Transguttural Harmony in Gitksan: Its Development and Typological Implications*

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Rigsby (1986) states translaryngeal harmony is observed in Gitksan. But the data I obtained from Eastern Gitksan consultants suggests that it is not just translaryngeal: nonhigh vowels in the stem can be copied onto the pronominal suffix across not only a glottal stop but also a uvular consonant. The discrepancy between these two observations can be seen as an ongoing change of the transguttural harmony in the present-day Gitksan. In an Optimality Theory (Prince & Smolensky (1993)) analysis, it will be shown that the system with laryngeal transparency and the system with guttural transparency are attained with the reranking of a HARMONY constraint, along a language-specific markedness constraint hierarchy. This approach limits variations among sets of transparent consonants among gutturals, and tells us not only 'how' but also 'why' harmony is being extended in the way it is.

1 Introduction

This paper examines Vowel Harmony (henceforth, VH) in Gitksan, a Tsimshianic language spoken in the Skeena River valley on the Northwest coast of British Columbia. The main goal of this paper is to give evidence showing that Gitksan is developing transguttural harmony.

The evidence is based on a contrast between Rigsby's (1986) data and mine as well as a unified phonological analysis for both systems that I will propose. It will turn out that the difference between Rigsby's data and mine is in the possible type of 'transparent' consonants, i.e., the 'intervening' consonants

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between trigger and target, which do not block VH. I will show that the system with laryngeal transparency and the system with guttural transparency would be attained with the reranking of a HARMONY constraint. The framework I adopt is Optimality Theory (henceforth, OT) advocated by Prince & Smolensky (1993) (henceforth, PS93).

Within a language, the intervening consonants get augmented in a principled way, not random. It seems that Gitksan transparency is expanded in accord with the markedness scale of Place of Articulation (henceforth, PoA). Firstly, translaryngeal harmony is maintained in two generations of speakers. Secondly, transuvular harmony is in progress in the younger generation. Thirdly, transpalatal harmony is sporadically attested only in the younger generation.

This paper is organized as follows: Section 2 surveys the type of vowel harmony on which I have mainly elicited and shows the segment inventory of Gitksan. Section 3 reveals my findings with new data, and generalizes the difference of the harmony systems between Rigsby (1986) (henceforth, R86) and mine. Section 4 presents an OT analysis which captures both systems and states the theoretical implications of the proposal. Section 5 concludes the discussion.

2 Background

2.1 Vowel harmony in Gitksan

R86 observes translaryngeal harmony, where the unstressed vowels assimilates to [E, O, A] in stem only across laryngeal consonants. He suggests that this harmony operates in the mirror-image environment; left-to-right (e.g., *behe'y* [bÉhE'y] /pe·x̣-ə'y/ 'my lungs' (R86:223)) and right-to-left (e.g., *hlehes Bruce* [ɬEhÉs] Bruce /ɬə-hi=s Bruce/ 'What Bruce said' (R86:224)). The other transconsonantal harmony that is left-to-right [O] harmony which targets an unstressed vowel preceded by a uvular obstruent (e.g., *anjog̲o'y* [ʔnǰÓᶢ̣O'y] ~ *anjog̲a'y* [ʔnǰÓᶢ̣A'y] /ʔən-cuq-ə'y/ 'my camp' (R86:222)), but he notes that some speakers lack this rule and produce the unstressed vowel as [A], no matter what the preceding vowel is.

I have collected data from Eastern Gitksan speakers born in the 1930's. The focus is placed on the left-to-right VH in the domain which consists of a noun and the first singular Series II pronominal suffix written as *'y*.[1] This is given in (1) below.

(1) Vowel harmony (VH) in Gitksan: left-to-right in NP

$[[\ \acute{V}_1 \quad C\ ]_N \ + \ [\ V_2 \quad \text{'y}\ ]_{\text{1sg Series II}}\ ]_{NP}\#$

VPlace e.g., *behe'y* [bÉhE'y] /pe·x̣-ə'y/ 'my lungs' (R86:223)[2]

[1] R86 states that the underlying representation is /'y/ and is realized as ['y] or [ʔⁱ].
[2] The targeted V_2 here may be epenthesized [ə] (see R86 (p. 217-9), Hunt (1990)).

I began by eliciting VH of this domain because R86 explicitly states that both translaryngeal harmony and [O] harmony across uvulars occur here. The data I collected suggest that [E, O, A] can be copied onto the suffix across uvulars as well as laryngeals. What is not observed in R86 is (i) besides [O], [E] and [A] can also trigger harmony across a uvular, and (ii) in some cases, VH seems to occur across a palatal fricative. The discussion below focuses on (i).

In this paper, the "strict locality approach" is adopted. Spreading of features or articulatory gestures applies only between segments that are adjacent on the root tier. Thus no gapped representation is allowed (Padgett (1995), Walker (1998[2000], among others). Following this approach, I will use the term "transparency", in the sense that a consonant is able to bear vowel features (Gafos & Lombardi (1999:86) (henceforth, GL99)).

2.2 Segment inventory

According to R86, Hoard (1978) (henceforth, H78) and Hunt (1990), the phonemic inventory of Gitksan includes at least the following thirty consonants:

(2) Consonant inventory

	Lab(ial)	Cor(onal)			Dor(sal)			
	Labial (or bilabial)	Alveolar with PMR	Alveolar with MSFR	Alveolar with LFR	Palatal (or front velar)	Labiovelar	Uvular (or back velar)	Laryngeal
Plain	p	t	ts [3]		k	k^w	q	
Glottalic	p'	t'	ts'	tl' [4]	k'	k'^w	q'	ʔ
Fricative			s	ɬ [5]	x	x^w	χ [6]	h
Plain	m	n		l	y	w		
Glottalic	'm	'n		'l	'y [7]	'w		

(PMR: plain median release, MSFR: median sibilant fricative release, LFR: lateral fricative release (R86:144))

The columns denote the PoA, which is taken from R86 (p. 144). R86 actually does not include "laryngeal" in the PoA of the obstruent phonemes (p. 144), but

[3] /ts/ and /ts'/ follows Hunt (1990:153). R86 and H78 gives /c/ and /c'/ here respectively.
[4] /tl'/ follows Hunt (1990). H78 gives /ƛ'/ (/ƛ/ = Crossed Lambda) to this position, but according to Pullum & Ladusaw (1986) (henceforth, PL86) (p. 94), (i) /ƛ/ is not used in IPA, and (ii) in American Usage, /ƛ/ represents voiceless alveolar lateral released affricate, i.e., [tl̥] in IPA. R86 gives /Ł'/, but not used in IPA either.
[5] /ɬ/(Belted L) represents voiceless alveolar lateral fricative in IPA (PL86:89), but /ł/ (barred *l*) is used instead in R86.
[6] R86 uses /x̣/ for voiceless uvular fricative and [g̣] for its voiced version. In this paper, I will use /χ/ and [ɢ] respectively, according to IPA.
[7] R86 and Hunt (1990) put /y/ and /'y/ in this column, but H78 puts them in the column of Alveolar with MSFR in the table.

includes /h/ and /ʔ/ in his inventory as "(Non-resonant) Glides" (p. 121). All obstruents are voiceless and all sonorants are voiced. Surface voiced obstruents do exist, but are derived by a voicing rule [-cont] → [+voiced] / ___ [+sonor] (H76:114).

According to R86 (p. 121), Gitksan has three short and five long vowels:

(3) Vowel inventory

Short			Long		
i		u	iː		uː
(e)	(ə)	(o)	eː		oː
	a			aː	

There is some controversy here. First, R86 notes that /e/ and /o/ are probably emerging new phonemes (R86:208). Second, Hunt (1990:153) includes schwa in the inventory, but R86 does not explicitly state that schwa is in his inventory. However, as Hunt (1990:160) points out, R86 does use schwa in his phonological representations as the default vowel subject to colouring from adjacent segments (see R86:222-5 for examples). The justification of vowel phonemes will not be discussed in this paper. The following discussions proceed based on R86.

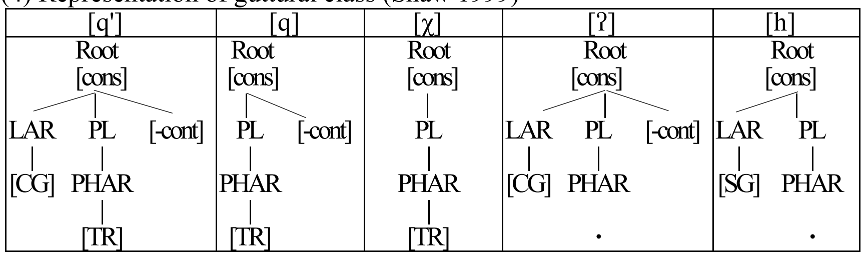
2.3 Featural representations

As for the feature-geometric representations of the consonants, I will essentially adopt McCarthy's (1991, 1994) proposal that the bifurcation of the Place node into Oral and Pharyngeal, and that uvulars, pharyngeals and laryngeals all have the Pharyngeal node as part of their representation. Pharyngeal consonants are also known as gutturals (Hayward and Hayward (1989)), and in many languages they pattern as a natural class to phonological processes such as VH, faucal harmony, lowering, degemination, epenthesis, and reduplication (Bessell (1998), Brown (in prep), Cole (1987), McCarthy (1991, 1994), Rose (1996), among others).

As for the distinctions between gutturals, I will assume representations as in (4). Shaw (1999) presents these representations for uvulars and laryngeals in Nisgha. I adopted these here, because Gitksan is a neighboring language of Nisgha and the two languages have the identical consonant inventory, at least phonemically.[8]

[8] Other phonological similarities are also found, such as the epenthetic vowel quality in CVC reduplicants: a-like quality adjacent to uvulars and laryngeals, u-like quality before labiovelars, and i-like quality elsewhere (see Shaw (1987, 1999) for Nisgha, and R86 (p. 98-102, 224-5) for Gitksan).

(4) Representation of guttural class (Shaw 1999)



The distinction between uvulars and laryngeals is made by [Tongue Root] (abbreviated as [TR]). The distinction between fricatives and stops is made by [-continuant] (abbreviated as [-cont]). The distinction between glottalic and plain manner is made by [Constricted Glottis] (abbreviated as [CG]).

As for the vowels, I will assume the following features:

(5) Underlying and surface vowels

<table>
<tr><td colspan="2"></td><td>-back</td><td colspan="2">+back</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="2">(-round)</td><td>(+round)</td><td></td></tr>
<tr><td rowspan="2">+hi</td><td rowspan="4">-low</td><td>i, iː</td><td rowspan="4"></td><td>u, uː</td><td>+ATR</td></tr>
<tr><td>I</td><td>U</td><td>-ATR</td></tr>
<tr><td rowspan="4">-hi</td><td>e, eː</td><td>o, oː</td><td>+ATR</td></tr>
<tr><td>E, Eː</td><td>O, Oː</td><td>-ATR</td></tr>
<tr><td rowspan="2">+low</td><td rowspan="2"></td><td>a, aː</td><td rowspan="2"></td><td>+ATR</td></tr>
<tr><td>A, Aː</td><td>-ATR</td></tr>
</table>

The assignment of the distinctive values of [high], [low], [back] and [round] to these vowels follows R86 (p. 121). [-ATR] vowels can be derived by faucal harmony (or guttural laxing in (6)) as well as other processes. Schwa has no distinctive features, therefore it will be coloured by the adjacent segments (cf. Shaw (1999)).

It should also be noted that the VH I will treat in the subsequent sections should be applied to the outputs of the guttural laxing below.

(6) Guttural Laxing (cf. R86:204-5)

/í, ú, á/ → [É, Ó, Á] / __ ʔ, χ, q, q'   (right-to-left, segmentally local)

([E] = epsilon, a laxer mid front or (half-open) unrounded vowel; O = open o, a laxer mid back (or half-open) rounded vowel; [A] = alpha,[9] a low central (or open) vowel ranging up to the carat (R86:126))

Only the nonhigh [-ATR] vowels derived by this process can be copied onto the unstressed vowels.

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9 <ɑ> is not used in IPA. In American usage, it represents as a typographical substitute for either symbols of [ʌ], [ɑ], and [ɒ]. For the details, see PL86 (p. 8).

3 Gitksan harmony is not just translaryngeal

3.1 My findings: Harmony across uvular and palatal fricative

Recall that R86 analyzes Gitksan harmony as translaryngeal. But the data I collected from my consultant, DJ, suggest that it is transuvular as well.

The first evidence for this comes from the quality of V_2 after /χ/.

(7) Uvular fricative

/χ/	V_1-V_2	Gloss	Orthography	root-my
a.	A-A	snowshoes	*nax̲*	nÁχ-A'y
b.	E:-E	lungs	*pex̲*	bÉ:χ-E'y [10]
c.	O-O	mother, mother's sister	*nox̲*	nÓχ-O'y

The data show that harmonized [A, E, O] can appear after /χ/, suggesting transuvular harmony.

The question is why /χ/ has become transparent (i.e., apparently being skipped) for VH. It is clear from R86's statement "During my 1982 fieldwork, I observed that *some younger speakers did not glide intervocalic /x̣/ to /h/, but retained it instead*, which gives rise to such forms as ...ba**x̲**a'y, corresponding to older ...ba**h**a'y.. (p. 174) (emphasis mine)". Thus DJ's speech fits the pattern of the *younger* speakers mentioned by R86, who retain /χ/ intervocalically. In a broader sense, rule (iii) below is simply lost (while rules (i, ii) are retained).

(8) Posttonic intervocalic fricative gliding rule ('Rule 14' in R86:173)

$$\begin{matrix}\text{(i)}\\ \text{(ii)}\\ \text{(iii)}\end{matrix}\qquad \left\{\begin{matrix} x \\ x^{w} \\ \boldsymbol{\chi}\end{matrix}\right\} \rightarrow \left\{\begin{matrix} y \\ w \\ \mathbf{h}\end{matrix}\right\} \quad / \quad \acute{V}(y)\ \_\_\_\ V$$

In R86's system, the translaryngeal harmony [bÉ**h**E'y] (*behe'y* 'my lungs') would be applied to the output of rule (8 iii); /pe:**χ**-ə'y/ [bÉ:**χ**-ə'y] → [bÉ:**h**-ə'y]. But the present system, due to the loss of rule (8 iii), produces [bÉ:**χ**E'y]. This would change our view of the natural class of transparency, because [χ], which is not laryngeal, is involved in the transparent consonants. What is more interesting is that the new member of transparency is not restricted to /χ/, as listed below.

The second evidence that the harmony is not strictly translaryngeal comes from the quality of V_2 after /q'/ and /q/.

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[10] R86 (p. 223) notes that in this example the underlying long vowel shortens to become [bÉhE'y], and there are no phonetic [...V·hV...] sequences in the language. ([·] indicates that the sound represented by the preceding letter is half-long (PL86: 212).)

(9) Glottalized uvular

/q'/	V_1-V_2	Gloss	Orthography	root-my
a.	A-A	clam	*ts'a<u>k</u>'*	ts'Áq'-A'y
b.	O-O	eel	*lo<u>k</u>'*	lÓq'-O'y
c.	O-O	salmon belly	*ts'o<u>k</u>'*	ts'Óq'-O'y

(10) Plain uvular

/q/	V_1-V_2	Gloss	Orthography	root-my
a.	A:-A	mouth (outer opening), lips	*aa<u>k</u>*	Á:G-A'y
b.	E:-E	foam, blossoms	*<u>x</u>ee<u>k</u>*	χÉ:G-E'y
c.	E:-E	hoof	*nee<u>k</u>*	nÉ:G-E'y
d.	O:-O	law, to order, command	*ayoo<u>k</u>*	ayÓ:G-O'y
e.	O:-O	rhubarb	*ha'moo<u>k</u>*	hamÓ:G-O'y

The third evidence is the quality of V_2 after /x/.

(11) Palatal fricative

/x/	V_1-V_2	Gloss	Orthography	root-my
a.	a:-i:	bread	*anaax*	aná:x-i:, aná:-i:
b.	E:-E	tallow	*k'eex*	k'É:x-E'y
c.	O-O	halibut	*t<u>x</u>ox*	tχÓx-O'y

All of the data above, except for example (11a), show that the quality of V_2 is in harmony with V_1. (V_2 after Lab, Cor and labiovelars would have i-like quality by default, regardless of V_1.) The class of transparency seems to have been augmented from solely laryngeals to also include uvulars, and /x/ in some cases.

The main finding I have shown here is that the consonants which do not block VH are more extensive than what R86 described. If the chronological gap around 20 years between R86 and the present would be taken into consideration, the two different systems should be admitted. In the next section, I assume that each system belongs to the speakers of different generations.

3.2 Difference between R86's observation and mine

This section discusses the asymmetry of the two systems from the viewpoint of the shift of the consonant transparency. For the purpose of this, I will assume that R86's systems belong to the 'older generation', and the system I newly found belongs to the 'younger generation'.

R86 (p. 222-4) witnesses two groups of speakers: Speakers A have translaryngeal harmony triggered by [A, O, E], while speakers B have [O] harmony across a uvular, in addition to the former system. This is summarized in

(12a). (In the subsequent discussion, the length distinction of trigger vowels will be ignored, as the focus here is on the quality of vowels.)

(12) a. Older generation (R86:222-4)

(i) Speakers A								
	Palatal			Uvular			Lar	
	k'	k	x	q'	q	χ	ʔ	h
A				√	√	√	√	√
O							√	√
E							√	√

(ii) Speakers B								
	Palatal			Uvular			Lar	
	k'	k	x	q'	q	χ	ʔ	h
A				√	√	√	√	√
O				√	√	√	√	√
E							√	√

b. Younger generation

	Palatal			Uvular			Lar	
	k'	k	x	q'	q	χ	ʔ	h
A				√	√	√	√	%
O			%	√	√	√	√	%
E			%		%	%	√	%

In the younger generation, some aspects are newly found as in (12b). First, [h] is superseded by [χ] as a transparent consonant, due to the loss of gliding rule (8iii). Second, [E] is added to triggers of cross-uvular VH. Third, [x] may be added to the list of transparent consonants although the triggers are limited to [E, O].

As described in the previous sections, uvulars and glottals form a natural class of gutturals. For that reason, it seems odd that [x] would start to be transparent. However, the class of gutturals seems controversial and varies in its members: (i) uvulars, pharyngeals and laryngeals (McCarthy (1991, 1994)), (ii) *velars*, uvulars, pharyngeals and laryngeals (Paradis & LaCharite (2001)).[11] If this variation is determined on a language-specific basis in the sense of Mielke (2004), including velars in the Gitksan guttural class would not be a problem.[12]

Furthermore, there is a reason that may be able to support the fact that [x] and other gutturals pattern together in younger generation. The emergence of cross-[x] VH does not seem to be unrelated to the shift of [h] to [χ]. One possible unified account is to relate them with a diachronic chain shift in the order of [h]→[χ]→[x]. I speculate that the surface [x] which is derived from historical [χ] may pattern together with other gutturals in VH. For example, in Palestinian Arabic it is reported that there are two kinds of surface velars, and only velars derived historically from a uvular do pattern with pharyngeal (Davis (1995:479-483)).

If all these consonants are treated as non-blockers of VH, the generalization can be made in the following way: VH in younger generation is

[11] In Iraqw, a Cushitic language spoken in Tanzania, round harmony applies across velars and uvulars as well as the other gutturals (Rose (1996:77-8)).
[12] If the distinctive features used in language are learned rather than innate as Mielke hypothesizes, [pharyngeal] may have been interpreted as including palatal fricative due to its phonetic similarity to uvular fricative.

more extensive than in older generation, in that uvulars and palatal fricatives, as well as laryngeals, act as non-blockers of VH. Thus, this transition can be seen as transguttural harmony in progress.

4 Phonological analysis

4.1 Constraints and constraint hierarchies

This section will show that variant systems in (12a, b) are attained with constraint interaction in OT. PS93 hypothesizes that (i) all constraints are universal, (ii) rankings of constraints are language-specific, (iii) fixed constraint hierarchies limit the typological consequences of ranking permutation. An analysis I present is to show that cross-linguitic variation of guttural transparency can be attained by the "fixed place markedness hierarchy" (Lombardi (2001), GL99) with reranking of the HARMONY constraint.

In order to capture the shift of consonant transparency to harmony in OT, I propose the following constraints and hierarchies.

(13) Proposed constraints and hierarchies
- a. HARMONY: No disagreement of features is allowed between the V-V sequence.
- b. Place Markedness
  - (i) *β: β should be prohibited in the output. (β=any place feature)
  - (ii) *LAB/*COR >> *DOR(LAB) >> *DOR(COR) >> *PHAR(TR) >> *PHAR (DOR(LAB) = labiovelar, DOR(COR) = palatal, PHAR(TR) = uvular, PHAR = laryngeal)
- c. Continuancy
  - (i) *γ-VLink: Do not share vowel place with γ (i.e., $*[\text{V-}\gamma\text{-V}]_{\text{VPlace}}$).
  - (ii) *[-cont]-VLink >> *[+cont]-VLink

HARMONY is phonetically-grounded and motivated by articulatory inertia (Pulleyblank (2002, 2003)). Among the three constraints in (13), only this constraint is rerankable.

Part of the hierarchy (13bii) is motivated by the hierarchy *DOR/*LAB >> *COR >> *PHAR (Lombardi (2001)). But there are several modifications: First, *DOR(LAB), which prohibits [x^w, k^w, k'^w], and *DOR(COR), which prohibits [x^y, k^y, k^{y}'], are introduced. Rigsby & Ingram (1990:253) state that /x, k, k'/ in Gitksan are not really velar, but "palatal", which should be denoted as [x^y, k^y, k^{y}']. These phonemes are contrastive with "labiovelar" /x^w, k^w, k'^w/ which consist of primary articulation of velar and secondary articulation of [+round]. The secondary articulations [^{y}] and [^{w}] are represented here by (COR) and (LAB) respectively. This distinction enables us to account for the transparency of "palatal" fricative and the opacity of "labiovelar". In Gitksan, VH is not attested for labiovelar, thus this distinction is necessary. The hierarchy *DOR(LAB) >> *DOR(COR) is motivated by "banning the worst-of-the-worst" effect (PS93:180).

Secondly, *COR is ranked higher than the pair of *DOR constraints. A possible argument against this ranking is that it would militate against the generally hypothesized unmarked status of Cor. But the unmarked segments may vary from language to language (Blevins (2004)), since some cases have been found where a place other than Cor seems to be least marked (see Rice (2003) for Dor, and Hume & Tserdanelis (2003) for Lab). In Gitksan harmony, *COR >> *DOR is crucial because if it is reversed, Cor should be transparent whenever Dor is so, but it is not the case. This ranking is also supported by the observation that Dor seems to be less marked than Cor in Gitksan. For example, (i) the phonotactic condition in the syllable onset: initial triconsonantal clusters always begin with either /x/ or /χ/, which is Dor (R86:231) (Recall that English initial triconsonantal cluster always begins with /s/, which is Cor), (ii) the distribution in phonemic inventory: Dor includes 3 plain stops and 3 fricatives, while Cor has only 2 for each (see (2)), and (iii) /χ/ insertion is found in loanwords (e.g., ***x̲***_dii_ 'tea', _Galdim_ ***x̲***_kofi_ 'coffeepot' (Hindle & Rigsby (1973)).

Thirdly, the division of *PHAR(TR) and *PHAR is introduced. This makes the distinction between uvulars and laryngeals possible. Although GL99 examine transguttural harmony, they leave the treatment of uvulars as an open question. The ranking *PHAR(TR) >> *PHAR is motivated by (i) the assumption that simplex segment is less marked than complex segment (PS93), and (ii) the typological fact that languages having a uvular segment have strong likelihood of having a laryngeal segment, but not vice versa (cf. Maddieson (1984)).

Fourthly, the continuancy hierarchy (13cii) is necessary to explain why only /x/ can be transparent to the exclusion of /k, k'/. This kind of dichotomy is partially supported by the similar sonorancy hierarchy *V-obs-V >> *V-son-V (GL99). Their hierarchy is based on the acoustic feature [sonor], but mine is based on the articulatory feature [cont]. Both features are inherent in vowels, the harmonic trigger, thus both proposals would agree to the ideas (i) the similar the segments between trigger and target, stronger the interaction (Pulleyblank (2002, 2003), Suzuki (1998)) and (ii) the intervening segment tends not to block harmony when it shares more features with the trigger (Walker (1998, 1999), McCarthy (2004)). I speculate that either [+cont] or [+sonor] may contribute to the place markedness hierarchy in terms of language-specific choice.

Based on the mechanism of local conjunction (Smolensky (1993)), the hierarchies (13bii) and (13cii) can be conjoined. This is given in (14a).

(14) Proposed conjoined constraints

a. { *DOR(LAB) >> *DOR(COR) >> *PHAR(TR) >> *PHAR }
&
{ *OBS-VLINK >> *FRIC-VLINK }

b. *DOR(LAB)OBS-VLINK >> *DOR(LAB)FRIC-VLINK >>
*DOR(COR)OBS-VLINK >> *DOR(COR)FRIC-VLINK >>
*PHAR(TR)OBS-VLINK >> *PHAR(TR)FRIC-VLINK >>
*PHAROBS-VLINK >> *PHARFRIC-VLINK

The hierarchy (14b) derived by (14a) can be paraphrased as in *[Vk'^{w}V], *[Vk^{w}V] >> *[Vx^{w}V] >> *[Vk'^{y}V], *[Vk^{y}V] >> *[Vx^{y}V] >> *[Vq'V], *[VqV] >> *[VχV] >> *[VʔV] >> *[VhV] (where [ ] represents harmonic "span" in the sense of McCarthy (2004)), and assumed to be "fixed" (see GL99).[13]

4.2 Development of transguttural harmony in Gitksan

Given this hierarchy, the various rerankings of HARMONY yield the typology of harmony systems. (The abbreviations used in the tableaux follows: [V-C-V] = a harmonized pattern; V-C-V = a non-harmonized pattern; Q = a set of uvular stops; k = a set of palatal stops; > = the optimal output.)

(15) a. No Harmony

V_1-C-V_2			*DOR (COR) OBS -VLINK	*DOR (COR) FRIC -VLINK	*PHAR (TR) OBS -VLINK	*PHAR (TR) FRIC -VLINK	*PHAR OBS -VLINK	*PHAR FRIC -VLINK	HARMONY
a		[V-h-V]						*!	
	>	V-h-V							*
b		[V-ʔ-V]					*!		
	>	V-ʔ-V							*
c		[V-χ-V]				*!			
	>	V-χ-V							*
d		[V-Q-V]			*!				
	>	V-Q-V							*
e		[V-x-V]		*!					
	>	V-x-V							*
f		[V-k-V]	*!						
	>	V-k-V							*

b. Harmony across /h/

V_1-C-V_2			*DOR (COR) OBS -VLINK	*DOR (COR) FRIC -VLINK	*PHAR (TR) OBS -VLINK	*PHAR (TR) FRIC -VLINK	*PHAR OBS -VLINK	HARMONY	*PHAR FRIC -VLINK
a	>	**[V-h-V]**							*
		V-h-V						*!	
b		[V-ʔ-V]					*!		
	>	V-ʔ-V						*	
c		[V-χ-V]				*!			
	>	V-χ-V						*	
d		[V-Q-V]			*!				
	>	V-Q-V						*	
e		[V-x-V]		*!					
	>	V-x-V						*	
f		[V-k-V]	*!						
	>	V-k-V						*	

[13] See Steriade (1987) for the non-dichotomy of laryngeal fricative and glottal stop.

c. Harmony across /h, ʔ/; Stage I in Gitksan (=12a)

V_1-C-V_2			*DOR (COR) OBS -VLINK	*DOR (COR) FRIC -VLINK	*PHAR (TR) OBS -VLINK	*PHAR (TR) FRIC -VLINK	HARMONY	*PHAR OBS -VLINK	*PHAR FRIC -VLINK
a	>	**[V-h-V]**							*
		V-h-V					*!		
b	>	**[V-ʔ-V]**						*	
		V-ʔ-V					*!		
c		[V-χ-V]				*!			
	>	V-χ-V					*		
d		[V-Q-V]			*!				
	>	V-Q-V					*		
e		[V-x-V]		*!					
	>	V-x-V					*		
f		[V-k-V]	*!						
	>	V-k-V					*		

d. Harmony across /h, ʔ, χ/

V_1-C-V_2			*DOR (COR) OBS -VLINK	*DOR (COR) FRIC -VLINK	*PHAR (TR) OBS -VLINK	HARMONY	*PHAR (TR) FRIC -VLINK	*PHAR OBS -VLINK	*PHAR FRIC -VLINK
a	>	**[V-h-V]**							*
		V-h-V				*!			
b	>	**[V-ʔ-V]**						*	
		V-ʔ-V				*!			
c	>	**[V-χ-V]**					*		
		V-χ-V				*!			
d		[V-Q-V]			*!				
	>	V-Q-V				*			
e		[V-x-V]		*!					
	>	V-x-V				*			
f		[V-k-V]	*!						
	>	V-k-V				*			

e. Harmony across /h, ʔ, χ, Q/; Stage II in Gitksan (=12b without /x/)

V_1-C-V_2			*DOR (COR) OBS -VLINK	*DOR (COR) FRIC -VLINK	HARMONY	*PHAR (TR) OBS -VLINK	*PHAR (TR) FRIC -VLINK	*PHAR OBS -VLINK	*PHAR FRIC -VLINK
a	>	**[V-h-V]**							*
		V-h-V			*!				
b	>	**[V-ʔ-V]**						*	
		V-ʔ-V			*!				
c	>	**[V-χ-V]**					*		
		V-χ-V			*!				
d	>	**[V-Q-V]**				*			
		V-Q-V			*!				
e		[V-x-V]		*!					
	>	V-x-V			*				
f		[V-k-V]	*!						
	>	V-k-V			*				

f. Harmony across / h, ʔ, χ, Q, x/; Stage III in Gitksan (=12b with /x/)

	V₁-C-V₂		*DOR (COR) OBS -VLINK	HARMONY	*DOR (COR) FRIC -VLINK	*PHAR (TR) OBS -VLINK	*PHAR (TR) FRIC -VLINK	*PHAR OBS -VLINK	*PHAR FRIC -VLINK
a	>	**[V-h-V]**							*
		V-h-V		*!					
b	>	**[V-ʔ-V]**						*	
		V-ʔ-V		*!					
c	>	**[V-χ-V]**					*		
		V-χ-V		*!					
d	>	**[V-Q-V]**				*			
		V-Q-V		*!					
e	>	**[V-x-V]**			*				
		V-x-V		*!					
f		[V-k-V]	*!						
	>	V-k-V		*					

Gitksan can be assumed to have shifted grammar (c)→((d)→)(e)→(f) in this order. Then this picture would allow us to see that the diachronic change of harmony system is a result of the promotion of the HARMONY constraint.

Below are the overall constraint hierarchies for some variant systems in Gitksan. (Constraints not crucial to differentiate these stages are omitted.)

(16) Development of transguttural harmony in Gitksan

Stage I (=15c)	Stage II (=15e)	Stage III (=15f)
*DOR(COR) OBS-VLINK	*DOR(COR) OBS-VLINK	*DOR(COR) OBS-VLINK
*DOR(COR) FRIC-VLINK	*DOR(COR) FRIC-VLINK	**HARMONY**
*PHAR(TR) -VLINK	**HARMONY**	*DOR(COR) FRIC-VLINK
HARMONY	*PHAR(TR) -VLINK	*PHAR(TR) -VLINK
*PHAR -VLINK	*PHAR -VLINK	*PHAR -VLINK
↓ **[h, ʔ]**	↓ **[h, ʔ, χ, q, q']**	↓ **[h, ʔ, χ, q, q', x]**

In this version of the constraint-based framework, the extension of transparent consonants would result from the promotion of HARMONY. Interestingly, [h, ʔ] in Stage I is a subset of [h, ʔ, χ, q, q'] in Stage II, which is a subset of [h, ʔ, χ, q, q', x] in Stage III. The subset relation among systems is obtained because the markedness hierarchy is fixed in all the stages and only HARMONY is reranked.

The analysis here tells us not only 'how' but also 'why' VH extended the transparent consonants in the way it did: The conjoined markedness constraints banning complex structures are outranked by phonetically-grounded constraint HARMONY. In other words, paradigmatic featural co-occurrence within a guttural consonant is sacrificed by syntagmatic featural agreement of the oral node. HARMONY, which prohibits resetting the articulator in a V-to-V sequence, has been dominating along the markedness hierarchy in a systematic way.

4.3 Typological implications

The grammars proposed are also attested crosslinguistically. Grammar (a) is observed in English; grammar (b) is observed in loanwords in Japanese (Hall 2003); grammar (c) is observed in Arbore (Hayward (1984), Steriade (1987)), Kashaya (Buckley (1994)) as well as Stage I of Gitksan; grammar (d) is Jibbāli (Hayward et al. (1988), Rose (1996), Parkinson (1993)) (if we replace uvulars with pharyngeals, Iraqw (reference cited in Rose (1996)[14]) and Tiberian Hebrew (McCarthy (1991)) would fit in here); and grammar (e) is in Stage II of Gitksan and grammar (f) is in Stage III of Gitksan. It suggests that subset structures of consonant transparency are attained by the analysis that I proposed in the previous section.

The advantage of this grammar is that it makes an important prediction: harmony across a marked PoA should always imply harmony across less marked PoA, but not vice versa. Therefore, for instance, there should not exist harmony across uvulars only (without laryngeals), or harmony across velars only (without uvulars and laryngeals), if the language in question has laryngeal, uvular and velar in its inventory and they are legitimate intervocalically.

5 Conclusion

This paper presented a view that transguttural harmony seems to be in progress in Gitksan, by clarifying the differences between Rigsby's data and mine, and by providing both of the systems with a unified phonological analysis. The claims of the optimality-theoretic analysis I proposed follow. Firstly, the shift from 'laryngeal' transparency to 'guttural' transparency is a response to the domination of the HARMONY constraint over structural markedness. Secondly, the place markedness hierarchy I proposed predicts (i) both of the systems of R86 and mine fit into the typology of harmony systems and (ii) the variation of consonant transparency among gutturals is not at all random.

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[14] Pharyngeals involve tongue root retraction similarly to uvulars (cf. Carlson and Esling 2003), thus this common property could contribute to the parallel behavior of uvulars and laryngeals.

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