Dual-Counting Feet in English

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The syllabic trochee is assumed for English. However, all syllable-counting theories require devices to consult moraic information, guaranteeing the at heavy syllables receive stress. Furthermore, given the standard assumption that a minimal word is a foot, syllable counting theories predict that the minimal word in English is disyllabic. However, this disyllabic minimal word requirement is plainly inadequate. On the other hand, mora-counting is not sufficient, either; Hayes'(1995 : 123) moraic trochee theory must refer to syllables in order to guarantee that moras belonging to a single syllable cannot be separated into two different feet, i.e., to preserve syllable integrity. Moreover, extrametricality is defined in terms of syllables rather than moras. These suggest, then, that English needs both moraic and syllabic levels. Consequently, I propose to make both moras and syllables represented in the phonological representations for English.

1. Introduction

The purpose of this paper is to make one small proposal for the metrical structure of English: a dual-counting foot structure. Previously, analyses of English stress which depend on the foot use either moras or syllables. That is, feet are formed based on either moras or syllables, not on both. However, I will show all these analyses need information about both syllables and moras to account for the stress patterns of English words. In fact, all analyses do make use of both of them, which causes a problem. The problem is that one of the two structures is unaccessible. Consequently, I propose to represent both syllabic and moraic structures in foot structures.

Generalizations on the stress patterns of English are given in (1), which forms the basis of discussion in the rest of the paper. Stressed syllables are marked in bold type.

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(1) English Stress
a. Heavy penultimate stress, if there is one: a**gen**da
otherwise, antepenultimate stress: A**me**rica
b. Superheavy final stress, if there is one: pre**vent**
otherwise, penultimate stress: **di**ffer

(1a) is the pattern that nouns follow while (1b) is the one that verbs follow (Hayes 1985; Halle & Vergnaud 1987; Halle 1998; Hammond 1999).[1] As can be seen in (1), English stress is sensitive to syllable weight. With the generalizations in (1) as a basis, I review works by Halle & Vergnaud (1987), Halle (1998), and Hammond (1999). The review is focused on nouns.

2. Previous Analyses

Previous analyses of English stress can be classified into two groups depending on what is the counting unit: the syllable or the mora. While mora-counting theories consider a moraic trochee in (2a) as a basic foot, syllable-counting theories consider a syllabic trochee in (2b) as a basic foot for English. The letters 'm' and 's' represent the mora and the syllable respectively. The letter 'x' marks the head of a foot.

(2) a. Moraic Trochee b. Syllabic trochee

x	x
[m m]	[s s]

Mester (1994) and Hayes (1995) belong to the former group while Halle & Vergnaud (1987), Halle (1998), and Hammond (1999) belong to the latter. Hammond's (1999) framework is different from those of Halle & Vergnaud (1987) and Halle (1998) but same in that the counting unit is the syllable rather than the mora. This paper deals only with syllabic

1. In addition to the stress patterns in (1), there are exceptional stress patterns which cannot be covered by (1). Words such as *ba**na**na*, *gi**raffe***, *a**necdote***, and *de**fer*** exhibit the exceptional patterns. However, these words are excluded since regular words are enough to show both syllabic and moraic structures are required for stress placement in English

trochaic theories since Mester (1994 : 1) and Hayes (1995 : 92, 181) just suggest English is a moraic trochaic system but do not analyze English words.

Now, let us examine the syllable-counting theories which most scholars working on English stress adopt.

2.1. Halle & Vergnaud (1987)

Halle & Vergnaud (1987, H & V henceforth) provide one of the most comprehensive analyses of English stress since Hayes (1981). Under H & V's (1987) system, the first thing to do in order to find stress locations is to represent stress bearing phonemes, which are vowels, by asterisks. Since each stress bearing phoneme is represented as an asterisk, syllable weight is not reflected in the representation.

H &·V's stress rules required for English are the Extrametricality Rule, the Accent Rule, and the English Stress Rule. The Extrametricality Rule given in (3) makes the final syllables of nouns and suffixed adjectives invisible to rules. However, the rule is stated so as not to apply to final syllables with long vowels:

(3) Extrametricality (H & V 1987 : 234)
* -> . / _____] in line 0 in nouns and in certain suffixes provided * dominates a rime with a short vowel.

The Accent Rule is stated in (4).

(4) Accent Rule (AR) (H & V 1987 : 231)
Assign a line 1 grid to a syllable with a branching rime with the proviso that the word-final consonant is not counted in the determination of rime branchingness in the case of the final syllable of underived verbs and adjectives.

The function of (4) is to assign stress to heavy syllables. The problem with this rule is its reference to 'syllables with branching rime'. That is because each stress bearing phoneme is represented with one asterisk and thus the information about syllable internal structure is not

available in the representation.

The third rule is the English Stress Rule in (5). C and n indicate whether a given rule applies in the cyclic stratum or in the noncyclic stratum. For our purposes, it is sufficient to consider cyclic rules to be primary stress rules and non-cyclic rules to be secondary stress rules.

(5) English Stress Rule (ESR) (H & V 1987 : 228)
a. c/n Line 0 parameter settings are [binary, left-head, right to left]
b. c/n Construct constituent boundaries on line 0.
c. c/n Locate the heads of line 0 constituents on line 1.
d. c Line 1 parameter settings are [unbounded, right-headed]
e. c Construct constituent boundaries on line 1.
f. c Locate the head of the line 1 constituent on line 2.
g. Conflate lines 1 and 2.

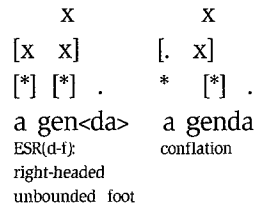
ESR (a-c) requires that a binary foot is formed when the penultimate syllable is light and the head of the foot is on the left. According to ESR (d-f), the rightmost foot is a head foot when there is more than one foot. In addition to the rules mentioned above, H & V have other rules which are irrelevant here. (6) shows how H & V's system works to locate stress in nouns.

(6) a. Nouns with heavy penults[2]

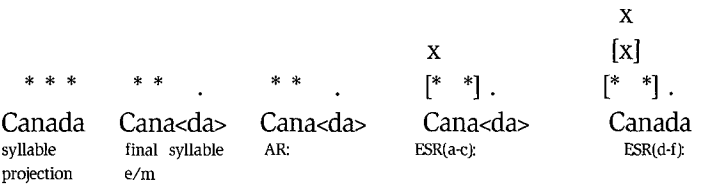
		x	x x
* * *	* * .	* * .	[*] [*] .
agenda	agen<da>	agen<da>	a gen<da>
syllable projection	final syllable extrametricality	AR: heavy stressing	ESR(a-c): left-headed binary foot

2. The derivation is not completed until the second round of ESR (a-c) and the Stress Deletion applies as shown below, but the application does not affect the current discussion but may confuse it.

x	x
[x x] .	[. x] .
[*] [* *]	*[* *]
a genda	agen da
ESR(a-c)	Stress Deletion



b. Nouns with light penults



The first syllable of *agenda* can form a foot since H & V (1987: 15) allow degenerate feet.

To sum up, H & V's rules correctly assign stress on the penultimate syllable of nouns with heavy penultimates but on the antipenutimate syllable of nouns with light penultimates, forming an [H] or a [s L] foot at the end of words. To put in other words, under H & V's syllable counting system, weight-sensitivity of English stress seems to be successfully handled. However, note that for this success, H & V devised means such as the provision of Extrametricality, AR, the Stress Deletion Rule and Conflation[3] to peer into the internal structure of syllables. This is basically not accessible information under the syllable-counting system since every syllable is projected as an '*' regardless of its weight.

2.2. Halle (1998)

Like H & V, Halle (1998 : 543) projects stress-bearing phonemes, which are vowels, onto the line 0 and constructs feet over them. As a result,

3. Stress Deletion Rule (H & V : 239) removes stress on light syllables when they are adjacent to another stress to its right but not on heavy syllables. Stress Deletion accounts for the existence of secondary stress on the first syllable in *bandana* in contrast to the absence of it on the first syllable in *banana*.

each syllable is represented as one '*' regardless of its weight since each syllable has one stress bearing phoneme. However, the two systems differ in foot representations. Feet in Halle (1998) can be formed by a single boundary as in (7), following Halle & Idsardi's (1995) proposals. Under the single boundary foot theory, all three of (7) are good feet.

(7) Feet (Halle 1998 : 545)
a. [* * b. * *] c. [* *]

Halle (1998) has three rules for English stress: the Edge-Marking Rules in (8), the Main Stress Rule in (9), and the Rhythm Rule (10) applying in that order. These rules are not in the same forms as presented in Halle (1998). For ease of understanding, these rules are paraphrased in this paper but the wording is Halle's.

(8) Edge-Marking Rules (EMR) (Halle 1998 : 548-549)
a. RLR Edge Marking (RLR)
Insert a right square bracket to the left of the rightmost syllable on line 0.
Condition J: the final syllable contains a short vowel.
b. LLR Edge-Marking (LLR)
Insert a left square bracket to the left of the rightmost syllable on line 0.

(9) Main Stress Rule (MSR) (Halle 1998 : 548-549)
a. Construct a binary foot at the end of string on line 0.
Condition K: the last '*' projects a light syllable
b. Construct a unary foot where the syllable is heavy or there are not enough syllables in the word.

(10) Rhythm Rule (RR) (Halle 1998 : 550)
Build a left-headed foot on line 1.

The Edge-Marking rules apply first, after stress bearing phonemes are projected. RLR is ordered before LLR, which applies only in words

where RLR has not applied. The effect of the rules is to make final syllables with short vowels unfooted, as in (11a), while making final syllables with long vowels footed, as in (11b).

(11) a. RLR b. LLR

```
*  *]  *   *  *] *      *  * [*      *  *   [*
a gen da  ho ri zon    hu rri cane  sta lag mite
```

Due to Condition K of MSR, (s L) or (H) is built on the leftover string after EMR applies, as in (12i) and (12ii), respectively. The boundaries inserted by MSR or RR are marked with parentheses to avoid confusion with those inserted by the EMR.

(12)

```
                i) Light penult    ii) Heavy penult
a. RLR:           x                  x
                 (*  *]  *         * ( * ]  *
                 Ca na da           a gen da

b. LLR:          x    x               x   x
                 (*   * [ *          * (  *   [*
                hu rri cane         sta lag mite
```

RR builds a left-headed foot over the heads of feet built by EMR and MSR. The foot is binary when LLR applies while it is unary when RLR applies. Due to RR, the head of a non-final foot bears primary stress, as illustrated by *hurricane.*

(13)

```
                                    x
line 1    x    x                  (x   x
line 0   (*   *[*                 ( *  *[*
         hurricane    RR ->       hurricane
```

Look at how these three rules assign stress in *Canada* and *agenda.*

(14) a. Noun with a light penult b. Noun with a heavy penult

x	x	
(x	(x	RR
(* *] *	* (*] *	EMR, MSR
Ca na da	a gen da	

To summerize, Halle's rules seem to correctly assign stress on the antepenultimate syllable when the penultimate syllable is light as in *Canada* and on the penultimate syllable when the penultimate syllable is heavy as in *agenda*. However, under this analysis, it should be assumed that EMR and MSR are informed about the syllable weight of the penultimate syllable, even though the information is not available since every stress bearing unit is projected as an '*'.

2.3. Hammond (1999)

Hammond (1999) formulates his analysis of English stress in the OT framework (Prince & Smolensky 1993). Hence, constraints and constraint-rankings are important. The constraints central to Hammond's analysis are summarized in (15). I have simplified Hammond's (1999) constraints since the details of mora assignment, needed for the original constraints, go beyond the focus of this paper.

(15) Basic foot constraints
- a. Trochee (T): stress occurs on the left side of the binary foot.
- b. Foot Binarity (FtBin): feet are binary.
- c. Nonfinality (NF): the final syllable is not footed.
- d. Weight-to-Stress Principle (WSP): heavy syllables are stressed.

Trochee requires disyllabic feet to be stressed on the first syllable. FtBin states that disyllabic feet are optimal. FtBin for Hammond is defined on syllables and thus the foot [H] violates FtBin, even though it is binary in terms of moras. From this constraint, we can see that feet are formed over 'syllables'. The Nonfinality forbids final syllables to be footed. Weight-to-Stress Principle ensures that heavy syllables are stressed.

The ranking among the constraints is given in (16).

(16) Constraint ranking for English stress
Trochee >> NF >> WSP >> FtBin

Before looking at how the constraints interact to select an optimal output, it would be of help to introduce Hammond's syllabification theory. In Hammond (1999), syllable boundaries are determined through interaction of constraints and the procedures are more complex than are presented here. To mention what is relevant in this paper, syllabification is affected by stress location (Hammond 1999 : 246). When a stressed syllable contains a lax vowel without a coda consonant, then the following consonant closes the stressed syllable making the syllable heavy: *Can.a.da.* That is, syllabification and stress assignment are done simultaneously.

(17) shows how the constraints select the candidate with correct stress: heavy penultimate stress, otherwise, antepenultimate stress.

(17) a. Nouns with a heavy penult

agenda	NF	WSP	FtBin
√ a[gen]da			*
a[gen.da]	*!		
[ag.en]da		*!	
agen[da]	*!	*	*

b. Nouns with a light penult

Canada	T	NF	FtBin
√ [Can.a]da			
Ca[nad.a]		*!	
[Can]ada			*!

In (17a), the candidate with a degenerate foot of a heavy syllable, *gen*, wins since NF outranks WSP and WSP in turn ranks over FtBin. The third candidate violates WSP since the second syllable, *en*, is heavy but stressless. In (17b), the first candidate with initial stress is the winner

since it does not violate either NF or FtBin.

Weight sensitivity of English stress is handled by the constraint, Weight-to-Stress in Hammond's syllable-counting model. The operation of the Weight-to-Stress constraint assumes access to the syllable internal information. However, when introducing FtBin, we have seen feet are formed or checked on syllable levels in Hammond (1999). Then, the problem is to find out which syllable is heavy and which is light at the syllabic level.

2.4. Problems with the presvious analyses

It has been shown that the syllabic trochee is the foot type assumed for English except for Hayes (1995). Notice, however, that all syllable-counting theories require devices, such as H & V's Accent Rule, Halle's Main Stress Rule, and Hammond's Weight-to-Stress, to consult the internal structure of syllables i.e., moraic information, guaranteeing that heavy syllables receive stress. Another way of putting this is to say that moraic structure is used even in syllable counting theories. Furthermore, given the standard assumption that a minimal word is a foot (Selkirk 1980; McCarthy and Prince 1986; Kager 1993, 1999; Hayes 1995), syllable counting theories predict that the minimal word in English is disyllabic. However, this disyllabic minimal word requirement is plainly inadequate. One would have to further stipulate that monosyllabic words are allowed, but only if they contain two moras as can be seen in *pie* and *pin*. This allowance for bimoraic minimal words can be taken as evidence that English is also a mora-counting system. On the other hand, mora-counting is not sufficient, either; Hayes' (1995 : 123) moraic trochee theory must refer to syllables in order to guarantee that moras belonging to a single syllable cannot be separated into two different feet, i.e., to preserve syllable integrity. Moreover, extrametricality is defined in terms of syllables rather than moras. These suggest, then, that English needs both moraic and syllabic levels. Consequently, I propose to make both moras and syllables represented in the phonological representations for English.

3. Dual-Counting Feet

I represent both syllabic and moraic levels in foot structures, as in (18) and refer to such foot structures with two levels as dual-counting foot structures.[4]

(18) Dual-counting foot structure

x	
[s s]	s(yllabic)- foot
so da	string of segment
[mm] m	m(oraic)- foot
x	

Over the moras and syllables the moraic trochee and the syllable trochee are constructed and the heads of them are marked.

The dual-counting foot theory assumes three levels of stress: S-stress (primary stress), M-stress (secondary stress), no stress. S-stress is stress of a syllabic foot and M-stress is stress of a moraic foot. If a syllable hosts neither an S-head nor an M-head, the syllable is stressless. These stresses are exemplified by the foot structure in (19).

(19) Three Levels of Stress

x	S-head
[s s] s	S-foot
an ti pode	
[mm] m [mm]	M-foot
x x	M-head

The first syllable is M- and S-stressed, the second syllable is stressless, and the third syllable is M-stressed. S-stress establishes primary stress. M-stress plays a slightly different role. Though not standardly recognized, the concept of M-stress is supported: unreduced vowels bear apparent

4. The fact that a single language can count both moras and syllables has been noted in the literature (Prince 1980; McCarthy and Prince 1986; Prince and Smolensky 1993; Kenstowicz 1995; Duanmu 1999).

stress in English due to vowel quality as in the second syllable of ***gen**tile* (Chomsky & Halle 1968; Hayes 1995; Ladefoged 2001). This, then, is the function of M-stress in the present proposal, as illustrated in (20).

(20) M-stressed syllables

```
    x
   [s   s]
  gen  tile
  [mm][mm]
   x    x
```

Let us now examine where primary stress occurs in longer words. The main question to consider is what happens when a word has more than one S-stress. Take *propaganda,* with two S-stresses, one on the first syllable and the other on the penultimate syllable, as in (21).

(21) Foot structure of *propaganda*

```
    x          x
  [s    s]  [s    s]    S-foot
   pro pa   gan  da
  [mm] m   [mm] m      M-foot
    x          x
```

The dual-counting foot theory does not predict which syllable bears primary stress and which has secondary stress. What the theory does determine is that the first and the penultimate syllables are S-stressed. The apparent difference between primary and secondary stress is interpreted as a result of the superimposition of a neutral intonation pattern (Ladefoged 1993; Beckman and Pierrehumbert 1986). To make this tonal interpretation of primary stress explicit, I assume Tone Linking in (22).

(22) Tone Linking[5]

Align a (neutral) high tone with the last S-foot.

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5. The Tone-linking has the same effect of the End Rule or Align (head).

In *propaganda,* for example, the penultimate syllable is more prominent than the first syllable because of the high tone aligned with it, as seen in (23).

(23) (Neutral) H-tone linking

```
          H
          |
    x     x
  [s   s] [s   s]
  pro pa gan  da
  [mm] m [mm] m
    x     x
```

Thus, (22) provides a successful analysis of primary stress in words like *propaganda,* where primary stress falls on the last S-foot of the word.[6] The dual-counting foot structures for *Canada* and *agenda,* our original testing words, are given in (24).

(24) a.

```
        H
        |
        x
    s [s   s]
    a gen da
    m [mm] m
        x
```

b.

```
    H
    |
    x          S-head
  [s  s] s     S-foot
  Ca na da
  [m  m] m     M-foot
    x          M-head
```

In these words, the heavy penultimate syllable of *agenda* and the antepenultimate syllable of *Canada* are stressed and linked with a high tone, hosting primary stress.

In (24b), the final syllable is not footed while that in (24a) is footed. This different footing of the final syllables raises a question about extrametricality assumed in the dual-counting foot theory. There is no

6. There are words such as *dynamite* that has primary stress on a the non-final foot. Compare this with *nectarine* which has similar syllable structure but has different stress pattern. The primary stress on the non-final foot cannot be accounted for under the dual-counting foot theory. However, the difference in stress location seen in *dynamite* and *nectarine* has been a problem for all analyses including all three reviewed in this paper.

obligatory extrametrical constituent in the dual-counting theory. Instead, there are such requirements for good feet as Foot Binarity, Trochee, and No Lapse.[7] It is assumed that any metrical structure is well-formed as long as it satisfies these surface requirements. In this way, it is accountable that the English lexicon displays flexibility illustrated in ***Ca****nada* and *ba****na****na* which have apparently the same syllable structures but have different stress patterns. This approach of foot checking is suggested since English stress is considered to be phonemic as can be seen in ***differ*** and ***defer*** and thus to be listed lexically (Hayes 1995: 112). In (24), the final syllables can be unfooted but not necessarily since either way, the structures in (24) do not violate any of the requirements and are well-formed.

The major advantage of the dual-counting foot structure is to overcome the drawbacks of the syllable-counting and the mora-counting accounts since the dual-counting foot structures have both the syllabic and the moraic levels. Consequently, Syllable Integrity, reference to the final 'syllable' as an extrametrical element, stress on heavy syllables (weight sensitivity), and minimal word requirement can be set out without access to unavailable information.

4. Conclusion

If possible, it is much more preferable to restrict a theory by selecting one foot type rather than two for a language. In relation to this restrictiveness, one might think the dual-counting theory is less desirable than either the syllable-counting or mora-counting theories. However, none of the previous mora counting or syllable counting analyses for English stress do without either moras or syllables. Strictly speaking, none of the previous accounts stand in a better position than the dual-counting account in terms of restrictiveness, since all of them use both syllables and moras. The difference between the previous analyses

7. As an anonymous reviewer pointed out, the current proposal cannot explain stress on the word final syllable as in *prefer* and ***amount*** since it assumes Foot Binarity at both moraic and syllabic levels. Also, if words with configurations such as (**VC** VV)(**V** V) or VV (**VC** VC) (**V** V) are attested, they cause problems to the dual-counting theory.

and the current proposal lies in whether they access both syllabic and moraic structures illegitimately or legitimately. Under requires of foot types in English, it is better to make the two level accessible rather than to use one of them illegitimately.

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