THE CONSONANTS OF GOSIUTE

by

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As member of the Final Examination Committee, we certify that we have read the dissertation prepared by Dirk Allen Elzinga

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Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copy of the disseration to the Graduate College.

I hereby certify that I have read this disseration prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

Dissertation Director	Date

STATEMENT BY AUTHOR

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Dedication

This dissertation is dedicated to the memory of Wick Miller.

And to my wife and son for their love and patience.

> "No theory can exclude everything that is wrong, poor, or even detestable, or include everything that is right, good, or beautiful."
>
> - Arnold Schoenberg

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Abstract

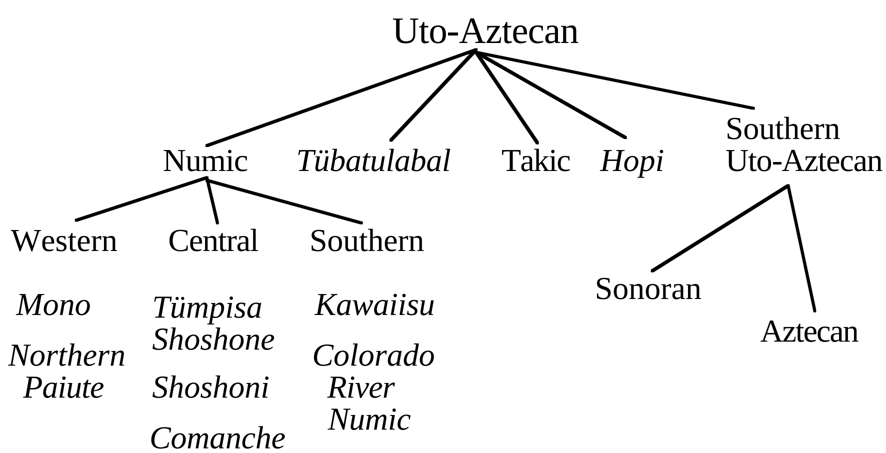
This dissertation is an analysis of the consonantal phonology of Gosiute, a member of the Numic group of Uto-Aztecan languages. The Numic languages are characterized by consonant alternations and distributional patterns which are rooted in patterns of phonetic naturalness. In this dissertation I provide an analysis of these patterns of distribution and alternation within the framework of Optimality Theory (Prince and Smolensky 1993). This dissertation accomplishes three things. First, it provides the most detailed treatment to date of the consonant system of a Numic language. Second, it demonstrates the efficacy of Grounding Theory (Archangeli and Pulleyblank 1994) in the analysis of the consonantal patterns under investigation. Third, it shows that Optimality Theory is up to the task of providing a framework for the analysis of large portions of the phonological system of a single language.

Chapter 1: Introduction

1. Gosiute as a Numic Language

The Numic languages form one of the five immediate sub-families of the large Uto-Aztecan language family (1) and comprise a far-flung group ranging from Death Valley and the lower Colorado River valley in the south and west to central Wyoming and the Southern Plains of Oklahoma and Texas in the north and east. Despite the wide area covered by Numic languages, they form a linguistically tight-knit family.

(1) Uto-Aztecan Family Tree (Miller 1983, Miller 1984)



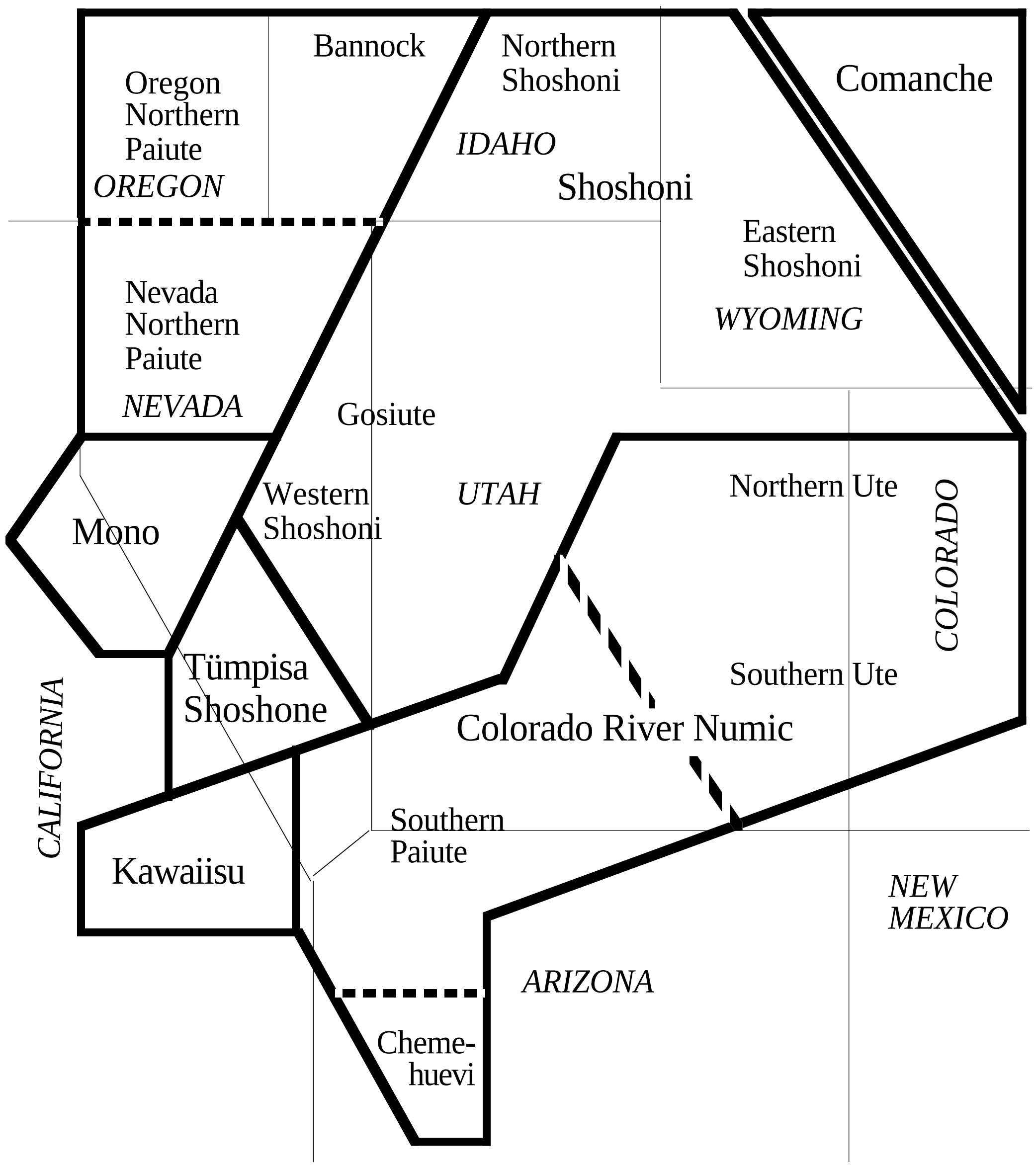
The Numic family is divided into three branches: Western Numic, Central Numic, and Southern Numic. There has been an attempt to group Central and Southern Numic together into a branch coordinate with Western Numic (Freeze and Ianucci 1979), but the interpretation of the evidence for this grouping is controversial. In this work, I will not enter into a discussion of the internal classification of Numic and assume the traditional tripartite division of Numic which is illustrated in (1).

Within each branch of Numic there is a basic division between a "core" and a "periphery" language (Lamb 1958: the terms "core" and "periphery" are mine). The core Western Numic language is Mono, the core Central Numic language is Tümpisa Shoshone (Panamint), and the core Southern Numic language is Kawaiisu. The core languages occupy a much more restricted area and display greater internal dialect diversity than do the periphery languages. Furthermore, the dialects of the periphery languages that are closest to the core show greater internal diversity than the dialects located farther away; dialect boundaries become increasingly difficult to determine the farther one goes from the core. The clearest boundary in the periphery languages is found in Central Numic between Shoshoni and Comanche. This is due to a mounted migration of one or several bands of Eastern Shoshoni speakers to the Southern Plains in the early 1700s, which effectively removed them from contact with their former Shoshoni neighbors (Shimkin 1986).

The relative positions of the Numic languages are shown in (2). The language names are given in a larger typeface, with important dialects noted in smaller type. I have labelled the Southern Numic periphery language in (1) and (2) *Colorado River Numic*; I use this term to avoid cumbersome circumlocutions like "Chemehuevi-Ute" (Kroeber 1907, Lamb 1958) or to avoid applying to the whole branch misleading and potentially offensive labels such as "Ute" (Lamb 1958, Miller 1983). Following Dayley (1989) I have also labelled the Central Numic core language in (1) and (2) *Tümpisa Shoshone* rather than Panamint.[1]

[1]The spelling "Timbisha" is the spelling used by speakers; Dayley (1989) spells this "Tümpisa."

(2) Relative locations of the Numic languages (based on Nichols 1974: 9; the political boundaries are not to scale)



2. Consonant Alternations and Numic "Final Features"

The Numic languages, especially Southern Paiute, have been a source of great theoretical interest for phonologists (see for example Sapir 1949, Harms 1966, Chomsky and Halle 1968 (pp 345-51), Miller 1982, McLaughlin 1984, Suzuki 1995). This is due in large part to consonant gradation which is present to some degree in every Numic language. Data such as that in (3) from Gosiute illustrate a typical Numic gradation pattern; the initial consonant of the suffix -pai 'have NOUN' has four different alternants—voiced stop preceded by a homorganic nasal (3a), geminate voiceless stop (3b), voiceless fricative (3c), and voiced fricative (3d)—depending on the noun stem to which it is attached.[2]

(3)	a.	'bead'	[tθoː]
		'have beads'	[tθoːmbai]
	b.	'pine nut'	[tɨβa]
		'have pine nuts'	[tɨβappai]
	c.	'money'	[moni]
		'have money'	[moniɸai]
	d.	'house'	[kahr̃i]
		'have a house'	[kahr̃iβai]

There are similar series of alternations for nasal-initial suffixes. The initial consonant of the suffix -mai 'with' has different alternants—geminate nasal (4a, b), cluster of [h]+nasalized glide (4c), or voiced nasalized glide (4d)—again, depending on the stem to which it is attached.

(4)	a.	'bead'	[tθoː]
		'with the bead'	[tθoːmmai]
	b.	'pine nut'	[tɨβa]
		'with the pine nut'	[tɨβammai]
	c.	'mouse'	[ponai]
		'with mouse'	[ponaihw̃ai]
	d.	'house'	[kahr̃i]
		'with the house'	[kahr̃iw̃ai]

---

[2] I make use of the following conventions in transcribing Gosiute: [t̪θ], [t̪t̪θ], and [d̪ð] are interdental affricates, and [tš], [ttš], and [dž] are palato-alveolar affricates; long vowels are written [Vː] while heterosyllabic sequences of identical vowels are written [VV]. Vowel clusters in which [i] is the second member are tautosyllabic (e.g. [ɨi], [ui], [oi], [ai]), while all other vowel clusters are heterosyllabic.

The alternations shown in (3) and (4) are quite regular, and provide the basis for distinguishing four lexical classes of noun stems. The first group of stems is followed by a nasal-voiced stop cluster or a geminate nasal (3a, 4a) and are referred to as *Nasalizing* stems. The second group is followed by a geminate, either oral or nasal (3b, 4b), and they are referred to as *Geminating* stems. The third group is followed by a voiceless fricative or partially voiceless nasalized continuant (3c, 4c) and are referred to as *Aspirating* stems. Finally, the fourth group is followed by a voiced fricative or nasalized continuant (3d, 4d); this group is the most numerous and are referred to as *Spirantizing* stems. The effect of a stem on a following consonant is called the *final feature* of that stem.[3] The terms 'Nasalizing', 'Geminating', and 'Spirantizing' were introduced in Sapir (1930: 62); the term 'Aspirating' was coined by Wick Miller.[4]

The same range of consonants and clusters found at morpheme boundaries is also found morpheme-internally. This is illustrated in (5).

(5)	a.	'wild carrot'	[yamba]
		'brown'	[ondɨ]
	b.	'father'	[appɨ]
		'snow'	[takka]
	c.	'pine cone hook'	[exo]
		'five'	[naːɸaiθɨ̥]
	d.	'sun'	[taβe]
		'grandmother (MoMo)'	[kaɣu]
	e.	'jackrabbit'	[kammu]
		'aspen'	[sɨnnaβi]
	f.	'husband'	[kuhw̃a]
		'house'	[kahr̃i]
	g.	'tooth'	[taw̃a]
		'mouse'	[por̃ai]

[3]The term "final feature" was first used in Nichols (1974: 13) and has since become a standard term in Numic literature. Note that the use of the word 'feature' in this term is non-theoretical and does not presuppose an analysis based on distinctive feature theory.

[4]In this dissertation I will capitalize the terms referring to Numic final features (i.e., Nasalizing, Geminating, Aspirating) in order to distinguish them from more general phonetic and phonological processes which occur in the world's languages.

(5a) illustrates morpheme-internal nasal-voiced stop clusters, analogous to Nasalization; (5b,e) illustrate morpheme-internal geminate stops and nasals, analogous to Gemination; (5c,f) illustrate morpheme-internal voiceless fricatives and partially voiceless nasalized continuants, analogous to Aspiration; and (5d,g) illustrate morpheme-internal voiced fricatives and nasalized continuants, analogous to Spirantization. A table summarizing the Gosiute consonant series is given in (6); alternants in parentheses occur following a front vowel [i] or [e]. In this table, I also include the continuants [s, h, y, w]; however, these segments do not participate in the alternations discussed in (3-5).

(6) Gosiute consonant series

	Initial	Nasalized	Geminated	Aspirated	Spirantized
Labial	p- m-	-mb- -mm-	-pp- -mm-	-ɸ- -hw̃-	-β- -w̃-
Dental	tθ-	-n̪d̪ð- (-ñdž-)	-t̪t̪θ- (-ttš-)	-θ- (-š-)	-ð- (-ž-)
Alveolar	t- n- s-	-nd- (-n̪d̪-) -nn- -s-	-tt- (-t̪t̪-) -nn- -s-	-θ̠- (-θ-) -hɾ̠̃- (-hỹ-) -s-	-ɾ- (-ð-) -ɾ̃- (-ỹ-) -s-
Palatal	y-	-y-	-y-	-y-	-y-
Velar	k-	-ŋg-	-kk-	-x-	-ɣ-
Labio-velar	k^w- w-	-ŋg^w- -w-	-kk^w- -w-	-x^w- -w-	-$ɣ^w$- -w-
Glottal	h-	-h-	-h-	-h-	-h-

This dissertation is an extended analysis of the table presented in (6).

3. Theoretical Assumptions

In this section, I lay out the theoretical assumptions I am making in this dissertation. In section 3.1, I provide a short introduction to Optimality Theory. In 3.2, I discuss the

Grounding Hypothesis (Archangeli and Pulleyblank 1994) and an extension of it, Positional Grounding.

3.1. Optimality Theory

Optimality Theory (see Prince and Smolensky 1993, McCarthy and Prince 1993a, McCarthy and Prince 1995, among others) arose from the observation that many generalizations in phonology can take the form of constraints on a surface string. This view was first articulated in generative phonology in Kisseberth (1970), where it was noted that rules of formally different types may conspire to produce surface strings with similar phonotactic properties. He introduces *derivational constraints* to capture the phonotactic properties which rules conspire to produce, and which prevent a derivation from yielding an illicit surface string.

Optimality Theory elevates this notion of 'constraint' from a meta-grammatical device which evaluates possible derivations to an active component of the grammar proper. Optimality Theory takes the notions of constraint satisfaction and well-formedness as central concerns. The form which an Optimality Theoretic grammar takes can be described as the composition of two functions, Gen and Eval, shown in (10).

(10) Gen(input) $\rightarrow$ {cand_1, cand_2, … }
Eval({cand_1, cand_2, … }) $\rightarrow$ ouput

Gen supplies a set of analyses of an input in the form of candidate outputs; in doing so, it may modify the input in building the candidate set by inserting, deleting, permuting, or changing segments and features and by providing or altering prosodic structure. Eval rates the well-formedness of each member of the candidate set thus produced by means of a set of constraints, each of which is ideally a true statement describing the output. Constraints are generally of three kinds: Faithfulness Constraints, which demand identity between underlying and surface forms; Markedness Constraints, which constrain surface forms based on considerations of phonetic and phonological plausibility; and Structural Constraints, which govern the arrangement of linguistic constituents.

In typical cases, the output will actually violate one or more constraints. By ranking these constraints with respect to each other, distinctions of *relative* well-formedness can be made. That candidate which best satisfies the most highly ranked constraints, even at the expense of violating lower ranked ones, will be favored over other candidates. This is illustrated schematically in (11).

(11) A » B

	/input/	A	B
a. ☞	$cand_1$		*
b.	$cand_2$	*!	

In this tableau, the constraints A and B are listed in ranked order from left to right across the top. This ranking is also expressed by the statement 'A » B'. The candidate outputs are listed in a column, with the sign '☞' indicating the candidate which is judged by Eval as optimal. An asterisk in a cell indicates a violation of the constraint by the candidate in that row and an exclamation point indicates a fatal violation, one which excludes a candidate from further consideration. Shaded cells in the tableau indicate that whether a candidate satisfies or violates a constraint is no longer relevant to the outcome of Eval and the selection of the optimal candidate.

3.2. Grounding

Archangeli and Pulleyblank (1994) contains several important proposals concerning the cooccurrence of features and the structure of segments. Perhaps the most important proposal is the Grounding Hypothesis itself, for which the book is named. This, in brief, is the idea that statements governing the cooccurrence of features in segments must be phonetically motivated. In formalizing this notion, they define the domain of cooccurrence statements as a *path*. Informally, a path is a set of associated nodes, features, or prosodic categories such that no more than one token of any node, feature, or prosodic category is included in the set (Archangeli and Pulleyblank 1994: 21, 50). They define cooccurrence statements as *path conditions*; a path condition is an implicational statement which determines whether paths between features are well formed or ill formed (Archangeli and Pulleyblank 1994: 169). Path conditions which express phonetically motivated feature cooccurrence statements are called *grounding conditions* (12).

(12) Grounding Conditions (Archangeli and Pulleyblank 1994: 177)

I. Path conditions invoked by languages must be phonetically motivated.
II. The stronger the motivation for a path condition Φ,
  a. the greater the likelihood of invoking Φ,
  b. the greater the likelihood of assigning a wide scope to Φ within a grammar,
  and vice versa.

Common grounding conditions which are introduced and explored by Archangeli and Pulleyblank (1994) include the following:

(13) a. HI/ATR: If [+high], then [+ATR]; if [+high], then not [–ATR].
  b. LO/ATR: If [+low], then [–ATR]; if [+low], then not [+ATR].

Each of these statements expresses not only a positive requirement but also a prohibition on the cooccurrence of features.

In this dissertation, I introduce grounding conditions in my analysis of the distributional and alternation patterns of Gosiute consonants. Such conditions include those in (14) below; motivation for these conditions will be presented as they appear in the analyses which follow.

(14) Some grounding conditions used in this dissertation

OBS/VOI: If [–sonorant] then [–voice]; if [–sonorant] then not [+voice].
SG/VOI: If [+spread glottis] then [–voice]; if [+spread glottis] then not [+voice].
NAS/CONT: If [nasal] then [–cont]; if [nasal] then not [+continuant].

Grounding conditions have been adopted into OT as constraints; as such, they are rankable and violable like any other constraint. (For work in OT which adopts grounding conditions as constraints, see Archangeli and Suzuki 1995, Pulleyblank 1994, 1997).

3.2.1. Positional Grounding

In Gosiute consonant gradation, stops are variously voiced, voiceless, continuants, or stops, depending on the position they occupy in a word or phrase. For example, stops are voiceless word-initially,

(15)	[pia]	'mother'
	[t̪θuhr̃i]	'bone'
	[tua]	'child; son'
	[kɨnu]	'grandfather (FaFa)'
	[kʷasu]	'shirt'

but medially these voiceless stops alternate with voiced fricatives,

(16)	[nɨβia]	'my mother'
	[nɨðuhr̃i]	'my bone'
	[nɨrua]	'my son'
	[nɨɣɨnu]	'my grandfather'
	[nɨɣʷasu]	'my shirt'

and following nasals, initial voiceless stops alternate with voiced stops.

(17)	[ɨmbia]	'your (2s) mother'
	[ɨn̪d̪ðuhr̃i]	'your (2s) bone'
	[ɨndua]	'your (2s) son'
	[ɨŋgɨnu]	'your (2s) grandfather'
	[ɨŋgʷasu]	'your (2s) shirt'

Westbury and Keating (1986) suggest that the position of a stop within a word or phrase is as important as its laryngeal configuration in determining the naturalness or likelihood of voicing. They maintain that intervocalic position is a fine place for stop consonant voicing, while utterance-initial or utterance-final positions are less good. Lindblom (1983) makes a similar suggestion for continuancy (in the guise of "undershoot"); that is, continuants are at home intervocalically, but less so in other positions. In other words, the alternation patterns in Gosiute conform to phonetically motivated markedness restrictions on consonants in various environments.

This kind of pattern can be captured using grounded path conditions and narrowing the scope of these conditions by including positional requirements. Assume the grounded path condition in (18).

(18) OBS/VOI: 'if [–son] then [–voice]; if [–son] then not [+voice]'.

Positional Grounding would restrict the scope of OBS/VOI based on position to yield the conditions in (19).

(19) positionally grounded conditions interacting with OBS/VOI

a. VOI: V_V: 'if intervocalic then [+voi]'
b. VOI: N_: 'if post-nasal then [+voi]' (= *NC; Pater 1996)

For the effects of a positionally grounded constraint to be apparent, the relationship between the features expressed by the more general grounded condition must be modified. In (18), the relationship between [–sonorant] and [voice] is such that [–voice] is required in case [–sonorant] is present. In the positionally grounded constraints this relationship is altered so that i) [+voice] is required when [–sonorant] is present, and ii) both features are on a path which occurs intervocalically (19a) or post-nasally (19b). Formally speaking then, positional grounding involves the local conjunction of constraints (Smolensky 1995, Zoll 1998); however, the phonetic literature shows that these kinds of positional requirements on featural cooccurrence are robust enough that they can be discussed without further decomposition into their conjoined components. The tableau in (20) illustrates how positional grounding interacts with context-free grounding; the data is taken from (17), and involves the voicing of post-nasal stops.

(20) VOI: N_ » OBS/VOI

input: /ɨn-pia/	VOI: N_	OBS/VOI
a. ☞ ɨmbia		*
b. ɨmpia	*!	

In this tableau, the positionally grounded constraint is ranked above the context-free grounded constraint. The result is that the candidate which has a voiced stop following a nasal (20a) will beat a candidate which has a voiceless stop following a nasal (20b).

Beckman (1997) argues for a type of IDENT constraint in which faithfulness is sensitive to positions like initial syllable, stressed syllable, onset, and so forth. In effect, what Positional Faithfulness does is limit the occurrence of otherwise licit features and feature combinations in certain positions by ranking an IDENT-<position>-[F] constraint above some kind of markedness constraint which is in turn ranked above a garden variety IDENT-[F] constraint.

Beckman (1997) presents an analysis of Shona vowel harmony which makes use of positional faithfulness. In Shona verbs, the mid vowels [e] and [o] are constrastive only in root-initial syllables. These vowels may appear in non-initial syllables only when preceded by a mid vowel in the first syllable of the root. In (21) the verb roots are augmented by either an applicative suffix -*ira* or the causative suffix -*isa*. When the verb root contains a mid vowel, the suffix also contains a mid vowel (21a); otherwise, the suffix contains a high vowel (21b). (The data in (21) is taken from Beckman 1997, who cites as her source Fortune 1955).

(21) Shona Height Harmony

a.	pera	'end'	per-e̲ra	'end in'
	sona	'sew'	son-e̲ra	'sew for'
	oma	'be dry'	om-e̲sa	'cause to get dry'
b.	ipa	'be evil'	ip-i̲ra	'be evil for'
	bvuma	'agree'	bvum-i̲sa	'make agree'
	vava	'itch'	vav-i̲ra	'itch at'
	pamha	'do again'	pamh-i̲sa	'make do again'

Beckman analyzes this pattern using a positional faithfulness constraint IDENT-σ_1, defined in (22).

(22) IDENT-σ_1(hi): A segment in the root-initial syllable in the output and its correspondent in the input must have identical values for the feature [high].

By ranking this constraint above the markedness constraints *MID and *HIGH, which prohibits the feature combination [–high, –low] and [+high, –low], respectively, Beckman shows that the desired restriction on mid vowels emerges logically from constraint interaction.

(23) IDENT-σ_1(hi) » *MID » *HIGH » IDENT(hi) (Beckman 1997: 18)

input: /per-ira/ / \\ [–hi,–lo][+hi,–lo]	IDENT-σ_1(hi)	*MID	*HIGH	IDENT(hi)
a. perira / \\ [–hi,–lo][+hi,–lo]		*	*!	
b. ☞ perera \\ / [–hi,–lo]		*		*
c. pirira \\/ [+hi,–lo]	*!		*	*

In the tableau in (23), three candidates are considered for the input /per-ira/ 'end in'. Candidate (23c) violates the positional faithfulness constraint IDENT-σ_1(hi) and is eliminated from the competition. Candidate (23a) violates the markedness constraint *HIGH, and is also eliminated, leaving candidate (23b) as the optimal candidate output. The effect of Positional Faithfulness is to limit the distribution of normally contrastive segments; mid vowels in Shona are contrastive, but only in the root-initial syllable.

In Gosiute, the distribution of contrastive elements is not at issue; rather, it is the distribution of non-contrastive elements which is of interest. While it would be possible to use IDENT constraints to capture the distributional properties of non-contrastive elements, this is not very insightful. If segments never contrast but are completely predictable based on their surface environments, using faithfulness costraints to capture the allophony misses important generalizations. This is especially true in Gosiute given the phonetic plausibility of the Gosiute patterns. Capturing phonetic plausibility is something that grounding conditions do well, and adding positional information to grounding conditions can capture the Gosiute distributional and alternation facts in a clear and phonetically insightful way. Faithfulness as such would play a diminished role in this kind of analysis.[5]

The rest of this section illustrates the utility of Positional Grounding by exploring the relationship between the grounded condition HI/ATR and the positionally grounded condition ATR:_C]$_\sigma$, defined below.

(24) a. HI/ATR: If [+high] then [+ATR]; if [+high] then *not* [–ATR].
b. ATR:_C]$_\sigma$: in closed syllables vowels are [–ATR].

In the following section, I discuss the neutralization of the [±ATR] distinction in mid vowels in French closed syllables. I contrast the European French example with a similar case of [ATR] neutralization in closed syllables in Canadian French, this time extended to high vowels as well as mid vowels.

3.2.2. French Mid Vowels

French mid vowels show complementary distribution; [–ATR] mid vowels occur in closed syllables, while [+ATR] mid vowels occur in open syllables; this is illustrated in (25).[6]

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[5]Please note that I am not claiming that Positional Faithfulness should be supplanted by Positional Grounding. In the discussion on nasal-stop homorganicity found in chapter 2 I make use of a Positional Faithfulness to account for the preference for preservation of onset place of articulation; see chapter 2, section 3.3 for details of nasal-stop homorganicity in Gosiute.

[6]Valdeman (1976: 57) confines this distributional pattern to a particular dialect group, the Méridional dialects, spoken in southern France. Casagrande (1984), however, does not restrict this distributional pattern to any particular dialect.

(25) Distribution of French mid vowels (Casagrande 1984: 89-90)

[selɔ̃]	'we seal'	[sɛl]	'they seal'
[sedɔ̃]	'we yield'	[sɛdʁɔ̃]	'they will yield'
[ʁeñã]	'reigning'	[ʁɛñ]	'they reign'
[tete]	'to nurse'	[tɛt]	'she nurses'
[so]	'stupid.m'	[sɔt]	'stupid.f'
[devo]	'devout.m'	[devɔt]	'devout.f'
[vø]	'wish'	[vœl]	'they want'
[pø]	's/he can'	[pœv]	'they can'
[ø]	'eggs'	[œf]	'egg'

In French, the activity of the positionally grounded condition ATR:_C]$_\sigma$ (24b) yields [-ATR] vowels in closed syllables. When this positionally grounded condition is ranked above IDENT$_{IO}$[+ATR], the complementary distribution of mid vowels follows (26).

(26) ATR:_C]$_\sigma$ » IDENT$_{IO}$[+ATR]

input: tète /tet/		ATR:_C]$_\sigma$	IDENT$_{IO}$[+ATR]
a.	tet	*!	
b. ☞	tɛt		*

Because ATR_C]$_\sigma$ outranks IDENT$_{IO}$[+ATR], any candidate which includes a [+ATR] vowel in a closed syllable will lose to a candidate which is identical except in the value for [ATR] on the vowel in the closed syllable, regardless of its input specification.

Canadian French extends the closed syllable laxing pattern of French mid vowels to high vowels; thus, high vowels also show the effects of the positionally grounded condition ATR:_C]$_\sigma$. In Canadian French, high vowels in open syllables are [+ATR] (27).

(27) [+ATR] in Canadian French high vowels (Picard 1987: 59)

[i]		[y]		[u]	
[viʁilite]	'virility'	[ʒyliɛn]	'Julienne'	[kuʁaʒ]	'courage'
[tʁavɛsti]	'travesty'	[deby]	'début'	[peʁu]	'Pérou'
[imaʒ]	'picture'	[ynivɛʁsɛl]	'universal.m'	[uvɛʁtʏʁ]	'opening'

However, high vowels in closed syllables are [–ATR] (28).

(28) [–ATR] in Canadian French high vowels (Picard 1987: 57-58)

[ɪ]		[ʏ]		[ʊ]	
[emɪl]	'Emile'	[zʏl]	'Jules'	[seʊl]	'Seoul'
[pɪp]	'pipe'	[venʏs]	'Venus'	[sʊp]	'soup'
[afrɪk]	'Africa'	[tʏb]	'tube'	[rʊt]	'route'
[bɪskɥi]	'biscuit'	[bʏltɛ̃]	'bulletin'	[bʊlvaʁ]	'boulevard'
[fɪltras]	'filtration'	[gʏstav]	'Gustave'	[gʊʁme]	'gourmet'
[mɪʃlɛ̃]	'Michelin'	[pʏʁte]	'purity'	[pʊʁsɥɪt]	'pursuit'

Thus high vowels show complementary distribution with respect to [ATR]. In open syllables, high vowels are [+ATR], while in closed syllables they are [–ATR]. The presence of [–ATR] high vowels in closed syllables is interesting in the present context because it is in direct conflict with the grounded condition HI/ATR, defined in (29).

(29) HI/ATR: if [+high] then [+ATR]; if [+high] then not [–ATR]. (Archangeli and Pulleyblank 1994: 174)

According to HI/ATR, all high vowels should be [+ATR], but this condition is violated in closed syllables. To account for the high vowel pattern in Canadian French, the positionally grounded constraint ATR_C]$_\sigma$ is ranked above the grounded constraint HI/ATR (30).

(30) ATR:_C]$_\sigma$ » HI/ATR

input: [pip] 'pipe'		ATR:_C]$_\sigma$	HI/ATR
a.	pip	*!	
b.	pɪp		*

In (30), candidate (30b) contains a [–ATR] vowel in a closed syllable and satisfies ATR_C]$_\sigma$; this candidate bests candidate (30a) which satisfies the general grounded condition HI/ATR. This is exactly the type of interaction one would expect between a positionally grounded condition and a grounded condition without positional restrictions. Notice also that this result is achieved without recourse to constraints on the identity of segments under correspondence, but is rather the result of the interaction of phonetically grounded constraints on surface forms. Identity constraints may well be present (and given the universal nature of Con, most likely are), but they play no role in the selection of the optimal candidate.

4. Overview of the Dissertation

The rest of this dissertation is organized as follows. In chapter 2 I discuss the distribution of continuancy and voicing in obstruents in Gosiute. Voiced obstruents occur intervocalically or following nasals, voiceless ones occur elsewhere. Likewise, continuants occur intervocalically while stops occur elsewhere. These simple facts, which underlie the system of Gosiute consonant gradation, are readily described and explained by positional grounding interacting with context-free grounding and faithfulness requirements.

In chapter 3 I provide an introduction to the analysis of final features in Gosiute. I discuss the distributional properties of final features and examine Gemination in some detail. I show that there are arguments for considering final features to be full segments rather than floating features or "latent segments" (Zoll 1996). The argument for Gemination consists in the featural content of the final feature itself. I propose that Gemination consists of a root node specified [+consonantal] since its effects are restricted to consonants.

In chapter 4 and 5 I give accounts of Nasalization and Aspiration in Gosiute. Like Gemination, I argue that these final features are best considered full segments rather than latent segments. The argument for segmental status of these final features comes from their interaction with the accusative suffix *-a*.

Chapter 6 is an examination of coronal alternations in Gosiute. Coronal obstruents are found in distributional patterns which depend on the presence or absence of a preceding front vowel. In the pattern I call Fronting, alveolar stops alternate with dental stops—dental stops occur following front vowels, while alveolar stops occur elsewhere. In the pattern I call Palatalization, dental affricates alternate with palato-alveolar affricates—palato-alveolar affricates occur following front vowels, while dental affricates occur elsewhere.

I argue that the change in place of articulation involved in Fronting is a result of the greater surface area of the tongue in contact with the roof of the mouth. This alternation thus reduces to an alternation between laminals and apicals, with laminals following front vowels and apicals occurring elsewhere. Palatalization, on the other hand, is a change in stridency; dental affricates are non-strident, while palato-alveolar affricates are strident. Gosiute Fronting and Palatalization can thus be seen as a two step chain shift: alveolar > dental > palato-alveolar. To capture the chain shift of the Gosiute alternations requires the Local Conjunction of constraints. Viewing the alternations in this 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 Universal Grammar.

5. Empirical and Theoretical Contributions

There are three main contributions which are made by this dissertation. First, this dissertation provides a thorough description of the consonantal system of a Numic language. While the Numic languages have been under phonologists' scrutiny since Sapir (1949), a study of this length concerning the consonantal system of a single Numic language has not been undertaken until now. This dissertation thus provides an important piece of documentation for this language family.

Second, this dissertation provides an example of the efficacy of Optimality Theory as an analytical framework in the investigation of a single language. Much of the work currently undertaken in Optimality Theory is typological in nature. While this typological work is of tremendous value, it is also important to demonstrate that Optimality Theory is up to the task of a more detailed examination of the phonological phenomena of a single language; in this respect, this dissertation follows the lead of McCarthy and Prince (1993), which provides a survey of prosodic phenomena in Axininca Campa.

Third, the Gosiute language provides an ideal proving ground for the Grounding Hypothesis, since much of the phonology of Gosiute is driven by phonetic considerations. This has important implications within Optimality Theory concerning the nature of the input. Since so much of Gosiute phonology can be shown to be driven by phonetic considerations (as formalized in the Grounding Conditions), the role of faithfulness to underlying representations is greatly reduced. This leaves open the possibility that inputs need not be uniquely specified and that a given output may have many potential inputs. This idea was introduced in Prince and Smolensky (1993: 191) as *Richness of the Base*. Briefly, Richness of the Base prohibits an OT grammar from placing requirements on potential inputs (in essence, applying constraints to potential inputs), therefore all inputs are possible, whether they are underspecified, partially specified, or fully specified. It is left to the constraint hierarchy to decide on a uniquely specified output. In the following chapters I will show that Gosiute phonology has this property; constraints rooted in phonetic considerations determine the output forms present in the language.

Chapter 2: Continuancy and Voicing

1. Introduction

Voicing and continuancy are completely predictable in Gosiute. For example, fricatives only occur intervocalically (1); stops occur in all other positions (2).

(1) Intervocalic continuants

[tɨβa]	'pine nut'
[peðɨ]	'daughter'
[piži]	'breast'
[kaɣu]	'grandmother (MoMo)'
[yɨɣʷi]	'to say something'
[taw̃a]	'tooth'
[peỹa]	'honey'

(2) a. phrase-initial stops

[pia]	'mother'
[t̪θoː]	'beads'
[tua]	'son'
[kaɣu]	'grandmother (MoMo)'
[kʷasu]	'shirt'

b. stops in geminates

[moppo]	'mosquito'
[hut̪t̪θi]	'grandmother (FaMo)'
[potto]	'grinding stone'
[takka]	'snow'
[ekkʷi]	'smoky color'

c. stops following homorganic nasals

[yamba]	'wild carrot'
[wan̪d̪ði]	'antelope fawn'
[ondɨ]	'brown'
[haiñtšɨ̥]	'friend'
[puŋgu]	'horse, pet'
[peŋgʷi]	'fish'

Voicing is predictable as well. Voiced obstruents only occur intervocalically or when following nasals (3); voiceless obstruents occur elsewhere (4).

(3) a. intervocalic voiced obstruents

[tɨβa] 'pine nut'
[peðɨ] 'daughter; niece (SiDa)'
[eɣo] 'tongue'
[yɨɣʷi] 'to say something'

b. voiced stops following nasals

[yamba] 'wild carrot'
[wan̪d̪ði] 'antelope fawn'
[ondɨ] 'brown'
[puŋgu] 'horse, pet'
[peŋgʷi] 'fish'

(4) a. voiceless stops in phrase-initial position

[pia] 'mother'
[t̪θoː] 'beads'
[tua] 'son'
[kaɣu] 'grandmother (MoMo)'
[kʷasu] 'shirt'

b. voiceless stops in geminates

[moppo] 'mosquito'
[hut̪t̪θi] 'grandmother (FaMo)'
[potto] 'grinding stone'
[takka] 'snow'
[ekkʷi] 'smoky color'

The distributional facts shown in (1-4) illustrate the core patterns of voicing and continuancy in Gosiute (and the rest of Central Numic). However, there are exceptions to this general pattern: taps, which are generally thought to be non-continuants, occur intervocalically; this is an exception to the generalization that only continuants occur intervocalically (5).

(5) Intervocalic taps

[pɨɾa] 'arm'
[kuɾa] 'neck'
[poɾo] 'to dig'
[saɾiː] 'dog'

The fricative [s] is always voiceless and may occur phrase-initially as well as intervocalically; this is an exception to the generalization that fricatives occur only intervocalically (6).

(6) distribution of [s]

[saiya]	'mud hen'
[saɾiː]	'dog'
[tosa]	'white'
[wasɨ]	'to kill-PL.OBJ'

Finally, both voiced and voiceless fricatives may occur in intervocalic position; this is an exception to the generalization that obstruents are voiced intervocalically (7).

(7) Intervocalic voiceless fricatives

[wɨɸappɨ̥]	'frost'
[piθuː]	'to be stung (by a bee)'
[towɨθ̠ia][1]	'to pour'
[exo]	'pine cone hook'

The generalizations which are illustrated in (1-7) and which are to be accounted for in this chapter are summarized in (8).

(8) Voicing and continuancy generalizations

	stops		stridents		taps		fricatives	
	[+vc]	[–vc]	[+vc]	[–vc]	[+vc]	[–vc]	[+vc]	[–vc]
initial		✔		✔				
geminate		✔						
N_	✔							
V_V			(✔)[2]	✔	✔	✔	✔	✔

a. Non-strident continuants and taps occur intervocalically; stops occur elsewhere (i.e., phrase-initially, in geminates, and following nasals).
b. Strident fricatives are not confined to intervocalic position, but may also occur initially.
c. Voiced stops occur following nasals; elsewhere, stops are voiceless.

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[1]The symbol [θ̠] indicates a voiceless non-strident alveolar fricative.

[2]The only voiced strident fricative is [ž]; it is the result of both the Spirantization (see chapter 1, section 2) and Palatalization (chapter 6) of an underlying [t̪θ]. It will not be discussed in this chapter.

In this chapter I account for the generalizations in (8) by proposing constraints which restrict the cooccurrence of features such as [continuant], [consonantal], [voice], and [sonorant]. These constraints take the form of Grounding Conditions which apply to features within a single segment (Archangeli and Pulleyblank 1994; see chapter 1, section 3.2 for discussion of Grounding). In addition, I make use of constraints in which featural cooccurrence restrictions encoded by Grounding Conditions are changed when the segment occurs in a particular position in a string. For example, in section 3 I propose the constraint OBS/VOI which states that, all else being equal, obstruents are voiceless; this constraint is given in (9).

(9) OBS/VOI: 'If [–sonorant] then [–voice]; if [–sonorant] then not [+voice].'

This constraint is overridden in particular contexts, such as intervocalic or post-nasal position, where obstruents are predictably voiced. *Positional Grounding* asserts that the position of a segment within a string can affect the featural cooccurrence restrictions in phonetically natural ways. The effects of position are encoded directly in constraints; an example of a positionally grounded constraint is given in (10).

(10) VOI: N_: 'If post-nasal then [+voice]; if post-nasal then not [–voice].'

When the constraint in (10) is ranked above the constraint in (9), the result is a voiced stop following a nasal, but voiceless stops elsewhere (11).

(11) VOI: N_ » OBS/VOI

				VOI: N_	OBS/VOI
a.	/ontɨn/	i. ☞	ondɨ		*
		ii.	ontɨ	*!	
b.	/tua/	i.	dua		*
		ii. ☞	tua		
c.	/potto/	i.	poddo		*
		ii. ☞	potto		

In (11a), the candidate containing a voiced stop following the nasal is optimal, since the voiceless stop-nasal sequence violates the constraint VOI: N_. In (11b, c) the stops do not occur following nasals so the more general, context-free constraint OBS/VOI adjudicates in favor of the voiceless constraint. In similar fashion, the generalizations about continuancy are analyzed as the interaction of a positionally grounded constraint and a context-free grounded constraint. This chapter will not discuss consonant alternations which occur at morpheme boundaries; this is the domain of the *final features* (see chapter 1, section 2 for a brief introduction to the final features) and will be dealt with in chapters 3-5.

The remainder of this chapter is organized as follows. In section 2 I account for the distributional properties of continuancy in Gosiute. I show that the occurrence of continuancy is predictable, when the positionally grounded constraints are brought to bear on the problem. The exceptional cases of taps (5) are accounted for by noting that while phonetically taps may be non-continuants (although this is open to question in Gosiute), phonologically they behave as continuants. Specifying taps as [+continuant] brings them in line with other intervocalic fricatives. Also, I show in 2.4 that the preservation of continuancy for the fricative [s] in phrase-initial position (contrary to the general distributional pattern of other obstruents) results from pressure to preserve stridency cues; this pressure overrides the more general pattern of distribution in which only stops occur phrase-initially.

In section 3 I account for the distributional properties of voicing. In this section, I expand upon the analysis sketched above to account for the voicing of obstruents in post-nasal and intervocalic position. The approach to voiceless fricatives which I adopt in section 3 makes use of phonetic and phonological evidence which suggest that voiceless fricatives are produced with abducted vocal folds, and are hence specified as [+spread glottis]. Since the abduction of the vocal folds is antagonistic to voicing, the voicelessness of voiceless fricatives follows from their [+spread glottis] specification.

Section 4 concludes the chapter.

2. Continuancy: the generalizations

In Gosiute, the occurrence of continuancy is predictable. Non-strident fricatives and taps only occur intervocalically (12).

(12) a. non-strident fricatives

[tɨβa]	'pine nut'
[peðɨ]	'daughter; niece (SiDa)'
[piži]	'breast'
[kaɣu]	'grandmother (MoMo)'
[yɨɣʷi]	'to say something'
[wɨɸappɨ̥]	'frost'
[piθuː]	'to be stung (by a bee)'
[towɨθ̠ia]	'to pour'
[exo]	'pine cone hook'

b. taps

[pɨɾa]	'arm'
[poɾo]	'digging stick'
[saɾiː]	'dog'
[suɾɨ]	'that'

Stops occur elsewhere; i.e., in phrase-initial position (13a), in geminates (13b), and following homorganic nasals (13c).

(13) a. phrase-initial stops

[t̪θuhni]	'bone'
[pia]	'mother'
[tua]	'child; son'
[kuhwa]	'husband'
[kʷasu]	'shirt'

b. stops in geminates

[moppo]	'mosquito'
[hut̪t̪θi]	'grandmother (FaMo)'
[potto]	'grinding stone'
[takka]	'snow'
[ekkʷi]	'smoky color'

c. stops following homorganic nasals

[yamba] 'wild carrot'
[wan̪d̪ði] 'antelope fawn'
[ondɨ] 'brown'
[haiñtšɨ̥] 'friend'
[puŋgu̥] 'horse, pet'
[peŋgʷi] 'fish'

In contrast to the pattern shown by non-strident fricatives, the fricative [s] occurs in both phrase-initial position (14a) as well as intervocalically (14b).

(14) a. initial [s]

[siːppɨ] 'urine'
[sɨɣi] 'leaf'
[saiya] 'mud hen'
[sooβi] 'cottonwood; tree'
[sumbaːɾu] 'to learn something'

b. medial [s]

[pɨːsi] 'fine fur; down'
[wasɨ] 'to kill-PL.OBJ'
[tosa] 'white'
[pasoɣombi] 'sparrow'
[kʷasu] 'shirt'

The distributional generalizations concerning continuancy can be summarized in the following table.

(15) Continuancy generalizations

	stops	stridents	taps	fricatives
initial	✔	✔		
geminate	✔			
N_	✔			
V_V		✔	✔	✔

The limited distribution of non-strident fricatives and taps in Gosiute falls in line with well-attested lenition patterns in the world's languages, in which stops alternate or are in complementary distribution with fricatives in intervocalic position (see Lavoie 1996 and Kirchner 1998 for recent lenition surveys). In this section, I provide an analysis of the predictability of continuancy in Gosiute.

2.1. Consonants and continuancy

In this section I provide an account of the basic distributional pattern described above; namely, that non-strident fricatives occur intervocalically, while stops occur elsewhere. This account rests on the observation that consonants are more likely than not to be stops rather than fricatives, but that an opposing pressure preferring fricatives intervocalically takes precedence in the phonology of Gosiute.

The gesture required for the articulation of a stop can be described as "ballistic"—one articulator is thrown against another (Hardcastle 1976). This kind of gesture does not need to be precisely controlled for the articulatory and acoustic effects of airstream blockage to be realized. Fricatives on the other hand, require more precise control to achieve just enough closure to create a build-up of pressure, but not so much as to occlude airflow. This kind of precision should be relatively disfavored as being more effortful when compared with the ballistic gesture required for stops (Hardcastle 1976). Based on these phonetic considerations, I posit the grounded constraint in (16), which states that all other things being equal, a consonant should also be a stop.

(16) C/CONT: 'If [+consonantal] then [–continuant]; if [+consonantal] then not [+continuant].'

In spite of the imperative expressed in (16), Gosiute shows fricatives on the surface; this fact requires explanation.

2.2. Frication in Gosiute

Lenition frequently relates stops and fricatives in alternation patterns (Lavoie 1996, Kirchner 1998). This kind of alternation frequently occurs in intervocalic position. If vowels are considered to be maximally open from a gestural point of view, then the lenition of a stop to a fricative in intervocalic position can be seen as a type of gestural assimilation or accomodation; under the influence of surrounding vowels, the magnitude of the stop gesture is reduced to the point that closure is no longer achieved and a fricative is the result. This can be captured in formal terms as an example of Positional Grounding, where featural cooccurence relations are influenced by the surrounding segments (see chapter 1, section 3.2.1). The constraint in (17) captures the preference of intervocalic consonants to be continuants.

(17) CONT:V_V: 'If intervocalic then [+continuant].'

This constraint is necessarily ranked above C/CONT else its effects could not be observed. The constraint interaction is shown in (18) for an intervocalic obstruent.

(18) CONT:V_V » C/CONT

	/tɨba/	CONT:V_V	C/CONT
a.	tɨba	*!	
b. ☞	tɨβa		*

This is a typical example of constraint interaction in Optimality Theory. In (18), candidate (17a) violates top-ranked CONT:V_V, while (18b) satisfies this constraint. This is enough to decide the competition, and (18b) is judged to be optimal, in spite of its violation of the context-free constraint C/CONT.

The input consonants in (18) are specified as [–continuant]. If they had been specified [+continuant] instead, the outcome would have been the same, since the constraint hierarchy does not involve faithfulness to underlying values of [continuant]. This leaves open the possibility that the input need not be uniquely specified. This idea was first introduced in Prince and Smolensky (1993: 191) as Richness of the Base. Their position was that since constraints operate only on outputs, there should be no limitations on what a potential input should look like, other than what the evidence from alternations would suggest. This means that not only are inputs free to be fully specified as well as underspecified, but that also there may be a set of inputs which converge upon a single output. This is precisely the situation which occurs in Gosiute. For this reason, I will not propose uniquely specified underlying representations except where the evidence from alternations requires them.[3]

The same constraint hierarchy correctly rules out phrase-initial fricatives (19a), geminate fricatives (19b), and post-nasal fricatives (19c). In each of these cases, the constraint CONT:V_V has no effect, since none of the consonants occur intervocalically, the positional condition required by the constraint. It is thus up to the context-free grounded constraint C/CONT to determine the optimal candidate.

(19) Correct results for phrase-initial (a), geminate (b), and post-nasal obstruents (c)

				CONT:V_V	C/CONT
a.	/pia/	i. ☞	pia		
		ii.	ɸia		*!
b.	/appɨ/	i. ☞	appɨ		
		ii.	aɸɸɨ		*!
c.	/yamba/	i. ☞	yamba		
		ii.	yamβa		*!

In each case in (19), the constraint C/CONT adjudicates in favor of the candidate containing a stop rather than a fricative. These are precisely the environments in which stops are observed on the surface in Gosiute: word-initially (19a), in geminates (19b), and following nasals (19c). Note again that faithfulness to the input specification for [continuant] plays no role; the inputs in (19) could just as well have been fricatives, but the outputs would have been the same.

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[3]The model of OT contained in Prince and Smolensky (1993) assumed that all candidate outputs properly *contained* the input; therefore, no constraints evaluating input-output correspondence are necessary. With the introduction of Correspondence, constraints on input-output and output-input mappings as well as on output configurations are necessary. This opens the door for constraints on inputs; see Archangeli and Suzuki ().

Nasal stops are in complementary distribution with nasalized glides; nasalized glides occur intervocalically (20), while nasal stops occur elsewhere (phrase-initially, in geminates, and before homorganic oral stops) (21).[4]

(20) Intervocalic nasal glides and nasal taps

[taw̃a]	'tooth'
[yɨw̃ɨ]	'to swallow'
[t̪θuw̃ekku]	'okay'
[iw̃aː]	'morning; tomorrow'
[iỹappɨ̥]	'jerky'
[peỹa]	'honey; bee'
[saɾ̃aβi]	'pine sap'
[poɾ̃ai]	'mouse'

(21) Nasal stops

a. phrase-initial

[mia]	'to walk, go'
[mešo]	'cricket'
[moppo]	'mosquito'
[muβi]	'nose'
[niha]	'name'
[nɨkka]	'to dance'
[naŋga]	'to hear'
[noyo]	'egg, testicle'
[nukki]	'to run.SG SUBJ'

b. in geminates

[tommo]	'year; winter'
[sɨmmɨ]	'one'
[anni]	'to fall over'
[tennappɨ]	'man'

c. preceding homorganic oral stops

[yamba]	'wild carrot'
[wandði]	'antelope fawn'
[ondɨ]	'brown'
[haintšɨ̥]	'friend'
[puŋgu]	'horse, pet'
[peŋgʷi]	'fish'

[4]It should be noted that the only nasal stops which occur phrase-initially or in geminates are [m] and [n]; the range of place of articulation for nasals in nasal stop clusters is due to a homorganicity requirement on such clusters; an account of nasal-stop homorganicity is provided in section 3.3.

The distributional pattern of nasals and nasalized glides and taps is the same as that for oral stops and voiced fricatives, and a unified account of both patterns is available; the constraint hierarchy already established in (18) will also account for the nasal-nasalized glide distributional pattern illustrated in (20) and (21). This is shown in the tableau below for [taw̃a] 'tooth' (22).

(22) CONT:V_V » C/CONT

		CONT:V_V	C/CONT
a. ☞	taw̃a		
b.	tama	*!	

In (22), the candidate which contains an intervocalic nasalized glide is selected by the constraint hierarchy; (22b) violates the constraint C/CONT:V_V since medial [m] is [-continuant]. The medial glide of candidate (22a) doesn't fall under the scope of either of the constraints, since these constraints only evaluate segments which have a positive value for the feature [consonantal], and glides bear a negative value for this feature (Chomsky and Halle 1968: 303). Since glides do not fall under the scope of the constraints CONT:V_V and C/CONT, they satisfy these constraints vacuously.

In this section I have motivated the grounded constraint C/CONT and a positionally grounded constraint CONT:V_V and shown how their interaction yields the core distributional pattern of fricatives and stops in Gosiute, namely that fricatives occur intervocalically, and stops occur phrase-initially, in geminates or following nasals. Figure (23) fits these results into the big picture, where shaded cells indicate generalizations which have been accounted for.

(23) Continuancy generalizations

	stops	non-strident fricatives	taps	strident fricatives
position	initial, geminate, post-nasal	intervocalic	intervocalic	intervocalic, initial

In this section I also showed that input specification for [continuant] is irrelevant to the selection of the optimal candidate, since faithfulness to underlying [continuant] plays no role in the constraint hierarchy. This means that inputs are not uniquely specified with respect to continuancy, but that the surface distribution of continuancy is entirely predictable based on the surface distribution of segments. Thus, a set of inputs in each case will lead to a single output.

In the following sections, I discuss apparent counterexamples to the distributional generalization captured by the constraint hierarchy: intervocalic taps (2.3) and word-initial strident fricatives (2.4).

2.3. Tapping

In Gosiute, taps may also occur intervocalically, as shown in (24).

(24) Gosiute taps

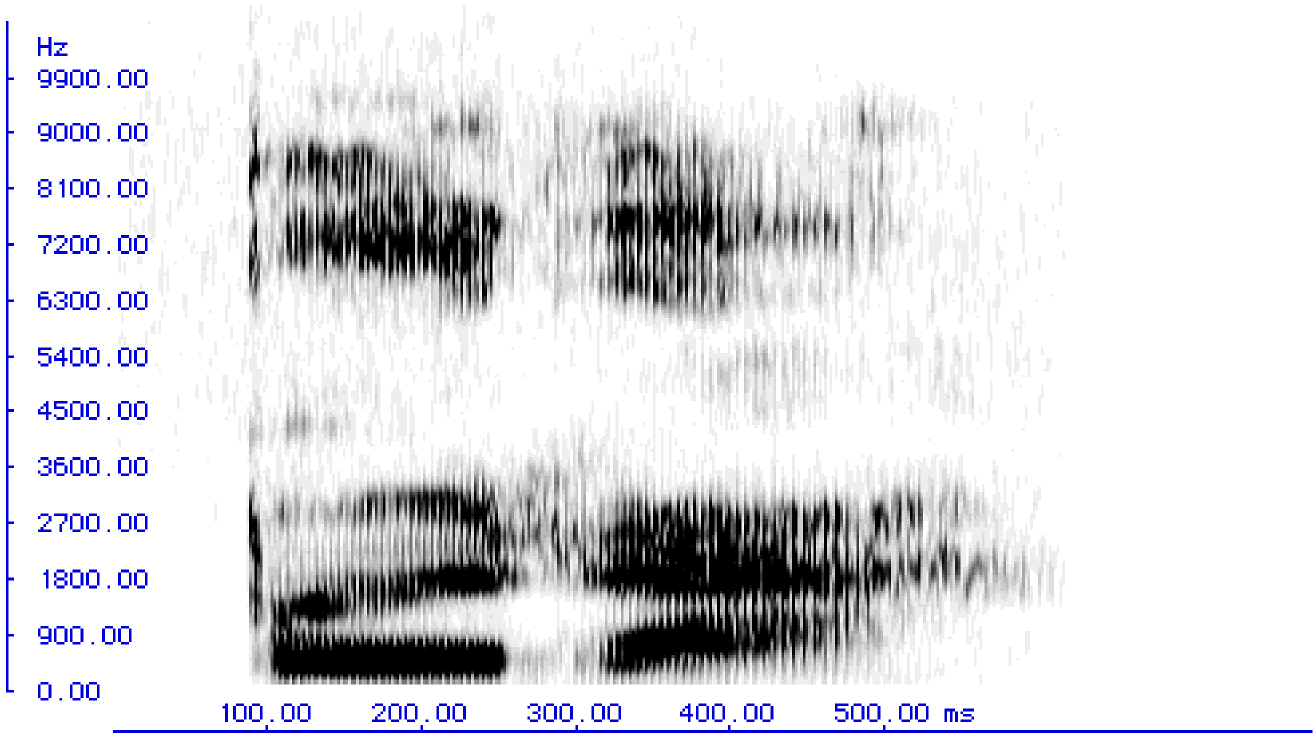
[pɨɾa]	'arm'
[kuɾa]	'neck'
[poɾo]	'to dig'
[saɾiː]	'dog'

All taps occur following a back vowel. Interdental and palato-alveolar fricatives occur following front vowels; this distributional pattern is dealt with in Chapter 6: Fronting and Palatalization.

There are conflicting descriptions in the literature concerning the articulation of taps. The majority of linguists refer to taps and flaps as non-continuants. For example, Jakobson, Fant, and Halle (1963: 21) describe taps as having an "interrupted" airstream, Ladefoged (1993: 168) describes taps as being "very rapid articulation[s] of a stop," and Ladefoged and Maddieson (1996: 230) state that taps and flaps "invariably have a single short closure." All of these statements can be construed to imply that taps can be described in featural terms as [–continuant]. However Laver (1994), in discussing the onset, closure, and release requirements of consonants, states that for taps, flaps and trills "oral airflow has to be present throughout all three phases in order to achieve the aerodynamic conditions necessary for the formation of these sounds" (Laver 1994: 363). This description seems to imply that continuous airflow is a defining property of flaps, taps, and trills. This is at odds with the description of taps as [–continuant].

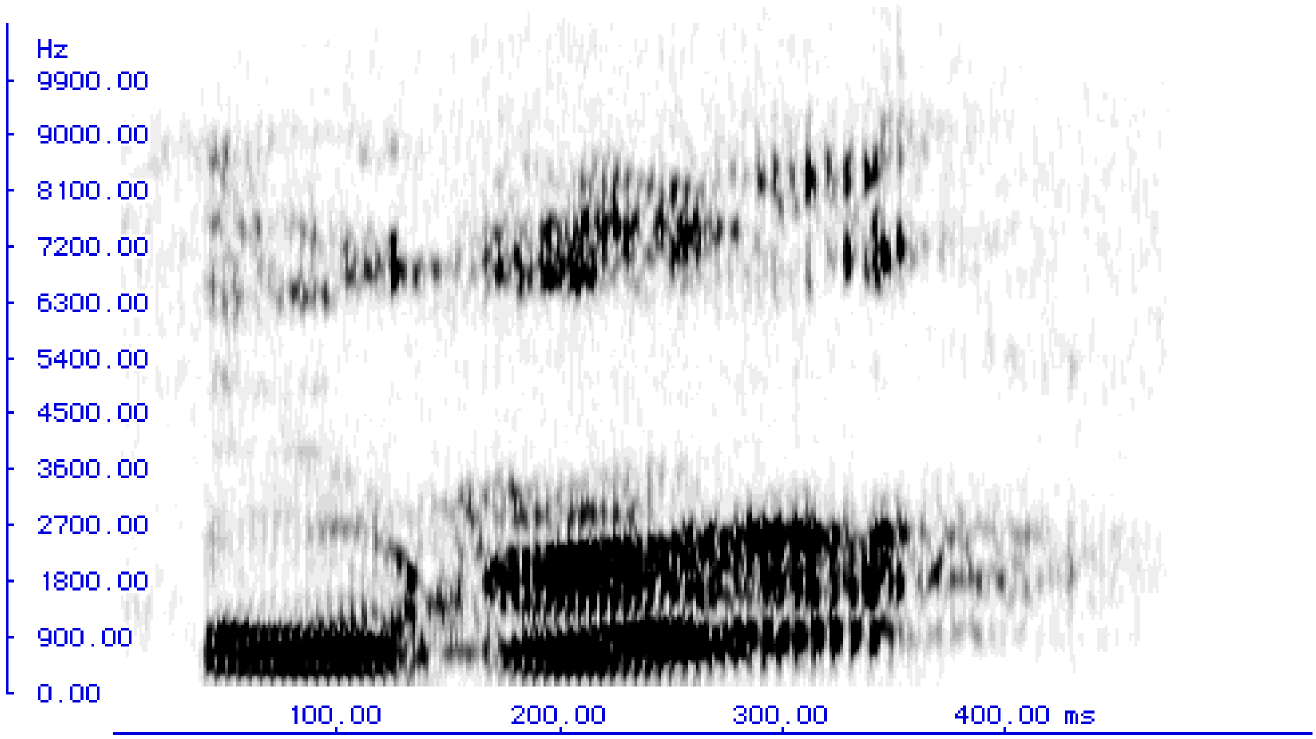
In spectrograms which I have made of Gosiute words containing what I have transcribed as [ɾ], there is often discernable formant structure or aperiodic noise throughout the articulation of this segment, with little or no release burst present; this suggests that these segments are approximants or fricatives. In (25) and (26), I provide spectrograms of Gosiute words containing taps. In each case, the portion of the spectrogram depicting the acoustic signal corresponding to a tap is characterized by continuous voicing and formant bands or aperiodic noise.

(25) spectrogram of [pɨɾa] 'arm'



p ɨ ɾ a

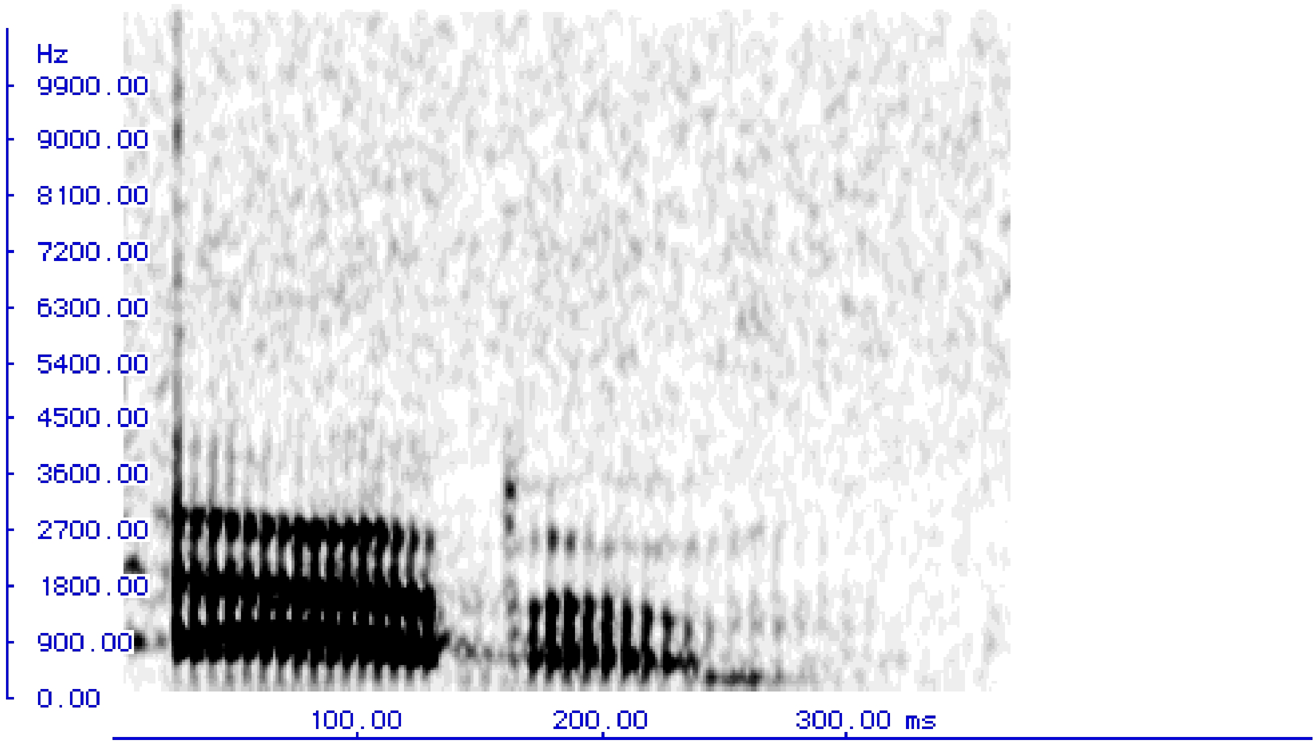
(26) spectrogram of [hoɾa] 'to dig'



h o ɾ a

This acoustic profile is unusual for a tap, as can be seen in comparing the Gosiute taps in (25) and (26) with the spectrogram for English 'atom' shown in (27). In (27), the tap has only a voicing band and no formant structure seems to be present. Additionally, the stopped character of the English tap is evident in the presence of a release burst at approximately 165 ms; in the Gosiute examples there is no comparable release burst.

(27) spectrogram of English [æɾəm] 'atom'



ʔ æ ɾ ə m

The distribution of taps and [t] in Gosiute suggest that taps should be specified [+continuant] since they only occur intervocalically like voiced fricatives; the instrumental evidence supports this feature specification and I adopt it here.

Other intervocalic coronals found in Gosiute [θ], [ð], [s], [š] and [ž] are all produced with secondary articulations which can be described in featural terms as [+distributed] and [+strident];[5] however, a tap bears neither of these features. This suggests

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[5] The feature [strident] is not usually considered to be an articulatory feature but rather an acoustic feature whose defining property is high frequency, high energy, aperiodic noise. However, in the production of a strident a thin jet of air is directed at the edge of the upper teeth; the interference of this airstream by the teeth produces the characteristic high frequency noise of stridents. These are articulatory facts about stridents, and so I will use the feature [strident] to refer to this particular articulatory configuration; see

that constraints requiring preservation of underlying [–distributed] and [–strident] play a role in the constraint hierarchy which selects as optimal a candidate containing an intervocalic tap. These constraints are given in (28) and (29).

(28) IDENT_{IO}[–dist]: 'An output correspondent of an input segment bearing [–distributed] itself bears [–distributed].'

(29) IDENT_{IO}[–str]: 'An output correspondent of an input segment bearing [–strident] itself bears [–strident].'

The ranking relations obtaining among the three constraints, IDENT_{IO}[–dist], IDENT_{IO}[–str], and C/CONT:V_V cannot be determined, since a candidate with an intervocalic tap will satisfy all of them. The tableau in (30) illustrates their interaction.

(30) { IDENT_{IO}[–dist], IDENT_{IO}[–str], CONT:V_V } » C/CONT

input: /pɨda/		IDENT_{IO} [–dist]	IDENT_{IO} [–str]	CONT: V_V	C/CONT
a.	pɨda			*!	
b.	pɨza		*!		*
c.	pɨða	*!			*
d. ☞	pɨɾa				*

In (30), any candidate containing an intervocalic obstruent is eliminated from the candidate competition, leaving only the candidate with a medial tap (30d). This candidate is thus selected by the constraint hierarchy as optimal.

To summarize, I have argued that taps are phonologically [+continuant] in Gosiute; they thus conform to the generalization that only [+continuant] segments are found intervocalically. The results thus far are summarized in the table in (31). Cells which are shaded indicate generalizations which have been accounted for; darker shading indicates generalizations dealt with in this sub-section.

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chapter 6 for a more detailed discussion of the articulation of segments specified [+distributed] and [+strident].

(31) Continuancy generalizations

	stops	non-strident fricatives	taps	strident fricatives
position	`	intervocalic	intervocalic	intervocalic, initial

In the next section I deal with the exceptional behavior of strident fricatives and show that their occurrence in phrase-initial position is due to constraints governing the perception of stridency.

2.4. Stridents

Lexical items with an initial [s] provide a challenge to the account developed in this chapter thus far for the predictability of continuancy since they do not follow the generalization that stops occur initially, while fricatives only occur intervocalically; [s] is found in both environments (32).

(32) initial and medial [s]

[siɣo]	'navel'
[sɨɣi]	'leaf'
[sumbaːɾu]	'to learn somthing; to know somebody or something'
[soŋgo]	'lung'
[saiya]	'mud hen'
[saɾiː]	'dog'
[pɨːsi]	'fine fur; fine feathers or down'
[tosa]	'white'
[wasɨ]	'to kill-PL.OBJ'

It has been observed that the strident portion of an affricate like [ts] or [tš] is shorter than that of the corresponding fricatives [s] or [š] (Pickett 1980: 131). Increasing the duration of stridency should increase the likelihood that the acoustic cues for stridency are perceived. Thus, continuant segments like [s] or [š] should be more favored for the expression of stridency than segments which are not continuants or segments which have a continuancy contour, such as affricates, since stridency in [s] and [š] is extended over a longer period than the strident portion of affricates like [ts] or [tš]. For this reason, I posit the constraint in (33).

(33) STR/CONT: 'If [+strident] then [+continuant]; if [+strident] then not [–continuant].'

If this constraint, together with IDENT_{IO}[+str], a constraint preserving an input specification of [+strident], is ranked above C/CONT the correct generalization emerges from the constraint hierarchy, as shown by the tableau in (34).

(34) {STR/CONT, IDENT_{IO}[+str]} » C/CONT

input: /saiya/	IDENT_{IO} [+str]	STR/CONT	C/CONT
a. ☞ saiya			*
b. tsaiya		*!	
c. taiya	*!		

Candidate (34c), which fails to preserve underlying [+strident] fails the constraint IDENT_{IO}[+str]. Candidate (34b) preserves stridency, and in harmony with context-free C/CONT is [–continuant]. However, it violates STR/CONT and is eliminated from the competition. This leaves candidate (34a) as the optimal candidate, which is the desired result.

An interesting property of the Gosiute segmental inventory is the presence of an interdental affricate [t̪θ] where other dialects have a strident alveolar affricate [ts] (35).[6]

[6]In the following discussion, I take Western Shoshoni to be representative of the other dialects of Shoshoni with respect to the quality and distribution of the coronal affricate.

(35) Coronal affricates in Gosiute and Western Shoshoni

Gosiute	Western Shoshoni	gloss
[t̪θippɨ̥]	[tsippɨ̥]	'prairie dog, ground squirrel'
[t̪θɨɣɨ]	[tsɨɣɨ]	'brush rabbit'
[t̪θaː]	[tsaː]	'good'
[t̪θoappɨ̥]	[tsoʔappɨ̥]	'ghost'
[t̪θuhɾ̃i(ppɨ̥)]	[tsuhni]	'bone'

What remains constant across dialects is the presence of a coronal affricate; what varies is the quality of this affricate. In Gosiute the coronal affricate is interdental and non-strident, while in Western Shoshoni the coronal affricate is alveolar and strident. The fact that all dialects have an affricate on the surface is due to a constraint preserving the stop-fricative contour characteristic of affricates (36); this constraint is unviolated in any known dialect of Shoshoni.

(36) IDENT$_{IO}$(contour): 'An output correspondent of an input segment bearing a [-continuant][+continuant] contour also bears a [–continuant][+continuant] contour.'

The difference between Gosiute and Western Shoshoni can be accounted for by the variable ranking of the constraints STR/CONT and IDENT$_{IO}$[–dist]. When STR/CONT is ranked above IDENT$_{IO}$[–dist], the Gosiute inventory pattern emerges (37). When this ranking is reversed, the Western Shoshoni pattern emerges (38).

(37) Gosiute

{IDENT$_{IO}$(contour), STR/CONT} » IDENT$_{IO}$[–dist]

input: /tsaː/		IDENT$_{IO}$ (contour)	STR/CONT	IDENT$_{IO}$ [–dist]
a.	tsaː		*!	
b. ☞	t̪θaː			*
c.	taː	*!		

(38) Western Shoshoni

{IDENT$_{IO}$(contour), IDENT$_{IO}$[–dist]} » STR/CONT

input: /tsaː/	IDENT$_{IO}$ (contour)	IDENT$_{IO}$ [–dist]	STR/CONT
a. ☞ tsaː			*
b. t̪θaː		*!	
c. taː	*!		

In both (37) and (38) the candidates which fail to preserve an input affricate are eliminated from the competition. In (37), candidate (37a) fails STR/CONT, and so candidate (37b) is judged by the constraint hierarchy as optimal, since STR/CONT is ranked above IDENT$_{IO}$[-dist]. In (38), the violations assessed to each candidate are the same, but since the constraints appear in a different ranking, candidate (38a) with a strident affricate wins the competition.

In this section, I provided an account for the appearance of [s] in word-initial position, an apparent counterexample to the distributional generalizations that only stops occur word-initially. This was accomplished by invoking the constraint STR/CONT, which in essence requires stridency to be expressed on segments specified [+continuant], regardless of their location within a string. As shown in the summary table in (39), all of the generalizations concerning continuancy have now been accounted for.

(39) Continuancy generalizations

	stops	non-strident fricatives	taps	strident fricatives
position	initial, geminate. post-nasal	intervocalic	intervocalic	intervocalic, initial

In addition, the occurrence of [t̪θ] in Gosiute as a reflex of Shoshoni [ts] was seen to fall out from the dominance of IDENT$_{IO}$[–dist] over STR/CONT in the hierarchy of Gosiute; the opposite ranking resulted in the general Shoshoni inventory pattern.

2.5. Summary

In this section, I have provided an account of the distribution of continuancy in Gosiute. The constraints invoked in this section show the ranking relations in (40).

(40) Constraint hierarchy

$$\left\{\begin{matrix} \left\{\begin{matrix}\text{IDENT}_{IO}\text{(contour)}\\ \text{STR/CONT}\end{matrix}\right\} \gg \text{IDENT}_{IO}[-\text{dist}] \\ \text{CONT:V\_V} \\ \text{IDENT}_{IO}[+\text{str}] \\ \text{IDENT}_{IO}[-\text{str}]\end{matrix}\right\} \gg \text{C/CONT}$$

The ranking CONT:V_V » C/CONT accounts for the core distributional pattern of continuancy; continuants occur intervocalically, while stops occur elsewhere. I have shown that taps fall in with this general pattern by i) the assumption of the feature specification of [+continuant] for taps, and ii) ranking IDENT$_{IO}$[–dist] and IDENT$_{IO}$[–str] above C/CONT, insuring that taps preserve underlying values for these features. The perseveration of the continuancy of stridents, even in phrase-initial position, is accounted for by ranking STR/CONT and IDENT$_{IO}$[+str] above C/CONT. Finally, the presence of an interdental reflex in Gosiute of the Central Numic coronal affricate /ts/ is accounted for by ranking STR/CONT above IDENT$_{IO}$[–dist]; other Central Numic languages have the opposite ranking, and thus allow [ts] on the surface.

In the next section I turn to the predictability of voicing for Gosiute consonants.

3. The voicing of obstruents

The occurrence of voicing on stops in Gosiute is predictable. Stops are voiced following homorganic nasals (41); stops are voiceless in phrase-initial position (42a) and in geminates (42b).

(41) stops following homorganic nasals

[yamba]	'wild carrot'
[wan̪d̪ði]	'antelope fawn'
[ondɨ]	'brown'
[puŋgu]	'horse, pet'
[peŋgʷi]	'fish'

(42) a. voiceless stops in phrase-initial position

[pia]	'mother'
[t̪θuhni]	'bone'
[tua]	'child; son'
[kuhwa]	'husband'
[kʷasu]	'shirt'

b. voiceless stops in geminates

[moppo]	'mosquito'
[hut̪t̪θi]	'grandmother (FaMo)'
[potto]	'grinding stone'
[takka]	'snow'
[ekkʷi]	'smoky color'

Voicing is not predictable for fricatives; both voiced and voiceless fricatives occur intervocalically (43a,b). However, what is predictable is that voiced fricatives only occur intervocalically (43c).

(43) a. intervocalic voiced fricatives

[tɨβa]	'pine nut'
[peðɨ]	'daughter; niece (SiDa)'
[pɨɾa]	'arm'
[eɣo]	'tongue'
[yɨɣʷi]	'to say something'

b. intervocalic voiceless fricatives

[wɨɸappɨ̥] 'frost'
[piθuː] 'to be stung (by a bee)'
[towɨθ̠ia] 'to pour'
[exo] 'pine cone hook'

c. non-occurrence of phrase-initial voiced fricatives

[tɨβa] (*[ðɨβa]) 'pine nut'
[peðɨ] (*[βeðɨ]) 'daughter; niece (SiDa)'
[kaɣu] (*[ɣaɣu]) 'grandmother'

The figure in (44) summarizes the generalizations concerning voicing in Gosiute.

(44) Voicing generalizations

	stops	fricatives (incl. taps)
voiceless	initial, geminate	intervocalic
voiced	post-nasal	intervocalic

a. Voiced stops occur following nasals; voiceless stops occur elsewhere.
b. Voiced and voiceless fricatives occur intervocalically.

In this section I provide an account for these generalizations concerning the predictability of voicing in Gosiute.

3.1. On the naturalness of voiceless obstruents

Voicing is the periodic vibration of the vocal folds. According to the myoelastic-aerodynamic theory of phonation (van den Berg 1958), vocal fold vibration occurs when there is adequate pressure drop and airflow across the glottis (Laver 1994, Pickett 1980, Westbury and Keating 1986, Hayes 1995). When the vocal tract is completely occluded in the production of a stop this pressure quickly equalizes since the air has no place to escape. This equalization of pressure suppresses airflow and consequently vocal fold vibration. For a stop to be voiced, it must therefore be shorter in duration than a voiceless stop to avoid spontaneous devoicing (Ohala 1983). The shorter duration of a voiced stop requires more precise motor control and more rapid movement of the active articulators; voiced stops should therefore be relatively disfavored compared with voiceless stops (Lindblom 1983). And this indeed seems to be the case. Ohala (1983) reports that of the 706 languages surveyed by Ruhlen (1975), 166 have only voiceless stops and 4 have only voiced stops; this shows a decisive "tilt" in favor of voicelessness for stops, which suggests that voicing in obstruents is disfavored.[7]

Voicing in fricatives is antagonistic to the production of noisy airflow which make fricatives perceptually salient. This is because voicing is easier with low oral pressure, but frication requires high pressure to force air through the consonantal constriction (Ohala 1983). Thus, voiced fricatives should be expected to be relatively rare cross-linguistically. Of the 317 languages which are surveyed in Maddieson 1984, I have counted 18 which have no fricatives at all; of the remaining 299, 138 have only voiceless fricatives, while only 3 have only voiced fricatives. This again is a decisive tilt in favor of voiceless obstruents—in this case, fricatives.

Based on these phonetic and typological considerations concerning voicing in obstruents, I posit the grounded constraint in (45), where [–son] indicates an obstruent.

(45) OBS/VOI: 'If [–son] then [–voice]; if [–son] then *not* [+voice].'

In Gosiute, this grounded constraint is ranked above any faithfulness constraints requiring that input and output correspondents have matching values for [voice]. This ensures that inputs with phrase-initial or geminate voiced stops will yield outputs with

[7]This result does not take place of articulation into account. Ohala (1983) goes on to note that when place of articulation is considered, velars are less likely to be voiced than are other places of articulation, and labials are more likely to be voiced than are other places of articulation.

voiceless stop correspondents. This is shown in the tableaux in (46) for the words [pia] 'mother' and [moppo] 'mosquito'.

(46) OBS/VOI » IDENT(voice)

				OBS/VOI	IDENT(voice)
a.	/bia/	i. ☞	pia		*
		ii.	bia	*!	
b.	/mobbo/	i. ☞	moppo		*
		ii.	mobbo	*!	

The constraint IDENT(voice) is violated when the candidate has a value for voice which differs from that of the input. Regardless of the input specification for [voice], the hierarchy demands that obstruents be voiceless in Gosiute. Thus candidate ii. in both (46a) and (46b) with a faithful [+voice] in the output is rejected in favor of candidate i. which violates IDENT(voice) but satisfies higher ranking OBS/VOI. Note that if the inputs had specified voiceless stops, the outcome would have been the same; this is because of high-ranking OBS/VOI, which demands voiceless obstruents, and not because of faithfulness to underlying feature values. That is, regardless of the input value of [voice], the output is constrained to be [-voice] by OBS/VOI. This again demonstrates that multiple inputs may converge on a single output. For this reason, it is not necessary that there be one uniquely specified input.

In the next section I discuss the voicing of stops following nasals.

3.2. Post-nasal obstruent voicing

Since voicing is normally inhibited in obstruents, there must be additional mechanisms to enable and prolong obstruent voicing, since voiced obstruents do occur in the world's languages. If voicing is the result of a pressure drop and airflow across the glottis, anything which encourages this airflow or maintains the pressure differential will have a favorable effect on voicing.

One way of encouraging transglottal airflow is to expand the supraglottal cavity; this creates rarefaction above the glottis which helps preserve the pressure differential across the glottis. This supraglottal expansion can take place passively; places of articulation nearer the front of the mouth provide larger surfaces of soft tissue in the vocal tract walls which can expand and allow more air supralaryngeally (Hayes and Stivers 1996). Supraglottal expansion can also take place actively, as when the pharynx is expanded by advancing the tongue root and lowering the larynx.

Supraglottal volume can also be actively expanded by raising the closed velum (Hayes 1995, Hayes and Stivers 1996). When the velum is closed it seals off the nasal cavity, but even when the velum is closed, it can still be raised. Raising the velum while closed creates a partial rarefaction in the oral cavity which reduces supraglottal pressure, helping to maintain a pressure differential across the glottis which is conducive to voicing.

The velum is highest for obstruents and lowest for nasal consonants. So between a nasal consonant and an obstruent the velum must rise. As it rises, the supraglottal pressure is kept somewhat lower, helping to maintain the pressure differential across the glottis which facilitates voicing. The result is a nasal-voiced-obstruent sequence, if the obstruent closure is brief enough; otherwise there is a voiced-voiceless sequence on the obstruent.

Turning to the grammaticization of the phonetic post-nasal voicing pattern, Pater (1996) argues that the mechanism for prohibiting nasal-voiceless consonant sequences should simply be expressed in the grammar as the constraint in (47).

(47) *NC̥: 'No nasal/voiceless obstruent sequences'

Implicit in this constraint is a cooccurrence restriction between the features [–sonorant] and [–voice] following nasals. This is a typical case of Positional Grounding; in Positional Grounding a featural cooccurrence relation is dependent on structural or syntagmatic considerations which may override context-free statements of cooccurrence relations between features (see chapter 1, section 3.2.1 for a discussion of Positional Grounding). The normal case is for obstruents to be voiceless due to OBS/VOI. However, following nasals this pattern is reversed; obstruents are typically voiced in this position. I will therefore reinterpret the constraint in (41) as a positionally grounded constraint. This constraint is given below in (48).

(48) VOI: N_: 'If post-nasal then [+voice]; if post-nasal then not [–voice].'

The phonetic post-nasal voicing effect becomes part of the grammar as the constraint OBS/VOI: N_ when stops are required to be completely voiced following a nasal. To achieve post-nasal voicing in Gosiute, the constraint VOI: N_ is ranked above OBS/VOI; the tableau (49) illustrates the ranking argument for the word [tɨmbe] 'mouth'.

(49) VOI: N_ » OBS/VOI (» IDENT(voice))

	/tɨmpe/	VOI: N_	OBS/VOI	IDENT(voice)
a. ☞	tɨmbe		*	*
b.	tɨmpe	*!		

In the tableau in (49), candidate b. violates the constraint VOI: N_ because of the occurrence of a voiceless stop following a nasal. Candidate a. is selected as optimal in spite of its violation of OBS/VOI, since this constraint is ranked below VOI: N_. Note that it doesn't matter if a voiceless stop or a voiced stop occurs in the input; the interaction of the markedness constraints yields the correct results, rendering the Identity constraint on voicing inactive in the grammar.

In this sub-section I have motivated an account of the voicing of stops in post-nasal position. This account involved the interaction of a context-free grounding constraint, OBS/VOI which requires obstruents to be voiceless, and a positionally grounded constraint, OBS/VOI:N_, which requires obstruents to be voiced just in case they follow a nasal. Figure

(50) fits these results into the big picture, where shaded cells indicate generalizations which have been accounted for.

(50) Voicing generalizations

	stops	fricatives (incl. taps)
voiceless	initial, geminate	intervocalic
voiced	post-nasal	intervocalic

In the next section, I discuss a tangentially related issue, the homorganicity of nasal-stop clusters.

3.3. Excursus on NC homorganicity

In NC clusters, the nasal and the following stop share place of articulation; this is true whether the NC cluster is morpheme-internal, or is spread across morpheme boundaries. Thus [tɨmbe] 'mouth' is well-formed with a homorganic NC cluster, but *[tɨnbe] is not, since the members of the NC cluster do not share a single place of articulation. In this section I provide an account for the homorganicity of NC clusters by appealing to Steriade's (1993, 1995) notion of positional neutralization and licensing.

Steriade (1993, 1995) argues that features which are marked may be restricted to certain salient positions within the word; these positions might include a stressed syllable (rather than an unstressed syllable), an initial syllable (rather than a non-initial syllable) or syllable onset (rather than the coda). This kind of restriction explains properties such as the neutralization of vowel quality in unstressed syllables, or, relevant to the phonology of Gosiute, the neutralization of a nasal's place of articulation in a coda. In these cases, Steriade refers to the *licensing* of features in certain positions. A licensing statement for the requirement on homorganicity of coda-onset clusters in given in Steriade (1995: 163):

(51) [αF], where F is a consonantal point of articulation feature must be licensed, *in at least one associated segment*, by membership in the onset.

This licensing statement requires that a place of articulation feature be allowed only when associated to a segment in an onset. The place of articulation is indirectly licensed in the coda by the presence of an onset which bears the same place feature. In the OT analysis of homorganicity in Gosiute NC clusters, I will adopt this licensing statement as a constraint on NC clusters and label it PLONS (Suh 1997: 91). Given an input nasal-stop cluster where the nasal is a coda and the stop is the onset of the following syllable, PLONS will favor a candidate which links place features of the stop onset to the preceding nasal coda rather than assigning independent place features to the nasal coda. To insure that the place features which are shared are those of the onset, the constraint IDENT$_{IO}$ONS[Place], requiring place features in the onset to be preserved, also plays a role (52):

(52) Activity of PLONS:

input: n] [b | | COR LAB	PLONS	IDENT$_{IO}$ONS [Place]	IDENT$_{IO}$ [Place]
a. ☞ m] [b \ / LAB			*
b. n] [d \ / COR		*!	*
c. n] [b | | COR LAB	*!		

In the tableau in (52), both PLONS and IDENT$_{IO}$ONS[Place] are ranked above IDENT$_{IO}$[Place]. Candidate (52c), which is completely faithful to the input, fails PLONS by not licensing the feature COR of the nasal coda. Candidate (52b) satisfies PLONS by sharing a single COR specification between the coda and the following onset, however it violates IDENT$_{IO}$ONS[Place] by failing to preserve the onset place of articulation. This leaves candidate (52a) as the winner, in spite of its IDENT$_{IO}$[Place] violation.

In summary, the constraint PLONS requires that place features in consonants be linked to the onset, effectively prohibiting an independent place of articulation from being linked to the coda. This insures that coda consonants are homorganic with following onsets when PLONS is ranked above IDENT$_{IO}$[Place]. Ranking IDENT$_{IO}$ONS[Place] above IDENT$_{IO}$[Place] ensures that preserving the identity of place of articulation of consonants in onsets also takes priority over preserving identity of place of articulation of the nasal. The end result is that regardless of the input specifications for place of articulation of a pre-stop nasal, the hierarchy will ensure homorganicity of the output NC cluster.

3.4. Voicing and fricatives

As mentioned in the introduction, the voicing of intervocalic fricatives is not predictable; both voiced and voiceless fricatives occur intervocalically (53).

(53) a. intervocalic voiced fricatives

[tɨβa]	'pine nut'
[peðɨ]	'daughter; niece (SiDa)'
[pɨɾa]	'arm'
[eɣo]	'tongue'
[yɨɣʷi]	'to say something'

b. intervocalic voiceless fricatives

[wɨɸappɨ̥]	'frost'
[piθuː]	'to be stung (by a bee)'
[towɨθ̠ia]	'to pour'
[exo]	'pine cone hook'

In this section I provide an account which retains a distinction among intervocalic fricatives without disrupting the results for the predictability of voicing on stops.

3.4.1. Intervocalic voicing

Westbury and Keating (1986) report the results of a software simulation of a model of the vocal tract. These results show that voicing on stops is favored in intervocalic positions, but disfavored in initial or final positions. This finding places a positional qualification on the interaction of the features [–sonorant] and [voice] which is expressed in formal terms in the constraint in (54).

(54) VOI: V_V: 'If intervocalic then [+voice]; if intervocalic then not [–voice].'

Westbury and Keating (1986) only report findings for stop consonant voicing. However, the lenition surveys found in Lavoie (1996) and Kirchner (1998) show that voicing of intervocalic fricatives is also common. For this reason, I will assume that VOI: V_V applies equally to stops and fricatives.

As with VOI: N_, VOI: V_V must be ranked above OBS/VOI in order for its effects to be visible on the surface. The interaction of these two constraints produces the results in (55) for the word [tɨβa] 'pine nut'.

(55) VOI: V_V » OBS/VOI

input: /tɨɸa/	VOI: V_V	OBS/VOI
a. tɨɸa	*!	
b. ☞ tɨβa		*

In the tableau in (55), the interaction of the constraints conspires to yield a voiced fricative intervocalically. Candidate (55a) violates VOI:V_V, while candidate (55b) satisfies this constraint. This is enough to decide the competition, and candidate (55b) is judged by the constraint hierarchy as optimal, in spite of its violation of OBS/VOI. In (55), I assume a voiceless fricative in the input for purposes of demonstration; this is not meant to be an argument for or against this particular input representation. If the input had contained a voiced fricative, the constraint hierarchy would still have selected [tɨβa]. This is because the selection of this output has nothing to do with preservation of underlying values of [voice], but with accounting for the attested surface patterns.

The constraint hierarchy VOI:V_V » OBS/VOI captures the occurrence of voiced intervocalic fricatives; the table in (56) summarizes the results thus far.

(56) Voicing generalizations

	stops	fricatives (incl. taps)
voiceless	initial, geminate	intervocalic
voiced	post-nasal	intervocalic

In the next subsection I fill the gap in the table in (56) and provide an account for intevocalic voiceless fricatives.

3.4.2. Voicing and [+spread glottis]

In this section I present phonetic and phonological evidence that voiceless fricatives bear the feature [+spread glottis], and I argue that the surface contrast in voicing for Gosiute fricatives follows from an underlying contrast for the feature [+spread glottis]; voiceless fricatives are [+spread glottis], while voiceless fricatives are [–spread glottis].

Vaux (1998) argues that voiceless fricatives bear the feature [+spread glottis] ([+sg]). The evidence for this comes from patterns of assimilation in the New Julfa dialect of Armenian. New Julfa Armenian has a four-way laryngeal constrast among stops (57).

(57) New Julfa consonant system (Vaux 1998: 498)

b	b^h	p	p^h	f	v	m					
d	d^h	t	t^h	s	z	n					
dz	d^hz	ts	t^hs								
dʒ	d^hʒ	tʃ	t^hʃ	ʃ	ʒ						
g	g^h	k	k^h	χ	ʁ						
				h	ɦ						
							j	ɾ	r	l	ɫ

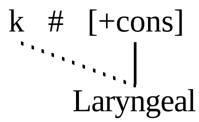
New Julfa marks the future tense with a prefix *k*- attached to the present subjunctive. This prefix surfaces as [k] before vowels and plain voiceless consonants (58a), as [g] before plain voiced consonants (58b), as [k^h] before voiceless aspirated stops and voiceless fricatives (58c), and as [g^h] before voiced aspirates (58d).

(58) New Julfa future tense (Vaux 1998: 498)

	Underlying form	Surface form	Gloss
a.	k-ert^h-a-m	kert^{h}am	'I will go'
	k-t-a-m	kətam	'I will give'
	k-kien-a-m	kəkienam	'I will exist'
b.	k-bzz-a-m	gəbəzzam	'I will buzz'
	k-l-a-m	gəlam	'I will cry'
	k-zr-a-m	gəzəɾam	'I will bray'
c.	k-t^{h}oʁ-n-ie-m	k^{h}ət^{h}oʁniem	'I will allow'
	k-t^{h}ʃap^h-ie-m	k^{h}ət^{h}ʃap^{h}iem	'I will measure'
	k-χnd-a-m	k^{h}əχəndam	'I will laugh'
	k-savor-ie-m	k^{h}əsavoriem	'I will grow accustomed to'
d.	k-b^{h}ier-ie-m	g^{h}əb^{h}ieriem	'I will carry'
	k-g^h-o-m	g^{h}əg^{h}om	'I will come'
	k-d^h-n-ie-m	g^{h}əd^{h}əniem	'I will put'
	k-d^{h}ziev-ie-m	g^{h}əd^{h}zieviem	'I will form'

From the examples given in (58) it can be seen that the prefix *k*- assimilates in voicing and aspiration to a following consonant. Vaux (1998) interprets this assimilation as evidence for the Laryngeal place node. This node contains at least the features [sg], which is responsible for aspiration, and [voice], which is responsible for voicing. Assimilation of the future tense prefix can now be seen as the spreading of the Laryngeal node of the stem-initial consonant to *k*- (59).

(59) Laryngeal Spreading (Vaux 1998: 499)



If Laryngeal Spreading results in a voiceless aspirated reflex of the future tense prefix before a stem beginning with a voiceless fricative (58c), then the obvious conclusion is that voiceless fricatives bear the feature [+sg] in New Julfa Armenian.

Vaux also provides evidence from synchronic and historical processes at work in Sanskrit that voiceless fricatives bear the feature [+sg]. When a plain voiceless stop is followed by a voiceless fricative, the result is a voiceless aspirated stop/fricative sequence (Vaux 1998: 500-1).

(60)	Underlying form	Surface form	Gloss
	/b^{h}iṣak siːs-ena/	[b^{h}iṣak^{h}siːseṇa]	healing lead-instrumental
	/ap-su/	[ap^{h}su]	water-locative

The forms in (60) demonstrate that the feature [+sg] spreads from the fricative to the preceding stop in the same manner as in the future prefix assimilation found in New Julfa Armenian.

In the historical development of Pali from Indic (here represented by Sanskrit), fricative/stop sequences are simplified by deletion of the fricative in initial position (61a), and by gemination of the stop in medial position (61b). In each case, the original plain stop is aspirated.

(61)

			Sanskrit	Pali	Gloss
	a.	Initial	skand^{h}á-	k^{h}and^{h}a-	shoulder
			stána-	t^{h}ana-	breast
			sparʃa-	p^{h}assa-	touch
	b.	Medial	hásta-	hatt^{h}a-	hand
			yaʂʈí-	yaʈʈ^{h}i-	pole

These changes represent a general simplification of syllable structure that occured between Old Indic (Sanskrit) and Middle Indic (Pali). Sanskrit allows complex onsets and place features in codas, but Pali did not. In the case of onset simplification, an entire segment was lost. In the case of coda deletion, the vacated timing unit was reassociated to the following onset resulting in a geminate.

What is interesting in this context, is that the content of the laryngeal node remains intact in spite of the deletion of a segment and is reassociated to a remaining segment. This is a pattern familiar from Autosegmental Phonology (i.e, Autosegmental Stability; Goldsmith 1976: 30-35), and it demonstrates that the feature [+sg] is present on the voiceless fricative.

Abduction of the vocal folds (=[+spread glottis]) is antagonistic to voicing since voicing requires the close proximity of the vocal folds. Weismer (1980) reports observations concerning the production of voiceless fricatives which indicate that they are produced with a glottal aperture which resembles that of voiceless aspirated stops. I therefore propose the following grounded constraint on the features [+sg] and [voice].

(62) SG/VOI: 'If [+sg] then [–voice]; if [+sg] then not [+voice].'

If [+sg] is distinctive on obstruents, then ranking IDENT$_{IO}$[+sg] (63) along with SG/VOI above VOI:V_V will produce the desired results; this is shown in the tableau in (64) for the word [exo] 'pine cone hook'.

(63) IDENT$_{IO}$[+sg]: 'An output correspondent of an input segment bearing [+spread glottis] also bears [+spread glottis].'

(64) $\left\{\begin{matrix}\text{IDENT}_{\text{IO}}\text{[+sg]} \\ \text{SG/VOI}\end{matrix}\right\}$ » VOI:V_V

input:	/exo/	IDENT$_{IO}$[+sg]	SG/VOI	VOI:V_V
a. ☞	exo			*
b.	eɣʰo		*!	
c.	eɣo	*!		

In (64) the input contains a voiceless fricative, specified [+sg]. Candidate (64c) is eliminated because it does not preserve this input feature. Candidate (64b) preserves [+sg], but violates the grounded constraint SG/VOI by having an voiced aspirated (=[+sg]) fricative. Candidate (64a) is thus selected as optimal, in spite of its violation of VOI:V_V since it satisfies the higher ranked constraints by preserving the input value of [sg] and conforms to the grounded constraint prohibiting [+sg] to occur on a path with [+voice].

3.4.3. Is Voicing distinctive for Gosiute fricatives?

At this point, a natural question to ask is "Why not distinctive [voice] for Gosiute fricatives?" Below I show that if the feature [voice] is assumed to be distinctive, the predictability of voicing on stops is lost.

To show the distinctiveness of voicing on intervocalic fricatives, a constraint compelling the identity of feature values for the feature [voice] must be active in the constraint hierarchy. For purposes of demonstration, I will assume that the active constraint is IDENT$_{IO}$[–voice]; this constraint would be ranked above VOI:V_V (65).

(65) IDENT$_{IO}$[–voice] » VOI:V_V

				IDENT$_{IO}$[–voice]	VOI:V_V
a.	/exo/	i. ☞	exo		*
		ii.	eɣo	*!	
b.	/eɣo/	i.	exo		*!
		ii. ☞	eɣo		

In both (65a) and (65b), the constraint hierarchy selects the correct candidate as optimal for the forms [exo] 'pine cone hook' and [eɣo] 'tongue'. In (65a), the preservation of [–voice] is crucial in the selection of the correct output; candidate ii, which violates this constraint is rejected in favor of the candidate which preserves underlying [–voice]. In (65b), since the intervocalic obstruent of the input is [+voice], the constraint IDENT$_{IO}$[–voice] has no effect. The burden of selecting the optimal candidate is left to the positionally grounded constraint, VOI:V_V.

The same ranking will also account for the voicelessness of stops in phrase-initial position, provided that these are specified underlyingly as [–voice] (66).

(66) phrase-initial voiceless stops

	/pia/	IDENT$_{IO}$[–voice]	VOI:V_V
a. ☞	pia		
b.	bia	*!	

When VOI:N_ is ranked above IDENT$_{IO}$[–voice], the resulting hierarchy will also correctly account for post-nasal voicing (67).

(67) VOI:N_ » IDENT$_{IO}$[–voice]

	/ontɨ/	VOI: N_	IDENT$_{IO}$[–voice]	VOI: V_V
a.	ontɨ	*!		
b. ☞	ondɨ		*	

While these results are promising, the ranking IDENT$_{IO}$[–voice] » VOI:V_V results in the loss of the predictive capacity of the grammar with respect to stop voicing; this is unfortunate, especially given the exceptionless nature of the generalizations concerning stop voicing. To see this, I need to discuss an alternation occuring across morpheme boundaries which relates a phrase-initial voiceless stop with an intervocalic voiced fricative.

An obstruent which surfaces as a voiceless stop in phrase-initial position surfaces as a voiced fricative when preceded by a vowel. In (68) I show examples of nouns which bear the first person singular possessive marker nɨ-.

(68) alternations between voiceless stops and voiced fricatives[8]

[pia]	'mother'
[nɨβia]	'my mother'
[t̪θoː]	'great-grandparent'
[nɨðoː]	'my great-grandparent'
[kɨnu]	'grandfather (FaFa)'
[nɨɣɨnu]	'my grandfather'

The constraint hierarchy established in (65) will give wrong results in heteromorphemic contexts; non-occurring *[nɨpia] 'my mother' is selected by the constraint hierarchy instead of correct [nɨβia]; this is shown in (69).

(69) IDENT$_{IO}$[–voice] » VOI:V_V

input: /nɨ-pia/	IDENT$_{IO}$[–voice]	VOI: V_V
a. ✘ nɨpia		*
b.(☞) nɨβia	*!	

Reranking the constraints so that VOI:V_V outranks IDENT$_{IO}$[–voice] will solve the problem for stops, but then the unpredictability of fricative voicing remains unaccounted for. It is apparent that this approach is not able to account for the contrast of intervocalic fricatives in Gosiute. The analysis presented in 3.3.2, however, which posits an underlying [+sg] for surface voiceless fricatives provides a consistent account for the surface contrast of intervocalic fricatives.

With this section, all of the generalizations concerning voicing have been accounted for, as shown in figure (70).

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[8]The interaction of obstruents and continuancy is discussed in section 2.

(70) Voicing generalizations

	stops	fricatives (incl. taps)
voiceless	initial, geminate	intervocalic
voiced	post-nasal	intervocalic

3.5. Summary

The ranking relations among the constraints motivated in this section are given in (63).

(63) ranking relations

$$\left\{\begin{matrix}\left\{\begin{matrix}\text{IDENT}_{IO}[+sg]\\ \text{SG/VOI}\end{matrix}\right\} \text{ » VOI:V\_V}\\ \text{VOI:N\_}\end{matrix}\right\} \text{ » OBS/VOI}$$

This section has provided an account for the predictability of voicing for stops. Phrase-initially and in geminates stops are voiceless, in conformity with the grounded condition OBS/VOI, which requires obstruents to be voiceless. Following nasals, stops are voiced; this is due to the requirements of VOI:N_, which requires obstruents to be voiced when following a nasal. The unpredictability of voicing on intervocalic fricatives is due to an underlying distinction among fricatives with respect to the feature [+sg]. Segments bearing this feature are voiceless due to the grounded constraint SG/VOI; other segments fall under the scope of the constraint VOI:V_V, which requires obstruents to be voiced intervocalically.

4. Conclusion

This chapter has provided a comprehensive account of the patterns of voicing and continuancy found in Gosiute. In addition, the analyses presented here have provided an argument for the efficacy of Positional Grounding. Grounded conditions provide context-free statements of feature cooccurrence restrictions, but these conditions may be regularly violated in particular (syntagmatic) positions. Positing constraints which supply positional restrictions provides a simple account of these regular patterns of context-free grounding violations.

I have shown that the patterns of voicing and continuancy discussed in this chapter are predictable and phonetically natural; therefore analyzing voicing and continuancy patterns in terms of the preservation of underlying feature values (=IDENT) isn't a satisfying or insightful account. However, an analysis which makes use of surface-based generalizations such as those provided by the Grounding Hypothesis can provide insight into the observed patterns of Gosiute. This has implications for the nature of underlying forms. If faithfulness to [voice] and [continuancy] play no role in the evaluation of candidate outputs, then input values for these features are irrelevant to the selection of the optimal output. Inputs may thus be fully specified, underspecified, or "wrongly specified" (that is, specified for a feature value which never surfaces). That means that there will be a set of inputs which all converge on the same output, and it is not necessary to uniquely specify inputs. This allows for a fair amount of variation in the range of possible inputs, retaining only a bare minimum of necessary specification in order to yield the desired and attested output forms.[9]

The results of this chapter have been confined to tauto-morphemic contexts; consonant alternations which occur at morpheme boundaries have not been dealt with. These alternations are very similar to the distributional patterns discussed here (see chapter

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[9]This "bare minimum of specification" should not be construed as a tacit argument in favor of Underspecification theory. In Underspecification theory, the organization of the grammar mandates that inputs be reduced to only the specifications required to establish contrasts. While this kind of an input is permitted in OT, it is not required; inputs may just as well be fully specified as underspecified. By Richness of the Base, all kinds of inputs are acceptable, so long as the output is correct.

1, section 2 for an overview of consonant alternations associated with the final features), and the analysis proposed here for the distribution of voicing and continuancy will be extended to alternations of voicing and continuancy which occur at morpheme boundaries. In addition, patterns of expression and deletion displayed by the final features will be accounted for.

Chapter 3: Introduction to the Final Features: Gemination

1. Introduction

In the previous chapter I accounted for the distribution of voicing and continuancy in consonants within morphemes. In this chapter, I introduce the final features of Gosiute, consonant alternations in hetero-morphemic contexts which parallel the distributional patterns discussed in chapter 2. As an example of how final features work I provide an account of Gemination in the second part of this chapter. I begin though with a discussion of final features and their distributional properties.

2. Final features

Final features are morpheme-final elements which surface when a stop or nasal immediately follows. Data such as that in (1) illustrate Gosiute final features (repeated from chapter 1, section 2); the initial consonant of the suffix -pai 'have NOUN' has four different alternants—voiced stop preceded by a homorganic nasal (1a), geminate voiceless stop (1b), geminate voiceless fricative (1c), and voiced fricative (1d)—depending on the noun stem to which it is attached. Similar alternations occur for stops at all places of articulation.

(1) Numic Final Features

a.	'bead' 'have beads'	[t̪θoː] [t̪θoːmbai]
b.	'pine nut' 'have pine nuts'	[tɨβa] [tɨβappai]
c.	'money' 'have money'	[moɾ̃i] [moɾ̃iɸai]
d.	'house'	[kahɾ̃i]

'have a house' [kahr̃iβai]

There are corresponding alternations for nasal-initial suffixes (2). Here, the initial nasal consonant of the postposition -mai 'with' has three different alternants based on the noun stem to which it is affixed. In (2a) and (2b) [m] alternates with a geminate nasal, in (2c) with a cluster consisting of [h] and a nasalized labio-velar glide, and in (2d) with a nasalized labio-velar glide. Similar alternations occur for morpheme-initial [n] as well.

(2)	a.	'bead'	[t̪θoː]
		'with the bead'	[t̪θoːmmai]
	b.	'pine nut'	[tɨβa]
		'with the pine nut'	[tɨβammai]
	c.	'mouse'	[por̃ai]
		'with mouse'	[por̃aihw̃ai]
	d.	'house'	[kahr̃i]
		'with the house'	[kahr̃iw̃ai]

In section 2 of chapter 1 I discussed the regularity of these alternations, which provide the basis for distinguishing four lexical classes of noun stems. These stem classes are distinguished from each other by the type of final feature which they bear; *Nasalizing* (an oral stop alternates with a cluster of a homorganic nasal and voiced stop, a nasal stop alternates with a geminate nasal stop), *Geminating* (an oral or nasal stop alternates with a geminate oral or nasal stop), *Aspirating* (an oral stop alternates with a voiceless fricative, a nasal stop alternates with a partially voiceless nasalized continuant), and *Spirantizing* (an oral or nasal stop alternates with a voiced continuant).

The occurrence of a final feature on a noun stem in Gosiute is an idiosyncratic, lexical property of the stem and cannot be predicted based on the stem's prosodic or segmental profile. The forms in (3) illustrate minimal pairs in which one member contains a final feature and the other does not. In (3), the first member of each pair is devoid of a final feature, which is demonstrated by the fact that the voiceless stop of the suffix undergoes Spirantization.[1] The second member of each pair, which in isolation is phonetically identical to the first member, differs with respect to the presence of a final feature; Nasalizing in (3a), Geminating in (3b) and Aspirating in (3c). The effects of the final feature are apparent in the initial consonant of the suffix.

(3) Unpredictable distribution of Gosiute final features

	surface	underlying	
a.	[t̪θoː]	/t̪θoː/	'great-grandparent'
	[t̪θoːβai]	/t̪θoː-pai/	'have a great-grandparent'
	[tθoː]	/t̪θoːn/	'beads'
	[t̪θoːmbai]	/t̪θoːn-pai/	'have beads'
b.	[pui]	/pui/	'blue/green'
	[puiɣai]	/pui-kai/	'be blue/green'
	[pui]	/pui"/	'grass'
	[puippai]	/pui"-pai/	'have grass'
c.	[hai]	/hai/	'uncle (FaBr)'
	[haiβai]	/hai-pai/	'have an uncle'
	[hai]	/haih/	'crow'
	[haiɸai]	/haih-pai/	'have a crow'

For any given stem in Gosiute containing a final feature, the quality of the final feature is also a lexical property of the stem and is not predictable. This is demonstrated in (4) with minimal pairs which differ only in the identity of the final feature.

[1]It is generally accepted among Numicists that stems which induce the effects of Nasalization, Gemination or Aspiration in a following morpheme contain specific phonological elements which are responsible for the phonetic expression of the final feature, while those stems which induce Spirantization are devoid of any such elements. The transcription of underlying forms of Gosiute reflect this analysis. Thus, Nasalization is transcribed as a morpheme-final /÷n/, Gemination as a morpheme-final /-"/, and Aspiration as a morpheme-final /÷h/; Spirantization, being the absence of a stem-final phonological element, is indicated by a vowel-final morpheme.

(4) Unpredictable quality of final features

	surface	underlying	
a.	[pui]	/pui"/	'grass'
	[puippai]	/pui"-pai/	'have grass'
	[pui]	/puih/	'eye'
	[puiɸai]	/puih-pai/	'have an eye'
b.	[aː]	/aːn/	'horn'
	[aːmbai]	/aːn-pai/	'have a horn'
	[aː]	/aː"/	'grey'
	[aːttoɣo]	/aː"-toko/	'potato bug' (toko 'MoFa')

In phrase-final position, the identity of the final feature is not apparent and only becomes so when a stop follows.

In Gosiute, final features which occur phrase-finally or before vowels or continuants remain silent (5). In (5) the first member of each triplet shows the effects of the final feature; in (5a) the first person plural inclusive pronoun terminates with a Nasalizing final feature, while in (5b) the first person dual inclusive pronoun terminates with an Aspirating final feature. These final features are not realized before vowels or continuants, as shown by the second and third members of each triplet.

(5) Surface absence of final features

	surface	underlying	
a.	[tammɨmbia]	/tammɨn-pia/	'our (PL.INCL) mother'
	[tammɨaɾa]	/tammɨn-ata/	'our (PL.INCL) uncle (MoBr)'
	[tammɨyaippɨ]	/tammɨn-yaippɨ/	'our (PL.INCL) mother-in-law'
b.	[tawɨ̥ɸia]	/tawɨh-pia/	'our (DU.INCL) mother'
	[tawɨaɾa]	/tawɨh-ata/	'our (DU.INCL) uncle (MoBr)'
	[tawɨ̥yaippɨ]	/tawɨh-yaippɨ/	'our (DU.INCL) mother-in-law'

An apparent exception to the pre-vocalic deletion pattern occurs when a noun is inflected for accusative case. The accusative suffix consists of the vowel -a, and so would be expected to trigger deletion of a Nasalizing or Aspirating final feature, but this does not happen.[2] In the accusative the Nasalizing final feature is realized as [n] (6) and the Aspirating final feature is realized as [h] (7); Spirantizing stems show no intrusive consonant before the accusative suffix (8). In each triplet in (6-8), the first member shows the noun in isolation; the final features are not present on the surface in these cases. The second member of each triplet shows the effects of the final feature (where present) on the stop of the following suffix. The third member of each triplet shows that the final feature surfaces before the accusative suffix; for Nasalizing stems the final feature surfaces as alveolar [n] and for Aspirating stems the final feature surfaces as [h]; (8) shows that when the accusative suffix is attached to a stem devoid of a final feature, a vowel-vowel cluster results.

(6) Accusative case and Nasalizing stems

	surface	underlying	
a.	[paɣa]	/pakan/	'arrow'
	[paɣambai]	/pakan-pai/	'have an arrow'
	[paɣana]	/pakan-a/	'arrow-ACC'
b.	[t̪θoː]	/t̪θoːn/	'beads'
	[t̪θoːmbai]	/t̪θoːn-pai/	'have beads'
	[t̪θoːna]	/t̪θoːn-a/	'beads-ACC'
c.	[taindɨ]	/taintɨn/	'hole'
	[taindɨŋgappa]	/taintɨn-kappan/	'inside the hole'
	[taindɨna]	/taintɨn-a/	'hole-ACC'

(7) Accusative case and Aspirating stems

	surface	underlying	
a.	[pui]	/puih/	'eye'
	[puiɸai]	/puih-pai/	'have an eye'

---

[2] There are in fact four types of accusative inflection: i) suffixation of *-a*, ii) suffixation of *-i*, iii) qualitative change of a final [ɨ] to [i], and iv) no change. There is a certain amount of predictability in determining how a given stem is inflected for the accusative; for example, stems which bear a Nasalizing or Aspirating final feature take the *-a* suffix and *-i* is suffixed to stems ending in [a]. This predictability is limited, however, and will not be discussed further.

	[puiha]	/puih-a/	'eye-ACC'
b.	[ai]	/aih/	'crow'
	[aiθ̠ukka]	/aih-tukkan/	'under the crow'
	[aiha]	/aih-a/	'crow-ACC'
c.	[sappɨ̥]	/sappɨh/	'belly'
	[sappɨ̥xappa]	/sappɨh-kappan/	'inside the belly'
	[sappɨ̥ha]	/sappɨh-a/	'belly-ACC'

(8) Accusative case and Spirantizing stems[3]

	surface	underlying	
a.	[t̪θoː]	/t̪θoː/	'great grand-parent'
	[t̪θoːβai]	/t̪θoː-pai/	'have a great-grandparent'
	[t̪θoːa]	/t̪θoː-a/	'great-grandparent-ACC'
b.	[appɨ]	/appɨ/	'father'
	[appɨβai]	/appɨ-pai/	'have a father'
	[appɨa]	/appɨ-a/	'father-ACC'

In summary, final features are morpheme-final elements which are realized phonetically before morphemes beginning with a stop or nasal. However, final features are silent in phrase-final position and before continuants and vowels. Exceptionally, the Nasalizing and Aspirating final features are realized as full segments [n] and [h] before the accusative suffix -a, in spite of the fact that the accusative suffix is vowel-initial.

At first sight, the odd mixture of realization and silence which characterizes final features is reminiscent of "ghosts" or *latent segments*. According to Zoll (1996), latent segments are phonological elements which show properties which are distinct from those of *full segments*, or segments which consist of a root node with or without dependent features. These properties include the following: i) The particular quality of a latent segment is a lexical property of the morpheme in which it appears. ii) The presence or absence of a latent segment in a particular morpheme cannot be predicted based on that morpheme's prosodic or featural profile. iii) Latent segments do not appear in all contexts in which a normal

[3] I have been unable to find examples of Geminating noun stems which take the *-a* accusative suffix.

segment may be expected to appear. iv) The inventory of latent segments in a language is a subset of the full segmental inventory of that language. v) Latent segments do not contribute to the weight of syllables in languages which are sensitive to syllable weight. These properties are summarized in (9).

(9) properties of latent segments (Zoll 1996: 29)

a. unpredictable quality
b. unpredictable distribution
c. propensity for exceptional deletion
d. inventory limited in principled ways
e. no underlying length

Zoll demonstrates that these properties follow from the representation of latent segments as phonological elements devoid of a root node (10).

(10) latent segment full segment

```
                          ®        (= root node)
                          |
      [features]      [features]
```

The final features of Gosiute seem to have all of the properties of latent segments. They are unpredictable in quality and their distribution in the lexicon cannot be predicted on prosodic, featural or any other grounds; that is, given a noun stem, it is not possible to determine which of the final features it will bear, if any (9a, b). Final features are subject to deletion, which is not true of other segments in the language (9c). Final features comprise a limited inventory compared with the consonants of Gosiute (9d). Finally, final features do not contribute to syllable weight (9e), a point which will be demonstrated in section 3.2.

However, these diagnostics prove to be misleading. Part of the burden of this chapter, and the two chapters which follow, is to demonstrate the the Gosiute final features are in fact full segments complete with root nodes, rather than latent segments devoid of root nodes. In the remainder of this chapter, I will discuss the distributional properties of Gemination as a final feature and show that the correct representation for Gemination is as a root node with a [+consonantal] feature. This argument rests on the observation that coda consonants in Gosiute are not moraic; geminates cannot, therefore, be represented as moraic consonants.

3. Gemination

As a demonstration of some of the distributional properties of final features, I will provide an account of Gemination in Gosiute. Although Gemination is more limited in scope than any of the other final features, many of the representational and distributional issues dealing with Gemination are relevant for the analysis of the other final features. The crucial questions in the representation of Gosiute final features are (i) Are final features "latent segments" (Zoll 1996) or full segments in their own right? and (ii) Are coda consonants moraic in Gosiute? In this chapter I provide additional evidence from Gemination that final features are full segments, and that coda consonants are not moraic but are best represented by a separate root node (Selkirk 1990). Some of these arguments will extend to the analysis of Nasalization and Aspiration.

3.1. Descriptive generalizations

Following certain morphemes, a voiceless stop or nasal will surface as a geminate; the examples in (11) demonstrate this with the morphemes tɨpa″ 'pine nut', tua″ 'son', tuː″ 'black', and the instrumental prefix ta″- 'with the foot'.[4]

(11) gemination at morpheme boundaries

[4]Quote marks ⟨"⟩ mark a Geminating final feature; this convention was introduced in Miller (1972) and has been adopted by most scholars working with Central Numic final features.

	surface	underlying	
a.	[tɨβa]	/tɨpa"/	'pine nut'
	[tɨβappai]	/tɨpa"-pai/	'have pine nuts'
	[tɨβattukka]	/tɨpa"-tukkan/	'under the pine nuts'
	[tɨβakkaβa]	/tɨpa"-kapan/	'among the pine nuts'
	[tɨβammai]	/tɨpa"-mai/	'with the pine nuts'
b.	[tua]	/tua"/	'son'
	[tuappai]	/tua"-pai/	'have a son'
	[tuammai]	/tua"-mai/	'with the son'
c.	[tuː]	/tuː"/	'black'
	[tuːttaiβo]	/tuː"+taipo/	'Negro' ('black'+'European')
	[tuːkkʷasu]	/tuː"-kʷasun/	'soldier' ('black'+'shirt')
d.	/ta"-/		'with the foot'
	[tattoː]	/ta"-toː/	'put on shoes'
	[tannua]	/ta"-nua/	'push with the foot'

When stems bearing a Geminating final feature occur phrase finally, the final feature is silent (12).[5]

(12) Phrase-final Gemination

[suɾɨ wihỹu suβa wɨːɾa ikki̥ u muhyumma kattɨŋgahr̃iβa suɾɨn denna]
sutɨ wihnu supa wɨːta ikkih u muhyun -ma kattɨn kahni -pa sutɨn tenna"
that then on.it bear here it door -at sitting house -on that man
'That man was sitting here at the door of the house of Bear.'

When stems bearing a Geminating final feature occur before vowels or continuants, the final feature is silent (13).

(13) Pre-vocalic and pre-continuant Gemination

[kona wasɨŋgina]
kona" wasɨ -(n)ki -na
wood kill.PL.OBJ -hither -ASP
'The wood has been killing us.'

---

[5]Geminating stems account for only 1% of the vocabulary of Gosiute, according to a count I have made of the dictionary found in Miller (1972). For this reason, it is very difficult to find examples of geminating stems in the relevant contexts. This accounts for the scarcity of examples in (12) and (13).

[ɨɣit̪t̪θi wihỹu nɨ ɾua ɨɣit̪t̪θi nɨmiðɨ]
ɨkit̪t̪θi wihnu nɨ tua" ɨkit̪t̪θi nɨmi -tɨn
now-a-days then my son now-a-days live -ASP
'My boy is still living.'

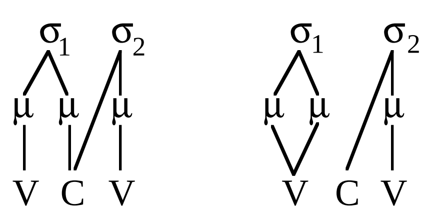
To summarize, Gemination as a final feature is phonetically realized only on stops and nasals; before all other segments and in phrase-final position, Gemination is silent.

3.2. The representation of Gemination

A popular view of the representation of geminate consonants analyzes them as a single root node simultaneously linked to a mora on the left and a syllable node (or a mora) on the right (see among others, Hyman 1985, Hayes 1989, McCarthy and Prince 1986, 1990). Syllables closed by a geminate (14a) thus form a natural class with syllables containing a long vowel (14b).

(14) heavy syllables in moraic phonology (V = vocalic root node, C = consonantal root node)

a. $[\underline{VC}_1.C_1V]$ b. $[\underline{V:}.CV]$

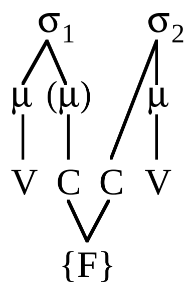


An implication of this representation is that syllables closed by a geminate behave identically with syllables containing long vowels with respect to phenomena such as stress and prosodic morphology (reduplication, infixation, templatic morphology, etc). This prediction has been borne out in many languages of the world (but not all; see Tranel 1991).

A constrasting view of geminates is presented in Selkirk (1990). There, gemination is represented by a single set of features linked to two root nodes (15).

(15) Two-root theory of geminates (Selkirk 1990)

[VC:V]



Under this view of gemination, a syllable closed by a geminate consonant may be bimoraic, but need not be. A crucial test to distinguish the moraic theory of geminates from two-root theory of geminates would thus involve a language which can be shown to be sensitive to syllable weight in the assignment of stress, but nevertheless fails to count geminates as contributing to syllable weight (Selkirk 1990: 41). Gosiute is just such a language.

Stress in Gosiute counts moras. The general stress rule is that from the left, every odd numbered mora is stressed, with the leftmost mora receiving primary stress (16).

(16) Gosiute stress: every other mora

[pížahìβiðɨ̀]	'drinking milk'
[tóimbìðɨ]	'finally came out'

Heavy syllables attract stress. This will move stress from the first mora to the second when the second mora is part of a heavy syllable. In each of the forms in (17) main stress passes by the first mora and becomes fixed on the second, since in each case the second mora is part of a long vowel.

(17) Stress and heavy syllables

[nuɾá:nnu̥]	'ran'
[kottó:xʷa]	'made a fire'

However, syllables closed by a geminate are not stressed except when the vocalic mora happens to be an odd numbered one or if the syllable contains a long vowel, which would have been stressed in any case. In the forms in (18), stress passes by a syllable closed by the first half of a geminate (underlined).

(18) Unstressed syllables closed by geminates

a.	[híβikkʷà]	'drank'
	*[híβìkkʷa]	
b.	[yáɣettɨ̀ɣixàndɨ]	'crying constantly'
	*[yáɣèttɨɣìxàndɨ]	

The stress facts thus point unequivocally to the conclusion that geminates are not moraic in Gosiute.

In addition to the stress facts cited above, there is typological evidence to consider Gosiute geminates as non-moraic. In the forms in (19), a geminate voiceless stop follows a long vowel in the first syllable. If geminates were moraic, that would imply a trimoraic syllable (two for the long vowel, one for the coda), which is typologically unusual.

(19) Geminates and long vowels

[tɨːppai]	'whip'
[aːttoɣo]	'potato bug'
[waːppi]	'cedar tree'
[tuːkkʷasu]	'soldier'

Both the stress data and typological considerations argue against a representation of gemination involving an empty mora, and I therefore conclude that in Gosiute geminates are non-moraic. This satisfies Selkirk's (1990) test to distinguish moraic geminates from two-root geminates; I assume the latter representation for geminates in Gosiute.

4. The analysis of Gemination

Having motivated a representation for Gemination as a root node, I turn now to an account of the distribution of the phonetic reflexes of Gemination. Gemination is audible before stops and nasals, but is silent elsewhere. In this section I account for this distribution.

4.1. The expression of Gemination

Here I account for the gemination of stops and nasals following a morpheme with a Geminating final feature. If geminates are treated as a sequence of two root nodes in Gosiute, then anything other than a one-to-one mapping between input and output root nodes will be suboptimal. The constraint ROOT-UNIFORMITY is then crucial in preventing such an input-output pairing. It is defined in (21).

(21) ROOT-UNIFORMITY (UNIF): 'No root node of the output has multiple correspondents in the input.'

This constraint is violated when a root node in the output has multiple correspondent root nodes in the input; that is, when two underlying segments coalesce into a single surface segment, a situation depicted in (22).

(22) *ROOT-UNIFORMITY

®$_1$ ®$_2$ input
\ /
®$_{1,2}$ output

Such a configuration cannot be the outcome of Gemination in Gosiute.

Another constraint which is crucial for the correct outcome of Gemination is MAXROOT. This constraint acts to prevent the deletion of a root node from the input. It is defined in (23).

(23) MAXROOT (MAX): 'Every root node of the input has a corresponding root node in the output.'

The constraint MAX marks input-output pairings such as (24) as ill-formed:

(24) *MAX

®$_1$ ®$_2$ input
|
®$_1$ output

In chapter 2 I motivated the constraint PLONS, which demands that consonantal place features be licensed by association to an onset. In the analysis of Gemination PLONS insures that the root node which is the Geminating final feature share place of articulation features with a following stop or nasal. The activity of these three constraints is demonstrated in the tableau in (25).

(25) Gemination

	/tɨpa"$_1$-p$_2$ai/	PLONS	MAX	UNIF
a. ☞	tɨβap$_1$p$_2$ai			
b.	tɨβap$_{1,2}$ai			*!
c.	tɨβap$_2$ai		*!	
d.	tɨβat$_1$p$_2$ai	*!		

In this tableau, any violation of any of the three constraints PLONS, MAX, or UNIFORMITY renders a candidate suboptimal, leaving only the candidate which satisfies all three of them (25a). In (25d), the Geminating final feature receives a Coronal place of articulation; this violates PLONS since the following consonant is Labial; the Coronal feature is not licensed in this position. Candidate (25c) violates MAX since the root node indexed "1" has no correspondent in the output. Candidate (25b) violates UNIF since a single root node in the output is indexed as a correspondent to two root nodes in the input. Candidate (25a) satisfies all of the requirements of the constraints presented since the Labial feature is licensed on the coda consonant by its association with the following onset; furthermore, each input root node has exactly one correspondent in the output, satisfying both MAX and UNIF.

4.2. The surface absence of Gemination

There are no other phonetic reflexes of Gemination. In particular, Gemination is silent in the following environments: phrase-finally, pre-vocalically, and before continuants. I will account for each of these environments in turn.

4.2.1. Phrase-final Gemination

The absence of gemination in phrase-final position involves nothing more than the ranking of constraints already established in section 4.1. If PLONS is ranked above MAX, the correct results ensue (26).

(26) PLONS » MAX

	/tɨpa"/	PLONS	MAX
a. ☞	tɨβa		*
b.	tɨβat	*!	

In the tableau in (26), candidate (26b) fails PLONS since the final consonant, [t], has place features not associated to an onset; these features are thus not licensed. This violation is more egregious than the MAX violation which ensues if the final feature is deleted altogether, so candidate (26a) is judged by the constraint hierarchy to be optimal.

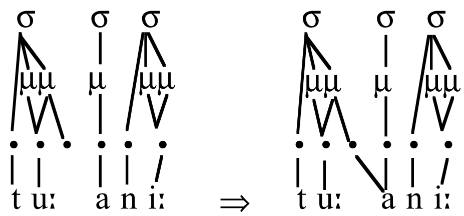
4.2.2. Prevocalic Gemination

In section 3 I argued that Gemination should be represented as a root node. Vocalic features as well as consonantal features may be linked to a root node, so in principle there is nothing to prevent a Geminating final feature from lengthening a following vowel. In (27), a potential vowel-lengthening situation arises when the morpheme tu:" 'black', which ends in a

Geminating final feature, is immediately followed by the vowel-initial morpheme aniː 'ant'.

(27) Faulty realization of Gemination

/tuː"+aniː/ *[tuːaːniː] 'black ant'



This structure is anomalous since elsewhere long vowels are bimoraic, while in (27) the derived long vowel is monomoraic. Since it is this association of a vowel with the root node representing Gemination which is faulty, I propose the constraint in (28) to prohibit this configuration.

(28) DEPASSOC(V) (DEP-A(V)): An output association to [–cons] has a correspondent in the input.

This constraint prohibits the insertion of an association line from a segment specified [-consonantal] to an empty root node, precisely the operation shown in unattested (27).

A different sort of problem emerges if the Geminating final feature is assigned consonantal features rather than vocalic features, say, by inserting the feature [+constricted glottis] ([+cg]) to produce a glottal stop. The preservation of [+consonantal] is not at issue since the surface glottal stop is specified [+cg]. By mapping the Geminating feature to a surface glottal stop, the constraint DEP-A(V) is satisfied, as is MAX. Additionally, all of the candidates vacuously satisfy PLONS since vowels and glottal stop don't carry consonantal place of articulation features (29).

(29) false prediction

	/tuː"$_1$-a$_2$niː/	DEP-A(V)	PLONS	MAX
a. (☞)	.tuː.a$_2$.niː.			*!
b. ✘	.tuː.ʔ$_1$a$_2$.niː.			
c.	.tuː.aː$_{1,2}$.niː.	*!		

In the tableau in (28) candidate (28b) is erroneously judged the winner, since it satisfies all of the constraints introduced thus far. It bears the feature [+consonantal], glottal stop has no place of articulation features and thus satisfies PLONS vacuously, and its root node is the output correspondent of the input Geminating final feature. However, Gosiute does not have a glottal stop in this position.

It should be noted that candidate (29b) shows a mismatch between syllable and morpheme boundaries. That is, the glottal stop corresponding with the Geminating final feature is morphologically affiliated with the material to its left, but at the same time, it forms the onset of the syllable to its right. This state of affairs is generally not permitted in Gosiute; this is due to the constraint in (30), based on the Alignment Schema of McCarthy and Prince (1993).

(30) ALIGN (Morph, R; σ, R) (ALIGN-R): 'For every morpheme there is a syllable such that the right edge of the morpheme and the right edge of the syllable coincide.'

This constraint is violated every time a syllable crosses a morpheme boundary. Adding this constraint to those already established yields the desired results and eliminates candidate (29b) from the competition. This is shown in the tableau in (31). (In this tableau PLONS has been suppressed since none of the candidates violates it.)

(31) {DEP-A(V), ALIGN-R} » MAX

	/tuː"$_1$-a$_2$niː/	DEP-A(V)	ALIGN-R	MAX
a. ☞	.tuː.a$_2$.niː.			*
b.	.tuː.ʔ$_1$a$_2$.niː.		*!	
c.	.tuː.aː$_{1,2}$.niː.	*!		

Now because of the mismatch between syllable and morpheme boundaries, candidate (31b) tu:ʔani: is rejected in favor of (31a). This is the desired outcome.

4.2.3. Precontinuant Geminate deletion

Gemination also has no phonetic effect on a fricative. To account for this fact, I propose the constraint in (32).

(32) *FF: 'Avoid geminate fricatives.'

This constraint is based on the effort-based approach to lenition found in Kirchner (1998). Reporting on a software simulation of a bio-mechanical model of effort relations in speech sounds, Kirchner found that considerably more effort is expended in the production of a geminate fricative than in a singleton. Adding this constraint to the group of constraints at the top of the Gemination hierarchy will account for the absence of geminate fricatives in Gosiute (33).

(33) No Geminate fricatives

	/tu:"$_1$-s$_2$aiya/	*FF	DEP-A(V)	PLONS	ALIGN-R	UNIF	MAX
a.	tu:s$_1$s$_2$aiya	*!					
b. ☞	tu:s$_{1,2}$aiya					*	
c. ☞	tu:s$_2$aiya						*

In the tableau in (33), three candidates are considered. Of these three, the first, (33a), violates the constraint *FF because of the geminate fricative. Candidates (33b) and (33c) each violate a single constraint; (33b) violates UNIF since the output [s] is indexed to two segments in the input, while candidate (33c) has no output correspondent for the Geminating final feature, and thus violates MAX. At this point, there is no ranking argument for deciding which of these two constraints would decide the competition; in chapter 5 I will argue that MAX must outrank UNIF (see chapter 5, section 4.1).

4.3. Summary

In this section I have provided an account of the expression and deletion of the Geminating final feature. The final ranking of constraints introduced here is given in (34).

(34) Gemination: Final constraint ranking

$$\left\{\begin{array}{c}\text{UNIF}\\ \left\{\begin{array}{c}\text{*FF}\\ \text{DEP-A(V)}\\ \text{ALIGN-R}\\ \text{PLONS}\end{array}\right\} \text{ » MAX}\end{array}\right\}$$

This ranking accounts correctly for the patterns of realization of Gemination. The general strategy for Gosiute is to delete the Geminating final feature when conditions for its expression haven't been met; this is encoded in the constraint hierarchy by the low ranking of the constraint MAX.

5. Conclusion

In this chapter I have introduced the final features and discussed their distributional properties. I have demonstrated that Gemination in particular is best treated as a root node, and that geminates in Gosiute should be represented as a sequence of two root nodes linked to the same featural content (Selkirk 1990). This conclusion was the result of an examination of the stress system of Gosiute, which is mora-counting but which doesn't count coda consonants. Gemination is thus best considered to be a full segment, one which is provided with a root node. In this chapter I also accounted for the distributional properties of Gemination; Gemination is phonetically realized before stops and nasals but is silent phrase-finally and before vowels and continuants. The role of the representation of Gemination is crucial to this account.

Chapter 4: Nasalization

1. Introduction

In the previous chapter, I discussed the distributional properties of Gemination as a final feature. The behavior of Nasalization is similar; the Nasalizing final feature emerges before stops and nasals and is silent elsewhere. In this chapter I give an account of the surface distribution of Nasalization. In this account, I also show that Nasalization, like Gemination, should be considered a full segment in its own right; that is, a segment with a root node and dependent features, rather than a floating feature or latent segment. The argument for this position will not be made explicitly until section 4, but the correctness of this position will be assumed throughout this chapter. The organization of this chapter is as follows. Section 2 provides descriptive summaries and an analysis of Nasalization as a final feature. Section 3 accounts for the absence of Nasalization on the surface on stems which would otherwise be expected to show it. Section 4 discusses the behavior of Nasalization with the accusative suffix -a; this behavior is interesting because it presents an apparent exception to the deletion patterns discussed in section 3, and because it provides a clear argument for considering Nasalization to be a full segment. Section 5 is a short summary.

2. Description of Nasalization patterns

In this section, I give a descriptive summary of the patterns of realization and silence which are characteristic of the Nasalizing final feature. In 2.1 I provide examples of the surface expression of Nasalization, and in 2.2 I show examples where Nasalization is not realized on the surface.

2.1. The realization of Nasalization

The discussion of the Nasalizing final feature begins with the following observation: following certain morphemes, a voiceless stop alternates with a nasal-voiced stop cluster. Some examples are given in (1).

(1) Nasalization

[aː]	'horn'	[aːmbai]	'have a horn'
[t̪θoː]	'beads'	[t̪θoːmbai]	'have beads'

(cf. [t̪θoː] 'great-grandparent' [t̪θoːβai] 'have a great-grandparent')

/ɨn-/ 'your (SG)'			
[pia]	'mother'	[ɨmbia]	'your (SG) mother'
[tua]	'son'	[ɨndua]	'your (SG) son'
[t̪θoː]	'great-grandparent'	[ɨndðoː] grandparent'	'your (SG) great-
[kaɣu]	'grandmother'	[ɨŋgaɣu]	'your (SG) grandmother'
[kʷasu]	'shirt'	[ɨŋgʷasu]	'your (SG) shirt'
[kʷasu] 'shirt'			
/-pan/	'on top'	[kʷasumba]	'on top of the shirt'
/-tukkan/	'under'	[kʷasundukka]	'under the shirt'
/-kappan/	'inside'	[kʷasuŋgappa]	'inside the shirt'
[yuː] 'gentle'			
/-pit̪t̪θɨh/	'ABSOLUTIVE'	[yuːmbittšɨ̥]	'gentle animal'
[kuittšu]	'cow'	[yuːŋguittšu]	'buffalo'
[kahni]	'house'	[yuːŋgahni]	'tipi'
[ontɨ] 'brown'			
/-kaitɨ/	'ABSOLUTIVE'	[ondɨŋgaiðɨ]	'brown'
[paː]	'water'	[ondɨmbaː]	'whiskey'

In the examples in (1), the stems are vowel-final in isolation. Upon concatenation with a stop-initial morpheme, a nasal stop cluster is formed (underlined); Comparing 'have a bead' with 'have a great-grandparent' in (1) shows that the presence of a surface NC cluster is dependent on the leftmost morpheme; the otherwise homophonous forms [t̪θoː] 'beads' and [t̪θoː] 'great-grandparent' differ only in that 'beads' is followed by a nasal-stop cluster upon suffixation, while 'great-grandparent' is followed by no such cluster. This suggests that there is some nasal element at the right edge of morphemes like 'beads', 'horn', 'gentle', and the plural suffix; it is this nasal element which is the Nasalizing final feature. I transcribe the Nasalizing final feature as /-n/ in underlying forms (in section 2.4 I argue that these morpheme-final elements are in fact full segments). Thus, the underlying form of 'bead' is represented as /t̪θoːn/, and that of 'horn' as /aːn/.

Nasalization is not confined to interactions between morphemes in a single word but also occurs in phrasal contexts (2).

(2) Nasalization in phrasal contexts

[nɨmmɨm̱ ḇɨaišɨ ɨkkʷoihondui]

nɨmmɨn	pɨai	-sɨn	ɨkkʷoi	-hVn	-tui
we/EXCL	already	-EMPH	sleep/PL.SUBJ	-completely	-FUT

'We already went to sleep.'

[taiβow̃an̠ ḏeɣʷa]

taipo	-man	tekʷa
white.man	-with	talk/SG.SUBJ

'talk with the White Man'

[piɨnɨːn̠ ḏɨasɨ̥]

piɨ	-nɨːn	tɨa	-sɨn
boy/NON.SG	-PL	also	-EMPH

'the boys also'

[nɨmmɨŋ̱ g̱e šumbanainnḁ]

nɨmmɨn	ke	sumpanai	-nna
we/EXCL	NEG	know	-ASP

'We didn't know.'

[nɨmmɨŋ̱ g̱ia sattu miaɾɨ]

nɨmmɨn	kia	sattu	mia	-tɨn
we/EXCL	then	there	walk	-ASP

'We then walked through there.'

Following morphemes where stops alternate with NC clusters, nasals are regularly geminated. The examples in (3) demonstrate nasal-nasal clusters across morpheme boundaries.[1] In (3a) and (3b), the first member of each pair illustrates a typical heteromorphemic nasal-stop interaction; the second member of each pair shows a nasal-nasal cluster in a similar environment, demonstrating that the output consists of a geminate nasal.

(3) Nasalizing final features and nasal-initial morphemes

a. [animui ɨŋgʷasumbaŋ gattɨ]
animuih ɨŋ- kʷasun -pan kattɨ
fly your- shirt -on.top.of sit/DUR
'There's a fly sitting on top of your shirt.'

[animui ɨŋgʷasummaŋ gattɨ]
animuih ɨŋ- kʷasun -man kattɨ
fly your- shirt -on sit/DUR
'There's a fly sitting on (the side of) your shirt.'

b. [kežaːndɨ]
ke t̪θaːn -tɨn
NEG good -ASP
'(it is) no good'

[aɾɨŋ ge žaːn nɨwɨ]
atɨn ke t̪θaːn nɨwɨ
that NEG good person
'that no good person'

To summarize the Nasalization patterns seen thus far, a stem may end with a nasal element. This nasal element is realized as a homorganic nasal segment before a stop. Before a nasal, the stem-final nasal element is also realized as a homorganic nasal creating a surface geminate nasal.

Accounting for the hetero-morphemic alternation of voiceless stop with a nasal-stop cluster or of a singleton nasal with a geminate nasal involves constraints which were already

[1] There are many instances of geminate nasals within a single morpheme; some examples include: [tommo] 'winter, year', [kammu] 'jackrabbit', [tenna-ppɨ] 'man-ABS', [anni] 'to fall over'. It is impossible to determine if morpheme-internal geminate nasals in forms like these are due to Gemination or to Nasalization; I will make the simplifying assumption that it is Gemination. Historical and comparative analysis may help resolve this question on a case by case basis, but this will have little bearing (if any) on the synchronic phonology of Gosiute.

introduced in chapter 2. In particular, the following two facts need to be accounted for: i) the stop of the nasal-stop cluster is always voiced, and ii) the nasal-stop cluster is always homorganic. The first fact follows from constraints introduced in section 3.1-2 of chapter 2, repeated below.

(4) OBS/VOI: 'If [–sonorant] then [–voice]; if [–sonorant] then not [–voice].'
(figure (45) from chapter 2)

VOI: N_: 'If post-nasal then [+voice]; if post-nasal then not [–voice].'
(figure (48) from chapter 2)

The first constraint expresses a grounding condition on the features [–sonorant] and [voice] which is independent of the environment in which the segment finds itself. The second constraint expresses the generalization that segments which follow nasals prefer to be voiced. When these two constraints are ranked VOI:N_ » OBS/VOI, the voicing of post-nasal stops follows.

(5) VOI:N_ » OBS/VOI

	/aːn-pai/	VOI:N_	OBS/VOI
a. ☞	aːmpai		*
b.	aːmpai	*!	

In the tableau in (5), candidate (5a) satisfies VOI:N_, the top-ranked constraint. Candidate (5b) violates this constraint, and is therefore rejected in favor of (5a). This is a pattern familiar from the analysis of the distribution of voicing found in section 3 of chapter 2.

The homorganicity of heteromorphemic stop-nasal clusters is also dealt with using constraints already established in section 3.3. of chapter 2. These constraints are repeated in (6) below.

(6) PLONS: '[αF], where F is a consonantal point of articulation feature must be licensed, *in at least one associated segment*, by membership in the onset.' (figure (51) of chapter 2)

IDENT$_{IO}$ONS[Place]: 'The output correspondent of an input segment bearing a Place feature bears that same Place feature; this segment is in the onset.'

IDENT$_{IO}$[Place]: 'The output correspondent of an input segment bearing a Place feature bears that same Place feature.'

In the tableau in (7), the ranking PLONS » IDENT$_{IO}$ONS[Place] » IDENT$_{IO}$[Place] yields the correct results for heteromorphemic contexts (the voicing of the stop is assumed based on the results in (5)).

(7) Homorganicity of NC clusters

input: aːn-pai / \\ COR LAB	PLONS	IDENT$_{IO}$ONS [Place]	IDENT$_{IO}$ [Place]
a. ☞ aːmbai \/ LAB			*
b. aːndai \/ COR		*!	*
c. aːnbai / \\ COR LAB	*!		

In this tableau, candidate (7a), which preserves and shares the onset Place features between the members of the NC cluster, is selected as optimal. Candidate (7b) shares a Coronal feature between the nasal and the stop but fails to preserve the onset's Labial specification, in violation of IDENT$_{IO}$ONS[Place]. Candidate (7c) fails to license the coda Coronal feature and thus runs afoul of PLONS.

3. Nasal Deletion

The nasalization facts as presented and analyzed in section 2 are very regular and straightforward. In this section I discuss Nasal Deletion—cases where an underlying

Nasalizing final feature is not present on the surface; these cases are of three kinds. First, a stem-final nasal deletes when it occurs in word-final position. Second, when a stem with a final nasal precedes a vowel-initial morpheme the Nasalizing final feature is again absent in surface form. Finally, in potential NC clusters where C is a continuant ([s, h, y, w]) the nasal is absent in the output. These results are achieved by drawing on constraints which govern the potential mismatch between word and syllable boundaries, as well as constraints prohibiting certain features in adjacent segments. I discuss each of these cases in turn, beginning with phrase-final deletion.

3.1. Phrase-final Nasal Deletion

A stem-final nasal deletes when phrase-final (8).[2]

(8) a. [piɨnɨːn dɨasɨ̥]
pii -nɨːn tɨa -sɨn
boy/NON.SG -PL also -EMPH
'the boys also'

b. [sɨmmɨ ɣahniɣuppa]
sɨmmɨ kahni -kuppan
one house -in
'in one house'

c. [nɨmmɨŋ gia sattu miaɾɨ]
nɨmmɨn kia sattu mia -tɨn
we/EXCL then there walk -ASP
'We then walked (through) there.'

Notice that for each phrase-final nasal element, there is no following stop. The constraint PLONS thus provides a partial explanation for the illformedness of phrase-final nasals, since the nasals in these cases are not followed by an onset which can license place

[2]There is optional nasalization of vowels immediately preceding a stem final nasal. This nasalization may surface even when there is no consonantal reflex of Nasalization.

features. Requiring that place features be linked to the onset leaves two logical options for phrase-final nasals: (i) the nasal can emerge placeless, or (ii) the nasal can be deleted; otherwise, PLONS would be violated by allowing place features on a final nasal. In Gosiute, the nasal is deleted in phrase-final position. In Optimality Theoretic terms, this is construed as a violation of MAX, defined in (9).

(9) MAX: Every segment of the input has a correspondent in the output.

This constraint is ranked below PLONS; the tableau in (10) shows the candidate competition under this ranking.

(10) PLONS » MAX

	/mia-tɨn/	PLONS	MAX
a. ☞	miaɾɨ		*
b.	miaɾɨn	*!	

Candidate (10a) violates MAX by the deletion of the stem-final nasal; candidate (10b), which satisfies MAX, violates higher-ranking PLONS since the stem-final nasal, which has been retained, has place features which are not licensed by an onset. This candidate competition is a typical Optimality Theory pattern; satisfaction of the higher-ranking constraint, PLONS, comes at the cost of a violation of lower-ranked MAX. This ranking of PLONS and MAX ensures that candidate (10a) [miaɾɨ] emerges as the winner over candidate (10b) [miaɾɨn].

3.2. Pre-vocalic Nasal Deletion

Stem-final nasals are deleted when the second morpheme is vowel-initial; examples are given in (11).

(11) surface underlying

[tammɨaɾa] /tammɨn-ata/ 'our (INCL) uncle'
[tammɨot̪t̪θa] /tammɨn-ot̪t̪θa/ 'our (INCL) jug'

[nɨmmɨ oyɨsɨn daiβo niwɨnɨyu]
nɨmmɨn oyɨ -sɨn taipo niwɨnɨ -yu
we/EXCL always -EMPH white.man talk/PL.SUBJ -ASP
'We always spoke English.'

It is not immediately obvious why the nasal in these cases should delete; the resulting syllables would be perfectly well-formed with a surface nasal: /tammɨn aɾa/ → *[.tam.mɨ.na.ɾa.]. There seems to be no phonetically grounded reason for Nasal Deletion in these cases.

Note, however, that in each instance of pre-vocalic Nasal Deletion, the retention of the nasal would have required either syllabification across a morpheme boundary, or the unusual syllabification of the stem-final nasal as the coda of the preceding syllable leaving the following syllable onsetless. These two options are shown in (12).

(12) a. Syllabification across a word boundary:
/tammɨn-ata/ → *[.tam.mɨ.na.ɾa.]

b. Unusual syllabification:
/tammɨn-ata/ → *[.tam.min.a.ɾa.]

The syllabification shown in (12b) is prevented by the constraint PLONS, which requires a place of articulation to be linked to an onset, effectively prohibiting a coda from bearing a unique place of articulation. The syllabification pattern in (12a) is prevented by invoking the constraint in (13) based on the Generalized Alignment schema proposed in McCarthy and Prince (1993); this constraint was introduced in section 4.2.2 of chapter 3).

(13) ALIGN (Morph, R; σ, R) (ALIGN-R): 'For every morpheme there is a syllable such that the right edge of the morpheme and the right edge of the syllable coincide.'

The effect of the constraint in (13) is to prohibit the overlapping of morphemes and syllables; every morpheme boundary coincides with a syllable boundary as well.[3] The constraints PLONS and ALIGN-R are ranked above MAX. In the tableau in (14), syllable boundaries are indicated by parentheses, and morpheme boundaries are indicated by square brackets.

(14) {PLONS, ALIGN-R} » MAX

	/[tammɨn][aɾa]/	PLONS	ALIGN-R	MAX
a. ☞	[(tam)(mɨ)][(a)(ɾa)]			*
b.	[(tam)(mɨ)(n][a)(ɾa)]		*!	
c.	[(tam)(mɨn)][(a)(ɾa)]	*!		

Candidate (14c) violates PLONS because of the presence of a coda [n] with independent place features which are not linked to a following onset. Candidate (14b) violates ALIGN-R because of a mismatch in syllable and morpheme boundaries; the [n] of the possessive pronoun tammɨn is syllabified into the following noun stem. Violations of either PLONS or ALIGN-R are sufficient to eliminate candidates (14b) and (14c) and candidate (14a) emerges as the winner in spite of the fact that it violates MAX because of the deletion of the final nasal of the possessive pronoun; deletion of the nasal is actually the winning strategy.

[3]There are examples of suffixes which obligatorily begin with a geminate or nasal-stop cluster; these include /-ppɨh/ 'absolutive', /-ttθi/ 'diminutive', /-nkɨ/ 'causative; benefactive', and /-kka/ 'resultative'. In each case, there is a mismatch between syllable boundaries and morpheme boundaries since the geminate or nasal-stop cluster will close the final syllable of the preceding morpheme. I assume the activity of high-ranking morpheme-specific constraints ensuring the faithfulness of geminates and clusters in such suffixes, but I do not provide a detailed analysis here. The accusative suffix /-a/ is also an example of the potential mismatch between syllable and morpheme boundaries; it is discussed in section 4.

3.3. Pre-continuant Nasal Deletion

In morphological environments where the consonant of a potential NC cluster is a continuant, the stem-final nasal deletes (15). In each of (15a), (15b), and (15c), the forms illustrating the absence of the Nasalizing final feature is followed by a form in which it is present to demonstrate that there is in fact a Nasalizing final feature on the morpheme.

(15) Nasalization deletion

a.	[ɨsɨɣi]	/ɨn-sɨki/	'your (SG) leaf'
	[ɨhut̪t̪θi]	/ɨn-hut̪t̪θi/	'your (SG) grandmother (FaMo)'
	[ɨyaippɨ]	/ɨn-yaippɨ/	'your (SG) mother-in-law'
	[ɨwosa]	/ɨn-wosa/	'your (SG) burden basket'
	cf.		
	[ɨŋgaɣu]	/ɨn-kaku/	'your (SG) grandmother (MoMo)'
b.	[tɨhu:ppi]	/tɨn-hu:ppin/	'counting sticks' (rock + stick)
	cf.		
	[tɨmbi]	/tɨn-pin/	'rock' (rock + ABS)
c.	[ondɨyakkʷa]	/ontɨn-yakkʷa/	'deerfly' (brown + ?)
	cf.		
	[ondɨngaiθɨ̥]	/ontɨn-kaihtɨn/	'brown' (brown + ABS)

The reason for Nasal Deletion in these cases is to be found in the interaction of constraints governing the adjacency and cooccurrence of nasality and continuancy. In his survey of nasal-consonant assimilation, Padgett (1994) notes that for languages which show nasal place assimilation to a following stop, it is always the case that languages with nasal-continuant place assimilation will also have nasal-stop place assimilation, but that the reverse is not true; that is, languages with nasal-stop place assimilation do not always have nasal-continuant place assimilation. In fact, one of three things typically happens when there is no assimilation: i) the nasal receives a default place of articulation, ii) the nasal deletes, or iii) the nasal assimilates but simultaneously hardens the continuant to a stop or affricate (Padgett 1994: 470). Gosiute is an example of the second pattern—the nasal in nasal-continuant sequences deletes. Padgett posits the following marking condition on potential nasal-continuant sequences:

(16) Nasal/Continuant Marking Condition:
If [+nas, +cons] then [–cont]. (Padgett 1994: 478)

The formulation of this marking condition is identical to a grounded condition (Archangeli and Pulleyblank 1994); I will take it to be a constraint on surface forms in Gosiute and give it the abbreviation NAS/CONT.

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 the cooccurence of X and Y in a path, there is a *sequential* constraint which prohibits 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 constraint NAS/CONT there is also a related, subordinate sequential constraint NAS…CONT. It is the sequential constraint NAS…CONT which is active in the analysis of potential nasal-continuant clusters in Gosiute. This constraint is defined in (17).

(17) NAS…CONT: A path bearing [nasal] does not precede a path bearing [+continuant].

This constraint is ranked above MAX, which prohibits the deletion of underlying segments; it is preferable to delete the nasal segment than to allow it to be adjacent to a continuant.

While the constraint NAS…CONT is crucial in the analysis of underlying nasal-continuant clusters, it will not provide an account for the lack of surface nasal-continuant clusters by itself. There are three different cases to consider in the analysis of underlying nasal-continuant clusters: /ns/, /nh/ and /nG/ (where /G/ is a cover symbol for /w/ and /y/). In each case, the use of constraints motivated in the previous chapter will prove essential in accounting for each type of nasal deletion. I will discuss each of these in turn.

3.3.1. /ns/ clusters

Constraints from chapter 2 on the presence and preservation of stridency can be used to account for the deletion of nasals before /s/. IDENT$_{IO}$[str] ensures preservation of underlying stridency, and STR/CONT ensures that segments specified [+strident] are also [+continuant]. The constraint NAS…CONT introduced above militates against adjacent [nasal] and [continuant] specifications. All three of these constraints are ranked above MAX; the tableau in (18) illustrates.

(18) {IDENT$_{IO}$[str], STR/CONT, NAS…CONT} » MAX

/ɨn sɨki/		IDENT$_{IO}$ [str]	STR/ CONT	NAS… CONT	MAX
a.	ɨntɨɣi	*!			
b.	ɨntsɨɣi		*!		
c.	ɨnsɨɣi			*!	
d. ☞	ɨsɨɣi				*

In the tableau given in (18), any violation of IDENT$_{IO}$[str], STR/CONT, or NAS…CONT results in the disqualification of a candidate. Candidate (18d) satisfies all of these constraints and is judged as optimal by the hierarchy in spite of its violation of MAX.

3.3.2. /nh/ clusters

In chapter 2, the constraint IDENT$_{IO}$[+sg] was introduced and used to account for the presence of intervocalic voiceless fricatives (see chapter 2, section 3.3.2 for discussion). When this constraint is ranked above MAX along with NAS…CONT the nasal deletion effects in underlying /nh/ clusters falls out. The tableau in (19) illustrates.

(19) {IDENT$_{IO}$[+sg], NAS…CONT} » MAX

/ɨn hut̪t̪θi/		IDENT$_{IO}$ [+sg]	NAS… CONT	MAX
a.	ɨnʔut̪t̪θi	*!		
b.	ɨnhut̪t̪θi		*!	
c. ☞	ɨhut̪t̪θi			*

In (19), any candidate which violates IDENT$_{IO}$[+sg] or NAS…CONT is eliminated. Candidate (19c), which satisfies both of these constraints at the expense of a MAX violation is selected as optimal.

3.3.3. /nG/ clusters

In the analysis of underlying /nG/ clusters, the constraint IDENT$_{IO}$[+son] (defined in (20) below) plays a role similar to that of the other IDENT constraints discussed above.

(20) IDENT$_{IO}$[+son]: An output correspondent of an input segment bearing [+sonorant] also bears [+sonorant].

When IDENT$_{IO}$[+son] and NAS…CONT are ranked above MAX, surface deletion of the nasal from underlying /nG/ clusters results. The tableau in (21) illustrates.

(21) {IDENT$_{IO}$[+son], NAS…CONT} » MAX

/ɨn wosa/		IDENT$_{IO}$ [+son]	NAS… CONT	MAX
a.	ɨŋg^{w}osa	*!		
b.	ɨŋwosa		*!	
c. ☞	ɨwosa			*

Candidates (21a) and (21b) both crucially violate a high-ranking constraint; (21a) has a voiced labiovelar stop in correspondence with an underlying labiovelar glide, in violation of IDENTIO[+son] and is therefore eliminated. Candidate (21b) violates NAS…CONT because of the adjacency of [N], specified as [nasal], and [w] specified as [+continuant]; it too is eliminated. Candidate (21c) violates MAX since there is no output correspondent for input /n/. However, since MAX is ranked below the other constraints, candidate (21c) is judged as optimal.

3.4. Summary

In this section I have provided analyses for the deletion of morpheme-final nasals in various positions. Phrase final Nasal Deletion was shown in 3.1 to be the result of ranking PLONS above the faithfulness constraint MAX. Thus, coda nasals which could not share a place of articulation with a following stop were deleted. In 3.2, the analysis of pre-vocalic Nasal Deletion made use of the same hierarchy, PLONS » MAX, and re-introduced from chapter 3 the Alignment constraint ALIGN-R requiring morpheme edges to coincide with syllable edges. Finally, pre-continuant Nasal Deletion was shown to follow from a number of factors, including a general prohibition on nasal-continuant sequences (17), and a ranking of faithfulness constraints which give priority to the preservation of input features such as [+strident], [+sg], and [+sonorant] over the preservation of nasality.

4. Accusative Nasalization

In this section I discuss an apparent exception to Pre-vocalic Nasal Deletion, discussed in 3.2 above. This exceptional pattern occurs as a result of the suffixation of the accusative suffix *-a*. Recall that a stem-final nasal element doesn't surface when followed by a vowel-initial morpheme. The accusative pattern is different in that the stem-final nasal element *is* realized before the accusative suffix in a pattern that I will refer to as Accusative Nasalization. Compare the forms below in (22).

(22)	a.	k^waharɨmba	'on top of an antelope'
	b.	k^waharɨ oyɨsɨ	'(the) antelope also'
	c.	k^waharɨna	'antelope-ACC'

In (22a) the stem-final nasal element surfaces as [m] when the postposition 'on top of', realized here as [ba], is suffixed to the stem. In (22b) the stem-final nasal doesn't surface because the following morpheme is vowel-initial. In (22c), the nasal is realized before the accusative suffix -a.

In this section, I use this pattern to provide evidence for the representation of stem-final nasal elements as full segments. This section is organized as follows. In 4.1 I provide more examples of Accusative Nasalization, and compare this pattern with a similar pattern found with [h]-final stems (see Chapter 5: Aspiration) and the accusative pattern found with vowel-final stems. A constraint requiring an onset for the accusative suffix is proposed and ranked above the hierarchy given for Pre-vocalic Nasal Deletion. In 4.2 I show that assuming the stem-final nasal element to be a full segment provides complete coverage of the Accusative Nasalization data, as well as accounting for the lack of an onset on accusatives appearing on vowel-final stems. In 4.3 I show that assuming the stem-final nasal element to be a floating feature yields inconsistent results. 4.4 provides a brief summary.

4.1. Accusative Nasalization: the basic pattern

In (23), more examples are given of Accusative Nasalization. Each form in (23) is given in the nominative (uninflected), accusative, and with either a postposition or the verbalizing suffix, 'have X' (realized in the examples in (23) as [-bai]), to demonstrate that the stem does in fact have a final nasal.

(23) Accusative Nasalization

a.	[paɣambai]	'have an arrow'
	[paɣa]	'arrow'
	[paɣana]	'arrow-ACC'
b.	[t̪θoːmbai]	'have beads'
	[t̪θoː]	'beads'
	[t̪θoːna]	'beads-ACC'
c.	[taindɨŋgappa]	'inside the hole'
	[taindɨ]	'hole'
	[taindɨna]	'hole-ACC'
d.	[aːmbai]	'have a horn'
	[aː]	'horn'
	[aːna]	'horn-ACC'

The accusative pattern in (23) should be contrasted with the forms in (24), where no stem-final element is present. In these cases, the accusative suffix is simply affixed to the vowel-final stem.

(24) Gosiute Accusative -*a*

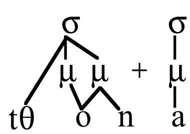
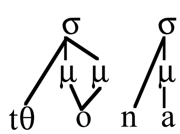
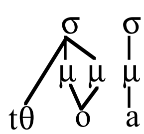
a.	[t̪θoː]	'great-grandparent'
	[t̪θoːa]	'great-grandparent-ACC'
b.	[poe]	'road, path'
	[poea]	'road-ACC, path-ACC'
c.	[ižappɨ]	'coyote'
	[ižappɨ]	'coyote-ACC'
d.	[appɨ]	'father'
	[appɨa]	'father-ACC'

Accusative Nasalization (24) suggests that the principle blocking deletion of stem-final nasals before the accusative suffix is a property of this suffix. In particular, it seems that the accustive suffix -*a* requires an onset. I formalize this notion in the constraint in (25).

(25) ONSACC: The accusative suffix -*a* has an onset.

This constraint can be seen as the particularization to a specific morpheme of a more general constraint on syllable structure, ONS (Prince and Smolensky 1993: 16), which requires syllables to have onsets.[4] ONSACC is ranked above ALIGN-R, which was motivated in section 3.2 for pre-vocalic Nasal Deletion, since its requirements take precedence over the deletion pattern presented there. The tableau in (26) shows the candidate competition for the form (23b) t̪θoːna 'bead-ACC' with prosodic structure made explicit, under the assumption that the Nasalizing final feature is a full segment.

(26) ONSACC » ALIGN-R

	ONSACC	ALIGN-R
a. ☞ 		*
b. 	*!	

In (26), candidate (26b) violates ONSACC since the accusative suffix is allowed to surface without an onset. This is a sufficiently serious violation to merit the elimination of this candidate, given the ranking of the constraints. Candidate (26a) however, satisfies ONSACC by syllabifying the Nasalizing final feature as the onset for the accusative suffix. This prosodic parse entails a violation of ALIGN-R since there is a mismatch between morpheme

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[4]Limiting a constraint to a single morpheme has precedents in the Optimality Theory literature. In Prince and Smolensky (1993), a discussion of Tagalog infixation makes reference to an Alignment constraint which is restricted to the morpheme *um* (Prince and Smolensky 1993: 35). More recent work (Hammond 1995, Russell 1995, and Elzinga 1995) carries this notion further and argues that underlying phonological forms as such do not exist, but are in fact encoded as constraints in the constraint hierarchy. This move allows for the elegant expression of exceptions and exceptional patterns.

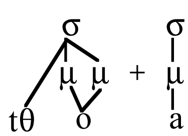
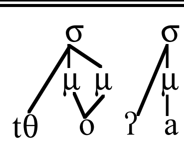
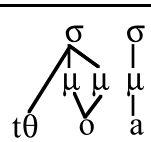
and syllable boundaries on the right edge, but this constraint violation is not serious enough to prevent the selection of (26a) as the optimal candidate.

In addition to the Faithfulness constraint MAX prohibiting deletion of an underlying segment, there is a constraint DEP which prohibits insertion of segments which are not present in underlying representation. As with MAX, I assume that by 'segment' is meant the root node and its associated features. In languages with epenthesis, DEP is violated regularly to rescue otherwise ill-formed prosodic structures. DEP is defined in (27).

(27) DEP: An output segment has a correspondent in the input.

The accusative forms given in (24) show that the constraint DEP must be ranked above ONSACC, since none of these forms provides the accusative suffix with an onset; this is shown in the candidate competition in (28) for the form in (24a) t̪θoːa 'great-grandparent-ACC'.

(28) DEP » ONSACC

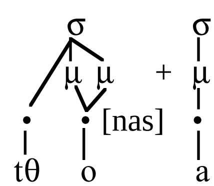
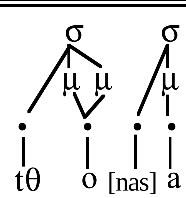
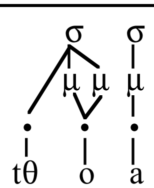
	DEP	ONSACC
a. 	*!	
b. ☞ 		*

In the tableau in (28), insertion of a consonant in (28a) to satisfy ONSACC results in a violation of higher-ranking DEP (I assume a glottal stop for purposes of illustration; any consonant would be as egregious a violation of DEP in this case). Candidate (28b) avoids this violation at the cost of an ONSACC violation. Since DEP is ranked above ONSACC the candidate satisfying it (28b) is preferred over (28a) which violates it, in spite of its violation of ONSACC. The constraint hierarchy DEP » ONSACC » ALIGN-R thus correctly accounts for the attested patterns of accusative formation in Gosiute under the assumption that the Nasalizing final feature is a full segment. This ranking of these three constraints in fact follows from this assumption.

4.2. Accusative Nasalization and floating [nasal]

The alternative to a segmental analysis of final features is to assume that they are latent segments consisting of floating features not linked to a root node. If the morpheme-final nasal element is a floating [nasal] feature underlyingly, then ONSACC must outrank DEP, as shown in (29) for the input /t̪θoːn-a/ 'bead-ACC'.

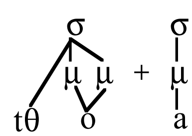
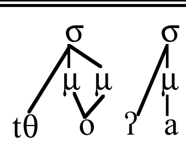
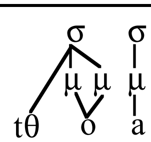
(29) ONSACC » DEP

	ONSACC	DEP
a. ☞ 		*
b. 	*!	

Candidate (29a) [t̪θoːna] violates DEP because of the insertion of the root node dominating the feature [nasal]. However, it satisfies higher-ranked ONSACC. Candidate (29b) [t̪θoːa] avoids a DEP violation by not providing the accusative suffix with an onset. In so doing, a violation of higher-ranking ONSACC is incurred. Candidate (29a) is judged optimal since it satisfies the higher ranked constraint, ONSACC.

This ranking predicts that noun stems which do not have a floating feature of any kind will insert a consonant in the accusative case. Recall from (24) that there are vowel-final noun stems which form the accusative simply by suffixation of -a. The ranking ONSACC » DEP incorrectly predicts that these forms will have an epenthetic consonant in order to satisfy the requirements of ONSACC. This is shown in the tableau in (30) for the underlying form /t̪θoː-a/ 'great-grandparent-ACC'.

(30) ONSACC » DEP: incorrect prediction

	ONSACC	DEP
a. ✘ 		*
b. (☞) 	*!	

In the tableau in (30), the ranking ONSACC » DEP demands the insertion of a consonant to avoid violation of high-ranking ONSACC. However, forms such as candidate (30a), which is selected by the constraint hierarchy as optimal, are unattested in the language. This constraint ranking thus fails to account for the full range of accusative suffix patterns of the language.

In summary, when the stem-final nasal elements are assumed to be floating features, the constraint ranking ONSACC » DEP which accounts for Accusative Nasalization cannot account for accusatives of vowel final stems. As with the discussion in chapter 4 concerning Gemination, the representation of the final feature as a segment with a root node is crucial for the correct outcome.

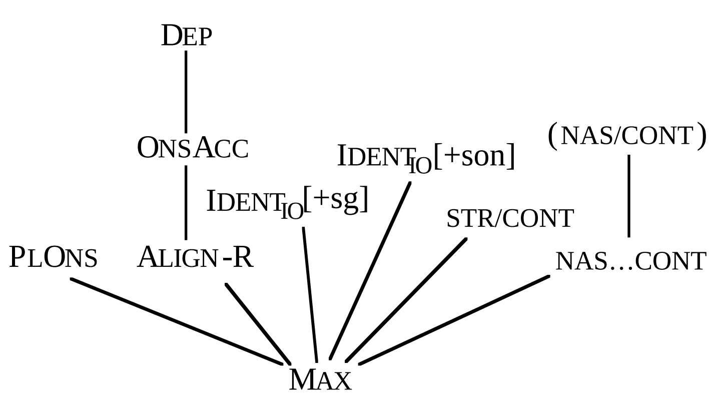
4.3. Summary

The analytical task of determining the ranking of ONSACC and DEP depended crucially on the representation of the morpheme-final nasal element. When this element was taken to be a floating feature the ranking required to get the Accusative Nasalization facts right (ONSACC » DEP) yielded false results for other cases not involving a final nasal element. Assuming that the final nasal element was a full segment required a ranking which not only got the Accusative Nasalization facts right, but also correctly accounted for cases where no such final element was present. For this reason, I conclude that morpheme final nasal elements in Gosiute are best represented as full segments.

5. Conclusion

The constraints invoked in this chapter show the ranking relations given in (31).

(31) Ranking relations



In this chapter I have provided an analysis of Nasalization in Gosiute. The homorganicity of NC clusters is primarily a consequence of the ranking of IDENT_{IO}ONS[Place] and PLONS above IDENT_{IO}[Place]; this ranking requires that place features be linked to an onset, thus prohibiting codas from having place features independent of onsets and that the place of the onset is preserved over the place features of the coda.

The deletion of the Nasalizing final feature is the result of low-ranking MAX. In heteromorphemic nasal-continuant sequences nasal deletion was shown to be in part the result of a sequential grounded constraint NAS…CONT. An explanation for nasal deletion before vowels was shown to follow from the ranking of PLONS and ALIGN-R above MAX. Nasal deletion before glides is the result of ranking IDENT_{IO}[+son] above MAX.

Finally, the decision to represent morpheme-final nasal elements as full segments received justification from an analysis of Accusative Nasalization. When the Nasalizing final feature is assumed to be a segment with root node, the ranking DEP » ONSACC » ALIGN-R yielded the correct outputs for Nasalizing stems and non-Nasalizing stems alike. Assuming Nasalization to be a floating feature led to a contradiction in which either the Nasalizing stems or the non-Nasalizing stems were accounted for, but not both at the same time.

Chapter 5: Aspiration

1. Introduction

In this chapter I discuss the final feature of Aspiration. Aspiration is the alternation of voiceless stops and voiceless fricatives following certain morphemes. In the examples in (1), the noun stems 'mother' and 'grandmother' begin with voiceless stops in isolation; when they follow the first person dual inclusive pronoun, the voiceless stop is replaced by a voiceless fricative of the same place of articulation.

(1) Aspiration and voiceless stops

[pia]	'mother'
[tawɨ̥ɸia]	'our (DU.INCL) mother'
[kaɣu]	'grandmother'
[tawɨ̥xaɣu]	'our (DU.INCL) grandmother'

There are similar alternations for nasals following these same morphemes. In (2), a stem-initial nasal alternates with a voiceless nasalized continuant; what is interesting about these segments is that the voicelessness is confined to the initial portion of the segment; that is, they consist of a voiceless-voiced sequence which I will transcribe as [hw̃] and [hɾ̃].[1]

(2) Aspiration and nasals

[moɾ̃appɨ]	'son-in-law'
[tawɨ̥hw̃oɾ̃appɨ]	'our (DU.INCL) son-in-law'
[nammi]	'younger sister'
[tawɨ̥hɾ̃ammi]	'our (DU.INCL) younger sister'

---

[1] A narrower, more accurate transcription of these segments would be [w̜̃] and [ɾ̜̃] using the IPA diacritic indicating voiceless onset but voiced release. I will continue to use the more traditional but less accurate transcriptions shown in (2) with the understanding that this convention indicates a single segment which is contoured with respect to voicing.

Aspiration as a final feature is unique to Central Numic (Tümpisa Shoshone, Shoshone, and Gosiute) and is a historical development of Proto-Numic Gemination. This is shown by the numerous cognates which Gosiute shares with the other Numic languages in which Gosiute has a voiceless fricative which corresponds to other languages' geminate voiceless stops (3).

(3) Numic cognates

Gosiute [exo], Kawaiisu [ekkuttsi]; 'pine cone hook'
Gosiute [aθ̠ḁɸɨ], Southern Paiute [attakɨpɨ]; 'jaw'
Gosiute [taɾ̃ixu], Kawaiisu [tanikku]; 'seed beater'

The historical origins of the voiceless fricatives in Central Numic lie in the interaction of the stress system and a regular pattern of vowel devoicing. Most of the Numic languages have an alternating stress pattern in which every other mora gets stressed. In Southern Paiute and Gosiute, stress is reckoned from left to right, in Mono from right to left. In Southern Paiute and Mono, every even mora gets stress, while in Shoshoni every odd mora gets stress (4).

(4) Stress by mora count in Numic

Gosiute:	µ́ µµ́ µµ́ µ …
Southern Paiute:	µµ́ µµ́ µµ́ …
Mono:	… µ́ µµ́ µµ́ µ

In Southern Paiute, short unstressed vowels are devoiced before geminate stops, which subsequently degeminate and become preaspirated. This is illustrated in (5).

(5) Southern Paiute voiceless vowels

… v̆pp … → … v̥ʰp …

The same process was at work in Central Numic; that is, short, unstressed vowels before geminates were devoiced and the geminate was degeminated and preaspirated. The preaspirated stops in Central Numic then became fricatives, yielding the distribution of voiceless fricatives currently found in Tümpisa Shoshone and in the various dialects Shoshone, including Gosiute.

The modern distribution of voiceless fricatives in Gosiute still show many traces of the historical situation. There are a handful of verbal suffixes which have two allomorphs: one beginning with a geminate voiceless stop, and one beginning with a voiceless fricative; the choice between the two is determined by the verb stem; some verbs take the geminate form of the suffix, while others take the suffix with the fricative.[2] In the non-verbal system, there is a single etymologically related pair which shows an alternation between a geminated voiceless stop and a voiceless fricative (6).

(6)	[tukku]	'meat, flesh'
	[pittu̥xu]	'buttocks'

In the modern language, there are many noun stems which bear the final feature of Aspiration without clear antecedents in the historical situation. In fact, modern words borrowed into the language are assigned an Aspirating final feature (7).

(7) Aspiration and new borrowings

atamoh	[aɾamo]	'automobile'
t̪θikinih	[t̪θiɣini̥]	'chicken'
monih	[moɾ̃i̥]	'money'
siːppɨh	[siːppɨ̥]	'sheep'

It is clear from these forms that Aspiration and the distribution of voiceless fricatives in Gosiute is more than the historical residue of a pre-Central Numic spirantization process.

This chapter has two goals. First, I will describe and account for the patterns of expression and silence which characterizes Aspiration as a final feature. Second, I will argue that Aspiration is best considered a full segment rather than a floating feature or latent segment. The structure of this chapter will closely parallel that of the previous chapter on Nasalization, since many of the same issues are involved; in particular, both final features

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[2]Miller (1993) has shown that the distribution of these suffixes with verb stems is not entirely lexicalized, but does show modern reflexes of Pre-Central-Numic stress patterns.

share the same pattern of expression and deletion, and both final features appear before the accusative suffix -a, contrary to the general pattern of pre-vocalic deletion. In section 2 I provide the descriptive generalizations to be accounted for. In section 3 I account for the alternations between stops and nasals on the one hand, and voiceless fricatives and clusters of [h] and nasalized continuants on the other. In section 4 I provide an account of the deletion of Aspiration phrase finally and before vowels, and in section 5 I discuss Accusative Aspiration. Section 6 summarizes the results of this chapter.

2. Description and Generalizations

As shown in (1), Aspiration involves the alternation of a voiceless stop with a voiceless fricative following certain morphemes. More examples are provided in (8).[3]

(8) Voiceless stops and Aspiration

/tawɨh/	[tawɨ̥]	'1st person dual inclusive'
/tawɨh kaku/	[tawɨ̥xaɣu]	'our (DUAL) grandmother (MoMo)'
/puih/	[pui]	'eye'
/puih-pai/	[puiɸai]	'have an eye'
/atamoh/	[aɾamo]	'car (< Eng. 'automobile')'
/atamoh-kappan/	[aɾamoxappa]	'inside the car'

Following the same morphemes, nasals alternate with nasalized continuants with a voiceless-voiced contour (9).

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[3]It is possible that the outcome of Aspiration is in fact a geminate voiceless fricative. Measurements of the duration of voiceless fricatives indicate that, while they are longer than voiced fricatives, they are not often as long as geminate voiceless stops. I will continue to assume singleton fricatives in this chapter.

(9) Nasals and Aspiration

/tawɨh/	[tawɨ̥]	'1st person dual inclusive'
/tawɨh nammi/	[tawɨ̥hɾ̃ammi]	'our (DUAL) younger sister'
/puih/	[pui]	'eye'
/puih-mai/	[puihw̃ai]	'with an eye'
/atamoh/	[aɾamo]	'car (< Eng. 'automobile')'
/atamoh-man/	[aɾamohw̃a]	'on (the side of) the car'

These same morphemes have no influence on any other following consonants or vowels. However, if a vowel preceding the Aspirating final feature is short, unstressed, and not part of a vowel cluster, it is regularly devoiced; before vowels and continuants then, this is the sole phonetic realization of Aspiration (10).

(10) Absence of Aspiration

/tawɨh ata/	[tawɨ̥ aɾa]	'our uncle (MoBr)'
/tawɨh sɨki/	[tawɨ̥ sɨɣi]	'our leaf'
/tawɨh hut̪t̪θi/	[tawɨ̥ hut̪t̪θi]	'our grandmother (FaMo)'
/tawɨh yaippɨ/	[tawɨ̥ yaippɨ]	'our mother-in-law'
/tawɨh wosa/	[tawɨ̥ wosa]	'our burden basket'

These patterns are similar to the patterns of alternation found in Nasalization in that both Aspiration and Nasalization target voiceless stops and nasals, and their effects are (largely) absent before vowels and continuants.

3. The analysis of Aspiration

In this section I provide an analysis of the descriptive generalizations made in section 2. In 3.1 I account for the alternation of voiceless stops and voiceless fricatives. In 3.2 I account for the alternation of nasals and clusters of [h] and nasalized continuants.

3.1. Aspiration and voiceless stops

In the discussion of Aspiration, I assume that the final feature is represented as a full segment, as in (11). Justification for treating Aspiration as a segment will come in section 5, where I will show that, parallel to the Nasalization case, the interaction of Aspiration and the accusative suffix provide compelling evidence that Aspiration has a root node, just like any other segment.

(11) Representation of final feature /h/

```
        /h/
         |
         •
         |
    LARYNGEAL
         |
[+spread glottis]
```

In (11), Aspiration is represented as a [+sg] feature ultimately dependent on a root node. In chapter 2 I argued that voiceless fricatives bear the feature [+sg], and that it is this feature which compels their voicelessness in order to satisfy the constraint SG/VOI.

Silverman (1997) contains an extended discussion of the patterns of overlapping and simultaneity of glottal gestures with other gestures such as place of articulation. He observes that languages will stagger or "phase" implementation of glottal gestures with respect to supralaryngeal gestures to optimize their perception. That is, no language will implement a laryngeal abduction gesture to exactly coincide with supralaryngeal closure, as in figure (12). In this figure, laryngeal adduction and the onset of voicing is timed to coincide with the release of the labial stop closure.

(12) Unattested realization of an aspirated "p" (Silverman 1997: 4)

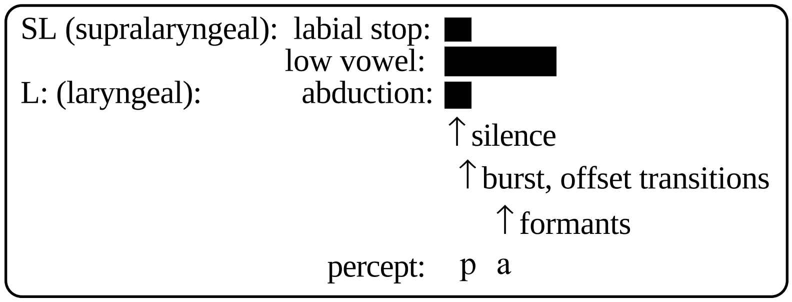
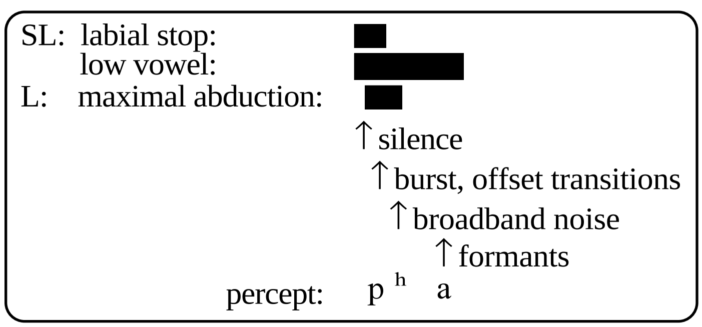


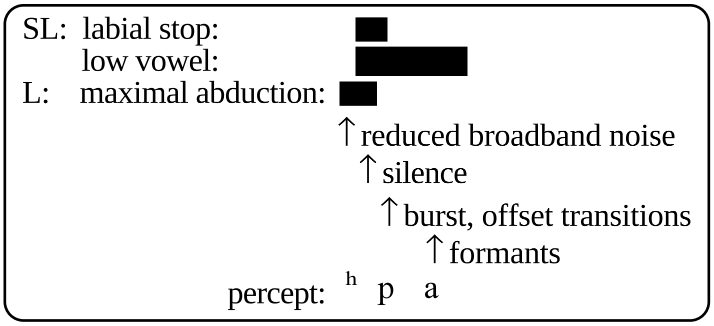
Figure (13) shows a gestural score for an optimally realized aspirated "p". In this gestural score, the laryngeal gesture significantly overlaps the bilabial closure but also extends beyond it. The onset of voicing thus lags behind the release of the labial closure; this optimizes the perception of laryngeal abduction.

(13) Optimal realization of an aspirated "p" (Silverman 1997: 5)



In (14), a less satisfactory realization of an aspirated "p" is shown. Again, the laryngeal gesture is staggered with respect to bilabial closure, but rather than following bilabial closure, in this case laryngeal abduction precedes it producing a pre-aspirated bilabial stop. This also makes the perception of laryngeal abduction possible.

(14) Sub-optimal realization of an aspirated "p" (Silverman 1997: 6)



Aspirated stops and voiceless fricatives are often related historically in languages around the world. In Classical Greek, there were three series of stops: voiced [b, d, g], voiceless [p, t, k], and voiceless aspirates [p^h, t^h, k^h]. By the end of the fourth century AD, however, the voiceless aspirates had become voiceless fricatives [ɸ, θ, x] (Horrocks 1997: 112-3).

Within the Indo-Iranian branch of Indo-European, where Sanskrit has voiceless aspirates, Avestan has voiceless fricatives (Baldi 1983).

(15) Sanskrit gát^hā-, Avestan gaθao 'song, verse'

In the Pomoan family of languages spoken in California, South Eastern Pomoan shows consistent voiceless fricative reflexes where the other languages have voiceless stops or voiceless aspirated stops (Grekoff 1964).[4]

(16) Proto-Pomoan to Eastern Pomoan

Proto-Pomo	Southern	South Western	South Eastern	gloss
*ʔihp^há	ī́'pa	—	fa	intestines
*ʔahq^há	á'ka	aká	xa	water
*q^hahbé	ká'be	kabé	xabé	rock
*q^halé	kále	kalé	xalé	tree

[4]My thanks to Mauricio Mixco for bringing this data to my attention.

In each case, the change proceeds from an aspirated stop to a voiceless fricative. I propose that this change is due to the grounding constraint found in (17).[5]

(17) SG/CONT: 'If [+sg] then [+cont]; if [+sg] then *not* [–cont].'

On the phonetic side, if post-aspiration is a better realization of [+sg] than pre-aspiration, then the simultaneous realization of [+sg] with place of articuation cues is even better, provided that the consonant is a continuant. This is the option selected by Gosiute and the other Central Numic languages, and this is the imperative expressed in the constraint in (17).

I assume the activity of a general constraint which prohibits consonants devoid of place of articulation features. This constraint in defined in (18).

(18) *NOPL: Consonants without place of articulation features are prohibited.

In Gosiute, this constraint has unusually wide application. Comparative work in Central Numic shows that in many cases Gosiute cognates of Central Numic forms with initial [h] lack this consonant altogether.

(19) [h]-less cognates in Gosiute

Western Shoshone	Gosiute	gloss
[huːppi]	[uːppi]	'stick'
[huittšuː]	[uittšuː]	'small bird'

A further constraint which is involved in Aspiration is given in (21). This constraint militates against geminate voiceless fricatives; it was introduced in chapter 3, section 4.2.3. It is ranked above UNIFORMITY.

(20) *FF: 'Avoid geminate fricatives.'

[5]This grounding constraint is the continuancy counterpart to the grounding constraint SG/VOI introduced in section 3.4.2 of chapter 2.

The constraints in (17), (18), and (20) interact with IDENT$_{IO}$[+sg] to yield the optimal output from a candidate competition arising from the input of an Aspirating final feature and a voiceless stop. The tableau in (21) illustrates.

(21) Aspiration and voiceless stops

	/haih$_1$p$_2$ai/	IDENT$_{IO}$ [+sg]	*NOPL	SG/CONT	*FF	UNIF
a.	haip$_1$p$_2$ai	*!				
b.	haih$_1$p$_2$ai		*!			
c.	haip$^h{}_1$p$^h{}_2$ai			*!		
d.	haiϕ$_1$ϕ$_2$ai				*!	
e. ☞	haiϕ$_{1,2}$ai					*

In the tableau, UNIFORMITY is ranked below the other constraints introduced in this section. Candidate (21e), which satisfies all of the top-ranked constraints wins, in spite of its violation of UNIFORMITY.

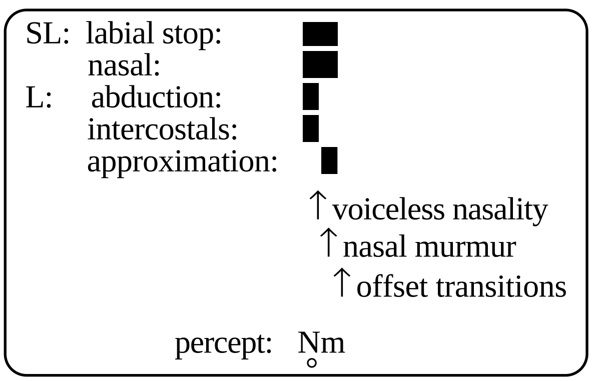
3.2. Aspiration and nasals

The constraints introduced thus far yield the result that the simultaneous expression of obstruent place of articulation and [+sg] is optimized when the obstruent is a continuant. In this case, place of articulation cues are not seriously compromised by the addition of the feature [+cont]. However, when laryngeal abduction occurs with a nasal, there is a dramatic decrease in energy which may obscure the perception of place of articulation cues (Ladefoged and Maddieson 1996: 107-8, Silverman 1997: 86). Therefore the simultaneous expression of laryngeal abduction and nasal place of articulation represents a suboptimal configuration for the recoverability of these features. If the laryngeal abduction gesture is truncated with respect to the nasal gesture and sequenced with respect to voicing such that the latter portion of the nasal is realized with modal voice, the acoustic cues for laryngeal abduction and for place of articulation can be recovered. Silverman (1997: 87) puts it this way:

> The laryngeal abduction may be sequenced to the left of voicing, resulting in early voicelessness followed by late modal phonation: [n̥n]. Here, recovery is optimal: acoustic energy increases incrementally. Alternatively, breathy phonation may be implemented at the latter portion of the nasal: [nn̤].

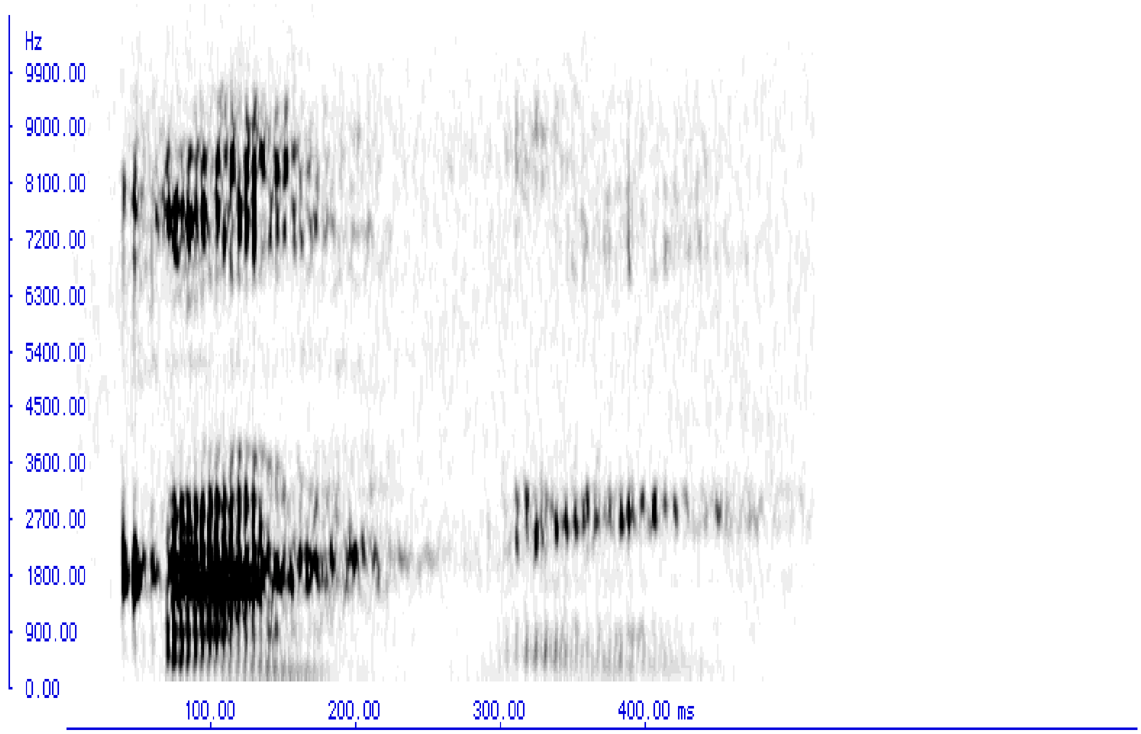
The figure in (21) shows a gestural score for a Burmese voiceless nasal, taken from Silverman (1997: 88); note that while labial and nasal gestures are present through the duration of the sound, the laryngeal abduction is phased to the beginning and is truncated, presenting the acoustic profile of a voiceless-voiced nasal sequence.

(22) Gestural score for a Burmese voiceless labial nasal (Silverman 1997: 88)



This is precisely the situation in Gosiute. The segment resulting from Aspiration of a nasal stop shows the effects of this phasing. The laryngeal abduction gesture is shortened with respect to the whole segment and is confined to the onset phase. The release is voiced and allows the perception of place of articulation cues—thus the common transcription of these segments is as clusters of [h] and a nasalized continuant. In (23), I show a spectrogram of [kar̜̃i] 'house'. Voicing bars begin at about 280 ms, indicating the voiceless-voiced transition of the nasalized continuant.

(23) Spectrogram of [kaɾ̥̃i] 'house'



k a ã ɾ̥̃ ɾ̃ i

In the tableau in (24), I show the constraint interaction involved in the selection of the optimal output of an Aspiration-nasal input.

(24) Aspiration and voiceless stops

	/puih$_1$m$_2$ai/	IDENT$_{IO}$ [+sg]	*NOPL	SG/CONT	*FF	UNIF
a.	puim$_1$m$_2$ai	*!				
b.	puih$_1$m$_2$ai		*!			
c.	puim̥$_1$m$_2$ai			*!		
d.	puiw̥̃$_1$w̃$_2$ai				*!	
e. ☞	puiw̥̃$_{1,2}$ai					*

In the tableau shown in (24), the constraints already proposed for Aspiration and voiceless stops are sufficient to achieve the desired results. Again, candidate (24e) emerges as the winner; the low-level phonetic effects of phasing account for the perception of the voiceless nasalized glide as a voiceless-voiced contour.

4. Aspiration and Deletion

In this section, I provide an account for the absence of a segmental reflex of Aspiration in surface forms. Aspiration is absent on the surface in the following environments: phrase-finally, before vowels, and before continuants. In this respect, Aspiration is like Nasalization, which is also absent in these environments. However, Aspiration can be expressed on the immediately preceding vowel, in which case the vowel surfaces as voiceless. This vocalic expression is obligatory when the vowel is short, unstressed and not part of a vowel cluster or sequence. In section 4.1 I discuss phrase-final Aspiration deletion; in section 4.2 I discuss pre-vocalic and pre-continuant Aspiration deletion. Section 4.3 provides a short summary.

4.1. Phrase-final Aspiration Deletion

I begin by discussing phrase-final Aspiration deletion. Analogous to Nasalization, the Aspirating final feature disappears at the end of a phrase.

(25) Phrase-final absence of Aspiration

sɨmme ɣia suɾɨ išaβaippɨ̥
sɨmme kian sutɨn isapaippɨh
thus maybe that Coyote
'Coyote said something like that.'

pɨaišɨ wa:ɣo akku̥hɾ̃a:kku̥
pɨaisɨn wa:ko akkuh na: -kkuh
already Frog there be -COMPL
'Frog got ahead of him.'

wa:ɣo βɨiši akku̥
wa:ko pɨisɨn akkuh
Frog already there
'Frog was already there.'

While the consonant [h] is absent from surface forms, there are other phonetic reflexes of Aspiration, namely the devoicing of the immediately preceding vowel, when that vowel is short, unstressed, and not part of a cluster. This devoicing is the result of merging of the Aspirating final feature with the vowel to its immediate left; in Optimality Theoretic terms, this entails a violation of UNIFORMITY. Other constraints which come into play are *NOPL, MAX, and IDENT_{IO}[+sg], each of which is ranked above UNIFORMITY, as shown in the tableau in (26).

(26) {*NOPL, IDENT_{IO}[+sg], MAX} » UNIFORMITY

	/tawɨ₁h₂/	*NOPL	IDENT_{IO} [+sg]	MAX	UNIFORM
a.	$\text{taw}ɨ_1h_2$	*!			
b. ☞	$\text{taw}ɨ̥_{1,2}$				*
c.	$\text{taw}ɨ_{1,2}$		*!		*
d.	$\text{taw}ɨ̥_2$			*!	

In the tableau in (26), any violation of *NOPL, IDENT_{IO}[+sg], or MAX disqualifies a candidate. Candidate (26b) emerges as the winner in this competition in spite of its UNIFORMITY violation, since it satisfies all of these high ranking constraints.

4.2. Prevocalic and Precontinuant Aspiration Deletion

In this section, I count for the deletion of Aspiration in prevocalic and precontinuant positions. Recall from chapter 3 that the constraint ALIGN-R ensured that the right edges of syllable and morpheme boundaries coincide (27).

(27) ALIGN (Morph, R; σ, R) (ALIGN-R): For every morpheme there is a syllable such that the right edge of the morpheme and the right edge of the syllable coincide.

Adding this constraint to the set of constraints ranked above UNIFORMITY achieves the desired results; the Aspirating final feature is absent as a separate consonant in prevocalic and precontinuant positions.

(28) Pre-vocalic Aspiration

	/tawɨ$_1$h$_2$ ata/	*NOPL	IDENT$_{IO}$ [+sg]	MAX	ALIGN-R	UNIFORM
a.	tawɨ$_1$h$_2$a$_3$ɾa	*!				
b. ☞	tawɨ̥$_{1,2}$a$_3$ɾa					*
c.	tawɨ$_{1,2}$a$_3$ɾa		*!			*
d.	tawɨ̥$_1$a$_3$ɾa			*!		
e.	tawɨ$_1$ḁ$_{2,3}$ɾa				*!	*

In this tableau the winning candidate, (28b), coalesces the Aspirating final feature and the immediately preceding vowel into a voiceless vowel. In spite of this violation of UNIFORMITY, this candidate is the winner since any violation of any one of *NOPL, IDENT$_{IO}$[+sg], MAX or ALIGN-R is sufficient to eliminate a candidate from competition.

The same constraints account for pre-continuant Aspiration deletion as well. This is illustrated in the tableaux in (29).

(29) Pre-continuant Aspiration

	/tawɨ$_1$h$_2$ w$_3$osa/	*NOPL	IDENT$_{IO}$ [+sg]	MAX	ALIGN-R	UNIF
a.	tawɨ$_1$h$_2$w$_3$osa	*!				
b. ☞	tawɨ̥$_{1,2}$w$_3$osa					*
c.	tawɨ$_{1,2}$w$_3$osa		*!			*
d.	tawɨ̥$_2$w$_3$osa			*!		
e.	tawɨ$_1$w$_{2,3}$osa		*!			
f.	tawɨ$_1$w̥$_{2,3}$osa				*!	*

Again, in this tableau, candidate (29b) wins in spite of the UNIFORMITY violation incurred by the coalescence of the Aspirating final feature and the preceding vowel, since any violation of a higher ranked constraint is sufficient to remove a candidate from competition.

4.3. Summary

In this section I have accounted for the absence of a consonantal reflex for Aspiration in phrase-final, pre-vocalic and pre-continuant positions. The preservation of underlying [+sg] and input segments as well as the proper alignment of syllable and morpheme boundaries conspire to yield the correct outcome in which the Aspirating final feature merges with the immediately preceding vowel.

5. Accusative Aspiration

In this section I discuss an apparent exception to the pre-vocalic deletion of Aspiration, discussed above in section 4.2. This exceptional pattern occurs as a result of the suffixation of the accusative suffix -a. In (30a) Aspiration is realized as a geminate voiceless fricative when the postposition -pan, 'on (top of)' is suffixed to the stem. In (30b) Aspiration doesn't surface as a separate consonant because the following morpheme is vowel-initial. In (30c), Aspiration is realized before the accusative suffix -a.

(30) Accusative Aspiration

a.	t̪θiɣini̥ɸa	'on top of a chicken'
b.	t̪θiɣini̥ oyɨsɨ	'(the) chicken also'
c.	t̪θiɣini̥ha	'chicken-ACC'

Recall from the discussion in section 4.2 that the Aspirating final feature doesn't surface when followed by a vowel-initial morpheme. The accusative pattern is different in that the stem-final nasal element *is* realized before the accusative suffix in a pattern that I will refer to as Accusative Aspiration, paralleling Accusative Nasalization in chapter 4. Since the following discussion parallels that of Accusative Nasalization, I will only present the arguments in brief form; section 5 of chapter 4 contains a fuller presentation of the issues involved.

5.1. Accusative Aspiration: the basic pattern

In (31), more examples are given of Accusative Aspiration. Each form in (31) is given in the nominative (uninflected), accusative, and either with a postposition or the verbalizing suffix, 'have X' (realized in the examples in (31) as [-bai]), to demonstrate that the stem does in fact have an Aspirating final feature.

(31) Accusatives and Aspirating stems

a.	[pui]	'eye'
	[puiha]	'eye-ACC'
	[puiɸai]	'have an eye'
b.	[ai]	'crow'
	[aiha]	'crow-ACC'
	[aiɸai]	'have a crow'
c.	[sappɨ̥]	'belly'
	[sappɨ̥ha]	'belly-ACC'
	[sappɨ̥xuppa]	'inside the belly'

These forms should be compared with those in (32), which demonstrate the accusative pattern on stems devoid of a final feature. In each of these stems, the accusative surfaces as a bare vowel without an intervening consonant, demonstrating that the accusative suffix consists of only the vowel [a].

(32) Gosiute Accusative -*a*

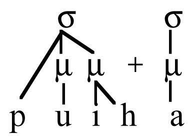
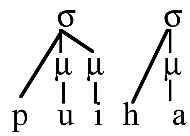
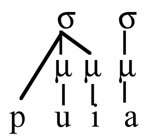
a.	[t̪θoː] [t̪θoːa]	'great-grandparent' 'great-grandparent-ACC'
b.	[poe] [poea]	'road, path' 'road-ACC, path-ACC'
c.	[ižappɨ] [ižappɨ]	'coyote' 'coyote-ACC'
d.	[appɨ] [appɨa]	'father' 'father-ACC'

If the accusative suffix consists only of a single vowel, the expected outcome of suffixation on an Aspirating stem would be that the Aspirating final feature remain mute; this was the result of section 4.2. However, the fact that Aspiration surfaces with the accusative suffix suggests that this suffix prefers to have an onset. This is expressed in the constraint in (33), which was introduced in the discussion on Accusative Nasalization found in section 4 of chapter 4.

(33) ONSACC: The accusative suffix -*a* has an onset.

This constraint is ranked above ALIGN-R. If ALIGN-R requires the right edges of morphemes and syllables to coincide, then ONSACC is in direct conflict with it since it demands that the syllable to which the accusative suffix belongs reaches across the morpheme boundary to find an onset, in this case the Aspirating final feature. The candidate competition is illustrated in the tableau in (34).

(34) ONSACC » ALIGN-R

	ONSACC	ALIGN-R
a. ☞ 		*
b. 	*!	

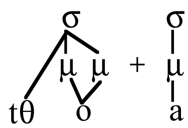
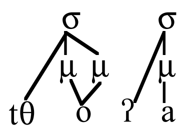
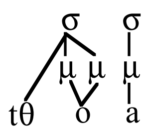
In (34), candidate (34b) violates ONSACC since the accusative suffix is allowed to surface without an onset. This is a sufficiently serious violation to merit the elimination of this candidate, given the ranking of the constraints. Candidate (34a) however, satisfies ONSACC by syllabifying the Aspirating final feature as the onset for the accusative suffix. This prosodic parse entails a violation of ALIGN-R since there is a mismatch between morpheme and syllable boundaries on the right edge, but this constraint violation is not serious enough to prevent the selection of (34a) as the optimal candidate.

In addition to the Faithfulness constraint MAX prohibiting deletion of an underlying segment, there is a constraint DEP which prohibits insertion of segments which are not present in underlying representation. As with MAX, I assume that by 'segment' is meant the root node and its associated features. In languages with epenthesis, DEP is violated regularly to rescue otherwise ill-formed prosodic structures. DEP is defined in (35).

(35) DEP: An output segment has a correspondent in the input.

The accusative forms given in (32) show that the constraint DEP must be ranked above ONSACC, since none of these forms provides the accusative suffix with an onset; this is shown in the candidate competition in (36) for the form in (32a) t̪θo:a 'great-grandparent-ACC'.

(36) DEP » ONSACC

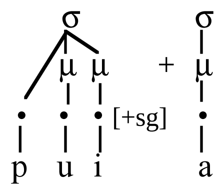
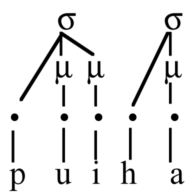
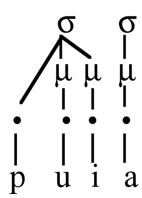
	DEP	ONSACC
a. 	*!	
b. ☞ 		*

In the tableau in (36), insertion of a consonant in (36a) to satisfy ONSACC results in a violation of higher-ranking DEP. Candidate (36b) avoids this violation at the cost of an ONSACC violation. Since DEP is ranked above ONSACC the candidate satisfying it (36b) is preferred over (36a) which violates it, in spite of its violation of ONSACC. The constraint hierarchy DEP » ONSACC » ALIGN-R thus correctly accounts for the attested patterns of accusative formation in Gosiute under the assumption that the Aspirating final feature is a full segment. This ranking of these three constraints in fact follows from this assumption.

5.2. Accusative Aspiration and floating [+sg]

The alternative to a segmental analysis of final features is to assume that they are latent segments consisting of floating features not linked to a root node (see figure (9)). If Aspiration is a floating [+sg] feature underlyingly, then ONSACC must outrank DEP, as shown in (32) for the input /pui^{h}-a/ 'eye-ACC'.

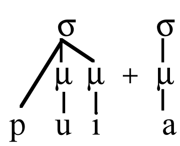
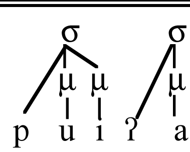
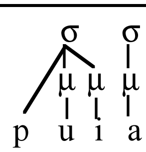
(37) ONSACC » DEP

	ONSACC	DEP
a. ☞ 		*
b. 	*!	

In this tableau, the correct prediction is made; the accusative suffix gains an onset because of high ranking ONSACC at the cost of the insertion of a root node, a violation of DEP. Under this ranking, candidate (37a) is the winner.

However, things go wrong when considering an input which contains the accusative form of a noun stem devoid of a final feature. This is demonstrated in (38).

(38) ONSACC » DEP: incorrect prediction

	ONSACC	DEP
a. ✘ 		*
b. (☞) 	*!	

In this tableau, pressure from top-ranked ONSACC forces the insertion of a segment which was not present in underlying representation. However, this is not what occurs in Gosiute, as shown by the forms in (32); the accusative suffix on a noun without a final feature surfaces without an onset. This cannot be captured with the constraint ranking in (37) and (38), arising from the assumption that Aspiration is a latent segment. Therefore, the assumption that Aspiration is a segment, and the constraint hierarchy which this entails (DEP » ONSACC » ALIGN-R), must be correct.

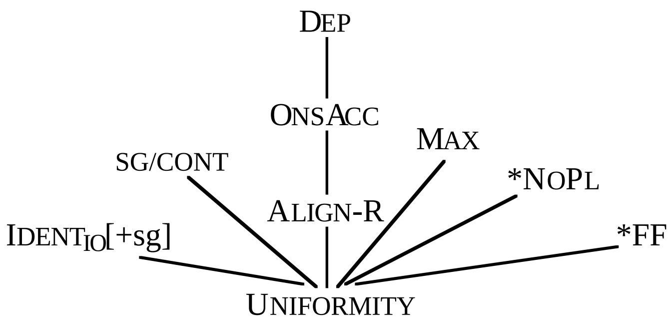
5.3. Summary

In this section, I have provided evidence from the interaction of the accusative suffix and the Aspirating final feature to show that this final feature is a segment with a root node. The analytical task of determining the ranking of ONSACC and DEP depended crucially on the representation of Aspiration. When the Aspirating final feature was taken to be a floating feature the ranking required to get the Accusative Aspiration facts right (ONSACC » DEP) yielded false results for stems without a final feature. Assuming that the Aspirating final feature was a full segment required a ranking which not only got the Accusative Aspiration facts right, but also correctly accounted for cases where no such final element was present. For this reason, I conclude that final features in Gosiute are best represented as full segments.

6. Conclusion

In this chapter I have provided descriptive and analytical accounts of the behavior of the Aspirating final feature. The constraint ranking which accounts for the behavior of this final feature is given in (39) below.

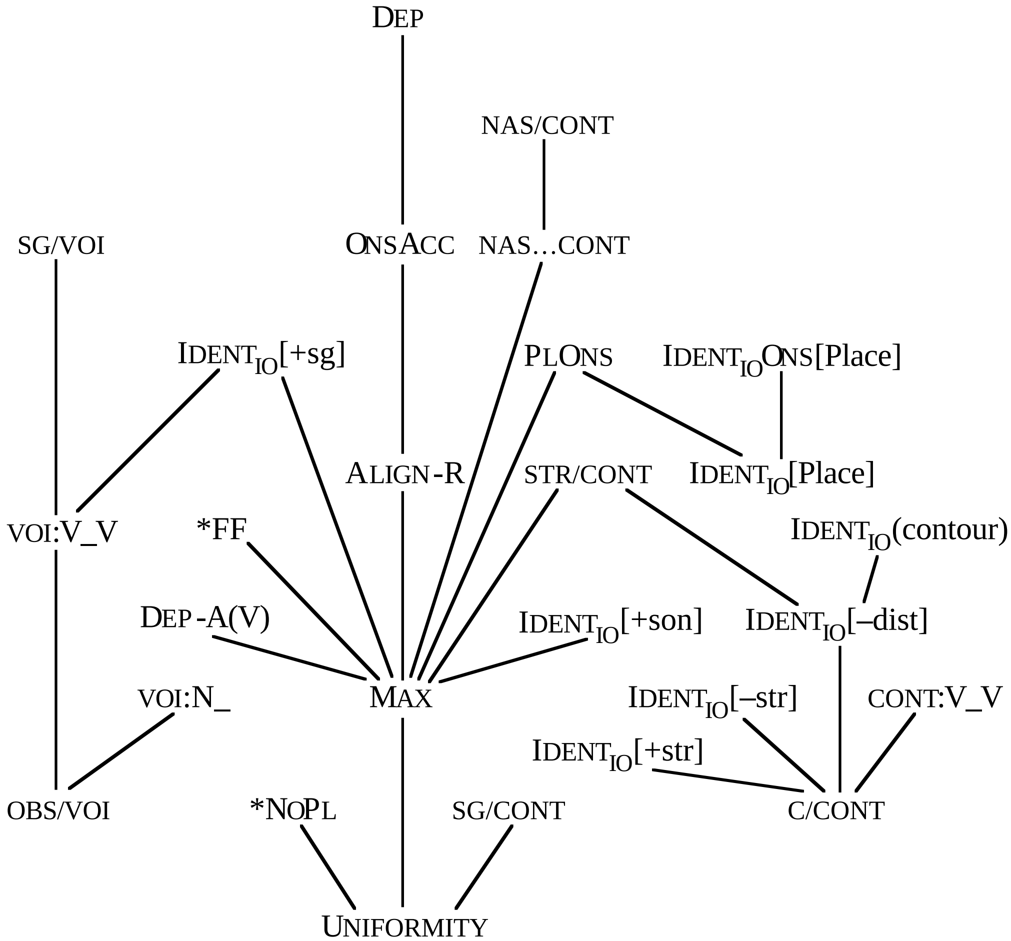
(39) Ranking relations for the constraints involved in Aspiration



The "spine" of this constraint ranking, DEP » ONSACC » ALIGN-R » UNIFORMITY, accounts for the interaction between the Aspirating final feature and the accusative suffix, as discussed in section 5. The other constraints are each in a ranking relation only with the constraint UNIFORMITY. In each case, satisfaction of the higher-ranked constraint resulted in the deletion of Aspiration as a segment and its coalescence with a preceding vowel or following consonant segment.

The ranking relations of the constraints established in chapters 2-5 are combined in the following figure.

(40) Final features constraint ranking



In this figure, the prominent role of Grounding and Positional Grounding in the analysis of the final feature system of Gosiute is apparent in the number of constraint rankings which have at their roots the grounding constraints. The ranking CONT/V_V » C/CONT captures the significant generalization that consonants are continuants when intervocalic and stops otherwise (see chapter 2, section 2). The exceptional behavior of stridents is the result of ranking IDENT_{IO}[+str] above C/CONT. Taps were shown to be continuants and to therefore be subject to the same generalizations as other continuants.

The central generalizations regarding the distribution of voicing is expressed in the ranking {VOI:V_V, VOI:N_} » OBS/VOI. This ranking captures the generalization that consonants are voiced when i) intervocalic, or ii) following a nasal. This generalization is tempered by the behavior of fricatives; fricatives may be either voiced or voiceless when intervocalic. In section 3.4 of chapter 2 I discussed the voicing properties of fricatives and showed there that the relevant contrast in Gosiute fricatives is one involving the feature [spread glottis] rather than [voice]. In constraint terms, this constrast is expressed by high-ranking IDENT$_{IO}$[+sg]. Ranking the grounding constraint SG/VOI above VOI:V_V insures that such segments are [–voice] on the surface.

The analyses for the final features Gemination, Nasalization, and Aspiration build on the foundational analysis of the distribution of continuancy and voicing. Central to these accounts are the patterns of expression and silence which the final features exhibit. Generally speaking, final features are phonetically realized before stops and nasals, and are silent elsewhere. In the constraint hierarchy this is espressed by the relative rankings of MAX and UNIFORMITY with markedness and featural faithfulness constraints.

Finally, in chapters 3-5 I have argued that the final features are best represented as segments with root nodes. For Gemination, this argument comes from representational considerations. Based on the non-moraic nature of codas in Gosiute I concluded that the most consistent representation for geminates is the two-root structure proposed in Selkirk (1990). Furthermore, based on the surface distribution of the Geminating final feature I concluded that Gemination must involve a root node and should therefore be considered a segment. For Nasalization and Aspiration the argument for segmental status was based on the interaction of the final features with the accusative suffix, as presented in section 4 of chapter 4 and section 5 of the present chapter.

In the following chapter I discuss alternation and distributional patterns among the coronal consonants of Gosiute which are conditioned by front vowels. While these patterns are not directly related to the final features, they are interesting in their own right and properly belong in a discussion of the consonants of this language.

Chapter 6: Fronting and Palatalization

1. Introduction

In Gosiute, coronal obstruents are found in distributional patterns which depend upon 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):

(1) Gosiute Fronting

a. dental: [sit̪t̪u] 'here' (si- 'PROXIMAL' -ttu 'LOCATIVE STEM')
b. alveolar: [sattu] 'here' (sa- 'DISTAL' -ttu 'LOCATIVE STEM')

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

(2) Gosiute Palatalization

a. palato-alveolar: [moɣittši̥] 'bag' (moɣi 'bag' -t̪t̪θi̥ 'ABSOLUTIVE')
b. interdental: [poniat̪t̪θi̥] 'skunk' (ponia 'skunk' -t̪t̪θi̥ 'ABSOLUTIVE')

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

(3) Morpheme-internal Fronting in Gosiute

a. dental: [nit̪t̪oi] 'sing'
b. alveolar: [potto] 'grinding stone'

(4) Morpheme-internal Palatalization in Gosiute

a. palato-alveolar: [huittšu] 'small bird'
b. interdental: [hut̪t̪θi] '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) Gosiute coronals following front vowels

a.	Fronting	[t̪] ⟵	/t/		
b.	Palatalization	/t̪θ/	⟶	[tš]	
		(dental)	(alveolar)	(palato-alveolar)	

In fact, from figure (5) it is plain to see that not only are coronals moving in opposite directions in the same environment, but that they cross paths: an alveolar stop becomes *dental* following a front vowel, but an inter*dental* affricate in the same environment becomes palato-alveolar.

In this chapter I analyze these alternation patterns as two steps of a chain shift. 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 (6).

(6) 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 identy 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 (see King 1969: 194-200 on early generative accounts of chain shifts). In the informal analysis of Fronting and Palatalization given in (7), Palatalization is ordered before Fronting.

(7) Rule-based approach to Fronting and Palatalization

a. Palatalization
dental → palato-alveolar / $\underset{\text{[-back]}}{\text{V}}$ __

b. Fronting
alveolar → dental / $\underset{\text{[-back]}}{\text{V}}$ __

While a rule-based approach accounts for the facts, it splits up a unified phenomenon into a set of formally unrelated rules. The following comment from McLaughlin (1987) expresses this failing of rule-based approaches in the analysis of Fronting and Palatalization:

> "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.)

A different problem posed by chain shift phenomena arises in non-derivational theories of phonology 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 OT, however, these intermediate levels are unavailable; an OT 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. In this chapter I provide an account of how

Local Conjunction in the Gosiute constraint set provides a unified and constrained account of both Fronting and Palatalization.

The remainder of this chapter is organized as follows. In section 2 I argue that Fronting in Gosiute is the result of a general phonological requirement on coronals to bear the feature [+distributed] in the environment of a front vowel. In section 3 I argue that Gosiute Palatalization is the result of a requirement on coronals in the environment of a front vowel to bear the feature [+strident]. In section 4 I show how the Local Conjunction of constraints in the Gosiute constraint set limits the distance between input and output forms to produce a chain shift pattern. This chapter concludes in section 5.

2. Fronting and [+distributed]

In this section I analyze Fronting in Gosiute as the result of a general, cross-linguistic requirement on coronals to bear the feature [+distributed] in the environment of a front vowel. In 2.1 I provide the data and generalizations to be accounted for, and in 2.2 I give an analysis which proposes that the correct distributional pattern is between laminal and apical coronal consonants; the change in place of articulation is a by-product of the apical-laminal contrast. A short summary is provided in 2.3.

2.1. Fronting data and generalizations

Fronting in Gosiute involves the complementary distribution of alveolar and dental obstruents; dentals occur following front vowels, and alveolars occur elsewhere. The data in

(8) illustrates this pattern.[1] In (8a), voiced alveolar taps and voiced dental fricatives occur between vowels; dental fricatives follow [i] or [e], and alveolar occur taps elsewhere. In (8b), voiced alveolar and dental stops occur following homorganic nasals; dental nasal-stop clusters follow [i], and alveolar nasal-stop clusters occur elsewhere. In (8c), voiceless alveolar taps and voiceless dental fricatives occur between vowels; dental fricatives follow [i] and [e], and alveolar taps occur elsewhere. Finally, in (8d), 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.

(8) Gosiute Fronting: complementary distribution of dental and alveolar consonants

	{i, e} __		elsewhere	
a.	[piðɨ]	'to arrive'	[pɨɾa]	'arm'
	[peðɨ]	'daughter, niece (SiDa)'	[aɾa]	'uncle (MoBr)'
			[poɾo]	'stick'
			[nuɾaː]	'to run-PL.SUBJ'
b.	[tain̪d̪ɨ]	'hole'	[kɨndu]	'yesterday'
			[pandɨi]	'killdeer'
			[ondɨ]	'brown'
			[nasundaw̃a]	'to remember'
c.	[piθuː]	'to be stung by a bee'	[towɨɾ̥ia]	'to pour'
			[aɾ̥aɸɨ]	'jaw'
d.	[nit̪t̪oi]	'to sing'	[kʷɨtti]	'to shoot'
			[pattu]	'dead-fall trap'
			[potto]	'grinding stone'
			[uttappɨ̥]	'fine dust'

In (9), I provide examples of the conditioned alternation of dental and alveolar consonants in suffixes following a stem-final front vowel.

[1]In addition to Fronting, the data in (8) adhere to the generalizations concerning voicing and continuancy and that in (9) show the now familiar effects of the final features; see chapters 2-5 for discussions and analyses of these patterns.

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

{i, e} __		elsewhere	

a. -*(*n*)*tui 'future'

[nukki-n̪d̪ui]	'will run'	[naːɾɨa-ɾui]	'will race'
[hanni-ðui]	'will use'		

b. -tɨ 'generic aspect'

[hiβi-ðɨ]	'drinking'	[kaɾɨ-ɾɨ]	'sitting'
[pekkai-ðɨ]	'killing'	[tɨkka-ɾɨ]	'eating'

c. -tɨ 'participle'

[wattsɨwi-θɨ̪̥]	'four'	[sɨːmaː-ɾ̪̥ɨ]	'ten'
[maneɣi-θɨ̪̥]	'five'		
[naːɸai-θɨ̪̥]	'six'		

d. -*ttu* 'locative stem'

[si-t̪t̪u]	'here'	[sa-ttu]	'there'
[se-t̪t̪u]	'here'		

The alveolar obstruents in the first column of both (8) and (9) 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.[2] The alternation of Fronting thus reduces to an alternation between laminals and apicals; laminals follow front vowels and apicals occur elsewhere. Using [t̪] and [t] as cover symbols for the dental and alveolar consonants under discussion here, the figure in (10) summarizes their distribution.

(10) Distribution of dental and alveolar consonants

i, e __	elsewhere
laminal [t̪]	apical [t]

[2]These articulatory observations were made by speakers of the language reporting and commenting on their own pronunciation of the sounds under investigation.

2.2. Analysis of Fronting

I turn now to an analysis in terms of distinctive features to account for the distribution of dental and alveolar consonants in Gosiute. 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 Fronting entails the equation of [+distributed] and laminal (= dental), and [–distributed] and apical (= alveolar).[3] Figure (11) shows the feature matrix for the consonants involved in Fronting.

(11) Feature matrix for Gosiute dental and alveolar consonants

	t	t̪
anterior	+	+
strident	-	-
distributed	-	+

In featural terms, Fronting involves a change in the value of [distributed] from "-" to "+":

(12) Fronting

$$\underset{\begin{bmatrix}\text{COR}\\ \text{-dist}\end{bmatrix}}{\text{t}} \rightarrow \underset{\begin{bmatrix}\text{COR}\\ \text{+dist}\end{bmatrix}}{\text{t̪}}$$

[3]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.

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 (13) captures this generalization:

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

This constraint is an example of sequential grounding (Archangeli and Suzuki 1995; Suzuki 1995, 1997). Sequential grounding was introduced in chapter 4, where the constraint NAS…CONT played a role in the analysis of the behavior of the Nasalizing final feature. Briefly, for any grounded condition X/Y prohibiting the cooccurence of X and Y in a path, there is a *sequential* constraint which prohibits X and Y in adjacent paths. This constraint is abbreviated X…Y, and is universally lower-ranked than the constraint X/Y. Thus for the constraint FR…DIST there is a higher-ranked constraint FR/DIST which prohibits [–back] and [+distributed] from cooccuring in the same path.[4]

Support for constraints with substantive content similar to that of (13) can be found in the Australian languages, where there are intimate connections between dentals and palato-alveolars. For example, in Yukultu, described in Keen (1983), a noun stem-final /t/ alternates with laminal [t̪] or [t^j] when followed by a suffix which begins with /i/. When the vowel preceding stem-final /t/ is /i/, then the alternant is [t^j] (14a); otherwise the alternant of /t/ is /t̪/ (14b). In both cases, an apical alternates with a laminal in the environment of a following front vowel.

[4]The feature [–back] is usually construed as a vocalic feature and [+distributed] as a consonantal feature, so on first sight it may seem unusual to posit a grounding condition which would prohibit these features from cooccuring in a path. However, recent work in Feature Geometry suggests that consonants may also bear vocalic features depending from a V-Place node. See Clements and Hume (1995) for a summary of such proposals.

(14) Yukultu Laminalization

a.	ŋit-a wood-ABS	ŋit^j-iɭu wood-ALL
b.	ʈaŋkawalat-a man+plenty-ABS	ʈaŋkawalat̪-iɭu man+plenty-ALL
	jaɭput-a meat-ABS	jaɭput̪-iɭu meat-ALL

Figure (15) summarizes this alternation pattern; figure (16) gives a feature matrix for Yukultu coronals:

(15) t^j / i __ + i
t̪ / a,u __ + i
t / elsewhere

(16) Feature matrix for Yukultu coronals:

	t̪	t^j	t	ʈ
distributed	+	+	–	–
anterior	+	–	+	–
high		+		

The Yukultu alternation pattern is very similar to Gosiute Fronting. In both languages the presence of [+distributed] is conditioned by a [–back] vowel. The major difference between the two languages is that in Yukultu, the conditioning front vowel follows the alternating obstruents, rather than preceding them as in Gosiute.

Additional support for the front vowel-laminal coronal connection is provided by South Greenlandic Eskimo (SGE: Swadesh 1946). In this language there are distributional patterns involving apicals and laminals which are conditioned by a front vowel. The inventory of coronal obstruents is given in (17); the descriptions "point" and "blade" are Swadesh's own.

(17) Southern Greenlandic Eskimo coronal inventory (Swadesh 1946: 31)

dental	alveolar	
point	point	blade
t		
	s̺	s

There is a regular alternation between [t] and [s̺] between vowels; both alternants are apical, or "point" to use Swadesh's term (p32; no examples are given). In addition, there is an alternation between [t] and [s] (laminal or "blade") following an [i] in a preceding syllable (p33); this [i] is distinguished from a separate vowel [ĭ], which is phonetically identical to [i] but which has no laminalizing effect upon [t] (18) (see Kaplan 1981 and Underhill 1976 for discussion of this vowel in other dialects).

(18) a. akisik /aki-tik/ 'the coat of two of you'
nipitik /nipĭ-tik/ 'the voice of two of you'

b. aɣɣiɣsuq /aɣɣiq-tuq/ 'he who comes'
qanittuq /qanĭt-tuq/ 'he who is close'

Again, the distinction between laminal and apical is conditioned by a high front vowel showing that the Gosiute pattern is not unique.

Satisfaction of FR…DIST comes 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 the *identity* of corresponding elements (McCarthy and Prince 1995). In this case the constraint is IDENT$_{IO}$[–dist], defined in (19):

(19) IDENT$_{IO}$[–dist]: An output segment specified [–distributed] has an input correspondent specified [–distributed].

Ranking FR…DIST above IDENT$_{IO}$[–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 (20).

(20) Ranking: FR…DIST » IDENT$_{IO}$[–dist]

<table>
<tr><th></th><th>/hittoː/
|
[-dist]</th><th>FR…
DIST</th><th>IDENT$_{IO}$
[–dist]</th></tr>
<tr><td>a. ☞</td><td>hit̪t̪oː
|
[+dist]</td><td></td><td>*</td></tr>
<tr><td>b.</td><td>hittoː
|
[-dist]</td><td>*!</td><td></td></tr>
</table>

In the tableau in (20) candidate b. preserves an underlying [-dist] at the cost of violating the higher ranked FR…DIST; candidate a. on the other hand fails to preserve underlying [-dist] but satisfies FR…DIST and is therefore chosen by the constraint hierarchy as optimal.

2.3. Summary of Fronting

In this section I have provided an account of Fronting in Gosiute. This analysis rests on the observation that laminals and apicals are in complementary distribution; 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].

3. Palatalization and [+strident]

In this section I analyze Palatalization in Gosiute as the result of a general, cross-linguistic requirement on coronals to be [+strident] in the environment of a front vowel. In 3.1 I provide the data and generalizations to be accounted for, and in 3.2 I give an analysis which proposes that the correct distributional pattern is between strident and non-strident coronal consonants. A short summary is provided in 2.3.

3.1. Palatalization data and generalizations

Palatalization in Gosiute is a distributional pattern involving two *laminal* obstruents; palato-alveolar obstruents follow front vowels while interdental obstruents occur elsewhere. In (21a), voiced interdental fricatives and voiced palato-alveolar fricatives occur between vowels; palato-alveolar fricatives follow [i] and [e], and interdental fricatives occur elsewhere. In (21b), 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 (21c), 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.

(21) Gosiute Palatalization

	{i, e} __		elsewhere	
a.	[ižappɨ]	'coyote'	[ɨðɨ]	'to stink'
	[ežikko]	'sling shot'	[paði]	'older sister'
			[moðo]	'beard, whiskers'
			[huðiðoː]	'shin'
b.	[mawiñdžoːɣo]	'bracelet'	[tɨn̻d̻ðoː]	'hand game bones'
			[wan̻d̻ði]	'buck antelope'
			[moːn̻d̻ði]	'domesticated onion'
			[tuɣun̻d̻ðia]	'raspberry'
c.	[huittšuː]	'small bird'	[hɨt̻t̻θippɨ̥]	'saliva'
	[pettšɨ]	'holler-DUR'	[wat̻t̻θɨwiθɨ̥]	'four'
			[pot̻t̻θi]	'hop, jump'
			[hut̻t̻θi]	'grandmother (FaMo)'

In (22), alveolar [s] is in complementary distribution with palato-alveolar [š].

(22) {i, e} __ elsewhere

[išaβaippɨ̥]	'Coyote'	[pɨːsi]	'body hair, fur'
[kʷeši]	'tail'	[kasa]	'wing'
		[tosa]	'white'
		[kusippɨ̥]	'ashes'

The data in (23) provides examples of the conditioned alternation of dental and palato-alveolar obstruents in suffixes following a stem-final front vowel.

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

{i, e} __ elsewhere

a. -t̪t̪θi̥ 'absolutive'

[moɣi-ttšɨ̥]	'bag'	[aɾaŋgu-t̪t̪θi̥]	'red ant'
		[ponia-t̪t̪θi̥]	'skunk'

b. -t̪t̪θi 'diminutive'

[kahni-ttši]	'little house'	[appɨ-t̪t̪θi]	'dear father'

In addition to the Palatalization data in (23), there are also alternations between [s] and [š] at morpheme boundaries; [š] follows a front vowel, and [s] occurs elsewhere (24).

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

{i, e} __ elsewhere

a. -sɨ 'demonstrative stem'

[i-šɨ]	'this'	[u-sɨ]	'that'
[e-šɨ]	'this'	[a-sɨ]	'that'

b. -sɨ 'emphatic'

[pɨe-šɨ]	'already'	[oyɨ-sɨ]	'always'

Figure (25) summarizes the distributional patterns in (21-22) and the alternations in (23-24).

(25)

	i, e ___	elsewhere
Palatalization:	laminal [tš]	laminal [t̪θ]
	laminal [š]	apical [s]

In the next section I show that these patterns are the result of pressure placed on coronals to be [+strident] when following a front vowel.

3.2. Analysis of Palatalization

Dentals and palato-alveolars are commonly described in featural terms as [+distributed]. In addition, palato-alveolars share with [s] the feature [+strident]. Thus, all of the segments involved in Gosiute Palatalization are specified as either [+distributed] or [+strident] or both; in (26) I give the feature matrix for these segments.

(26)

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

The analysis of the [s] ~ [š] pattern shown in (21) and (23) is the same as that for Fronting; in both cases an apical coronal alternates with a laminal coronal. In constraint terms, FR…DIST is ranked above IDENT$_{IO}$[–dist] (27):

(27) FR…DIST » IDENT$_{IO}$[–dist]

/pɨe-sɨ/ | [-dist]	FR…DIST	IDENT$_{IO}$ [–dist]
a. ☞ pɨešɨ | [+dist]		*
b. pɨesɨ | [-dist]	*!	

In (27), the candidate which satisfies high-ranking FR…DIST is selected over the candidate which preserves an underlying [-distributed], a pattern familiar from Fronting (see (20)).

The distributional pattern involving dentals and palato-alveolars shown in (22) and (24) is not governed by the constraint FR…DIST, since both dentals and palato-alveolars are already specified [+distributed]; In Palatalization it is the value for [strident] which is conditioned by a following front vowel. This generalization is captured in the constraint given in (28).[5]

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

Support for constraints similar to (28) can be found in the alternation in Finnish known as Assibilation (Anttila 1989: 83-4, 219-20; Kiparsky 1993: 282-3, 285-8). In Assibilation [t] and [s] alternate before a following [i] in morphologically conditioned environments (29):

(29) Finnish Assibiliation:

past tense:

halusi	/halut-i/	'want-PAST'
tilasi	/tilat-i/	'order-PAST'
tunsi	/tunte-i/	'know-PAST'

partial nominal paradigms:

	nominative	essive	stem	gloss
	vesi	vete-nä	/vete/	'water'
	käsi	käte-nä	/käte/	'hand'
cf.	koti	koti-na	/koti/	'home'

In verbs, the addition of the past tense suffix *-i* conditions the alternation of *t* and *s*. The partial nominative paradigms show the effects of a more general alternation in which *e* is raised to *i* word-finally; it is this derived *i* which conditions the alternation of *t* and *s*.

[5]While this constraint is less convincing as a sequential grounding constraint, it is clear that there is an intimate connection between [–back] and [+strident], as shown by the Finnish example below. See Bhat (1978: 57-58) for examples of this relationship from other languages.

In featural terms, the feature [+strident] is added to the feature matrix for [t] when followed by a high, front unrounded vowel (in this case, the past tense suffix -*i*). While an OT analysis of the Finnish data would take me too far afield because of the complexities of the morphological conditioning, it is apparent that a constraint similar to (28) plays a role in Assibilation, lending support to its use in Gosiute Palatalization.

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 IDENT$_{IO}$[–str], defined in (29):

(29) IDENT$_{IO}$[–str]: An output segment specified [–strident] has an input correspondent specified [–strident].

For the effects of FR…STR to be seen, it must be ranked above IDENT$_{IO}$[–str]. These constraints are added to the constraints already existing; their interaction is illustrated in the tableau in (30).

(30) FR…STR » IDENT$_{IO}$[–str]:

[-str] | /huit̪t̪θuː/ | [+dist]	FR…DIST	FR…STR	IDENT$_{IO}$ [–str]	IDENT$_{IO}$ [–dist]
a. ☞ [+str] | huittšuː | [+dist]			*	
b. [-str] | huit̪t̪θuː | [+dist]		*!		
c. [+str] | huittsuː | [-dist]	*!	*!	*	*
d. [-str] | huittuː | [-dist]	*!			*

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 satifies both of them (huittšuː).

3.3. Summary of Palatalization

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 (30) is still instructive.

4. Chain Shifts and 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 IDENT$_{IO}$[–str]; this was demonstrated in (30). However, the effects of this same ranking are disasterous for simple Fronting (31).

(31) disaster

	[-str] | /nittoi/ | [-dist]	FR…DIST	FR…STR	IDENT$_{IO}$ [–str]	IDENT$_{IO}$ [–dist]
a. ✘	[+str] | nittšoi | [+dist]			*	*
b.(☞)	[-str] | nit̪t̪oi | [+dist]		*!		*
c.	[+str] | nittsoi | [-dist]	*!	*!		
d.	[-str] | nittoi | [-dist]	*!	*!		

In (31) 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 in coronal obstruents which is characteristic of a chain shift. In Fronting a plain apical alveolar becomes laminal, adding [+dist]; and in Palatalization a laminal dental affricate becomes a laminal palato-alveolar affricate, adding [+strident] (32a). The constraint hierarchy in (30) and (31) cannot capture this stepwise alternation pattern; it requires an "all-or-nothing" change, so that both plain apical [t] and interdental [t̪θ] both become [tš] following front vowels (32b).

(32) a. Attested stepwise pattern:

Fronting (alveolar → dental)	Palatalization (dental → palato-alveolar)
t → t̪	t̪θ → tš
[COR] → [COR, +dist]	[COR, +dist] → [COR, +str, +dist]

b. Unattested "all-or-nothing" pattern:

t , t̪θ → tš

[COR] , [COR, +dist] → [COR, +str, +dist]

The problem is that adding one of [+distributed] or [+strident] is fine, 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 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 by definition ranked above both of its constituent constraints and is violated only in the case where both of the 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 IDENT constraints IDENT$_{IO}$[–str] and IDENT$_{IO}$[–dist] are conjoined into a single constraint, IDENT$_{IO}$[–str] &$_{loc}$ IDENT$_{IO}$[–dist] (=IDENT(S&D)). The conjoined constraint IDENT(S&D) is violated only in the case where both IDENT$_{IO}$[–str] and IDENT$_{IO}$[–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 (33).

(33) Gosiute Palatalization: {IDENT(S&D), FR…DIST, FR…STR} » {IDENT$_{IO}$[–str], IDENT$_{IO}$[–dist]}

[-str] | /huit̪t̪θuː/ | [+dist]	IDENT (S&D)	FR…DIST	FR…STR	IDENT$_{IO}$ [–str]	IDENT$_{IO}$ [–dist]
a. ☞ [+str] | huittšuː | [+dist]				*	
b. [-str] | huit̪t̪θuː | [+dist]			*!		
c. [+str] | huittsuː | [-dist]	*!	*!		*	*
d. [-str] | huittuː | [-dist]		*!	*!		*

In (33), any violation of FR…DIST or FR…STR will eliminate a candidate from competition; in this respect it is identical to the tableau in (30). Additionally, since candidate c. violates both IDENT_{IO}[–str] and IDENT_{IO}[–dist] on the same segment it receives a violation mark for the conjoined constraint IDENT(S&D). However, since either ranking of IDENT(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.

In constrast to (33), the constraint competition illustrated in (34) is clear in demonstrating the role played by the conjoined constraint in the selection of the correct output.

(34) Gosiute Fronting: {IDENT(S&D), FR…DIST} » FR…STR

	[-str] | /nittoi/ | [-dist]	IDENT (S&D)	FR…DIST	FR…STR	IDENT_{IO} [–str]	IDENT_{IO} [–dist]
a.	[+str] | nittšoi | [+dist]	*!			*	*
b. ☞	[-str] | nit̪t̪oi | [+dist]			*		*
c.	[+str] | nittsoi | [-dist]		*!		*	
d.	[-str] | nittoi | [-dist]		*!	*		

Candidates c. and d. both violate high-ranking FR…DIST; these violations remove them from competition. Because candidate a. violates both IDENT_{IO}[–str] and IDENT_{IO}[–dist] on the same segment, it also violates high-ranking IDENT(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 (35).

(35) $\left\{\begin{matrix}\text{IDENT(S\&D)} \\ \text{FR…DIST}\end{matrix}\right\}$ » FR…STR » $\left\{\begin{matrix}\text{IDENT}_{IO}\text{[–str]} \\ \text{IDENT}_{IO}\text{[–dist]}\end{matrix}\right\}$

5. Conclusion

In this chapter I have shown that the alternations of Fronting and Palatalization in Shoshoni reduce to alternations between laminal and apical coronals. The constraint FR…DIST captures the generalization that laminals occur following front vowels, while apicals occur elsewhere. The change in place of articulation from alveolar to dental on the one hand, and from alveolar to palato-alveolar on the other, is a by-product of the laminal/apical alternation. The constraint FR…DIST was shown to be plausible on cross-linguistic grounds; similar alternations are found in Yukultu and South Greenlandic Eskimo. Extending the analysis to Gosiute necessitated the positing of the constraint FR…STR requiring obstruents to bear the feature [+strident] when following a front vowel. Again, cross-linguistic evidence bears this move out. Alternations which were previously thought to be unrelated (or unrelateable) now admit of a single, simple explanation.

The analysis presented here has several implications. First, I have shown that alternations like Fronting and Palatalization, which seemingly must involve a change of place of articulation can be accounted for purely in terms of the articulatory contrast between laminals and apicals. Second, Gosiute provides support for the analysis of chain shifts by invoking the formal device of Local Conjunction of constraints. Only by Local Conjoining constraints can the Gosiute alternations be accounted for. Finally, a typological picture of the interaction of front-vowels and coronals is emerging from the data presented here; on the one hand there are languages like Shoshoni, Yukultu, and South Greenlandic Eskimo in which the distinction between laminal and apical is senstive to the presence of front vowels; and on the other hand, languages like Finnish show that sibilants are sensitive to the presence of front vowels. Gosiute is unique in this typology by displaying both types of behavior.

Chapter 7: Concluding Remarks

1. Introduction

In this dissertation, I have provided a comprehensive account of the phonological behavior of the consonants of Gosiute. The data and their analysis are of theoretical interest on several fronts. In this concluding chapter I wish to summarize some of the theoretical points made in this dissertation. I begin in section 2 with a brief recapitulation of the role of Grounding in the analysis of Gosiute consonants. In section 3 I discuss the idea of Richness of the Base and its implications for Gosiute underlying forms. In section 4 I discuss the role of representations in Optimality Theory, as illustrated by the analysis of the final features. In section 5 I address the issue of the role of phonetics in a phonological analysis. Section 6 provides a brief conclusion.

2. Grounding

Central to the account of Gosiute consonants which I have provided in this dissertation is the analysis of the distributional properties of continuancy and voicing given in chapter 2. The central generalizations were that non-strident fricatives only occur intervocalically (1a), while stops occur in all other positions (1b-d); and that voiced obstruents only occur intervocalically or when following nasals (2a, b), while voiceless obstruents occur elsewhere (2c, d).

(1) a. intervocalic fricatives

[tɨβa]	'pine nut'
[peðɨ]	'daughter'
[poɾo]	'digging stick'
[kaɣu]	'grandmother (MoMo)'
[yɨɣʷi]	'to say something'

b. phrase-initial stops

[pia]	'mother'
[t̪θoː]	'beads'
[tua]	'son'
[kaɣu]	'grandmother (MoMo)'
[kʷasu]	'shirt'

c. stops in geminates

[moppo]	'mosquito'
[hut̪t̪θi]	'grandmother (FaMo)'
[potto]	'grinding stone'
[takka]	'snow'
[ekkʷi]	'smoky color'

d. stops following homorganic nasals

[yamba]	'wild carrot'
[wan̪d̪ði]	'antelope fawn'
[ondɨ]	'brown'
[puŋgu]	'horse, pet'
[peŋgʷi]	'fish'

(2) a. intervocalic voiced obstruents

[tɨβa]	'pine nut'
[peðɨ]	'daughter; niece (SiDa)'
[eɣo]	'tongue'
[yɨɣʷi]	'to say something'

b. voiced stops

[yamba]	'wild carrot'
[wan̪d̪ði]	'antelope fawn'
[ondɨ]	'brown'
[puŋgu]	'horse, pet'
[peŋgʷi]	'fish'

c. voiceless stops in phrase-initial position

[pia]	'mother'
[t̪θoː]	'beads'
[tua]	'son'
[kaɣu]	'grandmother (MoMo)'
[kʷasu]	'shirt'

d. voiceless stops in geminates

[moppo]	'mosquito'
[hut̪t̪θi]	'grandmother (FaMo)'
[potto]	'grinding stone'
[takka]	'snow'
[ekkʷi]	'smoky color'

The generalizations illustrated by (1-2) are summarized in (3).

(3) Voicing and continuancy generalizations

	stops		fricatives	
	[+voi]	[–voi]	[+voi]	[–voi]
initial		✔		
geminate		✔		
N_	✔			
V_V			✔	✔

I showed in chapter 2 that constraints mandating the preservation of underlying values for continuancy and voicing play little role in the surface distribution of these features. Rather, their expression and distribution depend on constraints which are grounded in the phonetic plausibility of the surface patterns; that is, in cross-linguistic tendencies and sympathetic articulatory gestures. In formalizing this account, I made use of the theory of Grounding proposed and defended in Archangeli and Pulleyblank (1994); this is the source of constraints such as C/CONT and OBS/VOI. I also demonstrated the need for grounding constraints which take position into account. For example, while obstruents generally prefer to be voiceless, intervocalic position is a natural place for voiced obstruents (Westbury and Keating 1986); this observation is the source for the constraint VOI:V_V. When these positionally grounded constraints are ranked above context-free grounded constraints, the result is expression of positionally determined phonetic patterns, such as intervocalic or post-nasal voicing. In the ranking in (4a), high ranking CONT:V_V requires intervocalic consonants to be continuants; otherwise, consonants are stops. In (4b), consonants which are intervocalic or post-nasal are voiced; otherwise they are voiceless.

(4) Continuancy and voicing constraint rankings

a. Continuancy: CONT:V_V » C/CONT

b. Voicing: {VOI:N_, VOI:V_V} » OBS/VOI

The generalizations of (3) thus fall out from the interaction of the grounding constraints shown in (4).

3. Richness of the Base

Richness of the Base is the idea that any kind of representation may serve as an input in an Optimality Theoretic grammar; since Optimality Theory is an output-oriented model, what matters is that the output is correct (Prince and Smolensky 1993: 191, Archangeli and Langedoen 1997: 203-4). Therefore, any input which leads to a correct output should be permitted. The tableaux in (5) provide a concrete illustration of this principle.

(5) Different inputs, same output

	input	candidates	VOI:N_	OBS/ VOI	IDENT (voi)
a.	/ontɨ/	i. [ontɨ]	*!		
		ii. ☞ [ondɨ]		*	*
b.	/ondɨ/	i. [ontɨ]	*!		*
		ii. ☞ [ondɨ]		*	

In (5), the presence of the IDENT constraint makes no difference in the outcome of the candidate competition. In particular, it doesn't matter if the input is taken to have a voiced post-nasal stop or a voiceless post-nasal stop; the output is the same in either case.

In discussions of the nature of the input, the idea of Richness of the Base has usually preceded discussion of Lexicon Optimization (Prince and Smolensky 1993, chapter 9; Ito, Mester, and Padgett 1995). Lexicon Optimization takes the set of possible inputs (any of which lead to the desired output) and selects a single input, using the method of the *tableau de tableaux*. Applying Lexicon Optimization to the tableaux in (5) would give /ondɨ/ as the most harmonic input. This is shown via the tableau de tableaux in (6).

(6) Tableau de tableaux

	input	candidates		VOI:N_	OBS/ VOI	IDENT (voi)
a.	/ontɨ/	i.	[ontɨ]	*!		
		ii. ☞	[ondɨ]		*	*
b. ☞	/ondɨ/	i.	[ontɨ]	*!		*
		ii. ☞	[ondɨ]		*	

The input-output pair /ondɨ/-[ondɨ] is selected by the tableau de tableaux as more harmonic since this input-output mapping lacks an IDENT(voi) violation which is incurred by the pair /ontɨ/-[ondɨ]. If this operation is part of Universal Grammar, it has implications for learnability. Prince and Smolensky (1993: 191) speculate that if Lexicon Optimization were part of Universal Grammar, children learning a language would never posit underlying forms which never appear on the surface. That is, given a constraint ranking such as that in (5) and (6), and the possible inputs in (6), the child would never retain (6a) as the input form for the output [ondɨ] 'brown'. This appears to be a reasonable position. However, data on Gosiute acquisition is lacking, and is likely never to be forthcoming since the language is no longer being learned by children. For this reason I have not pursued Lexicon Optimization in this dissertation. The constraint ranking which was established for Gosiute (see chapter 5, section 6) allows for a fair amount of variation in the range of possible inputs, each of which may be characterized by containing only a bare minimum of necessary specification in order to yield the desired and attested output forms.

4. The role of representations in OT

In chapters 3 through 5 I argued that final features are complete with root nodes, rather than being floating features or latent segments. There are two kinds of arguments which were brought to bear on this issue. First, in chapter 3 I provided an argument based on representational considerations that Gemination should be a root node. I showed there that geminate consonants in Gosiute cannot be represented as moraic since they have no effect on the stress pattern of the language, which is mora-counting. I also argued that since Gemination only affects consonants, a root node must be involved, given the structure of the root node argued for by McCarthy (1988). The only alternative is to represent geminates as two root structures linked to the same set of features (Selkirk 1990), and Gemination thus as a root node.

The second argument for the segmental status of final features came from the interaction of Nasalization and Aspiration and the accusative suffix -*a*. Assuming that Nasalization is best represented by a full segment yields the constraint ranking DEP » ONSACC, which requires the accusative suffix to have an onset, but prohibits the insertion of a segment to bring this about. This forces the Nasalizing and Aspirating final features to be realized before the accusative as full segments. Assuming Nasalization and Aspiration to be floating features necessitates the insertion of a root node to provide the accusative suffix with an onset. This requires the ranking ONSACC » DEP. This ranking in turn demands the insertion of a default consonant for the accusative forms of stems which are devoid of a final feature in order to provide the accusative suffix with an onset; this does not happen in the language, however. Therefore the assumption that final features are full segments with the concomitant ranking DEP » ONSACC is shown to be correct.

5. Why isn't this just phonetics?

A great many of the constraints proposed for this account of the consonantal phonology of Gosiute are rooted in phonetic naturalness and plausibility. This invites the question, "So why isn't it *all* phonetics?" The alternations discussed in chapters 3-5 only apply to non-verbal stems. Some verbs show traces of a Nasalizing final feature, but this only appears with certain tense/aspect suffixes, usually ones which are /t/-initial. In (7) I show some examples of the future suffix and a residual Nasalizing final feature.

(7) residual Nasalization

a.	/nukki-tui/	[nukkiṇḍui]	'will run'
	/tɨkka-tui/	[tɨkkaɾui]	'will eat'
b.	/nukki-tɨn/	[nukkiðɨ]	'running'
	/nukki-tɨn/	[tɨkkaɾɨ]	'eating'

In (a), the verb stem /nukki/ seems to have a Nasalizing final feature, since the future suffix -tui surfaces with an initial nasal-stop cluster. It obviously doesn't inhere in the suffix, as shown by the form [tɨkkaɾui] 'will eat', in which the future suffix surfaces without Nasalization. However, Nasalization is not present when the generic aspect suffix -tɨn follows the verb stem nukki 'run'. While this verb appears to have a Nasalizing final feature, it certainly doesn't behave in the way described in chapter 4.

There are two points to be made with this example. First, Nasalization surfaces only with certain suffixes and is absent with all others; this is not phonetic behavior. Second, the fact that verbal stems seem to be outside of the regular final features system is also unexpected. Clearly, there are residual traces of final features on verbs; the examples in (7) demonstrate this. However, the system is far from regular; it is clearly not phonetic behavior. An analysis which seeks to explain verbal final feature alternations may well use phonetically motivated constraints; doing so, however, does not oblige one to toss out phonology in an effort to let phonetic considerations do all of the work.

6. Conclusion

This final chapter has summarized some of the theoretical issues which arose in the account of Gosiute consonants given in this dissertation. Whether or not Optimality Theory survives into the 21st century as a viable theoretical model, the phonological phenomena of Gosiute will provide a good proving ground for phonological theory, and any model of phonology will have to come to grips with its intricate surface patterns.

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