

Shoshoni Verb Classes and the Perception of Aspiration

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Shoshoni verb classes and the perception of aspiration*

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1. Introduction.

In Shoshoni, a Numic language of the Uto-Aztecan family, there are a handful of verbal suffixes which show variation in the realization of the initial consonant between a voiceless fricative and a geminate stop; this variation is dependent on the class of the verb to which the suffix is attached and is largely unpredictable synchronically; representative examples are given in (1).

- (1) Some alternating suffixes in Shoshoni (Miller 1996)
- | | | | |
|----|--|--------------------|----------------------------------|
| a. | <i>-kk^wa/-x^wa</i> ‘momentaneous’ | | |
| | [híβikk ^w a] | ‘drank up’ | [tíkkax ^w a] ‘ate up’ |
| b. | <i>-kka/-xa</i> ‘resultative’ | | |
| | [híβikka] | ‘have drunk’ | [tíkkaxa] ‘have eaten’ |
| c. | <i>-ppinni/-φinni</i> ‘progressive; frequentive’ | | |
| | [híβippinni] | ‘be drinking; sip’ | [tíkkəφinni] ‘be eating; nibble’ |

The historical explanation for this alternation rests on the interaction of the stress system, degemination, and the optimization of perceptual cues for aspiration. The alternating verbal suffixes in Shoshoni are modern reflexes of historically invariant geminate-initial suffixes. These geminates underwent degemination and preaspiration following short unstressed vowels; this parallels the situation described in Sapir (1930) for Southern Paiute geminate stops. The Shoshoni preaspirated stops underwent a further development and became voiceless fricatives. The conditioning environment for degemination and preaspiration was subsequently lost, leaving behind a lexically determined alternation between geminates and voiceless fricatives (Miller 1980). In this paper I propose that the abductive gesture of the vocal folds which underlies aspiration is more readily perceived on a voiceless fricative than on a preaspirated voiceless stop, and that the change from preaspirated stops to voiceless fricatives in Shoshoni was driven by the perceptual optimization of this gesture.

Support for this analysis comes from a comparison of similar changes in the world's languages; aspirated stops and voiceless fricatives are often related historically in languages around the world; a reasonable explanation for the change from aspirated stop to voiceless fricative is the optimization of the perception of the

* My thanks to John McLaughlin for discussion of this material, as well as to Wick Miller, now deceased, for introducing me to the wonders of Numic phonology. All errors found herein are my own responsibility.

laryngeal abduction gesture; this gesture is transparently recoverable from a voiceless fricative.

The rest of this paper is organized as follows: section 2 provides background in the consonant alternations of Shoshoni and shows the historical origin of the alternating suffixes. Section 3 provides an analysis for the change from preaspirated stop to voiceless fricative and supports this analysis by briefly reviewing similar historical changes in the world's languages. Section 4 is a brief conclusion.

2. Shoshoni final features.

Shoshoni stops undergo certain changes when they stand in phrase-medial position. In initial position they are voiceless and unaspirated; however, in medial position they are variously realized as geminates, as prenasalized voiced stops, or as voiced or voiceless fricatives. This variation depends on the final phonological element of the preceding syllable; these elements are known in Numic studies as the "final features", though it is usual to restrict that term to elements which appear in word-final position. Numic scholars have reconstructed three final features for Proto-Numic: Gemination, Nasalization, and Spirantization.¹ To illustrate, examples of each of these final features are given from Shoshoni; each of the forms in (2) contains a noun followed by the verbalizing suffix *-paʔi* 'have'. The initial *p* of the suffix is realized as a geminate voiceless stop [pp] under Gemination (2a), as a homorganic nasal-stop cluster [mb] under Nasalization (2b), and as a voiced fricative [β] under Spirantization (2c).

- (2) Numic final features: Shoshoni²
- a. Gemination: [tiβappaʔi] 'have pine-nuts' (*tipa* "pine nut", *-paʔi* 'have')
 - b. Nasalization: [tso:mbaʔi] 'have beads' (*tso:n* 'bead')
 - c. Spirantization: [tso:βaʔi] 'have a great-grandparent' (*tso:* 'great-grandparent')

Shoshoni (and the other Central Numic languages) have also developed a fourth series, Aspiration, which is historically derived from Gemination, but which is now distinct from it. Under Aspiration, a voiceless stop is realized as a voiceless fricative, often preceded by a voiceless vowel (2d).

- (2) d. Aspirated: [haiŋt̪s̪iʔaʔi] 'have a friend' (*haintsih* 'friend')

All of the Numic languages show evidence of final features. In Southern Paiute final features regularly appear morpheme-internally, and apply more or less regularly across all morpheme boundaries. In Shoshoni, while morpheme internal occurrences of the consonantal series are fairly regular, they are only preserved across morpheme boundaries for non-verbs. Within the verbal system of Shoshoni the set of final features has been almost completely lost, and all verb stems now end

¹I capitalize the names of the Numic final features in order to distinguish them from more general phonetic and phonological processes which occur in the world's languages.

²The final features in Shoshoni are conventionally represented by *-* for Gemination, *-n* for Nasalization, and *-h* for Aspiration; Spirantization is not formally represented. The representations for Nasalization and Aspiration presuppose a segmental analysis of the final features; lack of space precludes discussion. See Elzinga (1999) for arguments concerning the segmental representation of the final features in Shoshoni.

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with a vowel; the initial consonant of most suffixes surfaces in Spirantized form.³ There are six verbal suffixes which alternate between a geminate initial consonant and a voiceless fricative initial consonant; these suffixes are shown below in (3) with the verb stems *tikka* 'eat' and *hipi* 'drink':

- (3) Shoshoni variable suffixes
- | | | | |
|----|---|----------------------|---|
| a. | -kk ^w a/-x ^w a 'momentaneous' | | |
| | [híβikk ^w a] | 'drank up' | [tíkka ^w a] 'ate up' |
| b. | -kka/-xa 'resultative' | | |
| | [híβikka] | 'have drunk' | [tíkka ^x a] 'have eaten' |
| c. | -ppinni/-φinni 'progressive; frequentive' | | |
| | [híβippinni] | 'be drinking; sip' | [tíkkaφinni] 'be eating; nibble' |
| d. | -kkandi/-xandi 'stative' | | |
| | [híβikkandi] | 'be full (of drink)' | [tíkka ^x andi] 'be full (of food)' |
| e. | -ttai/-θai 'finally' ⁴ | | |
| | [híβittai-] | 'finally drink' | [tíkkaθai-] 'finally eat' |
| f. | -tti ^w i/-θi ^w i 'start to' | | |
| | [híβitti ^w i] | 'start to drink' | [tíkkaθi ^w i] 'start to eat' |

The choice of suffix depends on the verb stem; some verb stems select the geminate-initial variant, while others select the fricative-initial variant.

All verbs in Shoshoni belong to one of two classes based on the selection of fricative-initial or geminate-initial variants of the alternating suffixes. While there are phonotactic patterns in the verb stems which can help predict a geminate or fricative realization of the suffix-initial consonant, these verb classes are largely opaque to speakers of the language, and are thus lexical in nature. Some examples of verbs of each class are given in (4) below.

- (4) Shoshoni verb classes
- | | |
|---|--|
| <p>a. Aspirating</p> <p><i>tikka</i> 'eat'</p> <p><i>nattia</i> 'race'</p> <p><i>típui</i> 'wake up'</p> <p><i>wiya:</i> 'dangle'</p> <p><i>anni</i> 'fall over'</p> <p><i>nanka</i> 'hear'</p> <p><i>niik^wi</i> 'say'</p> | <p>b. Geminating</p> <p><i>hipi</i> 'drink'</p> <p><i>pui</i> 'see'</p> <p><i>tsua</i> 'be used up'</p> <p><i>mi:</i> 'do'</p> <p><i>yimi</i> 'swallow'</p> <p><i>tiki</i> 'place'</p> |
|---|--|

The alternation between geminated and aspirated suffixes was originally allophonic; these suffixes were underlyingly geminate. Many of these alternating suffixes have cognates in the other Numic languages which are invariably Geminating (5)⁵:

³ There are remnants of a Nasalizing final feature on some verb stems which is evident only before the future suffix *-tu?* and the generic aspect suffix *-tin*.

⁴ [θ] is a voiceless non-strident alveolar fricative. Earlier descriptions of Shoshoni referred to this sound as a voiceless tap, but instrumental analysis clearly reveals that it is a fricative.

⁵ Kawaiisu distinguishes lenited and non-lenited forms; the non-lenited forms are cognate to Numic geminates.

(5)	Shoshoni	Southern Numic	Western Numic
	- <i>ɸinni</i> / <i>-ppinni</i>		- <i>ppinni</i> (Northern Paiute)
	- <i>xa</i> / <i>-kka</i>	- <i>ka</i> (Kawaiisu)	
	- <i>x^wa</i> / <i>-kk^wa</i>	- <i>k^wee</i> (Kawaiisu)	- <i>kku</i> (Mono)

A regular alternation between geminates and preaspirates is observed in Southern Paiute. In Southern Paiute, a geminate stop degeminates and preaspirates when following a stressless vowel; otherwise, the geminate surfaces as such. A separate process devoices a vowel which occurs before a preaspirated stop (6):

- (6) Southern Paiute preaspiration
- a. /pikkák^wittia/ 'sore buttocks.ACC'
 pi^hkáγ^wi^ht̪i̯a
 [p̪ikáx^wit̪i̯a]
- b. /pattákkittù/ 'cause to burst'
 pa^htákki^htù
 [p̪atákkjtù]

In (6a, b), the geminates which close the first and third syllables follow stressless vowels and are thus degeminated and preaspirated. The geminate which closes the second syllable of (6b) follows a stressed syllable and is not subject to degemination.

The same conditions obtained historically for Shoshoni. After the change from geminate to preaspirated stop, the stress shifted removing the complementary environments which gave rise to the alternation. This effectively stranded geminate-initial suffixes in aspirating environments and lexicalized the alternation (7).

(7)	Historical Aspiration in Shoshoni	
	*t̪ikka-kk ^w a	*hipi-kk ^w a
Aspiration	*t̪ikka- ^h k ^w a	_____
Stress Shift	_____	*h̥ipi-kk ^w a

The final development in Shoshoni was from a preaspirated stop to a voiceless fricative (8).

- (8) *t̪ikka-^hk^wa > [t̪ikkax^wa]

As in Southern Paiute, the vowel is devoiced by a separate process. With this as background, I turn now to an analysis of the change from preaspirate to voiceless fricative.

3. Analysis.

In this section I motivate the change from preaspirated stop to voiceless fricative by arguing that perceptual cues for aspiration are more salient on a voiceless fricative than on a stop. The outline of my argument is as follows. First, I assume that aspiration is represented in the grammar by the feature [+spread glottis]. Second, I show that voiceless fricatives are also characterized by the feature [+spread glottis]. Third, I argue that voiceless fricatives are better exponents of the feature [+spread glottis] than aspirated stop are, and that the change from preaspirated stop to voiceless fricative is entirely natural and motivated by optimizing the perception of aspiration.

3.1. Aspiration as [+sg].

I take the feature [+spread glottis] (henceforth [+sg]) to be the grammatical expression of the vocal fold abductive gesture underlying aspiration. In an Optimality Theoretic grammar, preservation of aspiration is expressed by the constraint IDENT_{IO}[+sg]:

- (9) IDENT_{IO}[+sg]: An output correspondent of an input segment bearing [+sg] itself bears [+sg].

I will assume that the promotion of IDENT_{IO}[+sg] in the constraint hierarchy accounts for the lexicalization of the Geminate/Aspirate suffix alternation in Shoshoni.

3.2. Voiceless fricatives and [+sg].

In this subsection, I summarize Vaux (1998), which argues that voiceless fricatives bear the feature [+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 contrast among stops (10).

- (10) 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 ^h z	ts	t ^h s			
dʒ	d ^h ʒ	tʃ	t ^h ʃ	ʃ	ʒ	
g	g ^h	k	k ^h	χ	ɣ	
				h	ɦ	

j r r̥ l ɫ

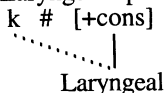
New Julfa marks the future tense with a prefix *k-* attached to the present subjunctive. This prefix surfaces as [k] before vowels and plain voiceless consonants (11a), as [g] before plain voiced consonants (11b), as [k^h] before voiceless aspirated stops and voiceless fricatives (11c), and as [g^h] before voiced aspirates (11d).

- (11) 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	gəzəram	'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 niem	'I will put'
	k-d ^h ziev-ie-m	g ^h əd ^h zievem	'I will form'

From the examples given in (11) 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-* (12).

(12) 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 (9c), 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).

(13)	Underlying form	Surface form	Gloss
	/b ^h iʃak si:s-ena/	[b ^h iʃak ^h si:sena]	healing lead-instrumental
	/ap-su/	[ap ^h su]	water-locative

The forms in (13) 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 (14a), and by gemination of the stop in medial position (14b). In each case, the original plain stop is aspirated.

(14)		Sanskrit	Pali	Gloss
a.	Initial	skand ^h a-	k ^h and ^h a-	shoulder
		stána-	t ^h ana-	breast
		sparʃa-	p ^h assa-	touch
b.	Medial	hásta-	hatt ^h a-	hand
		yaṣṭi-	yatt ^h i-	pole

These changes represent a general simplification of syllable structure that occurred 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. Although the segment was deleted, the featural content of the Laryngeal node was preserved and associated to the remaining consonant. 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.

In light of this evidence, I will assume that the feature [+sg] is universally present on voiceless fricatives and therefore on voiceless fricatives in Shoshoni.

3.3. Optimization of [+sg].

In this subsection I argue that the perception of a [sg] contrast is enhanced if [+sg] is expressed on a voiceless fricative. To this end, I provide cross linguistic data in which aspirated stops have become voiceless fricatives; this suggests that if [+sg] is a gestural implementation of a perceptual [+noise] feature, then a fricative is a better exponent of [+noise] than an aspirated stop (Boersma 1998).

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 (15). In this figure, laryngeal adduction and the onset of voicing is timed to coincide with the release of the labial stop closure.

(15) Unattested realization of an aspirated *p* (Silverman 1997: 4)

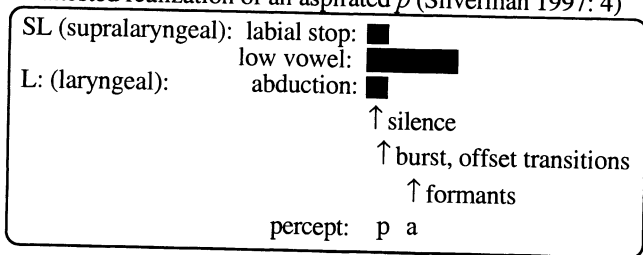
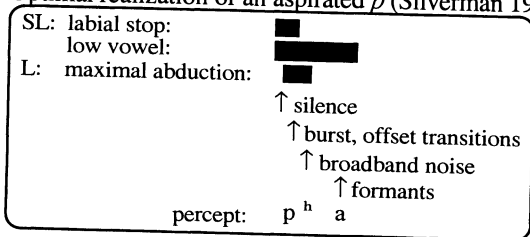
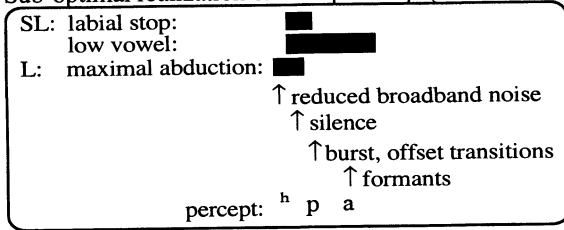


Figure (16) shows a gestural score for an optimally realized aspirated *p*. In this gestural score, the laryngeal gesture significantly overlaps the bilabial closure but also extends beyond it. The onset of voicing thus lags behind the release of the labial closure; this optimizes the perception of laryngeal abduction.

(16) Optimal realization of an aspirated *p* (Silverman 1997: 5)



In (17), 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.

(17) 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 [ϕ, θ, χ] (Horrocks 1997: 112-3).

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

(18) 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).⁶

(19) Proto-Pomoan to Eastern Pomoan

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

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 (20) (see Archangeli and Pulleyblank 1994 for a discussion of Grounding and its role in grammar).

(20) SG/CONT: ‘If [+sg] then [+cont]; if [+sg] then not [-cont].’

This constraint, along with the constraint IDENT_{IO}[+sg] is ranked above the constraint IDENT_{IO}[-cont], which exerts pressure on the grammar to preserve an input [-cont] specification. The interaction of these three constraints is shown in the tableau in (21).

⁶My thanks to Mauricio Mixco for bringing this data to my attention.

(21) IDENT₁₀[+sg], SG/CONT » IDENT₁₀[-cont]

	tikka-h ^h ka	IDENT ₁₀ [+sg]	SG/CONT	IDENT ₁₀ [-cont]
a.	tikkaxa			*
b.	tikka ^h ka		*!	
c.	tikkaka	*!		

Candidate (21c) fails because an underlying [+sg] is not preserved on the surface. Candidate (21b) fails because the feature [+sg] is realized on a [-cont] segment. Candidate (21a) bests the others since it both preserves the feature [+sg] and realizes it on a segment specified [+cont].

The interaction of constraints in the tableau in (21) shows the role that the realization of [+sg] on voiceless fricatives plays in the historical phonology of Shoshoni. An original preaspirated stop becomes a voiceless fricative in order to optimize the perceptual cues which accompany vocal fold abduction. This change is not unique to Shoshoni but occurs in many of the world's languages.

4. Conclusion.

In this paper I have shown that the historical development of Shoshoni alternating verbal suffixes from preaspirated stop to voiceless fricative has been motivated by considerations governing the perception of aspiration. These considerations dictate that the feature [+sg] is more readily perceived on voiceless fricatives than on voiceless stops. Support for this move has been marshalled from other languages which show a similar historical change. These results provide another instance of the importance of perceptual cues in understanding language change.

The scope of this paper has been modest; but the demonstration of the role of grounding and perception in the change from preaspirated stop to voiceless fricative is important in our understanding of Pre-Shoshoni phonology.

References

- Archangeli, Diana and Douglas Pulleyblank. 1994. *Grounded Phonology*. Cambridge, MA: MIT Press.
- Baldi, Philip. 1983. *An Introduction to the Indo-European Languages*. Southern Illinois University Press: Carbondale, Illinois.
- Boersma, Paul. 1998. *Functional Phonology: Formalizing the Interaction between Articulatory and Perceptual Drives*. Ph.D. dissertation. University of Amsterdam.
- Elzinga, Dirk. 1999. *The Consonants of Gosiute*. Ph.D. dissertation. University of Arizona, Tucson.
- Goldsmith, John. 1976. *Autosegmental Phonology*. Ph.D. dissertation. Massachusetts Institute of Technology.
- Grekoff, George. 1964. A Note on Comparative Pomo. In Bright, W. ed. *Studies in Californian Linguistics*. University of California Publications in Linguistics 34. Berkeley, CA: University of California Press.
- Horrocks, Geoffrey. 1997. *Greek: A History of the Language and its Speakers*. London: Longman.
- Miller, Wick. 1980. Preaspirated Consonants in Central Numic. in *American Indian and Indoeuropean Studies: Papers in Honor of Madison S. Beeler*. The Hague:

- Mouton.
- Miller, Wick. 1996. Sketch of Shoshone, a Uto-Aztecan Language. In *Languages*. ed. Ives Goddard, 693-720. Handbook of North American Indians, vol. 17. William C. Sturtevant, gen. ed. Washington, D.C.: Smithsonian Institution.
- Sapir, Edward. 1930. *Southern Paiute, a Shoshonean Language*. Proceedings of the American Academy of Arts and Sciences.
- Silverman, Daniel. 1997. *Phasing and Recoverability*. PhD dissertation. University of California, Los Angeles. Published by Garland Press, New York.
- Vaux, Bert. 1998. The Laryngeal Specification of Fricatives. *Linguistic Inquiry* 29: 497-511.

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