# Stress shift revisited: what does stress variation in English suggest? *

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## 1. Introduction

This paper studies stress variation in present-day British English, and discusses its implications for so-called stress shift in English. In my previous work (Hattori 2003a, b; 2007), I described the stress variants of adjectives such as *formidable, applicable, justifiable, communal, premature, comparable* and *preferable*, and suggested that both phonetic and syntactic factors trigger stress variation. This paper proposes a way to interpret variation data within the framework of 'boundary mapping and boundary deletion', a theory of the PF interface. This approach opens up a possibility of new theoretical interpretations of established facts on stress clash and stress shift in English.

## 2. Eurhythmy in English

### 2.1 Rules of eurhythmy

Stress shift in English, also called the Rhythm Rule, is leftward movement of late-main-stress to avoid stress clash. Within the framework of metrical theory, Hayes (1984: 44-45) says:

(1) The Rhythm Rule applies more readily when as a result the text receives a more highly valued rhythmic structure. The value of a rhythmic structure is computed from its grid by a set of rules I will call rules of eurhythmy.

Eurhythmy means 'equal spacing of grid marks at all levels' (Hayes 1984: 45), and the three rules proposed in Hayes (1984) are as follows:

(2) (i) Quadrisyllabic Rule
(ii) Disyllabic Rule
(iii) Phrasal Rule

Let us see these rules individually.

(3) Quadrisyllabic Rule (Hayes 1984: 46)
A grid is eurhythmic when it contains a row whose marks are spaced close to four syllables apart.

This refers to a particular spacing of marks at some level of grid, and this interval 'appears to center around four syllables, with greater dysrhythmy at greater divergence (Hayes 1984: 45).

(4) Disyllabic Rule (Hayes 1984: 48-49)
The domains delimited on the level of scansion should be divided evenly by a mark on the next lower grid level.

Thus, the stress clash in (5)(i) is dissolved by Quadrisyllabic Rule (3), and then the rhythmic structure in (5)(ii) gains a more highly valued rhythmic structure as in (5)(iii) by Disyllabic Rule (4).

(5) (i)

```
                    x
                *x---*x
        x         x   x
    x   x   x   x   x   x
    a hundred thirteen men
```

→

(ii)

```
                    x
        x----------------x
        x         x   x
    x   x   x   x   x   x
    a hundred thirteen men
```

(iii)

```
                    x
        x           x
        x---------x-------x
    x   x   x   x   x   x
→   a hundred thirteen men
```

(based on Hayes 1984: 49)

What is crucial to this paper is the following observation made by Hayes (1984: 52) and its formulation as 'Phrasal Rule.'

(6) A look at longer utterances, however, produces a surprising result: the target is not really a doubling of the quadrisyllabic interval. Instead, the second strongest stress is placed as early as possible in the phrase, even at the expense of binary alternation.

(7) Phrasal Rule (Hayes 1984: 52; originally pointed out by Bolinger 1965: [160] 157-158)

A grid is more eurhythmic if its second highest level bears two marks, spaced as far as possible.

This is an expression of 'the need to demarcate the beginnings of phrases' (Hayes 1984: 56). Thus, the phrase-initial syllable in the following example receives the second highest level of stress.

(8) 2 3 3 1

Topics in the Theory of Generative Grammar (Hayes 1984: 52)

**2.2 Phonetic spacing**

The rules of eurhythmy (2) are based on syllable count, while there is an alternative to syllable counting, which Hayes believes deserves serious consideration (Hayes, 1984: 70). This involves the idea of phonetic spacing (e.g. Liberman & Prince 1977: 320). The meaning of 'phonetic' spacing can be based on either actual physical time, or some more abstract phonological timing measure (Hayes, 1984: 70). It is pointed out that 'when speakers are asked to enact texts that are eligible for the Rhythm Rule without actually carrying the rule out, their response is usually to lengthen the interval between the two principal stresses' (Hayes 1984: 70). Thus, the underlined syllables in (9)(ii) and (10)(ii) are considerably longer than they would be in the stress-shifted version in (9)(i) and (10)(i), respectively.

(9) (i) fòurteen wómen (ii) fourtèen wómen

(10) (i) Mìssissippi législature (ii) Mississìppi législature

**2.3 Early Pitch Accent Placement in the Phrase**

Behind the Phrasal Rule (7) is the idea of 'Early Pitch Accent Placement in the Phrase', first proposed in Bolinger (1965, 1986) and developed by Shattuck-Hufnagel, Ostendorf & Ross

(1994) and Shattuck-Hufnagel (2000). According to the proponents of this theory, there is a tendency to locate the first accent of a new phrase as early as possible; early accent is to mark phrase onset, while nuclear accent is on the main-stress syllable. Their theory does not rely on the shift of rhythmic stress in response to rhythmic stress clash. That is, rhythmic stress clash and shift are not a prerequisite to early pitch accent placement. This 'phrase onset marker' theory makes it possible to explain early prominence without clash. This will be discussed in detail later in section 7.

### 3. Previous studies and aims of this paper

Analysis of the recorded data of twenty-one native speakers of British English shows an interesting inter- and intra-speaker variation (Hattori 2003a, b; 2005; 2007) and leads to a proposal that right branching structures can be a trigger of stress variation (cf. Kubozono 1995, on the universally marked nature of right branching structures). This paper aims to demonstrate how to interpret data on stress variation, especially to show that a study of intra-speaker variation of stress can cast new light on so-called stress shift if combined with the framework of 'boundary mapping and boundary deletion,' a theory of the PF interface proposed by Tokizaki (2005a, b).

The data dealt with in this paper is part of the distribution of stress variants of *premature* in present-day British English (Hattori 2005; 2007). The items in (11) below are three of the eight items presented to the twenty-one subjects in the experiment, and the distribution of the inter- and intra-speaker variation is illustrated in Table 1. Here the overall picture of distribution is omitted in order to focus on the representative cases: (i) attributive use of the adjective, (ii) attributive use of the adjective with a right branching structure, and (iii) predicative use of the adjective.

(11) (i) Parents of premature babies are being given training to allow them to care for their children at home.
(ii) The long-term effects of a cloud that slowly thins out could include late spring and premature fall frosts.
(iii) The final judgement was premature, but this captures the mood of the times, especially in Italy.

Table 1: (part of) distribution of the inter- and intra-speaker variation of *premature*

| | 5 | 9 | 12 | 1 | 2 | 10 | 18 | 14 | 11 | 17 | 20 | 4 | 8 | 13 | 3 | 19 | 6 | 7 | 15 | 21 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| i | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| ii | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| iii | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

(where '1' refers to initial stress and '2' to non-initial stress and/or double stress.)

Before proceeding to demonstrate how to interpret stress variation within the framework of 'boundary mapping and boundary deletion,' an overview of the theory of the PF interface is provided in the next section.

## 4. An overview of the theory of the PF interface proposed in Tokizaki (2005a, b): 'boundary mapping and boundary deletion' ('boundary phrasing')

This section is based on Tokizaki (2000; 2005a, b). The theory of the PF interface proposed there, named 'boundary mapping and boundary deletion', is a theory that maps label-free phrase structure onto prosodic structure with boundaries. He assumes bare structure in the sense of Chomsky (1995). Syntactic phrase structure is mapped onto phonological structure by the rule (12).

(12) Interpret boundaries of syntactic constituents [...] as prosodic boundaries /.../.

The rule (12) interprets boundaries of syntactic constituents as prosodic boundaries. For example, (13) has the bare phrase structure (14).

(13) Alice loves hamsters.

(14) [$_{IP}$ [$_{N}$ Alice] [$_{VP}$ [$_{V}$ loves] [$_{N}$ hamsters]]]

The mapping rule (12) applies to the completely bare phrase structure (15), and the rule interprets the brackets in (15) and changes them into prosodic boundaries as in (16).

(15) [[Alice] [[loves][hamsters]]]

(16) // Alice /// loves // hamsters ///

Then, prosodic phrasing is produced by the boundary deletion rule (17).

(17) Delete *n* boundaries between words. (*n*: a natural number)

This rule is assumed to be in the PF component and interprets the basic disjuncture between words mapped from syntactic structure as the actual speech with prosodic phrasing. Depending on the value of *n*, three different phrasing patterns are obtained as shown in (18).

(18) a. / Alice // loves / hamsters // ($n = 1$)

→ (Alice) (loves) (hamsters)

b. Alice / loves hamsters / ($n = 2$)

→ (Alice) (loves hamsters)

c. Alice loves hamsters ($n = 3$)

→ (Alice loves hamsters)

It is also assumed that the number of boundaries to be deleted (*n*) corresponds to the speed of utterance.

**5. Stress variants of *premature***

Within this framework of PF interface, our variation data is interpreted as follows.

(19) $_{NP}$[ $_{A}$[premature] $_{N}$[babies]]

[[premature] [babies]]

// premature // babies //

If *n* is 1, the phrase is divided into two prosodic phrases: */ premature / babies /.* If *n* is 2, it contains one prosodic phrase: *premature babies.* In the latter case, there is no boundary. This situation is shown in Table 1 above; stress shift is observed in ALL the subjects.

Another item that shows intra-speaker variation in (ii) on Table 1 is given the following prosodic boundaries.

(20) $_{NP}$[ $_{A}$[premature] $_{NP}$[ $_{N}$[fall] $_{N}$[frost]]]

[ [premature] [ [fall] [frost]]]

// premature /// fall // frost ///

(21) (i) premature / fall frost / (*n* = 2)

→ (premature) (fall frost)

(ii) premature fall frost (*n* = 3)

→ (premature fall frost)

I propose that all but one subject use prosodic phrasing (21)(ii) , while the only subject that shows non-initial stress adopts prosodic phrasing (21)(i). I argue that the prosodic phrasing (21) (ii) presents 'apparent' stress shift, the same as the 'early pitch placement' proposed in Shattuck-Hufnagel et al., while the prosodic phrasing (21)(i) does *not* require stress shift because there is a boundary after *premature*. To support this interpretation, I will present the results of acoustic measurements in the next section.

**6. Acoustic measurements of the stress variants**

A phonological boundary may be acoustically realized, for instance, in the following ways (e.g. Kitagawa 2005: 324).

(22) (i) a pause (is possible but not obligatory)
(ii) lengthening of the syllable(s) immediately preceding the boundary (in many languages, perhaps universally)
(iii) a reset of the fundamental frequency, with details that are language-dependent.... in a language with low end-tones (as in most contexts in English) a reset is from low to high.

Impressionistic analysis of the recorded data of the subject who shows non-initial stress in (11)(ii) (Subject #16) reveals that there is a pause after the adjective in question. Proposed prosodic phrasing for this subject is (21)(i). Acoustic measurements of the subject reveal (i) lengthening of the syllable immediately preceding the boundary, that is lengthening of *-ture* and (ii) a reset of the fundamental frequency after the boundary, that is, *fall* starts higher than *premature*. Table 2 shows the length of each syllable (in seconds) and the average, maximum and minimum frequency (in Hz) for the subject. Average frequency here means that the value is measured in the middle of the voiced portion in the spectrogram, and it does not necessarily correspond to the average value of the Max and the Min of the frequencies in each column. Table 3, on the other hand, shows a result of measurements for a subject who always shows initial stress with no intra-speaker variation for the adjective.

Table 2: Subject #16, the only subject who shows non-initial stress in (11)(ii)

| | *prema* | *TURE* |
|---|---|---|
| length (sec) | 0.2750 | 0.3673 |

| | *pre* | *ma* | *ture* | *fall* |
|---|---|---|---|---|
| Average Fx (Hz) | 134.2 | 127.5 | 123.6 | 152.3 |
| Max Fx (Hz) | 138.7 | 130.2 | 133.8 | 175.8 |
| Min Fx (Hz) | 124.5 | 117.8 | 120.4 | 128.9 |

Table 3: Subject # 9, a subject who always shows initial stress with no intra-speaker variation

| | *PREma* | *ture* |
|---|---|---|
| length (sec) | 0.3722 | 0.1883 |

| | *pre* | *ma* | *ture* | *fall* |
|---|---|---|---|---|
| Average Fx (Hz) | 222.9 | 200.3 | 192.9 | 233.6 |
| Max Fx (Hz) | 231 | 211.2 | 214.6 | 282.5 |
| Min Fx (Hz) | 211.2 | 188.5 | 180.7 | 175.5 |

Table 4 shows a result of measurements for a subject who shows initial stress in (11)(ii) but non-initial stress in predicative use, that is, in (11)(iii). This result is presented here in order to demonstrate that a reset of the fundamental frequency at the beginning of *fall* is lacking. This suggests lack of a boundary after *–ture,* and coincides with our interpretation that this type of subject adopts prosodic phrasing as in (21)(ii).

Table 4: Subject # 19, a subject who shows initial stress in (11)(ii) but non-initial stress in predicative use

| | *PREma* | *ture* |
|---|---|---|
| length (sec) | 0.2309 | 0.2278 |

| | *pre* | *ma* | *ture* | *fall* |
|---|---|---|---|---|
| Average Fx (Hz) | 121.4 | 116.6 | 112.5 | 119.4 |
| Max Fx (Hz) | 124.5 | 123.9 | 123.9 | 124.5 |
| Min Fx (Hz) | 114.3 | 96.4 | 103.4 | 115.6 |

**7. 'Apparent' stress shift**

So far, examples of stress variants in three constructions have been examined. In section 2.3, a view presented by Shattuck-Hufnagel et al. is introduced. Based on an analysis of a speech corpus, they propose that early accent placement is possible in the absence of rhythmic stress clash. Following their method (Shattuck-Hufnagel, Ostendorf & Ross, 1994), ratio of shifted and non-shifted stress of *premature* among the subjects who show intra-speaker variation (19 subjects in total) is calculated to investigate the validity of their claim. There are 5 sentences (contexts) that meet the condition of stress clash in our data. Some of them are as follows.

(23) But premature ageing can be stopped and, to some extent, reversed.
Prevent the premature wrinkling and aging that is caused by sun damage.

One sentence that does not meet the condition of stress clash is like this.

(24) Emma and Amy are the world's most premature surviving twins.

Table 5 shows that our data support their claim; even in the non-clash context, 'apparent' stress shift has been observed. This will be attributed to early pitch accent placement in the phrase.

Table 5: Ratio of shifted and non-shifted stress for *premature* among those that show intra-speaker variation (19 subjects)

| stress clash | shifted stress | non-shifted stress |
|---|---|---|
| Yes (5 sentences) | 85 | 11 |
| No (1 sentence) | 9 | 10 |

Although more detailed acoustic measurements are needed, non-shifted stress in the stress-clash context (11 cases out of 96 cases) is partly given explanation. This study has made it clear that one subject that does not shift stress in a stress-clash context has recourse to lengthening of the syllable and a reset of the fundamental frequency after the boundary in order to avoid stress clash.

**8. Concluding remarks and remaining issues**

The present study offers a new perspective on so-called stress shift, by combining variation data with the theory of 'boundary mapping and boundary deletion.' It is shown that the 'apparent' stress clash can be resolved by recourse to lengthening of the syllable that contains the non-shifted primary stress. It is also shown that the 'apparent' leftward movement of primary stress is not necessarily in response to stress clash and that it should be dealt with separately from stress shift, as a phrase-onset marker. While other stress variants observed in

present-day British English await acoustic measurements, modeling stress variation in terms of presence/absence of a phonological boundary will likely bring us closer to understanding the true nature of stress and so-called stress shift.

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