THE ROLE OF MUSIC IN DOCUMENTING PHONOLOGICAL GRAMMAR:
TWO CASE STUDIES FROM WEST AFRICA
LAURA MCPHERSON (DARTMOUTH COLLEGE)
INTRODUCTION
THE LANGUAGE-MUSIC CONNECTION

- Surge in interest on the relationship between language and music
- Heavy overlap in structural and cognitive areas:
  - Sound structure (Lerdahl and Jackendoff 1983, Lehrdal 2001, Patel and Daniele 2002, Iversen et al. 2008, i.a.)
  - Syntax (Maess et al. 2001, Patel et al. 1998a, i.a.)
BUT WE’RE PHONOLOGISTS…

- What does this have to do with phonology?
Artistic adaptation of language manipulates phonological structure

Metrics and phonological theory

What can musical practices tell us about phonological structure?
- Language-based music (though see e.g. Patel 2008 for instrumental classical musical)

Window onto speakers’ implicit knowledge of the sound system
TODAY’S TALK

- Two case studies from West Africa
  - Tone-tune association in Tommo So folk songs (vocal music)
  - Surrogate speech of the Sambla balafon (ostensibly instrumental music)
- Evidence for phonological organization
- Probe the interface between phonetics and phonology

- Not only can music advance phonological theory, but it can be a key tool in language documentation
  - Bonus: Documenting endangered musical traditions!
MUSIC AND PHONOLOGY
PREVIOUS STUDIES
PREVIOUS WORK

- **Text-setting**
  - **Non-tonal**: Halle and Lerdahl (1993), Shih (2008), Hayes (2009), Calder (2013), Starr and Shih (2017), *i.a.*
- **Grouping and phrasing**: Lerdahl and Jackendoff (1993), Katz and Pesetsky (2011), Katz (submitted), *i.a.*
- **Rhythm**: Patel and Daniele (2003), Seifart et al. (2018)
The mora clearly important in Japanese phonology (Vance 1987, Otake et al. 1993, Inaba 1998, i.a.)

But does this mean there is no evidence for the syllable? (Labrune 2012)

Starr and Shih (2017) on Japanese text-setting
JAPANESE: SYLLABLES OR MORAS?

- Both mora-based and syllable-based
- Consistent with non-musical evidence (e.g. Kawahara 2016)
MUSIC AS EVIDENCE

- Studies of music can provide evidence for:
  - Phonological structure and categories
  - Phonetic influence and the role of phonetics in phonology (Katz 2015, etc.)
CASE STUDY 1: TOMMO SO TONAL TEXTSETTING

JOINT WORK WITH KEVIN RYAN (HARVARD)
TOMMO SO

- Dogon language spoken in Mali by approx. 60,000 speakers
- Primary fieldwork from 2008-2012
- Tone system:
  - L, H, ∅ (McPherson 2011)

  - dàmmá 'hoe' LH
  - dàmmá 'village' H
  - dàmmá=ge 'the village' H=∅

- Intricate system of replacive grammatical tone (McPherson 2014, McPherson and Heath 2016)
What is the relationship between linguistic tone and musical melody?

Vast and growing literature on the question (e.g. Schellenberg 2012, Kirby and Ladd to appear, references cited therein)
### The Research Question

<table>
<thead>
<tr>
<th>Language</th>
<th>Paper</th>
<th>Number of Artifacts</th>
<th>Number of transitions</th>
<th>Parallel</th>
<th>Not opposing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cantonese Chinese</td>
<td>Wong &amp; Diehl (2002)</td>
<td>4</td>
<td>281</td>
<td>92%</td>
<td>98%</td>
</tr>
<tr>
<td>Ewe</td>
<td>Jones (1959)</td>
<td>1</td>
<td>105</td>
<td>68%</td>
<td>95%</td>
</tr>
<tr>
<td>Ewe*</td>
<td>Hornbostel (1928)</td>
<td>1</td>
<td>35</td>
<td>49%</td>
<td>89%</td>
</tr>
<tr>
<td>Hausa</td>
<td>Richards (1972)</td>
<td>1</td>
<td>380</td>
<td>53%</td>
<td>96%</td>
</tr>
<tr>
<td>Kalami (Gawri)</td>
<td>Baart (2004)</td>
<td>14</td>
<td>434</td>
<td>48%</td>
<td>89%</td>
</tr>
<tr>
<td>Shona</td>
<td>Schellenberg (2009)</td>
<td>3</td>
<td>140</td>
<td>53%</td>
<td>67%</td>
</tr>
<tr>
<td>Thai</td>
<td>List (1961)</td>
<td>8</td>
<td>no data</td>
<td>76%</td>
<td>no data</td>
</tr>
<tr>
<td>Wu-Ming Tai</td>
<td>Mark &amp; Li (1966)</td>
<td>6</td>
<td>(320 syll)</td>
<td>63%</td>
<td>no data</td>
</tr>
<tr>
<td>Xhosa*</td>
<td>Starke (1930)</td>
<td>25</td>
<td>281</td>
<td>67%</td>
<td>95%</td>
</tr>
<tr>
<td>Zulu*</td>
<td>Rycroft (1959, 1979)</td>
<td>2</td>
<td>36</td>
<td>92%</td>
<td>97%</td>
</tr>
</tbody>
</table>

Schellenberg (2012:270)
Women’s Folk Songs

- Recorded 1.5 hours of sung music in January, 2012
- Largely call and response
- Solo verse elaborates on a repeated chorus using some improvisation
- Pentatonic scale, with roughly the following corresponding notes:

  E♭  F  (G)  A♭  B♭  C  ((D))
WOMEN’S FOLK SONGS
CODING THE DATA

- Transcribed 11 minutes consisting of eight songs
  - 172 musical lines
  - 2223 musical bigrams (two note sequences)
Coded each bigram for:

- Tone  (e.g. HH, HL, etc.)
- Change in note (e.g. -1, 2, 0, etc.)
- Juncture strength
  - 0 = within-word, 1 = clitic, 2 = word
- Lexical vs. grammatical tone
- Improvised vs. rote
- Position in line
- Singer

<p>| | | | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>yaandO</td>
<td>21</td>
<td>-1</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>0</td>
<td>LL</td>
</tr>
<tr>
<td>ndO gi</td>
<td>21</td>
<td>1</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>2</td>
<td>LL</td>
</tr>
<tr>
<td>ginE</td>
<td>21</td>
<td>-1</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>0</td>
<td>LL</td>
</tr>
<tr>
<td>nE uwO</td>
<td>21</td>
<td>0</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>2</td>
<td>LL</td>
</tr>
<tr>
<td>uwO nE</td>
<td>21</td>
<td>1</td>
<td>H</td>
<td>0</td>
<td>H</td>
<td>0</td>
<td>1</td>
<td>LL</td>
</tr>
<tr>
<td>nE gwe</td>
<td>21</td>
<td>-2</td>
<td>0</td>
<td>H</td>
<td>0</td>
<td>H</td>
<td>2</td>
<td>LL</td>
</tr>
<tr>
<td>gwe na</td>
<td>21</td>
<td>0</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>2</td>
<td>LG</td>
</tr>
<tr>
<td>nale</td>
<td>21</td>
<td>1</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>0</td>
<td>GG</td>
</tr>
<tr>
<td>lee</td>
<td>21</td>
<td>1</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>0</td>
<td>GG</td>
</tr>
<tr>
<td>e em</td>
<td>21</td>
<td>-2</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>2</td>
<td>GG</td>
</tr>
<tr>
<td>emkE</td>
<td>21</td>
<td>1</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>3</td>
<td>GL</td>
</tr>
<tr>
<td>kEmin</td>
<td>21</td>
<td>1</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>0</td>
<td>LL</td>
</tr>
<tr>
<td>minjE</td>
<td>21</td>
<td>1</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>0</td>
<td>LL</td>
</tr>
<tr>
<td>jE sa</td>
<td>21</td>
<td>1</td>
<td>H</td>
<td>L</td>
<td>H</td>
<td>H</td>
<td>2</td>
<td>LG</td>
</tr>
<tr>
<td>same</td>
<td>21</td>
<td>1</td>
<td>L</td>
<td>L</td>
<td>H</td>
<td>L</td>
<td>0</td>
<td>GG</td>
</tr>
</tbody>
</table>
BASIC RESULTS

- Following the methodology in Schellenberg (2012), Kirby and Ladd (to appear), etc.
  - **Parallel**: (up with up, level with level, down with down)
  - **Contrary**: (up with down, down with up)
  - **Oblique**: (up with level, down with level)
**BASIC RESULTS**

- **Contrary** mappings avoided
- **Oblique** mappings tolerated

<table>
<thead>
<tr>
<th></th>
<th>2+ up</th>
<th>1 up</th>
<th>same</th>
<th>1 down</th>
<th>2+ down</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>up (LH)</strong></td>
<td>40 (80%)</td>
<td>178 (62%)</td>
<td>243 (29%)</td>
<td>46 (12%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td><strong>same (LL or HH)</strong></td>
<td>7 (14%)</td>
<td>97 (34%)</td>
<td>404 (48%)</td>
<td>238 (60%)</td>
<td>27 (61%)</td>
</tr>
<tr>
<td><strong>down (HL)</strong></td>
<td>3 (6%)</td>
<td>10 (4%)</td>
<td>193 (23%)</td>
<td>112 (28%)</td>
<td>17 (39%)</td>
</tr>
</tbody>
</table>
Contrary mappings more strongly avoided in larger musical intervals

- 1 step: 10.0% contrary
- 2+ steps: 3.2% contrary
GROUPING OF TONAL TRANSITIONS
OTHER FACTORS MODULATING STRICTNESS

- Juncture strength (stricter within word than across)
- Position in line (stricter at the ends of lines)
- Lexical or grammatical tone (stricter for lexical tone)
- Rote vs. improvised material (stricter for rote)
MODELING TONE-TUNE ASSOCIATION

- Maximum entropy harmonic grammar (Goldwater and Johnson 2003, Hayes and Wilson 2008, *i.a.)*
  - Input: Tonal bigram
    - Surface tone
    - Lexical tone
    - Juncture strength
    - Position in line
  - Output: Musical transition

<table>
<thead>
<tr>
<th>L, L</th>
<th>Lex = LH Intraword .85</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2</td>
<td></td>
</tr>
<tr>
<td>-1</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
MODELING TONE-TUNE ASSOCIATION

- **CONTRARY**: Penalize contrary mapping by the absolute size of the interval separating the two notes.
- Stringency hierarchies (**CONTRARYCG** = clitic group, **CONTRARYLEX** = lexical tone)
- **NONPARALLEL**: Penalize any non-parallel mappings by absolute size of the interval separating the two notes.
- Musical constraints: **STEP** and **UP**
## Modeling Tone-Tune Association

<table>
<thead>
<tr>
<th>L, L lex=LH, crossword</th>
<th>Obs’d N</th>
<th>Obs’d p</th>
<th>Gen’d p</th>
<th>$\mathcal{H}$</th>
<th>*STEP</th>
<th>*CONTRARY</th>
<th>*UP</th>
<th>*NONPARALLEL</th>
<th>*CONTRARY CG</th>
<th>*CONTRARY Leg</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. -2</td>
<td>0</td>
<td>.000</td>
<td>.054</td>
<td>-2.436</td>
<td>-2</td>
<td>0</td>
<td>0</td>
<td>-2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>b. -1</td>
<td>1</td>
<td>.026</td>
<td>.182</td>
<td>-1.218</td>
<td>-1</td>
<td>0</td>
<td>0</td>
<td>-1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>c. 0</td>
<td>28</td>
<td>.737</td>
<td>.616</td>
<td>-0.000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>d. 1</td>
<td>9</td>
<td>.237</td>
<td>.114</td>
<td>-1.685</td>
<td>-1</td>
<td>0</td>
<td>-1</td>
<td>-1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>e. 2</td>
<td>0</td>
<td>.000</td>
<td>.034</td>
<td>-2.903</td>
<td>-2</td>
<td>0</td>
<td>-1</td>
<td>-2</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
RETURNING TO SPOKEN TOMMO SO

- Two insights from tonal textsetting on Tommo So phonology:
  - Rising vs. non-rising
  - Latent effect of lexical tone
RISING VS. NON-RISING

- Organizing principle of tonal textsetting
  - *CONTRARY(broad): penalize rising melody on non-rising tone and non-rising melody on rising tone
  - Inclusion improves model fit
    - Improves AIC by 6
RISING VS. NON-RISING

- Organizing principle of Tommo So (lexical) tone
- Native vocabulary entirely /LH/ or /H/ (rising or non-rising)
  - 6% of nouns are HL (mostly loanwords from Fulfulde)
- Grammatical overlays almost never rising (instead: {H}, {L}, {HL})
Both HH and HL sequences are phonetically falling
- ~0.6 semitones for HH and ~3.5 for HL

LH can be phonetically rising or level
- Near-total downdrift (HLH)

Rises are salient
PHONETICS OR PHONOLOGY?

- Tonal text-setting informed by either:
  - Phonetic facts that LH is the only tone to remain level or rise  -or-
  - The phonological division between LH and H (/L{/HL}) in the phonological grammar
### LEXICAL AND GRAMMATICAL TONE

- Latent effect of lexical tone in text-setting words with a grammatical tone overlay

<table>
<thead>
<tr>
<th>Surface tone sequence</th>
<th>Underlying tone sequence</th>
<th>% of musical changes that are rises</th>
<th>Out of N total bigrams</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonrising Nonrising</td>
<td>Nonrising Rising</td>
<td>17%</td>
<td>116</td>
</tr>
<tr>
<td></td>
<td></td>
<td>36%</td>
<td>42</td>
</tr>
<tr>
<td>Rising Rising</td>
<td>Nonrising Rising</td>
<td>82%</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100%</td>
<td>6</td>
</tr>
</tbody>
</table>
HOW WE MODELED IT

- Input contains both surface tone and underlying tone
- $\text{CONTRARY}$ and $\text{CONTRARY}_{\text{LEX}}$
INCOMPLETE NEUTRALIZATION?

- Grammatical consists of word-level overlays (McPherson 2014, Heath and McPherson 2013, McPherson and Heath 2016)
  - \{L\} when modified by adjectives, demonstratives, relative clauses, nominal possessors
  - \{H(L)\} when modified by pronominal possessors (inalienable)

\[ \text{dàmmá 'village'} \]
\[ \text{dàmmà’ nó ‘this village/hoe'} \]
\[ \text{dàmmá ‘hoe'} \]
INCOMPLETE NEUTRALIZATION

- Data suggestive of variably incomplete neutralization/application of overlays

jàndúlu  ‘donkey’

jàndùlù́ píl  ‘white donkey’
The young woman’s donkey that I hit... The young woman whose donkey that I hit...
Lexical tone and grammatical tone both activated
- Bleed through of lexical tone

As with rising vs. non-rising, this raises question of phonetics or phonology in tonal textsetting
INTERIM SUMMARY
Linguistic tone constrains musical melody

Binary distinction between rising and non-rising tone sequences

Strictness modulated by numerous grammatical and extra-grammatical factors

- Many find parallels in metrics
Tighter connection between phonology and phonetic implementation

Musical adaptation is a window into a speaker’s implicit knowledge of their phonology
INCREASING TONAL COMPLEXITY

- Tone-tune association in a (supposed) three-tone language?
- Seenku music in Burkina Faso
CASE STUDY 2: THE SAMBLA BALAFON
SAMBLA AND SEENKU

- Sambla: Mande ethnic group in southwestern Burkina Faso
  - Exonym for people and language
- Seenku: endonym for the language
- Western Mande, Samogo
- ~15,000 speakers
- Primary fieldwork 2013-present
Normalized tones (female)

- Four contrastive levels
  - Super-high (S, ŋ)
  - High (H, ã)
  - Low (L, à)
  - Extra-low (X, ã)
TONE SYSTEM

Multiple contours
- Falling:
  - SX
  - SH
  - HX
  - HL
- Complex:
  - XHX
  - LSX
  - HXS, etc.

Rising:
- LS
- XH
- HS
Mostly mono- and sesquisyllabic (Matisoff 1990, Pittayaporn 2015)

\[(C\varepsilon)CV(V)(n)\]

<table>
<thead>
<tr>
<th>Monosyllabic</th>
<th>Sesquisyllabic</th>
</tr>
</thead>
<tbody>
<tr>
<td>tɛ́     ‘who’</td>
<td>təgɛ́   ‘chicken’</td>
</tr>
<tr>
<td>gɔ́ɛɛ́ ‘woods’</td>
<td>dəgɔ́ɛɛ́ ‘place(s)’</td>
</tr>
<tr>
<td>dən ‘basket holder’</td>
<td>ɲəgən ‘guinea fowl’</td>
</tr>
</tbody>
</table>
SAMBLA BALAFON

- Pentatonic scale:
  - 1
  - b3
  - 3
  - 5
  - 6
SURROGATE LANGUAGES

- Two types (Stern 1957)
  - Abridgement systems encode phonemic aspects
  - Lexical ideogram systems symbolize concepts
- Found world-wide on all sorts of instruments:
  - Drums (e.g. Yoruba, Beier 1954)
  - Flutes (e.g. Gavião, Moore and Meyer 2014)
  - Trumpets (e.g. Asante, Kaminski 2008)
  - Jaw harps (e.g. Khmu, Proschan 1994)
METHODS

- Transcribed 135 phrases for notes and inter-strike duration
  - Both elicited and naturally occurring phrases
- ~823 words
- Coded for a number of factors

<table>
<thead>
<tr>
<th>Line</th>
<th>Word</th>
<th>Syllable</th>
<th>Tone</th>
<th>Note(s)</th>
<th>Total duration</th>
<th>Contour</th>
<th>Long</th>
<th>Diphthong</th>
<th>Sesquisyllabi</th>
<th>Coda</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>jê</td>
<td>HL</td>
<td>Bc3-T3</td>
<td>259 Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>mènì</td>
<td>L</td>
<td>T3-T3</td>
<td>282 N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>nà</td>
<td>LS</td>
<td>Bc3-B4</td>
<td>278 Y</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>mó</td>
<td>H</td>
<td>Bc3</td>
<td>181 N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>bò</td>
<td>X</td>
<td>Tc3</td>
<td>192 N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>tạgon</td>
<td>L</td>
<td>T3-T3</td>
<td>275 N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>tạgon</td>
<td>L</td>
<td>T3-T3</td>
<td>f335.416666</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>
PRINCIPLES OF ENCODING

- Always encoded:
  - Tone (lexical and grammatical)
  - Vowel length
  - Sesquisyllabicity
- Never encoded:
  - Segmental information
- Sometimes encoded:
  - Coda nasals
  - Postlexical tone
TONE ENCODING

- Mí  'we'
- Mó  'I'
- Mɔ̰̏  'one'
- ...nã  sɔmâ  'will dance'
## Tone Encoding

<table>
<thead>
<tr>
<th>Tone</th>
<th>Symbols</th>
</tr>
</thead>
<tbody>
<tr>
<td>S (8)</td>
<td>![Green Symbol]</td>
</tr>
<tr>
<td>Sk (6)</td>
<td>![Blue Symbol]</td>
</tr>
<tr>
<td>T (5)</td>
<td>![Gray Symbol]</td>
</tr>
<tr>
<td>Bg (3)</td>
<td>![Red Symbol]</td>
</tr>
<tr>
<td>J (b3)</td>
<td>![Gray Symbol]</td>
</tr>
<tr>
<td>B (1)</td>
<td>![Gray Symbol]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sound</th>
<th>mǐ</th>
<th>mó</th>
<th>nǎ</th>
<th>səmâ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mǐ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>mó</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>nǎ</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**TONE ENCODING**

- Depends on the mode of the song (i.e. no absolute tone-note mapping)
  - But the most general mode is centered around note 1 (known as the *bâg-nà ‘balafon-mother’*)

<table>
<thead>
<tr>
<th></th>
<th>B (1)</th>
<th>J (b3)</th>
<th>Bg (3)</th>
<th>T (5)</th>
<th>Sk (6)</th>
<th>S (8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>0</td>
<td>1</td>
<td>8</td>
<td>22</td>
<td>38</td>
<td>158</td>
</tr>
<tr>
<td>H</td>
<td>4</td>
<td>0</td>
<td>72</td>
<td>85</td>
<td>154</td>
<td>28</td>
</tr>
<tr>
<td>L</td>
<td>2</td>
<td>1</td>
<td>9</td>
<td>73</td>
<td>15</td>
<td>7</td>
</tr>
<tr>
<td>X</td>
<td>101</td>
<td>2</td>
<td>93</td>
<td>57</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>
CONTOUR TONES

<table>
<thead>
<tr>
<th>S (8)</th>
<th>Sk (6)</th>
<th>T (5)</th>
<th>Bg (3)</th>
<th>J (b3)</th>
<th>B (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Words</th>
<th>jò</th>
<th>mənj</th>
<th>nă</th>
<th>mó</th>
<th>bō</th>
<th>təgon</th>
<th>təgon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Durations</td>
<td>107</td>
<td>152</td>
<td>65</td>
<td>217</td>
<td>73</td>
<td>182</td>
<td>190</td>
</tr>
</tbody>
</table>

Jò mənj nă mó bō təgon-təgon
water drink.ANTIP PROSP 1SG kill.IRREAL RED-completely
'I am dying of thirst.'
### Vowel Length

<table>
<thead>
<tr>
<th>Words</th>
<th>à</th>
<th>nả</th>
<th>kề</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>282</td>
<td>41</td>
<td>389</td>
</tr>
</tbody>
</table>

À nả kề 'he will go'

<table>
<thead>
<tr>
<th>Words</th>
<th>à</th>
<th>nả</th>
<th>kề</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>265</td>
<td>66</td>
<td>304</td>
</tr>
</tbody>
</table>

À nả kề 'it will dry up'
### SESQUISYLLABICITY

<p>| | | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>S (8)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sk (6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>T (5)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bg (3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J (b3)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B (1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Words1</td>
<td>səgã</td>
<td>bâ</td>
</tr>
<tr>
<td>Words2</td>
<td>bɛɛ</td>
<td>kərɛ</td>
</tr>
<tr>
<td>Duration</td>
<td>78</td>
<td>294</td>
</tr>
</tbody>
</table>

- səgã bâ  'ram'
- bɛɛ kərɛ  'boar'
Do we see the same behavior in the surrogate language as in Tommo So text-setting?  
- No!

Grammatical tone is always encoded
- Both tonal morphemes and grammatically-constrained sandhi
GRAMMATICAL TONE

- Plural formation
  - Vowel fronting
  - Tone raising

- Suffixation of two features, [+front] and [+raised] (McPherson 2017)

<table>
<thead>
<tr>
<th></th>
<th>X</th>
<th>L</th>
<th>H</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>upper</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>raised</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

bèè → bèè  ‘pig(s)’

bí → bí  ‘goat(s)’
GRAMMATICAL TONE

- Argument-head tone sandhi (McPherson in press, under review)
  - Possessor + inalienable noun
  - Object + irrealis verb
  - DP + postposition

  ã bã  ‘hit him!’

  mó bã  ‘hit me!’

  mĩ bã  ‘hit us!’
Both encoded on the balafon

mó nǎ bí sǎ
ISG PROSP goat.PL buy.IRREAL
‘I will buy goats’

Plural: bí → bǐ

Sandhi: bǐ sǎ → bǐ sǎ
POSTLEXICAL TONE

- Rarely encoded

Contour tone simplification:

Spoken: /mó nǎ/ → [mó 'nǎ] or [mó nà]

Balafon: N/A

<table>
<thead>
<tr>
<th></th>
<th>S (8)</th>
<th>Sk (6)</th>
<th>T (5)</th>
<th>Bg (3)</th>
<th>J (b3)</th>
<th>B (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Words</td>
<td>mó</td>
<td>nǎ</td>
<td>bǐ</td>
<td>sǐ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration</td>
<td>226</td>
<td>35</td>
<td>272</td>
<td>292</td>
<td>...</td>
<td></td>
</tr>
</tbody>
</table>
LEVEL OF ENCODING

- Surface phonetic
- Postlexical phonological
- Lexical phonological/morphophonological
- Underlying form
A QUESTION OF MODALITY?

- Sung music vs. surrogate speech
  - Availability of segmental contrasts
- Functional load of the tone system

➢ Would the same be true for Seenku tonal text-setting?
SEENKU TONAL TEXT-SETTING

- Koko te So
  - Vocal
  - (Balafon)
  - (Flute)
Absolute tone-note mapping doesn’t pattern like the balafon

<table>
<thead>
<tr>
<th></th>
<th>B (1)</th>
<th>J (b3)</th>
<th>Bg (3)</th>
<th>T (5)</th>
<th>Sk (6)</th>
<th>S (8)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>1</td>
<td>0</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>12</td>
</tr>
<tr>
<td>H</td>
<td>7</td>
<td>0</td>
<td>22</td>
<td>32</td>
<td>12</td>
<td>7</td>
</tr>
<tr>
<td>L</td>
<td>9</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>X</td>
<td>10</td>
<td>0</td>
<td>25</td>
<td>19</td>
<td>13</td>
<td>4</td>
</tr>
</tbody>
</table>
TONE-TUNE ASSOCIATION

- Strict relative (directional) tone-tune mapping:
  - Stricter than Tommo So (oblique mappings avoided)

<table>
<thead>
<tr>
<th></th>
<th>Music: +2</th>
<th>+1</th>
<th>0</th>
<th>-1</th>
<th>-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tone: Up</td>
<td>10 (83%)</td>
<td>515 (88%)</td>
<td>9 (14%)</td>
<td>1 (2%)</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>Same</td>
<td>2 (17%)</td>
<td>7 (12%)</td>
<td>52 (80%)</td>
<td>15 (31%)</td>
<td>3 (13%)</td>
</tr>
<tr>
<td>Down</td>
<td>0</td>
<td>0</td>
<td>4 (6%)</td>
<td>33 (67%)</td>
<td>19 (79%)</td>
</tr>
</tbody>
</table>
Return of postlexical tone:

\[ \text{í wà gáa màà măn’jó nà kú báa kǚ sǚ à gũn tò kõ kõ dón} \]
LEVEL OF ENCODING, REVISITED

- Surface phonetic
- Postlexical phonological
- Lexical phonological/morphophonological
- Underlying form

Sung music (segmental content available)

Surrogate speech (segmental content unavailable)
DISCUSSION
- Musical adaptation as evidence for implicit knowledge/psychological reality of:
  - Phonetics (Katz 2015, Tommo So tonal realization?)
  - Phonological structure (Starr and Shih 2017, balafon surrogate language)
  - Allophonic variation and postlexical processes (Seenku singing)
- Evidence can be used to test boundaries between components
Surrogate languages a valuable tool in “decoding” a novel tone system
- Amplifies tonal contrasts
- Window onto underlying form
Documenting the linguistic practices of a speech community
  - Music as a linguistic practice
- Topic of interest to the community
- Music is also endangered
FUTURE WORK

- Further investigation of Seenku sung music
  - A disappearing tradition
- Corroborate hypotheses about phonetics-phonology interface in non-musical ways
- A larger cross-linguistic and cross-modal study
  - Do surrogate languages typically encode underlying structure?
  - Is text-setting of vocal music usually sensitive to surface realization?
  - Where does an “oral” surrogate language like whistled speech (e.g. Rialland 2005) fall?
Thank you!
RHYME AND PHONETIC KNOWLEDGE

- Rhyme tells us about similarity
  - Phonetic or phonological?
  - Structural or perceptual?
- Katz (2015) on imperfect rhyme in hip-hop
  - Mismatched consonants (place and voicing) in three environments
    - Intervocalic (perceptually most distinct)
    - Domain-final
    - Pre-consonantal (perceptually least distinct)
## Rhyme and Phonetic Knowledge

<table>
<thead>
<tr>
<th>Place</th>
<th>R_R</th>
<th>R_#</th>
<th>R_T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mohawk</td>
<td>No contrast</td>
<td>No contrast</td>
<td>No contrast</td>
</tr>
<tr>
<td>Spanish</td>
<td>Contrast</td>
<td>No contrast</td>
<td>No contrast</td>
</tr>
<tr>
<td>Diola Fogny</td>
<td>Contrast</td>
<td>Contrast</td>
<td>No contrast</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voicing</th>
<th>R_R</th>
<th>R_#</th>
<th>R_T</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yukulta</td>
<td>No contrast</td>
<td>No contrast</td>
<td>No contrast</td>
</tr>
<tr>
<td>Russian</td>
<td>Contrast</td>
<td>No contrast</td>
<td>No contrast</td>
</tr>
<tr>
<td>Hungarian</td>
<td>Contrast</td>
<td>Contrast</td>
<td>No contrast</td>
</tr>
</tbody>
</table>

### Obstruent Voicing

![Obstruent Voicing Graph](image)

### Major Place (within manner)

![Major Place Graph](image)
Evidence of implicit knowledge of perceptual similarity
- Even in a language where it hasn’t been phonologized

IAMBIC ORGANIZATION

- Seenku syllable structure revisited
  - C(əC)(V)V(n)
- Or simplified:
  - C(X)V(n)
IAMBIC ORGANIZATION

- Phonological organization imported into musical form
- Though differs in its distribution from spoken language
  - Anything that increases **length**
  - **Not** short diphthongs (despite being C\(\times\)V)
  - **Variably** nasal codas (despite being CVX)
SINGING ON THE BALAFON

- Same lyrics are played on the balafon
- Follow the sung melodies
  - Learned by musicians as music
- Communicative power largely lost without segmental content