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

South	North	
(voi contrast+no tone)	(no voi contrast+tone)	
klaaŋ	kláaŋ	‘eagle’
glaaŋ	klàaŋ	‘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

ti	53	‘low’	di	31	‘lift’
ti	44	‘bottom’	di	22	‘younger brother’
ti	35	‘emperor’	di	13	‘field’

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.	/nə tə̀nkə̀kú/	> nə tə̀nkə̀kú	'I pressed'	
b.	/nə́ ɗûwàɬú/	> nə́ ɗúwáɬú	'I got tired'	
c.	/nə́ tə̀mbə̀lú/	> nə́ tə́m**b**ə̀lú	'I pressed'	(*tə́mb**ə́**lú)
d.	/nə́ bàzàrtú/	> nə́ **b**àzàrtú	'I shamed'	(*b**á**z**á**rtú)

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

- Low tone spreading in Bade (Schuh 2002)

a.	/dʒə̀.ɗgə́ kó:rón/	> dʒə̀.ɗgə̀ kó:rón	'we followed a donkey'
b.	/dʒə̀ kə̀rə́ kó:rón/	> dʒə̀ kə̀rə̀ kó:rón	'we stole a donkey'
c.	/dʒə̀ də̀psə́ kó:rón/	> dʒə̀ də̀**p**sə́ kó:rón	'we hid a donkey'
d.	/dʒə̀ gàfá kó:rón/	> dʒə̀ gà**f**á 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)

Nupe L-spreading

a. /è+dú/	→	[èdǔ]	'taxes'
/gí/	→	[à gǐ]	'will eat'
b. /è+lé/	→	[èlě]	'past'
/lá/	→	[èlǎ]	'is carrying'
c. /è+tú/	→	[ètú]	'parasite'
/tí/	→	[ètí]	'is hooting'

- 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. nə́n **kà**tə́w → nə́n **kə́!**tə́w 'I returned'

b. nə́n **là**wə́w → nə́n **lə́!**wə́w 'I ran'

c. nə́n **gà**fə́w → nə́n **gà**fə́w *nə́n gə́!fə́w '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
|
[-voi]

B. [+son] Lar
|
[+voi]

- 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

- Observation: in some languages H-toned moras attract stress (de Lacy 1999, 2002)
- 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)

LLL	kàw.lì.**gì**	‘post’
HLL	**á**.kò.là	‘wild fig tree’
LHL	gò.**má**.gì	‘type of sweet potato’
LLH	ò.nì.**bá**	‘snake’
HHL	sí.**bá**.gì	‘sweet potato type’
HLH	én.dè.**rín**	‘fire’

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

yo**gá**	‘egg’	(G99: 43)
ko**ɾét**˺	‘guan (sp.)’	(G99: 43)
ma**ndó**gon	‘rabbit (sp.)’	(G99: 40)

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

ma**ʔo̰**	‘ant (sp.)’	(G99: 42)
pə̰ŋa	‘dar’	(G98: 17)
moɾ**ḭ**ya	‘miçanga’	(G98: 39)
caɾ**ḛk**˺	‘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. maʔ**pɛ**	'gourd'	
kɔ**yɔ**	'crab'	
yaʔ**mbɔ**	'yam (sp.)'	
pa**kːɔ**	'fontanel'	
b. kɨɾɨ**wɛp̚**	'butterfly'	
kuɾuʔ**cu**	'saliva'	
c. **ya**ba	'rodent (sp.)'	
pibɛʔ	'foot'	
wɛɾɛ	'frog'	
kaɾo	'macaw'	
məga	'mouse'	
iʔ**cɔ**gɔ	'quati (sp.)'	

all combinations of son and -voi obstr in two final σs →
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, [-voi] V = 2μ, whereas [+voi] V = 1μ
- Karo sonorants are type A

Karo: A brief analysis I

- (5) *μ/Ons/[+voi] >> Moraic >> *μ/Ons/[-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

pibeʔ	*μ/ONS/ [+voi]	MORAIC	*μ/ONS/ [-voi]
☞ a. p^{μ}i.beʔ		*	*
b. pi.beʔ		**!	
c. p^{μ}i.b^{μ}eʔ	*!		*

Karo: A brief analysis II

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

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

	$\sigma_{[-voi]}$ $\sigma_{[+voi]}$	WSP	ALIGN-HD-R
☞	a. $\sigma_{\mu[-voi]}$ $\sigma_{[+voi]}$		*
	b. $\sigma_{\mu[-voi]}$ $\sigma_{[+voi]}$	*!	

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

	$\sigma_{[+voi]}$ $\sigma_{[-voi]}$	WSP	ALIGN-HD-R
	a. $\sigma_{[+voi]}$ $\sigma_{\mu[-voi]}$	*!	*
☞	b. $\sigma_{[+voi]}$ $\sigma_{\mu[-voi]}$		

Karo: A brief analysis III

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

	$\sigma_{[-voi]}$ $\sigma_{[-voi]}$	WSP	ALIGN-HD-R
	a. $\sigma_{\mu[-voi]}$ $\sigma_{\mu[-voi]}$	*!	*
☞	b. $\sigma_{\mu[-voi]}$ $\sigma_{\mu[-voi]}$	*!	

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

	$\sigma_{[+voi]}$ $\sigma_{[+voi]}$	WSP	ALIGN-HD-R
	a. $\sigma_{[+voi]}$ $\sigma_{[+voi]}$		*
☞	b. $\sigma_{[+voi]}$ $\sigma_{[+voi]}$		

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.	kiɾi**bɔp̚**	*ki**ɾi**bɔp̚	'frog (sp.)'	(G99:41)
b.	mɨɾɨ**ɾɨy**	*mɨ**ɾɨ**ɾɨy	'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 1984, Everett 1988, Goedemans 1998, Gordon 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.	**káo**.bá.baí	“almost fell”		[E: 239]	**PVV > BVV**
	pa.**hai**.bií	“proper name”		[E&E: 708]	
	pii.bi.gái	“deep water”		[Everett p.c.]	
b.	**bii**.oá.ii	“tired”		[Everett p.c.]	**BVV > VV**
	poo.**gáí**.hi.aí	“banana”		[E&E: 709]	
c.	pia.hao.gi.so.**ai**.pi	“cooking banana”		[E&E: 710]	**VV > PV**
d.	**ʔa**.ba.gi	“toucan”		[E&E: 710]	**PV > BV**
	ti.**po**.gi	“species of bird”		[E&E: 710]	
e.	ʔa.ba.**pa**	“Amapá”	***ʔa**.ba.pa	[E&E: 710]	**rightmost**
	ho.áo.**íi**	“shotgun”	*ho.**áo**.íi	[E&E: 710]	**heaviest**
	ti.**po**.gi	“bird (sp.)”	***ti**.po.gi	[E&E: 710]	**stress**

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 [ɾ͡ɾ̼] 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 [ɾ͡ɾ̼]/ o__i

  e.g. /ʔíbogi/ → {ʔíbogi, ʔíʙogi, ʔíboɾ͡ɾ̼i, ʔíʙoɾ͡ɾ̼i} ‘milk’

  /biísai/ → {biísai, miísai} ‘red’
- Crucially: all variants of [**ʔí**bogi] and [bií**sai**] 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 Alignσ́O: Align-L (σ́, C) [cf. Hyde (2007), Goedemans (1996, 1998)]
    - N.B: other constraints that target the stressed syllable directly include Anchor-σ́ (Nelson 1998), Max-σ́ (Madsen 2000, Beckman 1999)

Pirahã [cont...]

- (14) Pirahã syllable types and their weight

	Total number of moras	Onset	Mora composition
PVV =	3μ	YES	(2μ-nucleic, 1μ-onset)
BVV =	2μ	YES	(2μ-nucleic)
VV =	2μ	NO	(2μ-nucleic)
PV =	2μ	YES	(1μ-nucleic, 1μ-onset)
BV =	1μ	YES	(1μ-nucleic)

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 (σ́, C)

Pirahã: a sketchy analysis II

- **Proposed ranking for Pirahã**
  (15) WSP(N) >> WSP >> Alignσ́O >> Align-Hd-R

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

	$to^{\mu}i^{\mu}ba^{\mu}i^{\mu}$	WSP	ALIGN-HD-R
☞	a. $\mathbf{t}^{\mu}\mathbf{o}^{\mu}\mathbf{i}^{\mu}.ba^{\mu}i^{\mu}$	*	*
	b. $t^{\mu}o^{\mu}i^{\mu}.\mathbf{ba}^{\mu}\mathbf{i}^{\mu}$	**!	

- (17) WSP(N) >> Alignσ́O (cf. (13c))

	$ho^{\mu}a^{\mu}i^{\mu}pi^{\mu}$	WSP(N)	ALIGNσ́O
☞	a. $h^{\mu}o^{\mu}.\mathbf{a}^{\mu}\mathbf{í}^{\mu}.p^{\mu}i^{\mu}$		*
	b. $h^{\mu}o^{\mu}.a^{\mu}í^{\mu}.\mathbf{p}^{\mu}\mathbf{i}^{\mu}$	*!	

- (18) WSP(N) >> WSP: can be assumed, since more specific >> more general

Pirahã: a sketchy analysis III

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

	$ga^{\mu}o^{\mu}i^{\mu\mu}$	ALIGNσ́O	ALIGN-HD-R
☞	a. $\mathbf{ga^{\mu}o^{\mu}}.i^{\mu\mu}$		*
	b. $ga^{\mu}o^{\mu}.\mathbf{i}^{\mu\mu}$	*!	

- (20) WSP(N) >> AlignσO (cf. (13d))

	$po^{\mu\mu}ga^{\mu}i^{\mu}hi^{\mu}a^{\mu}i^{\mu}$	WSP (N)	WSP	ALIGNσ́ O	ALIGN-HD-R
☞	a. ...$\mathbf{ga^{\mu}i^{\mu}}.h^{\mu}i^{\mu}.a^{\mu}i^{\mu}$	*	* *		**
	b. ...$ga^{\mu}i^{\mu}.\mathbf{h^{\mu}i^{\mu}}.a^{\mu}i^{\mu}$	* *!	* *		*
	c. ...$ga^{\mu}i^{\mu}.h^{\mu}i^{\mu}.\mathbf{a^{\mu}i^{\mu}}$	*	* *	*!	

Pirahã : Summary

- Pirahã stress relies on nucleic weight, the presence of an onset (independently of its type) AND the weight of the onset
- *μ/Ons/[+voi] >> Moraic >> *μ/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: *μ/Ons/[+voi] >> *μ/Ons/[-voi] is universally fixed
- But the position of the cover-constraint Moraic is not
  - *μ/Ons/[+voi] >> Moraic >> *μ/Ons/[-voi]

    Only –voi onsets are moraic: differences bear on the behaviour of sonorants→ +voi in Pirahã; –voi in Karo
  - Moraic >> *μ/Ons/[+voi] >> *μ/Ons/[-voi]

    All onsets are moraic: possibly the case of CV minimal words in Bella Coola (Topintzi 2005)
  - *μ/Ons/[+voi] >> *μ/Ons/[-voi] >> 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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