ABC+Q: Contour segments and tones in (sub)segmental Agreement by Correspondence

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0 INTRODUCTION

- Phonological theory has long been challenged by the behavior of contour segments and contour tones in harmony patterns.

(1) Contour segments: segments with distinct gestures sequenced in time (Sagey 1986; et seq.)
  a. pre- and post-nasalized segments (e.g., "d, d")
  b. affricates (e.g., ⟨ʃ⟩)
  c. pre- or post-laryngealized segments (e.g., kʰ, kʰ)
  d. contour tones (e.g., ˍ ˍ ˍ)  
  e. diphthongs (e.g., ai)
  f. on- and off-glides (e.g., Ɂ, Ɂ)

(a), (c), see Steriade 1993; 1994; (b), see Lombardi 1990; see also Banner-Inouye 1989 on flaps

(2) Not covered in this talk: complex segments involving distinct gestures which overlap in time
  a. labiovelars, ⟨l⟩
  b. partially laryngealized vowels
  c. clicks, implosives, ejectives

(3) Conflicting behavior by contour segments in harmony patterns:
  - participate in phonology as whole units
  - their subsegmental parts act independently

(4) This talk: ABC+Q
  - Propose new subdivided, quantized segmental representations, which allow for a better characterization of the behavior of contour and simplex segments.
  - Quantized segmental subdivisions are grounded in phonetic reality and tuned to typological phonological generalizations incorporated in Agreement by Correspondence (ABC) theory (Hansson 2001, Rose & Walker 2004).
  - ABC+Q marries the representational strength of previous approaches, including Autosegmental Theory, Aperture Theory, and Articulatory Phonology, with the locality and similarity design features of ABC, to capture the unity and internal complexity of segments.
  - (Re)unites treatment of segmental phonology and tone.

1 PROPOSED REPRESENTATIONS: QUANTIZED SEGMENTAL SUBDIVISIONS

(5) Segments are subdivided into temporally-ordered, quantized subsegments:

\[
Q \rightarrow Q(q^1 q^2 q^3)
\]

a. Vowel with triple tone contour  \( V(\check{\acute{a}} \check{\acute{a}} \acute{a}) \)  e.g., Mende mbà̂ ‘companion’
b. Prenasalized affricate  \( C(n^1 t^2 ʃ^3) \)
c. Aspirated affricate  \( C(t^1 ʃ^2 h^3) \)  e.g., ʃʰ

(6) Quantized subsegments \( q \) are roughly phonetically grounded:

\( q^1 = \) Onset,  \( q^2 = \) Target,  \( q^3 = \) Release  (cf. “landmarks” in Gafos 2002: 271)
(7) Maximum of 3 \( q \) subsegments per segment \( Q \):
- 2- and 3-tone contours occur; 4-tone contours (e.g., LHLH or HLHL) are typologically rare (e.g., Qiyang: see Hu 2011; or Korean \textit{aegyo} markers; Moon, in prep) and apparently accompanied by lengthening of the host segment (Zhang 2001, et seq.)
- 2- and 3-\( q \) segments occur, but not 4-\( q \) segments. (Possible exception: Mazatec \([\texttt{t}\texttt{f}]\): Pike & Pike 1947; Steriade 1994; but cf. Golston & Kehrein 1998 for an alternative analysis.)

(8) Points of contact with Autosegmental Theory (Leben 1973; Goldsmith 1976), Aperture Theory (Steriade 1993, 1994), and Articulatory Phonology (Browman and Goldstein 1989, et seq.; Gafos 2002; a.o.)
- Similar to Autosegmental Theory and Aperture Theory in positing explicit features for subsegments.
- Similar to Aperture Theory and Articulatory Phonology in positing phonetically-grounded temporal subdivisions with different featural makeup for (some) segments.

(9) Some differences:
- Notion of ‘segment’ explicit in \( Q \) theory (vs. interpretive in Aperture Theory).
- All segments have subdivisions in \( Q \) theory.
- Subsegmental architecture is explicitly temporally-ordered.
- Maximum number of subdivisions is 3 in \( Q \) theory (vs. 2 in Aperture Theory).
  - All subsegments in \( Q \) theory are featurally uniform (contemporaneous): no more multiple associations (cf. Autosegmental Theory).
  - \( Q \) theory covers vowels as well as consonants—and tone as well as ‘segmental’ features.

### 2 BEHAVIOR OF CONTOUR SEGMENTS AND TONES IN HARMONY PATTERNS

(10) A (working) typology of contours in harmony:

<table>
<thead>
<tr>
<th>Participant</th>
<th>Whole contour: ( Q )</th>
<th>Partial contour: ( q )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ngbaka</td>
<td>Nasal co-occurrence</td>
<td>Samala, Navajo sibilant harmony</td>
</tr>
<tr>
<td>Changzhi, Blang</td>
<td>Contour tone copying</td>
<td>Guarani nasal harmony</td>
</tr>
<tr>
<td>Lalana Chinantec</td>
<td>Tonal harmony</td>
<td>Hakha-Lai partial contour tone agreement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pingyao partial contour tone agreement and whole contour dissimilation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Yoruba, Nupe, C. Mazatec contour tone creation</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Blocking</th>
<th>Kinyarwanda sibilant harmony</th>
<th>Terena nasal harmony (spread)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transparent</td>
<td>Kiyaka nasal harmony (similarly, Kikongo)</td>
<td>Oroch [RTR] harmony</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Runyambo vowel height harmony</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disharmony</th>
<th>Gurindji NC dissimilation</th>
<th>Basque stop dissimilation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ganda/Meinhof’s Law</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tianjin, Pingyao, Wuming Zhuang contour tone dissimilation</td>
<td></td>
</tr>
</tbody>
</table>

**Conclusion: schizoid behavior:**
- Contours act as units
- Contours don’t act as units: their constituent subsegmental \( q \)’s interact with one another
3 THEORETICAL APPROACHES TO CONTOURS IN HARMONY

(11) Autosegmental representations: driven by individual features or feature bundles
- A feature or class node spreads to adjacent timing slots.
- Correctly predicts assimilation to create or be triggered by parts of contours; has trouble with whole contour behavior (e.g., (15)). Contours are not units in standard autosegmental theory.

(12) Agreement by Correspondence (ABC): existing formulations based on segments
- Corresponding local segment pairs of segments, under conditions of similarity and proximity, are required to be identical in some respect.
  - consonant harmony (Walker 2000; Hansson 2001; Rose and Walker 2004; a.o.)
  - vowel harmony (Sasa 2009; Walker 2009; Rhodes 2010/2012; a.o.)
  - dissimilation (cf. Bennett 2013 (ABC but no similarity scales))
  - tone (esp. consonant tone interactions: Shih 2013)
- Correctly predicts whole segment agreement, including contours, but has trouble with partial contour behavior. The parts of contours are not units in standard ABC.

(13) Needed: Theoretical framework where contours are accessible to operations in part and whole
Proposal: ABC+Q (=ABC with enhanced representations)

4 QUANTIZED SEGMENTS: WHOLE AND PARTIAL CORRESPONDENCE

4.1 PARTICIPANT QS IN HARMONY
- ABC deals naturally with whole segments/contours participating in harmony.
- Correspondence and agreement targets segments, Q.

(14) Qₜ(q q q)… Qₜ(q q q)…………………Pair of corresponding segments
CORR-Q(q q q)→Q(q q q)…………………ABC constraint, establishes correspondence between whole segments meeting a certain threshold of similarity. Correspondence enforced locally on closest eligible pairs
Ident-QQ-[F]…………………ABC constraint, enforces identity (in [F]) among corresponding segments.

(15) Changzhi: tone contours copy as unit (see Yip 1989; Bao 1990; data cited from Duanmu 1994)
   a. /kuə_{213} -tə_{535}/ → [kuə_{213} -tə_{213}] ‘pan-DIM’
   b. /saŋ_{24} -tə_{535}/ → [saŋ_{24} -tə_{24}] ‘rope-DIM’
   c. /ti₃₅₅ -tə₃₅₅/ → [ti₃₅₅ -tə₃₅₅] ‘bottom-DIM’
   d. /kʰu₄₄ -tə₃₅₅/ → [kʰu₄₄ -tə₃₅₄] ‘pants-DIM’
   e. /tə₃₅₃ -tə₃₅₅/ → [tə₃₅₃ -tə₃₅₃] ‘bean-DIM’

(16) CORR-V(T T T)→V(T T T)
ENT-ENT-VV([tone] [tone] [tone])
ENT-ENT-IO-V([tone] [tone] [tone])
   Entire vowels correspond
   Corresponding vowels are tonally identical
   Vowels are tonally identical in input, output
Correspondence, identity not enforced

\[
\begin{array}{|c|c|c|}
\hline
\text{a. } / V_x(2\ 1\ 3)\ldots V_x(5\ 3\ 5) / & W1 & L \\
\hline
\end{array}
\]

Correspondence, identity enforced

\[
\begin{array}{|c|}
\hline
\text{b. } / V_x(2\ 1\ 3)\ldots V_x(2\ 1\ 3) / & 1 \\
\hline
\end{array}
\]

No correspondence, identity not enforced

\[
\begin{array}{|c|c|}
\hline
\text{c. } / V_x(2\ 1\ 3)\ldots V_x(5\ 3\ 5) / & W1 \text{ L} \\
\hline
\end{array}
\]

- Duanmu (1994) uses Changzhi to illustrate a distinction between copying versus harmony/spreading. In ABC, note that there is no formal distinction between these processes.
- Analogous to Ngbaka nasal co-occurrence restrictions (Hansson 2001; Rose and Walker 2004).

### 4.2 Transparent Qs in Harmony

- Transparency occurs when a Q does not meet the threshold for correspondence.
- ABC+Q can model threshold for correspondence of segments (Q) based on similarity of subsegmental architecture.

(18) Kiyaka: N\text{C} contours transparent to nasal harmony (Hyman 1995)

| a. kéb-ede | ‘faire attention’ |
| sód-ede | ‘déboiser’ |
| b. kém-ene | ‘gémir’ |
| són-ene | ‘colorer’ |
| c. finúk-ini | ‘bouder’ |
| mítuk-ini | ‘bouder’ |
| d. béc\text{g}-ede | ‘mûrir’ |
| kób\text{g}-ede | ‘balayer’ |
| kú\text{d}-idi | ‘enterrer’ |
| e. méé\text{g}-ene | ‘haïr’ |
| náá\text{g}-ini | ‘durer’ |

(19) Hierarchy of correspondence constraints operating on set of voiced consonants:

| Most similar | identity | CORR-C(N N N)--C(N N N) |
| Less similar | both simplex but differ in [nas] | CORR-C(N N N)--C(D D D) |
| Least similar | differ in [nas] and simplex vs. contour | CORR-C(N D D)--C(N N N) |
(20) Ranking of FAITH-IO C([nas]) within the CORR hierarchy prevents agreement between simplex and complex segments:

**IDENT-CC-C([nas] [nas] [nas])**

Corresponding C’s must be identical, in every q, for [nas].

**CORR-C(N N N)--C(N N N)**

Similar C’s must correspond.

**CORR-C(D D D)--C(D D D)**

**CORR-C(N N N)--C(D D D)**

**FAITH-IO-C([nas] [nas] [nas])**

Input and output are identical for [nas].

**CORR-C(N D D)--C(D D D)**

**CORR-C(N D D)--C(N N N)**

Ranking prevents correspondence and agreement between simplex and complex Qs = transparency

5 **q (SUBDIVISION) CORRESPONDENCE**

(21) **q...q...** Pair of corresponding subsegments

**CORR-q[F]--q[F]** ABC constraint, establishes correspondence between local pairs of q’s meeting a certain similarity threshold [F]

**Ident-qq-[F]** ABC constraint, enforces identity (in [F]) among corresponding segments.

(22) Types of harmony via correspondence, as applied to subsegments q:

1. Proximity: adjacent q’s correspond.
   (e.g., Yoruba, Ch. Mazatec, Hakha Lai tone; Guarani nasal harmony)
2. Featural Similarity: q’s with similar feature specifications correspond.
   (e.g., Samala sibilant harmony)
3. Structural Similarity: ‘prominent’ subsegments—i.e., head or target q’s—correspond.
   (e.g., Runyanmo, Oroch vowel harmonies)

5.1 **PROXIMITY: ADJACENT q CORRESPONDENCE**

(23) Hakha-Lai partial contour tone agreement (Hyman and VanBik 2002). Adjacent halves of contours must agree across syllable boundaries (as realized after the proclitic ka-’my’).

<table>
<thead>
<tr>
<th>Type</th>
<th>Contour</th>
<th>Realization</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>LH-HL</td>
<td>/thláan-zuû/</td>
<td>[thláan zuû] ‘grave beer’</td>
</tr>
<tr>
<td></td>
<td>HL-LH</td>
<td>/tlaân-tsâån/</td>
<td>[tlaân tsâån] ‘mountain time’</td>
</tr>
<tr>
<td></td>
<td>L-LH</td>
<td>/koom-tsâån/</td>
<td>[koom tsâån] ‘corn time’</td>
</tr>
<tr>
<td></td>
<td>HL-L</td>
<td>/tlaân-saa/</td>
<td>[tlaân saa] ‘mountain animal’</td>
</tr>
<tr>
<td></td>
<td>L-L</td>
<td>/koom-saa/</td>
<td>[koom saa] ‘corn animal’</td>
</tr>
<tr>
<td>b.</td>
<td>HL-HL</td>
<td>/tlaân-zuû/</td>
<td>[tlaân zuu] ‘mountain beer’</td>
</tr>
<tr>
<td></td>
<td>L-HL</td>
<td>/koom-zuû/</td>
<td>[koom zuu] ‘corn beer’</td>
</tr>
<tr>
<td></td>
<td>LH-HL</td>
<td>/thláan-tsâån/</td>
<td>[thláan tsâån] ‘grave time’</td>
</tr>
<tr>
<td></td>
<td>LH-L</td>
<td>/thláan-saa/</td>
<td>[thláan saa] ‘grave animal’</td>
</tr>
</tbody>
</table>

(24) Yoruba: partial assimilation creates contour tone (Akinlabi and Liberman 2000). [For a similar tone pattern, see Chiquihuitlán Mazatec (Jamieson 1977; Yip 2002); for an analogous segmental example, see Terena nasal spread (Piggott 1997, 2003)]

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<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>HL</td>
<td>/rárá/</td>
<td>[rárá] ‘elegy’</td>
</tr>
<tr>
<td>b.</td>
<td>LH</td>
<td>/álá/</td>
<td>[áltí] ‘dream’</td>
</tr>
</tbody>
</table>
(25) **CORR-q[V]-q[V]** Vocalic q’s across a syllable boundary must correspond
[IDENT-qq-[tone]] Corresponding q’s should be tonally identical

(26) */rárá*/  →  *[rárā]*

<table>
<thead>
<tr>
<th></th>
<th>V(H H H) ... V(L L L)</th>
<th>IDENT-qq-[tone]</th>
<th>CORR-q[V]-q[V]</th>
<th>IDENT-IO-q[tone]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>V(H H H,) ... V(L, L L)</td>
<td>W1</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>↵ b.</td>
<td>V(H H H,) ... V(H, L L)</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>V(H H H) ... V(L L L)</td>
<td>W1</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>d.</td>
<td>V(H, Hxy Hyz) ... V(Hza Hاب Hb)</td>
<td>W3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Correspondence, no identity
Correspondence, identity
No correspondence
Unnecessary correspondence

5.2 **FEATURAL SIMILARITY q CORRESPONDENCE**


Stops and sibilants in Samala: /s, sʰ, ʃ, jʰ, t, tʰ, ʈ, ʈʰ, ts, tsʰ, ʃ, ʃʰ, ʧ, ʧʰ/

<table>
<thead>
<tr>
<th></th>
<th>/k-su-ʃojin/</th>
<th>→  [kʃuʃojin]</th>
<th>‘I darken it’</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>/s-ʃi-tʃi-jep-us/</td>
<td>→</td>
<td>[sistisijepus]</td>
</tr>
<tr>
<td>b.</td>
<td>/s-api-ʧʰ-o-it/</td>
<td>→  [ʃapitʰolit]</td>
<td>‘I have a stroke of good luck’</td>
</tr>
</tbody>
</table>

(28) **CORR-q[S|--q[S]]** Sibilant q’s correspond [“S” = sibilant]
[IDENT-qq-[ant]] Corresponding q’s agree in anteriority

(29) */s-api-ʧʰ-o-it/  →  *[ʃapitʰolit]*

|       | /C(s s s) ... C(tʃh)/ | IDENT-qq-[ant] | CORR-q[S|--q[S]] | IDENT-IO-q[ant] |
|-------|------------------------|----------------|-----------------|----------------|
| a.    | C(s_xy s_yz) ... C(tʃz h) | W1 (ʃz)      |                | L               |
| b.    | C(s_xy s_yz) ... C(tʃz h) | W1 (ʃz)      |                | L1              |
| ↵ c.  | C(ʃx ʃxy ʃyz) ... C(tʃz h) | W1 (ʃz)      |                | 3               |
| d.    | C(s_x s_y) ... C(tʃh)   | W1 (ʃf)      |                | L               |
| e.    | C(s_x s_yz) ... C(tzaʃa h) | W1 (ʃa)      | W1 (ʃf)        | L               |
| f.    | C(ʃx ʃxy ʃyz) ... C(ʃzaʃa h) |           |                | W4              |
6 ADVANTAGES OF AN ABC+Q APPROACH

- Two major advantages of an ABC+Q approach to harmony (and disharmony) (contra a feature-spreading approach):
  1. Similarity basis for explicitly stating participant segments.
  2. Ability to capture both long distance and local (CV) phenomena.

6.1 THE SIMILARITY BASIS: CV AND TONE INTERACTIONS

- Similarity basis for harmony patterns afforded by ABC allows direct reference to participating segments in harmony: especially useful for CV and tone interactions (Shih 2013).

(30) Nupe partial spread after L tones to create rising contour is licensed when the intervening onset is [+voice] or sonorant (George 1970; Yip 2002: 143–144).

\[
\begin{array}{ll}
a. \text{ètù} & \text{‘parasite’} \\
b. \text{èdû} & \text{‘taxes’} \\
/è-lél/ & \rightarrow [èlè] \text{ ‘past’} \\
/è-mǐl/ & \rightarrow [èmǐl] \text{ ‘I’ or ‘me’ (in the Kpada dialect; in other dialects = [mǐ])}
\end{array}
\]

Optimal candidate [èdû]

\[
\begin{array}{ll}
(c_x c_x c_x) (d_x d_x d_x) (u_x u_x u_x) \\
[L][L][L] [L][L][L] [L][H][H]
\end{array}
\]

6 EXTENSIONS AND PREDICTIONS

- Disharmony
- Q/q independence
- Opacity – simplex segments can be opaque to interactions between contours and vice versa
- String-to-string correspondence

7.1 DISHARMONY AND Q/Q INDEPENDENCE

- ABC+Q analysis can extend to disharmony: corresponding segments undergo anti-agreement (cf. Bennett 2013).
- Q’s and q’s can behave independently with respect to agreement and disagreement.

(32) Tianjin whole contour Q dissimilation and partial contour q dissimilation (Chen 1985; Yip 1989: 163; 2002: 51, 179)

Adjacent whole tones dissipilate: contours simplify; adjacent L’s will have H insertion. Adjacent subsegments (q’s) across a syllable boundary must also disagree in tone.

\[
\begin{array}{ll}
a. \text{L.H.LH} & \rightarrow \text{H.L.LH} \\
& \rightarrow [x_i \text{H}, \text{lian}_\text{L.H}] \text{ ‘wash one’s face’} \\
\text{H.L.HL} & \rightarrow \text{L.H.L} \\
& \rightarrow [\text{jing}_\text{L}, \text{zhong}_\text{L.H}] \text{ ‘net weight’} \\
b. \text{L.L} & \rightarrow \text{LH.L} \\
& \rightarrow [\text{fei}_\text{L},] \text{ ‘airplane’} \\
c. \text{HL.L} & \rightarrow \text{H.L}
\end{array}
\]

¬IDENT-QQ-[tone] and ¬IDENT-qq-[tone] both active.
Unlike Tianjin, Pingyao demonstrates disagreement at the syllable/segment level and agreement at the subsegmental level (across syllable boundaries) (see also Hakha Lai for a similar pattern).

- IDENT-QQ-[tone] and IDENT-qq-[tone] both active.

### 7.2 Opacity and String-to-String Correspondence

- ABC+Q allows reference to simplex and contour segments simultaneously: no longer is ABC restricted to purely segmental correspondence.

Gurindji: correspondence induces opacity of simplex segments to contour dissimilation (see also similar patterns in other Australian languages (survey from Bennett 2013: 583); e.g., Bardi (Bowern 2004); Gooniyandi (McGregor 1990; Evans 1995; Suzuki 1998); Nhanda (Blevins 2001); Yindjibarndi (Wordick 1982; Suzuki 1998)) (cf. contour opacity to simplex segments in Kinyarwanda (Walker and Mpiranya 2006))

### (35) CORR-C(N C C)→C(C C C)  A pair of C’s, in at least one of which q^i=N, must correspond

- IDENT-CC-C(N O O)  Corresponding C’s cannot both be nasal-oral contours

### (36) /wipji-ŋka/ → [wipjika]
Here, opacity is introduced by a mismatch between what must correspond \{O, N, \(\tilde{N}\)O\} and which corresponding pairs are affected by anti-Identity = \{\(\tilde{N}\)O\} only.

(38) With the ability to reference simplex and contour segments at once, ABC+Q begins to converge with string-to-string correspondence in Aggressive Reduplication (Zuraw 2002) or what Yu (2007) calls ‘compensatory reduplication’ and Inkelas (2008) calls ‘phonological reduplication’.

- Similarity in the internal composition of a segment or of a string play into correspondence and harmony patterns.
- Formally, see also MAX-ABC (McCarthy 2010), which uses Aggressive Reduplication-reminiscent constraints in an ABC system. (Subtle differences in predictions still need to be worked out (see Zuraw 2002: 434–435; Shih, in prep).)

8 CONCLUSION

ABC: Why use ABC for harmony, rather than (say) autosegmental spreading?

- similarity among participating segments is a design feature, not a stipulation
- autosegmental spreading is phonologization of coarticulation (=temporal extension of gesture/percept); ABC models both coarticulation and motor planning effects

Q: Why modify the representations referred to in ABC?

- Quantized segments endow ABC with the ability to deal with phenomena beyond (and inside) segmental correspondence.
- Q-theory unites segments and tone under one treatment of harmony/disharmony.
- Q-theory further parameterizes locality (syllable-level, mora-level, segment-level, subsegment-level).
- ABC+Q can capture three types of harmony where participant segments are stated over the following:
  1. proximity
  2. featural similarity
  3. structural similarity
9. References


Shih, Stephanie S. 2013 under review. Consonant-tone interaction as Agreement by Correspondence. Ms. Stanford University.


