Positional weight constraints in OT

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1. Introduction

Certain prosodic positions such as word-initial syllables and the root are inherently stronger than others. The strength of these positions is manifested in several ways, including, among others, the attraction of stress (see, for example, Hyman 1977 on initial stress, Alderete 2001 on root stress), segmental fortition processes (Zoll 1998, de Lacy 2001, Smith 2000, 2002), the ability to license a richer array of phonological contrasts than other positions and resistance to deletion or lenition phenomena that threaten to eliminate contrasts (see, for example, Steriade 1995, Casali 1996, Beckman 1999, Lombardi 2001).

Two types of analyses of positional strength have emerged in the Optimality-theoretic literature. One approach assumes a series of positionally defined faithfulness constraints ensuring preservation of contrasts in strong environments (e.g. Casali 1996, Steriade 1997, Beckman 1999, Lombardi 2001). Another approach invokes positional markedness constraints to capture segmental fortition processes and distributional asymmetries between strong and weak positions (Zoll 1998, de Lacy 2001, Smith 2000, 2002). As these latter works show, positional faithfulness cannot explain cases in which contrasts neutralize in strong positions. For example, prominent positions are often targeted by segmental fortition processes that neutralize underlying contrasts, e.g. restrictions against high sonority onsets, onset epenthesis, vowel lengthening. These fortition processes cannot be attributed to positional faithfulness since they reflect decreased rather than increased faithfulness in the positions targeted by positional faithfulness constraints. An approach employing positional markedness constraints, on the other hand, successfully attributes fortition to constraints requiring increased prominence in strong positions.

This paper presents evidence for a novel family of positional markedness constraints singling out two of the prominent positions identified in the literature: word-initial syllables and syllables in the root. It will be shown that Weight-by-Position Adjunction (Hayes 1989) in certain languages preferentially applies in these psycholinguistically prominent positions, which play an important role in speech processing (see Smith 2002 for an overview). The asymmetric application of Weight-by-Position (WBYP) attracts stress to CVC syllables in prominent positions but not to CVC in other less prominent environments. It is further shown that positional faithfulness constraints are ill equipped to handle positional weight effects, since positional weight does not crucially rely on input-output correspondence relations. Furthermore, unlike cases of non-positional but variable CVC weight of the type discussed by Rosenthall and van der Hulst (1999) and Morén (2000), true positional weight cannot be attributed to opportunistic application of WBYP triggered by other highly ranked metrical constraints.

Evidence from two languages in support of positional WBYP constraints is presented. First, Tamil (section 2) provides evidence for a positional WBYP constraint targeting word-initial syllables. Hupa (section 3) is analyzed with a positional WBYP constraint referring to root-initial syllables. The proposed positional WBYP is couched within Smith's (2002) larger theory of positional markedness constraints in section 4. Section 5 considers and ultimately rejects two alternative proposals to positional WBYP: the first relies on a variant species of positional markedness constraints requiring that word-initial and root syllables be heavy, while the second assumes positional faithfulness constraints.

2. Tamil

Evidence for a positional WBYP constraint referring to word-initial syllables comes from Tamil, a Dravidian language whose phonology is described by Christdas (1988, 1996). According to Christdas (1996), stress falls on the first syllable (1a) unless the first is CV and the second is CVV, in which case stress is peninitial.[1]

(1) Tamil stress (examples from Christdas 1996)

a. ráːttirij → [ráːttiri] 'night'

pálakaːram → [páləxaːrə̃] 'snacks'

ómpat → [ómbədɯ] 'nine'

ʋájal→ [ʋájəl] 'field'

rúːpaːj → [rúːʋaː] 'rupee'

sándeːkam→ [sándeːxə̃] 'mother'

káɳːaːʈij → [káɳɳaːɖi] 'field'

b. paláːʋ → [pəláː] 'jack fruit'

puṟáːʋ → [pɯṟáː] 'pigeon'

pɔṟáːmaj → [pɔṟáːmə] 'envy'

paráːtij → [pəráːdi] 'complaint'

The most difficult aspect of the Tamil stress system to explain is the difference in weight between initial and non-initial syllables. In particular, one must account for the fact that initial CVC attracts stress away from peninitial CVV, and that initial CV takes stress over peninitial CVC. Initial CV does not, however, attract stress over peninitial

CVV. In brief, this pattern can be analyzed as follows. CV is monomoraic and CVV is bimoraic, thereby accounting for peninitial stress in words beginning with CV.CVV. Initial CVC is bimoraic, thus explaining initial stress in words starting with CVC.CVV. Non-initial CVC is monomoraic, however, which accounts for initial stress in words beginning with CV.CVC.

The analysis of Tamil stress relies on a mixture of familiar metrical constraints and novel positional WBYP constraints. First, the attraction of stress by the first syllable in most words results from an alignment constraint requiring that stressed syllables align with the left edge of a word (Prince and Smolenksy 1993), ALIGN (σ́, L, PRWD), being ranked above ALIGN (σ́, R, PRWD). The peninitial stress pattern found in words beginning with CVCVV provides evidence for the relevance of weight constraints. The first constraint is Prince's (1990) Weight-to-Stress Principle (2), codified as a constraint (Prince and Smolensky 1993).

(2) Weight-to-Stress Principle (WSP): Heavy (i.e. bimoraic) syllables are stressed.

A faithfulness constraint, formulated by Morén (2000) as MAXLINK-μ[V], requires that underlying associations between moras and vowels be preserved on the surface, as formulated in shorthand in (3) (see Morén 2000 for full definitions of the MAXLINK-μ family of constraints).

(3) MAXLINK-μ[V]: Do not delete an underlying mora from a vowel (Morén 2000:376)

Peninitial stress in words starting with CVCVV obtains if MAXLINK-μ[V] and WSP are ranked above ALIGN (σ́, L, PRWD), as shown in (4).

(4)

pɔ$^{\mu}$r̠aː$^{\mu\mu}$ma$^{\mu}$j	MAXLINK-μ[V]	WSP	ALIGN (σ́, L, PRWD)
☞ pɔ$^{\mu}$r̠áː$^{\mu\mu}$mə$^{\mu}$			*
pɔ́$^{\mu}$r̠aː$^{\mu\mu}$mə$^{\mu}$		*!	
pɔ́$^{\mu}$r̠ə$^{\mu}$mə$^{\mu}$	*!		

The most challenging aspect of the stress system is to explain the variable weight of CVC. Two WBYP constraints capture this pattern. The first is a generic constraint requiring that coda consonants be moraic (5).

(5) WBYP: Coda consonants are moraic.

The second constraint requires that codas be moraic in initial syllables and represents our first example of a positional WBYP constraint (6).

(6) WBYP/σ_1: A coda consonant in the initial syllable of a word is moraic.

The fact that non-initial CVC does not attract stress away from initial CV indicates that generic WBYP is ranked below ALIGN (σ́, L, PRWD).[2]

(7)

ʋa$^{\mu}$ja$^{\mu}$l	ALIGN (σ́, L, PRWD)	WBYP
☞ ʋá$^{\mu}$jə$^{\mu}$l		*
ʋə$^{\mu}$já$^{\mu}$l$^{\mu}$	*!	

A long vowel does not attract stress away from an initial CVC syllable. This follows if the positional constraint WBYP/σ_1 is ranked above WSP. This ranking is diagnosed by words starting with CVC.CVV, in which WBYP/σ_1 together with MAXLINK-μ[V] ensure that the first two syllables are both bimoraic. Because only one stress is allowed per word, a violation of WSP is thus triggered leaving Align (σ́, L, PrWd) to pull stress onto the initial syllable (8).[3]

(8)

sa$^{\mu}$ndeː$^{\mu\mu}$ka$^{\mu}$m	WbyP/σ_1	MaxLink-μ[V]	WSP	Align (σ́, L, PrWd)
☞ sá$^{\mu}$n$^{\mu}$deː$^{\mu\mu}$xə̃$^{\mu}$			*	
sə$^{\mu}$ndéː$^{\mu\mu}$xə̃$^{\mu}$	*!			
sá$^{\mu}$n$^{\mu}$de$^{\mu}$xə̃$^{\mu}$		*!		
sə$^{\mu}$n$^{\mu}$déː$^{\mu\mu}$xə̃$^{\mu}$			*	*!

The last aspect of the system to cover is the confinement of stress to one of the first two syllables even if both are CV and a later syllable is CVV: (pá$^{\mu}$lə$^{\mu}$)xaː$^{\mu\mu}$rə$^{\mu}$ not *pə$^{\mu}$lə$^{\mu}$(xáː$^{\mu\mu}$)rə$^{\mu}$. The relevant constraint is a positional lapse constraint banning adjacent unstressed syllables at the left edge of a word, *Lapse Left (Gordon 2002). It is ranked above WSP. We are thus left with the following ranking schema for Tamil: *Lapse Left, MaxLink-μ[V], WbyP/σ_1 >> WSP >> Align (σ́, L, PrWd) >> WbyP.

At first glance it might seem that the different weight status of initial and non-initial CVC in Tamil could be attributed to a single generic WbyP constraint working in conjunction with other metrical constraints. Such an analysis has been developed for Kashmiri (Rosenthall and van der Hulst 1999 and Morén 2000), in which CVC is heavy only in the absence of a heavier CVV syllable in a stress-eligible position. The Tamil stress data, however, cannot be captured by other metrical constraints. WSP is ranked above Align (σ́, L, PrWd) to account for peninitial stress in words beginning with CV.CVV. In turn, Align (σ́, L, PrWd) must outrank WbyP in order to capture the initial stress in words commencing with CV.CVC. However, the ranking WSP >> Align (σ́, L, PrWd) >> WbyP by itself incorrectly predicts peninitial stress and a light initial

CVC in words starting with CVC.CVV. The attraction of stress by initial CVC over CVV thus must follow from a positional weight constraint of the type proposed here and not from independent metrical constraints in conjunction with a single WBYP constraint.

3. Hupa

Evidence for a positional weight constraint referring to the root comes from Hupa, a Pacific Coast Athabaskan language (see Gordon and Luna to appear for further discussion of Hupa stress). In Hupa, stress falls on the leftmost long vowel in a word, whether that long vowel belongs to the root or not (9a). (The root is bracketed in the examples). In words lacking a long vowel and containing a monosyllabic root, the most common root shape in Athabaskan languages, stress falls on the root syllable (9b). Because of a general constraint against root final short vowels (Golla 1970), the stressed root syllable in such cases will always be CVC. Positional weight rears its head in polysyllabic roots in words not containing a long vowel. In such roots, stress falls on the leftmost CVC syllable (9c).

(9) Hupa stress (examples from author's fieldnotes)

a. [k'ɪléːxɪtʃ] 'boy'

tʃ'ɪɬɪ[q'áːw] 'he's fat'

[éːbilos] 'apple'

[q'antʃúːltʃʷɪl] 'teenage boy'

méːneːs[kit] 'I was afraid'

nɪlxʷéː[lɪk]tʰe 'I'll tell you'

b. nɪ[tɬ'ítʃ'] 'it's hard'

nɪs[kʰín] 'fir tree'

xoʌ[tʃ’ít] ‘I know him’

kʲ’oʔwi[láw] ‘He went fishing’

c. [míntɪtʃ] ‘wildcat’

noh[xóntah] ‘our house’

[xóltʃeh] ‘skunk’

[aláʃ] ‘nasty’

[ɪtʃɪpéh] ‘I’m afraid’

[tʃ’áhlaʔqateʔ] ‘sunflower’

[táhmɪneʔ] ‘yellow moss, lichen’

ALIGN (σ́, L, PRWD) captures the general leftward attraction of stress in cases of weight ties, e.g. nóːk’ɪneːjoːt not *noːk’ɪneːjóːt.[4] MAXLINK-μ[V] and WSP are both ranked above ALIGN (σ́, L, PRWD), thereby accounting for the stress on non-initial CVV.

(10)

[k’ɪ^{μ}leː^{μμ}xɪ^{μ}tʃ]	MAXLINK-μ[V]	WSP	ALIGN (σ́, L, PRWD)
☞ k’ɪ^{μ}léː^{μμ}xɪ^{μ}tʃ			*
k’í^{μ}leː^{μμ}xɪ^{μ}tʃ		*!	
k’í^{μ}le^{μ}xɪ^{μ}tʃ	*!		

MAXLINK-μ[V] is ranked above WSP, since words with more than one long vowel have a single stress but do not shorten unstressed long vowels: nóːk’ɪneːjoːt not *nóːk’ɪnejot.

Turning to the treatment of CVC, generic WBYP is ranked below MAXLINK-μ[V] and WSP, as CVC to the left of CVV fails to attract stress.

(11)

nɪ$^{\mu}$lx^{w}eː$^{\mu\mu}$[lɪ$^{\mu}$k]t^{h}e$^{\mu}$	MaxLink-μ[V]	WSP	WbyP
☞ nɪ$^{\mu}$lx^{w}éː$^{\mu\mu}$lɪ$^{\mu}$kt^{h}e$^{\mu}$			**
ní$^{\mu}$l$^{\mu}$x^{w}eː$^{\mu\mu}$lɪ$^{\mu}$kt^{h}e$^{\mu}$		*!	*
ní$^{\mu}$l$^{\mu}$x^{w}e$^{\mu}$lɪ$^{\mu}$kt^{h}e$^{\mu}$	*!		*

The positional weight constraint WbyP/Root (12) comes into play in ensuring the attraction of stress by CVC in the root over prefixal CVC in words lacking a prefix CVV.

(12) WbyP/Root: A coda consonant in a root syllable is moraic.

WbyP/Root is ranked above Align (σ́, L, PrWd).

(13)

xo$^{\mu}$ʍ[tʃ'ɪ$^{\mu}$t]	WbyP/Root	Align (σ́, L, PrWd)
☞ xo$^{\mu}$ʍtʃ'í$^{\mu}$t$^{\mu}$		*
xó$^{\mu}$ʍ$^{\mu}$tʃ'ɪ$^{\mu}$t	*!	

Generic WbyP cannot get the result in (13), since both the winner and the failed candidate violate it once.

The ranking of WbyP/Root over Align (σ́, L, PrWd) derives the attraction of stress by root CVC over a preceding CV belonging to the root, as shown in (14). The second candidate fails due to its non-moraic root-final consonant.

(14)

[a$^{\mu}$la$^{\mu}$ʃ]	WbyP/Root	Align (σ́, L, PrWd)
☞ a$^{\mu}$lá$^{\mu}$ʃ$^{\mu}$		*
á$^{\mu}$la$^{\mu}$ʃ	*!	

WSP outranks WBYP/ROOT, thereby ensuring that a CVC syllable in the root fails to attract stress away from a long vowel to its right within the root: [q'a$^{\mu}$ntʃúː$^{\mu\mu}$ltʃ^{W}ɪ$^{\mu}$l] not [q'á$^{\mu}$n$^{\mu}$tʃuː$^{\mu\mu}$ltʃ^{W}ɪ$^{\mu}$l].

There is no means for establishing the relative ranking of WBYP and ALIGN (σ́, L, PRWD). In order to diagnose the ranking of these two constraints, it would be necessary to find a word satisfying three conditions. First, the word would have to contain a CV.CVC string to the left of the root where WBYP/ROOT is irrelevant. Second, the word would have to lack CVV, since CVV independently attracts stress over CVC. Finally, the root would have to not contain any CVC, since WBYP/ROOT ensures that root CVC carries stress over prefixal CVC. It is this last requirement that cannot be satisfied, since all roots end in CVC or CVV.

One other complication not yet discussed concerns syllables ending in a glottal consonant, i.e. glottal stop or /h/. A glottal-final syllable optionally relinquishes stress to the leftmost syllable even if the glottal-final syllable is the only CVC in the word: ʍɪ́[taʔ] or ʍɪ[táʔ] 'my mouth', nɪ́[t'ah] or ni[t'áh] 'your pocket', k^{j}'óʔwin[lah]t^{h}e or k^{j}'oʔwin[láh]t^{h}e 'He will fish'. This means that another constraint banning moraic consonants lacking place features optionally outranks WBYP/ROOT. This constraint is formulated in (15).

(15) HAVEPLACE-μ[5]: A moraic consonant must have place features.

When HAVEPLACE-μ is ranked above WBYP/ROOT, ALIGN (σ́, L, PrWd) is able to pull stress leftward to the beginning of a word lacking CVV and containing a root with a single CVC syllable closed by a glottal consonant, as in (16).

(16)

kʲ'oʔwin[lah]tʰe	HAVEPLACE-μ	WBYP/ROOT	ALIGN (σ́, L, PRWD)
☞ kʲ'óᵘʔwiᵘnlaᵘhtʰeᵘ		*	
kʲ'oᵘʔwiᵘnláᵘhᵘtʰeᵘ	*!		**
kʲ'oᵘʔwiᵘnláᵘhtʰeᵘ		*	*!*
kʲ'óᵘʔᵘwiᵘnlaᵘhtʰeᵘ	*!	*	

The second and the fourth candidate in (16) both fail due to their moraic glottal consonants: /h/ in the second candidate and glottal stop in the fourth candidate. Candidates one and three (and four, as well, though its fate has already been decided) both have non-moraic coda glottals in the root and thus violate WBYP/ROOT. It then comes down to ALIGN (σ́, L, PrWd), which weeds out the third candidate with root stress in favor of the candidate with initial stress. It may be noted that the winning candidate and the fourth candidate both have initial stress and differ only in the moraic status of the glottal coda in the initial syllable.

If WBYP/ROOT is ranked above HAVEPLACE-μ, candidate two from (16) emerges as the victor, as shown in (17).

(17)

kʲ'oʔwin[lah]tʰe	WBYP/ROOT	HAVEPLACE-μ	ALIGN (σ́, L, PRWD)
kʲ'óᵘʔwiᵘnlaᵘhtʰeᵘ	*!		
☞ kʲ'oᵘʔwiᵘnláᵘhᵘtʰeᵘ		*	**
kʲ'oᵘʔwiᵘnláᵘhtʰeᵘ	*!		**
kʲ'óᵘʔᵘwiᵘnlaᵘhtʰeᵘ	*!	*	

The final Hupa rankings are thus: MAXLINK-μ[V] >> WSP >> {WBYP/ROOT <<>>HAVEPLACE-μ} >> WBYP, ALIGN (σ́, L, PrWd).

As in Tamil, there is no metrical constraint in Hupa that can account for the asymmetry between heavy root CVC and light prefixal CVC. ALIGN (σ́, L, PRWD) is unable to derive the asymmetry, since prefixal CVC fails to attract stress from root CVC, contrary to prefixal CVV, which does attract stress from root CVV. Conversely, a constraint requiring that roots be stressed (Alderete 2001) captures the attraction of stress by root CVC or prefixal CVC but incorrectly predicts that root CVV would attract stress from prefixal CVV as well. A positional weight constraint, in contrast, accounts for both the stress attraction by root CVC over prefixal CVC and the attraction of stress by prefixal CVV over root CVV.

4. WBYP constraints and the theory of positional markedness constraints

Positional WBYP constraints referring to word-initial syllables and the root represent an extension of the set of constraint families proposed in Smith's (2002) comprehensive theory of positional markedness constraints. Smith diagnoses word-initial position and the root as psycholinguistically prominent positions due to their important role in lexical access. In Smith's account, a series of positional markedness constraints require these strong positions to contain prominent elements. According to Smith's Segmental Contrast Condition, positional markedness constraints are crucially prosodic rather than segmental, thereby ruling out unattested segmental neutralization processes targeting strong syllables, e.g. loss of consonantal contrasts or contrasts in vowel height or place. Positional WBYP is consistent with the Segmental Contrast Condition as WBYP constraints are prosodic rather than segmental and thus do not neutralize the set of segmental contrasts in psycholinguistically strong positions. In summary, viewed from a broader typological perspective, positional WBYP constraints have the advantage of not requiring any modifications to the core principle hypothesized by Smith to constrain positional markedness constraints in word initial and root syllables.

5. Alternative accounts

5.1. Positional WBYP vs. positional syllable weight constraints

An alternative to positional WBYP constraints would be to assume positional markedness constraints requiring that psycholinguistically prominent syllables be heavy. One constraint, HEAVYσ/σ_1, would require that word-initial syllables be heavy, while another constraint, HEAVYσ/ROOT would require that root syllables be heavy. These constraints would be similar to constraints proposed by Smith (2002) to account for the tendency for stressed syllables to be heavy, but would differ in the domain of application, referring to psycholinguistically strong positions rather than phonetically strong contexts. Virtually the same constraint rankings would obtain in an analysis substituting HEAVYσ/σ_1 and HEAVYσ/ROOT for WBYP/σ_1 and WBYP/ROOT, except that the constraint requiring that output vocalic moras have an input correspondent, DEPLINK-μ[V] (Morén 2000), would be ranked above the relevant positional HEAVYσ constraint in both languages in order to block lengthening of short vowels in strong positions.

Although HEAVYσ/σ_1 and HEAVYσ/ROOT could correctly account for the Tamil and Hupa data, respectively, cross-linguistic evidence suggests that positional WBYP constraints provide a better fit to the typology of weight effects. Through constraint re-ranking, an analysis based on HEAVYσ/σ_1 and HEAVYσ/ROOT predicts the existence of languages in which all initial syllables are heavy and languages in which all root syllables are heavy. These patterns reflect the ranking of HEAVYσ above either DEPLINK-μ[V], in which case the strong syllable is made heavy through vowel lengthening, or above

DEPLINK-μ[C], in which case the following onset is geminated to satisfy the HEAVYσ constraint. Although many languages, Hupa included, have a minimal bimoraic root requirement, I am not aware of any languages that require all word-initial syllables to be heavy unless this requirement is a by-product of an independent constraint banning monomoraic stressed syllables. Thus, the pattern resulting from ranking HEAVYσ/σ_1 above DEPLINK-μ[V] appears to be unattested. In contrast, positional WBYP constraints have the virtue of not predicting unattested vowel lengthening effects, since they are sensitive to coda weight only and ignore vowels.

5.2. Positional faithfulness

Unlike an account based on positional markedness constraints, positional faithfulness constraints fail to account for the Tamil and Hupa facts, since the positional weight asymmetry between heavy and light CVC in both languages is not a matter of faithfulness. A positional faithfulness analysis would be feasible only if one were to assume that coda consonants are all underlying moraic, in which case a positional faithfulness constraint relativized to initial syllables in Tamil and root syllables in Hupa would ensure that coda moras are preserved only in strong syllables. Such an assumption is untenable, however, in light of Richness of the Base (Prince and Smolensky 1993), which mandates that non-contrastive properties be enforced by surface constraints rather than by restrictions on input forms. Although Tamil has geminate consonants, which behave parallel to codas not forming the first half of a geminate, there are many coda consonants that do not belong to a geminate. Hupa completely lacks monomorphemic geminate consonants. Thus, unlike in the case of vowels, there is no link between contrastiveness in consonant length and weight of CVC that would allow an analysis based on positional faithfulness to ensure that coda consonants surface with a mora only in strong positions.

6. Conclusions

In summary, the same prosodic positions that receive preferential treatment with respect to segmental properties and stress also provide a boost in the weight of CVC in certain languages. Thus, in Tamil, CVC is heavier in word-initial position than elsewhere, while in Hupa, CVC in the root is heavier than CVC belonging to an affix. Position-sensitive Weight-by-Position constraints effectively model the CVC weight asymmetries in Tamil and Hupa. Positional weight in Tamil and Hupa cannot be attributed to satisfaction of independent metrical constraints. Furthermore, Richness of the Base precludes the use of faithfulness constraints to analyze positional variation in coda weight.

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[1] Christdas (1996) reports that the primary phonetic property associated with stress is vowel reduction in unstressed syllables. Short /a/ and /u/ reduce to [ə] and [ɯ], respectively, and /i/ often laxes to [ɪ]. Further support for the stress patterns comes from a phenomenon which Christdas terms “emphasis”, by which a stressed syllable is lengthened when carrying contrastive scope.

[2] The fact that peninitial CVC closed by a geminate fails to attract stress from either initial CV or initial CVC, e.g. tá$^{\mu}$ŋgə$^{\mu}$cci$^{\mu}$ ‘younger sister’, indicates that MaxLink-μ[C] is also ranked below Align (σ́, L, PrWd) (see Ham 2001 for discussion of non-moraic representations of geminates).

[3] Note that there is an additional candidate in (8) which must be ruled out: a candidate with stress on both the initial and peninitial syllable: sá$^{\mu}$n$^{\mu}$déː$^{\mu\mu}$xə̃$^{\mu}$. Given that WSP is ranked above Align (σ́, L, PrWd), Align (σ́, L, PrWd) cannot rule out this candidate. Following Morén’s (2000) analysis of Kashmiri, another language with variable CVC weight, I assume an undominated constraint (not shown here) which bans multiple stresses in the same word and which is ranked above WSP and the WbyP constraints.

[4] As in Tamil, an undominated constraint bans multiple stresses in the same word.

[5] Thanks to a reviewer for suggesting this analysis. See also Bagemihl (1991) and Hargus (2001) on non-moraic glottals in Bella Coola and Witsuwit’en, respectively.