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THE ENGLISH STRESS SYSTEM: CONDITIONS AND PARAMETERS

Introduction

Despite the unquestioned advancement of phonological theory over the past decades some areas of phonological enquiry are still mist-covered and vague. Stress seems to be one of the most thoroughly discussed and, surprisingly, least understood phonological phenomena.

This article is a presentation of work in progress and does not aspire to be a comprehensive and complete analysis of the English stress system. The argument is based on the assumption that stress position is deducible from the constituent structure of a prosodic word. The analysis of the constituent structure, together with a small number of constraints and parameters, as we hope, suggests a more natural explanation of feet formation and the metrification processes. We move away from the canonical, binary branching inventory of metrical feet (allowing ternaries) and propose conditions of well-formedness and exhaustiveness as well as a parameter on parsing final empty nuclear positions in verbs and adjectives. These correctly predict stress position within a prosodic word and naturally explain a number of stress-related phenomena, including some of the apparent inconsistencies of the English stress system, unrelated elsewhere and previously explained in a typically *ad hoc* manner.

English has a quantity sensitive stress system. Its quantity-sensitivity, however, lies not only in "the syllable" and its weight. It is rather sensitive to the overall quantity (weight) of metrical constituents, i.e. metrical feet and their hierarchical internal structure. Syllabic constituent structure is important only to the extent that it recognises two types of rhymes (single and branching) which ultimately contribute to the quantity of metrical feet. The position of stress, therefore, depends not merely on the quantity of a rhyme but primarily on its position in the hierarchic structure of a metrical foot.

This theory would be incomplete and inadequate without recognition of final empty nuclear positions (henceforth FEN). Despite their phonetic inaudibility, we claim that they are visible to metrical structure in verbs and adjectives and, as feet-forming slots, they can have the special effect of creating a *weak* foot with a lower rank in the hierarchy of English optimal feet structures.

The theory of constituents is adopted from the theory of Government Phonology (henceforth GP) (Charette 1992, Kaye, Lowenstamm and Vergnaud (henceforth KLV) 1990), which convin-cingly gets rid of constituents: syllable and coda. They will not be invoked in this work, either.

The phenomenon of stress in language gives rise to a number of difficulties which, roughly, fall into two categories: observational (empirical) and theoretical (representational). The problem behind the empirical analysis of stress follows from the fact that language prosody is hardly accessible to consciousness and does not lend itself to direct observation. To overcome the problem Chomsky and Halle (1968, henceforth SPE) followed a syntactic approach and radically relied on native speaker's stress judgements, taking their agreement as datum. A further difficulty concerns the proper definition of stress where agreement is reached only as far as the most primitive, or obvious, aspects of stress are concerned. As argued in Liberman and Prince (1977) stress is a linguistic manifestation of rhythmic structure and has the function of an 'organising framework' for the phonology and phonetics of an utterance. Since rhythm does not correspond to any particular physical phenomenon, then, quite automatically, stress has no invariable phonetic correlate.

This raises a serious phonological question of how stress should be represented. In the SPE tradition, which proved unfruitful and futile as far as prosodic phenomena were concerned, stress was believed to be a pro-perty of single vowels. Thus, the need for elaborate rules, their ordering and an impressive theory to account for a large group of exceptions.

A radical break-through came with the development of metrical theory of stress (Lieberman and Prince, 1977, Hayes, 1981), where stress was first represented as the relative prominence of syllables rather than a binary vocalic feature (see also: Selkirk 1980 for a criticism of the [+/– stress] feature). The disjunction of segmental rules from prosodic ones was achieved by postulating different levels of representation; stress became a domain of the syllabic level, thus, making phonological rules "local" on appropriate levels. The metrical rules referred to the construction of "metrical feet", i.e. larger groupings of syllables with one member obligatorily stressed. The internal structure and the sizes of metrical feet, however, were heavily restricted (Hayes 1981, 1985) to binary (two syllable members) and unbounded (unlimited) ones.

Limiting the possible (hence well-formed) structure of a metrical foot to a binary branching one (as concluded in Hayes (1985), Halle and Vergnaud (henceforth HV)(1987) and others to date) is indeed a tempting option. Such a strict restriction on foot construction, however, would have only been an advantage in

a theory which could, at the same time, point at a direct relation between the structure of such a metrical foot (or some higher-rank groupings of them) and the stress position. What we think is lost is an observation regarding dependency relations within a foot since the rules arbitrarily assign values strong/weak to a foot at some level. Anything that follows in those analyses is simply repairing the unwelcome structures obtained (de-stressing, cyclic vs post cyclic applications of rules). Furthermore, such theoretical and formal solutions have very little to say about metrical changes under suffixation. In our approach, we chose not to delimit the number and kind of metrical structures at the price of a massive apparatus of processes that would have to be involved to obtain the desired results, but rather to propose a process of metrification (with a small number of parameters) plus a strict well-formation condition based on dependency relations within feet plus a set of templates of all well-formed feet.

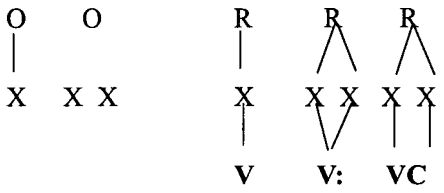
The recognition of exclusively binary metrical feet had a remar-kable constraining effect on the theory but entailed a need for a sub-theory of "extramatncality" with an extrametncality rule which "designates a particular prosodic constituent (segment, syllable, foot, etc) as invisible for purposes of rule application; the rules analyse the form as if the extrametncal entity were not there" (Hayes 1985, p 57). The notion was farther constrained by the conditions of peripherality, edge markedness (right edges unmarked) and non-exhaustivity (the entire stress domain cannot be extrametncal). Whichever theory is applied, however, English seems to evade neat generalisations and, despite its weight-sensitive nature, it displays a descriptional unpredictability.

1. Syllabic constituents and empty nuclear positions

The existence of two syllabic constituents is postulated: the onset (0) and the rhyme (R). (A nucleus (N) is not important in this analysis as it is invariably projected onto a rhyme that dominates it.) A syllabic constituent may be defined as a maximally binary branching governing domain where the relation of government is characterised by the conditions of locality and directionality (for an extensive discussion see Charette (1992) and KLV (1990)). All possible syllabic constituents are presented in (1) below:

(1)

a. Onsets: **b**. Rhymes



It is not a novel conception in phonology that certain phonological positions, although not produced phonetically, are indeed present in phonological representations. English, as well as Polish for that matter, is famous for its numerous vowel-zero alternations: *meter-metrical, monster-monstrous* where FEN is indeed present. Without going into a detailed analysis, we follow an approach extensively argumented within the framework of GP (see Charette 1992, KLV 1990) and claim that for all words that end in a consonant there exists a parameter which licenses a final empty nuclear position. This may, potentially, have influence on metrical structure and consequently the stress position within a word. Within such an approach, an immediate advantage is that, once a final empty nucleus is recognised, the need to account for the extrametrical nature of a final surface consonant disappears as the consonant belongs to the onset of a separate syllable with the FEN by which it is licensed. Consequently, the extrametricality of a final consonant becomes an obvious "extrametricality" of a phonetically unrealised syllable. As we will see later, regardless of its phonetic absence, the FEN is visible to and does contribute to the metrical structure of verbs and adjectives, resulting in (phonetically) final stress.

Empty nuclei are not restricted to the final position. Yet another context in which they appear is the one before [s]. An extensive discussion of this phenomenon can be found in Kaye (1992), supported with evidence from Italian and English. Due to its strange properties, not without a reason called "magic" by the author, [s] licenses a preceding empty nucleus and in initial consonantal clusters it is never a part of a branching onset but a complement of a rhyme whose nucleus is empty. The implications for our discussion are that [s], in a V[s]C sequence, belongs to a preceding rhyme which is, therefore, branching, hence heavy.

2. Conditions and Parameters underlying the English stress system

Having briefly outlined the constituent structure, we may now proceed to the discussion on how the nature of constituents is related to the stress position. We do not see any need whatsoever to invoke the notion of the syllable as the constituent seems superfluous. (For an extensive analysis of "the syllable's" redundancy in phonology see: Katarzyna Dziubalska-Kołaczyk 1995.) We will try to point out that the only constituent which is an ultimate building block of metrical structure is the rhyme.

It is more than obvious that stress as a phonological phenomenon is not an extra feature ascribed to particular vowels or syllables but rather a relatively greater prominence of certain rhymes (ultimately dominating nuclear positions). However, the choice of a particular type of rhyme (branching or non-branching) to carry stress does not seem to depend merely on its weight but rather on its position within the metrical structure of a word. The constituents that organise skeletal/syllabic structure into a metrical one are metrical feet, which by nature contain one and only one stressed element (rhyme).

Let's assume that a metrical foot can be defined in the following way:

(2)

Metrical Foot is an:

1. obligatorily branching,

2. hierarchically organised,

3. peripherally dominant

prosodic constituent composed of rhymes, which contributes to the rhythmic structure of an utterance.

Obligatory branching, i.e. minimum of two rhymes, is a natural conse-quence of the assumption that stress is a relative phenomenon. The hierarchical organisation reflects the observation that one and only one rhyme within a foot can dominate other members and consequently bear stress and peripheral dominance locates the stressed element at the right or left boundary of a foot resulting in an iambic and trochaic pattern correspondingly (the dominance being a language specific parameter). This largely mirrors HV's (1987) parameter settings for English which are:

(3)

+ Head terminal
+ Bounded
+ Left-Headed

The definition in (2) would be incomplete without a stricter constraint on the feet's internal structure as it does not take into consideration the nature of relations that hold between the members of a proposed metrical foot and the peripheral members of neighbouring feet, namely the relations that refer directly to the weights of the rhymes that make up the foot. We postulate such reference to rhymes' weight in the Well-Formedness Condition below:

(4)

Well-Formedness Condition

A metricalfoot is well-formed only if:

1. its head is not of lower weight than other members it dominates.

The Well-Formedness Condition can be formalised in the following way:

(5)

$\ldots \geq R_o)_{F2}(< \mathbf{R_1} \geq R_2 \ldots)_{F1}$

$\ldots \geq R_o)_{F2}(< \mathbf{R_1} \geq R_3 \ldots R_n)_{F1}$

where R_1 is the head of Foot 1 $(\mathbf{F_1})$ and $\mathbf{R_2, R_3 \ldots R_n}$ are dominated rhymes.

The immediate implications of Well-Formedness are: the impossibility of assigning two consecutive stresses to the neighbouring rhymes and the possibility of non-exhaustive parsing, if the result would yield an ill- formed foot, i.e. one with distorted weight relations or a unary foot. Accordingly, the Exhaustiveness Condition (whose earlier, rule-based formulation can be found in HV (1987: 10–16) where it is additionally subject to Recoverability Condition) can be derived, which states that:

(6)

Exhaustiveness Condition

Parsing of rhymal material aims at exhausting the whole phonological string available unless it violates Well-formedness Condition.

Neither Well-Fromedness nor Exhaustiveness, however, presuppose any limit on a maximal foot span. Assuming that underived, morphologically simple lexical items with only one, primary stress contain only one metrical foot, we have observed that the English lexicon provides no examples of words where stress falls on a rhyme more remote from the end of the word than the third (antepenultimate) one [1]. Since all syllabic constituents, including rhymes, are maximally binary branching we can hypothesise that the maximum number of skeletal positions contained within one metrical foot is six, the largest well-formed foot being: $F=\{R_1(xx)R_2(xx)R_3(xx)\}$.

According to the Well-Formedness Condition and the parametrically left-hand direction of dominance within a foot, we can derive the following types of well-formed metrical feet [2]:

(7)

a. (x)(x) *'pity*	e. (xx) (xx) *'contact*
b. (xx) (x) *a'genda*	f (xx) (x) (xx) *'asterisk*
c. (x) (x) (x) *A'merica*	g. (xx) (xx) (x) *'orchestra*
d. (xx) (x) (x) *mandarin*	h. (xx) (xx) (xx) examples not found

[1] Verbs and adjectives are not considered here as display an observationally different metrical behaviour and they seem to allow F= R(xx). As we will argue, thisis due to special role played by FEN which contributes to the internal structure of a metrical foot, therefore yielding F= {[R(xx)][R=()]} and not F=R(xx) as one mayexept.

[2] Feet F={R(xx)} are exluded according to obligatory branching condition on metrical feet. (cf. Note [1])

The first observation is that English abounds in some of the above groupings, namely (7a,b,c,e), while it apparently disfavours (7d,f) and totally excludes those in (7h). As noted in SPE (1968) English nouns typically follow two major patterns: i) with a stressed heavy (branching) penultimate, if available (which mirrors our metrical foot template in (7b)), or ii) otherwise with a stressed light antepenult (which mirrors our foot template in (7c)). This, in turn, suggests that the favourable total weight of a metrical foot oscillates around the optimal number of three skeletal positions. While other, larger or smaller, weights are allowed, as we have seen in (7d,e,f), this is only because of the application of Well-Formedness Condition to a non-optimally organised rhymal material available, e.g. *mandarin, asterisk, orchestra.*

3. Towards optimal foot weight. Phonetic evidence

Vowel elisions. A number of supporting arguments can be quoted in favour of what we take to be the English metrical feet's optimal weight. As it has been already mentioned, certain vowels in non-head positions within a metrical foot can be syncopated in fast speech. This may happen either when they remain unmetrified, i.e. in the case of single initial unstressed syllables, e.g. *suppose* [s∅puz], *police* [p∅li:s] which conforms to Exhaustiveness, or else in unstressed medial positions if the foot which obtains is heavier than optimal, e.g. *favourite* ['feiv∅rit], *slavery* ['sleiv∅ri], *elementary* [,ele'ment∅ri],

Duplication of final consonants. Another argument (discussed extensively in Burzio 1994) in favour of the present approach follows from the observation that in certain words the final single consonants are doubled. Following the GP analyses, we assume that geminate consonants in English cannot belong to the same constituent. In formations like *shop* – (sh**op**ping), *japan* – ja(**pan**ned) the duplication of the final consonants may either imply their ambisyllabic nature or may reflect how the stressed, but non-branching rhymes, acquire an extra x-position to become heavy (branching) ones. Whichever option is chosen to be correct, the effect is exactly as was postulated, i.e. a foot of the optimal type $F=\{R_1(xx)R_2(x)\}$ obtains.

Trisyllabic laxing. Yet another argument is provided by the well-known phenomenon of trisyllabic laxing which produces tense-lax vowel alternations, as illustrated in *sane* ['sein] - *sanity* ['sćniti]. We believe that the vowel alternation is metrically conditioned as the adjunction of suffix *'-ity'*, which consists of two single rhymes, results in the total weight of four skeletal positions dominated by the foot: $F=\{R_1(xx)R_2(x)R_3(x)\}$. Therefore, the laxing mechanism serves as a 'fuse' to prevent the foot from being 'overweight' (the melodic aspect of the alternation being unimportant for us).

4. The Parsing Process

The mechanism of parsing the rhymal material into metrical feet is conditioned by Well-Formedness and Exhaustiveness. Its right-to-left direction reflects the general right-hand dominance of English word prosody. The process assigns stress to: i) a heavy rhyme if preceded by another rhyme of lower weight or nothing (according to Well-formedness Condition.) or ii) a light rhyme if the total weight of the resulting foot would exceed the optimal weight of three 'x' rhymal positions. Feet are created by assigning stress to every 'stopping rhyme' and the adjunction of the rhymal material to its right. Every recessive foot gets relatively weaker degree of stress. This results in the "saw-tooth" effect, i.e. falling prominence of stresses (primary, secondary, etc.) within a prosodic word[3].

The following, rather uncommon, examples in (9) below will help us illustrate how the process applies. As we will observe, the words in (9) do not differ in terms of their metrical stucture from other, well-known English lexical items.

(9)

a. *Monongahela* mo.(**non**.ga.)(**hi**:.la.)
b. *Ticonderoga* ti.(**kon**.de)(**rou**.ga)
c. *Tatamagouchi* (**ta**. ta. ma.)(**gu**:. czi.)
d. *Adirondack* (**a**.di.)(**rondć**.)k.)$_{EM}$

In (9a) the parsing process could potentially designate the rhyme (ga) to be the rightmost foot's head (yielding a structure parallel to *'A('me.ri.ca.)'*, i.e. *('ga.he.la.)*. The preceding rhyme, however, is heavy. Such a result is impossible, as Well-Formedness correctly predicts. Furthermore, there would be no way to account for (or, to put it in HVs (1987) terms, to 'de-stress') one of the two consecutive stresses. Metrification, then, chooses a non-optimal, bi-positional rightmost foot (**he**. la.) and, in order to satisfy the condition of optimal weight, it triggers diphthongisation to (hi:), thus yielding an optimal foot F_1==('**hi**:.la). The heavy rhyme in (**non**.), then, adjuncts the rhyme in (**ga**.) producing an optimal foot $F_{1=}$('**non**.ga). Both feet F_1 and F_2 are assigned primary and secondary stress correspondingly. The example in (9b) simply mirrors the metrical structure of (9a) and is subject to exactly the same parsing operations. Both (9a) and (9b) allow non-exhaustive parsing, which would result in ill-formedness of F_2, i.e. $*F_2=\{R_1(x)R_2(xx)R_3(x)\}$.

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[3] The "saw-tooth" effect (discussed in Burzio 1994), however, is somehow distorted within a ternary foot, where there seems to exist a stronger connection between the peripheral rhymes. (Note the frequent supressions of the schwa vowel in medial position within a foot, e.g. *favourite* ['feivØrit], *slavery* ['sleivØri], as discussed above.) In other words, the medial element of such feet is the weakest, hence most frequently reduced or suppressed totally, which fact may further point at some more complicated licensing relations within a foot. The discussion of licensing phenomena, however, goes far beyond the scope of this article.

(9c) differs from (9a,b) only as far as the leftmost foot F_2 is concerned. There is no word internal heavy rhyme which, according to Well-Formedness, could block exhaustive parsing. The initial rhyme in (ta.) is designated to be the head of the well-formed and optimally weighed foot F_2=={$\mathbf{R_1(x)}R_2(x)R_3(x)$}.

The last example (9d) illustrates how Well-Formedness co-operates with Exhaustiveness to override the requirement on a foot's optimal weight. The rightmost foot F_1 is metrically identical with the corresponding rightmost feet in examples (9a,b,c). (Note that the final consonant [k] constitutes the onset of an empty, hence extrametrical, syllable and as such is not metrified in nouns.) The adjunction of the un-metrified material to the left of F_1 gives rise to a non-optimal, i.e. F_2=={$R_1(x)R_2(x)$}, but well-formed foot. It becomes clear that non-exhaustive parsing is allowed only if one rhyme remains unmetrified, while two consecutive rhymes must always be metrified even if optimal weight of the resulting foot does not obtain.

We are now in a position to postulate the ranking of the conditions in (10) below:

(10)

I. Well-Formedness
II. Exhaustive Parsing
III. Optimal Weight

5. The metrical behaviour of verbs and adjectives

The metrical behaviour of morphologically simple verbs and adjectives seems to differ remarkably from that of nouns. Verbs and adjectives, as shown in (11) below, tend to be stressed on heavy final rhyme if available, or penultimate otherwise. Such deviation is due to the fact that verbs and adjectives do metrify the final empty nucleus, and thus structurally conform to well-formedness. The incorporation of FEN into metrical structure may function as the lexical marker of a word's category.

(11)

a. Noun		**b.** Verb/Adjective
['impo:t]	vs.	[im'po:t∅]
['daidest]	vs.	[reu'bst∅]
['ćdvent]	vs.	[pri'vent∅]

where ∅ is a metrified empty nucleus.

Therefore, we postulate the following parameter in (12) which licenses certain type of metrical feet, namely 'weak' feet[4], where the dominated rhyme is a phonetically inaudible nucleus.

(12)

Metrify FEN:
Nouns: NO
Verbs/Adjectives: YES

It remains to be seen whether the above parameter is valid for derived verbs and adjectives as well. Let us consider the following examples of such derived words ending in '*-ate*', '*-ise*', '*-ive*' in (13) below:

(13)

dominate ['domi,neit∅]
verbalise ['ve :belaiz∅]
appreciate [e'pri:*ʃ*i,eit∅]
appreciative *[e'pri:*ʃ*je,tiv∅}

Indeed, verbs like *dominate, appreciate, verbalise* do not seem to produce any systematic violations to (12), the only difference being the fact that the weak feet of the type Fw={R_1(xx)R_2()} do not receive primary but secondary stress instead. This observation stands in agreement with Burzio (1994: 16) who claims that 'primary stress falls on the rightmost *non-weak* foot.' Within this analysis, however, a well-formed foot (weak or non-weak) may not remain *un*stressed and must receive secondary stress[5]. Furthermore, the lack of secondary stress on the '*-ive*' ending in the adjective *appreciative* suggests that a weak foot of the type Fw=={R_1(x)R_2()} is not heavy enough to get any stress whatsoever, hence it is ill-formed.

Conclusion

We started our article by a short overview of some of the traditional accounts of the English stress system. As we have seen, however, most of them were fundamentally flawed by their reliance on rules which simply fail to capture generalisations.

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[4] The term 'weak foot' appears in Burzio (1994; 67-75) where it is extended to feet in which the dominated rhyme contains a full but 'phonetically weak' vowel. In the present analysis, weak feet obtain only if FEN is parametrically metrified.

[5] The statement seems problematic in larger morphological formations like (,nationa) [**laiz**∅]('ation) where the weak foot (**laiz**∅) is never stressed. Without going into detailed analysis of the phenomenon, we can only say that weak feet are not metrified word-intemally, i.e. $F_1F_wF_3$ is an ill-formed sequence.

As we see it, certain generalisations can be reached only within an approach which could point at the connection between the stress position and the constituent structure where rhymes serve as timing slots and weight units. Naturally, they contribute to the total weight of prosodic constituents, i.e. metrical feet. We have postulated two conditions, namely Well-Formedness and Exhaustiveness, which control the process of parsing metrical material into feet. The analysis of the English lexicon has proved that the underived nouns predominantly choose certain foot types rather than others. This opened the way to postulate an optimal weight for English feet. Where such optimal feet cannot obtain we have observed a number of phonetic processes take place in order satisfy the condition of the optimal weight.

English verbs and adjectives turned out to be only minimally different from nouns in their stress patterning since they parametrically parse a final empty nuclear position which in case of short two 'syllable' words results in (phonetically) final stress. Longer verbs and adjectives, however, receive only secondary stress on such rightmost (weak) foot. This has led us to the conclusion that the main final stress on a foot containing a metrified empty nucleus in those two lexical categories is to some extent 'defective'.

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