Elicitation and documentation of tone

What is the place of quantitative analysis in the study of tone?

THIS PPT CONTAINS A SUBSET OF THE ILLUSTRATIONS

Bert Remijsen, University of Edinburgh

Master Class, 4th International Conference on Language Documentation and Conservation
What is the place of the quantitative angle in the study of tone?

- Does the second syllable have a high tone pattern or a rising one?

Figure. Waveform, spectrogram and F0 trace of the word /dawa/ ‘lots (quantity)’ in Kakua. Data from Katherine Bolanos, cited in Hyman (2014:553).
Even in a system with just Low vs. High, the alignment matters:

<table>
<thead>
<tr>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>gìk-ání á-lèŋ kì kɛŋ</td>
<td></td>
</tr>
<tr>
<td>PRON:P-DEM  PAST-take:2SG PREP place:S.DEM</td>
<td></td>
</tr>
<tr>
<td>‘Somebody has taken them gradually in this place.’</td>
<td></td>
</tr>
<tr>
<td>gìn-ání á-lɛŋ  bùul</td>
<td></td>
</tr>
<tr>
<td>PRON:S-DEM  PAST-beat:APPL.2SG drum:S</td>
<td></td>
</tr>
<tr>
<td>‘You have used it to beat the drum.’</td>
<td></td>
</tr>
</tbody>
</table>
Even in a system with just Low vs. High, alignment matters:

Figure 1: Schematic representations of Low and High tone configurations on CV syllable, preceded by a High target and followed by a Low target.
Xu & Sun (2002) on the speed of f0 change

Figure from Xu & Sun (2002:1402), showing the difference between response time and overall time of the f0 change.
Table from Xu & Sun (2002:1405), showing the difference between response time and overall time of the f0 change.

<table>
<thead>
<tr>
<th>Direction</th>
<th>Interval</th>
<th>4</th>
<th>7</th>
<th>12</th>
<th>4</th>
<th>7</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excursion size (st)</td>
<td>3.3</td>
<td>3.7</td>
<td>4.4</td>
<td>4.5</td>
<td>6.8</td>
<td>6.1</td>
<td>3.9</td>
</tr>
<tr>
<td>Excursion time (ms)</td>
<td>120</td>
<td>129</td>
<td>123</td>
<td>133</td>
<td>144</td>
<td>148</td>
<td>122</td>
</tr>
<tr>
<td>Response time (ms)</td>
<td>75</td>
<td>64</td>
<td>72</td>
<td>65</td>
<td>80</td>
<td>73</td>
<td>76</td>
</tr>
<tr>
<td>Excursion/response</td>
<td>1.62</td>
<td>2.07</td>
<td>1.70</td>
<td>2.07</td>
<td>1.82</td>
<td>2.04</td>
<td>1.62</td>
</tr>
</tbody>
</table>
A perceptual source of time pressure: the glissando threshold

Glissando threshold (Rossi 1971, 1978; Greenberg & Zee 1978; ‘t Hart, Collier & Cohen 1990): the smaller the time domain is small, the greater an f0 change needs to be in order to be heard as a pitch change.
A perceptual source of time pressure: the glissando threshold

Figure from ‘t Hart, Collier & Cohen (1990:32). The glissando threshold as a function of duration, meta-analysis of several experimental studies.
Glissando threshold (Rossi 1971, 1978; Greenberg & Zee 1978; ‘t Hart, Collier & Cohen 1990): the smaller the time domain is small, the greater an f0 change needs to be in order to be heard as a pitch change.

Formula from ‘t Hart, Collier & Cohen (1990) – for a given duration (D), the glissando threshold, in semitones (ST) per second = 0.16 / D^2

Example – a change from 150 to 135 Hz (1.83 ST). Perceived as a pitch contour over 100 ms, but as a level pitch over 50 ms.
Alignment in a falling contour tone (Shilluk example)

**Low**

`gìk-áńí á-lɛ̀ŋ kì kɛṅ`

PRON:P-DEM  PAST-take:2SG  PREP  place:S.DEM

‘Somebody has taken them gradually in this place.’

**Fall**

`gìn-áńí  á-lɛ̀ŋ kì kɛṅ`

PRON:S-DEM  PAST-beat  PREP  place:S.DEM

‘Somebody has beaten it in this place.’

**High**

`gìn-áńí  á-lɛ̀ŋ  bùul`

PRON:S-DEM  PAST-beat:APPL.2SG  drum:S

‘You have used it to beat the drum.’
Figure 1: Schematic representations of Low, High and Falling tone patterns on a CV syllable, preceded by a High target and followed by a Low target.
“[I]t might be that in some languages pitch changes are timed relatively early in the syllable, and in other languages they are timed relatively late. Such control would only be phonetic, never phonological.” [Odden 1995:450]

“[T]here is no possible opposition between two HL or two LH contours where the two tones are synchronized differently within the syllable.” [Hyman 1988:51]

“If the contours are composed of levels, the existence of two falls implies at least three levels, and then in fact we might expect up to three contours of the same shape.” [Yip 2002:29]
Null hypothesis: tonal alignment not contrastive in contour tones

Figure. Schematic representations of early- vs. late-aligned falling contours within the syllable domain.
Evidence for contrastive tonal alignment in contour tones: Yoloxóchitl Mixtec

Figure: From DiCanio, Amith & Castillo García (2014): time-normalised f0 traces, for early- vs. late-aligned rises, on monosyllabic words in citation form.
Evidence for contrastive tonal alignment in contour tones: Dinka

**Dinka**

- **Example:**
  - Early-aligned Fall (allophonic variant of Low toneme)
    
    - ràaan ā-leel
    - person:S  AG.S-isolate:3S
    - ‘You isolate a person.’
  
    - ràaan ā-leel
    - person:S  AG.S-isolate:3S
    - ‘He isolates a person.’
  
  - Late-aligned Fall (realisation of Fall toneme)
    
    - ràaan ā-leel
    - person:S  AG.S-isolate:PASS
    - ‘A person is being isolated.’
  
    - ràaan ā-leel
    - person:S  AG.S-provoke:PASS
    - ‘A person is being provoked.’
Evidence for contrastive tonal alignment in contour tones: Dinka

Figure. Averaged f0 traces on normalised time axis (4 sets, 13 speakers). From Remijsen (2013).
Confronted with a constellation like the one below, representing the contours as level tones is not an option.

Figure. Schematic representations of four tone categories distinguished by tonal alignment.
Evidence for contrastive tonal alignment in contour tones: Shilluk

Low

\[
\text{PRON:P-DEM} \ \text{PAST-take:2SG} \ \text{PREP} \ \text{place:S.DEM}
\]

‘Somebody has taken them gradually here.’

Early-aligned Fall

\[
\text{PRON:S-DEM} \ \text{PAST-beat} \ \text{PREP} \ \text{place:S.DEM}
\]

‘Somebody has beaten the it here.’

Late-aligned Fall

\[
\text{PRON:S-DEM} \ \text{PAST-beat:FUG} \ \text{village:S}
\]

‘Somebody went away to the village to beat it.’

High

\[
\text{PRON:S-DEM} \ \text{PAST-beat:APPL.2SG} \ \text{drum:S}
\]

‘You have used it to beat the drum.’
Evidence for contrastive tonal alignment in contour tones: Shilluk

Figure. Averaged f0 traces of the target word on a normalised time axis (whole dataset).
Evidence for contrastive tonal alignment in contour tones: Shilluk

Figure. Means and standard deviations for tonal alignment of the high turning point by Tone.
Evidence for contrastive tonal alignment in contour tones: Shilluk

Figure. Means and standard deviations for the F0 height of the high turning point, by Tone. Separate panels for raw f0, in hertz (left), and after conversion to ERB scale and z-transformation per speaker (right).
Bibliography


Kuang, Jianjing (2013). The tonal space of contrastive five level tones. Phonetica 70, 1-23.


Remijsen, Bert (2013). Tonal alignment is contrastive in falling contours in Dinka. Language 89(2), 297-327.


The following slides have bits and pieces that might come in handy in response to questions
• Number of utterance tokens: 293

• Aggregated over repetitions, ahead of quantitative analyses: 154 types. So there are 8 missing values, given a logical total of 162 (18 items x 9 speakers).

• ANOVAs are based on balanced dataset, with 105 types. So there are 3 missing values, given a logical total of 108 (12 items [3 for each level of Tone] x 9 speakers).
Background on Shilluk and Dinka

Shilluk

- A Western Nilotic language, within the Nilo-Saharan language family
- Spoken in South Sudan
- At least 200,000 speakers

Figure. Map from Storch (2005), showing the Western Nilotic languages
House (1990)

- Evidence from perception experiments, in which tonal alignment is varied across the syllable
- Perception of falling f0 patterns according to House (1990:133ff):

<table>
<thead>
<tr>
<th>Segmental sequence</th>
<th>F0 contour</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>C</td>
</tr>
</tbody>
</table>
House (1990)

“For the movement contour features Falling [...] and Rising to be optimally perceived, three conditions must be fulfilled”:

1. The fall takes place through a zone of relative spectral stability;
2. The fall sets in 30-50 milliseconds into the vowel;
3. The vowel is at least 100 milliseconds long.

But there is some counterevidence
But there is some counterevidence

House (1990)

• “Another area altogether is that of tonal distinctions: what if anything is quantal about them? Candidates for quantal characterizations of tone do not leap immediately to mind.”

[Stevens & Keyser 2010:13]

• House’s hypothesis is in effect a proposal for such a quantal threshold.
Noise in f0 traces: voicing in plosive consonants

Figure. F0 traces of 2 question-word question in Kuot (Papuan, New Ireland). Data from Eva Lindström.
Noise in f0 traces: spikes between vowels and (nasals, [l])

Figure: F0 trace of a question-word question in Kuot (New Ireland). Data from Eva Lindström.