

Penultimate devoicing in Chaha: phonetic enhancement* rather than devoicing

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Tak, Jin-young. 2011. Penultimate devoicing in Chaha: phonetic enhancement rather than devoicing. *Studies in Phonetics, Phonology and Morphology* 17.1. 103-120. Two of the most well-cited phonological processes in Chaha, ‘devoicing’ (i.e., voiceless consonants alternating with voiced counterparts in the penultimate) and degemination, are reinvestigated to provide a uniform account for laryngeal representations in obstruents within the framework of Dimensional Theory (Avery and Idsardi 2001). In this approach, different from Banksira (2000) and O’Byan and Rose (2004), devoicing is viewed as articulatory enhancement which assigns [stiff] to Glottal Tension, not a process which deletes the underlying specified feature [voice]. This is drawn from Ohala and Ridordan’ (1979) finding that vocal fold vibration resulting from a prolonged constriction (i.e. geminate consonants) is articulatorily effortable; the phonetic change to [tt] from /dd/ is motivated. Furthermore, Vaux’s Law and the special status of /t/ in Chaha are introduced to account for devoicing in Chaha since devoicing applies when the final consonant is either a sonorant or /t/, which is assumed to be not specified for the Laryngeal articulator (Banksira 2000). (Sejong University)

Keywords: laryngeal representation, spread glottis, constricted glottis, devoicing, degemination, Chaha, Dimensional Theory

1. Introduction

This paper departs from the assumption that Chaha consonants are laryngeally contrastive and that the laryngeal characteristics incorporated in Dimensional Theory (Avery and Idsardi 2001) can account for Chaha devoicing and degemination, resulting in opacity. Different from previous research (Petros 1993, Rose 1997, Banksira 2000, O’Brayn and Rose 2004), the present paper shows that penultimate geminate obstruents specified for the Laryngeal articulator can be a target of devoicing when followed by a segment that has a bare laryngeal articulator.

This approach is similar to Banksira’s (2000) in the sense that a laryngeal representation of the final consonant conditions devoicing. However, unlike Banksira who assures at least [-sonorant] for /t/, the present theory posits that /t/ may be regarded as an empty C-slot that is not specified for any feature. This is based on a dual function of /t/: patterning like a sonorant in devoicing and behaving as an obstruent elsewhere. The status of /t/ is further supported by [t(ɿ)]-insertion between vowel-final

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subject pronoun and the verb ‘to be’ (Banksira 2000).¹ [t(ɪ)]-insertion in Chaha implies that /t/ is the least specified consonant and should be treated differently from the other voiceless stops.

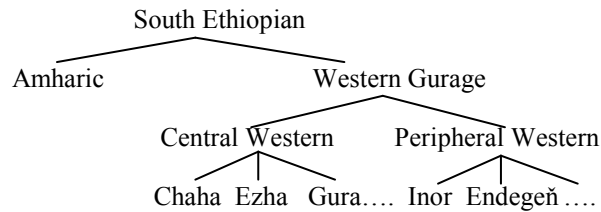
This paper is organized as follows: Section 2 briefly provides a description of Chaha, and Section 3 introduces the data from a purely descriptive perspective. Section 4 shows how Dimensional Theory applies to devoicing and degemination in Chaha. Finally, Section 5 offers a summary of this paper.

2. Preliminaries to Chaha

2.1 Phonology and morphology

Belonging to the South Ethiopian languages under the Semitic family, Chaha is mostly spoken south of Addis Ababa, Ethiopia. The genealogical position of Chaha is shown in (1), following Hetzron (1977:17) and Prunet (1996).

(1) Genealogical position of Chaha



As seen in figure (1), Chaha belongs to the Central Western Gurage branch, where it has been reported that there are about a dozen other languages. Due to being genetically related to each other under the Western Gurage, these languages share many similarities, which might support this analysis. We will cite some data from Ezha, Inor, and Endegeñ later in this paper.

The phonemic inventory of Chaha consonants are given in (2). Relevant allophones to an analysis of present paper are indicated in parenthesis.

¹ [tɪ] is epenthesized before CC, while [t] before CV.

(2) Phonemic inventory of Chaha consonants (Banksira 2000:40)²

		bilabial	labiodental	alveolar	palatal	velar	gluttal
stop	voiceless	(p)		t		(k)	
	voiced	(b)		d		g	
	ejective			t'		k'	
fricative	voiceless		f	s		x	A
	voiced			z			
nasal		m		n			
approximant		β		r	l	U	

In Chaha, /t/ is treated as the only phonemic voiceless stop. [p] and [k] are regarded as variations of /β/ and either /x/ or /g/, respectively. The ejective stops /t', k'/ are licit sounds, while /p'/ is illicit, which is never found in Chaha. The voiced stops /d, g/ are present in the underlying representation; [b] is derived from /β/. The fricatives /f, s, z, x/ are phonemic; /f, x/ do not have a voiced counterpart.

Verbs in Chaha are analyzed as consisting of the two following elements: a consonantal root (i.e., a radical), which carries the basic lexical meaning and a template (i.e., a CV-skeleton and fixed vowels), which carries the grammatical meaning (Rose 1997, Prunet 1996). For example, √sxr means 'to get drunk', and √sβr means 'to break something'; √k'rbA denotes 'sojourn', and √srbt denotes hit, break at once.' A template refers to a set of vowels inserted among the radicals. For example, C₁VC₂C₂VC₃ and ə-ə- are a pattern indicating the perfective. Consider the detailed description in (3).

(3) Chaha verb radicals and templates (Banksira 2000)³

a. Tri-consonantal roots

	imperative	imperfective	perfective
	transitive: C ₁ C ₂ C ₃	-C ₁ əC ₂ (t)C ₃	C ₁ əC ₂ C ₂ əC ₃ -
	intransitive: C ₁ C ₂ əC ₃		
√sβr	sɪβɪr	tɪ-səβɪr	səpər-xə-m
√sxr	sɪxər	tɪ-səxɪr	səkər-xə-m

² The labiodorsal vocoid /U/ and the palatal vocoid /l/ trigger palatalization and labialization, respectively. When /U, l/ cannot find a consonant to dock into, /U/ surfaces as a back rounded vowel, /l/ as a front vowel. /A/, surfacing [a], is categorized as either a fricative or a sonorant.

³ Vowel epenthesis breaks consonant clusters in Chaha. For example, the transitive verb template is C₁C₂C₃; /t/ may be epenthesized between consonants. Banksira (2000:28) proposes that C₁C₂C₃ can be broken and realized as either C₁C₂tC₃, C₁lC₂C₃, or both, depending on the nature of the consonants. This is not discussed here as it is beyond the scope of this paper.

b. Quadri-consonantal roots

	imperative	imperfective	perfective
	$C_1\bar{\alpha}C_2C_3\bar{\alpha}C_4$	$C_1C_2\bar{\alpha}C_3C_3(\bar{\alpha})C_4$	$C_1(\bar{\alpha})C_2\bar{\alpha}C_3C_3\bar{\alpha}C_4$
$\sqrt{k'rbA}$	kəmba ⁴	tɪ-k'rəpa	k'rəpa-xə-m
\sqrt{srbt}	səmbɪt	tɪ-srəpɪt	sɪrəpət-xə-m

As seen in (3a), the perfective penultimate of tri-consonantal verbs is voiceless, while the imperative and imperfective penultimate is voiced. On the other hand, in the quadri-consonantal verbs in (3b), the perfective and imperfective penultimate is voiceless; the imperative penultimate is voiced. This process is defined as a requirement on the penultimate consonant in certain aspectual forms.⁵ Interestingly, some forms do not have this alternation. In the literature of Chaha phonology, the voicing alternations in these forms are the result of mandatory degemination and optional devoicing of the penultimate geminate root (Rose 1997, Banksira 2000, O'Bryan and Rose 2004). The underlying penultimate geminates are supported through synchronic and diachronic data from the related languages such as Ezha, Inor, and Endegeñ (Rose 1997, O'Bryan and Rose 2004).

(4) Historical forms of $\sqrt{sd\beta}$ 'curse' → *səddəβ

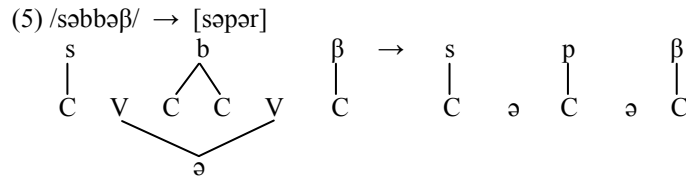
Language	Perfective	Imperfective	Jussive
a. Ezha	səddəβ -ə-m	yɪ-sədiβ	yə-sdiβ
b. Endegeñ	səttəβ -ə	ɪ-sədiβ	ə-sdiβ
c. Inor	sətəβ -ə	yɪ-sədiβ	ə-sdiβ
d. Chaha	sətəβ -ə-m	yɪ-sədiβ	yə-sdiβ

As seen in the data of (4), Ezha maintains original geminates; Chaha and Inor develop single segments in the perfective. Here, Endegeñ shows the intermediate stage, yielding voiceless geminates. Leslau (2000) posits that voiced geminate obstruents in the penultimate position became voiceless, and that all geminates degeminated in Chaha diachronically. Based on the diachronic data in (4), it can be argued that the penultimate consonants in Chaha (4) are underlyingly voiced geminates and surface as voiceless singletons. If a geminate analysis is not proposed, it can hardly be justified why some selected aspectual forms (i.e., the perfective of tri-consonantal verbs and the perfective/imperfective of quadri-consonantal root) undergo devoicing, while the others do not. The templates, which contain a

⁴ The underlying /r/ is nasalized in the following three conditions: (1) it occurs initially, (2) it is a geminate, and (3) it is a penultimate coda.

⁵ Devoicing is lexical, depending on the classification of verb roots, which is based on patterns of conjugation (i.e., Type A, B, C, D). However, what is clear is that the perfective forms of all the verb types undergo devoicing. Since the classification of verb roots is not the issue of the present paper, this paper limits the data into the perfective of tri-consonantal roots and the perfective/imperfective of quadri-consonantal roots.

penultimate geminate (i.e., $C_1\text{ə}C_2C_2\text{ə}C_3$, $C_1C_2\text{ə}C_3C_3(\text{t})C_4$, or $C_1(\text{t})C_2\text{ə}C_3C_3\text{ə}C_4$), are the target for degemination and devoicing. On the other hand, degemination in Chaha applies to all the penultimate geminates regardless of whether they undergo devoicing or not by a language-specific constraint No Geminate in the surface. Given this, Banksira (2000) and O'Bryan and Rose (2004) provide the underlying representation of \sqrt{sdb} within McCarthy's (1984) approach, as illustrated in (5).



According to Banksira (2000) and O'Bryan and Rose (2004), in Chaha, devoicing is determined by the following root consonant. Their varying positions toward this phonological process are discussed in Section 3.

2.2 Data

Chaha tri-consonantal verbs in the perfective and quadri-consonantal verbs in the perfective and the imperfective may be categorized into two; one undergoes penultimate obstruent devoicing, and the other does not.⁶

(6) Verbs undergoing devoicing

Jussive	Perfective	Root	Gloss
a. yə-mgər	məkər	\sqrt{mgr}	'suppurate'
b. yə-sβər	səpər	$\sqrt{s\beta r}$	'break'
c. yə-sdɪβ	sətəβ	\sqrt{sdr}	'curse'
d. yə-gərdəm	gɪrətəm	\sqrt{grdm}	'break something into two'
e. yə-zaβt	zapət	$\sqrt{zA\beta t}$	'lose one's way'

(7) Verbs not undergoing devoicing

Jussive	Perfective	Root	Gloss
a. yə-t'ɪβs	t'əbəs	$\sqrt{t'\beta s}$	'roast something'
b. yə-ndɪf	nədəf	\sqrt{rdf}	'sting'
c. yə-zɪβk'	zəbək'	$\sqrt{z\beta k'}$	'daub'
d. yə-mbət'	nəbət'	$\sqrt{rbt'}$	'warm up, be flexible'

⁶ There are geminate strengthening processes in Chaha, ensuring the change from /ββ/ to [b], from /r/ to [n], and from /xx/ to [k]. /β/ surfaces as either [b] through geminate strengthening as in (7) or [p] through both geminate strengthening and devoicing as in (6). Furthermore, word-initial strengthening is also another well-known process in Chaha; /r/ is strengthened into [n] word-initially, as seen in (7).

e. yə-ŋgɪd	nəgəd	√rgd	‘touch’
f. yə-xɪβd	a-xəbəd	√xβd	‘touch’

As illustrated in (6), if the final radical is a sonorant or [t], the penultimate obstruent in the perfective (and the imperfective if the verb is quadri-consonantal) devoices. However, if the final radical is either a fricative (7a-b), an ejective (7c-d), or a voiced stop (7e-f), the penultimate keeps the voicing feature. In other words, these verbs have a consistent voiced feature for the penultimate segment. However, penultimate voiceless obstruents remain voiceless (i.e., as [kətəf] from √ktf ‘chop’) and also penultimate sonorants keep their [voice] feature (i.e., as [k’əməs] from √k’ms ‘taste’).

Interestingly, in Chaha devoicing is not carried over to the reduplicated forms in internal reduplication (copying the penultimate segment with a fixed vowel /ə/) encoding the meaning of frequentativity or repetition. Consider the data (Rose 2003) in (8).

(8) Internal reduplication in the perfective in Chaha

Regular		Reduplicated	
a. səpər	‘break’	sɪβəpər	‘shutter’
b. zəkər	‘jump’	zɪgəkər	‘jump again and again’

Therefore, the reduplicative patterns in (8) and the imperative of tri-consonantal verbs in (6) may provide a cue for the underlying representation of the penultimate segments.

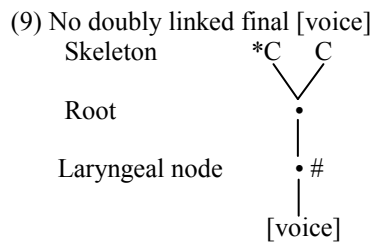
2.3 Previous studies

2.3.1 Banksira (2000)

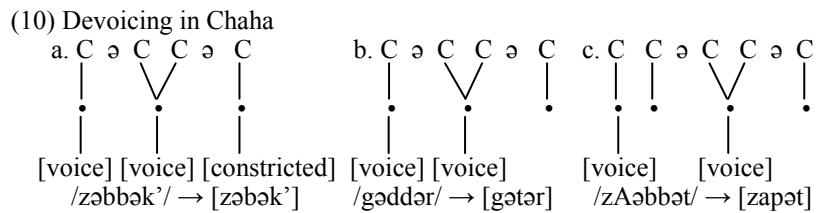
Banksira (2000) suggests that the laryngeal representation of the final consonant determines applicability of penultimate consonant devoicing in the perfectives for tri-consonantal verbs. Within Banksira’s (2000: 4) proposal, ejectives are specified for [constricted glottis]; voiced obstruents and voiceless fricatives are for [voice] and [spread glottis], respectively. In contrast, the phonemic /t/ is not laryngeally specified, unlike other obstruents. Also, he argues that /t/ is the only plain voiceless stop permissible as a final radical; only /t/ among obstruents allows penultimate voicing alternation. From this perspective, /t/ behaves differently from other obstruents. Therefore, it might be assumed that /t/ does not have any laryngeal features different from voiced stops and fricatives. Given this assumption, Banksira (2000) proposes that the phoneme /z/ is specified for both [voice] and [spread glottis] and /d/ only for [voice]. In addition, [voice] is an inactive, redundant feature for sonorants. Therefore, it is not specified. Based on the fact that /β/ can trigger devoicing like other sonorants, as shown in (6c), he suggests that /β/ is a bilabial approximant,

not fricative, in Chaha (Rose 2003). For that reason, as for /β/, [sonorant] is specified; [voiced] and [continuant] are underspecified since these features are phonologically inactive for the description of sonorants. In contrast, a voiced fricative such as /z/ should be specified for both features [continuant] and [voiced] in the underlying representations.

Given this assumption, Banksira (2000) proposes that devoicing in Chaha is a constraint to ban a doubly linked final [voice]. In other words, if penultimate geminates are the rightmost laryngeally specified obstruent of a morpheme, they devoice. This is seen in (9).



This constraint correctly predicts the context of devoicing. This is illustrated in (10).



In (10a), when the final consonant is an ejective, specified for [constricted glottis], and consequently the penultimate geminate is not the rightmost laryngeally specified obstruent, devoicing does not occur. However, in (10b) and (10c), when the final consonant is either a sonorant or /t/, the penultimate geminates do not undergo devoicing; sonorants and /t/ in Chaha lack laryngeal features, and so the penultimate is the rightmost laryngeally specified obstruent.

However, his approach adapts both binary and privative feature systems at the same time. For example, only laryngeal features are represented by means of privative features [voice], [spread glottis], and [constricted glottis]. Then, for the other features except for the laryngeal features, he uses a binary feature system. For example, [-sonorant], [+sonorant], and [+approximant] are used for obstruents, sonorants, and /β/, respectively.

Additionally, as pointed out by O'Bryan and Rose (2004), Banksira fails to provide the exact status of [k] and [p], which are derived from /x/ and /β/.

What is clear in Chaha is that [t] is different from [k] and [p]. However, he does not account for this fact in detail.

More acutely, he assumes that fricatives are underlyingly specified for [spread glottis], so it can trigger devoicing. However, [spread glottis] is a phonetic manifestation that does not need to be specified underlyingly for fricatives; the feature [continuant] guarantees fricatives, and therefore, the feature [spread glottis] is redundant, filled up at the later stage. Banksira (2000) adopts underspecification; he does not comply with one of the most important assumptions that a redundant feature is not specified in the underlying representation.

2.3.2 O'Bryan and Rose (2004)

Taking consideration of other Western Gurage dialects (i.e., Inor, Gyeto, Endegeñ), O'Bryan and Rose (2004), based on Leslau (1976, 1978, 1979), depart from the assumption that there is no phonological feature that differentiates the segments that trigger devoicing and the ones which do not. Based on the phonetic measurement of consonant duration, O'Bryan and Rose classify consonants in Western Gurage dialects into a degemination trigger class (with a longer duration) and a non-trigger class (with a shorter duration). Ejectives and fricatives whose duration is 118 ms and 116 ms belong to the trigger class, while the others with a relatively shorter duration than ejectives and fricatives belong to the non-trigger class. Furthermore, they split Banksira's degemination into two diachronic rules. Degemination 1 is applied when the final radical is characterized by a longer duration (i.e., ejectives and fricatives), while consonants with a short duration (i.e., sonorants and stops) blocked degemination. According to O'Bryan and Rose (2004), degemination was blocked either to maintain a minimal duration or to ban two long segments (i.e., a geminate and a long consonant). Then the remaining geminates devoiced and simplified through Degemination 2. This is seen in (11).

(11) Historical form	*səbbər	*nəddəf	
Degemination 1	-----	nədəf	
Geminate Devoicing	səppər	-----	(=Endegeñ)
Degemination 2	səpər	-----	(=Chaha, Gyeto, Inor)
	səpər	nədəf	

However, as indicated by O'Bryan and Rose (2004: 6), consonants have different intrinsic durations when they are geminates; it is difficult to assert that geminates are always longer than a singleton. Since in Chaha geminates are not phonetically realized, it is impossible to measure their duration synchronically. They hold just abstract status. Second, they fail to provide why degemination should be split into two different types and why the short period of the final radical, rather than the long period of the final

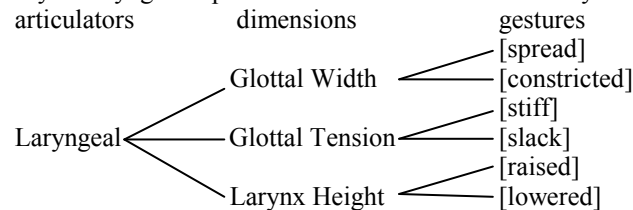
radical, induces degemination.

3. Dimensional Theory

Within the framework of Dimensional Theory, this paper aims at redefining laryngeal features in Chaha by investigating penultimate devoicing. Dimensional Theory of laryngeal representations was reshaped by Avery and Idsardi (2000) based on Halle and Stevens (1971) and Ladefoged (1973). The four familiar laryngeal features introduced by Halle and Stevens (1971) and Ladefoged (1973) are [spread glottis], [constricted glottis], [stiff vocal folds], and [slack vocal folds]. In the binary system, there are sixteen different combinations. However, the glottis cannot be both spread and constricted simultaneously, nor the vocal folds both stiff and slack. Therefore, all sixteen configurations cannot be realized; only nine configurations are possible. In contrast, Lombardi (1991) and Iverson and Salmons (1995) developed three privative features [voice], [spread glottis], and [constricted glottis]. In this approach, Hawaiian, where there is no laryngeal contrast, has no laryngeal specification, while in Japanese, which displays two-way voicing contrast, [voice] is specified.

In Dimensional Theory, laryngeal is an articulator dominating three dimensions (i.e., Glottal Width, Glottal Tension, Larynx Height). In turn, there exist two subordinated gestures under each dimension. This is seen in (12). This is based on Iverson and Ahn (2007).

(12) Geometry of laryngeal representation in Dimensional Theory



Dimensions and gestures are positioned under the articulator ‘Laryngeal.’ Subordinated under the dimension of Glottal Width, [spread glottis] and [constricted glottis] are antagonistic features, only one of which is phonologically active. This concept of antagonisticism also applies to the description of the other dimensions and their subordinated features such as [slack] vs. [stiff].

Before introducing how Dimensional Theory distinguishes obstruents from dimensions, the laryngeal contrast of the privative laryngeal features is presented in (13).

(13) Laryngeal contrasts with [voice], [spread], [constricted]

	/p ~ b/	/b/	/p ^h /	/p'/	/b ^h /
English	[]		[spread]		
Japanese	[]	[voice]			
Hausa	[]	[voice]		[constricted]	
Hindi	[]	[voice]	[spread]		[spread] [voice]

The laryngeal distinctions in (13) are systematically translated within Dimensional Theory as in (14).

(14) Laryngeal contrasts in Dimensional Theory

	/p ~ b/	/b/	/p ^h /	/p'/	/b ^h /
English	[]		GW		
Japanese	[]	GT			
Hausa	[]	GT		LH	
Hindi	[]	GT	GW		GW, LH

According to Kingston (1985), ejectives are marked by Larynx Height implicating [raised], and implosives by both Laryngeal Height implicating [lowered] and Glottal Tension implicating [slack]. However, [constricted glottis] subordinated to Glottal Width can also ensure ejectives. Therefore, following Ahn and Iverson (2004), this paper adopts a phonetic enhancement that bestows [constricted glottis] to ejectives and implosives.

4. Analysis

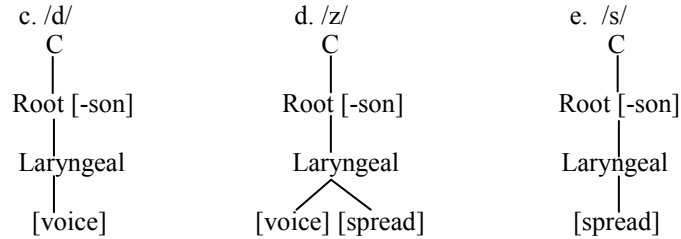
What is interesting in Chaha devoicing is that the penultimate voiced obstruents in the perfective (and the imperfective if the verb is quadri-consonantal) devoice when the final consonant is a sonorant or even /t/. Banksira (2000) is the first phonologist to notice that /t/ can also trigger devoicing. Banksira's (2000) approach is worthy since he captures the behavior of /t/ functioning together with sonorants rather than other obstruents in the process of devoicing. Given this, Banksira (2000) strongly suggests that /t/ in Chaha functions like a sonorant, not like other obstruents in terms of laryngeal specifications. The featural representations of Chaha consonants in Banksira (2000) are as follows:

(15) a. /t/

C
|
Root [-son]

b. /β/

C
|
Root [+approximant]



As seen in (15a) and (15b), /t/ and /β/ are not specified for laryngeal features, while as shown in (15c), (15d), and (15e), /d/ is for [voice], /z/ for [voice] and [spread], and /s/ for [spread glottis]. What is interesting in this analysis is that [spread glottis] is specified for /s/ in the underlying representation.

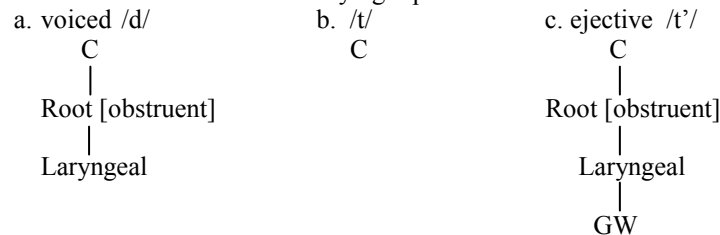
However, unlike Banksira (2000), this paper suggests that /t/ in Chaha is an empty C-slot based on the segmental makeup of /t/. /t/ in Chaha has a dual nature in that in some respects it behaves like a sonorant while it functions like an obstruent in others. If it is assumed that /t/ is underspecified for only laryngeal features, it can be hardly accounted for why it behaves differently from other voiceless stops such as [p] and [k], which are also underspecified for laryngeal features. To account for this, it is proposed that /t/ is a default consonant, which has only a C-slot. Consider the [t(i)]-insertion in Chaha.

(16) [t(i)]-insertion in subject+be+object

a. xɪno-r-o	xɪnotro	‘it is them (masculine)’
b. xɪnəma-r-əma	xɪnəmatrəma	‘it is them (feminine)’
c. ɪyya-n-x ^w	ɪyyatɪnx ^w	‘it is me’
d. ɪyna-n-də	ɪynatɪndə	‘it is us’

Based on the data in (16), this paper assumes that a segmentally empty syllable position is filled by a default consonant [t] and vowel [ɪ]. Therefore, /t/ is represented as an empty C-slot and later completed with the relevant features. The representations of obstruents in Chaha are shown in (17). Note the difference from Banksira’s proposal on /t/ in (15a).

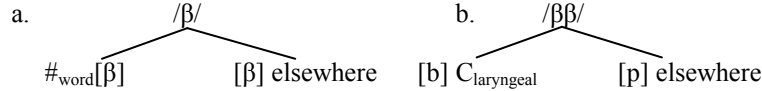
(17) Chaha obstruent contrast-underlying representation



As seen in (17a), a voiced obstruent is specified for Laryngeal, and later the default feature [slack] directly dominated by Glottal Tension under Laryngeal is filled up. As shown in (17b), /t/ is an empty C-slot. As for the ejective /t'/ in (17c), Glottal Width is specified, and [constricted glottis] is completed at the later stage. Along with Ahn and Iverson (2004) and Iverson and Ahn (2007), it is assumed that Glottal Tension is the default dimension under Laryngeal and [slack] under Glottal Tension (Ahn and Iverson 2004, Iverson and Ahn 2007). This paper proposes however that [constricted glottis] is the default feature in Chaha since aspiration is not phonemic in Chaha.

Now, this paper will investigate distributions of other obstruents and provide their representations. First, [b, p] are in complementary distribution with a bilabial approximant /β/; the allophone [p] is found only stem-internally in the perfectives as in *səpər* 'has broken'; [b] occurs word-initially and stem-internally in the perfectives when followed by a sonorant radical or /t/. This is depicted in (18).

(18) The contexts for the allophones of /β/



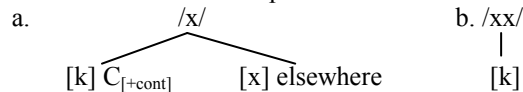
Given (18), [b] can be found as a simplified /ββ/ or strengthened /β/ word-initially, delinking [continuant] from /β/ may induce either [b] or [p].

Then, [k] is derived from either /g/ or /x/. More specifically, [k] and [x] are in complementary distribution. [k] is found before a fricative or stem-internally in perfective forms only when followed by sonorants and /t/; [x] is found elsewhere. This is seen in (19).⁷

- (19) a. *kəfət*/**xəfət* √xft 'has opened'
 b. *yɪ-rək(ɪ)s*/**yɪ-rəx(ɪ)s* √rxs 'he bites'
 c. *nəkəβ*/**nəxəβ* √rxβ 'has found'

The alternations in (19) can be schematized as in (20), following Banksira (2000: 97).

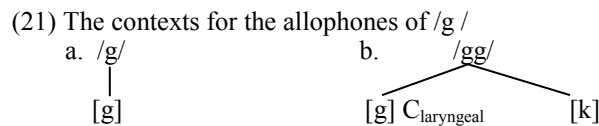
(20) The contexts for the allophones of /x/



⁷ For greater detail of the argument on the distributions of [k] and [x], refer to Kenstowicz and Banksira (1999).

Other fricatives do not undergo strengthening, whereas /x/ undergoes in the perfective. The realization of [k] in (19a) is attributable to (20a), while the ones in (19b)-(19c) are to (20b). This will be accounted for later in greater detail.

As with Banksira (2000) and O'Bryan and Rose (2004), this paper posits that [k] and [p] are derived consonants since [p] always occurs stem-internally in perfective forms. [k] never occurs stem-finally. [k] and [g] are also in complementary distribution. [k] is an allophone of /g/ in perfective forms when /g/ is a penultimate consonant and not followed by obstruents, except for /t/. This is seen in (21).



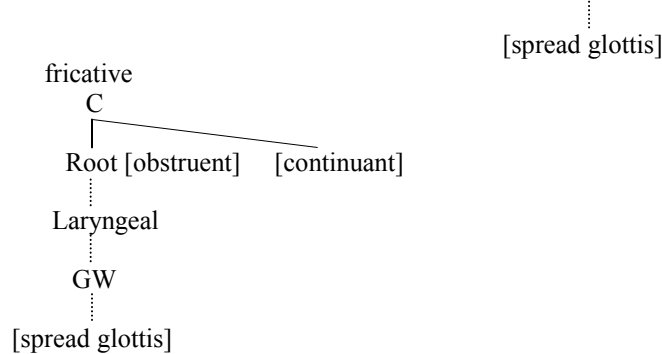
As seen in (20) and (21), [k] can be found as either a simplified /gg/ or /xx/.

Considering the distributions of obstruents in (18)-(21), it is proposed that the voiced obstruents are specified for Laryngeal and the ejectives are for Glottal Width. Then, this paper follows Banksira's (2000) essential assumption that geminates are devoiced if they are the rightmost segment, which is specified for the laryngeal features. However, his assumption is somewhat amended in such a way that the crucial factor to devoicing is not an existence of laryngeal features, but a Laryngeal articulator. In this scenario, /t/ is an empty C-slot which is not specified for any features; therefore, it triggers devoicing. The status of /t/ is different from that of Banksira (2000), which assumes that /t/ is not specified for laryngeal features, but specified for [obstruent].

Additionally, this paper proposes that phonemes /s, z, f, x/ are not specified for the Laryngeal articulator underlyingly; but at the later stage, they acquire [spread glottis] under Glottal Width. This view is supported by Vaux's (1998) assumption that /s, z, f, x/ may be invoked to enhance a contrast phonetically and to trigger devoicing even though laryngeal dimensions play no contrastive roles in fricatives in the underlying representation. Therefore, the fricatives, which are laryngeally unspecified, redundantly acquire the Glottal Width dimension. As Vaux argues, [spread glottis] is endowed in a given language if Glottal Width is not already contrastive in fricatives. This is also discussed with regards to the Korean /s/ by Ahn and Iverson (2004). Similar to Chaha, Vaux's Law assures that, in Korean where Glottal Width is not contrastive for fricatives, [s^h] is derived from /s/. This is clearly different from Banksira's assumption. Banksira (2000) assumes that [spread glottis] is specified for the fricatives underlyingly; however, this paper proposes that [spread glottis] is a redundant feature for fricatives in Chaha since both [obstruent] and [continuant] guarantee fricatives. Banksira's account for devoicing in

Chaha by adopting the feature [spread glottis] for fricative makes a crucial mistake in terms of underspecification. Therefore, this paper assumes that the feature [spread glottis] plays no contrastive role for fricatives in the underlying representation; it can be invoked to enhance a contrast phonetically, resulting in Chaha Geminate Enhancement. This is seen in (22).

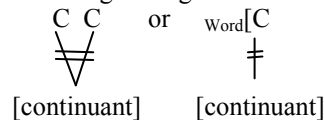
(22) Vaux's Law: Laryngeally unspecified fricative → Glottal Width



In this theory, voiceless fricatives are underspecified for laryngeal features; through Vaux's Law, they acquire [spread glottis] and then can trigger devoicing.

A geminated /xx/ is always realized as [k], while a geminated /ff/ and /ss/ are as [f] and [s], respectively, unaffected by strengthening. In addition, a word-initial /x/ is surfaced as [k]; a word-initial /f/ and /s/ remain intact. If so, what property differentiates /x/ from the other fricatives /s/ and /f/ while still blocking the devoicing of the penultimate in the perfective form? Ladefoged and Maddieson (1996) propose that /x/ is [+strident] like /s/ and /f/, while Chomsky and Halle (1968), Harris (1994), and Banksira (2000) assume that it is [-strident] different from /s/ and /f/. However, based on the fact that /x/ undergoes strengthening when it is a geminate or occurs word-initially like /β/ and /r/, this paper posits that /x/ in Chaha is [-strident]. Then, it is proposed that any segments that are specified for [continuant] and not specified for [strident] undergo strengthening. Therefore, Chaha Strengthening is delinking of [continuant] when they are not specified for [strident]. So /rr/, /ββ/, and /xx/ change into [nn], [kk], and [bb], while /ss/ and /ff/ remain as [ss] and [ff]. This is seen in (23).

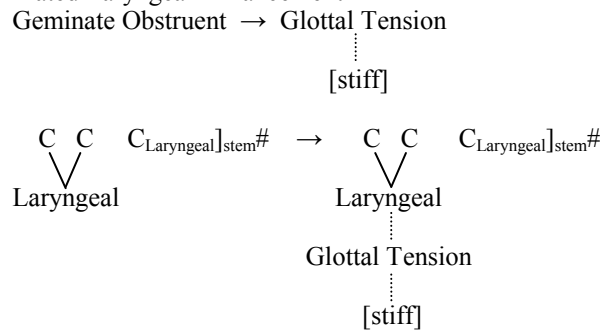
(23) Chaha Strengthening



Then, this paper proposes two Chaha Geminate Adjustments: Geminate Enhancement and Geminate Collapse, replacing the previous two rules (i.e., mandatory degemination and optional devoicing). This is based on Ohala and Ridordan's (1979) and O'Bryan and Rose's (2004) view that maintaining vocal fold vibration through a prolonged constriction (i.e. geminate consonants) is articulatorily difficult. Therefore, the phonetic change to [tt] from /dd/ is articulatorily motivated. However, in Chaha it is optionally applied when the final radical is an obstruent. This is counter to Banksira (2000) who argues that the laryngeal specification of the final radical conditions devoicing. This paper argues that /t/ is treated as a C-slot that is not specified for any features, so it behaves like a final obstruent radical, which is not specified for a Laryngeal dimension. In the framework of Dimensional Theory, it may be stated that voiced geminates acquire [stiff] instead of the default feature [slack] under Glottal Tension through enhancement.

Given this, this paper proposes that Chaha undergoes two adjustments associated with phonetic manifestation. One is degemination, which all geminate consonants have to undergo; the other is optional to enhance voiced obstruent by assigning [stiff] when the final radical is not specified for Laryngeal. Therefore, devoicing is enhancement of a Laryngeal articulator by assigning [stiff], rather than the deletion of [voice] proposed by Banksira (2000). Chaha laryngeal enhancement endows a segment to acquire a dimension (i.e., Glottal Tension) with its subordinated gesture (i.e., [stiff]), not just filling up the default feature [slack]). This is seen in (24).

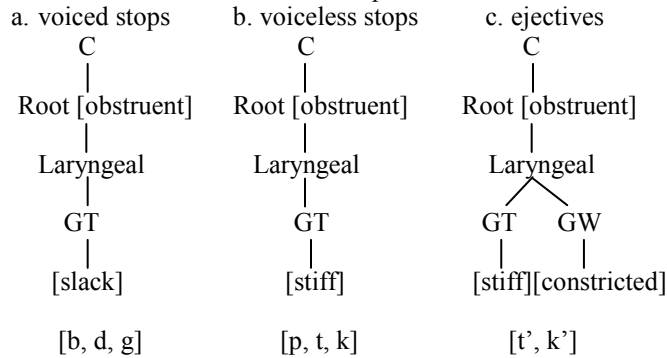
(24) Geminated Laryngeal Enhancement



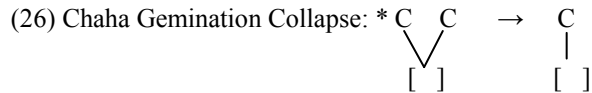
Glottal Tension is a lexical marker of voicing implicating [slack] in Chaha; the gesture [stiff] serves phonetically to enhance the absence of voicing in the geminate series in Chaha in penultimate voiced geminates. This relies on Iverson and Salmon's (2003) argument that an antagonistic gestural pair such as [slack] and [stiff] are never contrastive within the same system, but

a superficial enhancement is employed to increase the contrast encoded by the marked member of the pair. In this light, this paper suggests that in the context where voiced geminates are followed by a laryngeally underspecified segment, the contrast of the Glottal Tension dimension is enhanced. This leads penultimate voiced geminates to be endowed with [stiff]. This is seen in (25).

(25) Chaha obstruent contrast-surface representation



Then, Chaha undergoes another forceful constraint that bans surface geminates. This is shown in (26).



This constraint precludes gemination, but it does not block consonant clusters whose associations are independent of one another. Due to this constraint, the underlying penultimate geminates should degeminate, but not nongeminated consonant clusters.

As discussed, Chaha Geminate Enhancement in (24) embellishes a contrast of Glottal Tension by filling up [stiff] to penultimate voiced geminate obstruents when they are the rightmost segment specified for Laryngeal. Chaha Geminate Collapse in (26) is indebted to a surface singleton derived from underlyingly geminates. These two rules can successfully account for devoicing and degemination in Chaha within the framework of Dimensional Theory. This approach, attributable to Dimensional Theory, can also explain why the fricatives can trigger devoicing in spite of underspecification of laryngeal features by means of Vaux's Law. Additionally, by proposing that /t/ is an empty c-slot, this paper shows why it functions either as an obstruent or a sonorant.

4. Conclusion

Within the framework of Dimensional Theory, this paper argues that Chaha devoicing is filling up [stiff] under Glottal Tension when geminates are the rightmost segment specified for the Laryngeal dimension. Voiced obstruents are specified only for Laryngeal later completed by the subordinated gesture [slack] and ejectives for Glottal Width implementing the gesture [constricted glottis]. Fricatives that are not underspecified for Laryngeal acquire [spread glottis] through Vaux's Law; they can trigger devoicing. Moreover, due to the fact that /t/ in Chaha is the default consonant, which is an empty C-slot, it can also induce devoicing. This paper has shown that Dimensional Theory can successfully account for devoicing and degemination in Chaha in a uniform way such that devoicing is in fact filling up [stiff], but not deleting [voice].

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