Pre-Fortis Clipping and Syllable Quantity of VCV-Type Disyllabic Words

Akitoshi Fukushima

I Introduction

Both Wells (1990) and Abercrombie (1964) deals with syllable rhythm; importantly, what they have in common is that they pay attention to the treatment of intervocalic consonant(s). Wells states that the final voiceless consonant of a syllable clips the duration of the preceding vowel while Abercrombie states that the number of intervocalic consonants and the type of vowel which precedes them fix the syllable durations of disyllabic words.

The present paper scrutinises their theories and then proposes a new way of treating syllable rhythm found particularly in VCV-type disyllabic words.

II Material and recording procedure

The words to be examined are five minimal pairs of disyllabic words as follows:

1a machic	/ ˈmætʃɪk /	1b magic	/ ˈmædʒɪk /
2a neffer	/ ˈnefə /	2b never	/ ˈnevə /
3a happy	/ ˈhæpi /	3b habby	/ ˈhæbi /
4a profit	/ ˈpɹɒfɪt /	4b provit	/ ˈpɹɒvɪt /
5a meatow	/ ˈmetəʊ /	5b meadow	/ ˈmedəʊ /

They are composed of real and non-real words, sharing the feature that they have only one intervocalic consonant. To examine clipping, the intervocalic consonant of the non-real words has the opposite voicing to their counterparts.

A male RP speaker read the ten words listed above, which were randomly distributed among fifteen other words. To restrict the durational variations, the speaker read each word in time with a metronome at the speed of 75 beats per minute. He was asked to read the sequence of words in time with alternate beats, one beat for each word and one as a rest. The use of a metronome seems to have succeeded in blocking final lengthening.

The rendition was recorded directly on to an iMac (OS-X version 10.4.11) by using Scicon's *Mcquirer* speech analysis package (version 8.4.5) at the sampling rate of 44,000 hertz. The measurement of duration was done by using WASP sound analysis software (version 1.4).[1]

III Wells's analysis; pre-fortis clipping

It is well known that the vowels in *heart* and *hard*, for example, are different in duration; the former has shorter duration than the latter (Jones 1960[9], Gimson 2001[6]). This shortening of vowel duration is triggered by the voicelessness of the following consonant. This shortening of the vowel (clipping) does not take place when the consonant is voiced. In other words, the syllable final /t/ in *heart* is voiceless, and this would clip the duration of the preceding vowel. Although researchers have given this phenomenon different names, Wells himself adopted the name 'pre-fortis clipping.' So, following Wells, although both *selfish* and *shellfish* have /elf/ in them, the syllable rhythm of them are not the same. The vowel and the lateral /el/ (namely, sonorants) in *selfish* have a shorter duration than that of *shellfish* since /f/ is located in syllable final position in the first syllable and triggers the clipping, while the /el/ in *shellfish* is not clipped since /f/ is syllable initial in the second syllable, as the structure of the word suggests.

In addition, Wells (ibid.) suggests that syllabification is governed by a set of rules, one of which is as follows;

Rule 1: Subject to certain conditions, consonants are syllabified with the more strongly stressed of two flanking syllables.

Accordingly, the ten words should be syllabified under Wells's theory as follows:

1a mach – ic 1b mag – ic
2a neff – er 2b nev – er
3a happ – y 3b habb – y
4a prof – it 4b prov – it
5a meat – ow 5b mead – ow

In all the words, the intervocalic consonant is affiliated to the first syllable, and this affiliation ought to trigger clipping of the preceding vowel when it is voiceless. The measurements of vowel duration in the first syllable in each pair are given in Table 1 below.

Word	Duration
1a: m**a**chic	115
b: m**a**gic	147
2a: n**e**ffer	92
b: n**e**ver	131
3a: h**a**ppy	72
b: h**a**bby	101
4a: pr**o**fit	61
b: pr**o**vit	90
5a: m**ea**tow	94
b: m**ea**dow	101

Table 1: Durations of the first vowel in milliseconds

As is evident in the table, the clipping took place in the 'a' words, so that the vowel preceding the voiceless consonant has shorter duration than the counterparts in each pair.

If clipping took place, we could infer that the first syllable of 'a' words might have shorter duration than that of 'b' words. However, this is not the case, as Table 2 shows.

Word	Duration of 1st and 2nd syllables
1a: mach-ic	338－257
b: mag-ic	365－266
2a: neff-er	338－167
b: nev-er	324－138
3a: happ-y	329－153
b: habb-y	284－150
4a: prof-it	315－235
b: prov-it	223－277
5a: meat-ow	280－210
b: mead-ow	224－198

Table 2: Durations of 1st and 2nd syllables in milliseconds (Wells)

Although in pair 1 the first syllable of *machic* has shorter duration than that of *magic*, the rest of the pairs display completely the reverse pattern; the first syllable of 'a' words have longer duration than that of 'b' words, even though they each contain a voiceless intervocalic consonant. From this fact we are obliged to say that the target of pre-fortis clipping is only the preceding vowel, not the entire first syllable as under Wells's theory.

IV Abercrombie's analysis: syllable quantity

Abercrombie (ibid.) divided disyllabic words into three types according to the durational relationship between the first and the second syllables, namely: Type A (short-long), Type B (equal-equal), and Type C (long-short). The rules governing the three types are as follows:

Type A (short-long) : (C)V^1CV(C)
Type B (equal-equal) : (C)VCC(C)V(C) or (C)V^2(C)V(C)
Type C (long-short) : (C)V(C)#(C)V(C)
C=any consonant, (C)=consonant optional, V=any vowel or

diphthong, V^1=short vowels, V^2=long vowels and diphthongs, #=word boundary

In line with this theory, the ten words should be designated as Type A since all of them have a short first vowel and only one intervocalic consonant. This would lead the second syllable to be longer than the first syllable. Although Abercrombie does not mention where the word boundary should be located, the syllabification cannot be the same as Wells's, in that all the words under Wells's theory hold the duration pattern of 'long-short'. (See Table 2.) For the ten words to have 'short-long' pattern, the intervocalic consonant would have to be syllabified with the second syllable, not the first syllable. The syllabification of the words under Abercrombie's theory shall be as follows:

1a ma – chic 1b ma – gic
2a ne – ffer 2b ne – ver
3a ha – ppy 3b ha – bby
4a pro – fit 4b pro – vit
5a mea – tow 5b mea – dow

Accordingly, the durations of syllables in each pair should then be something like Table 3.

Word	Duration of 1st and 2nd syllables
1a: ma-chic	225－370
b: ma-gic	293－338
2a: ne-ffer	226－279
b: ne-ver	249－213
3a: ha-ppy	189－293
b: ha-bby	201－233
4a: pro-fit	186－364
b: pro-vit	212－288
5a: mea-tow	172－318
b: mea-dow	202－220

Table 3: Durations of 1st and 2nd syllables in milliseconds (Abercrombie)

Now we will examine if the voicing of the intervocalic consonant affects the syllable quantities. Let us compare the durations of the first syllables within each pair; we can see that all the 'a' words have shorter duration than the 'b' words; for example, in pair 1: 225 vs. 293, in pair 2: 226 vs. 249 milliseconds and so forth. Interestingly, this shows, at least, that the 'clippedness' seems to be reflected in the duration of the first syllable of 'a' words. Moreover, irrespective of the voicing of the intervocalic consonant, all ten words still have the Type-A pattern (short-long syllable relationship) except one word (3b: *habby*), although, of course, the durational ratios of the first to the second syllable are different within each pair.

What is particularly notable is the duration of the *second* syllable within each pair. We can see that 'a' words have longer durations than 'b' words, a pattern which is completely the reverse of the pattern shown by the first syllables. To put this another way, the words with a *voiceless* intervocalic consonant tend to have shorter first syllables and longer second syllables; the words with a *voiced* intervocalic consonant follow an opposite pattern. This tendency is shown in Figure 1.

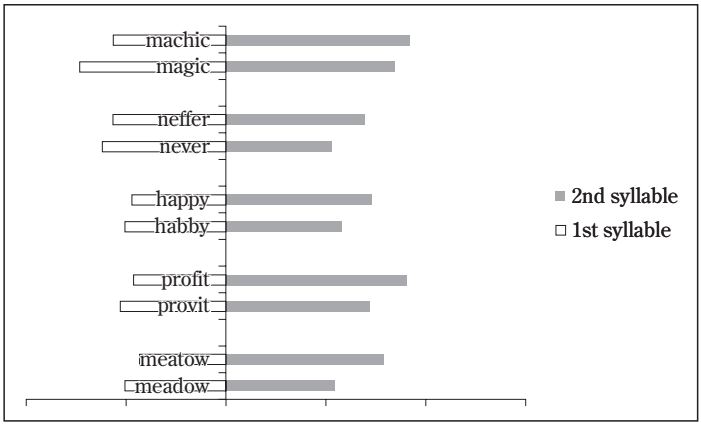

Figure 1: Durational relationship between 1st and 2nd syllables

V Discussion

As observed in section III, in 'a' words (the words including a voiceless intervocalic consonant) clipping *did* take place, making the preceding vowel shorter. However, the first syllable as a whole was not necessarily made shorter. In this sense, clipping should be treated, as it were, as a local phenomenon under Wells's theory; the target of clipping is just only the preceding vowel. Abercrombie, on the other hand, pays attention to the durational relationship between the first and the second syllables, although he never mentions the voicing of the intervocalic consonant. What was revealed in section IV is that Abercrombie's syllabification is not the same as the Wells's; in that he considered the intervocalic consonant to be affiliated to the second syllable. This treatment can reflect the fact that the consonant triggered clipping; the first syllables of 'a' words have shorter duration than those of 'b' words. And, still, both the 'a' and the 'b' words have the durational pattern of 'short-long', irrespective of the voicing of the intervocalic consonant. Now take a look at Table 4 which is a modified version of Table 3.

Words	$2^{nd}/1^{st}$	$2^{nd}-1^{st}$
1a:machic	1.6	145
b: magic	1.2	45
2a: neffer	1.2	53
b: never	0.9	36
3a: happy	1.6	104
b: habby	1.2	32
4a: profit	2.0	178
b: provit	1.4	76
5a: meatow	1.8	142
b: meadow	1.1	18

Table 4: Ratio of 2^{nd} to 1^{st} syllable and difference between 1^{st} and 2^{nd} syllables

In comparing 'a' with 'b' words, we can see that the durational ratios of the second syllables to the first (Column 2) are clearly different; the ratios of 'a' words are much greater than those of 'b' words. The durational differences between the first and the second syllables of 'b' words (Column 3) are: 45, 36, 32, 76 and 18 milliseconds respectively. According to Lehiste (1970), the difference limens in duration are 10 to 40 milliseconds in speech sounds ranging from 30 to about 300 milliseconds. Since the durations of our words well exceed this range, the durational difference between the first and the second syllables of 'b' words might have no chance to be perceived. In this sense, 'b' words might sound like Type B (equal-equal syllable relationship) rather than Type A.

What is noteworthy is that the duration of second syllable seems to undergo a compensation effect. The first syllable of 'a' words is made shorter due to clipping, while the second syllable is made longer to compensate for the clipping. For instance, in the *machic* and *magic* pair, the first syllable of the former is 225 milliseconds while that of the latter is 293 milliseconds; the second syllable of the former 370 milliseconds while the latter 338 milliseconds. This tendency applies to all the pairs. (See Table 3 and Figure 1 again.) This seeming compensation effect makes the 'a' words hold the syllable durations 'short-long' and the 'b' words rather like 'equal-equal'. The consistency of this syllable quantity behaviour found in the words, as well as the clipping effect, might help listeners to distinguish between the two types.

Syllabification is a complicated matter. Abercrombie's syllabification actually violates a phonotactic rule; checked vowels (short vowels in the present paper) cannot be in syllable final position (cf. Couper-Kuhlen 1986). (Fukushima (in preparation), though, reports that this kind of violation is likely to be supported by the word-dividing task; some American speakers preferred the syllabifications such as *pro–fit* and *ma–gic* to *prof–it*, and *mag–ic*. Open syllabicity might have overridden the violation.) However, his theory seems to reflect both the local phenomenon (= pre-fortis clipping) and

the syllable rhythm over the word (=durational relationship of the syllables). At least, what is happening in VCV words in terms of rhythm is a compensation effect between the syllables as well as pre-fortis clipping.

Notes

1: The release of final plosives, namely the ones in *machic / magic* and *profit / provit*, was excluded from the measurement.

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