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Iterative Rounding Spread in Tlingit [Lingít]:
A Puzzle for Theories of Contrast

1. Introduction

Questions raised by the process of iterative rounding spread in Tlingit [Lingít] :

- What does it mean for a feature to be contrastive in a given environment?
- What does it mean for two segments to contrast with respect to a given feature?

What's the problem?

- Consonantal segments behave differently from non-consonantals with respect to Lingít's process of iterative rounding spread. There is a "very natural intuition" that the difference is due to a subtle difference in how consonantals and non-consonantals are organized into contrasting pairs.

- More specifically, I seek a principled explanation of why consonantal and non-consonantal segments behave differently with respect to Lingít's process of iterative rounding spread. Interestingly, it's *very difficult* to state such an account within the language of serious, contemporary phonological theories of features and featural composition of segments. This is despite the fact that the rule is a simple one to state intuitively, and is a very easy part of the Lingít accent to pick up on and mimic.

2. Segmental Inventory of Lingít

Vowels: Representation in IPA follows the representation in Lingít orthography.

		Front	Central	Back
High	long/tense	ee [iː]		oo [uː]
	short/lax	i [ɪ]		u [ʊ]
Mid	long/tense	ei [eː]		
	short/lax	e [ɛ]	a [ʌ]	
Low	long/tense		aa [aː]	
	short/lax			

Consonants: Representation in IPA follows representation in Lingít orthography.

		Alveolar	Lateral	Palatal
Stop	plain	d [t]		
	aspirated	t [tʰ]		
	glottalized	t' [t']		
Affricate	plain	dz [ts]	dl [tɬ]	j [tʃ]
	aspirated	ts [tsʰ]	tl [tɬʰ]	ch [tʃʰ]
	glottalized	ts' [ts']	tl' [tɬ']	ch' [tʃ']
Fricative	plain	s [s]	l [ɬ]	sh [ʃ]
	glottalized	s' [s']	l' [ɬ']	
Nasal		n [n]		
Glide				y [j]

		Velar		Uvular		Glottal	
		plain	round	plain	round	plain	round
Stop	plain	g [k]	gw [kʷ]	g̲ [q]	g̲w [qʷ]	. [ʔ]	(.w [ʔʷ])
	aspirated	k [kʰ]	kw [kʰw]	k̲ [qʰ]	k̲w [qʰw]		
	glottalized	k' [k']	k'w [k'ʷ]	k̲' [q']	k̲'w [q'ʷ]		
Fricative	plain	x [x]	xw [xʷ]	x̲ [χ]	x̲w [χʷ]	h [h]	(hw [hʷ])
	glottalized	x' [x']	x'w [x'ʷ]	x̲' [χ']	x̲'w [χ'ʷ]		
Glide			w [w]				

There are thus 14 rounded segments in Lingít, which may be paired with 14 unrounded "counterparts".

w gw kw k'w gw kw k'w xw x'w xw x'w hw oo u
y g k k' g k k' x x' x x' h ee i

3. The Rule of Iterative Rounding Spread

A. Stated as a Simple, Intuitive Rule:

If a rounded segment precedes a segment S with a rounded "counterpart", then S is replaced with its rounded counterpart. (iterate until it can no longer apply)

B. Stated as a Surface Generalization:

No sequences S_1S_2 where S_1 is rounded and S_2 is unrounded, and either
   (i) S_2 can bear rounding,
   (ii) S_2 is a high vowel,
   (iii) S_2 is a palatal glide.

If (i) occurs in the input, then spread the rounding feature to S_2. If (ii) occurs in the input, then S_2 is made back and supplied with rounding. If (iii) occurs in the input, then S_2 is replaced with the labio-velar glide.

C. Stated as a Structure Preserving Process:

Rounding spreads as far to the right as possible. However, this spreading process will not make segments which do not independently exist in the Lingít inventory. How consonantals and non-consonantals satisfy the structure-preservingness of the process differ. A consonantal (obstruent) which cannot bear rounding will not undergo the process, and will halt any further rightward spread of rounding. A vowel or glide, however, will change their value of backness in order to facilitate the rightward spread of rounding. No segment changes its height value in order to facilitate rightward rounding spread.

4. The Rule of Iterative Rounding Spread in Action

4.1. Suffixal Allomorphy

Many nominal and verbal suffixes have the form V(C), where after rounded segments the V is realized as "oo" and after all other segments the V is realized as "ee".

(1)   a. Haat   g̲a-gúd-een.
          here   imperf-walk-contingent
          Whenever he comes here…

          b. Haat   gut   ga-nóogw-oon.
          here   walk   imperf-AUX-contingent
          Whenever he comes here…   (Story 1966; p. 106)

The most natural interpretation is that the V is underlyingly "ee" and undergoes rounding spread. Furthermore, there is no suffix surfacing as "ee(C)" which does not become "oo(C)" when following a rounded segment.

Some suffixes are simple Cs which can bear rounding ("-k" *iterative* ; "-k'" *diminutive*). Following rounded segments, they also become rounded.

(2)   Ax̲ yáakw – k' – ee   ➜   Ax̲ yáakw-k'w-oo.
         my   boat - dim - poss
         My little boat   (Story 1966; p. 18)

This example also illustrates the continued spread of rounding onto the following possessive suffix.

Suffixes of the form Cee where C is a segment without a rounded counterpart are such that their vowel "ee" is never a target of rounding spread. The 'conditional suffix' is always of the form "nee", even after rounded segments.

(3) A   kaa-x̲   at-x̲áa   núkw-nee.
       its surface-from indef-eat AUX-conditional
       If he eats from it…   (Story 1966; p. 106)

Similarly, if a suffix of the form C, where C is a segment without a rounded counterpart, occurs after a rounded segment, then no suffix after it will undergo a change in rounding induced by that rounded segment.

(4) A-kahéix̲   noo-j-een.
       3Ob-plant   AUX-habitual-decessive
       He always used to plant.   (Story 1966; p. 103)

Examples (1), (3) and (4) illustrate the fact that obstruents lacking a rounded "counterpart" will block the rightward spread of rounding.

4.2 The Form of Epenthetic Segments

Vowels are epenthesized to break up illicit tri-consonantal sequences within certain domains. If the preceding consonant is rounded, then the epenthetic vowel is "oo"; if the preceding consonant is unrounded, then the form of the epenthetic vowel is "ee".

(5)   a. táakl – ch   ➔   táakl-ee-ch
          hammer – instr
          with a hammer

       b. ts'itskw tlein   ➔   ts'itsg-oo tlein
          songbird   big
          big songbird   (Story 1966; p. 13)

Consonants are inserted to break up hiatus sequences. If the preceding vowel is rounded, then the epenthetic C is "w"; if the preceding V is unrounded, then the form of the epenthetic C is "y".

(6)   a. du saa – ee   ➔   du saa-y-ee
          his name-poss
          his name   (Story 1966; p. 18)

       b. haa too – ee   ➔   haa too-w-oo
          our inside-poss
          our spirit / our feeling   (Naish 1966; p. 15)

4.3 Generalizations Regarding the Base

There is a phonotactic constraint active in Lingít which bans from the base (lexicon) all sequences S_1S_2 where S_1 is rounded and S_2 is an unrounded segment with a rounded "counterpart." In other words, there is strictly progressive rounding harmony 'in the base'.

Supporting Facts [1]:

- There are many roots – both nominal and verbal – that contain syllables whose onsets are rounded consonants: "x̱waal" (shake); "ḵwáan" (people, nation). There are also many roots containing syllables whose nuclei are high unrounded vowels: "seew" (rain); "neekw" (to feel bad, to be sick). However, there is no nominal or verbal root in Lingít containing a syllable whose nucleus is high and unrounded,

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[1] The following claims about the phonological form of Tlingit roots are supported by a careful examination of the following works: Story & Naish 1973 and Naish, Story, Davis & Leer 1996.

and whose onset is rounded. Where C_1 is any consonant, there are no roots containing the syllables $C_1^w ee(C)$, $C_1^w i(C)$, wee(C) , or wi(C).[2]

- Many roots in Lingít have syllables whose nuclei are rounded: "woon" (maggot); "goot" (walk). There are also many roots containing syllables whose codas are unrounded consonants with rounded "counterparts": "teey" (patch); "naak̲" (to stand). Nevertheless, there is no nominal or verbal root containing a syllable whose nucleus is rounded *and* whose coda is an unrounded consonant with a rounded "counterpart." Where C_1 is a roundable consonant, there are no roots containing the syllables (C)ooC$_1$, (C)uC$_1$, (C)ooy, (C)uy [3].

- Nevertheless, it is possible for a root in Lingít to contain a syllable with a rounded nucleus and an *onset* which is a unrounded consonant with a rounded counterpart. That is, where C_1 is a roundable consonant, there are plenty of roots containing the syllables C_1oo(C) , C_1u(C) , yoo(C), yu(C). Furthermore, Tlingit does not disallow its roots from containing syllables with high, front nuclei and rounded codas. Roots of the form (C)eew , (C)iw , (C)eeC^w , (C)iC^w are widely attested.

5. Analyses

5.1 A Purely Descriptive, Uninteresting Account

Component Hypotheses:

1. Rounding Spreads Rightward

   Align([round] , R , Tail) >> Dep(Link)

2. Structure Preservation

   *[round, -back] >> Align([round] , R , Tail)

3. Rounding Spread Induces Place Change in Non-Consonantals

   Ident$_{OBST}$(back) >> Align([round] , R , Tail) >> Ident(back)

4. Rounding Spread Never Induces a Change in Height

   Ident(high) >> Align([round] , R , Tail)

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[2] There exists one possible counterexample. The word "wink" is a late borrowing for commercially purchased milk. We shall return to this form later on.

[3] A point of clarification is necessary here. There are many words in Lingít whose orthographic representation would make them appear to be counterexamples to this claim. For example, the verbal root meaning "to soften" is written as "chook". However, the Lingít orthography has the convention of not indicating rounding on obstruents which is the result of rounding spread. That is, Lingít orthography only indicates rounding on obstruents when it is contrastive. Ironically, it is the fact that there are no roots written as "CooCw" which indicates that rounding is not distinctive on obstruents in this environment.

Why this is a terrible story

- Constraint "Align([round], R, Tail)" is very suspect in this context. Kaun's perceptual theory can't be what's behind rounding spread in Lingít.
- Difference in behavior of consonantals and non-consonantals is stipulated.
- Structure preservation is stipulated by highly ranked inventory constraint.

5.2 Contrast-Based Analyses

5.2.1 Enhancement Motivates the Rounding Spread (Cable 2004)

Component Hypotheses:

1. In order to accentuate the contrast between rounded and unrounded back obstruents, an enhancing gesture of 'distinctly wide lip spread' is employed. All the unrounded obstruents which can bear rounding (unrounded back obstruents) are pronounced with a much wider lip spread than (a) their English correlates, (b) the unrounded obstruents which cannot bear rounding (unrounded front obstruents).

2. The palatal glide "y" is also produced with 'distinctly wide lip spread'. This gesture may either be a simple primitive of the phone, or it may be in place to accentuate the contrast between "y" and "w". (until very recently, "y" was an unrounded velar glide)

3. The high front vowels "ee" and "i" are produced with 'distinctly wide lip spread'. This gesture may either be a simple primitive of the phone, or it may be in place to accentuate the contrast between "ee" and "oo", and between "i" and "u".

4. There exists a constraint " *[round][spread] " which bans sequences where rounded segments are directly followed by segments with wide lip spread. A phonetic grounding for this constraint may be found in the especially great 'distance' between the gesture for rounding and the gesture for wide lip spread.

5. The constraint " *[round][spread] " is undominated in Lingít.

Benefits of this Story:

- Much of the structure-preservingness of this process follows from the distribution of the enhancement 'smiling'. Front obstruents do not undergo the process of rounding spread because (i) they do not contrast with another segment in rounding, so (ii) they are not produced with enhancement 'smiling', so (iii) they may follow rounded segments without incurring a violation of the constraint *[round][spread]. The same story holds for non-high vowels.

- The difference between consonantals and non-consonantals follows from the distribution of the enhancement 'smiling'. Front obstruents do not change their backness in order to facilitate rounding spread because they simply aren't motivated to undergo rounding spread. However, front vowels and glides do change their backness in order to facilitate rounding spread, because of their being pronounced with enhancement 'smiling'. In short, we may suppose that generally *[round][spread] outranks Ident(back). Front consonants never change their backness value because there is never any motivation to do so.

- We needn't appeal to an alignment constraint for rounding. Rounding spreads simply to eliminate abrupt changes in lip posture (why it spreads rightward and not leftward is unexplained).

Problems with this Story:

- There is reason to doubt that the hypothesized enhancement gesture exists.

  - It's never been reported before.
  - Ian Maddieson doesn't remember seeing (or measuring) such a thing when he and his team studied the phonetics of Lingít.
  - Their "k"s sure don't sound 'smiley'.

- **How does one test whether it does exist without access to an informant (at the moment)?**

  - There are videotapes of spoken Lingít at the ANLC, but they are poorly organized. One would have to call Jeff Leer (preeminent Lingít and Na-Dene scholar) and ask him for a favor.
  - I have several hours of spoken Lingít on CD (part of a beginners level Lingít textbook). *Perhaps one could acoustically measure whether the unrounded "k"s are 'smiley'?* What could the acoustic signature of 'smileyness' be? What are the comparisons that are to be made?

5.2.2 Rounding Spread Occurs Because Min-Dist Will Not Allow Labial Coarticulation of "k" to Co-Exist with "kw"

Component Hypotheses:

1. In Lingít there is much preservatory coarticulation of rounding, but not nearly so much anticipatory coarticulation of rounding. The constraints enforcing preservatory coarticulation of rounding are undominated in the language.

2. Let us represent rounded S as "Sw", and let us represent a S subject to rounding coarticulation as "S^w". There is active in Lingít a Min-Dist constraint preventing

these three segment-types from contrasting. The Min-Dist constraint preventing the contrast of S, Sw and S^w outranks Ident(round).

3. The consequence is that when a S that contrasts in rounding with Sw follows a rounded segment, the only way to satisfy the needs of the preservatory coarticulation constraint and the Min-Dist constraint is to change the value of S's rounding.

Benefits of this Story:

- Much of the structure-preservingness of this process follows from the set of contrasting segments in the language. Since "tw" is absent from Lingít, the Min-Dist constraints do not ban the surfacing of "t^w". Thus, there is no motivation for "t" to undergo rounding spread.

- Again, the difference between consonantals and non-consonantals follows from the inventory of Lingít. Front obstruents do not change their backness value to facilitate rounding spread because they do not contrast with another segment in rounding.

- We needn't appeal to an alignment constraint for rounding. Rounding spreads because Lingít speakers will not tolerate so fine a distinction as that between "kw" and "k^w".

Problems with this Story:

- We don't immediately have a handle on why rounding spread transforms "i^w" into "u". Perhaps "i^w" in Lingít ends up sounding very much like "ü" and some independent Min-Dist constraint governing the inventory of Vs stamps it out? (In a somewhat different form, this difficulty also holds for the analysis in 5.2.1)

- Long high vowels such as "ee" undergo rounding spread to transform into "oo". Is this really because a Min-Dist constraint won't permit the contrast between "e^{w}e" and "oo"? Speakers must still be able to perceive the difference between these two segments.

A Strategy for Research:
- Using my corpus of spoken Lingít, determine first the extent to which there is lengthy preservatory coarticulation in the language.
- Using that measure of rounding preservation, estimate the quality of hypothetical Lingít "uk^w"; from this quality estimate, estimate/test the 'perceptibility' of the contrast between "uk", "uk^w" and "ukw".
- Do the same for "kwee", "kwe^{w}e" and "kwoo".

What has been Obtained Thus Far:

I have compiled an organized database of 315 Lingít sound files. The files within this database contain the following sorts of syllables:

- Rounded nucleus – Front coda
- Unrounded nucleus – Front coda

- Rounded nucleus – Back coda
- Unrounded nucleus – Unrounded back coda
- Unrounded nucleus – Unrounded back coda

- Rounded onset – Non-high Vowel
- (Unrounded onset – Non-high Vowel ; not added yet)

- **Rounded onset – High Vowel (one token)**

Thus (when fully completed), this database will permit measures of the severity of preservatory coarticulation in Lingít. No measures have yet been formally carried out, but once they are, one can begin to truly pursue the research strategy laid out above.

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