Vowel Compression due to Syllable Number in English and Korean*

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ABSTRACT

Strong compression effects in a stressed vowel due to the addition of syllables have been adopted as evidence for stress-timing. In relation to this, Yun (2002) investigated the compression effects of number of syllables on Korean vowel. The results generally revealed that Korean had neither significant nor consistent anticipatory or backwards compression effects, especially when it came to the sentence level. This led us to claim that Korean would not be a stress-timed language. But the language investigated in the study was only Korean, and further cross-linguistic research was needed to confirm the claim. In this study, Yun's (2002) sentence level data are compared with Fowler's (1981) English data. The comparison reveals that Korean seems to be similar to English in the backwards compression effect, whereas the two languages are markedly different in the anticipatory compression effect. Thus, if English is a stress-timed language and the strong anticipatory compression effect is evidence in favour of stress-timing as is claimed, the present cross-linguistic study confirms Yun's (2002) suggestion - Korean is unlikely to be stress-timed. On the other hand, compression effects are revisited: the differences in vowel compression between English and Korean are discussed from the syntactic and phonological points of view.

Keywords: Vowel Compression, Syllable Number, Stress-Timing, Syntactic

1. Introduction

It has been assumed that regardless of the number of syllables, the inter-stress intervals tend to be equal in stress-timed languages (e.g., English). In order to realise the isochrony (or a weak form of isochrony) between stresses, the syllables in a stress foot have to lengthen or shorten inversely to the number of syllables composing the foot.

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Particularly the stressed syllable, which is substantially longer than other unstressed syllables, is expected to play a key role in absorbing the durational variation due to the change of the number of syllables in a foot. That is, the elastic stressed syllable would offer some space for a newly added syllable by reduction of its duration, or fill some of the space which a missing syllable leaves, by stretching itself. On the other hand, researchers have given attention to the fact that most of the variation in syllable duration is ascribed to vowels (Klatt, 1973, 1976; Oller, 1973). In addition, the significant syllable number effects on vowel compression have been regarded as an indicator of stress-timing (Fowler, 1981; Hoequist, 1983a, b; Vayra, Avesani & Fowler, 1983). In line with these, Yun (2002) investigated the compression effects of number of syllables on Korean vowel. The results were that Korean had neither a significant nor a consistent anticipatory or backwards compression effect on vowel duration, especially when it came to the sentence level (i.e., when the compression was measured in a carrier sentence). This indicates that Korean is not a stress-timed language, given that the significant compression effect is accepted as a characteristic of stress timing. But the study examined only Korean, and the claim should be confirmed by cross-linguistic research. In this study we will compare Yun's (2002) Korean data with Fowler's (1981) English data, whereby we will figure out how the compression effects are in Korean compared with English that is reportedly a representative language of stress-timing.

2. Comparison of English and Korean with Regard to Compression Effects

Fowler (1981) examined the compression effects on the stressed vowel of the following and preceding unstressed syllables in English, using nonsense words with stress patterns corresponding to those of real words. Six native speakers of American English served as subjects and the nonsense words were carried in a sentence (Now talk ..... two times). Part of her stimuli are shown in Table 1.

Table 1. English speech materials (after Fowler, 1981, p. 40)

Real Words	Nonsense Words
`day	/ˈsi/
`easy	/ˈsisʌ/
`mistle`toe	/ˈsisʌ`sʌ/
`ignorant	/ˈsisʌsʌ/
`ironing`board	/ˈsisʌsʌ`sʌ/
`day	/ˈsi/
as`leep	/sʌ`si/
inter`vene	/sʌsʌ`si/
`ironing`board	/ˈsʌsʌsʌ`si/

The subjects read the speech items 4 times, yielding a total of 192 tokens (8 items × 4 repetitions × 6 subjects). They practised reading the real word sentence version before recording the nonsense words. They were asked to mimic the real word version in every aspect including the stress pattern. The target of measurements was the interval of voicing of vowel /i/.

Yun (2002) used real words as stimuli (see Table 2). They were embedded in a carrier sentence "ce ..... cuseyo" (= Give me ....., please.). Six native Korean subjects produced the sentences at their moderate rates, yielding a total of 378 tokens (9 items × 7 repetitions × 6 subjects). The target of measurements was the interval of voicing of vowel /a/ of the word 'pap'.

Table 2. Korean speech materials and English glosses (after Yun, 2002, p. 175; /p/ is a phonologically voiceless unaspirated lax stop in Korean)

pap /CVC/	rice
papp^{h}ul /CVC-CVC/	a grain of cooked rice
papc'a /CVC-CV/	a rice spatula
papc'ukek /CVC-CV-CVC/	a rice spatula
papp^{h}ult'eki /CVC-CVC-CV-CV/	a grain of cooked rice
pap /CVC/	rice
ipap /V-CVC/	rice
kongpap /CVC-CVC/	bean-mixed rice
poripap /CV-CV-CVC/	barley-mixed rice
saengsunc^{h}opap /CVC-CVC-CV-CVC/	vinegary rice wrapped with fish

Prior to the comparison by graphs, the Korean and English data were reanalysed according to the number of syllables of a word. So we calculated the mean vowel

duration of the two three-syllable words in Fowler's data (i.e., /ˋsi̲sʌ sʌ/ *vs.* /ˋsi̲sʌsʌ/) and the average vowel durations of the two sets of disyllabic words in our Korean data (pa̲pp^{h}ul *vs.* pa̲pc'a; ipa̲p *vs.* kongpa̲p). Fowler counted only unstressed syllables as additional ones to the target syllable /ˋsi/ in accordance with the strict conventional definition of a stress foot. Thus although another stressed syllable precedes or follows unstressed syllables within a nonsense word boundary, it was not treated as an additional syllable; therefore she assumed that /ˋsi̲sʌˋsʌ/ had only one following syllable while /ˋsi̲sʌsʌ/ had two following syllables. Irrespective of stress, however, the syllables composing a word appear to be closely related to each other and may give a compression effect to the initial stressed syllable /i/. This conjecture is supported by a study. Huggins (1975) investigated whether there is a boundary that the compression effect (due to following unstressed syllables) cannot cross (e.g. word boundary, foot boundary). The stimuli comprised sixteen sentences derived from a sentence "Cheese(s) (a)bound(ed) (ab)out." where unstressed syllables are parenthesised. Interestingly, conflicting results were obtained concerning the compression effects. First, the stressed vowel /i/ of the word *cheese* underwent a significant shortening by a following unstressed syllable within the word boundary, whereas a slight lengthening of the vowel /i/ was found when an unstressed syllable is placed outside the word boundary (i.e. when it is added in the following word *bound*). This is contradictory to the conventional idea that the stress foot is a compensation unit. By contrast, the stressed vowel /au/ of the word *bound* revealed a significant shortening no matter where a following unstressed syllable is added (i.e., *bounded out* or *bound about*), even if the stressed vowel manifested itself as more reduced when the unstressed syllable belongs to the word *bound*. It could generally be construed as support for the foot as a compensation unit. Huggins sought a plausible reason for the contradiction from the syntactic boundary. It was indicated that the main syntactic boundary placed between the Subject *Cheese* and the remaining Predicate *(a)bound(ed) (ab)out* might block the compression effects on the stressed syllable /i/ despite the succeeding unstressed syllables. Whatever the reason is, it seems to be reasonable to assume that the unit word as well as the stress foot would function as a unit within which the syllables show compensation. A similar idea was proposed by Hoequist (1983b, p. 228): "The stress foot is clearly not the only unit influencing duration. Temporal compensation in a stress-timed language also occurs within words and across foot boundaries (e.g. accent adjacency), and may well jump both foot and word boundaries, though in a weakened form." All in all, it is not likely that we have to confine the added syllables to unstressed ones, when we examine the compression effects on a stressed vowel.

The two graphs (Figures 1 and 2) are comparing the reanalysed Yun's (2002) Korean data and Fowler's (1981) English data.

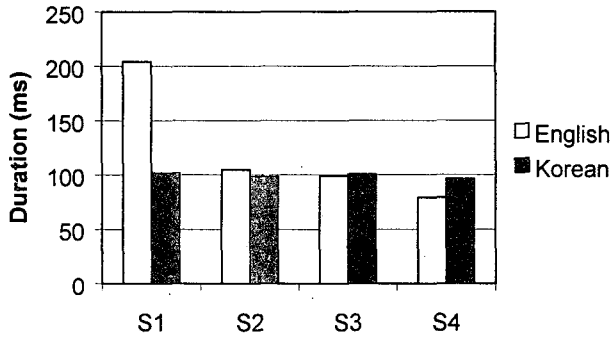

Figure 1. Comparison of anticipatory compression effects between Fowler's (1981, p. 42) English data and Yun's (2002, p. 179) Korean data (S1, S2, S3 and S4: mean durations of the target vowels /i/ and /a/ in one−, two−, three− and four−syllable words in English and Korean)

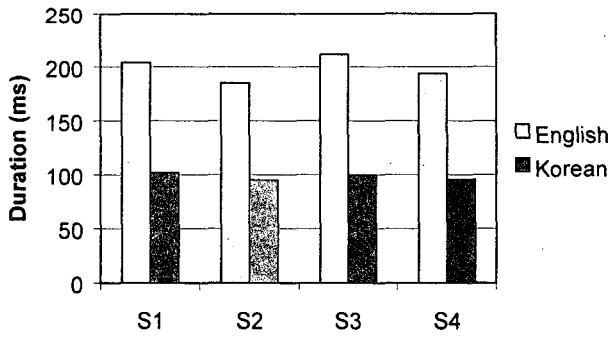

Figure 2. Comparison of backwards compression effects between Fowler's (1981, p. 42) English data and Yun's (2002, p. 180) Korean data (S1, S2, S3 and S4: mean durations of the target vowels /i/ and /a/ in one−, two−, three− and four−syllable words in English and Korean)

As seen in Figures 1 and 2, the English target vowel /i/ (S2) of /ˋsisʌ/ shortens by about 50% relative to that (S1) of the monosyllabic word /ˋsi/. Although the rate of compression remarkably reduces, S3 (the average of /ˋsisʌ sʌ/, /ˋsisʌsʌ/) shortens by 6% compared to S2. Finally S4 reduces by 20% relative to S3. On the other hand, the added preceding syllables did not induce a consistent backward shortening in the target vowel /i/.

The anticipatory compression effect in the Korean data is very weak and inconsistent

in comparison with the English data. The average duration (S2: 98 ms) of the vowel /a/'s of the two disyllabic words ("papp^{h}ul" and "papc'a") shows a 3.8 % shortening relative to that (102 ms) of the vowel /a/ (S1) in the monosyllabic word "pap". Yet the target vowel /a/ (S3) of the three-syllable word, "papc'ukek" even lengthened, as compared with S2. Finally S4, /a/ of the four-syllable word "papphult'eki" is only 5.5% shorter than S1. The syllables added before the target word "pap" also did not bring about a significant and consistent shortening to the vowel /a/ (see Figure 2). Hence the Korean data did not reveal significant compression effects on vowel duration due to the increase of syllables, regardless of the direction: anticipatory *vs.* backwards.

Overall, English shows marked anticipatory compression effects, while Korean does not. However, backwards compression effects are inconsistent in both languages. Yun's (2002) Korean data and Fowler's (1981) English data are not directly comparable due to different speech materials, etc. But the dramatic difference in the anticipatory compression effect between English and Korean suggests that the two languages should be differentiated in speech timing pattern. Thus, if English is a stress-timed language and the anticipatory compression effect can be evidence for stress timing as is claimed, Korean is unlikely to be stress-timed.

3. Compression Effects Revisited

There exist views in opposition to the traditional idea that the significant compression effects are indicative of stress timing. That is, some researchers reported no significant compression effects due to the increased number of syllables in English (Umeda, 1972; Harris & Umeda, 1974; Nakatani et al., 1981). In particular, Harris & Umeda (1974) and Nakatani et al. (1981) pointed out that the so-called anticipatory compression is just a boundary effect (i.e., position effect). They claimed that despite the additional following syllables, no significant compression occurred in a non-prepausal position. Let us have a look at Nakatani et al.'s (1981) study. They investigated prosodic aspects of American English speech rhythm using reiterant speech. Their basic speech materials were sentences embedding adjective-noun phrases. Those adjective-noun phrases were replaced by a constant syllable 'ma'. For example, "The *absurd day* made many ideas seem strange." was pronounced as "The *maMA MA* made many ideas seem strange." where 'MA' and 'ma' denote stressed and unstressed syllables. Among their findings it is notable that "nouns were longer than adjectives because phrase-final syllables were elongated" (p. 90). This is because phrase final positions are always filled with nouns in

their speech materials, whereas adjectives do not come to the position.

Here we need to return to the above comparison of English and Korean, as some points appear problematic. First, it could be pointed out that the carrier sentence in Fowler (1981) was "Now talk ..... two times". Perhaps a phrase boundary will be put just before the adverb phrase 'two times'. Therefore, provided that Nakatani et al.'s (1981) claim is the case, it is felt likely that the noticeably long duration of English S1 in Figure 1 may be attributed in part to phrase effects (final lengthening). In other words, /si/ is posited at the final position of the preceding phrase, although no physical pause exists between the test word /si/ and the following adverb phrase 'two times'. Hence, it seems to be difficult to ascribe the shortening from S1 to S2 only to compression effects due to an additional syllable (Fowler takes word final lengthening into account, but we may also have to consider that the target syllable /si/ is placed at phrase final position). With reference to this, Beckman (1992, p. 458) states that "it becomes very difficult to distinguish a rhythmic compression of the stressed syllable in a polysyllabic foot from the absence of a final lengthening for the prosodic word." By contrast, the durations of English S1, S2, S3 and S4 in Figure 2 do not show marked differences between them. This is probably because all of them are the final syllable of the phrase they belong to. On the other hand, it is interesting to think about why no noticeable differences are observed between Korean S1 and S2 in Figure 1. Above all, unlike English where nouns frequently appear in the final position of a phrase, nouns hardly come to this position in Korean. In general it is difficult to encounter a noun without a following particle or postposition in Korean, unless nouns are simply arranged (e.g., apple, pear, grapes and melon, ...). So Yun (2002) tried to avoid a morpheme which might be attached to the target nouns when he made the carrier sentence of the experiment (i.e., "ce ..... cuseyo" = Give me ....., please.). But it should be noted that when the target words do not have a particle or postposition, they are liable to form a rhythmic unit with the following verb phrase 'cuseyo'. Accordingly the monosyllabic word 'pap' would not have a final lengthening, which seems to be the crucial reason for the lack of a considerable durational difference between S1 and S2 in Korean. Of course, the fact that the target words do not have final lengthening is not a problem when we examine compression effects. Rather, it will be problematic if the target syllable /si/ in Fowler (1981) may have a phrase effect (final lengthening). The following example may confirm the claim that English words (adjectives) placed in non-phrase final position are shorter than words (nouns) placed at the final position of a phrase. The target word "lady" might be produced in two different positions as below.

(1) I saw a beautiful *lady* in the film.

(2) I saw a beautiful *lady* doctor in the film.

According to Nakatani et al.'s (1981) observation, the target word "lady" in (1) would be longer than that in (2), because the former has a phrase effect (final lengthening), while the latter does not. Thus, it is likely that Fowler's carrier sentence should have been one like sentence (2) to get rid of possible phrase effects.

Yet, despite the conflicting views, the differences regarding the anticipatory compression effects between English and Korean still seem to be meaningful. First, suppose the shortening in English stems from compression effects, the differences between the two languages are obvious as discussed earlier. Second, if the durational variation from S1 to S2 in English comes partly from the absence of phrase effects in S2, we need to note the syntactic or phonological differences between the two languages. As mentioned above, nouns (content words) frequently appear at the final position of a phrase in English, whereas in Korean they rarely appear there without morphemes (particles, endings). Therefore, no final lengthening will apply to the nouns with morphemes. In particular, Korean nouns frequently form a rhythmic unit with the following morphemes. English monosyllabic nouns are stressed and Korean monosyllabic nouns, though they are stressed, are pronounced together with the following morphemes.

Presumably these syntactic and phonological characteristics of each language contribute to the rhythmic (timing) differences between English and Korean. Provided English speakers pronounce our Korean speech materials in an English speech style, the target words (e.g. "pap") would have a phrase effect and would not be produced together with the final verb phrase "cuseyo". So it would sound more English than Korean. As opposed to that, if Korean speakers produce Fowler's English speech materials in a Korean speech style, the target words would be continuously spoken with the following adverb phrase "two times". That is to say, "/ˋsi/ two times" will be pronounced as "beautiful lady doctor" would be, and it would sound more like Korean. Therefore, apart from whether or not the shortening from S1 to S2 in Fowler's English data is only due to compression effects, the marked differences between English and Korean (see Figures 1 & 2) are worth noting. It would not matter what the reason is, i.e., phonetic, syntactic or phonological, as they interact and are not independent. Timing (rhythm) will be the outcome of the interaction of all timing factors – phonetic, phonological, and syntactic, semantic (cf. Lehiste, 1975).

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