Patterns of Laryngeal Neutralization: Asymmetry between Glottalization and Aspiration*

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Um, Hye-Young. 1999. **Patterns of Laryngeal Neutralization: Asymmetry between Glottalization and Aspiration.** *Linguistics*, 7-1, 161-180. This paper addresses the question: do all laryngeal features show the same behavior with regard to the laryngeal neutralization phenomenon? In examining the laryngeal neutralization patterns in languages with both aspirated and glottalized consonants, it is found that in some languages aspirated consonants and glottalized consonants behave differently with regard to the Laryngeal Constraint (Lombardi 1991) when only one laryngeal feature is neutralized. In languages with single-feature neutralization, the syllable-final contrast is always between glottalized and non-glottalized segments: the aspiration contrast is more frequently neutralized in syllable-final position. This paper proposes that the asymmetry between the features [spread glottis] and [constricted glottis] is due to their phonetic properties. That is, glottalized consonants have more cues to convey their distinctiveness in syllable-final position than aspirated consonants. The aspirated consonant has difficulty implementing its primary cue, VOT, in syllable-final or preconsonantal position, whereas the glottalized consonant can realize its glottalization in the preceding vowel. The observations made in examining the laryngeal neutralization typology in this paper suggest that phonetically-motivated constraints are needed for the explanation of the laryngeal feature distribution. **(Korea University)**

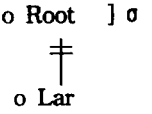
1. Introduction

In models of feature geometry such as those proposed by Clements

* This is a revised version of a part of the author's dissertation.

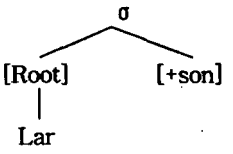
(1985) and Sagey (1986), the laryngeal neutralization process is expressed as the delinking of the laryngeal node, as shown in (1):

(1)



Lombardi (1991) accounts for the restricted occurrence of laryngeal features by way of a positive constraint which states that laryngeal features are licensed in the following configuration:

(2)



In the framework of Optimality Theory the following constraint (3) and its ranking with respect to the Faithfulness constraint (4) would describe the neutralization phenomenon:

(3) *Lar]σ
(4) *Lar]σ >> MAX-IO

These proposals involving the laryngeal node suggest that all laryngeal features, i.e., [voice], [spread glottis], and [constricted glottis] show the same pattern of distribution with respect to neutralization. They assert that in the unmarked case laryngeally-marked consonants are restricted to syllable-initial position. Indeed it has been noted that in most cases of laryngeal neutralization all laryngeal features are neutralized, and this was the main motivation for grouping all laryngeal features under the class node Laryngeal. It is true that cases where

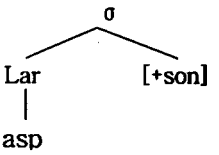
only one feature is neutralized are less common. However, there are languages that have more than one laryngeal distinction and have the Laryngeal Constraint only on a single feature. In other words, there are some languages in which a three- or four-way laryngeal contrast among consonants in syllable-initial position is reduced to a two-way contrast syllable-finally.

For example, Hupa (Woodward 1964) shows a three-way contrast between plain voiceless, aspirated, and glottalized among stops and affricates. However, only a two-way contrast between the plain voiceless consonant and the glottalized consonant is found syllable-finally. The Laryngeal Constraint for Hupa can be proposed as follows:

(5) *[spread glottis]]σ

Lombardi (1991) also notes a Hupa-type case and proposes that the constraint in such a language must mention the particular feature as in (6):

(6)



She claims that the Laryngeal Constraint should be construed as meaning a constraint on the entire node as in (2), unless otherwise specified. A constraint such as (5) or (6) would correctly restrict aspirated consonants to syllable-initial position. However, it does not explain why aspiration, but not glottalization is restricted to syllable-initial position. More importantly, the existence of this kind of constraint would not exclude the possibility of a constraint specifically marking the feature [constricted glottis].

In this paper, I examine the laryngeal neutralization patterns in languages with both aspirated and glottalized consonants[1]. We find that when only one laryngeal feature is neutralized, there is an asymmetry between aspiration and glottalization. In languages with a single-feature neutralization, the syllable-final contrast is always between glottalized and non-glottalized segments. Only the aspirated and plain voiceless opposition is neutralized.

I propose that the asymmetry between the feature [spread glottis] and [constricted glottis] is due to their phonetic properties. I show that the glottalized consonant has more cues to convey its distinctiveness in syllable-final position than the aspirated consonant. In brief, the aspirated consonant has difficulty implementing its primary cue, VOT (Voice Onset Time), in syllable-final or preconsonantal position, whereas the glottalized consonant can realize its glottalization in the preceding vowel. This proposal is in line with Steriade's (1996) approach of Licensing by Cue which argues that the main factor involved in neutralization and licensing is the distribution of cues to the relevant features.

This paper is organized as follows: Section 2 reviews and discusses the phonetic properties of aspirated and glottalized consonants and their laryngeal features. In Section 3, I summarize the typology of laryngeal feature occurrences. Section 4 discusses single-feature neutralization, focusing on the difference between aspiration and glottalization.

2. Phonetics of glottalized and aspirated consonants

2.1 Aspiration vs. glottalization

1. The main laryngeal features of interest in this paper are [spread glottis] or [aspiration] and [constricted glottis] or [glottalization] that the laryngeal segment glottal stop and /h/ are assumed to have. This is due to my original interest in laryngeals and their comparison with laryngeally-marked consonants, aspirated and glottalized. Therefore, I will not deal with the feature [voicing] in this paper.

Kingston (1985) claims that the glottal articulations in aspirated and glottalized stops are "bound" to the release. Therefore, according to his theory, the unmarked timing pattern in aspirated obstruents is that the peak of laryngeal gesture is timed to the release of oral constriction, which can be diagramed as follows (cited from Steriade 1996, also Ladefoged 1982):

(7) Unmarked timing pattern in aspirated obstruents

Glottal gesture: [---------glottal abduction----------]
Oral gesture: [-----oral closure----release---] [-----vowel-----]
↑
context cues for a
laryngeal feature here

In the above case, the cues for aspiration are at the release phase with its following aspiration noise and also in the following vowel. It is well documented that aspiration is cued, among other things, by its effect on the voice onset time or offset time of a neighboring sonorant. When the aspirated consonant occurs syllable-finally, due to the lack of structure on which vowel-dependent cues can be realized, we might expect the rearrangement of the laryngeal gesture as in (8) so that the preceding vowel has cues for aspiration:

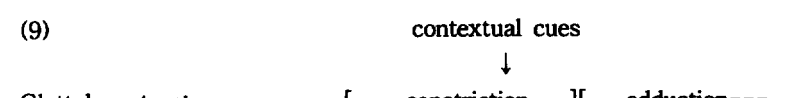
(8) Timing pattern in postvocalic preaspiration

Glottal gesture: [-------glottal abduction-------]
Oral gesture: [----vowel----] [------oral closure----release-----]
↑
context cues for a
laryngeal feature here

However, it is not common that postaspirated consonants change the timing pattern as above when they occur in postvocalic position.

In the case of the glottalized consonant, the following is the preferred timing for oral and glottal constriction that Kingston suggests (cited from Steriade (1996)):

(9)



However, examining the phonetic facts about glottalized and aspirated consonants, we find much more variance in the realization of glottalized consonants than aspirated consonants. In the case of the glottalized consonant, the relative timing of the oral and laryngeal gestures, its effect on the neighboring vowels, and the degree to which the glottalic airstream mechanism is used differ from language to language. Importantly, in many languages the relative timing of oral and laryngeal gestures changes depending on whether the glottalized consonant is pre- or post-vocalic.

There are some languages in which the glottal closure is simultaneous with or precedes the oral closure. For example, in the glottalized consonants of Sarsi (Hoijer and Joel 1963) the glottal and oral closures are simultaneous and the oral release precedes the glottal release by a very brief time, both syllable-initially and syllable-finally. In Tsez (Maddieson et al. 1996), which is a Caucasian language, the vocal folds close firmly before the oral closure, and the preceding vowel shows an abrupt cutoff of voicing. According to Roach (1979), in British English where the glottalization of voiceless stops is common in contexts other than prevocalic, laryngeal closure precedes oral closure. In addition, some languages adjust the timing pattern of glottalized consonants to that of the preglottalized consonants in postvocalic position as follows[2] :

(10)

contextual cues
↓
Glottal gesture: [-----constriction-----] [-----glottal closure-----
Oral gesture: [----vowel --------] [-----oral closure---

When the glottalized obstruent assumes the above timing pattern, the preceding vowel can easily or automatically laryngealize (creaky voiced or tinged with some glottal stricture) in anticipation of the full glottal closure or constriction[3]. That is, the glottal closure causes the change in the phonation pattern of the preceding vowel. I propose in a later section that this phonetic aspect underlies the different distribution of glottalized and aspirated consonants.

2.2 Aspiration and syllable-final release

VOT is the major element in differentiating the aspirated consonants from the unaspirated. However, although the major reference point, i.e., VOT, is not available in postvocalic position, aspirated and unaspirated consonants may show contrast in syllable-final position in some languages, if not many. In Eastern Armenian, the difference between voiceless aspirated and unaspirated stops in syllable-final position is reported to be in the strength of the release (Ladefoged and Maddieson 1996): voiceless unaspirated stops are weakly released or not released at all, whereas aspirated stops have a shorter closure and a noticeable

2. I did not include the release gesture here. (10) assumes the case where syllable-final consonants are not released. When the final consonants are released, the timing of glottal release and oral release differs from language to language.

3. Or in some cases, there could be an abrupt cutoff of the preceding vowel as is reported in Tsez, due to the following glottal closure. An abrupt onset is a property of a vowel following a glottal stop. An abrupt offset would be parallel to this phenomenon.

burst followed by noisy airflow that is sustained for some considerable time. This suggests that the release and a period of aspiration may suffice as cues for aspiration when a primary cue, i.e., VOT is not available.

In general, however, there is some confusion between aspiration and syllable-final release. In some languages all syllable-final or word-final stops are transcribed as aspirated stops. However, some linguists use the term aspiration to indicate a strong release, as in descriptions such as "a strong release sometimes approaching aspiration" (Woodward 1964:201). Consequently, it is difficult to tell what is a release and what is aspiration in syllable-final position.

Even though some languages successfully keep the distinction between aspirated and unaspirated consonants with syllable-final release, in many cases, it is likely that releasing the syllable-final consonants may result in the neutralization of aspirated and plain voiceless consonants. It seems that in many cases the cues for voiceless released consonants and aspirated consonants in final position are ambiguous. I propose that this ambiguity and the lack of VOT as a major cue for aspiration result in the neutralization of these consonants. Where there is a contrast maintained between voiceless and aspirated consonants, extra effort must be made to exaggerate the contrast.

3. The typology of the laryngeal feature occurrence

In this section, I examine the pattern of the laryngeal feature occurrence in languages where both aspirated and glottalized consonants exist as phonemes.

For the study of the laryngeal neutralization typology, I examine the languages from Maddieson's (1984) sample of the world's languages that are reported to have both aspirated and glottalized consonants. Among the 317 languages in the sample, 25 languages are reported to have both glottalized (ejectives) and aspirated consonants in addition to plain voiceless consonants. The following is a list of those languages:

(11) Eastern Armenian, Korean, Zulu, Navaho, Haida, Tolowa, Hupa, Klamath, Wintu, Kwakiutl, Tiwa, Yana, Zuni, Acoma, Wichita, Yuchi, Dakota, Quechua, Jaqaru, Georgian, Lak, Kabardian, Southern Nambiquara, Otomi, Mazahua

Among these, 6 languages -- Eastern Armenian, Lak, Otomi, Mazahua, Southern Nambiquara and Kabardian -- are excluded from consideration, simply because enough information is not available. However, except Lak for which there are no accessible sources and therefore no available information, they do not seem to be inconsistent with the general finding in the typology of neutralization patterns.

In addition to the above 19 languages, 7 languages from Ruhlen's (1976) database and 3 languages from my own data collected from the literature are additionally examined. The following is a list of the additional languages:

(12) Eyak, Slave, Kiowa, Sarsi, Takelma, Tlingit, Kashaya, Eastern Pomo, Wikchamni, Tol

The above 29 languages examined are divided into the following five groups according to the distributional patterns of laryngeal features that their aspirated and glottalized consonants have :

(13)

1. Laryngeal features occur without any restriction both syllable-initially and syllable-finally. There is no coda laryngeal neutralization in these languages: Kwakiutl, Yana, Georgian, Zuni, Wikchamni.

2. All laryngeal distinctions are neutralized in syllable-final position with laryngeal contrast only in syllable-initial position. This is the classic case of coda laryngeal neutralization: Korean, Navaho, Haida, Wintu, Dakota, Quechua, Kiowa.

3. Laryngeal features are restricted to syllable-initial position, but other factors such as syllable structure condition are involved. These languages require special syllable structure conditions: Zulu, Tiwa, Acoma, Yuchi, Jaqaru, Slave.

4. Only one feature is neutralized. That is, laryngeal features [constricted glottis] and [spread glottis] do not pattern together. These are single feature neutralization languages: Hupa, Wichita, Sarsi, Tligit, Eyak, Takelma, Kashaya, Tol, Eastern Pomo.

5. Laryngeal features on sonorants show a different pattern of distribution from those of obstruents. In these languages laryngeally-marked sonorants behave differently than laryngeally-marked obstruents: Tolowa, Klamath.

Of special interest are the languages in group 4 in which only one laryngeal feature is neutralized. There are a considerable number of languages that show single feature neutralization, and it is important to note that there is an asymmetry between aspiration and glottalization when only one laryngeal feature is neutralized. More specifically, in languages where there is single feature neutralization, the syllable-final contrast is always between glottalized and non-glottalized segments. In other words, the contrast that is neutralized in syllable-final position is always between aspirated and plain voiceless consonants. In the following section, I will discuss this type of single-feature neutralization.

4. Single-feature neutralization

There are some languages in which a three-way contrast among consonants is shown only in syllable-initial position, and syllable-finally there is only a two-way contrast. Hupa, Sarsi, Eyak, Tlingit, Tol, Takelma, Kashaya and Eastern Pomo belong to this group. An interesting fact is that, in all these languages, the distinction between aspirated and plain consonants is lost in syllable-final position. In these languages that show this pattern of single feature neutralization,

glottalized consonants, however, occur in syllable-final position as well as in syllable-initial position. Since glottalization is less restricted in occurrence than aspiration, grouping aspirated and glottalized consonants together under the laryngeal node and restricting their laryngeal feature occurrences by a general laryngeal constraint on the laryngeal node fails to describe this unequal tendency. I suggest that this asymmetry between glottalization and aspiration is rooted in their phonetic properties; aspirated consonants are more dependent on VOT than glottalized consonants are. Aspirated consonants have difficulty implementing their primary cue, i.e., VOT, syllable-finally. On the other hand, glottalization can be preserved by means of its transfer to the preceding vowel or in glottal closure made between the vowel and the consonant. Therefore, in this section, I suggest that a phonetically-based constraint referring to various cues for the individual laryngeal features is needed to correctly account for the laryngeal neutralization patterns.

In cases where the distinction between aspirated and plain voiceless consonants is neutralized in syllable-final position, two different patterns are observed: 1. Aspirated consonants are not allowed in syllable-final position; 2. There is no surface plain voiceless consonant in syllable-final position. In this case aspirated consonants are transcribed syllable-finally. The second pattern seems to be unusual in that plain consonants (which are generally thought to be unmarked) are more restricted than laryngeally-marked consonants (generally believed to be marked). In fact, some languages in which there are no syllable-final plain voiceless consonants are reported to have a syllable-final aspiration rule. Sierra Popoluca (Elson 1947) is one of those cases. In Sierra Popoluca aspirated consonants are not phonemic. As it was mentioned in Section 2.2, I point out that there is some confusion between syllable-final consonantal release and aspiration and that syllable-final aspiration can be interpreted as a strong release. Syllable-final release may be a strategy for boosting place of articulation cues which are generally weak in coda position. I argue

that syllable-final consonantal release obscures the distinction between aspirated and unaspirated consonants and causes neutralization. Let us examine each language in detail.

4.1 Type 1: No aspirated consonant in coda

In Hupa (Woodward 1964) and Sarsi (Hoijer and Joel 1963), the distinction between the aspirated consonant and the plain voiceless consonant is neutralized and the aspirated consonant does not occur in syllable-final position. Hupa has the following consonants :

(14) Hupa (Woodward 1964, Gordon 1996; Athapaskan)[4]

(p)	t		k^y		q	ʔ
	t^h		k^{yh}		(q^h)	
	t'		$k^{y'}$		q'	
	ʦ	ʧ				
	$ʦ^h$	$ʧ^h$				
	ʦ'	ʧ'	ɬ			
	s	(ʃ)			x	h
					x^w $χ^w$	
	l	y	w			
m	n			ɳ	ɢ	

There is a three-way contrast between plain voiceless, aspirated, and glottalized among stops and affricates. Any consonant but /ɢ/ may begin a syllable (or a word) and all but aspirated stops and affricates are found in syllable-final position. According to Woodward (1964), syllable-final consonants in Hupa are characterized by a strong release which is frequently a voiceless echo of the consonant or the preconsonantal element. In medial biconsonantal combinations, the full

4. In almost all the phonemic descriptions of Athapaskan languages, plain voiceless consonant symbols are used for aspirated consonants and voiced consonant symbols are used for plain voiceless consonants. I have converted these orthography-oriented symbols into IPA symbols.

release of the syllable-final first member separates the constituent consonants, marking the point of syllable division by a distinct hiatus. /t, k^y, q, ʦ, ʧ/ are reported to be articulated in final position with a strong release sometimes approaching aspiration (Woodward 1964: 201). /t', k^y', q', ʦ', ʧ'/ are voiceless, fortis, and glottalized initially and finally.

4.2 Type 2: No unaspirated consonant in coda

In some languages where the distinction between aspirated and plain voiceless consonants is neutralized in syllable-final position, surface consonants that occur in syllable-final position are transcribed as aspirated consonants. Plain voiceless unreleased consonants are not found in syllable-final position. Relatively many languages -- Eyak, Tol, Takelma, Eastern Pomo, Kashaya and Tligit -- show this pattern. There are two main points to be made in this section. One is that the consonants that are transcribed as aspirated consonants in syllable-final position can be reinterpreted as consonants with a strong phonetic syllable-final release. The other, more important point is that glottalized consonants are different from aspirated consonants in that they have more cues to express laryngeal contrast in syllable-final position. The glottalization feature of consonants can be realized on the preceding vowel or in the glottal closure between the vowel and the consonant. This explains why we find more neutralization of aspiration than that of glottalization in syllable-final position. Let us take a look at individual languages.

Eastern Pomo (McLendon 1975) has the following consonant inventory:

(15) Eastern Pomo (McLendon 1975; Hokan)

p	t	ṭ	c	ʧ	k	q	
p^h	t^h	$ṭ^h$	c^h	$ʧ^h$	k^h		
p'	t'	ṭ'	c'	ʧ'	k'	q'	?
b		d					
	s			ʃ	x		h
		r					
m̩		n̩					
m		n					
		l̩					
		l					
w̩				y̩			
w				y			

The four-way contrast among voiced, voiceless unaspirated, aspirated, and glottalized stops exists only syllable-initially. Syllable- and word-finally, only aspirated and glottalized stops contrast. Voiceless unaspirated stops, voiced stops, voiceless nasals, voiceless semivowels, and the spirant /h/ never occur in syllable-final position. The following illustrates the laryngeal contrast in syllable-initial and syllable-final position:

(16) /p'a:la:/ 'snail, slug'
/p^ha:la/ 'the one who goes last, or in the rear'
/pa:la?/ 'shovel'
/ba:lay/ 'blood'
/si:lo:t^hki:/ 'lick off'
/si:lot'ki:/ 'mash up something in the mouth'

No voiceless unaspirated consonants are found syllable-finally. McLendon (1975) reports that in morpheme-final position, aspirated stops other than /$ṭ^h$/ become the corresponding unaspirated stops when followed by a morpheme beginning with a vowel, as in (17):

(17) [xap^{h}a:tipay] 'with drift wood' /xap^{h}a:tip^{h}/ 'drift wood'
[c'otay] 'with a tule bog' /c'ot^{h}/ 'tule bog'
[ʧ^{h}icay] 'with a root' /ʧ^{h}ic^{h}/ 'root'
[xoʧa] 'two (things)' /xoʧ^{h}/ 'two'
[ba:ʈ^{h}inka] '(someone) got to be big' /ba:ʈ^{h}ink^{h}/ 'get big'

It is not clear, however, whether the underlying segment is a plain voiceless consonant that aspirates syllable-finally or the underlying segment is an aspirated consonant that deaspirates before vowels. In addition, syllable-final aspiration may be reinterpreted as release. It is unusual that an aspirated consonant becomes deaspirated in prevocalic position. It is rather more likely that the consonant described as aspirated is underlyingly unaspirated and becomes aspirated or released syllable-finally as shown in (18):

(18) a./c'ot/ 'tule bog'
[c'ot^{h}] <------ syllable-final aspiration or release
b. /c'ot + ay/ 'with a tule bog'
[c'otay]

In discussing word-final aspiration in Klamath, Blevins (1993) mentions that obstruents are neutralized to aspirates or, more accurately, to stops which are released with simultaneous frication and aspiration. She adds that this can be viewed as a language-particular phonetic rule specifying word-final release. Elson (1947) notes that in Sierra Popoluca the stops /p, t, t^{y}, k/ are aspirated in syllable-final position, if not followed by a phoneme of the same point of articulation. The condition that stops are aspirated when followed by a consonant with a different place of articulation suggests that they are released to compensate for weak place cues in coda position. "Aspiration" in syllable-final position is a phonetic/surface phenomenon which is not contrastive with syllable-final release, and may be understood as release. Similarly, in Eastern Pomo syllable-final aspirated consonants

can be viewed as released consonants.

One phonetic study shows that there are some subtle differences between phonemic aspiration and an aspirated release. Maddieson et al. (1996b) report that word-final stops in Tlingit are utterance-finally released quite audibly with some sustained noise following the release burst, and consequently these stops have been interpreted as aspirated. However, they point out that the amplitude of the noise following these utterance-final releases is markedly less than that which occurs in initial aspirated stops. They also note that utterance-final consonants other than stops are also followed by a marked audible release and following noise. As they conclude, the noisy audible release does not indicate that the final stops belong to the aspirated category. I suggest that the same is true for the other languages where a syllable-final aspiration rule is reported.

Let us turn to the phonetic aspect of glottalized consonants. Many phonetic descriptions of glottalized consonants show that their cues are more mobile and can appear on adjacent vowels. With the mobility of the glottalization feature the occurrence of glottalized consonants is less restricted to a certain position in the syllable, compared with aspirated consonants whose primary cue is VOT.

According to McLendon (1975), glottalized stops and the glottal stop in Eastern Pomo are accompanied by glottal stricture in the articulation of any preceding or following vowels. He says that a syllable closed by a glottal stop or glottalized consonant is characterized by glottal tension throughout the whole of its articulation. This suggests that the glottalized consonant has its cue for glottalization in the preceding vowel.

A similar phonetic phenomenon is also observed in Takelma and Tol (Fleming and Davis 1977). Let us examine Takelma. Takelma (Sapir 1912, Lee 1991) has the following consonant inventory:

(19) Takelma (Sapir 1912, Lee 1991; Penutian)

p	t		k	k^w	?
p'	t'		k'	k'^w	
p^h	t^h		k^h	k^{wh}	
	s		x		h
	ts'				
	l				
m	n				
w		y			

In Takelma, the distinction between aspirated and plain voiceless consonants is neutralized in syllable-final position by way of syllable-final obstruent aspiration as seen in (20):

(20) a. seep-a?n 'I roasted it'
seep^h 'he roasted it'
b. xutu-m-alt-a?n 'I whistle to him'
xutu-m-alt^h 'he whistles to him'
xutu-m-alt^h-k^{w}a 'he whistled to him'

Syllable-final obstruents in Takelma are always transcribed as their corresponding aspirated segments. However, it is not uncommon that authors transcribe heavy syllable-final release as aspiration. In addition, Lee (1991) claims that spirants /s/ and /x/ do not undergo the final aspiration rule, because they underlyingly have the feature [spread glottis], assuming that spirants inherently have the property of spread glottis usually found in aspirated stops. However, this also supports the idea that this may be in fact a phonetic phenomenon of final release. Release is a property that can be held by stops but not by fricatives and so it is natural that fricatives are not subject to this phonetic rule.

It is noteworthy that glottalized obstruents are also transcribed as aspirated in syllable-final position. Let us consider the following examples:

(21) a.	wa-akap'-in	'I shall make it tight'
	wa-ska?p^h	'make it tight'
b.	paa-xoot'-an	'I shall win over him'
	paa-xoo?t^h	'win over him'
	paa-xoo?t^h-ka?	'I won over him'

Notice that glottalized obstruents in syllable-final position become aspirated, or rather released, with a preceding glottal catch, i.e., /t'/ ---> [?t^h], /p'/ ---> [?p^h]. That is, if a glottalized obstruent occurs syllable-finally, it becomes a preglottalized released consonant. Lee (1991: 82) analyzes this process as Laryngeal Flop whereby the feature [constricted glottis] from the syllable-final consonant delinks and is relinked to the preceding nuclear timing slot. However, this phenomenon is just a phonetic one in which the final glottalized obstruent changes its timing pattern to become preglottalized. When glottalized consonants become ?C^h, release of the oral closure is preserved and the components that are already present in glottalized consonants of Takelma, namely a released closure and glottal stricture, are simply rearranged. Presumably, the preceding vowel may also be affected since it precedes the glottal catch. This parallels Eastern Pomo where the glottal stricture is heard in the preceding vowel.

When a final consonant is released, the distinction between aspirated and plain consonants is easily neutralized, since aspiration and strong release are ambiguous without additional cues such as VOT or deliberate degrees of release. However, the glottalized consonant resists neutralization not only due to its perceptually distinct release but also due to adjustments of oral and laryngeal gestures that affect the preceding vowel.

5. Summary

So far I have shown that there is a tendency for the aspiration

contrast to be neutralized in syllable-final position more frequently than a glottalization contrast. This is contrary to the claim that postaspirated consonants and ejectives typically neutralize in the absence of a following vowel or sonorant (Kingston 1985, Steriade 1996). I have suggested that the asymmetry between glottalization and aspiration, which has been neglected in any theory of laryngeal neutralization, is due to their cue distribution. Specifically, glottalization has more cues than aspiration in syllable-final position. In other words, a preceding vowel can carry the cues of glottalization to convey the laryngeal contrast, which makes it different from aspiration. The observations made in examining the laryngeal neutralization typology in this paper suggest that phonetically-motivated constraints are needed for the explanation of the laryngeal feature distribution.

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