Diachronic Factors in the Sensitivity to Coda Voicing in Tanacross Contour Tone Licensing

Jonathan Mankar
University of California, Berkeley

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Contour Tone Licensing

• (1.1) Many languages have restrictions on what syllable types may bear lexical contour tones (Hyman 1988, Zhang 2002).

• (1.2) Contour tones may be considered sequences of two level tones (Hyman 1985).
• (1.3) Thus, in languages where contour tones are considered to be sequences of H and L tones, two TBUs may be required to host a contour tone.

• For languages which such contour tone restrictions, this can be thought of in terms of light and heavy syllables with respect to tone (Gordon 2004): Syllables with two moras (heavy) may bear a contour tone, while those with only one (light) may not.
2. Common Systems of Contour Tone Licensing

• (2.1) Gordon (2004) proposed an implicational hierarchy of syllable types observed by different systems of syllable weight (stress, tone, minimal word, etc.).

• (2.2) Different weight-sensitive systems show strong tendencies to divide the hierarchy at specific places.
• For the purpose of **stress** assignment, final consonants (of any sonority) tend to make a syllable heavy, thus the cut-off is more likely at point C than B.

• For **tone**, (shown below) however, Gordon’s (2004) survey finds that 21 languages make that cut off at A (only long vowels = heavy), 25 make the cut off at B (long vowel or sonorant codas = heavy), and only 3 languages divide the hierarchy at point C (all CVC are heavy).
• (2.3) While the sonority of the coda is important in licensing a contour tone, no survey of languages with lexical contour tones (Gordon 2001, 2004, Zhang 2002) finds a language in which the voicing of the coda determines syllable weight for tone. This is precisely what occurs in the Tanacross (Athabascan) language.

• (2.4) Section 3 will give an overview of the phonetically-driven account of contour tone licensing; Section 4 will describe contour tone licensing in Tanacross; Section 5 will consider a non-phonetically driven account of Tanacross contour tone licensing; and Section 6 will consider the relevance of the phonetically driven account to the Tanacross data.
3. The Phonetically-Driven Account

- (3.1) To account for the pattern described in (2.2), Zhang (2002) and Gordon (2004) consider phonetic factors that shaped these most common phonological systems.

- (3.2) Pitch cues require some sort of voicing to recover the fundamental frequency from the acoustic source. Gordon: fundamental frequency is cued “not only by the fundamental itself but also by the higher harmonics” (2004:85).

- While the higher harmonics of sonorants are reduced in comparison to those of vowels, voiced obstruents are severely impoverished with regard to higher frequency harmonics.
• **(3.3)** Zhang likewise concurs that syllables with more sonorant duration are more likely to be able to host a contour tone (2002:24).

• **(3.4)** Furthermore, Zhang suggests that four phonological factors *should* cause an increase in sonorant duration at the surface (phonetic) level:
  1) long vowels  2) coda sonorants 3) lower vowels (/a/ vs. /i/) 4) and *voiced coda segments* (2002:33).

• Voiced coda segments, including obstruents, tend to cause the preceding vowel to lengthen, although this varies greatly from language to language (93).
(3.5) Since neither Zhang nor Gordon find any languages that make a distinction in contour tone licensing based on the voicing of the coda (CVD vs. CVT), Zhang suggests reasons for why this might be the case: the difference in sonorous duration in these two syllable types is not as profound as the difference in sonorous duration between CVR and CVO, and thus languages would make the split at this phonetically more salient distinction.

Furthermore, following the findings of Keating 1985, Zhang suggests that tonal languages may show less variation in vowel length before voiced and voiceless segments due to their tendency to have fixed stress.
4. Contour Tones in Tanacross

- (4.1) Tanacross is an Athabascan language spoken in central Alaska, and is part of a dialect chain along the Tanana River. As of 1997 there were an estimated 65 speakers out of a population of 220 (Krauss 1997), while most of these were over the age of 50 (Holton 2000).
• (4.2) Tanacross has four lexical tones: high, low, rising, falling (a fifth, extra high, occurs to indicate negative)

/tùː/ ‘water’ /nûːn/ ‘animal’
/dúʔ/? ‘and, also’ /xǐːθ/ ‘raft’

(examples from Holton 2000)

• (4.3) Tanacross is considered “high-marked”: low pitch is default, high tone is specified.

• High tone developed historically from syllables with laryngeal constriction. Tanacross is surrounded by tonally low-marked languages, where the same constriction resulted in low tone.
• (4.4) Level tones (high or low) can appear on any syllable type. **Contour tones, however, can only occur on syllables with a long vowel or a voiced coda segment.** This yields the following implicational hierarchy:

\[
\text{CVV(C)} > \text{CVD} \quad || \quad \text{CVT} > \text{CV}
\]

(4.5) Tanacross consonant inventory (Holton 2000) with allowable coda segments boxed (i.e., D can be anything that is boxed *and* voiced).
• (4.6) Tanacross preserves a proto-Athabascan system of full and reduced vowels:
  /ɛ o/ = always short / (monomoraic)
  /a e i u/ = always long / (bimoraic) in stem syllables except before /hʔ/ (Holton 2000:65)
• In prefixes all vowels are always short except for in the contraction of two prefixes (see 5.8).

• (4.7) Further evidence for monomoraic /ɛ o/ in stems: Tanacross has a **minimal stem requirement** such that a stem needs two rime segments (bimoraic).
  Unacceptable: *[-Cɛ]  *[-Co]
  Acceptable:  [-Caa], [-Cii], [-Cɛk] etc.
(4.8) Thus, contour tones are allowed on any stems with a full vowel since they are always long, except before [ʔ h]. An optional coda, whether voiced or voiceless, does not affect contour tone licensing.

\[
\begin{align*}
/dâː/ & \quad \text{DEONTIC} & /-ngâːɣ/ & \quad \text{‘eye’} \\
/x̂ːθ/ & \quad \text{‘raft’} & /dɛndĩːg/ & \quad \text{‘moose’} \\
\text{unattested: } /kâʔ/ & \quad \text{unattested: } /kâh/ \\
\end{align*}
\]

(4.9) Vowel length is only partially contrastive in Tanacross. Full vowels do display a morphologically conditioned length contrast before [ʔ] in stems. Thus long full vowels before [ʔ] can bear a contour tone.

\[
\begin{align*}
/túʔ/ & \quad \text{‘water’ (compound form, inalienable)} \\
/štūːʔ/ & \quad \text{‘my water’ (possessed, alienable)} \\
\end{align*}
\]
Thus, the only environment where we will see the licensing effect of the coda is in stem syllables with the reduced vowels /ɛ o/ because they are always short. **A contour tone is only permitted in these syllables when the final segment is voiced**, whether it be a sonorant or obstruent. The sonority of the coda does not matter---syllables with short vowels and voiceless sonorant codas may not bear contour tones.

/ꜜɛg/ ‘berry’

/ts’ôγ/ ‘spruce’

/na:tl’êdz/ ‘beads’

/ts’ĕdʔ/ ‘blanket’

/hên/ ‘river’

unattested: hêñ, -dismissible, ts’ôx, etc.
5. The Diachronic Account

• (5.1) The resulting contour tone licensing requirements of Tanacross, such that only syllables with two voiced rhyme segments (either a long vowel or a short vowel with a voiced coda) arose from a particular sequence of sound change that constrained the system in such a way.

• (5.2) Contour tones are the result of two historic level tones (high and low or low and high) becoming linked to a single syllable. This occurred in disyllabic and suffixed stems in conjunction with loss of the final vowel, but with preservation of the tone which was passed to the preceding syllable, represented below autosegmentally (reproduced from Holton 2000).
• (5.3) So in the example below, proto-Athabascan constriction results in high tone, in relation to what develops as default pitch. The tone is spread leftward and the final vowel deletes.

\[-k\dot{\text{y}}-\dot{\text{è}} > -\text{ká}:\text{y}-\dot{\text{è}} > /-\text{čâ}:\text{y}/ \text{‘woman’s grandchild’} \]

(Holton 2000)

• (5.3) The tone spread described above always occurred after a process of intervocalic obstruent voicing. Thus, the resulting system was constrained such that contour tones only occurred on short (reduced) vowels before voiced segments.

\[^{**}/-k\gamma^{\prime}\chi-\text{æ}/ > */-\text{č’òγ}-\text{á}/ > */-\text{č’óγ}/ \text{‘one’s quill’} \]

(Holton 2000)
• (5.4) Diachronic development of contours (w/ possessive suffix):

1) *CVT-Vʔ (no tone, –voi intervocalic segment)
2) *CVD-Vʔ (intervocalic segment > +voi)
3) *CV̊D-ʔ (tonogenesis)
4) CV̊Dʔ (vowel deletion, tone preservation and reassignment)
(5.5) This resulted in a productive alternation in the phonology of the language in the formation of possessives (examples from Holton 2000) (other contour tones occur on synchronically monomorphemic stems as in 5.3).

<table>
<thead>
<tr>
<th>Unpossessed</th>
<th>Possessed</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>łèt</td>
<td>-lĕdʔ</td>
<td>‘smoke’</td>
</tr>
<tr>
<td>xètl</td>
<td>-γĕdlʔ</td>
<td>‘sled’</td>
</tr>
<tr>
<td>żèθ</td>
<td>-źĕðʔ</td>
<td>‘snow’</td>
</tr>
<tr>
<td>tsèts</td>
<td>-tsĕdzʔ</td>
<td>‘wood’</td>
</tr>
<tr>
<td>tθ’á:k</td>
<td>-tθ’á:gʔ</td>
<td>‘plate’</td>
</tr>
<tr>
<td>t’é:s</td>
<td>-t’é:zʔ</td>
<td>‘charcoal’</td>
</tr>
</tbody>
</table>
(5.6) Holton (2000:79-80) actually describes the possessive morpheme as being a high tone attached to a [+voice] feature and a glottal stop, indicating that phonologically the timing units (or moras) for the tones are in fact voiced segments (this also occurs with the nominalizing suffix but without a glottal stop).
(5.7) An additional sequence of events, which is rarer, ensures that contour tones can only occur on a long vowel if the final segment is voiceless. In this case, an intervocalic consonant deleted followed by the contraction of two vowels of differing tones.

*χəŋəʔs > *xəŋəʔθ > /xǐ:θ/ ‘raft’ (Holton 2000)

(5.8) This also occurs in the cases where a contour tone can occur in a prefix. Normally prefix syllables take the form CV and thus are not licensed for contour tones, but if two prefixes of different tone contract, the result is a long vowel with a contour tone.

/xá-na-n-ɛt-tax/ → [xâ:neːtt’ax] ‘(3rd sng.) is flying around’ (Holton 2000)
6. The Phonetically-Driven Account, Reconsidered

• (6.1) The data from Tanacross is problematic for the current phonetically-driven account for one of two possible reasons:
  1. It is an example of a phonetically suboptimal phonological system that must have had a different source (diachrony), i.e. contour tone licensing is not necessarily rooted in phonetics.
  2. It depicts a system that is phonetically optimal under the right conditions, which requires some revision of the original predictions.

Here we will consider option #2.
• (6.2) Both Gordon (2001, 2004) and Zhang (2002) to some degree predict the possibility of a CVD vs. CVT split contour tone licensing system, though neither finds such a system. Both imply that voiced obstruents would be better at carrying pitch than voiceless obstruents, though would be so severely impoverished in comparison to voiced sonorants that no language would make that distinction when the more salient distinction between CVR and CVO is available (represented below impressionistically).
• 6.3) Additionally, such a system fits with the predictions of the sonorant hierarchy, but Gordon and Zhang consider the difference in pitch-bearing abilities between voiced and voiceless obstruents to be negligible.

• (6.4) If this were the phonetically driven explanation for Tanacross’s contour tone licensing system, it would make this system extremely improbable though maybe not impossible. The second possibility, however, is to consider whether there is a longer sonorant duration in voiced coda syllables in Tanacross.
(6.5) Zhang (2002) suggested the possibility of a CVT vs. CVD contour tone licensing system due to the tendency of a vowel lengthening before voiced segments. Sonorant duration difference not big enough?

(6.6) Currently, there has been no phonetic investigation of vowel length before voiced and voiceless segments in Tanacross, though given that vowel length is contrastive the difference would probably not be huge.

(6.7) However, phonetic impressions of contour tone syllables in Tanacross suggest that synchronic mechanisms may be at work for phonetic optimization.
• (6.8) Holton (2000:26) describes these final voiced stops as being truly voiced throughout the closure, and even being released with a bit of schwa [ə], although this varies among speakers.

• The vocalic release, when present, is described as being more prominent following [d] and [g] as opposed to voiced fricatives and affricates (pg. 26).

• This without a doubt would add to the sonorant duration, and may correlate with the ability of a segment to carry pitch cues.
7. Other Athabascan

• (7.1) Tanacross in many ways captures a snapshot of a larger trend where suffixes are deleted leaving their tone and voicing on the preceding remaining syllable.

• Lower Tanana: vowel suffix preserved underlyingly.

• Hän: lost all final voiced obstruents which resulted in the lengthening of preceding vowels (even historically reduced vowels).
(7.2) Tanacross--- snapshot of ongoing development. Phonetically suboptimal and unstable? This may explain the rarity of this system, despite common sound changes involved.

(7.3) If further work on the phonetics support the impressions of possible synchronic optimization, we might consider a lag model, where diachronic processes develop, blind to any phonetically suboptimal conditions they create, but synchronic phonetic constraints eventually overcome faithfulness constraints.
8. Conclusion

- (8.1) This paper brings together descriptive data that does not easily fit into the current theoretical framework on contour tone licensing, and proposes analyses that revise this framework in two possible ways.

- (8.2) The **diachronic account** suggests that the contour tone licensing of Tanacross arose from a sequence of sound changes and develop blindly with regard to any phonetically optimal system. This account seems adequate in explaining the facts as they occur in the underlying representations of contour tone syllables.
• (8.3) The current **phonetically-driven account** may be adequate if we accept the possibility that voiced obstruents may be able to carry pitch information better than voiceless segments to a significant enough degree that a split could be made between CVT and CVD syllables for contour tone licensing.

• Alternatively, voiced segments *may* in fact be able to add enough to sonorant rhyme duration (by lengthening the preceding vowel) for the CVT – CVD split.
• (8.4) Failing this, it still seems possible that synchronic, phonetically-driven factors are active in enhancing a suboptimal phonological system.

• (8.5) Further research will obtain quantitative phonetic data concerning the sonorant rhyme duration in order to answer these questions.

• Furthermore, additional study of the historical developments of CVR-CVO split languages may reveal the extent to which diachronic factors in other languages can account for the development of these phonological systems.
9. References


