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'
[tawi̥ɸia]	'our (DU.INCL) mother'
[kaɣu]	'grandmother'
[tawi̥xaɣu]	'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 [hr̃].[1]

(2) Aspiration and nasals

[mor̃appɨ]	'son-in-law'
[tawi̥hw̃or̃appɨ]	'our (DU.INCL) son-in-law'
[nammi]	'younger sister'
[tawi̥hr̃ammi]	'our (DU.INCL) younger sister'

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[1]A narrower, more accurate transcription of these segments would be [w̥̃] and [r̥̃] 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 [aθ̪a̤ɸɨ], 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 … → … y̥^{h}p …

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'
si:ppɨh	[si:ppɨ̥]	'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).

[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/	[tawɨ̥hr̃ammi]	'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 huʈ̈ʈ̈θi/	[tawɨ̥ huʈ̈ʈ̈θi]	'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.

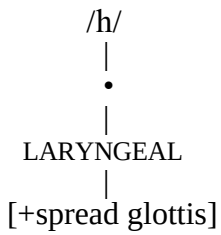
3. The analysis of Aspiration

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/



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)

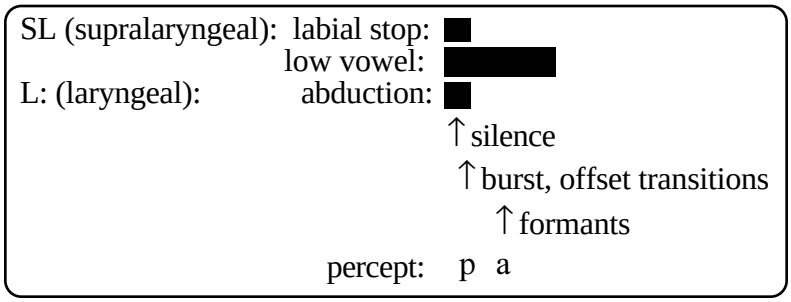
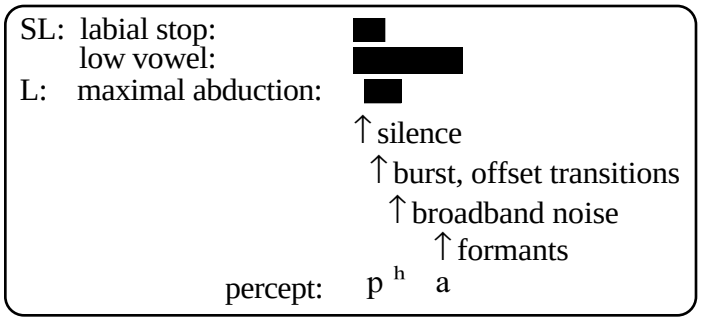


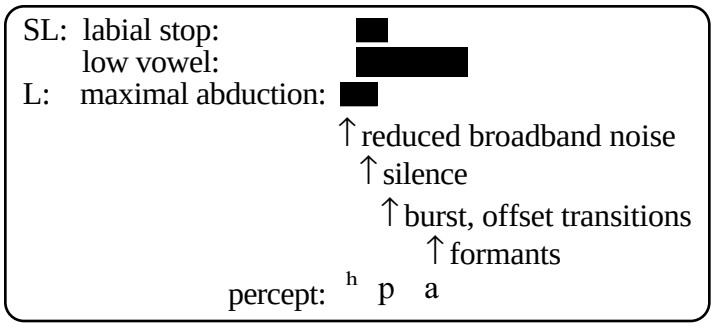
Figure (13) shows a gestural score for an optimally realized aspirated "p". In this gestural score, the laryngeal gesture significantly overlaps the bilabial closure but also extends beyond it. The onset of voicing thus lags behind the release of the labial closure; this optimizes the perception of laryngeal 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 gát͡t^hā-, Avestan ga͡θao '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
*ʔihp͡^{h}á	í'pa	—	f͡a	intestines
*ʔahq͡^{h}á	á'ka	aká	x͡a	water
*q͡^{h}ahbé	ká'be	kabé	x͡abé	rock
*q͡^{h}alé	kále	kalé	x͡alé	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.'

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[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.	haiɸ$_1$ɸ$_2$ai				*!	
e. ☞	haiɸ$_{1,2}$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

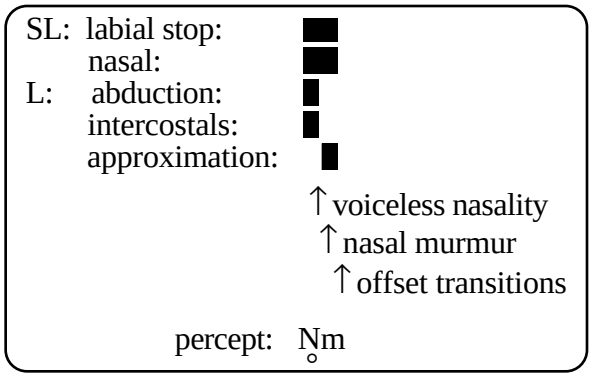
The constraints introduced thus far yield the result that the simultaneous expression of obstruent place of articulation and [+sg] is optimized when the obstruent is a continuant. In this case, place of articulation cues are not seriously compromised by the addition of the feature [+cont]. However, when 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: [nn̥].

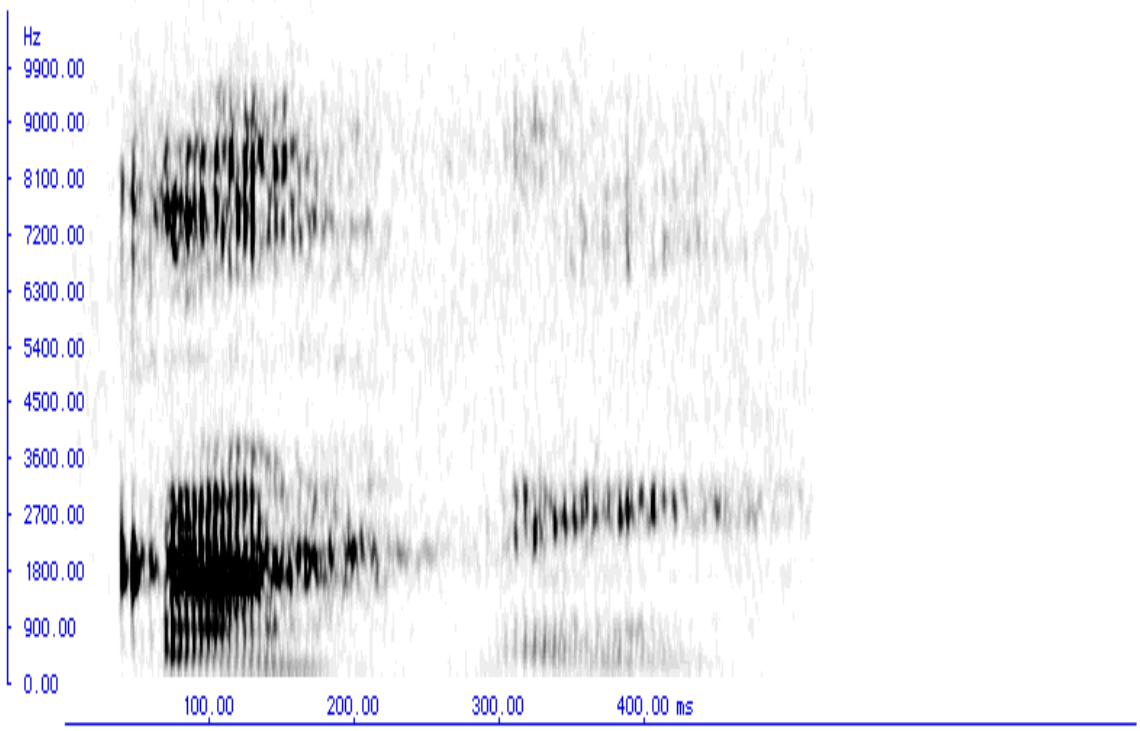
The figure in (21) shows a gestural score for a Burmese voiceless nasal, taken from Silverman (1997: 88); note that while labial and nasal gestures are present through the duration of the sound, the laryngeal abduction is phased to the beginning and is truncated, presenting the acoustic profile of a 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 [kaɲ̥i] 'house'. Voicing bars begin at about 280 ms, indicating the voiceless-voiced transition of the nasalized continuant.

(23) Spectrogram of [kar̥̃i] 'house'



k a ã r̥̃ 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.	puim$_1$m$_2$ai			*!		
d.	puiw̥̃$_1$w̥̃$_2$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 surɨ išaβaippɨ̥
simme kian sutin isapaippih
thus maybe that Coyote
'Coyote said something like that.'

pɨaiši wa:ɣo akkṵhr̃a:kkṵ
pɨaisin wa:ko ak̊kuh na:̥ -kkuh
already Frog there be -COMPL
'Frog got ahead of him.'

wa:ɣo βɨiši akkṵ
wa:ko pɨisin ak̊kuh
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) $\left\{ \begin{array}{c} \text{*NOPL} \\ \text{IDENT}_{\text{IO}}\text{[+sg]} \\ \text{MAX} \end{array} \right\}$ » UNIFORMITY

	/tawɨ$_1$h$_2$/	*NOPL	IDENT_{IO} [+sg]	MAX	UNIFORM
a.	tawɨ$_1$h$_2$	*!			
b. ☞	tawɨ$_{1,2}$				*
c.	tawɨ$_{1,2}$		*!		*
d.	tawɨ$_2$			*!	

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. ☞	tawɨ$_{1,2}$a$_3$ɾa					*
c.	tawɨ$_{1,2}$a$_3$ɾa		*!			*
d.	tawɨ$_1$a$_3$ɾa			*!		
e.	tawɨ$_1$a$_{2,3}$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. ☞	tawi̥$_{1,2}$w$_3$osa					*
c.	tawɨ$_{1,2}$w$_3$osa		*!			*
d.	tawi̥$_2$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 oɣɨsɨ	'(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*

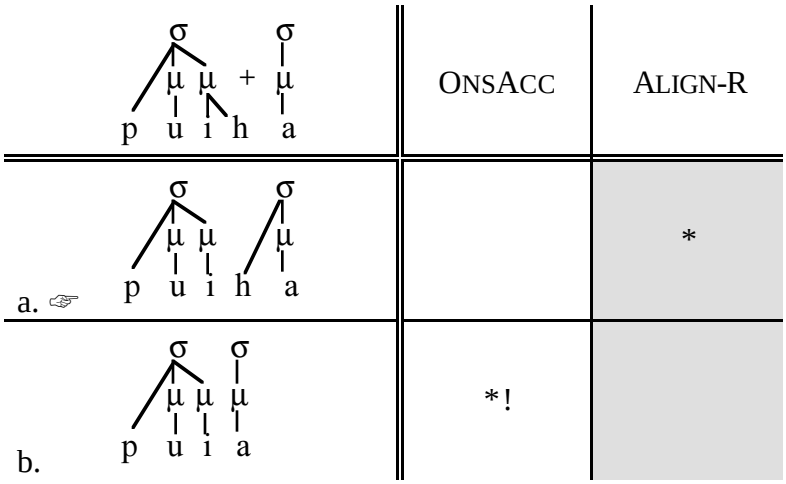
a.	[t̪θoː]	'great-grandparent'
	[t̪θoːa]	'great-grandparent-ACC'
b.	[poe]	'road, path'
	[poea]	'road-ACC, path-ACC'
c.	[ižappɨ]	'coyote'
	[ižappɨ]	'coyote-ACC'
d.	[appɨ]	'father'
	[appɨa]	'father-ACC'

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



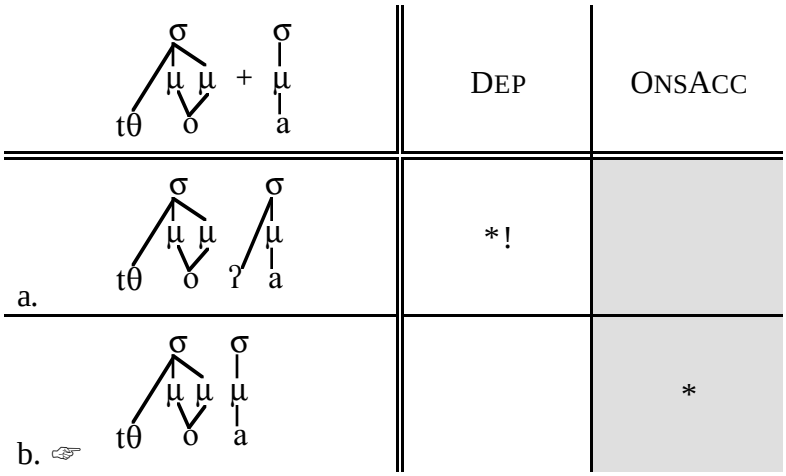
In (34), candidate (34b) violates ONSACC since the accusative suffix is allowed to surface without an onset. This is a sufficiently serious violation to merit the elimination of this candidate, given the ranking of the constraints. Candidate (34a) however, satisfies ONSACC by syllabifying the Aspirating 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) t̪θoːa 'great-grandparent-ACC'.

(36) DEP » ONSACC

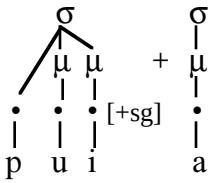
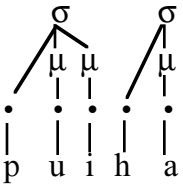
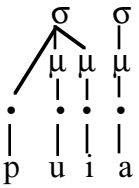


In the tableau in (36), insertion of a consonant in (36a) to satisfy ONSACC results in a violation of higher-ranking DEP. Candidate (36b) avoids this violation at the cost of an ONSACC violation. Since DEP is ranked above ONSACC the candidate satisfying it (36b) is preferred over (36a) which violates 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'.

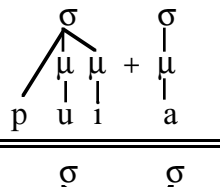
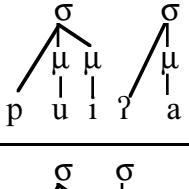
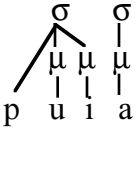
(37) ONSACC » DEP

	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.

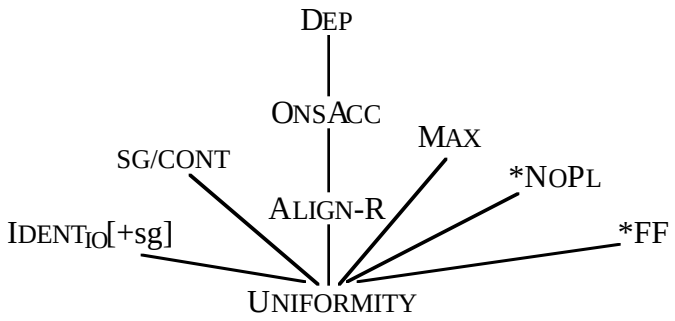
5.3. Summary

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.

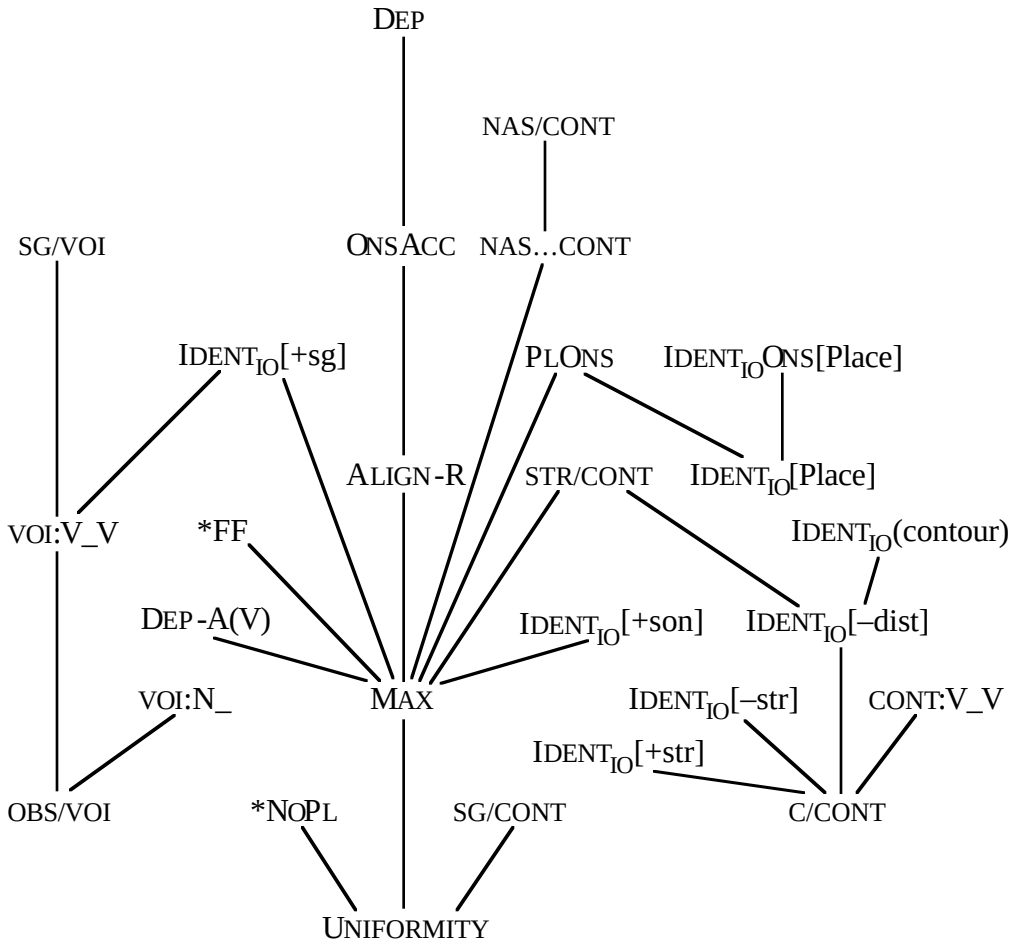
(39) Ranking relations for the constraints involved in Aspiration



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.