Morphosyntactic structure reveals stress universals in Nanti

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Background: Verbal stress in Nanti has been argued to show two unusual properties (Crowhurst & Michael 2005; C&M). First, it is sensitive to a fine-grained sonority scale (a > {e, o, u} > i), as partly illustrated in (1)-(2): Nanti feet are usually iambic, but the feet in bold show surprising trochaic stress. According to C&M, sonority is the cause: the vowel [a] can attract stress from its less sonorous sisters.

(1) **(nà.bo)**(bu.tái).ro 'I re-sew it' (2) (pi.pò)**(ká.kse)**.na 'you came to me'

While sonority-driven stress has been reported elsewhere (e.g., Kenstowicz 1997, de Lacy 2002), recent literature has reanalyzed the majority of cases (de Lacy 2013, Shih 2017, Rasin 2018, a.o.), reducing sonority-sensitivity to a binary structural distinction ($V > V_0$, where V_0 = structurally deficient). Since all Nanti vowels contrast for length (e.g., [aa] vs. [a]), the ternary distinction (a > {e, o, u} > i) is not one of length. Thus, Nanti is a stand-out exception to (3). The second unusual property is that main stress and 2-stress (secondary stress) are reportedly sensitive to different, partly opposing weight scales (e.g., [eN] is heavier than [a] for 2-stress while [a] is heavier than [eN] for main stress). Though scales can differ between processes in a given language, scale reversal is otherwise unattested (e.g., Gordon 2006), so Nanti is an exception to (4) as well.

(3) Universal: the distribution of stress is never directly conditioned by sonority
(4) Universal: in a given language, weight scales for stress cannot be reversed

Summary: We revisit the exceptional status of Nanti by examining the effects of its morphosyntax and phonological structure on stress. We develop a cyclic analysis in which apparent sonority-sensitivity and scale reversal are due to an unexceptional underlying system rendered opaque on the surface. For example, (1)-(2) are underlyingly (5)-(6). In (5), vowel deletion applies after stress assignment and makes an underlying iambic foot look trochaic; in (6), the suffix -ak is born with stress and keeps it on the surface. We replace C&M's sonority scale with the binary ({a, e, o, u} > i) which is consistent with (3) ([i] is deficient). We also avoid scale reversal. We present evidence for our analysis suggesting that it is at least as successful as C&M's and conclude that the universals in (3)-(4) can be maintained.

(5) /**no-a**bobu-áh-i=ro/ → (**no.à**).bo... →**nà**.bo (6) /pi-pok-**ák**-e=na/

Data and reanalysis: We use the stress data in C&M and Michael 2008 (122 words, collected by Lev Michael). We constructed a morphologically-analyzed corpus on the basis of the grammar in Michael 2008. Michael showed that the Nanti verb is divided into two domains (7) – the stem domain (prefixes + root) and the suffix domain (consisting of all suffixes) – which have different phonologies (e.g., vowel hiatus is resolved by glide formation or deletion in the stem domain but by [t]-epenthesis in the suffix domain). We propose a similar division of labor for stress: the stem domain is constructed first with its own phonology, then suffixes are added one-by-one, each triggering a pass through the cyclic phonology. Since Nanti shows (independently of our analysis) intra-cycle opacity of a kind that poses a challenge to parallel and stratal variants of OT, we present a rule-based analysis, starting with the stem domain.

(7) [SUBJECT=IRREALIS-CAUSATIVE-ROOT]-DERIVATION-INFLECTION=OBJECT
Stem domain (non-cyclic) — Suffix domain (cyclic)

In the stem domain, stress is simple: bisyllabic feet are constructed from left to right, iambic main stress is assigned to the rightmost foot and iambic 2-stress to all other feet. In each of the following examples (ex. numbers are from C&M), all syllables are of equal weight and the suffix domain (developed below) does not alter stress assigned in the stem domain. Object clitics (=) and final V (⟨⟩) are extrametrical.

Stem	(5d) (no.néh)	(5f) (o.kò)(wo.gó)	(5g) (i.rì).(pi.ŕi).ni
Final output	[(no.né).⟨he⟩=ro]	[(o.kò)(wo.gó).⟨te⟩=ro]	[(i.rì).(pi.ŕi).ni.⟨te⟩]

The first main difference between our analysis and C&M's is an opaque interaction between stress and independently-observed syllable-structure rules that apply later: glide formation (i → j / _ V) and vowel deletion (V → ∅ / _ V). Example (23a-iv) [já.nu.ti] (derivation below) illustrates: on the surface, the foot is surprisingly trochaic. According to C&M, [a] attracts stress due to its sonority. For us, [a] heads an underlying iambic foot (bold) and stress is assigned without reference to sonority. Glide formation then reduces the number of syllables. While stress is transferred to the next cycle as is, foot structure is destroyed (see Halle & Vergnaud 1987 for motivation) and gets reconstructed in each cycle.

$$\text{(23a-iv)}\quad \underbrace{\text{/i-anu/} \xrightarrow{\text{Footing}} \textbf{(i.a)}\text{.nu} \xrightarrow{\text{Stress}} \textbf{(i.á)}\text{.nu} \xrightarrow{\text{GF}} \text{[(já).nu]}}_{\text{Stem domain}} \longrightarrow \underbrace{\text{/já.nu-i/} \xrightarrow{\text{Footing}} \text{[(já.nu).}\langle\text{ti}\rangle\text{]}}_{\text{Suffix domain}}$$

In the cyclic suffix domain, every suffix comes with initial main stress (e.g., /-áko/, /-híg/), except for /-an/, /-ut/, and the reality-status markers (/-a/, /-e/, /-i/, /-eNpa/), which occur word-finally. In each cycle, syllable-structure rules apply first ([$\emptyset \rightarrow$ [a] / C _ C], then [$\emptyset \rightarrow$ [t] / V _ V], then [/h/ $\rightarrow \emptyset$ / V _ V]), followed by footing (degenerate feet are only allowed for stressed syllables). Stress reduction decides between two main-stressed syllables: the syllable with a longer nucleus wins; otherwise (if the two are of equal length), the leftmost stressed suffix wins. The loser is reduced to 2-stress. Finally, 2-stress is deleted from doubly-stressed or word-final feet. In (9b-iv) below, -ák attracts stress from an equally-short stem-vowel (a surface trochaic-seeming foot is due to a stressed suffix). In (29-iv), -ák loses to a long vowel. (32a-vi) has vowel deletion (a surface trochaic foot is underlyingly iambic). In (22-v), the suffix wins over an equally-long stem-vowel.

Stem UR	(9b-iv) /pi-pok/	(29-iv) /i-pait/	(32a-vi) /no-abobu/	(22-v) /no-oog/
FOOT, STRESS	(pi.pók)	(i.páit)	(no.à)(bo.bú)	(no-óog)
SYLLABLE RULES	-	-	(nà)(bo.bú)	(nóog)
Cycle I input	/pi.pók-ák/	/i.páit-ák/	/nà.bo.bú-áh/	/nóog-híg/
SYLLABLE, FOOT	(pi.pó).(kák)	(i.pái).(ták)	(nà.bo)(bú.táh)	(nóo.gáig)
STRESS REDUCTION	(pi.pò).(kák)	(i.pái).(tàk)	(nà.bo)(bù.táh)	(nòo.gáig)
2-STRESS DELETION	-	-	(nà.bo)(bu.táh)	(noo.gáig)
Cycle II input	/pi.pò.kák-e/	/i.pái.tàk-i/	/nà.bo.bu.táh-i/	/noo.gáig-a/
...	...	...	...	...
Final output	[(pi.pò)**(ká).⟨kse⟩**=na]	[(i.pái).ta.⟨kʃi⟩=ri]	[**(nà.bo)**(bu.tá⟨i⟩)=ro]	[(noo.gái).⟨ga⟩=ro]

Finally, TROCHAIC SHIFT applies to bisyllabic feet of the form (S_1 S_2) where S_2 is stressed, and shifts stress to S_1 depending on syllable weight. Here we inherit from C&M two different weight scales for main and 2-stress, but we replace the sonority scale with the binary (V > i) and avoid reversals. The scale for main stress is (VV > VN > {iN, V} > i) and for 2-stress it is (VV > VN > iN > V > i). TROCHAIC SHIFT applies if $S_1 > S_2$ (according to the relevant scale). When S_2 clashes with a following stressed syllable S_3, TROCHAIC SHIFT applies if $S_1 = S_2$ and S_3 is a short vowel (as long as S_1 is not preceded by a stressed syllable) or if $S_1 = S_2$ = [i]. TROCHAIC SHIFT is illustrated by examples like (17a-iii) [(nòN.ksen).(tá)⟨kse⟩=ro], (6a-ii) [(nò.ko)(gá.ko).⟨ta⟩=ro], and (20-i) [(ì.ri).(nó.ri).⟨je⟩].

Supporting evidence: The minimal pair (9b-v) [i.pò.ká.pai] vs. (32a-iii) [i.ʃì.ga.nái] supports a role for morphology in stress assignment and poses a problem for C&M's morphology-blind analysis, in which main stress falls on the rightmost strongest syllable (simplifying). C&M incorrectly predict final stress in both words since [ai] > [a]. For us, the difference comes from the morphology: /[i-pok]-ápah-i/ with one bisyllabic suffix vs. /[i-ʃig]-an-áh-i/ with two monosyllabic suffixes, one of which is unstressed (-an is never stressed in the data). The minimal pair (5f) [o.kò.wo.gó.te=ro] vs. (15-iv) [òN.ko.wo.gó.te=ro] is also a problem for C&M. Since [oN] > [o], C&M incorrectly predict *[(óN.ko)(wo.gò).te=ro] with main stress on the first, strongest syllable. For us, both words are assigned main stress at the stem level: [(o(N).kò)(wo.gó)]; without stressed suffixes, main stress does not shift. Most examples motivating C&M's claim that [a] > [eN] for main stress (but [a] < [eN] for 2-stress) involve stressed suffixes that happen to have [a]. C&M incorrectly predict pen-initial main stress in (6b-i) [(no.sà)(me.rè).(há.ka)] and (6b-ii) [(no.kà)(mo.sò)(wá.ti)]. For them, main stress on a short vowel in a word-final foot is avoided in favor of any preceding syllable of equal strength. Our analysis avoids this incorrect prediction: main-stress computation is local and normally only shifts stress rightwards from the stem.

Conclusion: Of the 122 stressed words in C&M and Michael 2008, our analysis covers at least 95 (after refinements omitted for space). It could cover 25 additional words which we did not have enough information to analyze (each word has a conceivable parse consistent with our analysis). Only 2/122 words – (27) [o.tá.sòN.ka.kse=ro] and (30-i) [sá.bi.ta.ka] – cannot be accounted for regardless of their morphology and must be treated as two exceptions. Our result justifies a reconsideration of the exceptional status of Nanti and allows for maintaining the universals in (3)-(4).