Beyond tonogenesis: voicing effects on stress

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Goals of the talk

• Summary of the voice-tone interactions
• Main claim: Pitch perturbations due to voicing in some languages are phonologized in terms of tone (Siswati, Kammu, Bade, Nupe, etc) and in others in terms of stress (by means of weight), e.g. Pirahã, Karo (and Arabela – which will not be discussed today)
• Present possible representations and constraints that capture the facts at hand
Structure of talk

- A common voice-tone interaction
- Phonetic explanation of the effect
- Evidence for binary [voi]
- The status of sonorants
- H tone and stress
- Voice and stress
- Karo
- Pirahã
- A factorial typology
A common voice-tone interaction

• Tonogenesis = the creation of tones
  – The evolutionary path of the emergence of tone can often be traced back
  – A common pattern (Haudricourt 1954; Hombert 1978; Kingston and Solnit 1988a, b; Peng 1992; Bradshaw 1999; Yip 2002)
    • Voiceless onsets → pitch raising of following V
    • Voiced onsets → pitch lowering of following V
  – Aspiration and glottalization may interact too (Yip 2002, Tang 2008), as in e.g. Kam; this is beyond the present talk
Phonetic explanation of the effect

- Honda’s (2004) survey:
  - voiced stops & F0 lowering: the larynx and hyoid bone are lower for voiced stops than voiceless ones → a lowered larynx results in lower F0
  - voiceless stops & F0 raising: for a voiceless stop the cricothyroid muscle stretches the vocal folds to obstruct vocal fold vibration → vocal fold tensing leads to higher F0

- Kingston and Solnit (1988b): depression of F0 after voiced stops is very likely universal

- Some languages phonologize this effect in terms of tones
  - Voiceless onsets induce H tone (Tang 2008 contra Bradshaw 1999)
  - Voiced onsets induce L tone (Bradshaw 1999)

- Languages that present both effects at once:
  - Bade, Jingpho, certain Chinese dialects, Masa, Yabem, etc. (see Tang 2008 and refs therein)
Kammu

- Such distribution is even evident synchronically among dialects of the same language, cf. South vs. North Kammu (Yip 2002: 35, citing Svantesson 1983)

(1) Kammu dialects

<table>
<thead>
<tr>
<th>South</th>
<th>North</th>
</tr>
</thead>
<tbody>
<tr>
<td>(voi contrast+no tone)</td>
<td>(no voi contrast+tone)</td>
</tr>
<tr>
<td>klaaŋ</td>
<td>klāaŋ</td>
</tr>
<tr>
<td>glaaŋ</td>
<td>klàaŋ</td>
</tr>
</tbody>
</table>

‘eagle’

‘stone’
Songjiang (Wu dialect of Chinese)

- Elsewhere, the voicing contrast remains, but with consistently lower pitch after a voiced obstruent and higher pitch after a voiceless obstruent (Yip 2002: 7).

(2) Songjiang tones

<table>
<thead>
<tr>
<th>Ti</th>
<th>53</th>
<th>‘low’</th>
<th>Di</th>
<th>31</th>
<th>‘lift’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ti</td>
<td>44</td>
<td>‘bottom’</td>
<td>Di</td>
<td>22</td>
<td>‘younger brother’</td>
</tr>
<tr>
<td>Ti</td>
<td>35</td>
<td>‘emperor’</td>
<td>Di</td>
<td>13</td>
<td>‘field’</td>
</tr>
</tbody>
</table>
**Bradshaw (1999)**

- Attempts to explain facts of this sort, by using a single unary feature that represents both [voi] and L tone
- Crucially for Bradshaw, this is the only feature allowed to interact with tone
- But this is problematic
  - Aspiration, glottalization etc. may also affect tone (Yip 2002, Tang 2008), so voice and tone cannot be a single feature
  - Unary [voi] cannot capture a fuller range of facts, instead binary [voi] is required
Evidence for binary [voi] (after Tang 2008)

• High tone spreading in Bade (Schuh 2002)

  a. /né těnʔékú/ > né těnʔékú 'I pressed'
b. /né dúwáʔú/ > né dúwáʔú 'I got tired'
c. /né těmbēlú/ > né těmbēlú 'I pushed' (*těmbēlú)
d. /né bǎzartú/ > né bǎzartú 'I shamed' (*bǎzartú)

  - *Voiced obstruents block H-spread*. OK if [voi] is active

• Low tone spreading in Bade (Schuh 2002)

  a. /dʒè.ɡá kó:rón/ > dʒè.ɡá kó:rón 'we followed a donkey'
b. /dʒè kərə kó:rón/ > dʒè kərə kó:rón 'we stole a donkey'
c. /dʒè dæpsá kó:rón/ > dʒè dæpsá kó:rón 'we hid a donkey'
d. /dʒè ɡáfá kó:rón/ > dʒè ɡáfá kó:rón 'we caught a donkey'

  - Problem: *voiceless obstruents block L-spread*. Thus, need for binary [voi], where both [+voi] and [-voi] can be active, contra Bradshaw (1999)
The status of sonorants I

- Variable behaviour
  - i) sonorants pattern with voiced obstruents (Ngizim, Nupe)

<table>
<thead>
<tr>
<th>Nupe L-spreading</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. /è+dú/ → [èdu]</td>
<td></td>
<td>‘taxes’</td>
</tr>
<tr>
<td>/gí/ → [à gí]</td>
<td></td>
<td>‘will eat’</td>
</tr>
<tr>
<td>b. /è+lé/ → [élē]</td>
<td></td>
<td>‘past’</td>
</tr>
<tr>
<td>/lá/ → [élã]</td>
<td></td>
<td>‘is carrying’</td>
</tr>
<tr>
<td>c. /è+tú/ → [ètú]</td>
<td></td>
<td>‘parasite’</td>
</tr>
<tr>
<td>/tí/ → [ètí]</td>
<td></td>
<td>‘is hooting’</td>
</tr>
</tbody>
</table>

- Voiced obstruents and sonorants are transparent for L-tone spreading
The status of sonorants II

• Variable behaviour
  – ii) sonorants pattern with voiceless obstruents (Suma, Siswati, Yaka, Miya, Digo, Bade)

Bade H-spreading
a. ṇ:n kàtāw → ṇ:n ká!táw ‘I returned’
b. ṇ:n läwáw → ṇ:n lá!wáw ‘I ran’
c. ṇ:n gáfáw → ṇ:n gáfáw *n:n gá!fáw ‘I caught’

• /HLH/ → [HH!H]. Such spreading occurs if the intervening consonant is a voiceless obstruent or a sonorant, but not if it is a voiced obstruent
The status of sonorants III

- This variability can be explained
  - **Phonetically**: since sonorants do not automatically perturb the F0 of adjacent vowels, there is no phonetic reason “...to expect that the fundamental frequency of the following vowel will be either elevated or depressed by the sonorant’s laryngeal articulation; instead the speaker may be free to choose either elevation or depression of fundamental frequency” (Kingston and Solnit 1988)
The status of sonorants IV

• This variability can be explained
  – **Phonologically**: Sonorants’ major class feature is [+son], which expresses their spontaneous phonetic voicing. The claim (to be developed more below) is that they can also phonologically be [+voi] or [-voi] accounting for their dual behaviour. Phonetically they will always remain voiced though, due to the main class feature [+son]. More on that next!
The status of sonorants V

- Two types of Sonorants
  A. [+son] Lar  
  B. [+son] Lar

- Suma, Siswati, Yaka, Miya, Digo, Bade sonorants seem to be type (A)
- Ngizim, Nupe sonorants seem to be type (B)
Interim summary

- The pitch perturbation due to voicing is often phonologized in terms of tone
- Voiceless obstruent onsets induce H tone
- Voiced obstruent onsets induce L tone
- Sonorants work either way, as they cause no inherent pitch perturbation

- Rest of the talk: pitch perturbation due to voicing is phonologized in some languages as tone, and in others as stress
H-tone and stress

- For example, in Golin, stress falls on the rightmost H-toned syllable. In the absence of H-toned syllables stress is word final

Golin H-tones and stress (de Lacy 1999; stress marked in bold)

<table>
<thead>
<tr>
<th>Tone Pattern</th>
<th>Word</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLL</td>
<td>kàw.li.gì</td>
<td>‘post’</td>
</tr>
<tr>
<td>HLL</td>
<td>á.kò.là</td>
<td>‘wild fig tree’</td>
</tr>
<tr>
<td>LHL</td>
<td>gò.má.gì</td>
<td>‘type of sweet potato’</td>
</tr>
<tr>
<td>LLH</td>
<td>ò.ni.bá</td>
<td>‘snake’</td>
</tr>
<tr>
<td>HHL</td>
<td>sí.bá.gì</td>
<td>‘sweet potato type’</td>
</tr>
<tr>
<td>HLH</td>
<td>én.dè.rín</td>
<td>‘fire’</td>
</tr>
</tbody>
</table>
H tone and stress: the crucial step

- So, H-toned moras may attract stress on them
- Voicing can also cause high pitch perturbation
- And pitch is one of the phonetic correlates of stress
voice and stress

• Prediction: pitch perturbation due to voicing may be phonologized as stress (rather than tone) in terms of moras
• Claim: voiceless obstruent onsets are more likely to add a mora to their syllable than the voiced counterparts and thus, attract stress more
• Fixed Ranking: *μ/Ons/[+voi] >> *μ/Ons/[−voi]
• Claim: sonorants due to their dual status can pattern either with −voi (Karo) or +voi obstruents (Pirahã)
Karo (Gabas 1998, 1999)

- Karo: trisyllabic stress window at R edge; but antepenult rarely gets stressed. Default stress is final, unless one of the following occurs

(3) Priorities for Karo stress assignment. **Boldface** indicates stress

A) if a syllable has H tone, then it gets stress

- **yogá** ‘egg’ (G99: 43)
- **korétʼ** ‘guan (sp.)’ (G99: 43)
- **mandógon** ‘rabbit (sp.)’ (G99: 40)

B) if there is no H-toned syllable, but there is one with a nasal vowel, then this receives stress

- **maʔo** ‘ant (sp.)’ (G99: 42)
- **pəṇa** ‘dar’ (G98: 17)
- **morjya** ‘miçanga’ (G98: 39)
- **carék’** ‘slow’ (G99: 23)

C) if none of the above is applicable, but if the final syllable has a voiced stop onset then the penult gets stressed
Karo (cont...)

(4) Karo stress and onset voicing (G99: 14, 39-41)

a. maʔpɛ  'gourd'
   kɔyɔ  'crab'
   yaʔmbɔ  'yam (sp.)'
   pakɔ  'fontanel'

b. kɔwɛp’  ‘butterfly’
   kuruʔcu  ‘saliva’

c. yaba  ‘rodent (sp.)’
   pibɛʔ  ‘foot’
   wɛɛ  ‘frog’
   kaɾo  ‘macaw’
   məga  ‘mouse’
   iʔcɔgo  ‘quati (sp.)’

all combinations of son and -voi obstr in two final əs →
Stress: consistently final
penult: +voi stop, final: son or -voi stop →
Stress: consistently final
penult: -voi stop or son final: +voi stop →
Stress: consistently penult
Karo Sonorants are Type A

- Sonorants and -voi obstruents pattern together in attracting stress to the exclusion of +voi obstruents
- Stress attraction can be due to heaviness: WSP
- So, \([-\text{voi}] \ V = 2\mu\), whereas \([+\text{voi}] \ V = 1\mu\)
- Karo sonorants are type A
Karo: A brief analysis I

• (5) \(*\mu/\text{Ons}/ [+\text{voi}] \gg \text{Moraic} \gg *\mu/\text{Ons}/ [-\text{voi}]\)

N.B.: *Moraic* is an abbreviation for whatever constraints induce weight, e.g. WbyP, FtBin, etc. (cf. Morén 2001)

N.B: Syllables with moraic onsets have an indexed mora

<table>
<thead>
<tr>
<th>pibe?</th>
<th>*\mu/\text{ONS}/ [+\text{voi}]</th>
<th>MORAIC</th>
<th>*\mu/\text{ONS}/ [-\text{voi}]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. p^{\mu}\text{i.be?}</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>b. pi.be?</td>
<td></td>
<td>**!</td>
<td></td>
</tr>
<tr>
<td>c. p^{\mu}\text{i.b^{\mu}}e?</td>
<td></td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>
Karo: A brief analysis II

- (6) WSP $>>$ Align-Hd-R

- (7) Penult stress as a result of stress shift (cf. (4c))

<table>
<thead>
<tr>
<th></th>
<th>WSP</th>
<th>ALIGN-HD-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>σ[-voi]</td>
<td>σ[+voi]</td>
<td></td>
</tr>
<tr>
<td>a. σµ[-voi]</td>
<td>σ[+voi]</td>
<td>*</td>
</tr>
<tr>
<td>b. σµ[-voi]</td>
<td>σ[+voi]</td>
<td>*!</td>
</tr>
</tbody>
</table>

- (8) Final stress as a result of WSP & Align-Hd-R satisfaction (cf. (4b))

<table>
<thead>
<tr>
<th></th>
<th>WSP</th>
<th>ALIGN-HD-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>σ[+voi]</td>
<td>σ[-voi]</td>
<td></td>
</tr>
<tr>
<td>a. σ[+voi]</td>
<td>σµ[-voi]</td>
<td>*!</td>
</tr>
<tr>
<td>b. σ[+voi]</td>
<td>σµ[-voi]</td>
<td>*</td>
</tr>
</tbody>
</table>
Karo: A brief analysis III

- (9) Final stress due to equal WSP satisfaction; Align-Hd-R decides (cf. (4a))

<table>
<thead>
<tr>
<th></th>
<th>WSP</th>
<th>ALIGN-HD-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $\sigma_{\mu}[-\text{voi}]$ $\sigma_{\mu}[-\text{voi}]$</td>
<td>*!</td>
<td>*</td>
</tr>
<tr>
<td>b. $\sigma_{\mu}[-\text{voi}]$ $\sigma_{\mu}[-\text{voi}]$</td>
<td>*!</td>
<td></td>
</tr>
</tbody>
</table>

- (10) Voiced onsets: Final stress because Align-Hd-R decides

<table>
<thead>
<tr>
<th></th>
<th>WSP</th>
<th>ALIGN-HD-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. $\sigma_{\mu}[-\text{voi}]$ $\sigma_{\mu}[-\text{voi}]$</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>b. $\sigma_{\mu}[+\text{voi}]$ $\sigma_{\mu}[+\text{voi}]$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Karo: Correct prediction unlike Gabas

- Recall: *penultimate stress occurs when the final onset is a voiced obstruent* (G99: 40)
- So for Gabas penult stress is anticipated even when the penult itself has a voiced obstruent onset
- Thus, he treats examples in (11) as exceptions

(11) Gabas’ incorrect predictions; OK in present analysis
   a. kiribiɔ̞p̪  *kiribiɔ̞p̪  ‘frog (sp.)’ (G99:41)
   b. miririy  *miririy  ‘toad (sp.)’  (G99:41)
Karo: Summary

- Karo stress is sensitive (among others) to the weight of the onset
- The latter is regulated by the onset’s voicing
- Universally fixed ranking: *µ/Ons/ [+voi] >> *µ/Ons/ [-voi]: [-voi] onsets make better moraic onsets than [+voi] ones
- *µ/Ons/ [+voi] >> Moraic >> *µ/Ons/ [-voi] provides such a mora
- In Karo, sonorants must be [-voi], since they pattern with the voiceless obstruents
A prediction

• The exact same ranking:
  *µ/Ons/ [+voi] >> Moraic >> *µ/Ons/ [-voi]
  should produce a different pattern in a language
  where sonorants are [+voi]

• In such case, sonorants should pattern with
  [+voi] obstruents, i.e. in being non-moraic
  onsets and thus incapable to attract stress due to
  WSP

• Indeed, such case is Pirahã (Everett & Everett
  2005)
Pirahã

(12) Pirahã weight scale:
PVV > BVV > VV > PV > BV [P= -voi obstr.; B= +voi obstr. & son]

(13) Pirahã examples (E&E=Everett&Everett 1984, E=Everett 1988)

a. **káō.bá.baí** “almost fell” [E: 239]  
  pa.hai.bií “proper name” [E&E: 708]  
  pii.bi.gái “deep water” [Everett p.c.]

b. **bii.oá.ii** “tired” [Everett p.c.]  
  poo.gái.hi.ái “banana” [E&E: 709]

c. pia.hao.gi.so.ai.pi “cooking banana” [E&E: 710]

d. ?a.ba.gi “toucan” [E&E: 710]  
  ti.po.gi “species of bird” [E&E: 710]

e. ?a.ba.pa “Amapá” *?a.ba.pa [E&E: 710]  
  ho.áo.íi “shotgun” *ho.áo.íi [E&E: 710]  
  ti.po.gi “bird (sp.)” *ti.po.gi [E&E: 710]
Pirahã Sonorants are Type B

- Pirahã sonorants pattern with the +voi Cs
- Everett (p.c.): there are no input sonorants, but they surface as allophones of voiced stops
  - /b/ → [b], [m] or bilabial trill [ʙ]
  - /g/ → [g], [n] or sui generis voiced apico-laminal alveolar-labial double flap [ɽɽ] only reported in Pirahã

- Some allophonic rules
  α) b → m/ pause __  β) b varies freely with ʙ/i or a___o
  γ) g varies freely with [ɽɽ]/ o___i
  e.g. /ʔíbogi/ → {ʔíbogi, ʔíBogi, ʔiboʃi, ʔiboʃi} ‘milk’
    /biísai/ → {biísai, miísai} ‘red’

- Crucially: all variants of [ʔíbogi] and [biísai] are stressed on the same syllable
Pirahã (cont...)  

- Pirahã weight depends on  
  i) VV vs. V  ii) CV vs. V  iii) PV vs. BV  
  - Focus here on (iii): see below  
  - (i) accounted for by WSP (N) [cf. Hammond 1999]  
  - (ii) accounted for by AlignσO: Align-L (σ, C)  

- N.B: other constraints that target the stressed syllable directly include Anchor-σ (Nelson 1998), Max-σ (Madsen 2000, Beckman 1999)
**Pirahã (cont...)**

- (14) Pirahã syllable types and their weight

<table>
<thead>
<tr>
<th>Total number of moras</th>
<th>Onset</th>
<th>Mora composition</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVV = 3µ</td>
<td>YES</td>
<td>(2µ-nucleic, 1µ-onset)</td>
</tr>
<tr>
<td>BVV = 2µ</td>
<td>YES</td>
<td>(2µ-nucleic)</td>
</tr>
<tr>
<td>VV = 2µ</td>
<td>NO</td>
<td>(2µ-nucleic)</td>
</tr>
<tr>
<td>PV = 2µ</td>
<td>YES</td>
<td>(1µ-nucleic, 1µ-onset)</td>
</tr>
<tr>
<td>BV = 1µ</td>
<td>YES</td>
<td>(1µ-nucleic)</td>
</tr>
</tbody>
</table>
Pirahã: a sketchy analysis I

- Align-Hd-R: Align the head syllable of a prosodic word to the right edge of the prosodic word
  - If low ranked, it ensures final stress, unless a more important imperative is applicable
- WSP: Heavy syllables are stressed
  - (N.B: gradiently assessed, i.e. a stressless bimoraic syllable incurs one violation, a stressless trimoraic syllable incurs two violations)
- WSP(N): Heavy syllables due to nucleic moras are stressed
- AlignσO: Align-L (σ, C)
**Pirahã: a sketchy analysis II**

- **Proposed ranking for Pirahã**
  
  (15) WSP(N) >> WSP >> Align\(\sigma\)O >> Align-Hd-R

- (16) WSP >> Align-Hd-R  
  (cf. (13a))

<table>
<thead>
<tr>
<th>sentence</th>
<th>WSP</th>
<th>Align-Hd-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{to}^{\mu}i^{\mu}\text{ba}^{\mu}i^{\mu})</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>a. (\text{t}^{\mu}\text{o}^{\mu}i^{\mu}\text{ba}^{\mu}i^{\mu})</td>
<td>*</td>
<td>!</td>
</tr>
<tr>
<td>b. (\text{t}^{\mu}\text{o}^{\mu}i^{\mu}\text{ba}^{\mu}i^{\mu})</td>
<td>**!</td>
<td></td>
</tr>
</tbody>
</table>

- (17) WSP(N) >> Align\(\sigma\)O  
  (cf. (13c))

<table>
<thead>
<tr>
<th>sentence</th>
<th>WSP(N)</th>
<th>Align(\sigma)O</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\text{ho}^{\mu}\text{a}^{\mu}i^{\mu}\text{pi}^{\mu})</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>a. (\text{h}^{\mu}\text{o}^{\mu}\text{a}^{\mu}i^{\mu}\text{pi}^{\mu})</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>b. (\text{h}^{\mu}\text{o}^{\mu}\text{a}^{\mu}i^{\mu}\text{pi}^{\mu})</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

- (18) WSP(N) >> WSP: can be assumed, since more specific >> more general
Pirahã: a sketchy analysis III

- (19) AlignˢO >> Align-Hd-R  (cf. (13b))

<table>
<thead>
<tr>
<th></th>
<th>AlignˢO</th>
<th>Align-Hd-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>ga^µo^µi^µµ</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>a.</td>
<td>ga^µo^µ.i^µµ</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td>ga^µo^µ.i^µµ</td>
<td></td>
</tr>
</tbody>
</table>

- (20) WSP(N) >> AlignˢO  (cf. (13d))

<table>
<thead>
<tr>
<th></th>
<th>WSP (N)</th>
<th>WSP</th>
<th>AlignˢO</th>
<th>Align-Hd-R</th>
</tr>
</thead>
<tbody>
<tr>
<td>po^µµga^µi^µhi^µa^µi^µ</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td>**</td>
</tr>
<tr>
<td>a. ...ga^µi^µ.h^µi^µ.a^µi^µ</td>
<td>*</td>
<td>*!</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>b. ...ga^µi^µ.h^µi^µ.a^µi^µ</td>
<td>*</td>
<td>*!</td>
<td>**</td>
<td>*</td>
</tr>
<tr>
<td>c. ...ga^µi^µ.h^µi^µ.a^µi^µ</td>
<td>*</td>
<td>*</td>
<td>*!</td>
<td>*</td>
</tr>
</tbody>
</table>
Pirahã : Summary

- Pirahã stress relies on nucleic weight, the presence of an onset (independently of its type) AND the weight of the onset.
- $\mu$/Ons/ [+voi] $\gg$ Moraic $\gg$ $\mu$/Ons/ [-voi] assigns moras on –voi onsets.
- In Pirahã, sonorants must be [+voi], since they appear as allophones of the voiced stops and behave in exactly the same way as they do.
A factorial typology

- Claim: \( *\mu/\text{Ons}/[+\text{voi}] \gg *\mu/\text{Ons}/[-\text{voi}] \) is universally fixed
- But the position of the cover-constraint Moraic is not
  - \( *\mu/\text{Ons}/[+\text{voi}] \gg \text{Moraic} \gg *\mu/\text{Ons}/[-\text{voi}] \)
    Only –voi onsets are moraic: differences bear on the behaviour of sonorants –+voi in Pirahã; –voi in Karo
  - Moraic \( \gg *\mu/\text{Ons}/[+\text{voi}] \gg *\mu/\text{Ons}/[-\text{voi}] \)
    All onsets are moraic: possibly the case of CV minimal words in Bella Coola (Topintzi 2005)
  - \( *\mu/\text{Ons}/[+\text{voi}] \gg *\mu/\text{Ons}/[-\text{voi}] \gg \text{Moraic} \)
    No onsets are moraic: the majority of languages
Conclusion

• Till now: pitch perturbation due to voicing is phonologized in some languages as tone (H or L)
• Current Proposal: such pitch perturbation in other languages is phonologized as stress
• Evidence from: Karo & Pirahã
• The dual status of sonorants (as +voi or −voi) found in tonal cases, is also found in stress cases
• The fixed ranking *μ/Ons/[+voi] >> *μ/Ons/[−voi] and the variable position of Moraic correctly generates: i) languages with no moraic onsets, ii) languages with moraic onsets, iii) languages where only [−voi] onsets are moraic
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