EXTRAMETRICALITY IN ENGLISH

Yongsung Lee

Abstract: Extrametricality, employed to mark exceptional stress patterns, poses problems in presenting a coherent analysis of English stress in Optimality theory. This paper seeks to find explanation for extrametricality effects without dividing the lexicon into several subgroups. To this end, it is assumed that coda consonants surface as moraic due to the interaction of constraints that govern syllable structure wellformedness. Secondly, surface non-alternating schwas are thought to be underlying. Schwa syllables, however, are light even when they have one or more coda consonants. Thirdly, this paper proposes prosodic subcategorization of suffixes, which imposes certain prosodic shapes on the base. The interaction of constraints from these proposals can explain not only the absence but also the presence of extrametricality effects in English.

1. Introduction

Different proposals on extrametricality have been made to account for English stress. The following are extrametricality proposals found in the literature:

(1) Extrametricality proposals
      The final consonant is extrametrical.
   b. Coda extrametricality (Davis (1987))
      The final consonant cluster is extrametrical.
   c. Syllable extrametricality (Hayes (1981), Kager (1989), etc.)
      In nouns (and some adjectives), the final syllable is extrametrical.
   d. Suffix extrametricality (Hayes (1981, 1982), etc.)
      Certain suffixes are marked as extrametrical.
   e. Foot extrametricality (Buckley 1994, Hayes 1995, etc.)
      Some feet are lexically marked as extrametrical.

The extrametrical consonant/coda proposals in (1a) and (1b) have the effect of making a final CVC(C) syllable light. With a final consonant being extrametrical, such syllables are treated light for the purpose of determining syllable weight. Syllable extrametricality in (1c), on the other hand, forces the final syllable to be unfooted. This produces initial primary stress in words with three syllables if all the syllables are light. Suffix extrametricality is very similar to syllable extrametricality in its effect. It is applied only to certain suffixes such as {-al}, {-ent}, {-ous} and others. Finally, foot extrametricality is applied to some affixes or to a monosyllabic foot at the end of a word. Foot extrametricality may also lead to the same result as the Alternating Stress Rule in Chomsky & Halle (henceforth SPE, (1968)). For some researchers, these extrametrical elements can accumulate (Hayes (1981, 1982), Buckley (1994)), but for some others, lexical entries may be marked for the absence or the presence of specific instances of extrametricality, and only one such instance applies to a given word. (Kager (1989), Hayes (1995))

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A recalcitrant problem of an extrametricality proposal for English is that it is only applicable to part of the English vocabulary. Compare for example the stress pattern of América and Mississippi. Both words have four light syllables. But they differ in stress placement. From an optimality perspective, a set of ranked constraints used for América fails to make Mississippi optimal and vice versa. In English, extrametricality has been used as a way to mark such exceptional stress patterns. This has led scholars to divide the English lexicon into two or more groups. In SPE, verbs and nouns are separated and disjunctive ordering of stress rules has been proposed. Kager (1989) proposes that there are at least three different subgroups of the English lexicon with respect to extrametricality: one with syllable extrametricality, another with consonant extrametricality, and the third group without extrametricality at all. Alcántara (1998) focuses only on Latinate words in English, tacitly assuming that non-Latinate words should be treated separately. Hayes (1995) uses extrametricality as a way of marking lexical exceptions in dealing with rhythmic stress.

Against this backdrop, this paper takes another look at extrametricality effects and tries to find an explanation, that is not directly dependent on the stipulation of extrametricality. It argues that the extrametricality effect is the result of the interaction of various constraints that are involved in selecting correct foot structures. To be more specific, this paper will propose that the syllable weight assignment is different in derived words and underived words. In derived words, suffixes may not have moraic consonants. Further, this paper proposes that non-alternating schwas on the surface are underlyingly present. Syllables headed by schwas fail to show up as heavy and they are not found in the head position of a foot. In other words, all the syllables that contain schwas, regardless of their location, are light. Further, it will be proposed that affixes have a prosodic subcategorization constraint; i.e. suffixes can impose certain prosodic shapes on the base. For example, a suffix {-ity} must be added to a head syllable of the stem. To observe foot binarity, the second syllable may not be incorporated into a foot.

As such, proposals in this paper eliminate exceptional extrametricality marking in the lexical entries and derive the extrametricality effect from the interaction of relevant constraints. One of the merits of the proposal in this paper is that we do not have to posit a different hierarchy of constraints in different parts of the lexicon. We can select the optimal foot structures and stress representation with one consistent ranking. In section 2, we will present a brief and partial survey of constraints that participate in English stress assignment and point out what problems extrametricality poses for the optimality theoretic analysis. In section 3, syllable weight will be discussed. It will be argued that there are underlying schwas, and that the schwa syllables cannot come in the stressed position. We will also see that the weight of a CVC(C) syllable differs depending on the nature of the morphological status of the syllable, whether it is a part of a stem or of a suffix. In section 4, prosodic subcategorization constraints will be introduced and their interaction with other relevant constraints will be discussed. Vowel shortening in English is also dealt with to show that prosodic subcategorization is also directly responsible for vowel quantity alternations. Section 5 is the summary and conclusion of this paper.

2. Constraints for Foot Building and Problems

In this section, we will briefly talk about constraints for English foot structure and show why extrametricality proves problematic in stress assignment. This will serve as a background for further discussion in the following sections. It will be tentatively assumed that both CVV and CVC syllables are heavy. The difference in underlying moraic status of consonants and off-glides, however, will be dealt with in section 3. (2) is the summary of constraints involved in foot building in English.

(2) Constraints in foot building\(^1\)

a. Rhythm Type = Trochee (Trochee)
   Feet are left dominant.

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\(^1\) Constraints used in this paper are represented in Italic forms with the first letter capitalized.
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b. Foot Binarity (FtBin)
Feet are binary at the moraic level.

c. Edgemostness (Align (σ', R, Pwd, R)) (Edge-R)
The head of a prosodic word (σ’) is on the right edge of a prosodic word.

d. Nonfinality (NonFin)
No prosodic head of a prosodic word (σ’) is final in a prosodic word.

e. Syllable licensing (Parse-σ)
Syllables are parsed into feet.

f. Ranking
FtBin, Trochee >> NonFin >> Edge-R >> Parse-σ

The constraints given in (2) by no means constitute an exhaustive list of constraints involved in stress assignment. It is assumed that FtBin is strictly enforced on the moraic level. This means that every foot must have no less or no more than two moras. Uneven trochees of the form, (HL) (where H represents a heavy syllable and L a light syllable) are not allowed. FtBin and Trochee are assumed to be undominated. For Edge-R and NonFin, only the head syllable of a prosodic word will be considered. If syllable extrametricality is regularly witnessed in English, we may assume that there is yet another constraint NonFin(Ft), which penalizes any foot standing at the right edge of a prosodic word. If NonFin(Ft) is sufficiently high in ranking, it leads to final syllable extrametricality effect. But the problem is that in one part of the vocabulary, NonFin(Ft) is never violated as in the América type, while in other parts, those of the Mississípi type, the violation is regularly witnessed. This is problematic in setting a consistent ranking for stress placement. The same may be said for consonant extrametricality, which may be captured by such constraints as LooseParse (Hung 1994), WeakEdge (Spaelti 1994) or simply NonFin(σ). Consonant extrametricality is readily observed in the majority of affixed words and in some underived words. If we posit extrametricalities as constraints, we can only deal with half of the English vocabulary. On the other hand, NonFin(σ’) is regularly observed in English. This means that a final heavy syllable does not carry the primary stress. Surely NonFin is violated, if the final heavy foot is the only foot in the word. This is due to the culminativity principle (Hayes 1995: 24-25) that may be translated to an undominated constraint Lex=Pwd (Prince & Smolensky (1993)).

As such, foot extrametricality is relatively well motivated. The crucial difference between foot extrametricality and other types of extrametricality is that the former does not interfere with syllabification or foot building. It is concerned only with the placement of the primary stress without disrupting independent foot building. What prove to be really problematic, then, are the consonant/coda extrametricality and the syllable/suffix extrametricality.

To visualize a problem in extrametricality, let’s consider two different words: Mississípi and América. The constraints and their ranking given in (2) can produce the correct stress pattern in “Mississippi” as in (3): 3

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2 There are English words that violate NonFin even if the final heavy syllable is not the only foot. One group is represented by nouns with autostressed suffixes (Fudge (1984)), which will be dealt with in 4.1. Another group contains verbs with Latinate roots, such as ressurréct, condescénd, expórt, transláte. Comparing these with similar words having different stress patterns such as víbrate, ligáte, vácate, we can generalize that the final syllables are stressed only when they are roots. This can be viewed as an expanded case of StemStress (the primary stress goes to the stems, where stems include roots but not suffixes). With the ranking, StemStress >> NonFin, we can explain the final stress in Latinate verbs. As for the noun-verb contrast in stress as in export-expórt, we may posit different morphological structures for them. For verbs, we may assume that the input is \{ex + port\}, while for nouns, they are derived from verbs by adding a zero suffix to denote a morphological conversion. Then the entire string \{export\} is the stem for nouns. StemStress then places a primary stress on \{port\} for verbs, and on \{export\} for nouns.

3 Other words of the “Mississípi” type are listed below:
Alabáma  Cúyahóga  Isadóra  pánoráma  càcciatóre
Côlorádo  ávocádo  bàllerína  hénriétta  márijuána
Light-syllabled words of non-Latinate origin belong to this category. Even the recent imports from other languages
Yongsung Lee

(3) Evaluation of “Mississippi”

<table>
<thead>
<tr>
<th></th>
<th>Trochee</th>
<th>FtBin</th>
<th>NonFin</th>
<th>Edge-R</th>
<th>Parse-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (missi)(ssippi)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(b) mi(ssis)ippi</td>
<td></td>
<td></td>
<td>!</td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(c) (missi)(ssippi)</td>
<td></td>
<td></td>
<td>!</td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(d) (mississi)ppi</td>
<td></td>
<td>!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) (missi)(ssippi)</td>
<td>!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(Feet are represented within parentheses)

With the proposed constraints and their ranking, the evaluation correctly picks out the optimal candidate in (3). The same ranked constraints, however, fail to pick out the optimal stress form for “America” and other words with similar structure as shown in (4):4

(4) Evaluation of “America”

<table>
<thead>
<tr>
<th></th>
<th>Trochee</th>
<th>FtBin</th>
<th>NonFin</th>
<th>Edge-R</th>
<th>Parse-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (ámé)(rica)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(b) a(méri)ca</td>
<td></td>
<td></td>
<td>!</td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(c) (ámé)(rica)</td>
<td></td>
<td></td>
<td>!</td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(d) (ámeri)ca</td>
<td></td>
<td>!</td>
<td></td>
<td></td>
<td>!</td>
</tr>
<tr>
<td>(e) (ámé)(ricá)</td>
<td>!</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(> indicates an unintended winner)

We would expect (4a) to be optimal, as in the case of (3a), but the real output is (4b) indicated by the backward black finger. There is no way to keep (3a) and (4b) as optimal at the same time. This is where the syllable extrametricality comes into play. “America” is marked for syllable extrametricality, while “Mississippi” is not. Translating them into an optimality framework, “America” must satisfy NonFin(Ft) (which is separate from NonFin(σ) used in this paper.) “Mississippi,” on the other hand, is not subject to such a constraint. This leads many researchers to propose that the English lexicon should be divided into several subgroups for correct foot building and stress assignment as in SPE and Kager (1989).

A similar problem can also be seen in consonant extrametricality. To discuss problems involving consonant extrametricality, three additional constraints are introduced here:

(5) Additional constraints for foot building

a. Rhythmic Alternation (Rhythm)5

Adjacent foot heads are prohibited.

b. Max-μ

Moras in the input should be in the output.

c. Weight-to-Stress Principle (WSP)

show the same stress pattern as in kàraóke, tèriyáki, and others.

4 Other examples of the “America” type are listed below:

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>monópoly</td>
</tr>
<tr>
<td>photógraphy</td>
</tr>
<tr>
<td>diplómacy</td>
</tr>
<tr>
<td>apólogy</td>
</tr>
<tr>
<td>anómaly</td>
</tr>
<tr>
<td>epiphany</td>
</tr>
<tr>
<td>hegémony</td>
</tr>
<tr>
<td>académy</td>
</tr>
<tr>
<td>diplómacy</td>
</tr>
<tr>
<td>anómalía</td>
</tr>
<tr>
<td>epifáncy</td>
</tr>
<tr>
<td>asparagus</td>
</tr>
<tr>
<td>metrópolis</td>
</tr>
<tr>
<td>análisis</td>
</tr>
</tbody>
</table>

Note that many words of this type (the first two lines) have word final {-y}, which behaves like a suffix. We find that the underived words with this pattern are very few in number.

5 The name of the constraint is from Hung (1993). There are other names for basically the same constraint, such as NoClash (Kager 1993: 393) and *AdjHead (Pater 1994).
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Heavy syllables are prominent in foot structure.

Rhythm is ranked higher than Edge-R, since the rhythmic clash has the effect of pushing the main stress further to the left, violating Edge-R. WSP penalizes any heavy syllable left unfooted. This is always observed in English. Long vowels may shorten and CVC syllables may be counted as light when they are forced into a foot with other light syllables. Such moraic underparsing (Prince & Smolensky 1993) results in the violation of Max-µ. Since Parse-σ can force the violation of Max-µ, we see that the former crucially dominates the latter. With these additional constraints, consider how the evaluation can correctly pick out the optimal form in “Hackensack,” as in (6): 6

(6) Evaluation of stress in “Hackensack”

<table>
<thead>
<tr>
<th></th>
<th>NonFin</th>
<th>WSP</th>
<th>Rhythm</th>
<th>Edge-R</th>
<th>Parse-σ</th>
<th>Max-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (hácken)(sàck)</td>
<td></td>
<td>**</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) ha(ckén)sack</td>
<td></td>
<td>*!</td>
<td>*</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) ha(ckén)(sàck)</td>
<td></td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) (hácken)(sáck)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Crucially important is the role of WSP and Rhythm in the tableau. In (6b) a heavy syllable -sak- is not in the foot structure, violating an undominated constraint, WSP. The natural footing given in (6c) violates Rhythm, and the only way to solve the clash is to move the stress one syllable leftward, and keep the secondary stress in the final syllable as in (6a). This represents a clear case of the exception to consonant extrametricality and syllable extrametricality. Compare it with other words with similar surface weight structure such as détérgent, or paréntal.7 Apparently, they have the same LHH structures, but this time, the stress goes to the second syllable and there is no secondary stress in the final syllable. The tableau in (7) clearly shows the problematic aspect of the analysis.

(7) Evaluation tableau for “parental”

<table>
<thead>
<tr>
<th></th>
<th>NonFin</th>
<th>WSP</th>
<th>Rhythm</th>
<th>Edge-R</th>
<th>Parse-σ</th>
<th>Max-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (páren)(tàl)</td>
<td></td>
<td>**</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) pa(rén)tal</td>
<td></td>
<td>*!</td>
<td>*</td>
<td>**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) pa(rén)(tàl)</td>
<td></td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d) (pàren)(tál)</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Here we see that the evaluation wrongly selects the output (7a) as optimal, while rendering an actual output (7b) as suboptimal. This is an undesirable effect. Again, one solution may be found in separating English words into different groups where different rankings or different constraints are involved in selecting optimal forms. For words like “Hackensack,” we may say that neither syllable extrametricality

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6 For the sake of simplicity, only the candidates that observe two undominated constraints, Trochee and FtBin are considered. Other words with apparent LHH structure with initial stress are given below:

- Hóttentòt
- sáturnìne
- misanthròpe
- pálimpsèst
- cívalcàde
- màckintòsh
- Càvendìsh
- àllotròpe
- válentìne
- módernìze
- prómulgàte
- démonstràte
- récognìze

7 Surface LHH structure with second syllable stresses is also found in the following words:

- defénsive
- cathédral
- propónent
- collósal
- fratérnal
- treméndous
- relúctant
- depéndent
- expénsive
- desírous
- Decémber
- philánder
- decánter
- evángel
- elóngate

Note that many words listed here are derived by suffixation. It will be shown later that affix syllables do not have moraic consonants (section 3) and that Subcat introduced by suffixes controls the stress placement in these words (section 4).
nor consonant extrametricality is applicable (Kager’s 1989 third group). For words like “parental,” we have to posit syllable/suffix extrametricality (NonFin(Fl)) or LooseParse (as in Hung 1993) or consonant extrametricality (NonFin(σ))

As such, extrametricality has been used as a way of capturing lexical idiosyncracies, which cannot be dealt with with general rules or constraints. In the following sections, alternatives will be presented within optimality theory without recourse to invoking lexical division.

3. Syllable Weight

In the preceding section, we have discussed problems related to extrametricality. In this section, I will present two alternatives to dispense with consonant/coda extrametricality. Specifically, it will be proposed that coda consonants are not moraic underlyingly but they appear as moraic due to the interaction of constraints. Secondly, it will be proposed that non-alternating schwas are underlyingly present. It will be shown that these two proposals can successfully eliminate problems related to consonant extrametricality.

3.1. The Weight of Coda Consonant

It has been noted (Hayes 1995, Tranel 1991, Clements & Keyser 1983 and others) that long vowels and diphthongs are universally heavy, while CVC syllables vary in their weight. They are heavy in some languages, while light in others. One way to deal with this variability is to assume that vowels and glides (vocalic segments) are underlyingly moraic while consonants are not. The mora assignment to the consonant is the result of the interaction of relevant constraints. Lee (1997) proposes two constraints related to mora assignment to coda consonants.

(8) Mora assignment

a. Align (syllable, R, mora, R) (Align-σ)
   The right edge of a syllable is aligned with the right edge of a mora.
   (Every syllable closes with a mora.)

b. No Moraic Consonant (NoMoraic-C)
   Consonants are not moraic

Given these two constraints, the CVC syllables receive the following evaluation:

(9) Constraint conflict for a CVC syllable

<table>
<thead>
<tr>
<th>Mora Assignment</th>
<th>Align-σ</th>
<th>NoMoraic-C</th>
</tr>
</thead>
<tbody>
<tr>
<td>σ</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>C V C</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As shown above, no natural parsing of a CVC syllable can satisfy both of the constraints. Here the ranking in individual languages is crucial in determining the weight of a coda consonant. In a language where the CVC syllable is heavy, Align-σ dominates NoMoraic-C. If the ranking is reversed, then CVC syllables are light.

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8 NoMoraic-C is equivalent to Dep-μ in essence, if we assume that all underlying consonants are not moraic. The present discussion, however, does not hinge on the moraic nature of post-vocalic consonants.

9 As shown in (9), the underlying status of the moraic consonant does not affect the surface wellformedness. For
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In English, the coda consonant seems to contribute to the syllable weight. In the majority of cases, CVC syllables are treated as heavy. But suffixes with CVC(C) shape are consistently treated as light. The difference is partly shown in tableaux (6) and (7). “Parental” differs from “Hackensack” in that it is derived by adding {-al} to “parent,” while “Hackensack” is an underived word. Based on this observation, I propose that Align-$\sigma$ should be divided into Align-$\sigma$(Stem) and Align-$\sigma$(Suffix), and that NoMoraic-C is ranked between the two Align-$\sigma$ constraints as in (10):

(10) Constraint ranking

Align-$\sigma$(Stem) $\gg$ NoMoraic-C $\gg$ Align-$\sigma$(Suffix)

Given the constraint ranking in (10), we see that suffixes like {-ent}, {-ence} constitute light syllables even if they have two coda consonants. This can incorporate the observation that consonant extrametricality is more readily found in affixed forms than in underived forms (Hayes 1981).

Interaction of these constraints with foot building constraints will be postponed to Section 4, since the full picture requires yet other constraints involved.

3.2 Underlying Schwas

In this subsection, another proposal based on the surface observation of English pronunciation will be made. It will be assumed that not all surface schwa sounds are derived from underlying full vowels. Though similar observations were made in the literature (SPE, Kahn 1976), it has been generally assumed that schwas are reduced vowels. I will first survey extrametricality proposals and will discuss how underlying schwas can help explain the problems that extrametricality faces.

The essence of the extrametricality proposal is to make a final CVC syllable light or even invisible for the purpose of foot building. But a brief survey shows that there are two types of exceptions to the consonant extrametricality proposal: some word-final CVC syllables are treated as heavy, and some CVCC syllables are treated as light. Ross (1972), arguing against the strong and weak cluster proposal in SPE, has surveyed surface forms including derived words and comes to the following conclusion:

(11) Ross’ (1972: 247, 250) Generalization

a. A (word-final) syllable that ends in two consonants will attract stress (i.e. be heavy) unless it consists of the following clusters: nt, st, ts, ns, rt, rd, rn. For nouns ending in the above clusters, stress cannot be predicted.

   b. A (word-final) syllable that ends in a short vowel plus one consonant will be stressed if it ends in ‘one of the sounds {p, b, f, v, š, z, č, k, g}.’ If the final syllable ends with a coronal consonant or a sonorant, then whether the syllable receives stress or not must be lexically marked.

The generalization simply tells us that the nature of final consonants is more idiosyncratic than regular. This seems to indicate that focusing on the consonant may not help in understanding the syllable weight in English. Hayes (1995: 15) moves his focus to the vowel and captures the generality that a syllable headed by a schwa is never stressed. A schwa in English has been traditionally considered as a reduced form of an underlying full vowel. In other words, schwas are not thought to be underlying. Even when a full vowel counterpart is not recoverable, researchers hesitate to posit underlying schwas. But consider the following note from SPE regarding the reduced vowel:

the sake of simplicity, therefore, it will be assumed that consonants are not underlyingly moraic. For a full interaction, we also have to consider the status of geminate consonants. A relevant constraint here is MoraGem (Geminates are moraic) as in Lee (1997). Having no geminates in underived words in English, however, we will not be concerned with geminates in this paper.

10 When these suffixes are followed by another suffix, they are treated as part of the stem. This means that they are treated as heavy in that environment. The alternation, reside-résident-résidential, shows that the syllable -den- is heavy before another suffix.

11 An input-output faithfulness constraint, such as Max-Seg should crucially dominate Align-$\sigma$(Stem). Otherwise, all the consonants in the coda will be deleted to satisfy Align-$\sigma$(Stem).
(12) A note from SPE (SPE, 37, fn. 27)

In the case of effort there is no way of determining the phonological quality of the underlying vowel, which need not, therefore, be specified in the lexical entry for this formative.

The remark here seems to indicate that we do not have to specify all the underlying vowels in their full forms. As a matter of fact, SPE uses \([\text{[v]}]\) to indicate a non-alternating schwa sound. Kahn (1976:122-123) also argues against deriving schwas from underlying full vowels, though he suggests positing syllabic sonorants instead of schwas in the underlying representation. Accordingly, it is proposed here that if a vowel always surfaces as a schwa, then by Lexical optimization (Inkelas 1994) (or by the Alternation convention in Kiparsky 1968), we may assume that the schwa is underlying. One piece of evidence for underlying schwas comes from vowel deletion in English. Consider the following data:

(13) Affixation to stem-final schwas

<table>
<thead>
<tr>
<th>a. Vowel deletion</th>
<th>b. Vowel lengthening</th>
</tr>
</thead>
<tbody>
<tr>
<td>aorta + ic</td>
<td>aortic</td>
</tr>
<tr>
<td>vanilla + ic</td>
<td>vanillic</td>
</tr>
<tr>
<td>apnea + ic</td>
<td>apneic</td>
</tr>
<tr>
<td>anaphora + ic</td>
<td>anaphoric</td>
</tr>
<tr>
<td>delta + ic</td>
<td>deltic (deltaic)</td>
</tr>
<tr>
<td>stanza + ic</td>
<td>stanz[ey]ic</td>
</tr>
<tr>
<td>algebra + ic</td>
<td>algebr[ey]ic</td>
</tr>
<tr>
<td>mora + ic</td>
<td>mor[ey]ic</td>
</tr>
<tr>
<td>zebr[ey]ic</td>
<td></td>
</tr>
</tbody>
</table>

All the unaffixed forms in (13a) and (13b) have word final schwas. When the suffix, \{-ic\}, is added to these words, two different patterns emerge: the word final schwa may be deleted as in (13a) or it is realized as a tense vowel. If we posit full vowels in word final position of (13a), there is no way to predict when the vowel is deleted or lengthened. On the other hand, if we assume that the final vowels are underlying schwas in (13a), we can effectively explain the deletion of word final schwas. Let us suppose that the suffix \{-ic\} must be added to a head syllable. (We will return to this in Section 4 in detail.) This requirement would place a stress on the stem final vowel, which is a schwa. But as Hayes (1995) observes, the schwa sound should not be stressed. The conflict is resolved by deleting stem final schwas. In (13b), however, schwas alternate with full vowels on the surface. It means that there are full vowels in the input. Those full vowels are lengthened before a vowel initial suffix \{-ic\} (an instantiation of VV tensing proposed in SPE.)

The examples in (13), therefore, strongly argue for underlying schwas. In (13a), words have underlying schwas, which delete under constraint conflict. In (13b), however, there are full vowels in the input, which are subsequently lengthened due to suffixation. These underlying reduced vowels, however, are not found in a stressed position as Hayes observes. A direct way to capture the lack of stress in syllables with schwas is to posit a wellformedness constraint as in (14):

(14) NoStressed-Schwa (*\(\sigma\))\(^{12}\)

A syllable with a schwa is not stressed.

In English, no schwa vowel appears in the stressed syllable. This means that *\(\sigma\) is an inviolable, thus undominated, constraint. Viewed from this perspective, we see that final \(\text{C}(\text{C})\) syllables must be light to avoid the violation of *\(\sigma\). This may be viewed as the effect of consonant/coda extrametricality. If an underlying schwa appears in a penultimate syllable as in XVC\(\text{C}V\)##, the final CV is forced to stay out of the foot, i.e. (CVC\(\text{C})\text{CV}## in order to avoid a foot headed by a schwa, *(C\(\text{C}V)##, or a non-trochaic foot, *(C\(\text{C}V)##. This is responsible for the syllable extrametricality effect.

Even the schwa sound in the initial syllable of LLLL words can affect the foot building. Consider the evaluation of “America” with *\(\sigma\) as in (15):

---

\(^{12}\) Féry (1999:15) also proposed a similar constraint NonHead(\(\sigma\)), in her explanation of German stress. Halle & Idsardi (1995: 439) assume that a schwa fails to project a line 0 grid mark, which is equivalent to eliminating schwas from possible head positions of feet.
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(15) Evaluation tableau for “America” (Revised from (4))

<table>
<thead>
<tr>
<th>( /s/-merica )</th>
<th>Trochee</th>
<th>FiBin</th>
<th>*( \sigma )</th>
<th>NonFin</th>
<th>Edge-R</th>
<th>Parse-( \sigma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (âme)(rica)</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>(b) (méri)ca</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>(c) (âme)(rica)</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td>***</td>
<td>*</td>
</tr>
<tr>
<td>(d) (méri)ca</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td>***</td>
<td>*</td>
</tr>
<tr>
<td>(e) (âme)(ricá)</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

The tableau in (15) shows the evaluation with NoStressed-Schwa (*\( \sigma \)\). The apparent syllable extrametricality effect is explained in the tableau by positing underlying schwas. Compare this with (4). The unintended winner in (4a) is successfully removed by the undominated constraint, NoStressed-Schwa in (15a). As such, underlying schwas and the constraint, *\( \sigma \), effectively explain the apparent extrametricality effect in English. Consider a brief survey of stress data given in (16):

(16) Survey of stress data of underived words

a. Disyllabic words with word final consonant clusters
   i) Final secondary stress
      (rám)(párt) (yó)gurt
      (Mó)(zár(t) (có)mfort
      (mán)(sár(d) (hággard)
      (gým)(nást) (tém)pest
   ii) No final secondary stress
      (ram)(part) (yogurt)
      (Mozart) (comfort)
      (man(sard) (haggard)
      (gym(nast) (temp)est

b. Trisyllabic words with two light syllables initially
   i) L(LL) parsing
      se(méster) go(rrilla) (Pámé)la (búffla)lo
      ba(nána) va(nilla) (cine)ma (ámá)(zón)
      me(niscus) spa(ghétti) (brócco)li (Cápi)tol
      Ne(brásk(a) Chí(cágo)
      Ne(váda) A(lásk(a)
   ii) (LL)L parsing
      (mester) gorilla (Pame)la (buffalo)
      (banana) vanilla (kine)ma (ama)zoon)
      (nicus) spaghetti (brocco)li (capitol)
      Nebrasca Chicago
      Nevada Alasca

c. LLLL words
   i) (LL)(LL) parsing
      (páno)(ráma) A(méri)ca
      (Ala)(báma) a(spára)gus
      (Missi)(ssippi)
      (Mônica)(Líza)
   ii) L(LL)L parsing
      (pano)(rama) America
      (ala)(bama) asparagus
      Mississippi
      MonicaLiza

d. Words with five or more syllables, the penults are generally stressed even when light.
   (ábra)ca(dábra) (Tí)(conde)(róga)
   (Táta)ma(gúchi) (mémo)ra(bília)
   (phán)(tá)sma(gória)
   (pichi)cí(ágó)

e. In HLLL words stress usually falls on the first L.
   (Món)(tána) (Al)(páca) (án)(ténna)
   (bán)(dána) (Ké)(n(tucky) (fál)(sétto)
   (El)(páso) (sein)(tilla) (nán)(tucket)
   (Gón)(zága) (Ur)(bána) (Ró)(gallo)

13 One more candidate which is not considered here is \{âme(rica)\}. This candidate may appear optimal given the constraint ranking in (15), since it fares better than (15b), in that it has one less violation of Edge-R. It, however, crucially violates Lapse (Green & Kenstowicz (1995)), or Parse-Syllable (Hammond (1997: 44)), which penalizes two adjacent unfooted syllables in the output. Though not discussed in detail in this paper, it is assumed that Lapse is ranked highly enough to render the candidate \{âme(rica)\} suboptimal.
The examples given in (16a) pose a serious problem to the extrametricality approach. There does not seem to be a way to account for both sets of data under one ranking. Notice that the same consonant sequences are treated as heavy in (16ai), but as light in (16aii). Moving our attention to vowels, however, we observe that the words in (16aii) have non-alternating schwas in the final syllables. Since they cannot be stressed, due to NoStressed-Schwa, they remain stressless. But if the final syllables in (16ai) are stressless, they violate WSP. Virtually the same explanation can be given to (16b). In the literature, suggestions were made to explain the difference. There were suggestions that the orthographic doubling in the second column of (16bi) can be used as an indicator that they are geminates (SPE, Fudge 1984), or that morpheme internal /sC/ clusters, as in seméster or meniscus, are hetero-syllabic (Fudge 1984). The true generalization, however, is that words in (16bi) have full vowels in the second syllables, while those in (16bii) have non-alternating schwas in the same position.

Again in LLLL words as in (16c), the general tendency among underived words is to have full parse, (LL)(LL). L(LL)L parsing is shown only when a schwa sound is found either in the first or in the third syllable (or both) in underived words. Examples in (16d) and (16e) strongly argue against the extrametricality proposal. With the extrametricality proposal, we would expect an unparsed syllable at the end of a word. But against such a prediction, the word internal syllables are left unfooted. Again in HLL words, if syllable extrametricality is applied at all, we would expect the primary stress on the first H syllable, e.g. (H')L<L>. But the primary stress goes invariably to the second syllable. The apparent exception to this generalization in such words as Cálgary, Gólgotha, Cálvary, and others falls under the (16bii) category, since these words have schwas in penultimate syllables. This strongly indicates that there is no need for positing syllable extrametricality.

Finally it is important to show that the new proposal here does not change the evaluation of “Hackensack” type of words. Consider the tableau in (17):

(17) Evaluation tableau of “Hackensack” (Revised from (6))

<table>
<thead>
<tr>
<th>{hackensack}</th>
<th>*σ</th>
<th>NonFin</th>
<th>WSP</th>
<th>Rhythm</th>
<th>Edge-R</th>
<th>Parse-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (hácken)(sáck)</td>
<td>*</td>
<td>NonFin</td>
<td>WSP</td>
<td>Rhythm</td>
<td>Edge-R</td>
<td>Parse-σ</td>
</tr>
<tr>
<td>(b) ha(ckén)sack</td>
<td>*</td>
<td>WSP</td>
<td>Rhythm</td>
<td>Edge-R</td>
<td>Parse-σ</td>
<td></td>
</tr>
<tr>
<td>(c) ha(ckén)(sáck)</td>
<td>*</td>
<td>WSP</td>
<td>Rhythm</td>
<td>Edge-R</td>
<td>Parse-σ</td>
<td></td>
</tr>
<tr>
<td>(d) (hácken)(sáck)</td>
<td>*</td>
<td>WSP</td>
<td>Rhythm</td>
<td>Edge-R</td>
<td>Parse-σ</td>
<td></td>
</tr>
</tbody>
</table>

Having posited no underlying schwa for “Hackensack,” we do not expect that there would be any violation of NoStressed-Schwa. The tableau in (17) shows that the introduction of NoStressed-Schwa does not change the former evaluation, since there is no schwa sound involved.14

Summing up, in underived words, a CVC(C) syllable, regardless of its location, is heavy except when the vowel is a schwa. The underlying schwa is responsible for the consonant extrametricality effect, since CaC(C) syllables are always light. It also accounts for the syllable extrametricality effect. When a schwa appears in a penultimate syllable, it must be in the weak position to satisfy NoStressed-

---

14 One may argue that the second syllable in this word contains a non-alternating schwa. Assuming an underlying schwa, however, does not change the evaluation as shown below:

<table>
<thead>
<tr>
<th>{hack/å/nsack}</th>
<th>*σ</th>
<th>NonFin</th>
<th>WSP</th>
<th>Rhythm</th>
<th>Edge-R</th>
<th>Parse-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) (hácken)(sáck)</td>
<td>*</td>
<td>NonFin</td>
<td>WSP</td>
<td>Rhythm</td>
<td>Edge-R</td>
<td>Parse-σ</td>
</tr>
<tr>
<td>(b) ha(ckén)sack</td>
<td>*</td>
<td>NonFin</td>
<td>WSP</td>
<td>Rhythm</td>
<td>Edge-R</td>
<td>Parse-σ</td>
</tr>
<tr>
<td>(c) ha(ckén)(sáck)</td>
<td>*</td>
<td>NonFin</td>
<td>WSP</td>
<td>Rhythm</td>
<td>Edge-R</td>
<td>Parse-σ</td>
</tr>
<tr>
<td>(c) (hácken)(sáck)</td>
<td>*</td>
<td>NonFin</td>
<td>WSP</td>
<td>Rhythm</td>
<td>Edge-R</td>
<td>Parse-σ</td>
</tr>
</tbody>
</table>

This time, NoStressed-Schwa actively participates in evaluating words even without extrametricality to make (b) and (c) suboptimal.
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Schwa, which has the effect of pushing the last syllable out of the foot. If the syllable is not heavy or headed by a schwa, it fails to constitute a foot by itself, due to $FtBin$, and is simply left unfooted at the end of a word.

The discussion in this section makes a strong and testable hypothesis about basic stress patterns in English. The primary stress falls on the penultimate syllable if the final syllable is light. This leads to stress patterns of $L(LL)$ and $(LL)(LL)$. The basic pattern proposed here is quite different from the syllable extrametricality approach which would argue for $(LL)L$ and $L(LL)L$. Though further research is required in this connection, we observe that the $(LL)(LL)$ pattern appears to be more productive than $L(LL)L$ for underived words and recently imported words (cf. footnotes 3 & 4).

4. Prosodic Subcategorization

In the previous section, we have talked about extrametricality effects in underived words, focusing on the proposal that non-alternating schwas are underlyingly present. Extrametricality effects are also shown by affixes. Hayes (1982) posited that some suffixes, like {-ic} or {-ish}, are marked for consonant extrametricality, while some other suffixes, like {-ent},{-ous} or {-al}, are marked for suffix extrametricality. In this section, I will propose that the deviant nature of suffixes can be explained by prosodic subcategorization constraints. Later in this section, we will also see how the subcategorization constraints interact with other constraints to produce the vowel shortening effects in {-ic} shortening and tri-syllablic shortening.

4.1. Subcategorization Constraints

One of the basic assumptions adopted in this paper is that affixes subcategorize for the prosodic status of bases to which they are attached, and that the subcategorization information comes in the form of constraints. In other words, a suffix can pose a certain prosodic shape on the base. A related observation is found in Fudge (1984: 40-45). Fudge surveys English affixes and generalizes that there are at least three kinds of suffixes that influence the location of lexical stress. His observation is summarized in (18):

(18) Suffixes and stress
a. Autostressed suffixes
   These suffixes attract the main stress onto themselves.
   -ade  -ee  -aire  -esce
   -ine  -esse  -ique
b. Pre-stressed suffixes:
   These suffixes place the main stress to a syllable immediately preceding them.
   -erie  -ic  -id
   -ish  -ity  -itory
c. Mixed stressed suffixes:
   These suffixes attract the main stress to the immediately preceding syllable or the second one to their left.
   -ate  -al  -ous
   -ent  -ive  -ary

Some suffixes have the stress on themselves as in (18a), while others attract the main stress to their neighboring syllables as in (18b). The suffixes in (18c) are interesting. The main stress comes either to the first or the second syllable to the left of these suffixes depending on the weight of the preceding syllable. It was also noted in SPE (p.86) that suffixes are related to stress assignment:

(19) A remark from SPE
Superficial examination would suggest that it is necessary to distinguish two other classes of affixes (apart from those that take primary stress), namely those of the –l category, which place
primary stress on the final syllable of the string to which they are affixed (e.g. -ion, -ic, -ity, -ify) and those of the –2 category, which generally place stress on the penultimate syllable of the string to which they are affixed (e.g. –y, -ate, -ize). Actually, most of these affixes are perfectly regular and require no special comment. In particular, the –2 category is superfluous.

SPE, however, dismisses the importance of the role of affixes in stress assignment since most of them “require no special comment.” The lack of special comment, as I see it, eventually leads to complexity and exceptions in stress description. Focusing on suffixes, we can see that they are actively involved in locating lexical stress. Fudge’s generalization given in (18) is almost without exception.

Given the observation, we may as well say that these suffixes prosodically subcategorize for their bases. Let us take for example the adjective-forming suffix {-al}, one of Fudge’s mixed stress suffixes (18c). The stress is assigned to the immediately preceding syllable if it is heavy, or to the second syllable to its left. The common property in either case is that {-al} is added immediately after a bimoraic constituent, i.e. a foot. With the same logic, we may say that suffixes in (18a) are required to be aligned in head syllable position, that those in (18b) are aligned with the head syllable, and that those in (18c) are aligned to a foot within the generalized alignment schema as in McCarthy & Prince (1993). The following subcategorization requirements are found in English:15

\begin{enumerate}
\item \textit{Align (Suffix, L, σ, L)} (=\textit{Align-In-σ}) (cf. (18a))
Suffixes are subcategorized to be placed in the head syllable.
\item \textit{Align (Suffix, L, σ, R)} (=\textit{Align-To-σ}) (cf. (18b))\footnote{See Spencer (1996: 274) for a similar proposal that suffixes like {-ic} makes the preceding syllable a foot.}
Suffixes are subcategorized to align with the head syllable.
\item \textit{Align (Suffix, L, Ft, R)} (=\textit{Align-To-Ft}) (cf (18c))
Affixes are added after a foot.
\item \textit{Align (Suffix, L, PrWd, R)} (=\textit{Align-To-Pwd})
Affixes are added after a prosodic word.
\end{enumerate}

It will be assumed that \textit{Subcat} is satisfied by the syllable that contains the relevant suffix. Since the constraints target prosodic units, it should be met by another prosodic unit such as a syllable, not by a morphological unit such as a suffix. Suffixes with the constraints in (20c) or (20d) are analogous to Class I suffixes, while those with (20d) resemble Class II suffixes in the suffix classification by Siegel (1974). This, however, does not mean that the constraints are a translation of the lexical phonological hypotheses into Optimality theory. The proposal here is different from Lexical phonology in a couple of important ways. First of all, a suffix may have one or more, or none of the prosodic requirements. Take a noun-forming suffix {-al} for example. We see that the suffix is added only to a prosodic word with a final stressed syllable. Consider the examples in (21):

\begin{enumerate}
\item \textit{Align-To-Ft}
\item \textit{Align-To-σ'}
\item \textit{Align-To-Pwd}
\end{enumerate}

Examples in (21a) show that the suffix is immediately preceded by a heavy syllable. This could mean that it has \textit{Align-To-Ft}. In (21b), however, we find that the noun-forming suffix is added after a foot, but still is not wellformed. The preceding syllable must be stressed. This shows that the suffix is also subject to \textit{Align-to-σ'}. Finally the examples in (21c) show that the stem must be a prosodic word, meaning that it must obey \textit{Align-To-Pwd}.15

\footnote{Subcat represents a host of constraints as in (20). Without any concrete evidence to the contrary, it is assumed in this paper that all these constraints are unranked with each other. (But see footnote (17).) There being no interaction among subcategorization constraints, I will represent them by a cover constraint \textit{Subcat} in the discussion.}

\footnote{How \textit{Subcat} is realized in evaluation is a matter of debate. One way to view it is to assume that the affix introduces new constraints. But this would mean the introduction of different ranking for each suffixes. Another possibility is to assume that the affix interacts with a set of constraints, for example with a constraint \textit{Head-σ} for the head syllable, or \textit{Head-S}. This would mean that the affix \textit{subcategorizes for} these constraints, and that these constraints are satisfied by the head syllable. But then it would be necessary to specify how these constraints are ranked, and that they are satisfied by the head syllable. The proposal here is different from Lexical phonology in a couple of important ways. First of all, a suffix may have one or more, or none of the prosodic requirements. Take a noun-forming suffix {-al} for example. We see that the suffix is added only to a prosodic word with a final stressed syllable. Consider the examples in (21):

\begin{enumerate}
\item \textit{Align-To-Ft}
\item \textit{Align-To-σ'}
\item \textit{Align-To-Pwd}
\end{enumerate}

Examples in (21a) show that the suffix is immediately preceded by a heavy syllable. This could mean that it has \textit{Align-To-Ft}. In (21b), however, we find that the noun-forming suffix is added after a foot, but still is not wellformed. The preceding syllable must be stressed. This shows that the suffix is also subject to \textit{Align-to-σ'}. Finally the examples in (21c) show that the stem must be a prosodic word, meaning that it must obey \textit{Align-To-Pwd}.15}
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Secondly, we see that even the suffixes with Align-To-Pwd, the traditional Class II suffixes, may participate in stress assignment. This is quite unexpected from the viewpoint of Lexical phonology, since Class II suffixes are assumed to be added after stress assignment. Consider the stress patterns of the following words:

(22) emplóy – empleyyée Jápán – Jàpányése cigár - cigàrrette

Since the suffixes, such as {-ee}, {-ese} and {-ette}, can only be added after a lexical word, they may be classified as Class II suffixes. Given the classification, they are not supposed to affect the stress patterns. Moreover, we find that the final stress in underived words is completely reduced with the suffixation. This may be an argument against the cyclical analysis of English stress. Coming back to the present discussion, we find that these suffixes have two requirements; Align-In-σ and Align-To-Ft. The stress shift effect, then, is due to Rhythm, which prohibits two adjacent strong syllables. The argument presented here clearly shows that the suffix Subcat is not simply a translation of the suffix classification in Siegel (1974).

A related proposal is made by Alcántara (1998). He proposes the subcategorization of suffixes with respect to stem boundaries. For example, {-ity} is added inside the stem, and stem final extrametricality is applied to make the final syllable extrametrical. But to protect {-ic} from extrametricality, he proposes that the underlying form of {-ic} is /ik/ and argues that there is a final vowel extrametricality which is applied only to final /a/. Minor differences aside, the major departure of the proposal in this paper from Alcántara is that suffixes are not passively added in (inside of) or to (outside of) the stems, but they actively enforce certain prosodic shapes on the bases through Subcat family of constraints.

Let us now consider the ranking. Without evidence to the contrary, it will be assumed that Subcat which refers to a foot or a head syllable is undominated. The constraints involved in mora assignment to the consonants are dominated by Rhythm, since clash is resolved by eliminating stem moras. For the sake of simplicity, it will be assumed that Align-σ(Stem) is assumed to be immediately below Rhythm in ranking. Consider the revised evaluation tableau of (7) as in (23):

\[ \text{view is to assume that all the constraints, like Align{-ic}-To-σ', Align{-al}-To-Fi, Align{-ness}-To-Pwd, etc., are fully ranked and already present in the evaluation, and relevant suffixes must satisfy the constraints concerned. This way, we can keep the entire ranking intact, while allowing underived words, having no relevant suffixes, to pass through Subcat with vacuous satisfaction.} \]

\[ \text{One more difference is that the subcategorization schema in this paper is assumed to be universal. It can also be used in explaining morphological stress by suffixes. Some examples of morphological stress in Subcat schema is given below:} \]

\[ (1) \text{Align-in-σ'} \]

a) In Mangarayi (Syllable trochee), there are four exceptional bisyllabic suffixes, {-mayin}, {-mingan}, {-mihi}, and {-yayi}, that have primary stresses. (Merlan (1982))
b) Payne noted the existence of exceptional suffixes that always take main stress in Asheninca (Iamb). (Hayes 1995: 296)
c) In Lenakel (Moraic trochee), verbs ending in the transitive suffix {-in} have a final stress. (Hayes 1995: 170)

\[ (2) \text{Align-to-σ'} \]

a) In Latin (Moraic Trochee), when enclitics are added to a word, stress shifts onto the last syllable of the host word regardless of the length of the host or the clitic. (Halle & Idsardi 1995: 426)
b) Hayes (1995: 312) observes that there are some pre-accenting suffixes in Cayuvava (Syllable trochee)
c) In Turkish (Iamb), a suffix {-dur} comes after a stressed syllable (Halle & Idsardi 1995: 416)

\[ (3) \text{Align-to-Ft} \]

In Manam (Moraic Trochee), the so-called AP suffixes, {-di}, {-ma}, {-i} place the primary stress on the preceding syllable if it is heavy, or on the anti-penultimate syllable (Kenstowicz 1994, 614).

\[ \text{Consider {-ee}, which attracts the main stress onto itself, even if it stands at the right edge of a word as in èmployyée. This shows that Align-In-σ' must at least be higher than NonFin. As for Align-To-Pwd, it may be ranked lower than other types of Subcat. This suggests that Subcat be decomposed and ranked separately. Left open in this paper is the possibility of moving Subcat down to some dominated position and of decomposing Subcat into subconstraints of a different hierarchy.} \]
(23) Revised evaluation of “parental”

<table>
<thead>
<tr>
<th></th>
<th>Subcat</th>
<th>NonFi</th>
<th>Rhythm</th>
<th>Alignσ(Stem)</th>
<th>Edge-R</th>
<th>NoMoraic-C</th>
<th>Parse-σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td>(páren)(tál)</td>
<td></td>
<td>*(n)</td>
<td>**</td>
<td>*(l)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>pa(rén)tal</td>
<td></td>
<td>*</td>
<td>**</td>
<td>*(n,l)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>pa(rén)(tál)</td>
<td></td>
<td>*!</td>
<td>*</td>
<td>*(n,l)</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>(páren)tal</td>
<td></td>
<td>*(n)</td>
<td>**</td>
<td>*(l)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e)</td>
<td>pa(rén)tal</td>
<td></td>
<td>*!</td>
<td>*(n)</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

In reading the tableau, it is assumed that all the candidates obey Trochee and FtBin, the two undominated constraints in English. Note that the relative ranking between Align-σ(Stem) and Edge-R is not crucial in picking out (23b) as optimal. We see that the suffix {-al} crucially does not have a moraic consonant, therefore (23b) does not have a WSP violation, unlike in (7b). The tableau in (23) shows that the evaluation can select the wellformed output without resort to syllable extrametricality.

In suffixes, a coda consonant, if any, is not moraic because NoMoraic-C dominates Align-σ(Suffix). Even consonant clusters in such suffixes as {-ent}, {-ance} fail to contribute to syllable weight. As for suffix syllable extrametricality, the answer given here is Subcat. Consider a {-VC} suffix that is subject to Align-To-Ft, such as {-al} or {-ous}. It cannot constitute a heavy syllable and it should be placed after a foot. The eventual outcome is that they must not be parsed into a foot. Another type of syllable extrametricality effect is found in disyllabic suffixes that are subject to Align-To-σ’ such as {-ity}. To observe FtBin, only the first vowel of these suffixes may be parsed as the weak member of a foot. This, in turn, means that the final syllable -ty- is pushed out of the foot, resulting in the syllable extrametricality effect.

4.2. Vowel Shortening

In this subsection, I will present supporting evidence for Subcat. One may argue that there is some degree of redundancy in the proposals made in this paper. Take {-ic} for example, the consonant extrametricality effect can be explained in two different ways. First, the final consonant simply fails to contribute to syllable weight, because it is part of a suffix and all consonants in suffixes are not moraic, due to the ranking NoMoraic-C >> Align-σ(Suffix). Second, since it should be added to a head foot, it must be in the weak position of a foot, which forces it to be monomoraic to observe FtBin. However, the redundancy does not come from the unconstrained nature of the proposal. That suffix codas are weightless is crucial in explaining the behavior of suffixes with the Align-To-Ft subcategorization constraint. Otherwise, all {-VC} suffixes with the Align-To-Ft constraint will show up as heavy syllables. Then again, we cannot dispense with Subcat, since it plays a crucial role in understanding the idiosyncratic behavior of suffixes. One step further, this subsection argues that Subcat is responsible for vowel shortening phenomena in English. Consider the following schematic structure:
Extrametricality in English

(24) Environment of vowel shortening in suffixation\(^{20}\)

a. Heavy syllable followed by suffixes with Align-To-\(\sigma\)' (H \(\rightarrow\) H-)


c[ow]n  c[α]nic  s[ay]gn  s[I]gnify

b. H-L sequence followed by suffixes with Align-To-Ft (H L \(\rightarrow\) H- L)

n[ey]tion  n[æ]tional  n[ey]ture  n[æ]tural

pron[aw]nce  pron[ʌ]nciation

Vowel shortening in English has been widely discussed in the literature. In SPE and others that follow in generative phonology, it is assumed that vowel shortening is caused by certain suffixes (-ic shortening) or due to the place of the target long vowel in a word (tri-syllabic shortening). Further research, however, shows that vowel shortening is not due to the location of a heavy syllable. Prince (1990) proposes that vowel shortening is a way of improving foot harmony. For example, (HL) is assumed to be less harmonic as a trochee than (LL). One way to improve the harmonic scale of an uneven trochee (HL) is to shorten the first H to make it L. Another suggestion in this context is the anti-trapping effect in Mester (1994). He assumes that foot binarity at the moraic level is strictly enforced, and views that an HL sequence is parsed as (H)L. Crucially L is left unfooted, or “trapped” in his terms. The trapped syllable is eliminated by parsing it into the preceding (H) foot. Subsequently it has the effect of shortening the head syllable. These proposals, the harmonic improvement and the anti-trapping effect, however, miss one important generalization in English that vowel shortening never takes place in underived words, like Nightingale, and words with Class II suffixes, such as kindness, likelihood, or bountiful.

Vowel shortening in this paper is viewed as being triggered by Subcat of suffixes. This will naturally explain the lack of vowel shortening in underived words or derived words without relevant suffixes. The highly ranked constraint, Subcat, literally imposes changes on the moraic structure of stems. Let us first think about the vowel shortening in (24a). When a suffix with the Align-To-\(\sigma\)' constraint is added to a stem that ends in a CVVC sequence, the surface form is a CVC-suffix, not the expected CVVC-suffix. Here vowel shortening comes from two different sources: Subcat, and Parse-\(\sigma\). Consider the following tableau exemplified with “serenity”:

(25) Vowel shortening in “serenity”

<table>
<thead>
<tr>
<th></th>
<th>FtBin</th>
<th>Trochee</th>
<th>Subcat (Align-[-ity]-To-(\sigma)')</th>
<th>Rhythm</th>
<th>Parse-(\sigma)</th>
<th>Max-(\mu)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>µ µµµ</td>
<td>µ µµµ</td>
<td>µ µµµ</td>
<td>µ µµµ</td>
<td>µ µµµ</td>
<td>µ µµµ</td>
</tr>
<tr>
<td>(a)</td>
<td>se(rémi)ty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b)</td>
<td>se(rémi)ty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c)</td>
<td>se(rémi)nty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(d)</td>
<td>se(rémi)nty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f)</td>
<td>(sère)(nity)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e)</td>
<td>(serè)(nity)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^{20}\)There are two more types of vowel shortening observed in the literature: pre-cluster shortening and rhythmic shortening. Pre-cluster shortening is seen in wide-width, deep-depth, perceive-perceptive alternations. It may be further expanded to include irregular past forms like keep-kept, hide-hid, feel-felt, as in Myers (1987). Rhythmic shortening is seen in such pairs as design-designation, saliva-salivation, defame-defamation or the like. When a heavy suffix (suffixes with long vowels such as {-ate} or {-ize}), is added after a heavy syllable, it induces rhythmic clash. As a result, the stress moves one syllable away from the suffixes (cf. Strong retraction in Hayes (1981)). Since these are not directly related to Subcat, we will not talk about these cases of shortening.
We may think of additional forms which violate Subcat, such as (se)r[iy](nity), but since a candidate like this crucially violate either $FtBin$ and $WSP$, it will be immediately eliminated. The tableau shows that (25a), though it is not perfect, still fares better than any other candidate. One of the competing candidates is (25c), which is faithful to underlying mora count, while observing Subcat. But it has one more violation of Parse-$\sigma$.$^{21}$ Grouping the last two syllables into a foot, however, results in rhythmic clash as shown in (25d). An attempt to avoid rhythm by pushing the primary stress leftward leads to a fatal violation of Subcat as in (25f). And a further attempt to avoid clash and satisfy $Subcat$, as shown in (25e), leads to Trochee violation.

Now consider the nation-national alternation (vowel shortening as in (24b)), induced by suffixes with Align-To-Ft. {-al} must be added after a foot to satisfy $Subcat$. Given the string $HL$-nal, neither $(H)L$-nal nor $H(L)$-nal can be correct. $(H)L$-nal violates $Subcat$, because it is not placed immediately after a foot. $H(L)$-nal may satisfy $Subcat$, but this time it violates $FtBin$. Notice that the base foot consists of one light syllable. As explained here, neither of the parsings can satisfy all the undominated constraints. The tension between these constraints results in vowel quantity change in English. The only way to satisfy both $FtBin$ and $Subcat$ is to reduce the heavy syllable into light to form a $(LL)$-nal structure. Consider the tableau given in (26):

(26) Vowel shortening in “national”

<table>
<thead>
<tr>
<th>$\mu\mu\mu\mu$ nation $+\mu$ al</th>
<th>$FtBin$</th>
<th>Trochee</th>
<th>$Subcat$ (Align-[-al]-To-Ft)</th>
<th>Rhythm</th>
<th>Parse-$\sigma$</th>
<th>Max-$\mu$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\mu\mu\mu\mu$ (a) (na)(tional)</td>
<td>$*$</td>
<td>$*$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu\mu\mu\mu$ (b) (na)(tional)</td>
<td>$*$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu\mu\mu\mu$ (c) (na)(tional)</td>
<td>$*$</td>
<td></td>
<td>$*$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu\mu\mu\mu$ (d) (nation)nal</td>
<td>$*$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\mu\mu\mu\mu$ (e) (nation)nal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In (26a), and (26c), we find that $Subcat$ is violated, therefore these candidates cannot be optimal given the presence of other candidates that are faithful to the given constraint. (26b) is no better. Notice here that the forced satisfaction of $Subcat$ incurs $FtBin$ violation. Of particular interest here is the comparison between (26d) and (26e). (26d), though it preserves all of the underlying moras, critically violate $FtBin$. Clearly the interaction shows that the suffix is responsible for the vowel shortening. For underived words, such as Nightingale, Stevedore, ivory, pirating and others, there is no pressure for vowel shortening, since they are not subject to $Subcat$.

One may question what would happen if the target heavy syllable does not contain a long vowel, i.e. the heavy syllable has a CVC(C) sequence. Cases like this can be treated in the same manner. Align-$\sigma$ has the effect of assigning a mora to a coda consonant, if they do not have one. Also note that Align-$\sigma$ (Stem) is lower in rank than Rhythm as in (23). Being undominated in English, $Subcat$ may force the violation of Align-$\sigma$(Stem). Consider the following evaluation tableau:

---

$^{21}$ Having two adjacent unfooted syllables is more than just two violations of Parse-$\sigma$. As noted in Footnote (13), this is a Lapse violation, which is assumed to be ranked high in English.
Extrametricality in English

(27) Evaluation of “personal”

<table>
<thead>
<tr>
<th></th>
<th>FitBin</th>
<th>Subcat</th>
<th>Rhythm</th>
<th>Align-σ (Stem)</th>
<th>Parse-σ</th>
<th>Max-µ</th>
</tr>
</thead>
<tbody>
<tr>
<td>µµµµµµ</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) (per)(sonal)</td>
<td></td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) (per)(so)nal</td>
<td></td>
<td>*!</td>
<td>*</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) (per)(so)nal</td>
<td></td>
<td>*!</td>
<td>*</td>
<td></td>
<td></td>
<td>**</td>
</tr>
<tr>
<td>(d) (perso)nal</td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>(e) (perso)nal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

Practically the same evaluation process is witnessed here. One thing different from vowel shortening is that when CVC appears light on the surface, it has a violation for Align-σ(Stem) and not for Max-µ. But the distinction is not important here since Subcat dominates both of them.

The discussion in this subsection strongly argues that the cyclicity effect of vowel shortening is due to Subcat of suffixes. Suffixes with the constraint Align-To-Ft, or Align-To-σ’ actively change the prosodic shape of a stem which results in the change of a heavy syllable into a light one. The discussion here shows that Subcat is not just an arbitrary proposal to deal with the stress system in English. It is shown that Subcat provides means to accommodate findings from Lexical phonology into Optimality without dividing the English lexicon into several subgroups. It is also shown that Subcat has direct relevance to foot structure in general in assigning stress. Finally it can also actively change the syllable weight of stems. It is shown that vowel shortening receives the most direct interpretation with Subcat, without level ordering and/or derivational stages.

5. Conclusion

In this paper, we have discussed the extrametricality effect in English stress placement. The focus of the paper is to develop proposals so that we do not have to divide the English lexicon into several subgroups and assume different rankings of constraints for different subgroups. Further, a solution to extrametricality is sought without resorting to catalectic syllables (Kager (1995)) or some abstract vowels (Alcántara (1998)) to deal with exceptions to extrametricality or exceptional extrametricality.

Coda consonants are assumed to be non-moraic in underlying representation. A consonant may get a mora to observe Align-σ. The constraint Align-σ is divided into Align-σ(Stem) and Align-σ(Suffix), intervened by NoMoraic-C. i.e. Align-σ(Stem) >> NoMoraic-C >> Align-σ(Suffix). The ranking predicts that coda consonants are moraic in stems but not in suffixes. The ranking, therefore, is partly responsible for the consonant extrametricality effect in derived words. As for underived words, the basic claim is that there is no extrametricality effect. The apparent extrametricality effect, having no stress in penultimate syllables, is due to the nature of underlying vowels. When there is no surface vowel alternation, the surface schwa is assumed to be underlying. In XC*CVC## structures, the lack of stress on the penultimate syllable is attributed to NoStressed-Schwa. In this case, the primary stress falls on the antepenultimate syllable due to the interaction of relevant constraints. Again final C*C(C) syllables are forced to be light due to NoStressed-Schwa, resulting in the consonant extrametricality effect.

In derived words, suffixes are assumed to have strong requirements in the form of Subcat on the prosodic shape of the base. Subcat is highly ranked, participating actively in tailoring the shape of stems for suffixation. Disyllabic suffixes with Align-To-σ’ or monosyllabic suffixes with Align-To-Ft result in an unfooted final syllable so as to observe relevant constraints, FitBin and Trochee. This explains the syllable extrametricality effect. This paper thus argues that the extrametricality effect in English comes from a variety of sources, and that it can be explained by the interaction of relevant constraints.
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