Latent feet in prosodic phonology

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Lee, Yongsung. 2008. Latent feet in prosodic phonology. Studies in Phonetics, Phonology and Morphology 14.3. 445-463. Not all foot-heads are stressed. Latent feet are the feet that do not have phonetic stress, though they have head elements. They surfaces when the constraint, FTHD=STRESS, is violated by being dominated by other related constraints such as PWD-PROM or NOCLASH. This interaction explains the absence of secondary stresses in Cairene Arabic, which crucially refers to maximally parsed foot structure for locating the primary stress. In Tiberian Hebrew, we see that secondary stresses show up on a selective basis. Secondary stress is assigned to the foot-heads which are not in the clash environments. The latent foot proposal, an OT extension of stressless feet, offers simpler and more consistent analysis of the lack of secondary stresses in Cairene Arabic and the selective presence of secondary stress in Tiberian Hebrew than previous related proposals. Further the same proposal can explain the selective absence of secondary stress in English. (Pusan University of Foreign Studies)

Keywords: latent feet, stress assignment, Arabic, Hebrew, Latin prefixation, English stress, Optimality theory, prosodic phonology.

1. Introduction

Metrical theory tacitly assumes that all the foot-heads are phonetically interpreted to carry some degree of stress. So an English word like Mississippi, parsed as (MIssi)(SSIppi), where the foot-heads are marked by capital letters, shows that all the foot-heads are stressed. The first foot-head carries a secondary stress and the second foot-head has a primary stress that gives the stress pattern, Mississippi. The corollary of this assumption is that if there is only one stress, then there is only one foot. A word like ba(nána), having just one foot, does not have any secondary stress. More specifically, the first syllable in banana does not have any stress, since it does not constitute a foot by itself. As such, it is assumed that there is a definite bijectivity principle between foot and stress. If there is a foot, there is a stress and if there is a stress then there must be a foot.

Optimality theory opens a possibility that surface-true forms are selected based on violable constraints and their relative ranking. Under such assumption, the bijectivity principle may be viewed not as a hard universal that all languages should obey but as a soft violable constraint. In other

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words, we can say that FOOTHEAD=STRESS is a part of universal constraints that can be violated in certain languages. If FOOTHEAD=STRESS is dominated, for example, by such constraints as NOCLASH (No stressed syllables are adjacent. cf. Kager 1999: 165), then a monosyllabic foot before a prosodic word head may not carry any stress. The foot that does not have any explicit stress is called a latent foot in this paper.

This paper argues that the latent foot proposal is a simple and straightforward way to deal with non-surface-true foot in prosodic phonology. It replaces or obviates tier conflation and/or sympathy approach to opaque stress, thereby simplify the phonological explanation. This paper supports the latent foot proposal with the analyses of Cairene (Classical) Arabic stress and vowel reduction in Tiberian (Biblical) Hebrew. It will be shown that latent feet are more than just a formal equivalent to tier conflation or sympathy. There are aspects that cannot be dealt with tier conflation, but can be explained with latent feet as will be illustrated with English examples in section 4.

The paper is organized as follows. In section 2, a proposal will be made that FOOTHEAD=STRESS is actually a violable constraint. When this constraint is dominated, not all the foot-heads may actually have stress. But such latent feet are referenced in explaining prosodically conditioned segmental phonology. Cairene (Classical) Arabic stress assignment and Tiberian (Biblical) Hebrew vowel reduction will be reanalyzed with the latent foot proposal. In section 3, previous proposals are introduced and compared. Here we see that the latent foot proposal is a logical extension and theoretical implementation of stressless feet proposed in Hayes (1995: 119). In section 4, the latent foot proposal will be extended to sonorant distressing and Latin-prefixation in English. Latinate prefixes such as {re-}, {pre-}, and {de-} seem to have long vowels though these prefixes do not carry any stress. It will be shown that tier conflation fails to explain the relevant data. Section 5 sums up and concludes the paper.

1. Latent foot proposal

The tacit assumption that every foot is correlated to some degree of stress can be made explicit by positing the following bijectivity principle:

(1) Bijectivity between headedness and stress
   a. If a foot-head, then there is stress.
   b. If stressed, then it is a foot-head.

It seems that both parts of the bijectivity condition have problematic aspects. In the literature on prominence based stress, (1b) is not considered to be a valid generalization. Prominence-based stress system does not need explicit foot parsing as shown in Hayes (1995) and Walker (1997) among others. Further (1a) necessitates unnecessary and sometimes problematic proposal to get rid of unwanted foot to abide by the bijectivity principle. We may translate (1a) into a constraint as given in (2):

(2)
(2) FOOTHEAD=STRESS (FTHD=STRESS)

A foot-head is stressed.

(Assign an asterisk for any foot that does not have stress.)

Given the principle in (1a), we might say that the constraint in (2) is inviolable in any human languages. The claim, however, seems to be too strong. We find cases where a foot structure must be present to explain the stress fact or foot-related segmental phonology, though there is no stress evidence of foot structure on the surface. The need for such non-surface-present feet or latent feet as named in this paper is found in much of the discussion in the literature. Some of them are given in (3):

(3) Need for Latent feet

a. Cairene Arabic stress: main stress assignment needs full footing, but there is no secondary stress. (de Lacy, 1998)
b. Tiberian Hebrew vowel reduction: vowels are deleted or reduced in weak position of a foot, which may not have overt stress on the surface. (Halle & Vergnaud, 1987, Churchyard, 1999)
c. Seminole/Creek main stress assignment is based on maximal quantity sensitive iambic parsing from the beginning of the word, but there is no evidence for secondary stresses. (Hayes 1995: 64-67)
d. Yawelmani vowel deletion when flanked by two light syllables is best described with full parsing. But there is no secondary stress. (Archangeli, 1984)
e. A Panoan language, Shipibo has a morphological alternation, *ribi*/riba, which crucially refer to fully parsed structure, but there is no secondary stress. (Eliás-Ulloa, 2005)
f. In Yaminahua, another Panoan language, many segmental changes, including vowel alternation, vowel insertion, consonant deletion and allomorph selection refer to fully parsed foot structure, but there is no reported secondary stress. (Gonzáles, 2005a)
g. Gonzáles (2005b) summarizes that phonology of other Panoan languages such as Capanahua glottal stop deletion, Huariapano [h] epenthesis, Amahuaca segmental phonology, Matis allomorph alternation are easily explained with maximally parsed feet. Again there is no secondary stress in these languages.

The illustrations given in (3) are part of what latent foot proposal can explain.1

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1 Prominence-based stress system may be analyzed with latent foot proposal. If we allow latent feet then we do not have to invoke special mechanism for prominence-related stress system. Researchers in metrical phonology have proposed separate mechanisms for prominence-based stress and foot-based stress as shown in Prince & Smolensky (1993), Hayes (1995), Zoll (1996) and Walker (1997) among others. In prominence-based stress, there is no overt foot that is related to the stress. Note that Halle & Vergnaud (1987: 50-55) employed non-binary feet to deal with prominence-based stress with final tier conflation to get rid of unwanted stressless feet. The latent feet, in this line of thought, can provide foot-based account to prominence-based stress system. Any further discussion on this topic is open to further research.
Of these, we will be focusing on the first two languages, which show that we need an intermediate stage where all the syllables are parsed into feet, but these feet are not phonetically interpreted to have stress or prominence.

In this paper, we argue that $F_{THD}=STRESS$ is actually a violable constraint, which can be dominated by prosodic word prominence as given in (4):

\[(4) \text{PROSODIC WORD PROMINENCE (PWD-PROM) (cf. MONOHEADEDNESS in Crowhurst 1996: 418, Uni-Pk in Kager 2000)} \]

A prosodic word has a unique prominence.

(Assign an asterisk for all the prosodic words that have no or multiple prominence.)

Now consider the ranking between $F_{THD}=STRESS$ and PWD-PROM. The ranking $[[F_{THD}=STRESS « PWD-PROM]]$ gives us the usual interpretation: all foot-heads carry stress. But the reversed ranking $[[PWD-PROM « F_{THD}=STRESS]]$ chooses a candidate with a primary stress but no secondary stress, hence the presence of latent feet. This is more than just a simple interpretation of tier conflation as proposed in Halle & Vergnaud. Suppose the ranking $[[M « F_{THD}=STRESS « PWD-PROM]]$, where $M$ is a certain markedness constraint that interacts with stress assignment. In this case, there are both primary and secondary stresses in that language, due to the ranking $[[F_{THD}=STRESS « PWD-PROM]]$, but the secondary stress is suppressed if and only if the presence of stress leads to the violation of $M$. As we will see, this is what happens in Tiberian Hebrew secondary stress placement.

Cairene Arabic stress in (3a) can be explained with the ranking $[[PWD-PROM « F_{THD}=STRESS]]$, while we need $[[NOCLASH « F_{THD}=STRESS « PWD-PROM]]$ to explain Tiberian Hebrew vowel reduction and stress facts. We will first present latent foot analyses of these two languages, Cairene Arabic and Tiberian Hebrew, to see how the latent feet interact with stress assignment and/or segmental phonology such as vowel reduction. These two languages are chosen, because they have quite different patterns on the surface. In Cairene Arabic, there is no secondary stress at all, though full parsing should be presupposed for the correct location of the main stress, Tiberian Hebrew shows the selective presence of the secondary stress: secondary stress is allowed only in non-clash environments. Each can be explained independently of the other. But this paper shows that despite the superficial difference, they both present evidence for the stressless feet.

2.1 Cairene Classical Arabic Stress Assignment

We will first take a look at the Cairene (Classical) Arabic (=CCA) stress to see how latent feet interact with primary stress assignment. CCA, according to Hayes (1995: 69) has moraic trochee structure with final
consonant and final mora (of a bimoraic open syllable) extrametricality. The feet are constructed from left to right. Heavy syllables form a foot by itself and degenerate feet are banned. With this we can actually see that the main stress falls on the head of the final foot as shown in (5):


<table>
<thead>
<tr>
<th>Footed Form</th>
<th>Actual Stress</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ka(ta)b(&lt;)t&gt;</td>
<td>[katábt]</td>
<td>‘I wrote’</td>
</tr>
<tr>
<td>(sa.ka)(kii)(&lt;)n&gt;</td>
<td>[sakakíin]</td>
<td>‘knives’</td>
</tr>
<tr>
<td>(ka.ta)(ba)</td>
<td>[kátába]</td>
<td>‘he wrote’</td>
</tr>
<tr>
<td>(ka.ta)(bitu)</td>
<td>[katábitu]</td>
<td>‘they wrote’</td>
</tr>
<tr>
<td>(j.a.(d)a)(ra.tu)hu</td>
<td>[jádará́tuhu]</td>
<td>‘his tree’</td>
</tr>
<tr>
<td>b. (mad)(rada)</td>
<td>[madrá́sa]</td>
<td>‘school’</td>
</tr>
<tr>
<td>(mus)(tafa)</td>
<td>[mustáfa]</td>
<td>‘personal name’</td>
</tr>
<tr>
<td>(mun)(ta.xa)(ba)</td>
<td>[muntáxaba]</td>
<td>‘elected (pausal)’</td>
</tr>
<tr>
<td>(ʃ a.(ʤ)a)(ra.tu)hu</td>
<td>[ʃ a.ʤ arátuhu]</td>
<td>‘his tree’</td>
</tr>
<tr>
<td>(ʃ a.(ʤ)a)(ra.tu)(hu).(ma)(&lt;)μ</td>
<td>[ʃ a.ʤ arátuhuma:μ]</td>
<td>‘their (dual) tree’</td>
</tr>
<tr>
<td>(ʔ ad)(wi.(ʤ)a)(tu.hu)(ma)(&lt;)μ</td>
<td>[ʔ adwi.ʤ atúhuma:μ]</td>
<td>‘their (dual) drugs’</td>
</tr>
</tbody>
</table>

The examples nicely illustrate that main stress pattern is neatly explained with full footing given in the first column of (5). The main stress falls on the head of the final foot, presumably due to the effect of \textit{EDGE-RIGHT}. Without full parsing, we may generalize the stress fact as follows:

(6) Describing the distribution of the primary stress in CCA

a. The main stress falls on the final super-heavy syllable. ((5a))

b. If the penultimate syllable is heavy, then stress that syllable. ((5d))

c. If all syllables are light, stress the final odd numbered syllable counting from the beginning of a prosodic word, if it is not the final syllable. ((5b))

d. If there is any heavy syllable, then stress the final odd numbered syllable counting from the final heavy syllable, if it is not the final syllable of the word. ((5c) and (5e))

Though the generalization in (6) is valid, there is no plausible way to

\(^2\) Many of the words in (5) are words from classical Arabic, pronounced with Cairene Arabic stress patterns. In de Lacy (1998: 2) and in Crowhurst (1996), a different footing is proposed based on McCarthy (1979). In their approach, all syllables are parsed into feet allowing degenerate feet. So the second example of (5e) is parsed as (j.a.\(d\)a)(ra.tu)\(hú\).\(ma\).\(n\)). We will not compare these two approaches and will simply adopt Hayes’s proposal. In any case, the different parsing does not affect the analysis given in this paper.
implement the entire syllable counting algorithm with constraints, if we do not allow full parsing.\(^3\) The full parsing, though, creates feet that do not have any stress. The bijectivity condition given in (1) leads to the prediction that there should be secondary stresses in the remaining feet. This is where the problem starts. On one extreme end of the proposal, we can say that there are secondary stresses in CCA (as in Weldon 1980). Or researchers try to come up with repair measures to deal with the unwanted prediction on the secondary stress. Putting detailed discussion on such discussion aside for the next section, we see that the proposal on latent feet can deal with the stress fact in a direct way.

We assume that the feet are present on the surface, but not all feet are prosodically interpreted to have surface stresses. Let us first briefly touch upon the constraints related to full parsing.

(7) Constraints for CCA stress
- **TROCHEE**: Feet are left headed.
- **FTBIN**: Feet are binary on moraic level.
- **PARSE-\(\sigma\)**: Syllables are parsed into feet.
- **EDGE-RIGHT**: Prosodic heads are located at the right edge.
- **ALL-FT-LEFT**: Parsing begins from Left to Right.
- **PWD-PROM**: There is only one stress.
- **FTHD=STRESS**: Foot-heads are stressed.

(8) Ranking
- No degenerate foot: **FTBIN** \(\gg\) **PARSE-\(\sigma\)**
- No secondary stress: **PWD-PROM** \(\gg\) **FTHD=STRESS**
- There are stressless feet: **PARSE-\(\sigma\)** \(\gg\) **FTHD=STRESS**
- Foot building is iterative: **PARSE-\(\sigma\)** \(\gg\) **ALL-FT-LEFT**
- Partial ranking: **TROCHEE, FTBIN, NONFIN, PWD-PROM** \(\gg\) **PARSE-\(\sigma\)** \(\gg\) **ALL-FT-LEFT** \(\gg\) **EDGE-RIGHT** \(\gg\) **FTHD=STRESS**

In the actual analysis of CCA stress, we may need more elaboration on the ranking of proposed constraints and more constraints than those given in (7), that explain the directionality of footing (**ALL-FT-LEFT**) and final mora (in the long vowel) extrametricality (**FREE-\(\mu\)**, or the equivalent), but we will not go into the details of the foot parsing for the sake of simplicity. Now consider the following tableaux:

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\(^3\) See de Lacy (1998) for detailed discussion on the need of full-parsing. The critical examples are in (5c). In LLL structure, the first syllable (the ante-penult syllable) is stressed while in LLLL the penultimate syllable is stressed. This is the result of the conflict in directionality: syllable-parsing starts from the beginning of a word, but stress is assigned to the final non-degenerate foot. Making one trochee at the end of the word fails to explain (5b). Thanks go to an anonymous reviewer for pointing this out to me.
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(9) Evaluation tableaux

<table>
<thead>
<tr>
<th>sakakiin</th>
<th>TROCHEE, FtBIN, PWD-PROM</th>
<th>PARSE -σ</th>
<th>ALLFEET-LEFT</th>
<th>EDGE-RIGHT</th>
<th>FtHD=STRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. (saka)(kii)n</td>
<td>✓</td>
<td>*</td>
<td>**</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>ii. (sàka)(kíi)n</td>
<td>✓</td>
<td>*(PWD-PROM)</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii. (saka)(kii)n</td>
<td>✓</td>
<td>*!</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv. (saka)(kii)n</td>
<td>✓</td>
<td>**</td>
<td>σ!σ</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>v. (saka)(kii)n</td>
<td>✓</td>
<td>*(PWD-PROM)</td>
<td>**</td>
<td>σσ</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>kataba</th>
<th>TROCHEE, FtBIN, PWD-PROM</th>
<th>PARSE-σ</th>
<th>ALLFEET-LEFT</th>
<th>EDGE-RIGHT</th>
<th>FtHD=STRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. (káta)(ba)</td>
<td>✓</td>
<td>*</td>
<td>σσ</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii. (káta)(ba)</td>
<td>✓</td>
<td>*(FtBIN)</td>
<td>**</td>
<td>σσ</td>
<td></td>
</tr>
<tr>
<td>iii. (káta)(ba)</td>
<td>✓</td>
<td>*</td>
<td>σ!</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>madrasa</th>
<th>TROCHEE, FtBIN, PWD-PROM</th>
<th>PARSE-σ</th>
<th>ALLFEET-LEFT</th>
<th>EDGE-RIGHT</th>
<th>FtHD=STRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. (mad)(rósa)</td>
<td>✓</td>
<td>*</td>
<td>σ</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>ii. (mád)(rósa)</td>
<td>✓</td>
<td>*(PWD-PROM)</td>
<td>*</td>
<td>σ</td>
<td></td>
</tr>
<tr>
<td>iii. mad(rósa)</td>
<td>✓</td>
<td>*!</td>
<td>σ</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For the ease of exposition, only the candidates that obey TROCHEE and FtBIN are shown in the tableaux in (9). The point here is that the foot-head may not be stressed, due to the interaction of relevant constraints. Note that the optimal forms in the tableaux in (9) have feet whose heads are not stressed. We need maximal parsing for correct primary stress assignments. The crucial example is given in (9b). We see that building one foot at the end of a word fails to explain the ante-penult stress as shown in (9biii). Then what we should do with those feet without stresses? Do we have to invoke another mechanism to erase superfluous feet, which may add complexity to the procedure? The answer is “No!” All we have to do is simply acknowledge that there is no bijectivity relationship between foot-heads and stress. There can be a latent foot, a foot with a stressless head, due to the low ranking nature of FtHD=STRESS in CCA.
2.2 Tiberian (Biblical) Hebrew vowel deletion and stress placement

Now let us move on to more complicated data from Tiberian (Biblical) Hebrew (=TBH). TBH needs covert feet to locate the vowel reduction sites, and the language has secondary stresses. Consider the following data that shows stress placement and vowel reduction:\(^4\)

<table>
<thead>
<tr>
<th>Footed form</th>
<th>Actual surface form</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. (ʔōha)(lay)</td>
<td>ʔōh'lē</td>
<td>‘tents of’</td>
</tr>
<tr>
<td>b. ʕē(naa)(bīim)</td>
<td>’nāabīim</td>
<td>‘grapes’</td>
</tr>
<tr>
<td>c. da(baa)(rii)m</td>
<td>d’baarīim</td>
<td>‘words’</td>
</tr>
<tr>
<td>d. (mar)kā(boot)</td>
<td>mark'bōot</td>
<td>‘chariots of’</td>
</tr>
<tr>
<td>e. (koo)t(g(biim)</td>
<td>koot’biim</td>
<td>‘writers (mas.)’</td>
</tr>
<tr>
<td>f. da(baa)r(ē)(kāa)</td>
<td>d’baar’kāa</td>
<td>‘your (m.sg.) word’</td>
</tr>
<tr>
<td>g. (ʔādā)(tmaa)(tiy)</td>
<td>’ad’maatīi</td>
<td>‘my ground’</td>
</tr>
<tr>
<td>h. (waʔa)(dab)b(ā)(rāa)</td>
<td>wā’dabb’rāa</td>
<td>‘and I spoke’</td>
</tr>
<tr>
<td>i. (mīn)(mīs)g(roo)(te)h(ēm)</td>
<td>mīmnīs’rōoteēhēm</td>
<td>‘from their (mas.) stronghold’</td>
</tr>
</tbody>
</table>

The footing given in the first column of (10) is based on Churchyard’s proposal. Churchyard (1999: 54) uses maximally bimoraic trochee iteratively from right to left to construct feet for TBH.\(^5\) And for the

\(^4\) The data are simplified to concentrate on the related aspects. First, the spirantization is not marked. Churchyard (1999) notes that stops are spirantized in certain phonological and morphological environments. Second, we will not go into Halle & Vergnaud’s (1987: 64) observation that there is pre-tonic lengthening that lengthens an open syllable before a syllable that has the main stress, which would interact with secondary stress assignment. Third, we will not be concerned with the word-final ay-ee alternation (10a) and iy-ii alternation in (10g). And finally, following Halle and Vergnaud (1987: 65) the reduced vowel is represented with an apostrophe. In reality, the reduced vowels can be actually deleted or are realized as weak vowels such as [ʔ], [ʔ], [ē] or [ə] (Churchyard 1999: 26) which are ‘either ultra short or schwa’ (Halle & Vergnaud 1987: 65). The simplification is to abstract away the irrelevant aspects to focus on stress and vowel reduction in the present discussion. As for secondary stress, Churchyard (1999: xvii) marks them only when it is relevant to his discussion. According to his description, CVVC syllables (derived from vowel reduction or deletion) have secondary stresses (p.106), and every other non-reduced syllable from the main-stress syllable carries secondary stress (p.40), though there are some variations (p.107). If we take his observation seriously, there should be a secondary stress on the first syllables in (10e) and (10g).

\(^5\) There are different proposals for footing Tiberian Hebrew words. For example, Halle & Vergnaud (1987:66) suggest that vowel reduction constituents are iambic, whereas stress feet are trochaic. The presence of multiple foot types within a language, however, is an even more recalcitrant problem to deal with. One particular example given in Halle & Vergnaud (1987:65), kotobeka→k’tob’kā (your (masc. sg.) writing), seems to suggest that iambic footing is needed. But other than that trochaic parsing for both stress and vowel reduction works without problem. Notice that the very example, k’tob’kā, suggests that the stress constituents should also be iambic. Either way, the example remains as a problematic exception.
convenience of exposition, the vowels reduced on the surface are marked with underlines in the first column. What we see here is a clear generalization that the vowels in weak syllable, a syllable not in the head of a foot, are subject to vowel reduction. As such full parsing correctly predicts the reduction sites for vowels. But there is one more complication. There are secondary stresses in TBH. Churchyard (1999: 40) says that “roughly speaking, a secondary stress is assigned to every other syllable containing an unreduced vowel.” As for our purpose, we might introduce NOCLASH to explain the presence of secondary stress. The relevant constraints and their ranking are given in (11) and (12):

(11) Constraints for TBH stress and vowel reduction.
\[ a. \ \text{TROCHEE: Feet are left-headed.} \]
\[ b. \ \text{FTBIN: Feet are binary on moraic level.} \]
\[ c. \ \text{PARSE-}\sigma: \text{Syllables are parsed into feet.} \]
\[ d. \ \text{EDGE-RIGHT: Prosodic heads are located at the right edge.} \]
\[ e. \ \text{PWD-PROM: There is only one stress.} \]
\[ f. \ \text{FTHD-STRESS: Foot-heads are stressed.} \]
\[ g. \ \text{NOWEAKSYLLABLE (\neg NO-}\acute{\sigma}:) \text{ Full vowels must be in the head position.} \]
\[ h. \ \text{NOCLASH: No adjacent stresses are allowed.} \]
\[ i. \ \text{NOLAPSE: No two unparsed syllables are adjacent.} \]

(12) Constraint Ranking
\[ a. \ \text{No degenerate foot: FTBIN } \text{PARSE-}\sigma \]
\[ b. \ \text{Full footing: NOLAPSE } \text{PARSE-}\sigma \]
\[ c. \ \text{There is a secondary stress: FTHD=STRESS } \text{PWD-PROM} \]
\[ d. \ \text{Stress clash is not allowed: NOCLASH } \text{FTHD=STRESS} \]
\[ e. \ \text{There is no surface violation of NO-}\acute{\sigma}, \text{FTBIN, NOCLASH, NOLAPSE: These are undominated.} \]
\[ f. \ \text{Partial ranking: TROCHEE, NO-}\acute{\sigma}, \text{FTBIN, NOCLASH, NOLAPSE } \text{FTHD=STRESS } \text{PWD-PROM, PARSE-}\sigma, \text{EDGE-RIGHT} \]

Most of the constraints given in (11) are independently motivated in other languages, except (11g), NOWEAKSYLLABLE (\neg NO-}\acute{\sigma}). Consider this constraint as a temporary and convenient device to explain the fact that full vowels are not allowed in the weak position of a foot, or in the unfooted syllable. This guarantees that full vowels in weak syllable must be reduced (or deleted). Now with the constraints and their ranking given in (11) and (12), the usual evaluation can correctly pick out the stress placement and the vowel reduction in Tiberian Hebrew. Consider the following exemplary tableaux.
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(13) Exemplary tableaux

a. /ʔohalay/ → [ʔohˈlée] (tents of) (10a)

<table>
<thead>
<tr>
<th></th>
<th>UNDOMINATED</th>
<th>FTHD=STRESS</th>
<th>PWD-PROM</th>
<th>PARSE:σ</th>
<th>EDGE-RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>ʔohˈlée</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii.</td>
<td>*(No-bl)</td>
<td>*</td>
<td>€</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td>*(NoCLASH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv.</td>
<td>*(NoLAPSE)</td>
<td></td>
<td></td>
<td></td>
<td>€</td>
</tr>
<tr>
<td>v.</td>
<td>*(vowel)</td>
<td>*</td>
<td></td>
<td></td>
<td>€</td>
</tr>
</tbody>
</table>

b. /dabaarekaa/ → [dˈbaarˈkáa] (your (m.sg.) word) (10f)

<table>
<thead>
<tr>
<th></th>
<th>UNDOMINATED</th>
<th>FTHD=STRESS</th>
<th>PWD-PROM</th>
<th>PARSE:σ</th>
<th>EDGE-RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>dˈbaarˈkáa</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii.</td>
<td>*(FtBin)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td>*(No-bl)</td>
<td>*</td>
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<tr>
<td>iv.</td>
<td>*(NoCLASH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>v.</td>
<td>*(vowel)</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

c. /waʔadabbəraa/ → [wàʔdabbˈráa] (and I spoke) (10h)

<table>
<thead>
<tr>
<th></th>
<th>UNDOMINATED</th>
<th>FTHD=STRESS</th>
<th>PWD-PROM</th>
<th>PARSE:σ</th>
<th>EDGE-RIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>(wàʔ)ˈdabbˈráa</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii.</td>
<td>*(NoCLASH)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td>*(NoLAPSE)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv.</td>
<td>*(vowel)</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>v.</td>
<td>*(vowel)</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The three tableaux are the sample evaluation of three examples given in (10). (13a) and (13b) illustrate that TBH needs full parsing to correctly predict the location of vowel reduction and stress assignment. Here again, we have to have a crucial assumption that some feet are not phonetically stressed. (13c) shows the divergence of TBH from CCA. Unlike in CCA, TBH has secondary stresses. But still not all the non-head feet are phonetically related to secondary stresses. In the absence of latent foot, which results from the interaction of relevant constraints, I do not see any possible way to explain CCA and TBH within a consistent framework. The basic mechanism, such as tier conflation, that prevents secondary stress in CCA will also block secondary stresses in TBH.

3. Previous proposals

In this section we will take a look at the previous proposals to deal with
CCA stress assignment and TBH stress and vowel reduction. We will see that these previous proposals may not properly analyze both of the languages in a consistent way. We see at least seven different proposals in the literature.

(14) Previous proposals

a. There are secondary stresses in CCA. (Weldon 1980)

b. Feet may not be phonetically interpreted. (Hayes 1995: 119)

c. Feet are grouped into cola in TBH. (Hayes 1995: 119, Halle & Clement 1983)


e. Tier conflation mechanism eliminates unwanted feet. (Halle & Vergnaud 1987: 50-55)

f. Sympathy theory can explain CCA stress. (de Lacy 1998)

g. HEADMAX requirement suppresses the secondary stress. (Crowhurst 1996)

First consider (14a). Weldon (1980) argues that there are overt secondary stresses in CCA. Since her observation given in the form of three statements does not match the stress data given in (5), there is no comparison with the present approach. Her basic claim is that secondary stresses appear on every other syllable counting left from the primary stress. The presence of secondary stresses in CCA, however, was disputed by de Lacy (1998) and was called for reconsideration in Hayes (1995: 71). Note that linguistically trained native speakers do not consider Cairene Arabic as having secondary stress. (p.c. with Davis) One special remark must be made in connection with secondary stress. Kenstowicz (1980) noted that there should be a metrical foot structure to account for the phrasal syncope in CCA. Kenstowicz uses the foot structure without specific claims that all the feet have stress correlates. His proposal is viewed in this paper, as an example that supports the presence of latent feet in CCA.

Hayes’s (1995: 119) remark on headless feet, given in (14b), is the basis of the proposal of latent feet in this paper. He suggests that “the phonetic and phonological rules of the language just happen not to provide any means of manifesting foot structure.” Hayes argues that such non-

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6 Weldon (1980: 99) summarizes that there are three generalizations in CCA stress patterns.

Statement I: Stress does not fall on the last syllable, whether it be heavy or not. (contra (5a))

Statement II: Stress falls on the last heavy syllable in a word. (contra (5c))

Statement III: If a heavy syllable does not occur, stress falls on the first syllable of a word. (contra (5b))

Weldon’s observation cannot account for the majority of data given in (5). Her claim on the presence of the secondary stress, however, may help the generalization, in the sense that the statements given above are about the primary as well as secondary stress patterns.
manifestation of foot structure is due to the lack of language-specific phonetic realization of stress. But given the detailed data from CCA and TBH, we may go one step further from Hayes in two respects. First, stressless feet are not the result of language-specific requirement, but the result of constraint interaction. Second, even the stressless feet actually do have heads. The natural extension of such line of thought leads to the constraint, FTHD=STRESS, that interacts with other relevant constraints to show the effect of the presence and absence of secondary stresses on the surface.

Further, Hayes’s assumption on the foot structure leads to propose another representational mechanism, a colon, to deal with the secondary stress in TBH given in (14c). The gist of his proposal is that non-head feet are grouped into cola with strong-weak labeling. This explains the selective presence of secondary stresses in TBH two syllables away from the stressed syllable. But notice that we need two different proposals for CCA and TBH. We need language specific non-manifestation requirement on foot structure for CCA and we need separate cola to explain the existence of selective secondary stresses assigned to every other foot in TBH. The proposal in this paper, however, combines these two and can analyze both of the languages without invoking language-particular conditions on stress realization.

The multi-planar representation approach in (14d) is a very strong assumption. It assumes that there can be more than one metrical representation. For example, in CCA, we may have two different representations, one plane with maximally parsed metrical structure, and the other is the surface structure that has only one foot (or stress). Halle & Vergnaud (1987: 66), based on Rappaport (1984), went as far to propose that there are two different metrical planes for TBH: one plane shows trochaic parsing to deal with the stress, and another plane that has iambic parsing to explain the vowel reduction in TBH. Such approach predicts that vowel reduction has nothing to do with stress or foot structure, which is clearly uncalled for. De Lacy (1998) was right in criticizing that such multiple representations are something that should be kept to minimum.

Tier conflation in (14e) is a well motivated mechanism to explain the absence of secondary stress on the surface without invoking multiple metrical planes. First the strings of syllables are maximally parsed into feet, then locate the primary stress and finally tier conflation erases the existing foot structures. This is a very convincing mechanism for CCA, but we need something more to incorporate TBH data. Note that tier conflation eliminates foot structure all together and that predicts the total absence of secondary stresses. And if tier conflation is not applied, all feet surface with stress. But we are faced with selective secondary stress in TBH. Some feet have secondary stress while other feet are stressless. Therefore, the brute force of tier conflation fails to deal with the selective secondary stresses found in TBH. We may still need cola, or the like, to explain the
distribution of secondary stresses in TBH. Or we may invoke refooting process after tier conflation, grouping two heavy syllables into syllable trochees.

The Sympathy proposal in (14f) may be viewed as the interpretation of tier conflation in Optimality frameworks. As noted in connection with tier conflation, we need maximally footed structure though there is no secondary stress on the surface. The basic claim in de Lacy’s (1998) sympathy proposal is that the maximally parsed structure is a sympathetic candidate that influences the choice of final optimal form without secondary stress. A constraint \*Ft (No feet are allowed) crucially dominates Parse-σ. But a high ranking sympathetic constraint, O-Ident-σ that dominates \*Ft allows just one foot that carries the primary stress. In order to employ Sympathy analysis, de Lacy has to posit a markedness constraint, Parse-σ, as a selector. It goes against the original proposal that a selector should be one of the faithfulness constraints (cf. McCarthy (1998: 5). De Lacy (1998) proposes the extension of selectors to markedness constraints as well.

Putting aside the validity of extending selectors to markedness constraints, detailed technical analysis, and the controversy over Sympathy theory in general, we note that the logic of de Lacy in proposing the sympathy analysis is to “minimize the representational solution” to the problem. While we agree that multi-representational approach in (14d) is not constrained, we do not agree that his proposal is any more minimal in representation than the one proposed here. Note that his sympathy proposal crucially refers to the maximally parsed representation. That representation is required both in de Lacy’s and in present analyses. And any added mechanism to eliminate the representation with maximal parsing cannot be viewed as a success of minimizing representational account. Further, it is inconceivable how Sympathy proposal can explain the presence of selective secondary stress in TBH.

The present proposal is closer to Crowhurst than to de Lacy. Crowhurst, as given in (14g), introduces Ft-to-Head and HeadMax to explain the lack of secondary stress. The constraint, Ft-to-Head, states that “every foot dominates a head element.” A head element is the one that is stressed. And HeadMax makes all the foot-heads the heads of a prosodic word. But MonoHeadedness allows only one prosodic prominence. Therefore the feet that cannot be the prosodic word head loses their head violating Ft-to-Head. Consider the following evaluation from Crowhurst (1996: 418)

(15) Crowhurst’s constraints and tableau

a. Constraints
   i. MonoHeadedness: Prosodic constituents are uniquely headed.
   ii. HeadMax: Link (Head(Ft), Head(PRWD)) – A foot-head is also a prosodic word head.
   iii. Ft-to-Head: Link (Foot, Head(Ft)) – Feet have heads.
b. Evaluation tableau

<table>
<thead>
<tr>
<th></th>
<th>MONO HEADEDNESS</th>
<th>HEADMAX</th>
<th>FT-TO-HEAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>i. (mas)(tába)</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii. (max)(taba)</td>
<td>*(!)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iii. (máś)(tába)</td>
<td>*!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv. (más)(tába)</td>
<td>*!</td>
<td></td>
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</tr>
</tbody>
</table>

The ranking [[HEADMAX » FT-TO-HEAD]] leads to the omission of foot-heads if they fail to surface as the head of a prosodic word, and the reversed ranking allows the secondary stress to appear on the surface. Further, she claims that the ranking [[FT-TO-HEAD » MONOHEADEDNESS]] can explain the appearance of multiple primary stresses in such languages as Arrente (an Australian aborigine language), Hixkaryana (a Carib language), and others.

Here, we will have to compare FT-TO-HEAD and FT HD=STRESS presented in this paper. Note that FT-TO-HEAD has the effect of eliminating head for stressless feet, while FT HD=STRESS indicates that stressless feet actually do have heads, but the heads are not phonetically interpreted to have a stress. This is an important difference, because all feet in CCA are trochees according to major research body on CCA, including de Lacy (1998), Crowhurst (1996) as well as the present analysis in this paper. In the Optimality framework, the constraint TROCHEE is undominated in both CCA and TBH. A headless foot crucially violates TROCHEE. Therefore even the stressless feet must have heads. Further in the analyses of Panoan languages given in (3e), (3f) and (3g), Gonzáles (2005a, b) shows that the distinction between head and non-head (weak) syllables in stressless feet plays a decisive role in foot-based account of segmental phonology. There should be head-dependent distinction even in stressless feet. Crowhurst’s non-head proposal is problematic in dealing with these languages. As such, we see that FT HD=STRESS works much better than FT-TO-HEAD with the rest of the constraints.

The crucial evidence that we do actually need heads for stressless feet is found in Shipibo (Elias-Ulloa 2005). In this language, the suffix ‘again’ has two forms, -ribi and -riba. Their alternation depends on the position of the suffix. Consider the following data:

(16) Shipibo -ribi, -riba alternations (Elias-Ulloa 2005)

a. (pi. -ma)(-ri _bi)-ki  ‘(He) made (him) eat (it) again.’
b. (miš. ti)(-ri _bi)-ki  ‘(He) cut his hand again.’
c. (pi. -ri _ibā, -ki)  ‘(He) ate (it) again.’
d. (his. -ri _ibā, -ki)  ‘(He) saw it again.’
e. (yo no)(-ma. -ri _ibā, -ki)  ‘(He) made (him) commanded (it) again.’

Crowhurst (1996: 418) does not show any violation mark here. Given the interpretation of the constraint in (15a), there should be a violation mark as noted in the parenthesis in the tableau (15b).
Shipibo has quantity-insensitive trochee system, with a proviso that syllables with long vowels form feet of their own. Footing in (16) is from Elias-Ulloa, though he is not concerned about the relationship between feet and stresses. Assuming that -ribi and -riba are both underlyingly present as in Lapointe (1999) or Mascaró (2007), we see that the choice of allomorphy is governed by the prosodic structures. Note that only two forms -ribi or -riba are well-formed. There are no *(rib), and *(ri)(ba) forms. In prose, we find that if the second syllable of the suffix is in the head position, the suffix is realized as /riba/, otherwise it is /ribi/.

The data in (16) and relevant observation shows that we need the notion head, even if the feet do not have stress. This shows a clear contrast between FT-TO-HEAD proposal in Crowhurst and FTHD=STRESS in this paper. Crowhurst eliminates a head in a stressless foot, so as to make sure that all the heads are stressed. The proposal in this paper, however, allows foot-heads, even when the foot-heads are not realized in the form of phonetic stress. We see that Shipibo data is left unexplained in Crowhurst’s framework.

4. Extension to English

We have seen in the preceding sections that there are feet which do not have any stress. Now we will turn to English, a language with primary and secondary stresses, to see there is any role that latent feet may play. There are at least two conspicuous cases where we find latent feet: The first case involves word-internal monosyllabic feet that stand before a prosodic head and second, some Latinate prefixes have long but stressless vowels. First consider the following data:

(17) Stress clash in the word-internal position


(pàra)(pèr)(nàli)a (protò)(gàn)(distìc) (sèdi)(mèn)(tà)(tion


b. (ùni)(ver)(sàlìty (instrù)(men)(tàlì)ty (sènte)(mèn)(tàlì)ty

(disad)(van)(tà)geous (simùl)(in)(tà)geous (ànte)(cè)(dèn)tal

Heavy syllables before a main stress, those marked with underlines in (17), do not have secondary stresses. Of particular interest are the examples in (17b). We see that the monosyllabic feet had the main stress in the

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8 Halle & Vergnaud observe that there are a few exceptions such as (Hàlli)(càr)(nèssus),(ìn)(càr)(nà)(tion), (ò)(stèn)(tà)(tion), and (ìn)(càn)(tà)(tion). I don’t have explanation for these exceptions other than it might be due to the careful pronunciation of unfamiliar words. Please refer to Burzio (1994: 110) that maintains that the absence of vowel reduction in the underlined syllables does not necessarily mean the presence of secondary stress. If we follow Burzio, what is idiosyncratic about these exceptions is not their exceptional stress, but their exceptional behavior to resist vowel reduction.
previous cycle as in *universal*, *instrumental* and *sentimental*. But there is no trace of stress in these examples. Halle & Vergnaud (1987: 267) proposed Sonorant Distressing to deal with these examples. The explanation in this paper is pretty straightforward. There is no need for destressing or defooting. In any case, the adjustments like destressing, stress conflation and/or defooting invoke the intermediate stages which are not readily incorporated in Optimality, which does not allow any intermediate stage. The ranking [\(\text{NOCLASH} \overset{\rightarrow}{=} \text{FTHD-STRESS}\)] makes the pre-tonic monosyllabic feet stressless. This is exactly parallel with what we found in TBH.

The second set of examples comes from prefixes of Latin origin, such as \{pre-\}, \{re-\} and \{de-\}. Consider the following data:

\[
\begin{align*}
\text{a. } & \text{pr[\textit{iy}]side } \text{pr[\textit{e}]	extit{ident}} \\
& \text{pr[\textit{iy}]fér } \text{pr[\textit{e}]	extit{ference}} \\
& \text{pr[\textit{iy}]páre } \text{pr[\textit{e}]	extit{paration}} \\
\text{b. } & \text{r[\textit{iy}]sign } \text{r[\textit{e}]	extit{signáte}} \\
& \text{r[\textit{iy}]fér } \text{r[\textit{e}]	extit{ference}} \\
& \text{r[\textit{iy}]sérve } \text{r[\textit{e}]	extit{servátion}} \\
\text{c. } & \text{d[\textit{iy}]sign } \text{d[\textit{e}]	extit{signáte}} \\
& \text{d[\textit{iy}]fáme } \text{d[\textit{e}]	extit{famátion}} \\
& \text{d[\textit{iy}]gráde } \text{d[\textit{e}]	extit{gradation}}
\end{align*}
\]

In (18), we see vowel alternations in the prefix forms. The vowel shortening reflects the one found in Tri-syllabic shortening in English as the alternations in ser[\textit{iy}]ne~ser[\textit{e}]	extit{nity} or n[\textit{ey}]tion~n[\textit{æ}]	extit{tional} show. If the data given in (18) are the instances of Tri-syllabic shortening, we would have to say that the prefix vowels in the first column are long. We cannot say that these are instances of optional short vowel alternation as in [\textit{i}]	extit{conomy}~[\textit{e}]	extit{conomy}, since such a short vowel alternation is only found in stressless syllables and they are optional variants. But the shortening in (18) is not optional and it takes place in the stressed syllable as shown in the second column of each example.

Therefore the prefix vowel should be long. Then given the high ranking nature of NoLapse-\(\mu\) (Adjacent unstressed moras must be separated by a foot boundary, Green & Kenstowicz 1995), the English prefix with a long vowel, by virtue of having two moras, should form a foot of its own. At the same time, we cannot say that the first syllables are stressed. It simply is

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*The description of the pronunciation in (18) is primarily based on the pronunciation diacritics given in Merriam-Webster Unabridged Online dictionary. The dictionary shows the alternation between pr\[\textit{e}]	extit{pre}, r\[\textit{e}]	extit{re}, and d\[\textit{e}]	extit{de} for these prefixes. The diacritic \[\textit{i}]/ is the pronunciation found in words like sea, ski and scene. This diacritic mark is transcribed as /\textit{iy}/ in this paper. The other form, \[\textit{e}\], is regarded as a variant resulting from optional reduction of a stressless vowel.*
not true. I have looked up the word, preside, in 5 different on-line dictionaries that mark both the primary and secondary stresses, but none of them marks secondary stress on the first syllable. The observation so far leads us to the conclusion that the prefix vowels in the first column of (18) should be long and should be footed but should not have a secondary stress. In short, we see that the prefixes in the first column are instances of latent feet, feet without secondary stress.

Here the presence of latent feet is due to the high ranking nature of a constraint that bans a foot formed with Latin prefix to have a stress, call it NOSTRESS-LATIN/PREFIX. Consider the ranking \([\text{NOSTRESS-LATIN/PREFIX} \gg \text{FTHD=STRESS} \gg \text{PWD-PROM}]\). \([\text{FTHD=STRESS} \gg \text{PWD-PROM}]\) allows the secondary stress in English. But \([\text{NOSTRESS-LATIN/PREFIX} \gg \text{FTHD=STRESS}]\) specifically prevents the feet made out of Latin prefixes from having overt stress. The ranking therefore explains the application of Tri-syllabic vowel shortening, the actual pronunciation of long vowels without stress in the examples given in the first column of (18).

5. Conclusion

In this paper, I have discussed the status of latent feet in prosodic phonology and how they interact with stress assignment. The latent foot proposal shows that not all the foot-heads are automatically stressed and the constraint FTHD=STRESS is a universal constraint that can be violated when dominated by other relevant constraints. We have seen that the constraint eliminate the need for additional mechanisms such as tier conflation, a colon that groups two feet into one constituent, or the controversial Sympathy theory. And still it can successfully explain the total or selective absence of secondary stress on the surface.

CCA does not have secondary stresses, but the location of the primary stress is predictable only from the maximally parsed structure. The analysis in this paper shows that the presence of stressless feet is the natural result of constraint interaction. The ranking \([\text{PWD-PROM} \gg \text{FTHD=STRESS}]\) explains the distribution of stressless feet and the surface lack of any secondary stresses in CCA.

In TBH, we have seen that stress assignment and vowel reduction are referring to the same prosodic structure. We do not have to invoke

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11 It is granted that more works are needed in the actual formulation of this constraint. As shown in the second column examples in (18), Latin prefixes can take stresses, once the vowel is shortened and the stem materials are incorporated into the feet. Here I make a tentative assumption that the word preside has a structure /pre-side/, where the prefix is clearly visible. But in president, the word structure is /preside-ent/ where {pre-} is not a prefix on its own. Rather it is part of the base for {-ent} suffixation.
different foot structure for stress and for vowel reduction. We see that vowels are reduced if they are in unparsed syllable or in a weak position of a foot. The presence of a latent foot shows that some syllables are in the head position of a foot, though they lack any overt stress. Further, we see that TBH does have secondary stresses that show up in non-clashing environments. This is explained with the ranking $[$NOCLASH $\gg$ FTHD=$\gg$ STRESS $\gg$ PWD-PROM$]$. Further the proposal is extended to English to show the selective absence of secondary stress in phonological clash environments or in certain morphological environments. As such, this paper shows that the proposal can deal with total absence of secondary stress (CCA), selective presence of secondary stress (TBH) and selective absence of secondary stress (English). It also opens the possibility of extending tier conflation of Halle & Vergnaud to prominence-based stress.

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