Phantom Structure: Tone association via 3D phonology

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Starting point: Is TONE different?

• Tone: Is it Different? (Hyman 2011)

• “Tone is like segmental phonology in every way—only more so” (p. 214)
  ◦ Quantitatively: Tone does certain things more frequently, to a greater extent, or more obviously than segmental phonology
  ◦ Qualitatively: Tone can do everything segments and non-tonal prosodies can do, but segments and non-tonal prosodies cannot do everything tone can do

• For most sub-topics, remains to be answered adequately

**TONE and long-distance effects**

- **Long-distance effects** have played a central role in driving phonological inquiry
  - A string of elements $ABCDE \rightarrow$ interaction of A and E
- Such patterns are important – Cannot easily be deconstructed into phonetically motivated interactions
- What is the nature of these effects, how are they constrained, and how should they be modeled?
TONE and long-distance effects

• Focus today: Multiple types of long-distance phenomenon involving floating tones
  ◦ I.e. tones which appear undocked to a vowel (or similar tone-bearing unit) in the input

• Examining a ‘counting effect’ in some types of floating tone association
  ◦ Input: to-ra\(^H\)-kirigiit-a → Output: to-ra-kirigiit-a

• Such patterns stretch our collective imaginations, justifying the innovations of our phonological representations and phonological computations

Kuria data: Marlo, Mwita & Paster 2015
Proposal: PHANTOM STRUCTURE

• To account for a collection of facts involving floating tones, I introduce a novel type structure within three-dimensional phonology (3DΦ) called Phantom Structure

• Multiple dimensions of phonological representation which exist independently, simultaneously, and not linearized with respect to other dimensions
Proposal: PHANTOM STRUCTURE

- Phantom Structure
- Input: to-ra kirigiit-a
- The counting effect:
  - Deconstructed as faithfulness to an abstract position
- Not literal counting
Basic roadmap

1. Big picture: What are the components of phonological theory?
2. Topic: What are tone languages and what is floating tone?
3. Focus: Long-distance floating tone association, in the Bantu languages of East Africa
4. Proposal: Phantom Structure within 3DΦ
5. Zooming out: A bird’s eye view of tone and phonological theory
Phonology

What and whither
What is PHONOLOGY?

- **A modular perspective**
  - What happens in the **syntactic module**?
  - What happens in the **phonological module**?
  - What happens at **spell-out**, the interface between the two?

What is PHONOLOGY?

- **Representation**: What are the contents of each individual state, i.e. the inputs and outputs?
- **Computation**: How are states mapped from one to another, i.e. the input-output procedure?

Whither PHONOLOGY?

• **Optimality Theory** set the agenda for studying the **Computation** for decades

• This lives on in our field
  - How can we set up our computational models to generate **phonological variation** and **probability distributions**? (Coetzee & Pater 2011)
  - Examining the **Computational Complexity** of phonological operations (e.g. with respect to the Chomsky Hierarchy) (Chomsky 1956)
Whither PHONOLOGY?

• A collective return to **Representation**

• What are the **primitives of phonological representation**?
  ◦ Phonemes, Segments, Tones, Features, Stress, Exemplars, Gestures, etc.
  ◦ Radically **Substance-Free** (No reference to phonetics) vs. **Substance-Full** (Primitives as Gestures – Articulatory Phonology)
  ◦ Do these have **internal composition** (e.g. subsegmental structure – Q Theory)?

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Whither PHONOLOGY?

• A collective return to **Representation**

• What are the **external relations** among these primitives?
  ◦ Prosodic **constituency** (*à la* Prosodic hierarchy)
  ◦ **Alignment** of Gestures, or the **Association** across Tiers (*à la* Autosegmental Phonology)

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[Diagram]

<table>
<thead>
<tr>
<th>Intonational phrase</th>
<th>$\uparrow$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phonological phrase</td>
<td>$\varphi$</td>
</tr>
<tr>
<td>Prosodic word</td>
<td>$\ominus$</td>
</tr>
<tr>
<td>Foot</td>
<td>$F_t$</td>
</tr>
<tr>
<td>Syllable</td>
<td>$\sigma$</td>
</tr>
</tbody>
</table>

Enter a world of tone
Enter a world of TONE

• What is a tone language?
  ◦ An indication of pitch enters into the realization of at least some morphemes

• Tonal vs. non-tonal languages
  ◦ When casting the widest possible net, liberal estimations of how many languages are tonal go as high as 70%
  ◦ A conservative estimate is about 40%

• Mandarin lexical tone contrasts

Definition: Welmers 1959, 1973, Hyman 2006; 70% figure: Yip 2002; Downing & Rialland 2016; 40% figure extrapolated from Maddieson 2013 (WALS survey)
Enter a world of TONE

• A less storied *ma* comes from Ebira (Niger-Congo):
  ◦ **Grammatical tone** contrasts in auxiliaries (*Rolle to appear*)
  ◦ ML  *mā̀a  vé* 'I am coming'
  ◦ HM  *máā  vé* 'I came'
  ◦ HH  *máá́  vé* 'did/do I come?'
  ◦ LH  *màá́  vé* 'if I come'
  ◦ MM  *māā̀  vé* '(that) I should be coming'
  ◦ LSM *màăā̀  vé* 'if I am coming'
  ◦ LHM *màăā́  vé* 'if I usually come'
  ◦ HHM *máăā́  vé* 'should I be coming?'

Data from Scholz 1976:53-54,65-66,107
Empirical focus: Tone in Africa

Bantu map: R. Blench
Empirical focus: Tone in Africa

Wamey [wəmɛj]
Ebira [èbirà]
Esan [éṣà]
Izon [ìzó]
Degema [dégémè]
Kalabari [kálá'gárí]
Ghomala’ [yòmálà?]
Kuria [ìyìkúrjá]
Cilungu [tʃílùŋù]
Makonde [símakòndè]
Lamba [tʃílámbá]
Chichewa [tʃítʃéwá]

Bantu map: R. Blench; Codes: Personal fieldwork in blue; Collaboration with fieldworker/native speaker-linguist in orange; Work from available literature in red
FLOATING TONE

• Autosegmental revolution (Goldsmith 1975)

• Tones can exist without segments (just as vice versa)
  ◦ What is known as the ‘stability’ of tone

• Associated: \[
\begin{array}{c|c}
T & V \\
\end{array}
\]

• Unspecified: \[
\begin{array}{c}
V \\
\end{array}
\]

• Floating: \[
\begin{array}{c}
T \\
\end{array}
\]

Autosegmental diagram of /búlù/
segmental tier:  b  u  l  u

tonal tier: H  L

FLOATING TONE: A unit of contrast

• Floating tone: Play familiar roles in phonologies of the world
• Parallel to other units of contrast in Izon (Rolle 2021)
  ◦ Ubiquitous floating tone: All lexical items exhibit floating tone

Four tone classes in Izon – Defined based on their replaciive tone pattern
a. Class A: ends in (L)H / tà ŁH + èrí / → [ tà èrí ] ‘see wife!’ [Gb-20190714:60]
b. Class B: ends in H / fù ṢH + èrí / → [ fù èrí ] ‘see salt!’ [Gb-20190714:60]
c. Class C: ends in L / wùn Ł + èrí / → [ wùn èrí ] ‘see sand!’ [Gb-20190714:60]
d. Class D: ends in H(L) / wò ṢL + èrí / → [ wè èrí ] ‘see him!’ [Gb-20190706:30]

• Functions to differentiate lexical items
  ◦ /àká + Ṣ/ ‘tooth’ /àká + L/ ‘corn’
FLOATING TONE: Epenthesis

• Vowels unspecified for tone: **Appear with default tone**
• Floating tones unspecified for vowel: **Appear with default** [ə]
• **Tone-driven epenthesis** (Rolle & Merrill *under review*)
  ◦ High otherwise which might be left floating in output due to contour markedness – Circumvented by inserting epenthetic vowel to host it
• Ghomala’ language (Grassfields Bantoid):

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>H</td>
<td>/láp/</td>
<td>[láp]</td>
</tr>
<tr>
<td>L⁰</td>
<td>/bàp⁰/</td>
<td>[bàp⁰]</td>
</tr>
<tr>
<td>L</td>
<td>/làp/</td>
<td>[làp]</td>
</tr>
<tr>
<td>HL</td>
<td>/làp/</td>
<td>[làp]</td>
</tr>
<tr>
<td>LH</td>
<td>/láp/</td>
<td>[láp ~ lápə]</td>
</tr>
</tbody>
</table>

FLOATING TONE: Suppletion

• Floating tone suppletive allomorphy (Rolle & Bickmore to appear)
  ◦ Cilungu (Bantu) exhibits suppletive floating tone allomorphs
  ◦ Floating tone allomorph at the more deeply embedded right edge is governed by the lexical tone at the less embedded left edge

• #  X  [  [  Z  ]  Y  ]  #

• Critical case study for theories of morphology:
  ◦ Constitutes typologically rare outward-looking phonologically conditioned suppletive allomorphy
  ◦ Entails that phonological information is available bidirectionally at spell-out

Floating tone association

Two types of long-distance patterns
Floating .ico association

• The empirical focus this point forward:
  ◦ The association of floating tones (⃗[T]) in the Bantu languages of East Africa

• Three types of association patterns of floating tone
  ◦ Local
  ◦ Long distance I
  ◦ Long distance II
Floating association

- **Local association**: Floating tones often dock directly adjacent to sponsor

- **Bantu case study 1 – Chichewa**
  - Permissive – No tone
    - `/mu-nga-menye/ → [mu-nga-meeny-e]` you can hit
  - Simple past – Lexical H
    - `/mu-ná-menye/ → [mu-ná-meeny-a]` you hit
  - Recent past – Floating ⓪
    - `/mu-na⓪-menye/ → [mu-na-méeny-a]` you hit (recently)

Chichewa data: Downing & Mtenje 2017
Floating -floating association

• **Long-distance association**: Floating tones can dock quite a distance from their sponsor – tone’s *mobility*

• Positive imperative – No tone
  /tembenuz-a/ → [tembenuuz-a]
  ‘turn around!’

• Negative imperative – Long-distance tone to Penult σ
  /ó-sa-tembenuz-a/ → [ó-sa-tembenúuz-a]
  ‘don’t turn around!’

Chichewa data: Downing & Mtenje 2017; Mobility: Clements & Goldsmith 1984:6, Yip 2002:133, Hyman 2018
Floating ① association

• **Two types** of long-distance floating tone association

• **I Phonologically-driven association**: Floating tone docks to a phonologically-prominent/default position
  ◦ E.g. prosodic edge/stressed position/lengthened position/etc.

• **II Targeted association**: Floating tone docks to some numerically-defined position within a string
  ◦ E.g. first/second/third/fourth/antepenult/penult/ultima/etc.
I Phonologically-driven \( T \) association

- Floating **tone-to-stress** domain association
- **Bantu case study 2 – Lamba**
  - Certain morphemes (underlined) sponsor a floating \( \Uparrow \)
  - Floating \( \Uparrow \) associates to 1\(^{st} \) mora (\( \mu \)) of the stress domain

```
  a. \( \Uparrow \)
      tu-[lúku-leemb-a]\textsubscript{STRESS DOMAIN}
      we-PROG\textsubscript{1}-write-FV
      ‘we are writing’

  b. \( \Uparrow \)
      ta-tu-[ká-kom-a]\textsubscript{STRESS DOMAIN}
      NEG-we-FUT-hurt-FV
      ‘we will not hurt’
```
I Phonologically-driven �� association

• Bantu case study 3 – Makonde
• Penultimate lengthening (Rolle & Hyman 2019)
  ◦ /kú-lúmúl-a/ → kúlúmúúlà ‘cut’
  ◦ /kú-lúmúl-áng-a/ → kúlúmuláángà ‘cut into small pieces’
• The hypothetical affirmative – No tone on verb
  ◦ káléká ngu-takatuk[ii]le ‘if I stood up’
• Makonde grammatical melodies attracted to penult
  ◦ ◦ consecutive ni-ka-takatuk[ií]la ‘and/if I stood up’
  ◦ ◦ future ni-nda-takatuk[ií]la ‘I will stand up’
  ◦ ◦ remote past ní-ndí-takatuk[ií]la ‘I stood up’
I Phonologically-driven \( \text{T} \) association

- Standard in *intonational* systems

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Gussenhoven 2004:23
II Targeted association

- Bantu case study 4 – Kuria (Mwita 2008) – /kirigiit/ ‘scrub’ (4 moras)
  - Hortatory imperative:
    `to-tá- [kirigiit-a]` ‘let us scrub’
  - Habitual past (focused):
    `n-to-ogá- [kírigiit-ire]` ‘we used to scrub (then)’
  - Past progressive (focused):
    `n-to-oga- [kírigiit-ire]` ‘(indeed) we have scrubbed (today)’
  - Remote future (focused):
    `n-to-re- [kírigíít-a]` ‘we will scrub (then)’
  - Inceptive:
    `to-ra- [kiriğiit-a]` ‘we are about to scrub’
  - Narrative past:
    `to-gá- [kírigíít-a]` ‘(and) we scrubbed’

Data from Mwita 2008; See also Odden 1987, Cammenga 2004, Marlo, Mwita, & Paster 2014, 2015, Paster 2019, Sande, Jenks, & Inkelas 2020, Rolle & Lionnet 2020
## Targeted association

<table>
<thead>
<tr>
<th>TAM set</th>
<th>Prefixes</th>
<th>Stem + Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>No stem tone</td>
<td>to-tá-</td>
<td>[kirigiit-a]</td>
</tr>
<tr>
<td>Tone to mora 1</td>
<td>n-to-ógá-</td>
<td>[kírigiit-ire]</td>
</tr>
<tr>
<td>Tone to mora 2</td>
<td>n-to-oga-</td>
<td>[kírígíit-ire]</td>
</tr>
<tr>
<td>Tone to mora 3</td>
<td>n-to-re-</td>
<td>[kirigíit-a]</td>
</tr>
<tr>
<td>Tone to mora 4</td>
<td>to-ra-</td>
<td>[kirigiít-a]</td>
</tr>
<tr>
<td>Tone to mora 1 and 4</td>
<td>to-gá-</td>
<td>[kírigiít-a]</td>
</tr>
</tbody>
</table>
## Targeted association

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<tr>
<td>No stem tone</td>
<td>PFX(_0)</td>
<td>[μ₁ μ₂ μ₃ μ₄ μ*]</td>
</tr>
<tr>
<td>Tone to mora 1</td>
<td>PFX(_1)</td>
<td>[μ₁ μ₂ μ₃ μ₄ μ*]</td>
</tr>
<tr>
<td>Tone to mora 2</td>
<td>PFX(_2)</td>
<td>[μ₁ μ₂ μ₃ μ₄ μ*]</td>
</tr>
<tr>
<td>Tone to mora 3</td>
<td>PFX(_3)</td>
<td>[μ₁ μ₂ μ₃ μ₄ μ*]</td>
</tr>
<tr>
<td>Tone to mora 4</td>
<td>PFX(_4)</td>
<td>[μ₁ μ₂ μ₃ μ₄ μ*]</td>
</tr>
<tr>
<td>Tone to mora 1 and 4</td>
<td>PFX(_{1+4})</td>
<td>[μ₁ μ₂ μ₃ μ₄ μ*]</td>
</tr>
</tbody>
</table>
II Targeted \( \text{⅔} \) association

- **What happens if word is too short?**
  - If not enough moras in target domain, it goes into next word within the phonological phrase (\( \varphi \) – Marlo, Mwita, & Paster 2015)

- **Inceptive – H to mora 4 – ‘we are about to _ a banana’**
  - to-ra-[karaaŋ-á]eyetɔɔkɛ \( \rightarrow \) (torakaraaŋgá \( \text{éyétóókɛ} \)\( \varphi \)) ‘...fry...’
  - to-ra-[sukur-a] \( \text{éyétɔɔkɛ} \) \( \rightarrow \) (torasukura \( \text{éyétóókɛ} \)\( \varphi \)) ‘...rub...’
  - to-ra-[rom-a] \( \text{eyétɔɔkɛ} \) \( \rightarrow \) (toraroma \( \text{eyétóókɛ} \)\( \varphi \)) ‘...bite...’
  - to-ra-[ry-a] \( \text{eyetóókɛ} \) \( \rightarrow \) (torarya \( \text{eyetóókɛ} \)\( \varphi \)) ‘...eat...’

Marlo, Mwita, & Paster 2015
An oft-ignored counting effect

- Many claims that human grammar cannot count, based on a variety of data and arguments
  - [https://twitter.com/RobertaArielli/status/148299293075113574?s=20](https://twitter.com/RobertaArielli/status/148299293075113574?s=20)

# Interim pattern summary

<table>
<thead>
<tr>
<th>Type</th>
<th>Example</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>Chichewa</td>
<td>σ ★ σ</td>
<td>→ σ ó</td>
</tr>
<tr>
<td>Long-distance I: Phono.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Stress domain)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Penult σ)</td>
<td></td>
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<td></td>
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<tr>
<td>Long-distance II: Targeted</td>
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<tr>
<td>(Counting to 3rd )</td>
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<td></td>
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<tr>
<td>(Counting to 4th)</td>
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<td>...</td>
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</tbody>
</table>
An account via Phantom Structure

A new kind of three-dimensional representation
Targeted association ...

- Input: to-\textsuperscript{H}-kirigiit-a $\rightarrow$ Output: to-ra-kirigiit-a
Targeted association ...

- Input: to-ra$^\oplus$-kirigiit-a $\rightarrow$ Output: to-ra-kirigiiit-a
... via Phantom Structure

• **Phantom Structure**: A multi-planar representation ([Rolle & Lionnet 2020](#))

• “Phantom structure is phonological structure that is needed for the full realization of the lexical entry, but which the lexical entry cannot provide itself – it is a ‘desire’ for missing structure, so to speak.”
... via Phantom Structure

- Input: to-ra\textsuperscript{H}-kirigiit-a

**SUBSTANTIVE PLANE**

**PHANTOM PLANE**

transplanar pre-association

phantom moras
Three-dimensional phonology

- Two-dimensional phonology: **Linearity** (horizontal relations) and **association** (vertical relations)
- Phantom Structure as **three-dimensional phonology** (3DΦ – Halle & Vergnaud 1980)

3DΦ: Beyond ‘flat’ relations

• Beginning with Autosegmental Phonology, major representational shifts involving 3D structures

• Feature Geometries

• /tθ/ → [tθ]

Clements 1985: 237; See also Sagey 1986, Cole 2018 [1991]
Phantom: Illustrated

- Input: to-ra®-kirigiit-a
Phantom: Illustrated

- Input: to-ra\textsuperscript{H}-kirigiit-a
Phantom: Illustrated

- Input: \textit{to-ra}\(^\text{H}\)-\textit{kirigiit-a}
- Two phonological strings
Phantom: Illustrated

- Input:  to-ra\(^{\mathbb{H}}\)-kirigiit-a

- Output:  to-ra-kirigiít-a

- Conflation:
Faithfulness competition

• Phantom Structure: Deconstructs this into two biplanar strings
  ◦ Phantom-Output Correspondence (the phantom plane)
  ◦ Substance-Output Correspondence (the substantive plane)

\[
\begin{array}{c|c|c|c}
\text{to}_{\alpha, a} - ra_{\beta, b} - & (\mu_c, \mu_d, \mu_e, \mu_f, \mu_g)_{\text{Stem}} & \text{ID-PHO}(\mu) & \text{MAX}(T) & \text{H/HEAD} & \text{ID-SUBO}(\mu) \\
\hline
\text{a. } & (k_i, \gamma, c, r_i, \delta, d, g_i, e, i_\zeta, f, t_a, \eta, g)_{\text{Stem}} & & * & * & \\
\text{b. } & (k_i, \gamma, c, r_i, \delta, d, g_i, e, i_\zeta, f, t_a, \eta, g)_{\text{Stem}} & *! & & * & \\
\text{c. } & (k_i, \gamma, c, r_i, \delta, d, g_i, e, i_\zeta, f, t_a, \eta, g)_{\text{Stem}} & *! & * & & \\
\end{array}
\]
Faithfulness competition

• Complex surface patterns are not (solely) the result of resolving pressures from Faithfulness vs. Markedness, but from Faithfulness vs. other Faithfulness

• Part of a long history of multiple faithfulness relations in competition, where IO-Corr co-occurs with:
  ◦ Base-Reduplicant Correspondence (BR-Corr)
  ◦ Agreement By Correspondence (ABC)
  ◦ Output-Output Correspondence (OO-Corr)
  ◦ Sympathy Theory (Candidate–Candidate Correspondence)
  ◦ Output-Underlying Representation Correspondence (O-UR-Corr)
Reimagining the ‘counting’ effect

- Not literal counting: ‘Counting’ as pre-specification
  - Kuria /itʃiimbáyo/ ‘hedges’

Mwita 2008: 29
Faithfulness vs. markedness

- Our two cases of long-distance association of floating tones
  - **Targeted association:**
    - Varies by morpheme
    - Greater range of positions, (including multiple simultaneously)
    - Not exclusive to unmarked positions
    - Due to (phantom) faithfulness
  - **Phonologically-driven association:**
    - Does not vary by morpheme
    - Associates to an unmarked position (e.g. stress/boundaries/prominence)
    - Due to markedness

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Tone</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFX₂</td>
<td>[μ₁ ı₂ μ₃ ı₄ μ*]</td>
</tr>
<tr>
<td>PFX₃</td>
<td>[μ₁ ı₂ ı₃ μ₄ μ*]</td>
</tr>
<tr>
<td>PFX₄</td>
<td>[μ₁ ı₂ μ₃ ı₄ μ*]</td>
</tr>
<tr>
<td>PFX₁+₄</td>
<td>[ı₁ ı₂ μ₃ ı₄ μ*]</td>
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</tbody>
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For overview of positions in targeted association across Bantu, see Odden & Bickmore 2014
Faithfulness vs. markedness

- Standard markedness constraints derive phonologically-driven association
- Deconstructed via markedness constraints
  - \text{T/Head}: Tone to prosodic heads (e.g. stress)
  - \text{AlignFt-L} \sim \text{AlignFt-R}: Alignment of tones to prosodic edges
  - \text{Non-initiality} \sim \text{Non-finality}: Accounting for edge-based extra-tonality
- E.g. Default Japanese tone – \textbf{Antepenultimate accent principle} (AAP)
- These cannot be used directly to capture T to 4\textsuperscript{th} mora
  - No language where tone aligns to the 4th mora, or 1\textsuperscript{st} and 4\textsuperscript{th} simultaneously
- Matches the typology of stress windows: No default 4\textsuperscript{th} position stress

AAP: Ito & Mester 2018; Stress Windows: Kager 2012
Faithfulness vs. markedness

- Markedness accounts must appeal to *ad hoc* constraints
  - $\mu^A$: “Assign one violation for each floating tone that does not surface four moras from its input location”

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<thead>
<tr>
<th>/to-ra$^H$-[$<em>\omega$ roma] [$</em>\omega$ eyetőőke]/</th>
<th>$\mu^4$</th>
<th>H, R</th>
<th>ID-T</th>
<th>H</th>
<th>Obs</th>
<th>Pred</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. [[$<em>\omega$ toraroma] [$</em>\omega$ eyetőőke]]</td>
<td>1</td>
<td>9</td>
<td>9</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>b. $\mathfrak{F}$ [[$<em>\omega$ toraroma] [$</em>\omega$ eyetőőke]]</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

- In a theory of constraints, do we capture counting literally?
Extensions of Phantom Structure

• Neutralization from Dominant tone
  ◦ In Kalabari, all nouns neutralized to [LH] in context of a demonstrative
  ◦ No trace of lexical tone contrast

• Tone-usurpers in Japanese
  ◦ If a root has a H tone, certain affixes will ‘usurp’ it, pulling it onto itself
  ◦ No effect if the root is toneless

• Tone exchange rules in Khoekhoe
  ◦ Causative causes tone values to switch (e.g. /H/→[M], /M/→[H])

• Interwoven tones in Kifuliiru
  ◦ $[\mu_1 \mu_2 \ldots \mu_P \mu_U] + [\mu^*_1 \mu^*_2 \mu^*_P \mu^*_U] \rightarrow [\mu_1 \mu_2 \ldots \mu_P \mu_U]$

• Morphological extensions
  ◦ Subcategorization generally (Kalin & Rolle in press)
  ◦ Infixation, 2nd position clitics, Morphotactics/Bigram effects

Wrapping up

What else does tone hold for us?
Summary

1. Starting point: Tension between representation (content and their geometric relations) and computation (input-output mapping)

2. Our case study was tone – Specifically the association of floating tone, which appear unanchored in the input

3. Examined two long-distance patterns
   a) Phonologically-driven Association – I.e. floating tone goes to a prominent position
   b) Targeted Association – I.e. tone to a numerically defined position, a counting effect
Summary

4. Phonologically-driven Association – Standard **markedness** constraints

5. Targeted Association – Posited new kind of **three-dimensional representation** called **Phantom Structure**, involving parallel substantive plane and phantom plane

6. Targeted Association emerges when 2 planes must be **conflated**, and **Faithfulness** to the position in the phantom plane is highly ranked → **Competing Faithfulness**
3DΦ: Upper limits of representation

• **Three-dimensional phonology** (Halle & Vergnaud 1980)

• Phantom structure represents a proposal at the upper limits of phonological representation

• Beginning with Autosegmental Phonology in the 1970s into the pre-OT 1990s, major representational shifts involving such upper limit structure
3DΦ: Upper limits of representation

• Feature Geometries

• /tθ/ → [tθ]

Clements 1985: 237; See also Sagey 1986, Cole 1991
3DΦ: Upper limits of representation

- **Prosodic Morphology**

- $\sqrt{KTB}$ ($\sqrt{WRITE}$)
  - k-t-atab
  - ‘was registered’

**Diagram:**
- Vocalic melody tier
- T-morpheme tier
- Prosodic template tier
- Root tier

**Plane conflation**

Open channels of communication

• Proposals like Phantom Structure are the result of *open channels* of communication in our field

  ◦ ‘Synchronic’: Result of open channels between *Theory* (Theoretical Phonology) and *Data* (Phonological Typology/Description/Fieldwork)

  ◦ ‘Diachronic’: Result of open channels between theoretical proposals of previous eras of phonology and our present era, understanding where there is ‘unfinished business’
Our original question: **How different is tone?**

Virtually every extension and application of tone is under-researched

- **Functional load of tone**: How ‘important’ tone is varies widely across tone languages (Chinese vs. Bantu) – How can we quantify the functional load of tone, both for lexical tone and grammatical tone?

- **Intonation**: Are there qualitative and quantitative differences between grammatical tone and intonation (w.r.t. variation, meaning, implementation)? Is this reflected in how tone and intonation interact?

- **Phonetics** (incomplete neutralization effects; c-center effects)

- **Sound change** (going beyond tonogenesis)

- **Sociolinguistic indexing**
TONE: How different?

• **Combating segmental bias**
  ◦ Incorporation of tone into linguistic theory outside of phonology proper sorely lags behind segmental counterparts

• ...tone has long been ignored in morphology textbooks...

• ...is only marginally discussed in morphology handbooks and overviews...

• ...and there is limited discussion of grammatical tone patterns akin to Kuria even in books dedicated to tone

**TONE: How different?**

- Important to acknowledge that current sample of human language suffers from under-description:
  - “Not more than 10-15 per cent of languages have been described comprehensively” (Comrie et al. 2005:3)

- The state of prosodic description and documentation (which includes tone) is much, much worse!
TONE: How different?

WALS map: Maddieson 2013; Data: Hammarström 2014:16 – See also Glottoscope on glottolog.org
Thanks for listening!

References:
https://nicholasrolle.com/output

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Appendices
Appendix 1:

Extensions of Phantom Structure
Neutralization from Dominant tone

- **Dominant tone** in Ijoid family, e.g. Izon (Rolle 2021) and Kalabari (Harry & Hyman 2014)

- In Kalabari: All nouns neutralized to [LH] in context of a demonstrative – No trace of lexical tone contrast

<table>
<thead>
<tr>
<th>Word</th>
<th>Tone</th>
<th>Neutralization</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>námá</td>
<td>H-H</td>
<td>mí námá</td>
<td>‘this animal’</td>
</tr>
<tr>
<td>pulo</td>
<td>L-L</td>
<td>mí pùló</td>
<td>‘this oil’</td>
</tr>
<tr>
<td>béle</td>
<td>H-L</td>
<td>mí bèlé</td>
<td>‘this light’</td>
</tr>
<tr>
<td>garí</td>
<td>L-H</td>
<td>mí gàrí</td>
<td>‘this garri’</td>
</tr>
<tr>
<td>bà rá</td>
<td>H-H</td>
<td>mí bàrá</td>
<td>‘this hand’</td>
</tr>
</tbody>
</table>

Data from Harry & Hyman 2014; Dominance: Kiparsky & Halle 1977, Kiparsky 1984, Inkelas 1998; Dominant tone also called ‘Replacive Tone’ in Africanist literature -- Welmers 1973
Phantom structure extension I

- **Dominant tone** in Ijoid family, e.g. Izon (Rolle 2021) and Kalabari (Harry & Hyman 2014)

- In Kalabari: All nouns neutralized to [LH] in context of a demonstrative – No trace of lexical tone contrast

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Japanese tone-usurpers

• **Tone-usurpers** in Japanese

• If a root has a H tone, certain affixes will ‘usurp’ it, pulling it onto itself – No effect if the root is toneless

  Agentive Suffix *-te* (Poser 1984: 50)

  a. /káki + te/ → kaki-té ‘writer’
     /yómi + te/ → yomi-té ‘reader’

  b. /katari + te/ → katari-te ‘narrator’
     /kiki + te/ → kiki-te ‘hearer’

Poser 1984:50; For related Japanese data, see Alderete 1999:228-229, Kawahara 2015:469
Phantom structure extension II

- Phantom floating tone counterpart
  - **Kuria patterns**: Substantive tone to phantom mora
  - **Japanese tone-usurpers**: Phantom tone to substantive mora
Phantom structure extension II

- H-toned stem
  - Input: káki-te → Output: kaki-té
Phantom structure extension II

- Toneless stem

  - Input: `kiki-te`  →  Output: `kiki-te`
Other extensions

• **Tone exchange rules** in Khoekhoe (‘Khoisan’)
  ◦ Causative causes tone values to switch (note: S=super high)
  ◦ /L/ → [LM] but /LM/ → [L]
  ◦ /M/ → [H] but /H/ → [M]
  ◦ /MS/ → [S] but /S/ → [MS]

• **Interwoven tones** in Kifuliiru (Bantu)
  ◦ $[\tilde{\mu}_1 \mu_2 \ldots \mu_P \tilde{\mu}_U] + [\tilde{\mu}_1 \mu_2 \tilde{\mu}_P \tilde{\mu}_U] \rightarrow [\tilde{\mu}_1 \mu_2 \ldots \mu_P \tilde{\mu}_U]$

• **Morphological extensions**
  ◦ Morphological and prosodic subcategorization generally (Kalin & Rolle in press)
    ◦ (Infixation, 2\textsuperscript{nd} position clitics, etc.)
  ◦ Morphotactics/Bigram effects

*Proclitics*: $[\_ [ ]_{PW}]_{PW}$

*Enclitics*: $[[ ]_{PW} \_ \_]_{PW}$
One prominent account of second position clitics is via prosodic subcategorization.

Latin = *que* must be right-adjacent to a p-word (*ᵩ*).

\[
\begin{align*}
\text{diu} & \quad = \quad \text{que} \\
\text{day} & \quad \text{and} \\
\text{noctu} & \quad \text{night}
\end{align*}
\]

→ \text{diu noctuque} ‘by day and by night’

PS and morphotactics

- **Morphotactics**: The CARP template of Chichewa (Hyman 2003)
  - Linear order: [CAUS][APPL][RECIP][PASSIVE]
- **Scope**: APPL > RECIP
  - mang-an-il- → mang-an-il-an-
  - tie-RECIP-APPL- tie-RECIP-APPL-RECIP
  - ‘tie each other for/at’ (*tie for each other)
- **Extension to other templatic/bigram effects** (Clem, Rolle, & Dawson *under revision*)
  - Phantom Structure predicts that it is always the phantom morpheme which doubles

Appendix 2:

Alternative representational account of Kuria
Against floating tone sequences

• / to-ra\textsuperscript{H}-hootooter-a /  
[ to-ra-hooto\text{o}\text{\text{o}}\text{\text{\text{o}}}ter-a ]

Hidden structure alternative:
ra\textsuperscript{LLLLH}

\begin{figure}
\begin{center}
\begin{tikzpicture}
\node at (0,0) {$H$};
\node at (-1.5,0) {$\mu$};
\node at (-3,0) {$\bullet \bullet$};
\node at (-3,-1.5) {$\mu$};
\node at (-3,-3) {$r a$};
\end{tikzpicture}
\end{center}
\end{figure}

vs.

\begin{figure}
\begin{center}
\begin{tikzpicture}
\node at (0,0) {$\mu$};
\node at (-1.5,0) {$\bullet \bullet$};
\node at (-3,0) {$r a$};
\end{tikzpicture}
\end{center}
\end{figure}

Cammenga 2004, Trommer 2019
Against floating tone sequences

• Argument against \( \text{LLLH} \) (Marlo et al. 2015)
  ◦ Additional H tone spreading operations would spread into this hypothetical \( \text{LLLH} \) sequence
  ◦ Expect spreading here to be blocked if there were bona fide L tones in the representation

\[
(12) \quad \frac{o-\breve{y}o-t\ddot{o}-ko^{H_2}}{H_1} - [\beta\acute{e}r\acute{e}ker-a]_{MS} / \rightarrow o-\breve{y}o-t\ddot{o}-k\acute{o} - [\beta\acute{e}r\acute{e}ker-\acute{a}]_{MS} \quad \text{‘to not call’}
\]
Against floating tone sequences

• One possibility (suggested by J. Trommer): Add floating ₋ at one stratum, but delete L’s at later stratum (Duke-of-York, A→B→A)

• Evidence against this:
  ◦ There may exist a few grammatical tone melodies which have real floating ₋
  ◦ *These* do not delete at the later stratum where H-tone spread happens
Against floating tone sequences

• Behavior of these (potential) ingleton differs from “ingletoningletonH” alternative

• **First data point:** These other ingleton’s **block** regular rightward H-spreading rule (cf. **previous slide**)
  - HORTATORY IMPERATIVE TYPE 1 (H tone on prefix)
  - [a-tá-βereker-a] (*[a-tá-βérekér-a]*) ‘let him call’
  - [a-tá-ry-a] ‘let him eat’

Marlo et al. 2014:287
Against floating tone sequences

• Behavior of these (potential)  Lunar differs from “L L L H” alternative
• **Second data point**: if there are a sub-minimal number of target moras, tone on the final mora is L, not H
  ◦ HORTATORY IMPERATIVE TYPE 2 (H tone on first mora)

Marlo et al. 2014:280,287; H to first mora of stem in *ntoo-ryá* ‘indeed, we have already eaten’ (Untimed past anterior focused)
Against floating tone sequences

• Behavior of these (potential) ① differs from “①②③④” alternative
• **Third data point**: With sub-minimal number of target moras, final tone can be either H or L
  ◦ MANDATORY IMPERATIVE (H tone on third mora)
  ◦ [турунгана] ‘welcome!’
  ◦ [рыа] ‘eat!’

---

Marlo et al. 2014:288-289
Against floating tone sequences

- Behavior of these (potential) \(\text{leton} \) differs from \(\text{letonletonleton} \) alternative
- **Third data point**: With sub-minimal number of target moras, final tone can be either H or L (variation)
  - MANDATORY IMPERATIVE (H tone on third mora)
  - \([\text{tɛrɛkâ}] \) ‘brew!’ ~ \([\text{tɛrɛkà}] \)

Cf. \(\text{H} \) alone
\([\text{ntore-tɛrɛkâ}] \) only

Marlo et al. 2014:282,288; \(\text{H} \) to third mora of stem in \([\text{ntore-tɛrɛkâ}] \) ‘we will brew (then)’ (Remote future focused)
Appendix 3:

Miscellaneous
Whence comes PHONOLOGY?

(MORPHO-)SYNTAX: word formation & phrase formation ("syntax all the way down")

Feature Lexicon
\(\sqrt{101}, \sqrt{102}, \sqrt{103}, \ldots\)
\([+a], [+b], [+c], \ldots\)

Operations
- Merge
- Move
- Agree
- ...
Phantom ≠ ghost segments

• Ghost/Latent segments refer to features which are unassociated to a root node in a representation.

• “The only thing that distinguishes latent segments from floating features in their realization then is that conventional floating features associate to an existing root node while latent segments associate to an epenthetic root node inserted only in certain phonological contexts” (Zoll 1996:34)

• What is distinct about phantom structure is that:
  ◦ It specifically does not emerge in all cases where it would be decrease markedness.
  ◦ It is not the first to delete to avoid markedness violations, as it literally never appears in any output.

3DΦ: Upper limits of representation

• “Single Melody Theory” of reduplication: Base and its reduplicant are underlyingly in parallel, not in sequence

• Tagalog CV reduplication:

  ◦ la-la:kad ‘walking’

Mester 1988:171ff. (see within for extensive references on similar ideas); Raimy 2000, Raimy & Cairns 2009
Conflation

• **Layer Drawings**
  ◦ by Nobuhiro Nakanishi
  ◦ ‘Light of forest’ (2014)

http://nobuhironakanishi.com/gallery/layer-drawings/ “This series portrays changes that take place in everyday life, like the sun rising or ice cream melting. These ordinary events were photographed at regular intervals, printed on transparent film and assembled in sequence. Capturing the accumulation of time as a sculpture allows the viewer to experience the ephemerality of time”
TONE: How different?

- **Functional load**: How ‘important’ tone is varies widely across tone languages. How can we quantify the functional load of tone, both for lexical tone and grammatical tone?

- **Intonation**: Qualitative and quantitative differences between grammatical tone and intonation (w.r.t. variation, meaning, implementation)? Reflected in how tone and intonation interact?

- **Incomplete neutralization**: Tone patterns are often neutralized in context, either due to their phonological environment or due to their grammatical context. Do these show incomplete neutralization patterns akin to those identified for segments (e.g. final devoicing)?

- **C-center effects**: How is tone coordinated with respect to their segmental ‘hosts’? Very little on African languages – Test hypothesis: if no c-center effect, then TBU=mora (E. Zsiga)

- **Sound change**: The focus is often on tonogenesis, but how do tone systems themselves evolve? Where do grammatical tone patterns (à la Kuria) come from?

- **Sociolinguistic indexing**: Tone systems can change rapidly very quickly, but tonality is very stable and contagious. How is tone used for sociolinguistic indexing?

C-center effects: Karlin 2014, 2018a,b; Zsiga colloquium: https://www.youtube.com/watch?v=zuY7GpFFQmo
Developing tone databases

Links: WALS; PHOIBLE; SMG