Two Types of Strategy for Clach Avoidance and Even-Spacing

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Two Types of Strategy for Clash Avoidance and Even-Spacing

Shin-ichi Tanaka

0. Introduction

The stress pattern of a word usually remains constant regardless of its environment although it is influenced by pitch change: that is, the relation between primary and secondary stresses in a word is always retained and not sensitive to its location in a sentence. But there is a well-known case in which this internal stress relation is altered. This is what we call "the Rhythm Rule", which can also be referred to as "stress shift".

This paper is an attempt to solve the drawbacks of the Rhythm Rule and the Lengthening Rule proposed in Selkirk (1984) and to provide a more adequate approach to the rhythmic and lengthening phenomena. It leads to the following specific conclusions:

(a) Both the Rhythm Rule and the Lengthening Rule aim at the target of clash avoidance and even-spacing;
(b) The two rules apply complementarily;
(c) Rhythmic and lengthening phenomena can be explained similarly by a fairly explicit system of rules and conditions, and their interaction can also be formulated by an algorithm.

In section 1, we introduce a characterization of metrical grids and present a grid-only analysis of the Rhythm Rule in Selkirk (1984). Then, we show that Selkirk's system has many kinds of defects. In section 2, we propose a grid-only approach to the Rhythm Rule that can resolve all the problems in the previous study. In section 3, we present the Lengthening Rule which is evidenced in Selkirk (1984), and point out that, as it stands, it has some incoherences.
and does not reflect the speaker's linguistic intuition properly. In section 4, we put forward a more adequate approach to the Lengthening Rule. It is argued that this rule aims at the same target of clash avoidance and even-spacing as the Rhythm Rule.

1. Selkirk's Rhythm Rule

Metrical grids properly define the prominence relations between syllables; that is, the height of each column reflects stress prominence of each syllable. Furthermore, grids play another important role: the rows of grids are taken to correspond to the interstress intervals. Compare the following two representations:

$$\begin{align*}
(1) \quad & a. \\
& \quad \text{Mississippi River}
\end{align*}$$

$$\begin{align*}
(1) \quad & b. \\
& \quad \text{Mississippi River}
\end{align*}$$

It is true that both trees and grids clearly reflect prominence relations, but the interstress interval cannot be defined only in terms of metrical trees. That is why Liberman and Prince (1977, hereafter LP) and Hayes (1984) resort to metrical grids in addition to metrical trees, since rhythmic phenomena are not explained without referring to the interstress interval between syllables.

According to LP and Hayes, metrical grids are originally an interpretation of metrical trees, and their Grid Construction is, therefore, an interpretive rule. On the other hand, Selkirk's Grid Construction arrays grids independently of trees in the following manner:
(2) Grid Construction
a. Each of the syllables is aligned with a first-level grid position;
b. Stressed syllables are aligned with a second-level position;
c. Main-word-stressed syllables are aligned with a third-level position at the least;
d. Phrase-stressed syllables are (usually) aligned with at least a fourth-level position.

Given this provision, the beats of Mississippi River are constructed in this order:

(3) a. x x x x L₂
    x x x x x x L₁
    Mississippi River → Mississippi River →

    b. x x x x L₂
    x x x x x x L₁
    Mississippi River → Mississippi River →

    c. x x L₃
    x x x L₂
    x x x x x L₁
    Mississippi River → Mississippi River

    d. x L₄
    x x x L₃
    x x x x L₂
    x x x x x L₁
    Mississippi River → Mississippi River

Now we turn to Selkirk's analysis of the Rhythm Rule. In her framework, the Rhythm Rule in English belongs to a universal system of "Grid Euphony Rules" which apply in a wide variety of rhythmic phenomena. For instance, the Rhythm Rule is two-fold in her terms, and her version of the rule is called "Beat Movement":

(4) Beat Movement
a. x x x
   x x x x x
   x x x x (left movement)

b. x x x
   x x x
   x x x (right movement)
These options (4a) and (4b) are regarded as parameters whose particular value must be fixed for each language. Since English has only (4a) type of movement, Beat Movement applies to Mississippi River in the following manner:

(5)  

\[
\begin{array}{cccccccc}
  & x & & x & & x \\
  x & x & x & x & x & x \\
  x & x & x & x & x & x & x & x & x \\
 Mississippi River \rightarrow \text{Mississippi River}
\end{array}
\]

Selkirk explicitly defines a universal condition on the whole grid configuration, which seems to be particularly relevant for the output form brought about by the Beat Movement. She calls it "The Principle of Rhythmic Alternation":

(6) The Principle of Rhythmic Alternation

a. Every strong position on a metrical level \( m \) should be followed by at least one weak position on that level;

b. Any weak position on a metrical level \( m \) may be preceded by at most one weak position on that level. (Selkirk (1984, p.52))

If we consider (6b) to be an output condition on the Beat Movement, the relevant minimal and maximal configurations prove to be something like (7a) and (7b) respectively:

(7) a. minimal  

\[
\begin{array}{ccccccc}
  & x & & x \\
  x & x & x & x & x \\
  x & x & x & x & x & x & x & x & x \\
\end{array}
\]

b. maximal  

\[
\begin{array}{cccccccc}
  & x & & x \\
  x & x & x & x & x & x & x & x & x & x & x & x & x & x & x \\
\end{array}
\]

Thus the output form of Mississippi River in (5) is consis-
tent with (6), but the shifted version of, say, indistinguishable sisters is not:

(8) a. 
\[
\begin{array}{cccc}
 & x \\
 x & x & x & x \\
 x & x & x & x & x \\
 x & x & x & x & x & x \\
\end{array}
\]
Mississippi River

b. 
\[
\begin{array}{cccc}
 & x \\
 x & x & x & x \\
 x & x & x & x & x & x \\
 x & x & x & x & x & x & x \\
\end{array}
\]
*indistinguishable sisters

We can now summarize Selkirk's formulation as in (9) (here, Rpr. = Representation, and con. = condition):

(9)

<table>
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<th>Rpr.</th>
<th>Rhythm Rule</th>
<th>output con.</th>
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<tr>
<td>grid</td>
<td>BM (4)</td>
<td>PRA (6)</td>
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Selkirk's universal system can apply to various rhythmic phenomena in English as well as other languages, and the stress theory she advocates might arguably see the subject in its proper perspective. But, as it stands, it is somewhat too strong in the sense that many bizarre cases are incorrectly produced; therefore this formalism must be constrained in some way. Consider the following instances:
(10)

a. analytical thought  →  *analytical thought
b. diacritical markings  →  *diacritical markings
c. Minneåpolis Mike  →  *Minneapolis Mike
d. Passaconaway Péte  →  *Pàssaconaway Péte
e. Potawàtomi verbs  →  *Potawatomi verbs

(11)

a. sensational claim  →  *sensational claim
b. abdominal pain  →  *àbdominal pain
c. magnificient parties  →  *magnificient parties
d. premédical students  →  *prèmedical students
e. Wagnerian sìnger  →  *Wàngerian sìnger

(12)

a. Tippecanoe River  →  *Tippecanoe River
b. harlequinesque nòvels  →  *hàrlequinesque nòvels
c. underemployèd people  →  *underemployed people

(13)

a. experimental science  →  *experimental science
b. anathemàtic féllows  →  *anàthematic féllows
c. antagonistic views  →  *antàgonistic views
d. Monongahèla River  →  *Monongahela River
e. disadvantaged  →  *disàdvantageous

tréaties  →  tréaties
None of the examples above undergo the Rhythm Rule, but Selkirk's Beat Movement predicts they would; and her output condition cannot filter them out.\(^3\)

In the next section, we present an alternative analysis which resolves all the problems with the previous study reviewed so far.

2. Rhythm Rule as Rule of Clash Avoidance and Even-Spacing

Although Selkirk's formalism is so strong as to generate many unacceptable cases, her grid-based universal system of both stress and rhythm seems to be very promising; thus we attempt to accept her system basically and restrict its expressive power. In what follows, we submit a more restrictive analysis of the Rhythm Rule, employing input and output conditions.

We assume that in stead of The Principle of Rhythmic Alternation (6), the following general principle is at work on the whole grid configuration:

(15) **The Principle of Grid Eurhythmy**

A grid must be as eurhythmic in its configuration as possible.

This principle entails that a dysrhythmic grid must be converted into a eurhythmic one; and one of the way to achieve
the conversion is the Rhythm Rule. Then a question arises what configuration is dysrhythmic and what configuration is eurhythmic. As is shown below, the dys- and eurhythmicity in configuration are defined by our input and output conditions respectively.

First, we propose the following input condition which depends mainly on the notion of "distance" defined in Ono (1984):

(16) Distance Condition
A grid is dysrhythmic when the distance between the clashing beats* is smaller than two syllables.

This condition predicts that in (17) below, for example, only (17a-e) are dysrhythmic and allowed to undergo the Rhythm Rule since the distance between the clashing elements is smaller than two syllables in each of these cases (the parenthesized number is intended to indicate the distance between the clashing beats):

(17) a. x b. x
    x-------x   x--x
    x x x x x x x x x
    harlequinesque novels(0) Dundee road(0)

c. x d. x
    x--x   x------x
    x x x x x x x x
    cockatoo orchis(0) coalition party(1)

e. x f. x
    x-------x   x------x
    x x x x x x x x x
    Gramercy Park(1) Mississippi connections(2)
The important thing is that our Distance Condition defines dysrhythmicity in grid configuration and guarantees proper clash avoidance.

Second, we adopt Selkirk's Beat Movement as our version of the Rhythm Rule (i.e. (4a), repeated here as (18)):

(18) Beat Movement

\[
\begin{array}{cccc}
 & & & \\
\text{x} & & & \\
\text{x} & \text{x} & & \text{x} \\
\text{x} & \text{x} & \text{x} & \rightarrow & \text{x} & \text{x} & \text{x}
\end{array}
\]

This rule applies to (17) in the following way:

(19) a.

\[
\begin{array}{cccc}
 & & & \\
\text{x} & & & \\
\text{x} & \text{x} & \text{x} & \rightarrow & \text{x} & \text{x} & \text{x} & \text{x} \\
\text{x} & \text{x} & \text{x} & \text{x} & \text{x} & \text{x} & \text{x} & \text{x}
\end{array}
\]

Harlequinesque novels (0) → Harlequinesque novels

b.

\[
\begin{array}{cccc}
 & & & \\
\text{x} & & & \\
\text{x} & \text{x} & \text{x} & \rightarrow & \text{x} & \text{x} & \text{x} & \text{x}
\end{array}
\]

Dundee road (0) → Dundee road

c.

\[
\begin{array}{cccc}
 & & & \\
\text{x} & & & \\
\text{x} & \text{x} & \text{x} & \rightarrow & \text{x} & \text{x} & \text{x} & \text{x}
\end{array}
\]

Cockatoo orchis (0) → Cockatoo orchis

Minneapolis connections (3)

((17b - e) are taken from Kenyon and Knott (1953))
Third, we define an output condition as in (20):

(20)  Eurhythmy Condition
A grid is Eurhythmic as the domain delimited by
the alternating beats \(x_1\) and \(x_2\) is more evenly
divided by a beat \((x_3)\) on the next lower level.
Ex. \(x_1\), \(x_2\)
\[
\begin{array}{c}
  x \\
  x \\
  x \\
\end{array}
\]
\[
\begin{array}{cccc}
  x & (x) & x & (x) \\
  x & x & x & x \\
  x & x & x & x \\
\end{array}
\]

In (21), for example, only the grid configurations in (a-g)
are regarded as Eurhythmic, but the others are not.
According to the Eurhythmy Condition, the output forms in (19b-e) (i.e. (22b-e)) are eurhythmic, and the results in turn insure the application of the Beat Movement. However, the output form in (19a) (i.e. (22a)) is not yet eurhythmic, and the application of the rule is blocked by this condition:

(22) a. x

b. x

*harlequinesque novels

Dundee road
c. x

cockatoo orchis
d. x

coalition party
It should be noted that the Eurhythmmy Condition defines eu-
rhythmnicity in grid configuration and insures proper even-
spacing.

Fourth, another output condition is required to account
for rhythmic phenomena more properly. We call it "Phrasal
Demarcation Condition":

(23) Phrasal Demarcation Condition
The landing site of the moved beat must be the
first syllable of the left-hand component word.

The shift in (24a), for instance, is permissible because the
encircled beat is landed on the first syllable, but the move-
ment in (24b) is not (concrete examples are given later):

(24) a. \[
\begin{array}{ccc}
  & x & \\
\times & x & \times \\
\times x & x & \times x \\
\times x & x & \times x \\
\end{array}
\]
\[
( [$.$.$.$.] [..$.$.$.] ) \rightarrow ( [$.$.$.$.] [..$.$.$.] )
\]

b. \[
\begin{array}{ccc}
  & x & \\
\times & x & \times \\
\times x & x & \times x \\
\times x & x & \times x \\
\end{array}
\]
\[
( [$.$.$.$.$.$.] [..$.$.] ) \rightarrow ( [$.$.$.$.$.$.] [..$.$.] )
\]

Given these three conditions plus the Beat Movement, we
can solve all the problems involved in Selkirk's analysis,
and how they are solved is exemplified as follows:
To conclude, our system is represented by the algorithm in (30) below:
Note that the Distance Condition and the Eurhythmy Condition guarantee clash avoidance and even-spacing respectively, by virtue of The Principle of Grid Eurhythmy (15).

3. Selkirk's Lengthening Rule

We have already been concerned with the Rhythm Rule, which applies in order to avoid a stress clash and to carry out eurhythmicity in speech. However, the Rhythm Rule is not the only way to avoid a clash and to produce a eurhythmic configuration: there is another way to achieve these two aims, namely, the Lengthening Rule. In this connection, LP (p.320), for example, observes as follows:

One can always say e.g. thirteen men, at the expense of lengthening the syllable -teen to compensate for the lack of intervening syllable... If... the left-hand element in the clash falls at the end of a constituent that is somewhat more loosely bound to what follows, a longer 'pseudopause' (lengthening of the terminal syllable(s) of the phrase) is likely to be employed in any case to mark the constituent boundary... Thus the acceptability of a stress clash depends, in part, on the extent to which the interstress interval is prone to be lengthened, independently, by prepausal lengthening.

Such phonetic lengthening is also discussed by Hayes (1984, p.70):
For example, 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. In fourteen women, for instance, the syllable teen is considerably longer than it would be in the relabeled form fourteen women. A somewhat lesser lengthening effect can be perceived on the sequence sippi in comparing Mississippi legislature with Mississippi législatu. This can be explained by assuming that the rules of phonetic length assignment are part of the means of achieving eurhythm — a monosyllabic or disyllabic interval on the level of scansion is more tolerable when it is phonetically longer.

Although the notions "pseudopause" and "phonetic length assignment" are tentative and are not explicitly formulated by LP and Hayes, their observations seem to be to the point.

As far as I know, Selkirk (1984) is the first to give an explicit account of such phenomena as lengthening and pausing at the end of a word. In her framework, the difference in rhythmic realization between shifted and non-shifted patterns is accounted for in terms of whether or not the grid in question has "silent demibeats" in it. Silent demibeats are introduced by a set of rules that are sensitive to the syntactic structure of an utterance; the number of silent positions correlates with the size of a constituent break. In other words, the greater the break is, the greater number of silent demibeats should be added. On the basis of this consideration, Selkirk formulates the following rule:

(31) Silent Demibeat Addition
Add a silent demibeat at the end (right extreme) of the metrical grid aligned with a word,
b. a word that is the head of nonadjunct constituent (e.g. V in VP, N in NP),
c. a phrase,
d. a daughter phrase of S.

(Selkirk (1984, p.314))

This rule gives quantitative values of duration to a word boundary, and they are added after the patterns of prominence have been defined (i.e. after the Grid Construction). For example, the rule applies to Marcel Proust, Marcel’s book, and Marcel proved (it) in the following manner (here, Selkirk thinks of the noun-modifier Marcel in (32a) as an adjunct, and the possessive NP Marcel’s in (32b) as a non-adjunct):

(32) a.      
  x        x        x        
  x        x        x        x
  x        x        x        x
  x        x        x        x        x
Marcel Proust —> Marcel Proust (By (31a))

b.      
  x        x        x        x
  x        x        x        x
  x        x        x        x
  x        x        x        x        x
Marcel’s book —> Marcel’s Book (By (31a,b))

c.      
  x        x        x        x
  x        x        x        x
  x        x        x        x
  x        x        x        x        x
Marcel proved (it) —> Marcel proved (it) (By (31a,b,d))

LP (p.320) observes that resistance to shifting increases with boundary strength in the phrases above in the following way:
(33) a. Marcel Próust
    b. ?Marcel's bóok
    c. ??Marcel proved (it).

To account for the applicability of the Beat Movement observed in this context, Selkirk devises the following rule, which is defined as one of the "Grid Euphony Rules" discussed in section 1.º:

(34) Beat Addition

a.  x
    x  x  →  x  x  (left-dominant addition)

b.  x
    x  x  →  x  x  (right-dominant addition)

Since in English (34a) is specified for its parameter, the rule applies to each output form in (32) like this:

(35) a.  x
    x  x
    x  x  x
    x  x  x
    x  x  x
    Marcel Proust  →  φ  (Blocked since the structural description does not match)

b.  x
    x  x
    x  x
    x  x  x  x
    x  x  x
    Marcel's book  →  Marcel's book

c.  x
    x  x
    x  x
    x  x  x  x
    x  x  x
    Marcel proved (it)  →  Marcel proved (it)
Here, the Beat Addition cannot apply in (35a) for the reason noted above; it may apply in (35b); and it must apply in (35c) because the input form in (35c), as it stands, violates The Principle of Rhythmic Alternation (cf. (6)). We see, then, that in (35b) and (35c), it is the added beat that undoes the clash and thereby blocks the Beat Movement, as shown in (36):

\[(36)\]

a.  

\[
\begin{array}{cccc}
  & x & x & x \\
  x & x & x & x \\
  x & x & x & x \\
  x & x & x & x \\
  x & x & x & x & x \\
\end{array}
\]

Marcel Proust → Marcel Proust

b.  

\[
\begin{array}{ccccc}
  & x & x & x & x & x \\
  x & x & x & x & x \\
\end{array}
\]

Marcel's book → # (Blocked since the structural description does not match)

c.  

\[
\begin{array}{cccc}
  & x & x & x & x \\
  x & x & x & x & x & x \\
\end{array}
\]

Marcel proved (it) → # (Blocked since the structural description does not match)

Thus, where the Silent Demibeat Addition has applied a sufficient number of times (and where the Beat Addition has followed on its heels), there will be no application of the Beat Movement. On the other hand, two-word phrases of the form Adjunct + Noun are given no more than one demibeat at the right extreme of the first word, so the Beat Movement will often occur. In other words, the applicability of the Beat Movement is sensitive to the presence of an added beat,
which in turn is determined by the Silent Demibeat Addition. The characteristics of Selkirk's Silent Demibeat Addition are summarized as follows. The first characteristic is that the Silent Demibeat Addition is precisely a syntactic timing rule because the number of demibeats is defined entirely in terms of the kind of constituent break or syntactic boundary. And Selkirk claims that these syntactically derived silent demibeats can account for final lengthening as well as pausing. The second characteristic is that unlike the Beat Movement and the Beat Addition, the Silent Demibeat Addition is not viewed as one of the "Grid Euphony Rules". This claim contrasts strikingly with that of Hayes (1984), according to which "the rules of phonetic length assignment are part of the means of achieving eurhythm\text{}" (see Hayes (1984, p.70)). The third characteristic is that, at least in explaining the correlation between rhythmic and lengthening phenomena, Selkirk's four rules seem to be ordered as:

(37) Grid Construction
    ↓
Silent Demibeat Addition
    ↓
Beat Addition
    ↓
Beat Movement
    \} Grid Euphony Rules

The fourth characteristic is that Selkirk assumes no input condition on the Silent Demibeat Addition; but an output condition, that is, The Principle of Rhythmic Alternation is imposed on it, as is the case with the Beat Movement.

But there are three types of problems yet to be resolved in Selkirk's analysis. First, as Hayes observed in the citation above, the lengthening effect in the case of non-shifted version of Mississippi législature is less than that in the case of non-shifted version of fourteen women: in fact, the
lengthening effect of a terminal syllable cannot be perceived in phrases like Narragansett occupations. But Selkirk’s system cannot account for these differences since the Silent Demibeat Addition assigns only one demibeat to each phrase:

(38) a.  x  
    x    x    x  
    x    x    x  
    x    x    x    x  

fourteen women  →  fourteen women
b.  x  
    x    x    x  
    x    x    x    x  
    x    x    x    x    x    x  
Mississippi legislature  →  Mississippi legislature
c.  x  
    x    x    x    x  
    x    x    x    x  
    x    x    x    x    x    x    x    x    x  
Narragansett occupations  →  Narragansett occupations

As noted earlier, Selkirk assumes that the size of a constituent break corresponds to the number of silent demibeats; thus, the added beats in (38a-c) are all the same in number since the constituent breaks involved are also the same. However, these results do not answer to our linguistic intuition. Second, the application of the Beat Movement is determined in patterns like Gramercy park and coalition party in the following way:

(39) a.  x  
    x    x    x  
    x    x    x    x  
    x    x    x    x  
    x    x    x    SDA  
Gramercy Park  →  Gramercy Park
As with Marcel Proust, the Beat Movement may apply to (39a) and (39b) since the Beat Addition cannot block it. But it is to be noted that the output forms in (39a) and (39b) are analogous to the ill-formed configurations of *sensational claim and *analytical thought respectively:

(40) a.  

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Gramercy Park vs. *sensational claim

b.  

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coalition party vs. *analytical thought

In Selkirk's system, the Beat Movement may apply after the Silent Demibeat Addition and may also apply without it, be-
cause she claims that the phrasal level application of the Silent Demibeat Addition is optional; thus, each pair in (40) may be produced equally by her system. But this is obviously an incoherence in her framework. Third, Selkirk proposes a rule called “Rhythmic Aux Contraction” to account for the lengthening of sentences with an auxiliary. The rule is formulated as follows:

(41) **Rhythmic Aux Contraction**

```
..... x ..... x ..... 
..... σ i ..... σ j ..... 
```

1 2 3 4 5 → 1, 2, 4, 3, 5

σ j = has, is, had, would

(Selkirk (1984, p.405))

Thus, the lengthening of, say, Marcel's finished is derived from the uncontracted form of Marcel has finished in the following way:

(42)

```
X X X X X X
X X X X X X X X
X X X X X SDA X X X X X X X X
Marcel has finished → Marcel has finished
```

```
X X X X X X X X
```

```
RAC X X X X X X X X BA X X X X X X X
→ Marcel has finished → Marcel's finished
```

As is shown below, we can give a simpler account of the lengthening of the contracted form without devising such a
restructuring rule.

In the next section, we will present an analysis of lengthening phenomena which can solve all the three problems reviewed so far, and show that i) the Lengthening Rule (i.e., the Silent Demibeat Addition) is not defined as a syntactic timing rule; ii) the Lengthening Rule does belong to the rules of eurhythm as is the case with the Rhythm Rule; iii) the Rhythm Rule and the Lengthening Rule apply complementarily; and that iv) the status of the Lengthening Rule is quite analogous to that of the Rhythm Rule on which both the Distance Condition and the Eurhythm Condition must be imposed.

4. Lengthening Rule as Rule of Clash Avoidance and Even-Spacing

Now we will present a more adequate approach to the Lengthening Rule. Here, we assume that the vertical alignment of beats reflects the relative prominence of each syllable while the horizontal alignment of silent beats reflects the relative length of the terminal syllable, and that the greater number of silent demibeats corresponds to the greater lengthening effect of the terminal syllable.

As LP and Hayes observe, the Lengthening Rule usually applies when the Rhythm Rule does not apply, because non-shifted patterns, as they stand, are often quite dysrhythmic. So it is natural to argue that the Lengthening Rule is a rule to avoid a clash and to produce a eurhythmic utterance: the Lengthening Rule is a rule for clash avoidance and even-spacing, as is the Rhythm Rule.

First, we use here again the Distance Condition (16), which guarantees clash avoidance and the Eurhythm Condition (20), which guarantees even-spacing. For example, the former condition stipulates that the forms in (43a-f) below are dysrhythmic and must be converted into eurhythmic ones. (43 g-i) are not so dysrhythmic since the distance is two syl-
lables, but, as they stand, they are not yet eurhythmic according to the latter condition.

<table>
<thead>
<tr>
<th></th>
<th>a.</th>
<th>b.</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>x---x</td>
<td>x---x</td>
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<tr>
<td></td>
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<tr>
<td>Dundee road(0)</td>
<td>cockatoo orchis(0)</td>
<td></td>
</tr>
<tr>
<td>c.</td>
<td>x</td>
<td>d.</td>
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<td></td>
<td>x---x</td>
<td>x-----x</td>
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<td>x x x x x x</td>
<td>x x x x x x</td>
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<tr>
<td>Tippecanoe River(0)</td>
<td>Salvation Army(1)</td>
<td></td>
</tr>
<tr>
<td>e.</td>
<td>x</td>
<td>f.</td>
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<tr>
<td></td>
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<td>x-----x</td>
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<td></td>
<td>x x x x x x x x</td>
<td>x x x x x x</td>
</tr>
<tr>
<td>Mississippi River(1)</td>
<td>Alamogordo relatives(1)</td>
<td></td>
</tr>
<tr>
<td>g.</td>
<td>x</td>
<td>h.</td>
</tr>
<tr>
<td></td>
<td>x----------x</td>
<td>x----------x</td>
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<tr>
<td></td>
<td>x x x</td>
<td>x x x</td>
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<tr>
<td></td>
<td>x x x x x x x x</td>
<td>x x x x x x x</td>
</tr>
<tr>
<td>sensational claim(2)</td>
<td>analytical thought(2)</td>
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<tr>
<td>i.</td>
<td>x</td>
<td></td>
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<tr>
<td></td>
<td>x----------x</td>
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<td>x x x</td>
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<td></td>
<td>x x x x x x x x</td>
<td></td>
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<tr>
<td>stratificational grammar(2)</td>
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<tr>
<td>j.</td>
<td>x</td>
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<td>x x x x x x x x</td>
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<tr>
<td>sympathetic conversations(3)</td>
<td></td>
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</table>

Second, our version of the Silent Demibeat Addition is
defined simply as follows:

(44) Silent Demibeat Addition (revised version)
Place one or more demibeats at the end of a word.

Here, the number of demibeats to be added depends entirely on the Eurhythmy Condition. Specifically, the silent demibeats should be added so as to accord with the eurhythmic configuration defined by this condition. Furthermore, after the application of (44), the Beat Addition (34a) can apply if possible in order to bring about eurhythmic configuration. Both rules apply to (45a–j) in the following way:

(45) a.  
\[ \begin{array}{l}
  x \quad x \quad x \\
  x--x \quad x \\
  x \quad x \quad x \\
  x \quad x \quad SDA \quad x \quad x \quad x \quad x \quad x \\
 \text{Dundee road}(O) \quad \rightarrow \quad \text{Dundee road} \\
  x \\
  x \\
  x \quad x \\
 \text{BA} \quad x \quad x \quad x \quad x \quad x \\
 \rightarrow \quad \text{Dundee road} \\
\end{array} \]

b.  
\[ \begin{array}{l}
  x \quad x \quad x \\
  x--x \quad x \quad x \\
  x \quad x \quad x \\
  x \quad x \quad x \quad x \\
  x \quad x \quad x \quad x \quad x \quad x \quad x \quad x \quad x \\
 \text{cockatoo orchis}(O) \quad \rightarrow \quad \text{cockatoo orchis} \\
  x \\
  x \\
  x \quad x \\
  x \quad x \quad x \quad x \quad x \quad x \quad x \quad x \quad x \\
 \rightarrow \quad \text{cockatoo orchis} \\
\end{array} \]
Tippecanoe River (0) → Tippecanoe River

Salvation Army (1) → Salvation Army

Mississippi River (1) → Mississippi River

Alamogordo relatives (1) → Alamogordo relatives
→ Alamosgordo relatives

g.  x
    x
    x
    x
    x
    x x x x x x x x x

→ sensational claim(2) → sensational claim

→ sensational claim

h.  x
    x
    x
    x
    x
    x x x x x
    x x x x x x x x x

→ analytical thought(2) → analytical thought

→ analytical thought

i.  x
    x
    x
    x
    x
    x x x x x x x x x
    x x x x x x x x x

→ stratificational grammar(2) → stratificational grammar

→ stratificational grammar
Finally, each output is checked by the Eurhythmy Condition. The results are as follows:

(46) a. x

Dundee road

b. x

c. x

Tippecanoe River
d. x

Salvation Army
e. x

Mississippi River

Mississippi River

sensational claim

f. x

Alamogordo relatives

g. x

analytical thought

i. x

stratificational grammar
On the basis of our system, which consists of DC, SDA, BA, and EC, let us now discuss how to solve Selkirk’s three problems discussed in section 3. First, Selkirk cannot account for the differences in the lengthening effect among fourteen women, Mississippi legislature, and Narragansett occupations; but our system clearly explains these differences:

(47) a. 

\[ \begin{array}{c}
\times \\
\times-------\times \\
\times \times \times \times \times \times \times \times \times \times \\
\times \times \times \times \times \times \times \times \times \times \times \times \times \\
\end{array} \]

fourteen women(0) \rightarrow fourteen women

b. 

\[ \begin{array}{c}
\times \\
\times-------\times \\
\times \times \times \times \times \times \times \times \times \times \times \\
\times \times \times \times \times \times \times \times \times \times \times \\
\end{array} \]

Mississippi legislature(1) 

\[ \begin{array}{c}
\times \\
\times \times \\
\times \times \times \times \times \times \times \times \times \\
\end{array} \]

\rightarrow Mississippi legislature
Note that the output forms in (47a-c) are quite consistent with Hayes’s observations at the beginning of section 3. Selkirk’s Silent Demibeat Addition, which is a syntactically-based timing rule, may explain the difference in the duration of pausing between phrase and sentence; note that her Silent Demibeat Addition is a rule for pausing and therefore does not belong to the rules of eurhythmý. But, as it stands, it cannot explain the difference in the duration of final lengthening among individual phrases as well as among individual sentences; so the Lengthening Rule must not be characterized as syntactically-based rule. Rather it must be a “distance-based” or “syllable-based” rule, which does belong to the rules of eurhythmý. Second, in Selkirk’s framework, some kinds of configurations are allowed which are considered well-formed in certain cases and ill-formed in others (cf. (40)). But our system never suffers from such a defect: we assume that the eurhythmic configuration is always constant, and that it is defined by the Eurhythmý Condition. Moreover, our system never allows the Silent Demibeat Addition to co-
operate with the Beat Movement in achieving eurhythm; in fact, the two rules apply complementarily. Consider the following examples:

(48) a.

```
  x
 x--x
 x  x  x
 x  x  x
 Dundee road(1)
```

```
 x
 x  x  BM  SDA  x  x
 x  x  x
 x  x  x
 Dundee road
```

b.

```
  x
 x-----x
 x  x  x
 xx x  x  x
 coalition party(1)
```

```
 x
 x  x  BM  SDA  x  x
 x  x  x
 xx x  x  x  x  x  x
 coalition party
```

The Beat Movement and the Silent Demibeat Addition are optional rules, but it is not true that they can apply at random whenever they match up to the relevant conditions; that is, other things being equal, the option is either to apply the Beat Movement or to apply the Silent Demibeat Addition. When the former application is strongly preferred, the latter will not apply, and vice versa. The important thing is that the Beat Movement and the Silent Demibeat Addition apply complementarily. The incoherence in Selkirk's system is simply attributable to the lack of this manner of applica-
tion. Third, Selkirk's Rhythmic Aux Contraction seems to be an ad hoc restructuring rule, but, in our system, the final lengthening of such contracted forms as Marcel's finished can be achieved without appealing to the construction Marcel has finished:

\[(49) \quad x \quad x
\]

\[
x-----x
\]

\[
x \quad x \quad x \quad x \quad x \quad x \quad x \quad x \quad x \quad x
\]

Marcel's finished(0) → Marcel's finished

The reason we can obtain the lengthened version of the contracted form so simply is that the rule application is distance-sensitive, not constituent-break-sensitive: so we don't have to refer to such an ad hoc restructuring rule.

It has been pointed out in the literature that the applicability of the Rhythm Rule is sensitive to such various factors as "speech rate", "familiarity or frequency of a word", "emphasis" or "word boundary", and so on (See Gimson (1980, p.285), Hayes (1984, pp.56-57), Selkirk (1984, pp.183-184), Kiparsky (1979, p.425, fn.2), Ono (1984, p.107), and Tanaka (1983, p.93)). The same is also true of the Lengthening Rule. The Rhythm Rule usually applies in fast speech, to a familiar or frequent word, or to a non-emphasized word while the Lengthening Rule usually applies in slow speech, to an unfamiliar or infrequent word, or to an emphasized word. In particular, these factors are crucial in the cases where either the Rhythm Rule or the Lengthening Rule may apply (Dundee road, cockatoo órghis, Gramercy Park, coalition party, etc.); that is, the application of one rule is preferred by the factors over the other. The Rhythm Rule cannot apply to Tippecanoe River, sensational claim, analytical thought and stratificational grammar, but the Lengthening Rule must apply to them irrespective of the factors. In the
case of phrases to which neither the Rhythm Rule nor the Lengthening Rule can apply, such as Narragansett occupations, sympathetic conversations and Minneapolis connections, these factors are wholly irrelevant. As for the word boundary, we should take into account not only the one in well-funded bank but also the one in Marsel's book and Marcèl proved (it). Selkirk assumes that the size of the constituent break correlates with the number of silent demibeads (i.e. the size of the final lengthening). But we claim that it is the applicability of the Silent Demibeat Addition, not the number of demibeads nor the size of duration, that is determined by the size of the constituent break; that is, the size of the constituent break correlates with the applicability of the Lengthening Rule. So the following prediction can be made:

(50) The Silent Demibeat Addition is more likely to apply to the following items in the order d > c > b > a: a = a word, b = a word that is the head of a nonadjunct constituent, c = a phrase and d = a daughter phrase of S.

For example, LP's prediction concerning Marcèl Proust, Mar- cèl's book, and Marcèl proved (it) (cf. (33)) can be explained by (50). Consider the following examples:

(51) a. x x
    x----x
    x x x
    x x x
    Marcel Proust(0) → Marcel Proust

b. x x
   x----x
   x x x
   x x x
   Marcel's book(0) → Marcel's book
In (51a-c), the application of the Silent Demibeat Addition is preferred in the order (51c) > (51b) > (51a), as (50) predicts; therefore, that of the Beat Movement is preferred in the opposite order (51a) > (51b) > (51c). This is because the two rules apply complementarily.

To conclude, the whole system of achieving eurhythmity is represented by the following algorithm:

\[\text{(52) input rules output} \]

\[\text{condition of eurhythmity} \]

Rhythm Rule

\[\downarrow \leftrightarrow \text{<DATA>} \rightarrow \downarrow \downarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow \rightarrow 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It should be noted that the Distance Condition and the Eu-
rythmy Condition are equally imposed on both the Beat Move-
ment and the Silent Demibeat Addition. And the applicability
of the Beat Movement and the Silent Demibeat Addition is sum-
marized as follows:

(53) The Beat Movement and the Silent Demibeat Addition
both apply optionally, and the option is either to
apply the Beat Movement or to apply the Silent
Demibeat Addition. Their application is sensi-
tive, independently of the system (52) itself, to
i) speech rate (fast or slow);
ii) familiarity or frequency of a word (familiar
and frequent, or unfamiliar and infrequent);
iii) emphasis of a word (non-emphasized or
emphasized)
iv) constituent break (weak or strong) cf. (56)

Notes

* This is a slightly revised version of part of my BA
thesis submitted to the University of Tsukuba in December
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Nonma and Masaharu Shimada for their invaluable comments and
suggestions on an earlier version of this paper. The re-
mainning errors and inadequacies are due to the author.

1 Liberman and Prince (1977) use the term "Rhythm Rule"
to indicate either stress-shift phenomena or general rules
of shifting a stress, not the name of a particular rule.
This usage is inherited in Prince (1983), Hayes (1984), Ono
(1984) and Selkirk (1984). On the other hand, Kiparsky (197
9) uses it to designate his rule itself. We will follow Li-
berman and Prince's usage here.

2 We use the term "Lengthening Rule" to refer to phenome-
na or general rules of lengthening the terminal syllable of a word. The contrast between the Rhythm Rule and the Lengthening Rule is exemplified as follows:

thirteen mén → thirteen mén vs. thirtiethenn mén

For example, Hayes (1984, p.35) formulates his Grid Construction as follows:

a. As a place marker, assign every syllable a mark on the lowest level of the grid;
b. Assign a mark at level two to the strongest syllable of every phonological word;
c. Assign sufficient additional marks so that the strongest syllable of every constituent labeled \_ has a higher grid column than the strongest syllable of its weak sister.

The "Grid Euphony Rules" contain three subrules: Beat Movement, Beat Addition and Beat Deletion. The formulation of Beat Addition is seen in (34) in section 3.

LP and Kiparsky (1979) also incorrectly predict that the outputs in (10) are acceptable. The system advocated in Hayes (1984) accepts the deviant shift in (11), (12) and (13). For further details, see Tanaka (1987).

The notion of "clash" or "stress clash" is defined in LP (p.314). In short, Elements are metrically clashing if they are adjacent on the same level and no other elements both on that level and on the next lower level intervene between them.

Here and below, the sign \(\phi\) indicates that the rule application is blocked by an input condition although the structural description matches or that the rule cannot apply since the structural description does not match.

According to LP (p.314), elements are metrically
alternating if they are adjacent on the same level some elements on the next lower level intervene between them.

9 Hayes (1984, p.72) also points out the difference in acceptability of the Rhythm Rule in proportion to the salience of such syntactic boundaries as:

a. the Alabama legislature
   ?? Alabama's legislature
   ?? Alabama legislated it.

b. the Bill Stevens Fán Club
   ?? Bill Stevens' fán club
   ?? Bill Stevens fanned it.

10 See fn. 4.

11 In example (42), she assumes that 2 = Marcel, 3 = silent demibeats and 4 = has.

12 Note that the Rhythm Rule cannot apply to (45g-i), but the Lengthening Rule does apply to them. This is because the outputs produced by the latter rule are more eurhythmic than the ones by the former rule.

\[
\begin{align*}
\text{analytical thought} & \quad \text{vs.} \quad \text{analytical thought} \\
\text{sensational claim} & \quad \text{vs.} \quad \text{sensational claim}
\end{align*}
\]
References


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