

Rhythmization of Sprung Rhythm by a Sub-beat

Sohn, Il-Kwon (Kyongbuk Provincial College)

sohn1@hanmail.net

1. Introduction

The main measures used in music are as follows.

- (1) a. 2/4 \odot \circ
 \downarrow \downarrow
 b. 3/4 \odot \circ \circ
 \downarrow \downarrow \downarrow
 c. 4/4 \odot \circ \circ \circ
 \downarrow \downarrow \downarrow \downarrow
 d. 6/8 \odot \circ \circ \circ \circ \circ
 \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow

We can recognize the change of rhythm better if grids are used in (1). 2/4 and 6/8 in (1) can be displayed with grids as follows.¹⁾

- (2) a. $\begin{array}{ccc} & x & \\ 2/4 & x & x \end{array}$ ---- measure / meter level
---- tactus level
- b. $\begin{array}{ccc} & x & \\ & x & x \\ 6/8 & x & x & x & x & x \end{array}$ ---- measure level
---- meter level
---- tactus level

But the problem that can occur in the expression like (2) is how to assign beats to the smaller notes, such as the underlined notes in (3), rather than the note suggested in (1)

- (3) $\begin{array}{ccc} & x & \\ & x & x \\ 2/4 & \downarrow & \underline{\downarrow} & \underline{\downarrow} & \underline{\downarrow} \end{array}$

In (3) the notes not to be associated with a beat must be solved at a level lower

1) Lerdahl and Jackendoff(1983) termed a basic musical beat a 'tactus'. For example, six-eight measure contains six tactuses.

than tactus level. Practically Lerdahl and Jackendoff(1983:72) suggested the beat recognition of '♪ ♪ ♪ ♪ ♪' as follows.



(4) shows there is a sub-beat²⁾ below a basic beat to express the smaller note.³⁾ Therefore we need the following constraint.

- (5) Smaller Note : The note smaller than the basic note must be associated with a sub-beat.

Rhythm theory is applied not only to linguistics but also to music. Therefore, if OT is applied to linguistics, it will have to be applied to musical rhythm. This paper will show how to express a sub-beat by using OT on the basis of Lerdahl & Jackendoff(1983), and furthermore assign a beat to Sprung Rhythm of Hopkins.

2. Sub-beat and OT

How is a sub-beat expressed? First think about the constraint to form a beat in music. Hayes(1994:34) suggests the following constraint to express a beat by a grid.

- (6) Continuous Column Constraint(CCC) : A grid containing a column with a mark on layer $n+1$ and no mark on layer n is ill-formed.

2) This paper uses the term 'sub-beat' to express a beat at a level lower than a tactus level.

3) Lerdahl and Jackendoff (1983:71) explained the fact that there is a beat at the level lower than the basic beat level in the following way:

The tactus is required to be continuous throughout the piece, but the levels smaller than the tactus level are permitted to drop out when unnecessary.

According to (6), the following cases are not permitted.

(7) a. * x x b. * x x x
 x x — — — —

(7a) violates CCC one time, and (7b) violates CCC three times because there is no beat below higher level beat.

But this beat construction in (6) needs the following constraint to be rhythmic.

(8) Alternation : Clash and Lapse must be avoided⁴⁾

Consider (8) in detail.

(9) a. * x x x x b. * x x x x
 x x → x x x x x x x x → x x x x

In (9a) a grid is inserted to avoid Clash and In (9b) a grid is deleted to avoid Lapse. A sub-beat must also follow the rules considered so far.

Let's consider the association between a sub-beat and a note. Abe(1999) has suggested the following constraints on the basis of Lerdahl & Jakendoff(1983).⁵⁾

(10) a. Note-to-Beat : The inception of a note must be associated with a beat.

b. Beat-to-Note : A beat must be associated with the inception of a note.

According to (10a), there must be a beat if there is a note, and according to

4) a. Clash : Avoid the adjacency of two beats on layer n without an intervening mark on layer $n-1$.

b. Lapse : Avoid more than three beats on layer n , none of which has a corresponding layer $n+1$.

5) Lerdahl & Jakendoff(1983:72) suggested the following rules to establish the relation of beats to attack points.

MWEF 1 : Every attack point must be associated with a beat at the smallest level of metrical structure.

MWEF 2 : Every beat at a given level must also be a beat at all smaller levels.

(10b), there must be a note if there is a beat. Therefore the following cases violate Note-to-Beat and Beat-to-Note.

(11) a. Note-to-Beat Beat-to-Note

2/4	x		
	x	x	
	x	x	x
	J	J	J

*

b.

	x		
	x	x	
	x	x	x
	J	_	J

*

Now consider the hierarchy between Note-to-Beat and Beat-to-Note.

(12) a. Beat-to-Note } Note-to-Beat

	x				
	x		x		
	x	x	x	x	x
	x	x	x	x	x
	J	J	J	J	J

!***

b.

	x				
	x		x		
	x	x	x	x	x
	x	x	x		
	J	J	J	J	J

*

For (12b), the expression of (5) by grids, to be an optimal constituent, 'Beat-to-Note' must dominate 'Note-to-Beat'. (12b) is an optimal candidate because it has more violations of Note-to-Beat and less violations of Beat-to-Note. An optimal constituent (12b) violates 'CCC' four times, but (12a) does not violate 'CCC'. It means that, even though there is no violation of 'CCC', the candidate which violates 'Beat-to-Note' such as in (12a) cannot be an optimal candidate. So 'Beat-to-Note' dominates 'CCC'.

Consider the hierarchy between 'Beat-to-Note' and 'Alternation'.

(13) a. Alternation > Beat-to-Note

x						
x			x			
x	x		x	x	x	x
x	x	x	x	x	x	x
♪		♪	♪	♪		♪

*!***

☞ b.

x						
x			x			
x	x		x	x	x	x
	x	x	x			
♪		♪	♪	♪		♪

*

(13a) satisfies 'Beat-to-Note' but violates 'Clash' at Four places. Thus for (13b) which doesn't violate 'Alternation' to be an optimal constituent, 'Alternation' must dominate 'Beat-to-Note'.

Consider the constituent exclusive of a sub-beat.

(14) a. Smaller Notes > Beat-to-Note

x						
x			x			
x	x		x	x	x	x
♪		♪	♪	♪		♪

*!

☞ b.

x						
x			x			
x	x		x	x	x	x
	x	x	x			
♪		♪	♪	♪		♪

*

For (14b) which violates 'Beat-to-Note' but satisfies 'Smaller Notes' to be a optimal constituent, 'Smaller Notes' must dominate 'Beat-to-Note'.

For a beat to be rhythmic, the following constraint is needed to keep beats at a regular interval, including 'Alternation' considered above.

(15) EQ-Beats : The time intervals between adjacent beats must be equal.⁶⁾

6) Lerdahl & Jackendoff(1983:69) suggesed the following constraint to be rhythmic.

Metrical Well-Formedness Rule 4

By (15), the following case is not permitted.

$$(16) * \begin{array}{cccccc} & \overbrace{\quad\quad} & \overbrace{\quad\quad\quad} & & & \\ x & & x & & & x \\ x & x & x & x & x & x \end{array}$$

Then consider the hierarchy between 'EQ-Beats' and 'Beat-to-Note'.

(17) a. EQ-Beats > Beat-to-Note

$$\begin{array}{cccccc} x & & & & & \\ x & & & & x & \\ x & x & & x & x & x \\ \hline x & & x & x & x & x \\ \Downarrow & & \Downarrow & \Downarrow & \Downarrow & \Downarrow \end{array} \quad *!$$

b.

$$\begin{array}{cccccc} x & & & & & \\ x & & & & x & \\ x & x & & x & x & x \\ \hline & & x & x & x & \\ \Downarrow & & \Downarrow & \Downarrow & \Downarrow & \Downarrow \end{array} \quad *$$

(17a) satisfies 'Beat-to-Note', but violates 'EQ-Beats'. Thus for (17b) which satisfies 'EQ-Beats' to be an optimal candidate, 'EQ-Beats' must dominate 'Beat-to-Note'.

Now consider the sub-beat which is placed before \Downarrow and is not associated with any note in (17). We can find that through the following grid construction, if one grid has a grid on the higher level, it becomes a strong beat, i.e., 'head' of a weak beat in the domain and level.

$$(18) \begin{array}{cccc} x & & & \\ (x & & x &) \\ (x & x) & (x & x) \end{array}$$

Therefore we need the following rule.

(19) Head : A beat must have a head

Head dominates Beat-to-Note as EQ-Beat does.

(20) a. Head > Beat-to-Note

x							
x			x				
x	x	x	x	x	x	x	
♪	—	x	x	♪	♪	♪	♪

*!

☞ b.

x							
x			x				
x	x	x	x	x	x	x	
♪		x	x	x	♪	♪	♪

*

Finally consider the necessity of sub-beat.

(21)

x		
x	x	x
<u>x</u>		
♪	♪	♪

In (21) the underlined sub-beat is not necessary. Therefore the following constraint is needed to use a sub-beat in the necessary case.

(22) *Sub-beat : Avoid a sub-beat.

*Sub-beat has a decisive role in deciding an optimal candidate in the following case.

(23) a. *Sub-beat Note-to-Beat

x			
x	x	x	
<u>x</u>			
♪	♪	♪	

* ! **

☞ b.

x			
x	x	x	
—	—	—	
♪	♪	♪	

Because a sub-beat must be used when there is a note smaller than a basic beat,

*Smaller Note dominates Sub-beat.

(24) a. Smaller Note > *Sub-beat

x x x x x x x x x ----- x ♪ ♪ ♪ ♪ ♪	*! *
--	-------------

☞ b. *Sub-beat

x x x x x x x x x ----- x x x ♪ ♪ ♪ ♪ ♪	*
--	---

As we can observe in the following case, *Sub-beat can be violated to satisfy 'Head'.

(25) a. Head > *Sub-beat

x x x x x x x x x ----- x x ♪ ♪ ♪ ♪ ♪	*! *
--	-------------

☞ b. *Sub-beat

x x x x x x x x x ----- x x x ♪ ♪ ♪ ♪ ♪	*
--	---

The hierarchy of rules which have been established so far is as follows.

- (26) Smaller Note, EQ-Beat *Sub-beat CCC
 Head, Alternation > Beat-to-Note > Note-to-Beats

3. Sub-beat and Sprung Rhythm

Though Hopkins(1844-1889) didn't write many poems, he is famous for the original metric, Sprung Rhythm. Consider the two poems that were written in Sprung Rhythm. In (27) which consists of four feet each line, the first and last lines have two or three actual stress, not four. And (28) has a outlier which is not found in the traditional fixed poem.

(27) Margarét, are you grieving? 1
 s s s s
 Over golden grove unleaving 2
 s s s s
 It is the blight man was born for, 13
 s s s s
 It is Margarét you mourn for. 14
 s s s s

(Spring and Fall)

(28) Summer ends *now*⁷⁾; *barbarous* in beauty, the stooks rise
 s s s s s
 Around; up above, what wind-walks! what lovely behavior
 s s s s s
 (Hurraing in Harvest)

Sprung Rhythm used in (27) and (28) is different from the traditional stress-syllable metrics. In Sprung Rhythm, Hopkins didn't make an one-to-one correspondence between accents(stresses of sense) and metrical stresses. Instead in the association between accents and metrical positions, he relaxed the firm constraint of strong and weak metrical positions and approached natural rhythm by using the constraint of syllable quantity. Therefore his feet may contain from one to four or more syllables, and it allows mismatches in both strong and weak positions, not to speak of 'outrider'. 'sprung' signifies 'abrupt', and This mean that sprung rhythm is more abrupt than the traditional rhythm in fixed meters. This can be felt in the weak position containing more than one syllable, the outrider, and the omission of weak position. In this chapter, I intend to consider these characters of sprung rhythm through a sub-beat.

The foot in Sprung Rhythm consists of one weak position and one strong position. Therefore duple measure(2/4) is suitable to the association between sprung rhythm and musical measure. First, consider (27).

7) Hopkins used \smile to represent an outrider, but I use italic type in this paper.

(29)	$\begin{array}{cccc} x & & x & & x & & x \\ x & x / & x & x / & x & x / & x & x \\ \text{Mar} & \text{gar} & \text{ét,} & & \text{are} & \text{you} & \text{grieving?} \\ s & & s & & s & & s \end{array}$	1
	$\begin{array}{cccc} x & & x & & x & & x \\ x & x / & x & x / & x & x / & x & x \\ \text{Over} & \text{golden} & \text{grove} & \text{unleaving} \\ s & & s & & s & & s \end{array}$	2
	$\begin{array}{cccc} x & & x & & x & & x \\ x/x & x / & x & x / & x & x / & x & x \\ \text{It} & \text{is} & \text{the} & \text{blight} & \text{man} & \text{was} & \text{born} & \text{for,} \\ s & & s & & s & & s & \end{array}$	13
	$\begin{array}{cccc} x & & x & & x & & x \\ x & x / & x & x / & x & x / & x & x \\ \text{It} & \text{is} & \text{Margar} & \text{ét} & \text{you} & \text{mourn} & \text{for.} \\ s & & s & & s & & s \end{array}$	14

(Spring and Fall)

The precondition in assigning beats such as in (29) is that the duration in the weak and strong position is the same. But it is awkward that we recite 'grieving', 'golden', 'glove un-', 'is the' in the strong and weak position without considering the syllable quantity. Besides, outrides and weak positions containing many syllable in (28) cannot be settled only by duple measure. I intend to settle this problem with the sub-beat observed in chapter 2. In sprung rhythm what is associated with a beat is not a note but a line, and therefore the syllable structure must be observed in the weak and strong position. Sohn(1999) suggested the syllable condition in the weak and strong position as follows.

- (30) a. Strong position must form a mora foot.
 b. Weak position cannot contain more than a mora foot.

According to (30a), strong position must have a head because it forms a mora foot. Especially in sprung rhythm, if a syllable consists only of VC, it can be placed in the strong position. And sometimes Hopkins placed the unstressed syllable on the strong position by using a stress mark. (30b), i.e., more than one mora foot cannot be placed in a weak

position, means that it is possible for many syllables to be placed there if a mora syllable is not formed. Stress is relative, and therefore monosyllabic word cannot be considered to contain stress. But in sprung rhythm a monosyllable content word has stress except in the case of being placed in outrider. Therefore (5) must be replaced by the following constraint in sprung rhythm.

(31) Syllable Constraint : All syllables that don't form a mora foot must be associated with sub-beats.

The underlined syllables violate (31) because they don't receive any beats.

(32)

		x			x	
		x			x	
	Why,	here	him,	hear	him	<u>babble and</u> drop down to his nest, (T.C.S)
	s		s		s	s s s s s

According to (31), associating the syllable which doesn't form a mora foot with a sub-beat depends on the syllable structure. First consider the relation between duple measure and a note.

(33)

x		x			:	♪	- basic beat			
x		x			-----					
x	x	x	x	x	:	♪	- sub-beat level 1			
x	x	x	x	x	x	x	x	:	♪	- sub-beat level 2

In (32) the syllable condition of basic beat associated with 1/4 note is stressed VV(C) and -VC(C). The strong beat linked with outrider and the weak beat which doesn't form a mora foot must be settled by a sub-beat. In this case, sub-beat level 1 is unstressed -VV(C), -VC(C), and sub-beat level 2 is unstressed -V. So (31) becomes (34).

(34) Syllable Constraint in Sprung Rhythm (hereinafter referred as 'SCSR')

x		x			:	-V̇V(C), -V̇C(C)		
x		x			-----			
x	<u>x</u>	x	<u>x</u>	x	<u>x</u>	<u>x</u>	:	-VV(C), -VC(C)
x	<u>x</u>	x	<u>x</u>	x	<u>x</u>	<u>x</u>	:	-V

According to (34), the lines containing outriders and weak positions consisting of many syllables such as in (28) can be assigned with sub-beats

(35)

x	x		x	x		x		x	x	
x	x		x	x		x	x	x	x	x

x	x	x	x		x	x	x	x		x
					x	x				
					x	x	x	x	x	x
Summer	ends	<i>now</i> ;		<i>barbarous</i>		in	beau	ty,	the	stooks
	s			s		s			s	s

x		x		x			x		x	
x	x	x	x	x			x	x	x	x

		x	x				x	x		
		xx					x	x	x	x
Around;	up	above,	what	<i>wind-walks!</i>	what	love	ly	behavior		
s		s		s		s		s		

(Hurrahing in Harvest)

In (35) '-ty, the, a-, and -ly' are associated with sub-beat level 2 by 'SCSR' and 'Head' makes a beat to be placed before them. 'Now' and 'walks' are placed in outriders, and they aren't stressed. As a result, they are associated with sub-beats. Though 'ends' and 'wind' violate SCSR, they are associated with sub-beats to satisfy 'Head'. This means that 'SCSR' can be violated to satisfy 'Head'. Thus the following hierarchy can be set up between 'SCSR' and 'Head'.

(36) Head > SCSP

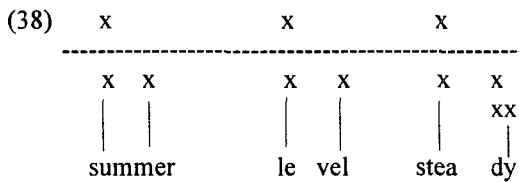
In sprung rhythm, we can find the case that the two syllable word is placed in weak position⁸⁾ such as in (37)

8) According to Sohn(1999), Onset dominates Nonfinality. Therefore the syllabication of underlined words is as follows.

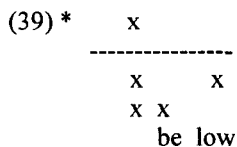
- (1) a. summer /sʌ. mḁ/ (μ. μ)
 b. level /le. vəl/ (μ. μ) μ
 c. steady /ste. di/ (μ. μ)

- (37) a. Summer ends *now*; now, *barbarous* in beauty, the stooks rise (H.I.H)
 w s s s s s
- b. Of the rolling level underneath *him* steady air, and striding (T.W)
 s w s s w s s

In (37) the syllables of the underlined words can be associated with beats such as in (38).



Solving the problem with sub-beats such as in (38) shows why two syllable words have stress on the first syllable. Consider the word with stress on the second syllable such as in 'below'.



In (39) '-low' has syllable structure VV with stress, and therefore it must be directly connected with a basic beat. But this violates (34) because '-low' is associated with a sub-beat.

To explain the underlined words in (40), Kiparsky(1989) suggested 'correction'⁹⁾, i.e., vowels before glides(y, w, h, r) become light syllables.

- (40) a. High *there*, how he rung upon the rein of a wimpling wing (T.W)
 s s s s s
- b. Acts in God's eye what in God's eye he is - (A.K.C.F)
 s s s s s
- c. Now he wrings for breath with the deathgush brown; (T.L.O.T.E)
 s s s s

9) *correpto attica* : *Vocalis ante vocalem corripitur*(A vowel before a vowel is short).

e.

x	x	x	x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x	x

xx	x	x	x	x	x	x	x	xx	xx	
x	x		xx					xx		
Majestic	-	as	a	stallion	stalwart,	very	vio	let-sweet!	(HIH)	
s			s	s			s	s		

f.

x	x	x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x

x	x	x	x	x	x	x	x	x	x	
	x	x		x	x		x	x		
			x	x		x	x			
Shares	their	best	gifts	sure	ly,	fall	how	things	will	(T.B.F.C)
s		s		s		s		s	s	

Stress is relative, and therefore strong beat in the strong position containing outrider must be recited more strongly as we can see from the height difference of grids between an outrider and a strong beat. And outriders must be recited as fast as possible because the beat duration is restricted. Therefore this makes sprung rhythm abrupt, and sub-beats show this change of rhythm.

4. Conclusion

To associate a note and a beat, it is appropriate to divide beats into a basic beat and a sub-beat, and the hierarchy of constraints to associate a sub-beat with a note is as follows.

- (43) W-Note *Sub-beat CCC
 Head > Beat-to-Note > Note-to-Beat
 EQ-Beat
 Alternation

In Sprung Rhythm, a sub-beat shows the change of rhythm well, and the following hierarchy is suggested to associate lines with beats.

- (44) Head > SCSP

In particular, a sub-beat can shows exactly the rhythm in both a outrider and a

weak position consisting of many syllables.

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