> See Akmajian et. al. 1990



- (6) DOR...HI: a dorsal consonant must precede a high vowel, and a high vowel must follow a dorsal consonant (to be modified).

This constraint claims that Sequential Grounding is bi-directional. That is, as long as the two segments are in the right order, the directionality does not matter. From this constraint, the sequence of [gi] does not violate this constraint, but the sequence [ge] does.

#### 4.2.2. COR...FR: [d] before [e]

Hume (1992) claims that front and coronal features are similar in quality. Coronal place implies the feature [+front] is embedded in a coronal segment. When the coronal consonant [d] precedes the front vowel [e], the consonant does not change its surface form, but when [g] precedes [e], it is coronalized to [d]. The next Sequential Grounding constraint is as follows:

- (7) COR...FR: a coronal consonant must precede a front vowel and a front vowel must follow a coronal consonant (to be modified).

The sequence [de] does not violate this constraint. Sequential Grounding explains the occurrence of the segments in sequence. A high vowel prefers to be preceded by a dorsal consonant, and a front vowel prefers to be followed by a coronal consonant.

### 5. Optimality Theoretical Analysis

In this section, the conditions given above are treated as OT constraints. The sound alternation in terms of the consonant-vowel interaction is accounted for by Sequential Grounding within the OT framework. Also, the Sequential Grounding constraints are interpreted in a different manner in this section. I call this new interpretation *Implicational Sequential Grounding*. The following sections show the analysis in order.

#### 5.1. Optimality Theory

Optimality Theory is developed by McCarthy and Prince (1993), and Prince and Smolensky (1993). This theory assumes that Universal Grammar includes a set of constraints, and these constraints and their rankings are responsible for language specific phonological phenomena. Within OT, the problem raised in the previous sections can be easily solved.

#### 5.2. Sound Alternation

First of all, I introduce a constraint from the IDENT family<sup>4</sup>. An IDENT constraint requires the identical features in both input and output. This is because the sound alternation in a sequence of [-cont] plus the vowels [i] and [e] occurs only for consonants, but not for following vowels. The vowels influence the consonant alternation, but they will not change their own surface form. If such vowel alternation occurs, it is a violation of IDENT[-cons].

- (8) IDENT[-cons]: any [-consonantal] segment in the input must have identical features in the output

The tableau in (9) illustrates the role of this constraint. Candidates (b) [ge] and (d) [de] which have vowels which are not identical to the vowel in the input are ruled out. The two candidates (a) [gi] and (c) [di] are tied.

- (9) Input: /gi/<sup>5</sup>

	Candidates	ID[-cons]
☞ (a)	gi	
(b)	ge	*!
⊗ (c)	di	
(d)	de	*!

The solution for the selection of the optimal candidate is shown next. The Sequential Grounding constraint, DOR...HI (section 3.1.1), helps the selection of the optimal candidate [gi]. The tableaux (10) - (13) below show the evaluation of the [d] - [g] alternation.

Candidate (a) [gi] and (c) [di] were tied in Tableau (9). They are no longer tied in tableau (10) and the correct candidate (a) is selected. Candidate (c) [di] violates the constraint DOR...HI. The correct candidate (a) [gi] satisfies the constraint. Only DOR...HI is crucial for the selection, and COR...FR should be lower ranked.

- (10) Input: /gi/

		ID[-cns]	DOR...HI	COR...FR
☞ (a)	gi			*
(b)	ge	*!	*	*
(c)	di		*!	
(d)	de	*!		

In Tableau (11) below, the input is /di/, but the correct candidate (a) [gi] is selected because (b) [ge] and (d) [de] violate the constraint IDENT[-cons], and candidate (c) [di] violates the constraint DOR...HI. The correct candidate [gi] violates COR...FR, but this is dominated by the other two constraints, so the violation is not significant.

<sup>4</sup> IDENT constraints are introduced in McCarthy (1995). The IDENT constraint in this paper departs slightly from the original IDENT in McCarthy (1995).

<sup>5</sup> I use only the significant part of the word: the last CV structure.

(11) Input: /di/

	Candidates	ID[-cns]	DOR...HI	COR...FR
☞ (a)	gi			*
(b)	ge	*!	*	*
(c)	di		*!	
(d)	de	*!		

In Tableaux (12) and (13), the input has the vowel [e] following the consonant. In Tableau (12), candidate (a) [gi] and (c) [di] violates IDENT[-cns] and they are ruled out. Candidate [ge] violates DOR...HI, and is also ruled out. The last candidate (d) [de] does not violate any constraint, and is selected as optimal.

(12) Input: /ge/

	Candidates	ID[-cns]	DOR...HI	COR...FR
(a)	gi	*!		*
(b)	ge		*!	*
(c)	di	*!	*	
☞ (d)	de			

In Tableau (13), candidate [de] is selected in the same way as Tableau (12).

(13) Input: /de/

	Candidates	ID[-cns]	DOR...HI	COR...FR
(a)	gi	*!		*
(b)	ge		*!	*
(c)	di	*!	*	
☞ (d)	de			

Since the Sequential Grounding constraint DOR..HI determines the correct candidate, the other Sequential Grounding constraint COR...FR must not be ranked higher than the other constraints because then a wrong candidate is selected. Thus, DOR...HI must dominate COR...FR. Also, the ranking of ID[-cns] and DOR...HI does not matter:

(14) IDENT[-cns], DOR...HI >> COR...FR

Recall that the two consonants, [d] and [g] do not alternate with each other when the following vowel is neither [e] nor [i]. For example, [magɔ] ‘feed’ and [hadɔ] ‘shout’ have either [d] or [g] followed by the vowel [ɔ]. These examples show that the sequences of [dɔ] and [gɔ] are ideosyncratic. The ideosyncrasy must be accounted for by the same constraints and the ranking given in (14) above. Let us look at the case which ends with a low back vowel, [ɔ]. As tableau

(15) shows, the wrong candidate (d) [dɔ] is selected by the constraint set and the ranking discussed so far. Candidates (a) [gi] and (c) [de] are ruled out by

ID[vowel]. However, the correct candidate (b) [gɔ] is ruled out because it violates the constraint DOR...HI by not being followed by a high vowel. Therefore, candidate (d) [dɔ] which only violates the lowest ranked constraint wins.

(15) Input: /gɔ/

	Candidate	ID[-cons]	DOR..HI	COR..FR
(a)	gi	*!		*
(b)	gɔ		*!	
(c)	de	*!		*
(d)	dɔ			*

This problem will be discussed in the following section.

### 5.3. Implicational Sequential Grounding

At this point, there is a difference between the interpretation of standard Grounding constraints and Sequential Grounding constraints. There is no direction indicated to a Sequential Grounding constraint. For example, the Sequential Grounding constraint, DOR...HI does not indicate the direction of influence from one to another in a sequence of segments. The current constraint DOR...HI claims that a dorsal precedes a high, and a high follows a dorsal. As long as the placement for the two is correct, the directionality of the logic does not matter. This is why the problem occurred in the tableau (15) above.

As an example, take the grounding conditions HI/ATR and ATR/HI (Archangeli and Pulleyblank 1994). Archangeli and Pulleyblank distinguish the two, HI/ATR and ATR/HI. As shown in (16a), the grounding condition requires that when the vowel is [+high], then it is also [+ATR]. Likewise, (16b) requires that when a vowel is [+ATR], then it is [+high]. In this sense, the condition is unidirectional while a Sequential Grounding constraint is bi-directional.

(16) HIGH and ATR

- a. HI/ATR: If [+high], then [+ATR], not [-ATR]
- b. ATR/HI: If [+ATR], then [+high], not [+low]

I propose that the directionality of the implication is crucial to Sequential Grounding. I call it *Implicational Sequential Grounding*. As opposed to the bi-directional Sequential Grounding shown in (6) and (7), Implicational Sequential Grounding is unidirectional. The notation of the Implicational Sequential Grounding is introduced as follows. I separate F...G into F./G and F.\G. The notation of Implicational Sequential Grounding is shown in (17) below. Notation (17a) represents directionality from left to right, and (17b) from right to left.

- (17) DOR..HI:  
 a) DOR../HI: If [+dor] precedes a vowel, then the vowel is [+high].  
 b) DOR.\.HI: If [+high] follows a consonant, then the consonant is [+dor].

The interpretation I select for this language is (17b): the second of two segments carries the strong feature and influences the sequence representation of the preceding segment. A vowel in the data doesn't change its feature at all, because the vowel is the segment that influences the alternation of the preceding consonant. Hence, the feature of the following vowel implies the feature of the preceding consonant. For example, if there is a [+high] vowel following [g] or [d], it must chose [g] as its precedent. The Implicational Sequential Grounding DOR../HI in (17a), on the other hand, does not support the evaluation of the optimal candidate. As shown in (18) below, DOR../HI rules out the correct candidate [gɔ] for not having a High vowel following the dorsal [g]. As a result, the wrong candidate [dɔ] wins. Therefore, the DOR../HI constraint in (7a) is not crucial in this paper.

(18)

	/gɔ/	DOR../HI
Ⓢ	gɔ	*!
	dɔ	

Likewise, I use the directional interpretation of COR..FR presented in (8b). This is shown in (19):

- (19) :  
 c) COR../FR: If [+cor] precedes a vowel, then vowel is [+front], not [-front].  
 b) COR.\.FR: If [+front] follows a consonant, the consonant is [+cor].

The interpretation (19b) for COR..FR is significant, and this is used in this paper. With this constraint COR.\.FR, the result from the tableau (15) is now differently evaluated:

(20)

	/gɔ/	ID[-cons]	DOR.\.HI	COR.\.FR
	gi	*!		*
Ⓢ	gɔ			
	de	*!		
Ⓢ	dɔ			

In Tableau (20), the correct candidate, which was violated in the previous tableau (15), does not violate the Implicational Sequential Grounding constraint DOR.\.HI. There is no [+high] vowel in [gɔ], so it vacuously satisfies this

constraint. As a result, both [gɔ] and [dɔ] win. This is fine because the two are possible surface forms in Kiowa.

The next step is to test the correspondence of the consonants [g] and [d] between the input and output. The consonant that precedes the vowel [ɔ] in the input must be identical to that of the output. The constraint ranked next is as shown below:

- (21) IDENT[cons]: features on a consonant segment in the input must be identical in the output.

In Tableau (22), Candidate [dɔ] violates ID[cons] twice by having [coronal] and lacking [dorsal]. Therefore, the correct candidate wins. This explains why [g] and [d] stays the same when they precede the vowel [ɔ].

(22)

	/gɔ/	ID[cons]
☞	gɔ	
	dɔ	*!*

The specific directional interpretation of the Implicational Sequential Grounding constraint and the addition of the ID[cons] must not affect the evaluation of the alternants [g] and [d] when followed by the appropriate vowel. As the tableaux below show, this is not a problem for the evaluation of the correct candidate as regards the sound alternation involving the sound [i]. In Tableau (23) below, the evaluation is determined by the constraints which are ranked higher than the ID[cons] constraint; although candidate [gi] violates the ID[cons] twice, the correct candidate [gi] is still the winner.

(23)

	/di/	ID[-cons]	DOR.\.HI	COR.\.FR	ID[cons]
☞	gi			*	**
	ge	*!			**
	di		*!		
	de	*!			

Similarly, Tableau (24) shows that the addition of the ID[cons] does not affect the correct evaluation of the sound alternation involving the vowel [e]. The correct output form is selected before the ID[cons] constraint. Candidate [de] is the winner, even though ID[cons] is violated.

(24)

	/ge/	ID[-cons]	DOR.\.HI	COR.\.FR	ID[cons]
☞	gi	*!		*	
	ge			*!	
	di	*!	*		**
	de				**

As shown in (25) below, [ki] and [ni] are added to the candidate set. They do not violate the constraint ID[-cons]. Candidate [ni] is ruled out by DOR...HI. Candidate [ki] is tied at the point of the evaluation under the constraint COR.\.FR. Comparing to the input, however, candidate [ki] lacks [+cor] and [+vc], and has two non-identical features, [-voice] and [+velar]. It has four violations. Hence, the correct candidate [gi] wins.

(25)

/di/	ID[-cons]	DOR.\.HI	COR.\.FR	ID[cons]
ki			*	***!*
ni		*!		***
gi			*	**

In addition, when candidates satisfy both the Implicational Sequential Grounding constraints, they also must be ruled out by ID[cons]. In the same way in tableau (26), [te] lacks [+voice] and [+velar], and has non-identical features [-voice] and [+dental] (four violations). [ne] lacks [+stop] and [+velar], and has non-identical features [+nasal] and [+dental] (four violations). The correct candidate has only two violations (lacking [+velar] and having [+dental]).

(26)

/ge/	ID[-cons]	DOR.\.HI	COR.\.FR	ID[cons]
te				***!*
ne				***!*
de				**

With the new interpretation of Sequential Grounding as Implicational Sequential Grounding, the correct output form is selected for all cases. In Kiowa, the directionality is from right to left. The crucial ranking is ID[-cons], DOR.\.HI >> COR.\.FR >> ID[cons].

**6. Voiceless Consonants**

There is only one [t]-[k] alternation found in the grammar provided by Watkins (1984). Watkins also claims that certain sequences of consonant and vowel do not occur: \*ti, \*di, \*si, \*ke, \*ge, etc. These possible/impossible consonant-vowel sequences are shown in the figure below. It seems to be that the combination of the sequence for both voiced and voiceless consonants is restricted by the ranking of DOR.\.HI >> COR.\.FR.

- (27) sequence found: [gi] [gu] [ki] [ku] [de] [te]  
 sequence not found: [ge] [ke] [du] [tu] [di] [ti] (marked by \*)



(28)

	i	e	a	ɔ	o	u
g		*				
k		*				
d	*					*
t	*					*

Shaded columns are not subject to the analysis of Implicational Sequential Grounding condition. Voiced and voiceless dorsals and coronals behave similarly to each other. Therefore, the analysis given above must account also for voiceless dorsals and coronals.

The Implicational Sequential Grounding DOR.\HI given above predicts [gi] [gu], [ki] and [ku]. The co-occurrence restrictions on voiceless C-V sequences shown in (28) are also accounted for by the Implicational Sequential Grounding in Optimality Theory. Tableau (29) shows that although the input is [ke], the sequence [te] which is possible in Kiowa is selected over [ke] which never appears. This is because [ke] violates COR.\FR even though [te] violates ID[cons] twice.

(29)

/ke/	ID[vowel]	DOR.\HI	COR.\FR	ID[+cons]
ke			*!	
te				**

In (30) below, [gu], which is found as a sequence, wins over [du] which is not found.

(30)

/du/	ID[vowel]	DOR.\HI	COR.\FR	ID[+cons]
du		*!		
gu				**

In summary, the Implicational Sequential Grounding constraints account for the occurrence of the consonant-vowel interactions. The hierarchy of the constraints used in this analysis is as shown in the following:

(31) IDENT[vowel], DOR..HI >> COR..FR >> IDENT[+cons].

## 7. Conclusion

The significance of the Implicational Sequential Grounding constraints must be attested. Only the direction of right to left is considered in this paper. This analysis predicts that there should also be left to right implications. A language in which this can be found would add evidence for the analysis proposed here. The verification of these points is suggested for a further work.

The [d]-[g] consonant alternation in Kiowa is analyzed, and several crucial points are given in this paper. First, Sequential Grounding accounts for the interaction between adjacent consonant and vowel. DOR..HI explains that in a consonant -vowel sequence, a dorsal and a high prefer to be adjacent to each



other. COR..FR claims that a coronal and a front prefer to be adjacent to each other. Second, Sequential Grounding must be expressed as a directional implication. There are two possible directions in terms of the implication captured by Sequential Grounding. In one direction, the precedent is the first of two segments, and the second segment is the consequent of the implication (F./G). In the other possible direction, the second of two segments is the antecedent of the implication (F.\G). In Kiowa, F.\G is the significant constraint. Finally, in the OT analysis, there are four constraints which are significant for the consonant alternation in Kiowa. In conclusion, Implicational Sequential Grounding is relevant for phonological analysis in terms of consonant-vowel interaction.

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