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Lenition and Glottalization in Nuu-chah-nulth*

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1 Introduction

This paper offers an explanation of lenition and glottalization in Nuu-chah-nulth, a Southern Wakashan language spoken on the west coast of Vancouver Island.[1] Specifically, it is argued that suffixes which trigger these processes carry a "floating" laryngeal feature (viz. [+voiced] and [+constricted glottis]). Throughout, special attention is given to the behaviour of fricatives, which become [+sonorant] in both lenition and glottalization. I conclude with a remark on the "segment inventory" of Nuu-chah-nulth.

2 Lenition in Nuu-chah-nulth

Rose (1976:13) describes Nuu-chah-nulth "lenition" as "the regular change of fricatives to glides preceding certain suffixes". The three "lenition suffixes" (or "softening suffixes" in Sapir's 1938 terms) found in Nuu-chah-nulth are /-'iɬ/ 'in the house'; /-'is/ 'at the beach'; /-'ačiƛ/ 'become ...'; e.g. (1).[2]

(1)	a.	/hiɬ-'iɬ/ LOC-in the house	[hiyiɬ]	there in the house
	b.	/ƛ'uš-'is/ dry-on the beach	[ƛ'uyis]	dried on the beach
	c.	/ʔiχ^{w}-'ačiƛ/ big-become	[ʔiwačiƛ]	get to be big

This lenition is often discussed within Wakashan studies (e.g. Sapir 1938, Sapir & Swadesh 1939, and Rose 1976 for Nuu-chah-nulth; Haas and Swadesh 1933 for Ditidaht; Boas 1947 for Kwak'wala), yet to date no uniform explanation is available. In this section I argue that this process is caused by voicing.

The key to my account of Nuu-chah-nulth lenition lies in the following discussion of sonorancy and voicing by Ohala and Ohala (1993:232-3):

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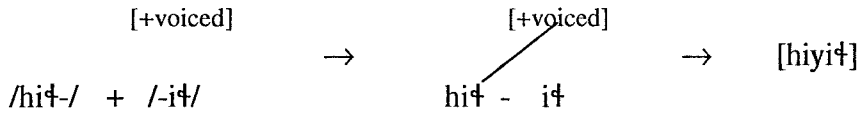
[1] The data used here is from earlier Port Alberni Nuu-chah-nulth (Sapir and Swadesh 1939 and Rose 1976).

[2] The diacritic /-'/ is used in the literature to indicate a lenition-triggering suffix.

> [U]nder ideal conditions of airflow ... one can identify a critical threshold at which smooth or "laminar" flow changes to turbulent flow. ... One might be tempted to associate [+sonorant] with conditions of airflow which are lower than this threshold and [-sonorant] to those which exceed it ... [A]mong the relevant variables with determine this threshold ... are not only the area of the constriction but also the velocity of the airflow. Thus, given a certain vocal tract configuration, say that for a palatal glide [j], there might be no appreciable turbulence when it is voiced, since the vibrating vocal cords offer sufficient resistance to the pulmonic airflow so that the velocity of air flowing past the ... constriction is relatively low. However, under voiceless conditions the same configuration may lead to noticeable turbulence, since now the escaping air is virtually unchecked and reaches much higher velocity levels.

Now in the unmarked case, fricatives involve high velocity, turbulent airflow (Ohala and Ohala 1993:240). From the above discussion it then follows that fricatives, when voiced, may become sonorant.[3] Thus in Nuu-chah-nulth let us assume that the so-called "lenition suffixes" /-iɬ/, /-is/ and /-ačiƛ/ each supply a "floating" feature [+voiced].[4] When this floater docks onto a root-final fricative, the latter is phonetically realized as a sonorant, as illustrated in (2) for (1a).

(2)



(The floating [+voiced] links to the right edge of the root, just like the suffix it is part of.)

Notice that "only certain fricatives are affected" by lenition (Rose 1976:15):

(3) *Lenition of Fricatives in Nuu-chah-nulth*

a.	Coronal fricatives:	s, š, ɬ →	y
b.	Dorsal fricatives:	x^w, $ħ^w$ →	w
		x, ħ remain unchanged.	

Under the phonetic explanation provided above, this is expected: A fricative may be realized as a sonorant only if it has the required vocal tract configuration. Thus a back

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[3] O&O draw a different, though related, conclusion: "a [+sonorant] can become [-sonorant] simply by virtue of becoming [-voice]" (ibid.). So for instance, "on the rare occasions when [voiceless nasals] do occur [e.g. in Burmese, Old Irish], they may show obstruent-like ([-sonorant]) behavior" (Ibid.). (Cf. O&O's Theorem B whereby nasals, when voiceless, are fricatives.)

[4] "Floating" ("free", "unassociated") features are well-established in the (nonlinear) phonological literature, starting with Leben (1973) and Goldsmith (1976).

fricative fails to be realized as a sonorant unless it already has the Labial specification needed to articulate [w]. Thus compare (4a) and (4b).

(4)	a.	/tunax-is/	[tunaxis]
		rushes-on_beach	rushes on the beach
	b.	/c'ax^{w}-is/	[c'awis]
		pointed_object-on_beach	a pointed object sticks in the beach

Before going further, note that to date it has been assumed that Nuu-chah-nulth has no voiced sounds, aside from sonorants (5).

(5) *Consonant inventory of Nuu-chah-nulth* (Rose 1976)

	labial	**alve-olar**	**alveo pal-atal**	**lat-eral**	**velar**	**labio velar**	**uvu-lar**	**labio uvu-lar**	**pha-ryn-geal**	**glo-ttal**
stop affri-cate	p	t c	č	ƛ	k	k^{w}	q	q^{w}		
glotta lized	p'	t' c'	č'	ƛ'	k'	k'^{w}	q'	q'^{w}	ʕ	
frica-tive		s	š	ɬ	x	x^{w}			ħ (ħ^{w})	
reso-nant	m	n	y			w				h
glot. res.	m'	n'	y'			w'				ʔ

Thus prima facie, it seems unlikely that some morphemes carry a floating [+voiced] which links to fricatives in this language. In fact, one may reasonably ask whether there is any independent, cross-linguistic evidence that Wakashan lenition-causing suffixes carry such a floater. As I will now show, the evidence is striking.

Evidence from Heiltsuk

The Nuu-chah-nulth lenition suffixes are also found in Heiltsuk (Northern Wakashan), e.g. /-'is/ 'on the beach', /-'iɬ/ 'in the house' (Rath 1981). As in Nuu-chah-nulth, these lenition-causing suffixes change root-final coronal fricatives into their sonorant counterparts. Thus compare the (a) examples with the (b,c) examples in (6-7). (Accented vowels have high tone; unaccented vowels have low tone.)

(6)	a.	/kús-a/	[kúsa]
		scrape-	to scrape
	b.	/kús-'is/	[kúyis]
		scrape-on_beach	scraping on the beach
	c.	/kús-'iɬ/	[kúyiɬ]
		scrape-in_house	shaving indoors

(7)	a.	/húɬ-a/	[húɬa]
		heap_up-	to heap up
	b.	/húɬ-'is/	[húlis]
		heap_up-on_beach	hump on the beach
	c.	/húɬ-'iɬ/	[húliɬ]
		heap_up-in_house	hump on the floor of the house

Heiltsuk lenition suffixes also cause labialized back fricatives to become [w], as in Nuu-chah-nulth:

(8)	a.	/λáχ^{w}-iɬ/	[λáwiɬ]
		stand-in_house	to stand indoors
	b.	/λáχ^{w}-is/	[λáwis]
		stand-on_beach	to stand on the beach
	c.	/λáχ^{w}-úx^{w}[R]-iɬ/	[λáλχ^{w}úwiɬ]
		stand-together-in_house	stand together indoors
	d.	/λáχ^{w}-úx^{w}-is/	[λáλχ^{w}úwis]
		stand-together-on_beach	stand together on the beach

The crucial point to be made here, however, is that Heiltsuk lenition suffixes cause stops and affricates to become [+voiced]. Thus compare the (a) examples with the (b,c) examples in each of (9-13).

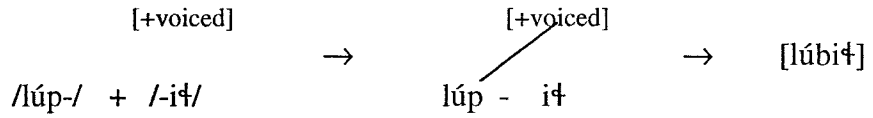
(9)	a.	/lúp-a/	[lúpa]
		empty	empty
	b.	/lúp-'is/	[lúbis]
		empty-on_beach	empty on the beach
	c.	/lúp-'iɬ/	[lúbiɬ]
		empty-in_house	unoccupied building

(10)	a.	/cít-a/	[cíta]
		list-	to list (as a boat)
	b.	/cít-'is/	[cídis]
		list-on_beach	in listing position on the beach (as a boat)
	c.	/cít-'iɬ/	[cídiɬ]
		list-in_house	in listing position indoors

(11)	a.	/ʔamák-a/	[ʔamáka]
		defecate-	to defecate
	b.	/ʔamák-'is/	[ʔamágis]
		defecate-on_beach	to defecate on the beach
	c.	/ʔamák-'iɬ/	[ʔamágiɬ]
		defecate-in_house	to defecate in bed
(12)	a.	/ʔasíqʷ-a/	[ʔasíɢʷis]
		other_side-	travel on the other side (of the channel)
	b.	/ʔasíqʷ-'is/	[ʔasíɢʷis]
		other_side-on_beach	on the other side of the beach
	c.	/ʔasíqʷ-'iɬ/	[ʔasíɢʷiɬ]
		other_side-in_house	on the other side of the interior of the house
(13)	a.	/ɢélq-χs/	[ɢélqχs]
		container-on_boat	container placed aboard the boat
	b.	/ɢélq-'is/	[ɢélɢis]
		container-on_beach	container placed on the beach
	c.	/ɢélq-'iɬ/	[ɢélɢiɬ]
		container-in_house	container placed on the floor in the house

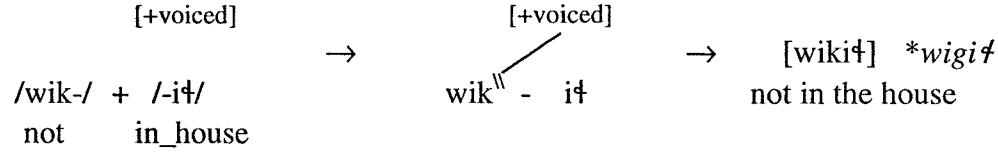
In other words, there is direct evidence that Wakashan lenition suffixes carry a floating [+voiced]. When such a floater docks onto a stop/affricate in Heiltsuk, the result is a voiced stop/affricate, as illustrated in (14) for (9c).

(14) Lenition in Heiltsuk



This does not happen in Nuu-chah-nulth, which disallows voiced (obstruent) stops. In all likelihood, this is due to a grounding condition (Archangeli and Pulleyblank 1994) which is active in Nuu-chah-nulth phonology but not in Heiltsuk: STOP/VOI *If [-continuant] then not [+voiced].* (Stops interrupt the airflow typically required for voicing.) E.g. (15):

(15) Lenition in Nuu-chah-nulth



By contrast, when the floating [+voiced] of a lenition suffix docks onto a fricative, the *phonological* result is a voiced fricative; the *phonetic* result is a sonorant,[56] as illustrated in (16) for Heiltsuk (8b), and in (17) for Nuu-chah-nulth (4b).

(16) Lenition in Heiltsuk

	[+voiced]		[+voiced]		
/λáχ^{w}-/	+ /-is/	→	λáχ^{w} - is	→	[λáwis]

(17) Lenition in Nuu-chah-nulth

	[+voiced]		[+voiced]		
/c'ax^{w}-/	+ /-is/	→	c'ax^{w} - is	→	[c'awis]

3 Glottalization in Nuu-chah-nulth

Recall the phonetic explanation given Wakashan lenition in the previous section. When a fricative becomes [+voiced], "the vibrating vocal cords offer sufficient resistance to the pulmonic airflow so that the velocity of air flowing past the ... constriction is relatively low" (Ohala and Ohala 1993:232). The phonetic result may be sonorancy. Interestingly, this explanation predicts that a *glottalised fricative* may also be realised as a sonorant, since arguably, the constricted vocal cords also "offer sufficient resistance to the pulmonic airflow so that the velocity of air flowing past the ... constriction is relatively low" (Ibid.). As I will now show, this prediction is borne out in Wakashan.

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[5] That is, voiced fricatives are assigned the feature [+sonorant] *by default*. I leave open the question of whether this happens in the phonology or in the phonetics. (Keating 1988 argues that a segment may remain unspecified for a feature, even at the output of the phonology.)

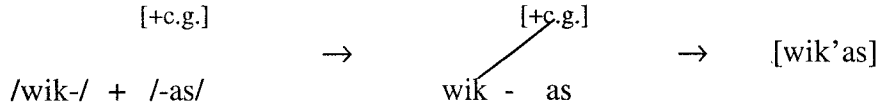
[6] Note that if we are correct in assuming that some phonetic sonorants are phonologically voiced fricatives, we might expect these "fake" sonorants to behave differently than "true" sonorants. This prediction is borne out in Heiltsuk: when followed by a lenition suffix, a "true" sonorant glottalizes, whereas a "fake" sonorant (i.e. a voiced fricative) fails to do so. For instance, compare (i) [=(7)] with (ii):

(i)	a.	/húɬ-a/	[húɬa]	to heap up
	b.	/húɬ-'is/	[húlis]	hump on the beach
	c.	/húɬ-'iɬ/	[húliɬ]	hump on the floor of the house
(ii)	a.	/k^{w}el-s/	[k^{w}els]	to lie on the ground outside
	b.	/k^{w}el-'is/	[húl'is]	to lie on the beach
	c.	/k^{w}el-'iɬ/	[húl'iɬ]	to lie in the house

In Nuu-chah-nulth, a large number of suffixes carry a floating [+constricted glottis], e.g. /-'as/ 'outside', /-'akƛi/ 'in rear', /-'i(:)č/ 'time'.[7] As we saw with [+voiced], a floating [+cg] links to the final element of the base of suffixation. So in (18a) for instance, a final [k] becomes [k'], as illustrated in (19).

(18)	a.	/wik-'as/	[wik'as]
		not-outside	id.
	b.	/ʔam-'akƛi/	[ʔam'akƛi]
		LOC-in rear	in the rear
	c.	/m'iƛ-'i(:)č/	[m'iƛ'i:č]
		rainy-time	id.
	d.	/yac-'as/	[yac'as]
		walk-outside	id.

(19)

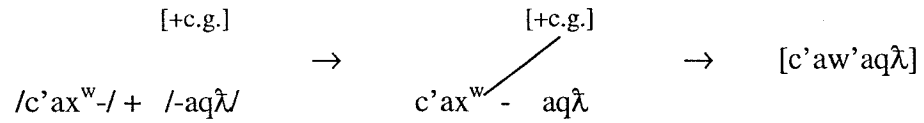


Crucially for us, when the floating [+constricted glottis] of a lexical suffix links to a root-final fricative, a glottalized sonorant results. So in (20) for instance, we can observe root-final coronal fricatives becoming [y'], and in (21), root-final labial-dorsal fricatives becoming [w']. (21a) is illustrated in (22).

(20)	a.	/his-'u:ƛ/	[hiy'u:ƛ]
		hit-on_rocks	id.
	b.	/ƛ'uš-'aqƛ/	[ƛ'uy'aqƛ]
		dry-inside	id.
	c.	/hiɬ-'aqƛ/	[hiy'aqƛ]
		LOC-inside	inside

(21)	a.	/c'ax^{w}-'aqƛ/	[c'aw'aqƛ]
		spear-inside	spear inside
	b.	/ʔanaχ^{w}-'iƛ[L]-aq[S]/	[ʔanuw'iƛaq]
		little-take-very	take very little

(22)



[7] This is represented diacritically by /-'/. Glottalization is discussed in e.g. Sapir (1938), Sapir & Swadesh (1939), and Rose (1976) for Nuu-chah-nulth; Haas and Swadesh (1933) for Ditidaht; Boas (1947) for Kwak'wala. On the notion of "floating" [+cg], see Archangeli (1983).

That is, as far as fricatives are concerned, the changes triggered by a floating [+constricted glottis] correspond exactly to those triggered by a floating [+voiced].

(23) *Glottalisation of Fricatives in Nuu-chah-nulth* -cf.(3)

a.	Coronal fricatives:	s, š, ɬ →	y'
b.	Dorsal fricatives:	x^w, $ħ^w$ →	w'
		x, ħ remain unchanged.	

Once again, this is because [+cg] and [+voiced] both offer resistance to airflow at the level of the vocal cords, which allows for the sonorization of continuant obstruents.

4 Conclusion

In this paper I have identified two "floating" features in the underlying representation of many Nuu-chah-nulth suffixes: [+voiced] and [+constricted glottis].[8] The effects of such floaters are observable morpheme-finally in words. For instance, the 'locative' morpheme /hiɬ-/ is pronounced [hiy] before a suffix with a floating [+voiced], [hiy'] before a suffix with a floating [+cg], and [hiɬ] before a suffix with no floating feature:

(24)	/hiɬ-/ LOC	[hiyiɬ]	there in the house
		[hiy'aqƛ̓]	there inside
		[hiɬʔatu]	stopping there

At this point, note the following paradox: in each case the "floating" feature is an integral part of a morpheme, yet individual features like [+voiced] and [+constricted glottis] are not considered part of the "segment inventory" of Nuu-chah-nulth (see (5) above).

To avoid this contradiction, individual features must be considered *primitives* of Nuu-chah-nulth morphemes. Note, however, that this move casts doubt on the very notion of "segment inventory", since "segments" are just combinations of features (and nodes) (Archangeli and Pulleyblank 1994). Thus, ultimately we must ask ourselves "whether the underlying phonological representations of morphemes are established through direct reference to the primitive notions of features and associations, or whether they are established through necessary reference to the derivative notion of segment" (Archangeli and Pulleyblank 1994:46). In other words, is (Nuu-chah-nulth) phonology non-segmental?

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[8] I have also found evidence for a floating [+continuant] in Heiltsuk. The suffix *-(x)ʔit* 'to begin' causes preceding stops and affricates to become +CONT, e.g. (i).:

(i)	a.	/ʔaen-'íq-(x)ʔit/	[ʔaen'íχʔit]	to begin to gather firewood
	b.	/ʔáenc-(x)ʔit/	[ʔáensʔit]	to begin to move over a bit
	c.	/ʔaen-'úk^w-(x)ʔit/	[ʔaen'úx^{w}ʔit]	to begin to get fire
	b.	/ʔamák-(x)ʔit/	[ʔamáxʔit]	to begin to defecate

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