A Constraint-Based Model of Word Stress in Polish English Acquisition: 'An American in Paris'*

Anna Marczak

Adam Mickiewicz University

This paper proposes an examination of English word stress which is part of my greater research project devoted to Polish English (henceforth PE) word stress acquisition (cf. Marczak 2008). It will be shown that a quasi-OT approach, using Burzio's (1995) suggestion to insert null vowels after final consonants, does not only offer a solution for English word stress assignment, but also shows a way of how to deal with stress on prosodic words, without making use of arguments other than phonological ones.

1. INTRODUCTION

When it comes to English stress, one may come across a striking difference between

(1) in America
(2) an American

In both (1) an (2) main stress falls on the same syllable, the second syllable of the word America. However, in (1) secondary stress appears on the first syllable of the whole phrase, so on 'in', whereas example (2) has no secondary stress at all.

One may try to explain this difference in terms of parts of speech, such as article and preposition, but here it will be shown how this difference can be explained in terms of constraint ranking and thus within an OT-like approach, such as the one proposed by Burzio (1995).

2. CLASSIFICATION

English word stress is a complicated matter, as has been shown by Chomsky and Halle's (SPE; 1968), McCarthy and Prince (1990), Liberman (1997), Hayes (1995) and others.

This is the result of a historical process. As is well known, the Germanic language English borrowed huge parts of its lexicon from French, a Romance language with a completely different stress pattern. This clash of systems resulted in the very idiosyncratic stress pattern of present modern English.

Traditionally English word stress has been described to consist of mainly four types A large majority of English words fall into one of the following four classes:

a. Stress on the 'superheavy' final syllable: *contain, decide, pertain*.
   So, mostly verbs.
b. Stress on the penultimate syllable with the final syllable being heavy and ending in a final consonant: *inhabit, merit*.

* I wish to express my deepest gratitude to Luigi Burzio for his very helpful comments. However, it goes without saying that he cannot be responsible for the remaining shortcomings of the article.

Again mostly verbs.

c. Stress on the heavy penult: *consensus, cumulonimbus*.

Mostly nouns.

d. Stress on the antepenultimate syllable with the penult light: *cabinet, asterisk.*
Mostly nouns.

In a more formal notation:

a. -…(H) <C>
b. -…(XL)<C>
c. -…(H) <X>
d. -…(XL)<X>,

where H stands for super heavy, L light, C consonant and X a variable.

Although this classification is well known, it is not very satisfactory. Not only since three of the four classes contain words which overtly end in a vowel: *obey*, *veranda*, *remedy*, but mainly because of the role of [H]. As Burzio (1994: 11) pointed out [H] offers problems when it comes to stress clashes. In a compound such as *nineteen* both *nine* and *teen* are [H] and so two [H] syllables follow each other without an intermediate [L]. Normally [H][H] is forbidden, which may raise question about the status of [H] or may lead to the introduction of an intermediate segment. That is what Burzio (1994:17) suggested. When discussing the difference between *contain* and *container,* he suggested the same description for both forms. *Contain* is stressed just like its derivation, because the two words are syllabically equivalent according to Burzio's description, for the syllabic form of *contain* is *con.tai.nø*, with ø as a null vowel[1]. This solution also works for *nineteen*, since *nine* should be syllabified as *ni.nø*. So the syllabic structure of *nineteen* should be [H][L][H]. However, *ø* is not 'light' but 'weak' in Burzio's terms, or ultralight [U], as it is called here, since weak may suggest a binary relation with strong, a term which is not used in this approach. So the syllabic structure of *nineteen* is [H][U][H].

Having introduced the concept of null vowels[2], the classification given above may be improved as follows, where feet should be read instead of syllables, since we are discussing the weight of syllables[3]:

a. -…(HX)
b. -…(XLX)
c. -…(HX), where the final null vowel is extrametrical
d. -…(XLX), where the final null vowel is also extrametrical,

where two classes are dactylic (b&d) and the two others trochaic (a&c), which restricts the classes of feet to two: (HX), trochaic and (XLX) dactylic where in two classes the final null vowel is metrified (a&b) and is extrametrical in the two others (c&d). Verbs strongly tend to metrify the final null vowel, whereas nouns do not.

Instead of a classification consisting of the four classes we started with, we end here with a classification consisting of two classes plus the notion extrametricality[4].

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[1] for null vowels see also Harris and Gussmann (1998)

[2] In the representations used in the rest of this article we will assume that a final consonant should always be followed by a null vowel.

[3] In this study we do not make use of the notion 'mora' since this research is part of a greater research project which studies Polish English, especially stress acquisition in Polish English (cf. Marczak 2008). While English might be seen as a mora counting language, Polish is not, just as Polish English. Therefore, we cannot make use of the same phonological apparatus when comparing the two languages. Consequently, we have chosen not to make use of morae and to describe English word stress differently.

3. GENERATOR

So far English word stress has only been described; when it comes to generate words with the right stress pattern, one has to start from a different angle.

In such a generator one should distinguish between six steps:

1. Add a null vowel after a final consonant
2. Syllabify the resulting word form and assign weight to the syllables. Mark a final syllable consisting of C + ø as [U].
3. In case there is a final [U], split the syllabified input form in one of the following two ways:
   a. with final [U] as extrametrical in case of nouns
   b. with final [U] as metrified in all other cases
4. In case the penultimate syllable is likewise [U], then assign extrametricality to [U][U].
5. Assign feet from right to left. Choose between the two priority options trochaic (H̲X)[5] or dactylic (X̲LX). If this turns out to be impossible try the suboptimal foot (L̲X); if this last option is impossible mark the syllable as a stray and skip it. Since foot assignment is a cyclic process, repeat the process till there are no syllables left.
6. Assign main stress to the rightmost foot, unless it is of the form (X̲U) and there happens to be another foot to the left, in which case one should assign stress to this foot.

3.1. Examples

The generator sketched above is able to produce examples such as:

1. Arizona
Step 1: vacuous, since there is not final consonant
Step 2: a. ri. zo. na
L L H L
Step 3: vacuous, since there is no final [U]
Step 4: vacuous, since there is no penultimate [U]
Step 5. L L (H̲ L)
(L̲L) (H̲L)
Step 6: (LL) (´HL) > ari´zona[6]

2. robust
Step 1: robustø
Step 2: ro. bus. tø
L H U
Step 3: L (HU)
Step 4: vacuous
Step 5: L (H̲U), where L is a stray
Step 6: L(´HU) > ro´bust

[4] In English one finds extrametricality at the right edge. Furthermore, it is optional and limited to a small class of syllables defined by the acoustic weakness of their nuclei: ə, i, ø and syllabic consonants. These syllables are [U] (cf. Marczak 2010).
[5] Underlining means stressed here.
[6] Secondary stress (on the first foot) is not mentioned here.

3. nominative
Step 1: nominative
Step 2: no. mə. nə. ti. vø
L L L U[7] U
Step 3: L L L U <U>
Step 4: L L L <U U>
Step 5: (L LL) <UU>
Step 6: (´LLL) <UU> > ´nominative

4. decide
Step 1: decidø
Step 2: de. ci. dø
L H U
Step 3: L (H U), since decide is –N(oun)
Step 4: vacuous
Step 5: L (HU), where L is a stray
Step 6: L (´HU)> de´cide

5. participant
Step 1: participantø
Step 2: pa. ti. ci. pan. tø
H L L H U
Step 3: H L L H <U>
Step 4: vacuous
Step 5: H (LLH) <U>, where the first H is a stray
Step 6: H (´LLH) <U> > par´ticipant

6. participate
Step 1: participatø
Step 2: pa.ti. ci. pa. tø
H L L H U
!Step 3 H L L H <U>, U is extrametrical as if *participate* is +N(oun)
Step 4 vacuous
Step 5: H (LLH) <U>, where the first H is a stray
Step 6: H (´LLH) <U> > par´ticipate

7. productivity
Step 1: vacuous
Step 2: pro. duc. ti. vi. ty
L H L L U
!Step 3: L H (L L U), U is metrified as if *productivity* was –N(oun)
Step 4: vacuous
Step 5: LH (L L U)
(LH) (LLU)
Step 6: (LH) (´LLU), produc´tivity[8]

As might be clear from these examples the generator as sketched above does not account for all cases. Especially the relation between extrametricality and parts of speech needs refinement. Moreover, step 4 turns out to be more or less superfluous. Step 4 is only not

[7] See footnote 2.
[8] Secondary stress (on the first foot) is not discussed here.

vacuous in cases like *nominative* and other words ending in *–(at)ive* , a small class of English words.

Furthermore it turns out not to be an incident that the generator produces the wrong results as in (7) and (8), where assignment of extrametricality conflicts with parts of speech.

See for instance the nouns *brocade* and *cement*.

9.	brocade	cement
step 1:	brocadø	cementø
step 2:	bro. ca. dø	ce. men. tø
	L H U	L H U
!step 3:	L (HU)	L (HU), U is metrified as if these words were -N(oun)
step 4:	--------	----------
step 5:	L (HU)	L (HU)
step 6:	L (´HU) > bro´cade	L (´HU) > ce´ment

10.	hesitate	penalize
step 1:	hesitatø	penalizø
step 2:	he. si. ta. tø	pe. na. li. zø
	L L H U	H L H U
!step 3:	L L H <U>	H L H <U>, U is extrametrical as if these forms were +N(oun)
step 4:	----------	----------
step 5:	(LLH)<U>	(HLH)<U>
step 6:	(´LLH) <U> > hesitate	(´HLH)<U> > ´penalize

Because of this serious weakness of the generator we will use a different approach for English stress placement, a more classical OT-like approach.

4. CONSTRAINTS

In the model which will be sketched here we do not use rules or steps as with the generator before, but constraints. These constraints are not absolute, but they are violable. It is the amount and the ranking of the constraints that decides about the preference for a possible output.

We start with a possible inventory of constraints, in which the simplest constraints come first.

(1) *UNARYFT: Feet are not unary
(2) * LONGFT: Feet are most ternary
(3) FTHEAD$_{LT}$: carry one stress each, on the left edge
(4) FTWEIGHTMAX$_{26}$: Foot weight is at most 26[9]
(5) RTMOSTPRIMARY: Primary stress is carried by the rightmost foot
(6) * STRESSWEAK: No stress falls on syllables with weak[10] nuclei
(7) IDSTRESS: Output stress matches input stress, if any (faithfulness constraint)
(8) * STRAYSTRING: There are no strings of stray syllables
(9) * WDINTFINSTRAY: There are no stray syllables word-internally or word-finally

[9] In counting foot weight H = 6, L = 2, U = 1. So trochees are weighted 2−1, dactyls are weighted 2−4−1. The heaviest foot allowed in English (HLH) thus weights (2x6)+(4x2)+(1x6) = 26. The method of calculating foot weight used here is positional, rather than adding up morae (see footnote 1). The numbers are chosen arbitrarily.

[10] For weak nuclei see footnote 2

(10) PRESERVESTRESS: Derived and inflected forms preserve the pattern of the stem words as (part of) their stress pattern
(11) FTWEIGHTMIN$_{13}$: Foot weight is at least 13[11]
(12) * METRIFYUNOUN: Nouns do not metrify the final U syllables
(13) METRIFYUVERB: Verbs metrify final U syllables
(14) METRIFYU$_{VV\emptyset]}$: Final U syllables are metrified long vowels
(15) IDMETRIFYU: Output extrametricality matches input extrametricality, if any

A possible ranking for English may be:

> *UNARYFT, * LONGFT, FTHEAD$_{LT}$, FTWEIGHTMAX$_{26}$, RTMOSTPRIMARY, *STRESSWEAK, IDSTRESS >> * STRAYSTRING >> * WDINTFINSTRAY >> PRESERVESTRESS (/FTWEIGHTMIN$_{13}$)
>
> and *UNARYFT >> * METRIFYUNOUN
>
> and IDMETRIFYU >> METRIFYU$_{VV\emptyset]}$ >> * METRIFYUNOUN, METRIFYUVERB

The examples given above can be explained within this approach as follows: The numbers in the examples below refer to the numbers of the constraints given before.

1. Arizona[12] ærɪ 'zəʊ nə
(LL) (HL)
(1) NA (= non applicable)
(2) yes
(3) yes
(4) (6) (14)
(5) yes
(6) yes
(7) NA
(8) NA
(9) NA
(10) NA
(11) ! violation by first foot
(12) NA
(13) NA
(14) NA
(15) NA
Optimal output: Ari´zona
(LL)(´HL)

In *Arizona* only constraint (11) is violated by the first foot, which has no consequences for stress assignment.

In the next examples constraints that are not applicable will be omitted. An exclamation mark signals violation of a constraint.

2. robust rəʊ ´bʌ stø
L (L U)
(2) yes

[11] The lightest heavy trochee (HU) weights (2x6)+(1x1) = 13
[12] Secondary word stress is not discussed here and elsewhere.

(3) yes
(4) Ø[13] (5)
(5) yes
(6) yes
(11) ! violation

Optimal output: ro´bustø
L (´L U)

In *robust* again constraint (11) is violated, which has no consequence since the foot that violates the minimum weight condition is the only one to bear stress.

3. nominative 'nɒ mənətɪv
(L L L)U U
(2) yes
(3) yes
(4) 14 Ø
(5) ! no
(6) yes
(11) yes
(15) yes

The optimal output would be *nomi´nativø* ,(LL´L) UU, without violation of (5) but with a bizarre foot type. However, the attested stress pattern is *´nominativø,* (´LLL)UU. So far *nominative* and other words ending in *–(at)ive* seem to be an exception or one might add a constraint on foot types.[14]

4. decide dɪ' saɪdø
L (H U)
(2) yes
(3) yes
(4) Ø 13
(5) yes
(6) yes
(11) yes
(13) yes

Optimal output: de´cidø
L(´H U)

In the next example three competing outputs will be presented.

5a. participant
pɑ :´tɪsɪpəntø
H (L L L)U
(1) ! violation left edge

5b. participant
pɑ :tɪsɪ´pəntø
(HLL) (HU)

5c. participant
pɑ :ø´tɪsɪpəntø
(HU) (LLH)U

[13] Ø means not counted.
[14] One should note that the generator above needed an extra step, step 4, to account for this small group. Apparently stress placement is a lexical matter for this subclass and should be accounted for in the lexicon. Therefore, one can imagine that the input should be supplied with this information.

(2)	yes	(2)	yes	(2)	yes
(3)	yes	(3)	yes	(3)	yes
(4)	Ø 14	(4)	! (30) (13)	(4)	
(5)	yes	(5)	violation	(5)	yes
(6)	yes	(6)	yes	(6)	yes
(10)	yes	(10)	yes	(10)	yes
(11)	yes	(11)	yes	(11)	yes
(12)	yes	(12)	! violation	(12)	yes
(15)	yes			(15)	yes

Optimal output:	pa´ticipantø	*patici´pantø	paø´ticipnatø
	H(´LLL)U	HLL)(´HU)	(HU)(LLH)U

The second optional output will not be realised because of three violations, instead one by the first output and none by the last. However, in the last case (5c) a null vowel follows a vowel, which is a not very desirable solution.

6.	participate[15]	pɑ :´tɪsɪpeɪtø	7.	productivity	prɒ dʌ k´tɪvəti
		H(LLL)U			(LH)(LU)U
(1)	! violation left edge		(2)	yes	
(2)	yes		(3)	yes	
(3)			(4)	(10) (5) Ø	
(4)			(5)	yes	
(5)			(11)	!! both feet <13	
(11)			(12)	yes	
(13)			(15)	yes	
(15)					

Optimal output:	par'ticipate	Optimal output:	produc´tivity
	H(´LLL)U		(LH) (´LU)U

The optimal output for *participate* violates two constraints, but as we have seen, the violation of constraint (1) may be solved by inserting a null vowel. In that case only the violation of a minor constraint (13) is left.

In the case of *productivity* the violation seems to be more serious. However, one should not forget that *–ivity* and similar suffixes are stress attracting, see *´active − acti´vity*.

In the next and last examples only violations of constraints will be shown.

8.	brocade	brəʊ ´keɪdø	9.	cement	cɪ´mentø
		L (HU)			L (HU)
(1)	! violation left edge		(1)	! violation left edge	
(4)	Ø 13		(4)	Ø 13	
(12)	! violation, *brocade* follows verb pattern		(12)	! violation, verb pattern	

Optimal output:	bro´cadø	Optimal output:	ce´mentø
	L(´HU)		L (´HU)

Violation of constraint (1) may be solved again by inserting a null vowel.

[15] For *participate* we could give three alternative foot structures as in the case of *participant,* but since the option (HLL) (HU) would violate more or less the same constraints as in 5b. and since we do not want to give a second example with a full vowel followed by a null vowel, we only describe the option H(LLL)U.

10.	hesitate	´hezɪteɪtø (LLH)U	11.	penalize	´pi:nəlaɪzø (HLH)U
(4)	18 Ø		(4)	! 34 Ø	
(13)	! violation, U not metrified		(13)	! violation, U not metrified	
Optimal output:		´hesitatø (´LLH)U	Optimal output:		´penalizø (´HLH)U

As may be clear from these examples, most of these forms violate one or more constraints. That is exactly what one may expect when discussing a not absolutely regular system as the English stress system. However, almost none of these examples weakenes the approach.

5. RANKING

Ranking of constraints may explain why a certain output is preferred, as will be shown in the next example. In this and the other following examples only a few possible candidates will be discussed.

1. Alabama

Alabama	* STRESSWEAK	* STRAYSTRING	* WDINTFINSTRAY	FTWEIGHTMIN$_{13}$
a(´labama)	*			
ala(´bama)		*		*
(´alaba)ma			*	
☞ (ala) (´bama)				*

This example shows among other things that violating constraint (11), FTWEIGHTMIN$_{13}$, is less harmful than violating constraint (6), * STRESSWEAK, which proves that constraint ranking plays a role in stress assignment.

The partial ranking which follows from this example is: * STRESSWEAK>> *STRAYSTRING>> * WDINTFINSTRAY>> FTWEIGHTMIN$_{13}$.

2. Second class

Stress assignment operates similarly in cases with NP's. Also in this case the input form should conform to the representation rules, which implies that a null vowel should follow a final consonant. Exclamation mark means violation of a constraint, as before.

	2a.	2b.	2c.
Input:	secondø classø secon(døcla)sø	secondø classø se(condøcla)sø	secondø classø (secondø) (classø)
	(3) FTHEAD$_{LT}$		
			(4) !FTWEIGHTMAX$_{26}$
	(6) !* STRESSWEAK	(6) ! * STRESSWEAK	
	(8) !* STRAYSTRING		
		(9) * WDINTFINSTRAY	
Output	secondø´classø	se´condø classø	´secondø classø

The winning output (2c) violates only one, low ranking, constraint, (4) ! FTWEIGHTMAX$_{26}$.

America

In the first paragraph of this article we introduced the difference between

(1) in America
(2) an American

We promised to give an analysis in which parts of speech do not have to play a role. Here follows an analysis that makes use of phonological arguments only.

:	(3)	America	(4)	American
	Input	əmerɪkə		əmerɪkənø
		ə(merɪkə)		ə(merɪkə)<nø>
		(L L U)		(L L U) U
Optimal output		A´merica		A´merican

There are of course several losing outputs as well, but we do not discuss these here since we are interested in the differences between (1) and (2). In the following analysis we will give an example of a losing output and of the optimal output. Of course there are several more losing candidates to imagine.

:	(5)	In America	(4)	An american
	Input	ɪnəmerɪkə		ənəmerɪkənø
		ɪnə(merɪkə)		ə.nə)(merɪkə)<nø>
		(L L U)		(U U) (L L U) U
	(8)	!* STRAYSTRING	(6)	!* STRESSWEAK, the first foot would be stressed
Losing output		in A´merica		´an A´merican

	(7)	In America	(8)	An american
	Input	ɪnəmerɪkə		ənəmerɪkənø
		(ɪ.nə)(merɪkə)		ə.nə(merkɪə)<nø>
		(L U) (L L U)		(L L U) U
	(11)	! FTWEIGHTMIN$_{13}$ (first foot)	(8)	!* STRAYSTRING the first foot would be stressed
Optimal output		A´merica		A´merican

Analyses (5) and (6) result in losing outputs because the constraints which are violated are ranked above the constraints violated by analyses (7) and (8) respectively. So the evaluator of the system will put the outputs of (5) and (6) aside.

However, the optimal output of (7) is not the actual realisation. Two main stresses within one phrase are impossible. So, one of the main stresses should be reduced. Since the stress on the first foot violates constraint (11), whereas the stress assignment on the second foot does not violate any constraint it is clear that the evaluator would consider second main stress (on *America*) as a better candidate for the resulting main stress. Subsequently the stress on the first foot (on *in*) should be reduced to a secondary stress.

In this way the final output becomes: ˌin A´merica.

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Anna Marczak

marczak1@amu.edu.pl