A Constraint-based Analysis of Stress and Suffixation in English

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1. Introduction

Since the early models of generative phonology and morphology, it has been assumed that there are two types of affixation in English. In Chomsky and Halle (1968) the distinction between them is drawn by positing different boundaries, $+$ and $\#$; the stress-affecting affixes are attached to their bases with a $+$ (morpheme) boundary, whilst the stress-neutral affixes (which do not affect stress placement) are attached with a $\#$ (word) boundary. Siegel (1974) uses the terms Class I and Class II respectively to refer to these affixes.[1] Commonly cited examples of Class I and II suffixes are as follows :

(1)　Class suffixes : +ion, +ity, +ic, +ate, +ify, +ous,
　　　　　　　　　　　+ive, +ian, +al (adjective forming)
　　　Class suffixes : #ness, #less, #hood, #ful, #ly, #like,
　　　　　　　　　　　#dom, #wise

　　　　　　　　　(cf. Siegel 1974, Fudge 1984, Spencer 1991, etc.)

The intriguing claim that Siegel (1974) has established is known as the Level Ordering Hypothesis, which demonstrates the principle that Class I affixes cannot be attached to a word to which a Class II affix has already been attached.[2] This level-ordering system has been incorporated into

the framework of Lexical Phonology with ordered strata, which account for the fact that certain phonological (cyclic) rules related to Level I, such as stress rules and shortening, do not apply to words with Level II affixes (cf. Kiparsky 1982, 1985 ; Halle and Mohanan 1985 ; Mohanan 1986, and others).

However, as Fudge (1984) has pointed out, there are a considerable number of derivational suffixes that are sometimes stress-neutral and sometimes not, which he refers to as 'mixed' suffixes. The examples are as follows : -able ; -ance, -ant ; -ary, -ery, -ory ; -ism, -ist ; -ise / -ize, -ite ; -ment. On the basis of the foot-parsing analysis, Burzio (1994) also provides persuasive general principles of the stress pattern concerning words with this type of suffix.

Let us here give an overview of Burzio's (1994) analysis, which has exercised a great influence upon the present paper. He claims that mixed suffixes demonstrate stress neutrality in principle under the 'metrical consistency' requirement that he defines as in (2 a) :

(2)   a. Metrical consistency (p. 228)

Every morpheme must be as metrically consistent as possible.

b. Metrical consistency hierarchy : i>ii (p. 254)

i) Stem consistency

ii) Suffix consistency

c. a ($^|$me.ri.ca) n $\Rightarrow$ a($^|$me.ri.ca) ($_|$nis.tϕ)

($_|$pro.pa) ($^|$gan.da) $\Rightarrow$ ($_|$pro.pa) ($^|$gan.dis) tϕ

(2 b) maintains that stem consistency is the stronger requirement overruling Suffix consistency, which is based on the fact that Stem consistency is achievable at the expense of Suffix consistency by alternate metrifications of a final weak syllable. This claim is exemplified in (2 c), which gives an example of the suffix -ist that intrinsically holds the structure of -is.tϕ .

(The parentheses represent foot boundaries, and two levels of word stress, primary and secondary, are annotated with two sorts of vertical lines, ׀and׀ respectively.) To account for the neutrality of mixed suffixes, Burzio also postulates that these suffixes hold the internal structure of 'Heavy-Weak (HW)' as *-is.tϕ*: the former (H) denotes heavy syllables bearing stress, and the latter (W) denotes weak syllables that can be uniquely extrametrical under his analysis, including syllables with null vowels (marked as ϕ), as has been illustrated in (2 c).

In this article, following Burzio's (1994) theory to a certain extent, we will re-examine in depth the correlation between stress and suffixation in English, addressing the metrical structure of words with the suffixes *-ery* and *-ary*, which could be considered as mixed ones. We also attempt to posit the general constraints on the interface of morphology and phonology and elucidate the discrepancy in foot parsing between British English (BrE) and American English (AmE). We will begin our discussion by probing the phonological behaviour of the suffix *-ery*.

2. The suffix *-ery*

In this section we will examine the phonological properties and foot parsing of words with the suffix *-ery*.[3] From the phonetic point of view, Wells (1990) makes noteworthy remarks on the characteristics of the suffix *-ery*: "This stress-neutral suffix is used only after a strong-vowelled syllable (e.g. *ma׀chi [i:]nery*); the variant *-ry* is used otherwise (e.g. *׀dentistry*)."

Let us first verify his observation, listing more examples of words with *-ery*, as in (3):

(3)   ׀battery, ׀bravery, ׀cutlery, ׀nunnery, ׀treachery, ׀bakery,
        ׀brewery, ׀fishery, ׀pottery, ׀crockery, ׀greenery, ׀scenery,

ma'chinery, 'slavery, 'archery, dis'tillery, a'dultery,

We note that the above examples are mostly short words consisting of [ ]ₛₜₑₘ + [ery]ₛᵤffᵢₓ, and that the (primary) stress falls on the syllable immediately before -ery, which in general is a heavy syllable.[4] But what particularly interests us here is Wells's second point, that the suffix -ery has an allomorph, -ry. Moreover, OED provides further information on -ry: "This suffix is a reduced form of -ery, occurring chiefly after an unstressed syllable ending in *d, t, l, n*, or *sh* (the usual type being words of three syllables with the stress on the first), but also in a few cases after stressed vowels or diphthongs." Some examples are given in (4):

(4)   'heraldry, 'husbandry, 'wizardry, 'dentistry, 'harlotry, 'infantry, 'peasantry, 'tenantry , 'chivalry , 'rivalry , 'yeomanry , 'poultry, 'pedantry, 'chantry, 'Englishry, 'Irishry, 'Jewry

(In some cases both -ery and -ry are in use as below.)

'jewel (le) ry, 'baptist (e) ry, 'missil (e) ry

According to OED's description, we can assume that the syncope of *e* in -ery provokes a sequence of homorganic sounds with the feature   [+coronal]. But what we should note here is that the number of syllables is reduced from four to three by syncopation, which provides significant grounds for our argument concerning the foot construction. That is, this phenomenon in the process of English word-formation attests that the foot -parsing patterns exemplified in (5) are implausible. (The vertical line '|' denotes the boundary between a stem and a suffix and σ denotes a syllable.)

(5)   a. *he.ral.de.ry $\Rightarrow$ ('$\sigma\sigma$) | (ₗ$\sigma\sigma$)

       b. *he.ral.de.ry $\Rightarrow$ ('$\sigma\sigma$ | σ) σ

The foot structure in (5 a) is metrically optimal because it fulfils the following three constraints that are usually exploited in Optimality Theory

(OT) (cf. McCarthy and Prince 1993 a, b ; Prince and Smolensky 1993, *et seq*.). One is concerned with the parametric constraint TROCHEE — feet in English are trochaic, i.e. stressed on the first syllable. The second constraint is Foot Binarity (FT-BIN) stated in (6):

(6)   Foot Binarity (FT-BIN)

      Feet must be binary under syllabic or moraic analysis.

Finally, the structure in (5 a) perfectly meets the constraint Parse-Syllable that is usually defined as below :

(7)   Parse-Syllable (PARSE-SYLL or PARSE-σ)

      All syllables (σs) must be parsed by feet.

Nevertheless, the syncope of the penultimate syllable in the case of (4) disallows the possibility of the foot-parsing pattern in (5 a).

   We can also assume that the structure of ternary feet in (5 b) cannot be parsed for the same reason above. Burzio (1994) postulates two basic types of foot structure, binary and ternary, which are illustrated in (8) giving his instances in BrE :

(8)   a. (Hσ)   : dis ($^{\rvert}$til.le) ry, ma ($^{\rvert}$chi : .ne) ry

      b. (σLσ) : vo ($^{\rvert}$ca.bu.la) ry, i ($^{\rvert}$ma.gi.na) ry

                        (H : heavy syllables, L : light syllables)

Our observation with respect to (5 b), however, might undermine the validity of Burzio's assumption since English word-formation does not substantiate the ternary foot parsing at least in this case. (But we do not intend to question the concept of ternary feet, rather, approve it with reference to English stress. Further discussion on this matter is beyond the scope of a brief paper.)

   Let us here turn to the stress neutrality of the suffix - (*e*)*ry*. In cases (3) and (4), there is no stress shifting in derivation, i.e. the stressed syllable of the base is preserved after suffixation (e.g. $^{\rvert}$*herald* → $^{\rvert}$*heraldry*),

which corresponds to Burzio's stem consistency as defined in (2 b). Again, it is of great interest to note that, as indicated in (1), the stress-neutral suffixes are all composed of a single syllable and that they hold a consonant as an onset (whilst the Class I suffixes are preceded by a vowel). The former finding accords with the concept of 'extrametricality', which renders a (single) peripheral (initial or final) element in a phonological form invisible to certain phonological processes (cf. Hayes 1982, Halle and Vergnaud 1987, etc.). Under the above observations, the suffix *-ery* is seemingly exceptional in that this suffix contains two syllables whose initial is a vowel (like *-ary* and *-ory*), which in fact gives rise to the problematic aspects of metrical structure. However, we should take into account the syncopation in (4) and the fact that even in the case of (3) vowel reduction or elision of the initial vowel usually occurs like [(ə)ri] at the level of the phonetic representation. These phenomena can be identified as an operation for forming a monosyllable suffix; and hence it should be presumed that the suffix *-ery* pertains to the stress-neutral Class II. Accordingly, we formulate the hypothesis concerning the definition of the two types of English suffix in terms of the interaction of metrical structure and suffixation, i.e. the complementary principle on the interface of phonology and morphology, as stated in (9):

(9)   a. Class II (stress-neutral) suffixes must not be parsed into feet.

      b. Class I (stress-affecting) suffixes must be parsed into feet.

We furthermore propose that the principle of (9) is integrated into a parametric constraint as defined in (10 a) and also the former constraint in (7) is re-defined as in (10 b):

(10) a. (*)PARSEσ-SUFF

         Suffixes must (not) be parsed into feet.

   b. PARSEσ-STEM

      All syllables(σs) of the stem must be parsed by feet.

We reiterate that our aim in this paper is to explicate the correlation of English stress and suffixation on the basis of a transderivational approach, addressing the interaction of surface constraints within the framework of OT. We thus assume that such morphological properties as Class I or Class II are already assigned to every English suffix in the lexicon and that, given an input structure, the suffixal index is checked and the parameter of the constraint in (10 a) is set.

    Returning to the examination of the suffix *-ery*, there are a small number of examples counter to the general property that we have discussed so far, as given in (11):

(11) cemetery, monastery

That is, the words in (11) retain the suffix form *-ery*, not *-ry*, although the (primary) stress falls on the first syllable. We can say that in BrE there is no query concerning these words since phonetically the vowel e of *-ery* is reduced to form a quasi-monosyllabic (i.e. stress-neutral) suffix. In AmE, however, the left syllable of the suffix *-ery* bears the secodary stress and hence the foot structure can be parsed as presented in (12), which is identical to that in (5 a) and should be ill-formed in English word-formation:

(12) $^{\mid}$ceme$_{\mid}$tery $\Rightarrow$ $(^{\mid}\sigma\sigma)\mid(_{\mid}\sigma\sigma)$

      $^{\mid}$monas$_{\mid}$tery $\Rightarrow$ $(^{\mid}\sigma\sigma)\mid(_{\mid}\sigma\sigma)$

This phonological phenomenon is, in fact, quite common in AmE and also applicable to cases of the suffix *-ary* (as will be argued in the following section). Evidently this property is antagonistic to that of BrE. Accordingly, we suppose a proviso for the foot parsing of certain suffixes in AmE, as in (13):

(13) In AmE, the two syllables forming a certain suffix must be parsed

as a trochaic foot ; it is therefore considered that the two-syllable suffixes, such as *-ery*, *-ary*, *-ory*, pertain to the Class I.

Consequently, (13) leads to the constraint PARSEσ-SUFF in (10 a).[5] In the next section, making a closer examination of the stress contours of words with the suffix *-ary*, we will attest to the validity of our argumentation in this section and furthermore attempt to formalise a general constraint on the foot structure preservation in transderivational terms.

3. The suffix *-ary*

In this section we will examine the metrical structure of words with the suffix *-ary*.[6] We begin our discussion by quoting Wells's (1990) remarks on the suffix *-ary* as follows : "In words of three syllables this suffix is usually weak, [əri] (e.g. ˈ*binary,* ˈ*glossary*). In longer words it is usually weak in BrE, [əri] (frequently reduced to [ri]) but strong in AmE, [eri] : thus *arbitrary* [
ˈɑːbitrəri ; <Am>ˈɑːrbətreri], *customary* [
 ˈkʌstəm(ə)ri ; <Am>ˈkʌstəmeri]. The stress may fall either one or two syllables further back (e.g. *ex* ˈ*emplary,* ˌ*anni*ˈ*versary ;* ˈ*mercenary,* ˌ*inter*ˈ*planetar*y)."[7]

We first confirm that Well's observation basically coincides with our accounts provided in the preceding section. Further examples of words with *-ary* are given in (14) :

(14) ˈsecondary, ˈtemporary, ˈordinary, ˈnecessary, ˈvoluntary,
    ˈlegendary, ˈsedentary, ˈcommentary, ˈadversary, ˈantiquary,
    iˈmaginary, preˈliminary, ˈsecretary, ˈsanctuary, voˈcabulary,
    revoˈlutionary, ˈdisciplinary, ˈveterinary, ˈmilitary, ˈsalutary

From the data listed above, we can detect that the (primary) stress is preserved in the same position as that of the base ; thus, ˈ*legendary* (<ˈ*leg*-

end), $^|$*disciplinary* ($<$$^|$*discipline*).But also in AmE, the secondary stress is assigned to the two-syllable suffix *-ary*, which is guided by the proviso in (13) ; and hence it constructs a binary trochaic foot, such as ($^|$*ne.ces*) ($_|$*sa.ry*) and *pre* ($^|$*li.mi*) ($_|$*na.ry*).

We can detect, however, that a group of long words ending in *-mentary* regularly bear the primary stress on the antepenultimate sylla-ble *-men-*, which is a common phenomenon to both AmE and BrE. The ex-amples are given in (15) :

(15) ele$^|$mentary, rudi$^|$mentary, testa$^|$mentary, docu$^|$mentary,

      sedi$^|$mentary, compli$^|$mentary, comple$^|$mentary

That is, these are exceptional cases by virtue of the stress shifting (e.g. $_|$*ele*$^|$*mentary* $<$$^|$*element*). So after a close scrutiny of the foot parsing of words in (15), we posit the foot structure exemplified in (16) :

(16) a. $^|$element $\Rightarrow$ ($^|$e.le) (men.tϕ)

     b. $_|$ele$^|$mentary $\Rightarrow$ ($_|$e.le) ($^|$men.ta) ry

In the case of (16 a), we assume two binary feet by employing the null vowel ϕ in the final position, following Burzio's (1994) analysis. (We do not consider that under the Optionality–theoretic analysis the null vowel ϕ violates the constraint FILL, which denotes that syllable positions are filled with segmental material.) In addition, if the words in (15) function as verbs, the secondary stress is assigned to the ending *-ment*, like $^|$*ele*$_|$*ment*. This finding could also demonstrate the cogency of the metrical structure in (16 a).

Turning to the example in (16 b), we should note that the foot struc-ture is compatible with that of the base in (16 a) although primary and secondary stress switch. We therefore propose an extensive constraint on the foot structure preservation in transderivational terms. This constraint posited in (17) is a revised version of 'Base-Identity' proposed by Ken-

stowicz (1996).

(17) Base-Foot Identity (B-F IDENT)

    Given an input structure [X(#/+)Y], output candidates are evalu-
    ated for how well they match the foot structure of the constituent
    [X]. (The symbols, # and +, conform to those in [1].)

In other words, Base-Foot Identity shows that the metrification for the [X
(#/+)Y] structure tries to match the stress contour of the immediate con-
stituent [X] considered in isolation. (17) is the constraint that we develop
in the framework of Correspondence Theory set within OT (cf. McCarthy
and Prince 1995 ; Benua 1995).

(18) a. BrE

/element # ary/	B-F IDENT	PARSE-STEM, *SUFF
e (le.men) ta.ry	**	*
(e.le) men.ta.ry	*	*
(e.le) (men) ta.ry	*	
☞(e.le) (men.ta) ry		*
& (e.le) (men.tφ)		

    b. AmE

/element + ary/	B-F IDENT	PARSE-STEM, SUFF
e (le.men) (ta.ry)	**	*
(e.le) men (ta.ry)	*	*
(e.le) (men) (ta.ry)	*	
☞(e.le) (men.ta) ry		*
& (e.le) (men.tφ)		

    To see how Base-Foot Identity works, let us examine in (18) the foot
construction of *elementary* in both cases of BrE and AmE. (We indicate
the base at the end of the tableau with an ampersand, following Ken-
stowicz's transcription.) As shown in the tableaux above, the last candi-

dates respectively match the foot structure of the base perfectly in spite of violating a lower ranking constraint of PARSE-σ, which effects have been stated in (10) and (13). Moreover, there is another type of word ending in -*mentary*, as given in (19):

(19) ˈcommentary, ˈmomentary, ˈsegmentary, ˈfragmentary,

The above data shows no occurrence of stress shifting, e.g. ˈ*segment* > ˈ*seg-men*$_{()}$*tary*. The foot structures of these words are illustrated as below:

(20) a. \<BrE\> (ˈseg.men)tϕ $\Rightarrow$ (ˈseg.men) ta.ry

      \<AmE\> (ˈseg.men)tϕ $\Rightarrow$ (ˈseg.men) ($_{|}$ta.ry)

   b. (ˈseg.men)tϕ $\Rightarrow$ *seg (ˈmen.ta) ry

Whilst each foot parsing in (20 a) perfectly meets the constraints B-F IDENT and PARSEσ-STEM, (*)SUFF, (20 b) meets neither.[8]

4. Concluding remarks

In this paper we have examined the correlation of stress contour and suffixation in English within the theoretical framework of OT by introducing two general constraints. First, the constraint on foot-parsing posited in (10) is deeply concerned with the interface of phonology and morphology, exploiting the traditional level-ordering hypothesis, i.e. applying the morphological properties of suffixes to foot parsing. The important point to note is that this constraint is subdivided into PARSEσ-STEM and (*) PARSEσ-SUFF, and the latter involves the binary parameter that is switched according to the type of suffix, i.e. Class I or Class II.

The other constraint that we have proposed is Base-Foot Identity (B-F IDENT) (17), in which the candidates for one output are evaluated with respect to their similarity to morphologically related outputs, based on a theory of transderivational output-output correspondence. Within the

scope of this paper, we have examined that Base-Foot Identity overrides PARSE-σ. But naturally our demonstrations for verifying the interaction of constraints are not exhaustive and there is room for further investigation covering more extensive phenomena.

Notes

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(1) These terms are also called Level I and Level II respectively by Allen (1978), who has extended Siegel's hypothesis and claimed that compounding takes place after Level II affixation but before (regular) inflection and thus the process of compounding can be regarded as Level III, and regular inflection regarded as Level IV.

(2) Selkirk (1982), who calls Siegel's observation the Affix Ordering Generalisation, has suggested that the Class I / Class II distinction falls out of a more general theory in which the two classes are replaced by affixes that attach to Roots (usually called Stems) and Words respectively, and that the Root is the domain for the (cyclic) assignment of syllable structure and foot structure that determines stress. Therefore, Selkirk's theory could be interpreted to follow in Chomsky and Halle's (1968) footsteps.

(3) Morphologically the suffix -ery forms nouns and originates in Old French -erie, which is composed of -ier (=-er in ModE) and -ie (=-y in ModE). This suffix has the major senses presented below : i) class of goods or things (e.g. greenery, machinery) ;) employment or condition (e.g. archery, slavery) ; iii) place of work (e.g. brewery, bakery), etc.

(4) There are some exceptions like ˈironmongery and conˈfectionery. The former is a compound [iron]$_{\text{STEM}}$ + [monger(y)]$_{\text{STEM}}$ and the latter has a sequence of suffixes [ion]$_{\text{SUFFIX}}$ + [ery]$_{\text{SUFFIX}}$. It is therefore assumed that these factors could yield the stress contours.

(5) Even in AmE, provided that the syllable preceding the suffix bears stress, the constraint PARSEσ-SUFF can be violated (e.g. maˈchi[i :]nery⇒ma(chi : ne) ry). But it is accounted for by the ranking of constraints, Base-Foot Iden-

tity 》PARSEσ-SUFF, in the same way as our discussion in section 3.

(6) The senses of *-ary* are classified into two major groups : i) denoting 'connected with', forming adjectives and nouns (e.g. *budgetary, dictionary*) ; ii) denoting 'belonging to', forming adjectives (e.g. *military*).

(7) As refered to by Wells, there are a few words that differ in stress between BrE and AmE (e.g.
*co*ˈ*rollary* ; <Am>ˈ*corollary*). We can also find, in AmE, a very small number of short words with *-ary* that give rise to stress clash, such as ˈ*pri*ˌ*mary*, ˈ*con*ˌ*trary*. But these cannot be discussed here for want of space.

(8) Incidentally, we notice that in *seg*ˈ*mental* the stress is shifted to the penultimate syllable and this shows the *-al* to be a Class I suffix.

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