Comments on stress

Juliet Stanton, NYU (stanton@nyu.edu)

MorrisHalle@100
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1 What is stress?

- An initial definition: stress is a perception of emphasis or prominence realized on a phonological unit.
- The study of stress spans multiple subdisciplines of linguistics.
  - **Phonetics**: how is stress realized? What acoustic properties distinguish stressed from unstressed units?
  - **Typology**: how are the stress systems of the world's languages similar? And how are they different?
  - **Phonology**: how is stress represented? What is the form of the grammar that governs its distribution?
  - **Morphophonology**: how can stress inform our understanding of the phonology-morphology interface?

My plan

- Briefly discuss the phonetics of stress, to orient those who are less familiar.
- Discuss two interlinked, open questions in the phonology of stress.
  - Is stress a reflex of metrical constituency? If so, what are the arguments for this conclusion? If not, what governs the presence and distribution of stress?
  - Less thoroughly: what are the units of stress? Is stress a property of a vowel, or something else?

2 The phonetics of stress

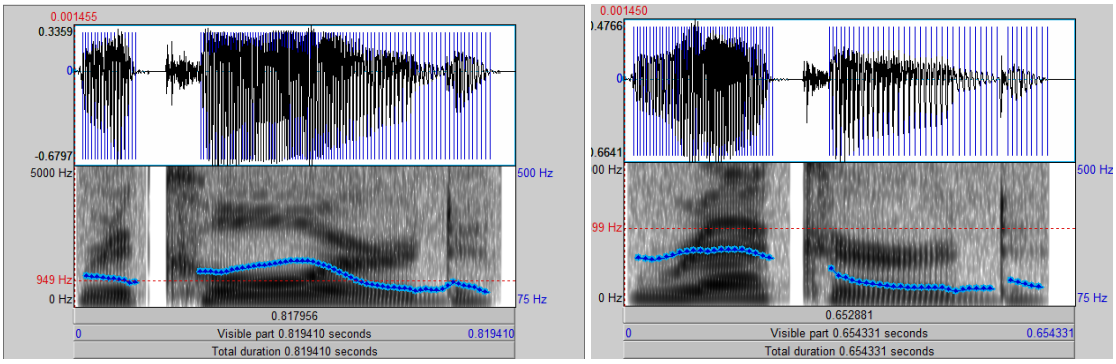
- **Credit where it is due**: the discussion in this section largely follows Gordon (2011).

2.1 The phonetics of stressed vowels

- Early work on the phonetics of stress in English (Fry 1955, 1958) found several acoustic correlates:
  - Greater duration (stressed vowels are longer).
  - Higher intensity (stressed vowels are louder).
  - Higher fundamental frequency (stressed vowels are higher-pitched).
- Stress is visible in spectrograms and waveforms, if you know what you're looking for!
  - Figure 1: recordings of recórd (v., left) and récord (n., right).[1]
  - Notice differences in duration and pitch. (Intensity is a bit harder to see.)
- Many other languages use some combination of these properties to cue stress. These include languages as distant as Polish (Jassem et al. 1968) and Chickasaw (Gordon 2004). See Gordon for more.

[1] From `https://corpus.eduhk.hk/english_pronunciation/index.php/4-2-lexical-stress/`.

Figure 1: Acoustic representations of recórd (left) and récord (right)



- The precise correlates of stress are difficult to measure, for several reasons.
  - The values associated with stress (duration, intensity, pitch) change across contexts.
    - ≻ Stress is realized on segments, and segments have inherently differing acoustic properties.
    - ≻ For example: stressed [a] will be louder and longer than stressed [ɪ]. Any attempt to quantify correlates of stress must take this into account, lest we think [a] bears a stronger stress than [ɪ].
  - The acoustic correlates to stress depend, to some extent, on phrasal context.
    - ≻ In English, stress is maybe better characterized as a pitch excursion, rather than higher pitch.
    - ≻ Compare: *It's Sunday.* vs. *It's Sunday?*
- The complexity inherent in identifying stress make studying stress, from any perspective, difficult.
  - To have meaningful theories, they need to be based on accurate data.
  - Phonologists have long been hesitant regarding the accuracy of stress transcriptions, especially in cases where the linguist does not speak the language they are studying. (See Hayes 1995:23, de Lacy 2014.)
  - Recent phonetic work suggests that a number of languages have been mischaracterized, in ways that affect phonological theory. (On sonority-driven stress, see Shih & de Lacy 2019.)

2.2 How stress affects other segments

- Much work on the phonetics of stress focuses on vowels (i.e. the nuclei of stressed syllables), but stress often affects the realization of nearby segments.
  - In English: simplifying slightly, voiceless stops are aspirated before a stressed vowel.

(1) English aspirated stops

a.	[pʰɪn]	'pin' (or 'pen'!)	cf. [hæpən]	'happen'
b.	[kʰiŋ]	'king'	cf. [smoʊkiŋ]	'smoking'
c.	[dətʰɜɪ]	'deter'	cf. [bʌɾəɪ]	'butter'

  - In Urubu-Kaapor (Tupi-Guaraní), oral stops (/p t k kʷ ʔ/) lengthen preceding a primary stress.

(2) Pre-tonic lengthening in Urubu-Kaapor (Kakumasu 1986, via Vaysman 2009:132)

a.	/katu/	→	[katːú]	'it is good'
b.	/nupãta/	→	[nupãtːá]	'he will hit'
c.	/waruwa/	→	[wàruwá]	'glass'
d.	/ixa/	→	[iʃá]	'it is a fact'

– Lest you think only the pretonic consonant can be affected by stress: post-tonic voiceless stops in Gualavía Zapotec (Otomanguean) can lengthen.[2]

(3) Post-tonic lengthening in Gualavía Zapotec (Jones & Knudson 1977, via Giavazzi 2010:97)

a.	/ɹapaʔ/	→	[ɹápːaʔ]	'I have'
b.	/ʃpaka/	→	[ʃpákːa]	'my tadpole'
c.	/ʃitja/	→	[ʃítːja]	'my onion'

- These effects are useful in that they can provide additional diagnostics for the presence of stress.
- They are also interesting in that they could inform our understanding of the representation of stress: given that segments adjacent to the vowel can be affected, are they part of the stressed unit?

3 The phonology of stress

- **Open question** (as formulated earlier): is stress a reflex of metrical constituency? If so, what are the arguments for this conclusion? If not, what governs the presence and distribution of stress?
- Before addressing this question more directly, I'll provide some context as to how it came about.

3.1 Stress as a feature

- A central assumption of Chomsky & Halle (1968) (SPE) was that phonology is linear: a phonological representation consists only of segments and junctures (boundaries).
- As such, they were forced to treat stress as a feature, akin to [±nasal] or [±consonantal]. But unlike other features, it can be assigned exclusively by rule.
  - In SPE, the feature [-stress] was treated as the default, in that it is assigned by rule to every segment and boundary early in the derivation.
  - Vowels become [+stress] by rule, over the course of the derivation. Here is an example of how this worked, from English verbs (Chomsky & Halle 1968:69-71):

(4) Stress in English verbs

a. Class I: *astónish, édit, consíder, imágine, intérpret, prómise*
b. Class 2: *maintáin, eráse, caróuse, appéar, cajóle, surmíse*
c. Class 3: *collápse, tormént, exháust, eléct, convínce, usúrp*

(5) Generalizations, drawn from (4)

a. Verbs with penultimate stress (Class I) end in a lax vowel followed by a consonant.
b. Some verbs with final stress (Class 2) have a tense vowel or diphthong in final position.
c. Other verbs with final stress (Class 3) end with a final cluster.

(6) (5) translates to a piece of the Main Stress Rule (incomplete); these are disjunctively ordered

a. $\mathrm{V} \rightarrow [1\ \text{stress}]\ /\ \underline{\quad}\ \mathrm{C}_0 \begin{bmatrix} -\text{tense} \\ \mathrm{V} \end{bmatrix} \mathrm{C}_0^1$

b. $\mathrm{V} \rightarrow [1\ \text{stress}]\ /\ \underline{\quad}\ \mathrm{C}_0$

  - (NB: while [+stress] denotes a stressed vowel, the actual feature values assigned to stressed vowels contained the degree of stress ([1 stress], [2 stress], etc.). [+stress] was effectively a cover term.)
  - In English words that contain more than one stress (as in (7)), extra steps are necessary to create the full stress contour (Chomsky & Halle 1968:77-8).

[2] I'm simplifying here: post-tonic gemination is only one of the possible realizations of stress in this language. Others include vowel lengthening and rearticulation.

(7) Examples of verbs with multiple stresses
víolàte, extrápolàte, insínuàte, expérimènt, ímplemènt, gállivànt, cáterwàul, éxercìse, éxorcìse, órganìze, récognìze, solídifỳ, transmógrifỳ

(8) Towards an analysis of (7)

a. The Alternating Stress Rule assigns stress to the antepenultimate syllable.
$V \rightarrow$ [1 stress] / _____ $C_0VC_0\overset{1}{V}C_0$

b. The pre-existing primary stress is demoted to secondary.

– The analysis of stress subordination in SPE was thorny. In some cases (as in (8b)), it was assumed to occur automatically. In others, it was effected by rule (example in (9)).

(9) Chomsky & Halle's Rule (108)
[2 stress] $\rightarrow$ [3 stress] / _____ C_0 [1 stress]

➢ See Chomsky & Halle 1968:116 to see what role this rule plays (it's useful for words like *relaxation*).

• While SPE does not provide an analysis of other stress systems, they note the possibility that, in other languages, a segment might carry an underlying specification for [±stress].

3.2 Stress as a reflex of metrical constituency

• As Liberman & Prince (1977) note, if [±stress] is a feature, it's an odd one. Both the feature and the rules that refer to it differ from other features and the rules that refer to them.

1. [±stress] does not have a set number of values.
   – Within [+stress], there is [1 stress], [2 stress], all the way to [*n* stress], where *n* is the weakest detectable stress.
   – Other features are binary (or, at least, have a limited range of values).
2. Values of [±stress] like [2 stress] or [3 stress] do not have independent meaning.
   – The [+stress] features are relationally defined: there can be no [2 stress] without [1 stress].
   – This is unlike other features: the definition of e.g. [-nasal] does not require reference to [+nasal].
3. Stress rules are unique in how the targets are characterized.
   – Most nonprosodic phonological rules act to change the feature specification of a single segment.
   – But with stress rules, the addition of a stress (for example) triggers a cascade of other changes. When adding a new [1 stress] to a word, all of the other stresses must be demoted.
4. A further way in which [±stress] differs from other features, from Hayes 1995:26:
   – Stress does not assimilate. There are no known rules of stress assimilation or harmony.[3]
   – Many segmental features readily participate in assimilation and harmony (e.g. [±voice], [±back]).

• Liberman & Prince (1977) propose to account for these asymmetries by treating stress not as a feature, but as a reflection of the hierarchical organization of binary constituents.

• **The idea**: in a tree, each constituent has a strong branch (abbreviated *s*) and a weak branch (*w*).

   – Stress is assigned by SPE-style rules. The tree is built as stress is assigned.
   – The distribution of *s* and *w* is also determined by rule (examples to come).

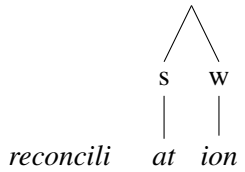
• Liberman & Prince (1977) demonstrate how this representation can capture both lexical and phrasal stress.

   – For **lexical** stress, assignment of *s* and *w* is made according to the rule in (10). We'll walk through how the tree for *reconciliation* is built (following Liberman & Prince 1977:267).

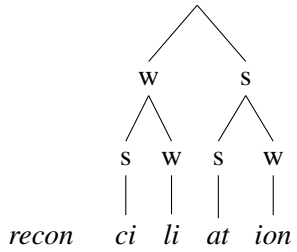
[3] Though cf. Stanton & Zukoff (2016), Kenstowicz (2019).

(10) Lexical Category Prominence Rule (Liberman & Prince 1977:270):
In the configuration [N_1 N_2], N_2 is strong if it branches.

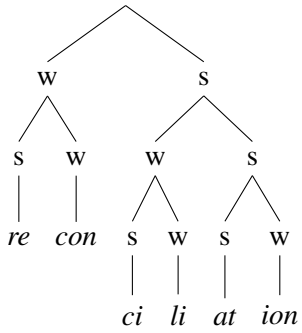
(11) Stress is assigned to the penultimate syllable (by rule).
A trochaic foot is created.



(12) The rightmost secondary stress is assigned (by rule).
Because N_2 branches, it is strong.



(13) The remaining secondary stress is assigned (by rule).
Because N_2 branches, it is strong.



– **Phrasal stress** works similarly; see Liberman & Prince (1977) for details.

- My impression from the literature is that the hierarchical representations proposed by Liberman & Prince (1977), and in particular the notion of metrical feet, caught on like wildfire!
- An influential criticism came from Prince (1983), who argued that tree-based representations are non-essential, and proposed to jettison metrical structure entirely.

3.3 The grid

- Prince (1983) contends that the only representation necessary for the analysis of stress is another representational device introduced by Liberman & Prince (1977): the grid.
- Liberman & Prince's motivation for proposing the grid came from the English rhythm rule.
  – The rhythm rule describes a type of alternation where a word's stress contour is modified in a phrase.

(14) Examples of the English Rhythm Rule

Stress in isolation		Expected stress under embedding		Actual stress	
achromatic	[2010]	*achromatic lens*	*[**302**01]	*achromatic lens*	[**203**01]
Tennessee	[201]	*Tennessee air*	*[**302**1]	*Tennessee air*	[**203**1]
thirteen	[21]	*thirteen men*	*[**32**1]	*thirteen men*	[**23**1]

– Intuition: the rhythm rule acts to create a more-alternating pattern by eliminating clashes.

– However, the notion of a stress clash was difficult to formalize with existing technology.

  ⩾ Stress numbers (or features) don't get us very far: how is [231] any better than [321]?

  ⩾ It is not much easier to define a stress clash by reference to relative prominence. (Among other reasons: some *w*s are stressed, while others aren't. So the linear sequence *ws* is ambiguous.)

- The grid represents the relative prominence in an utterance. Higher columns of *x*s mean greater prominence. The absolute number of *x*s in a column is not informative.

(15) Grids for words in isolation (from (14))

			x					x				x		level 3
x			x			x			x			x	x	level 2
x	x	x	x			x	x	x				x	x	level 1
achromatic						*Tennessee*						*thirteen*		

- The examples in (17) illustrate the stress we'd expect when the words in (15) are placed in their phrases.

(16) Expected grids for phrases, given (15)

					x							x						x		level 4
			x		x					x	x					x		x		level 3
x			x		x		x			x	x		x	x		x				level 2
x	x	x	x	x		x	x	x	x				x	x		x				level 1
achromatic lens						*Tennessee air*							*thirteen men*								

- But these aren't the attested prominence patterns. Liberman & Prince (1977) note that each of the patterns in (17) contains a stress clash, which can be diagnosed via the grid.

– Formula: locate two adjacent *x*s that are not separated by an intervening element in the next level down.

– Using this formula, we can locate a stress clash in each of the phrases in (17).

(17) Clashes (boxed) in grids for expected phrases, given (15)

					x							x						x		level 4
			x		x					x	x					x		x		level 3
x			x		x		x			x	x		x	x		x				level 2
x	x	x	x	x		x	x	x	x				x	x		x				level 1
achromatic lens						*Tennessee air*							*thirteen men*								

- In the attested prominence patterns, these clashes are avoided: the two highest peaks are separated by an intervening element (circled) in the next level down.

(18) Attested grids for phrases (from (14))

					x							x						x		level 4
x					x		x					x		x				x		level 3
x		ⓧ			x		x			ⓧ		x		x	ⓧ			x		level 2
x	x	x	x	x		x	x	x	x				x	x		x				level 1
achromatic lens						*Tennessee air*							*thirteen men*								

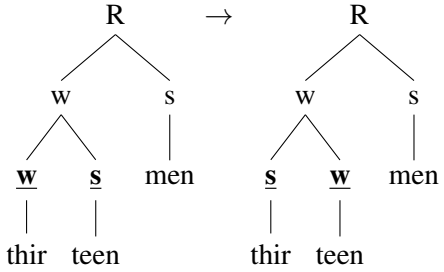
- Liberman & Prince (1977) assume that while the clash violation is identified via the grid, the actual repair (stress shift) is an operation performed on the metrical tree.

– The threat of clash prompts a reversal of the strong-weak relation within one of the tree's constituents.

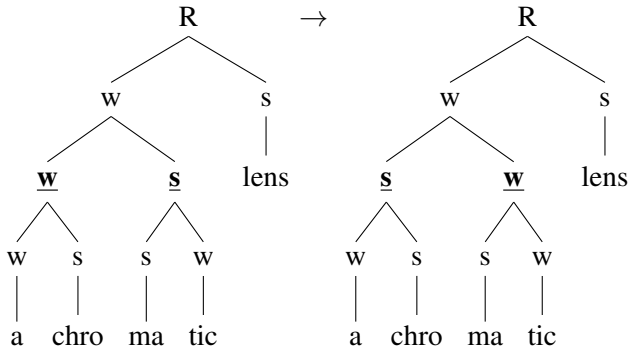
– The affected constituent can be at any level within the tree. As an example, consider (19). For clarity, the *s* and *w* that switch are bolded and underlined.

(19) Prominence reversal (adapted from Liberman & Prince 1977:316-317)

a. *thirteen men*



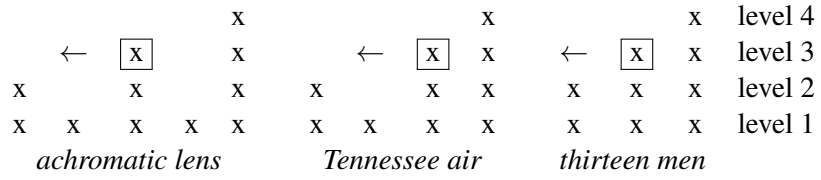
b. *achromatic lens*



- In a paper arguing that only the grid is necessary for a full theory for stress patterns, Prince (1983) shows that a successful analysis of the rhythm rule does not require both grids and trees.
- The prominence reversal in (19) can be performed directly on the grid, via Move *x* (Prince 1983:33).
  - Move *x* takes an entry at a certain level and moves it away from a position of clash.
  - The landing site for the moved *x* is the first position *x* can occupy, without creating a gap in the column.[4]
- With Move *x*, the effects of the rhythm rule can be captured without reference to constituents.

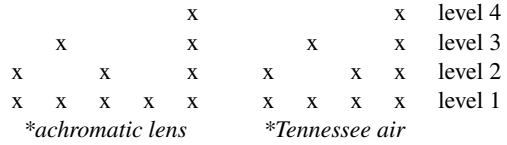
(20) The rhythm rule, as analyzed with Move *x*

a. Expected grids, and illustration of Move *x*



[4]More specifically: for a landing site to be legitimate, there cannot be a gap between the moved *x* and the next *x* down. The grids in (i) are thus ill-formed. (This restriction became known as the *continuous column constraint*, name due to Hayes 1995.)

(i) Applications of Move *x* that result in ill-formed grids



b. Attested grids, after Move *x* has occurred

				x				x				x			level 4
[x]				x		[x]			x		[x]			x	level 3
x		x		x		x			x	x	x				level 2
x	x	x	x	x		x	x	x	x		x	x	x		level 1
achromatic lens						*Tennessee air*					*thirteen men*				

- Prince 1983:87-8 on the type of evidence that convincing arguments for feet would have to provide:

> "...it is, as one says, a strictly empirical question whether we need to impose such further structure in the phonology. Grid theory raises the empirical stakes by undermining the distributional argument (feet put stresses in the right places) that has been the mainstay of the construct. Other oft-repeated arguments simply fail to reckon with competing, nonstructural explanations [...] in the absence of affirming evidence, it is appropriate to prefer the more restrictive grid theory."

3.4 Arguments for constituency

- Halle was a champion for metrical constituency; Halle & Vergnaud (1987) was some of the first work to respond to Prince's challenge by offering empirical arguments for feet.
- My impression is that Halle was convinced by cases where positing foot structure allows the analyst to predict the direction of stress shift, given the deletion of a stressed vowel.
  - Consider (21) (from Halle & Vergnaud 1987:28), and a variation in (22).

(21) Metrical structure from Halle & Vergnaud 1987:28

*	.	*	.	.	.	*	.	.	line 1
(1	2)	(3	4	5	6)	(7	8	9)	line 0

(22) Variation on metrical structure in (21)

*	.	*	.	.	.	*	.	.	line 1
(1)	(2	3)	(4	5	6	7)	8	9	line 0

  - What would happen if the segmental content associated with 7 is deleted? Where would its stress go?
  - The prediction: 7's stress should migrate to 8 in (21), but to 6 in (22).
  - More generally, the prediction is that stress will not leave its foot.
- I spent some time trying to find a clear-cut example that bears out this prediction. They're hard to find!
  - In some cases, there's little data. I wasn't able to rule out alternative, simpler analyses.
  - The more convincing arguments rely heavily on the theoretical machinery of the time. When looking at the same data through the lens of parallel constraint-based theories, alternative analyses emerge.
- I'll present two arguments for metrical constituency, and then I'll comment on why I don't find them convincing. Neither are from Halle, but they resemble cases he discussed.

3.4.1 Stress shifting in Bedouin Hijazi Arabic (BHA, Al-Mozainy et al. 1985)

- **Setting the stage**: relevant phenomena (from Al-Mozainy et al. 1985:136-8 unless otherwise specified).[5]
  - Stress assignment proceeds as follows:
    - ≻ If the final syllable is superheavy (CVVC or CVCC), stress that (23a).

[5] Al-Mozainy et al. (1985) also discuss an interaction between stress placement and metathesis. I do not understand how this phenomenon bears on the question of metrical constituency, so I'm not discussing it at this point.

⩾ Else: if the penult is heavy (CVV or CVC), stress that (23b).
⩾ Else: stress the antepenult (23c).

(23) Examples exhibiting the stress pattern

a. [maktúub] 'written'
[ðaṛábt] 'I hit'
b. [maktúufah] 'tied (f. s.)'
[gaabílna] 'meet us (m. s.)'
c. [máalana] 'our property'
[yášriḅin] 'they (f.) drink'

– Short [a] deletes in an open syllable given the presence of another short [a] in a following open syllable.

(24) Examples of low vowel deletion (adapted from Al-Mozainy et al. 1985:136)

a. /sahabna/ → [shábna] 'we pulled'
b. /sahabaw/ → [shábaw] 'they (m.) pulled'
c. /naxalah/ → [nxálah] 'a palm tree'
d. /salagah/ → [slígah] 'a hunting dog'

• **The argument**:

– When an antepenultimate [a] deletes, stress is realized on the penult (25).

(25) Stress assignment interacts with low vowel deletion

a. /ʔinkasaṛat/ → [ʔinksáṛat] 'she got broken'
b. /ʔinatðaṛan/ → [ʔintðáṛan 'they (f.) waited'
c. /ʔiftakaṛaw/ → [ʔiftkáṛaw] 'they (m.) remembered'
d. /ʔixatbaṛaw/ → [ʔixtbáṛaw 'they (m.) took an exam'

– This is unexpected: the penult is light, so stress should fall on the antepenult (as in (26))!

(26) Expected stress on the antepenultimate, with no low vowel deletion

a. /ʔinkisaṛ/ → [ʔínkisaṛ] 'he got broken'
b. /ʔintiðaṛ/ → [ʔíntiðaṛ] 'he waited'
c. /ʔifikaṛ/ → [ʔífikaṛ] 'he remembered'
d. /ʔixtibaṛ/ → [ʔíxtibaṛ] 'he took an exam'

– Al-Mozainy et al. (1985): if stress assignment is ordered before low vowel deletion, and if a stress may not migrate outside its original foot, the facts in (25) follow straightforwardly.
– (Assumption is that BHA has trochaic feet, assigned right-to-left, with the final rhyme extrametrical.)

(27) Deriving exceptional penultimate stress

/ʔinkasaṛat/	/ʔiftakaṛaw/	UR
ʔin(kása)ṛat	ʔif(táka)ṛaw	Stress and footing
ʔin(ksá)ṛat	ʔi(tká)ṛaw	Low vowel deletion
[ʔinksáṛat]	[ʔiftkáṛaw]	SR

• **Some thoughts**:

– I do not have a full reanalysis of (25) that goes without feet. But I think there are reasons to be skeptical of the analysis as proposed by Al-Mozainy et al. (1985).
– *Point 1:* there are other types of example of penultimate stress that can't receive the same analysis.

(28) Unexpected penultimate stress resulting from metathesis

a. /ʔistaʕzam/ → [ʔistʕázam] 'he accepted an invitation'
b. /ʔistaɣfar/ → [ʔistɣáfar] 'he asked Allah for forgiveness'

(29) Other examples of unexpected penultimate stress (from Al-Mozainy 1981:143)

a. [ʔaʕádi] ‘I am running’
b. [ʔaxádat] ‘she took’
c. [ʔumáṛa] ‘princess’

⩾ It would be nice to have a unified explanation for these similar classes of exceptions.

– *Point 2:* it is not clear that feet in BHA are actually trochaic.

⩾ McCarthy (2003) claims that BHA is iambic (following Hayes’s 1995 reanalysis of two related dialects, formerly thought to be trochaic, as iambic).

⩾ Effectively, his reanalysis makes penultimate stress the default position, as in (ʔaká)lat.[6]

⩾ To derive [ʔinksáṛat], McCarthy assumes that the alternative candidate *[ʔin(kasá)ṛat] is ruled out due to the presence of an LL iamb. Deletion of the unstressed vowel ameliorates this.

⩾ The rationale for this reanalysis: it allows one to avoid positing a Duke of York derivation as well as a ‘problematic stress-shift process’ (McCarthy 2003:41).

3.4.2 Segmental effects in Nganasan

• I used to think that the more convincing arguments for metrical structure come from cases where segmental phenomena suggest a rhythmic structure that is at odds with the stress system.[7]

Stress and consonant gradation in Nganasan (Vaysman 2009)

• Disclaimer: what I’m showing you is simplified, so please read the dissertation for more details.

• In Nganasan, stress is generally penultimate (with exceptions when the penult is [ə] or [ĭ]).

• Nganasan has a system of consonant gradation. (30) shows a subset of the reflexes.

(30) (Some) gradation reflexes (Vaysman 2009:41)

strong grade	h	t	k	s	ç	c
weak grade	b	ð	g	ɟ	ɟ	ɟ

• The distribution of strong and weak grade consonants is prosodically determined.

– Vaysman’s (2009) claim: weak grade consonants appear only foot-initially.

– In (31), the foot boundaries (Vaysman’s) do not match up with those we might posit for stress.

(31) Nganasan stress and foot boundaries do not match

(kó-**t**i)	‘your (du.) ear’	(bahí)-(**ð**i)	‘your (du.) wild deer’
(bàku)(nú-**t**i)	‘your (du.) salmon’	(béi)-(**ð**i)	‘your (du.) period of time’
(hai)(**ð**á-**t**i)	‘your (du.) ermine’	(dünhá)-(**ð**i)	‘your (du.) soft ground’
(ŋòru)(mu-**t**i)	‘your (du.) copper’	(le)(húa)-(**ð**i)	‘your (du.) board’

• But now I think Nganasan, and cases like it, are teaching us something entirely different.

– Though the Nganasan facts may suggest some kind of constituency, they aren’t arguments for the claim that *stress is a reflex of metrical structure*.

[6] Forms with initial stress, like [kítab], can be derived by assuming extrametricality. Forms like [ʔínkisaṛ], with a stressed heavy antepenult, can be derived by assuming foot extrametricality. I don’t know what McCarthy would say about [ʔalʕáṣuṛ], with an epenthetic final vowel; I think his proposal predicts antepenultimate stress.

[7] For an example of this kind of argument from Halle’s work, see Halle & Vergnaud 1987:83-6 on Tiberian Hebrew.

- They show that stress and metrical structure are dissociable: words may have an underlying rhythmic backbone, but stress is not obliged to pay attention to it.
- There is no reason why an underlying rhythmic backbone should have to be analyzed with feet. See Hyde (2016) for a foot-free theory that could be developed to account for the facts in (31).

4 Going forward

- I think the study of stress is hampered, to some extent, by the fact that we (as a field) have not gone back and systematically questioned the basis for representational assumptions made many decades ago.
- In the meantime, the theoretical frameworks that phonologists work in have changed and diversified.
- My conclusion, from having spent time with Morris's work on stress over the past month or so, is that going back to old data, with new eyes, is well worth it – and keeping in line with the spirit of his work.
  - For example: Morris went back many times to English data analyzed in SPE, revising his analyses to incorporate some theoretical developments and using the data to argue against others.
  - Some relevant work: Halle (1973), Halle & Vergnaud (1987), Halle (1989), Halle & Kenstowicz (1991), Halle (1995), Halle (1998).

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