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A Study of the Rhythm of Native, Chinese, and Korean Speakers of English in Read Speech

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This study investigated the rhythm of read speech in English of six native English speakers, 10 Chinese speakers and 10 Korean speakers by means of the durational variability in adjacent vowel intervals using normalized Pairwise Variability Indices (nPVI). The results of the analysis identified rhythmic differences among the three groups. The rhythm of Korean speakers' English is more syllable-timed than that of the native English speakers, and Chinese speakers are intermediate between the other groups. The L1 rhythm of Chinese and Korean speakers was also examined to see whether the speakers exhibit different rhythms according to their L1. The results showed that Chinese speakers and Korean speakers do not show the same rhythmic tendencies as their L1 when speaking English. Through this study, we can conclude that, although L1 interference of Chinese and Korean speakers is not prominent in their English-speaking rhythm, it is somewhat difficult for Korean speakers to acquire proper English rhythm due to the different syllabic structures between Korean and English.

[rhythm/nPVI/stress-timing/syllable-timing/
리듬/연속단위 변동성 표준화 지수/강세박자/음절박자]

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I. INTRODUCTION

In most research on rhythm in speech, rhythm usually refers to the isochronous recurrence of the duration of part or the entire segment. The majority of the world's languages can be classified into stress-timing and syllable-timing according to the periodic recurrence of the segment duration (Abercrombie, 1967; Pike, 1945). The former means that the interval between two stressed syllables tends to be near-equal. The latter means that the interval between two consecutive syllables tends to be near-equal. Moreover, another type of rhythm, mora-timing, was proposed by Han (1962). Because the successive morae have approximately equal duration, mora-timing is more similar to syllable-timed than to stress-timed. Many studies have examined the distinction of stress-timing and syllable-timing of speakers' native languages, including Chinese (Lin & Wang, 2007), German, Italian (Mok & Dellwo, 2008), Korean (Jang, 2009), Malay (Deterding, 2011), Spanish, French, and Dutch (White & Mattys, 2007), Estonian, Mexican Spanish, and Castilian Spanish (Low & Grabe, 2002; Nolan & Asu, 2009). These studies show cross-linguistic comparisons of speech rhythm between various languages.

If there is a difference in speech rhythm between the L1 and the target language, for example, English, the learners might encounter challenges and tend to show syllable-timed characteristics instead of stress-timing. Recent studies have investigated the influence of speakers' L1 on their production of L2 rhythm, including Cantonese English and Mandarin English (Mok & Dellwo, 2008), Chinese Taiwanese English (Jian, 2004), Korean English (Jang, 2008), Singapore English (Low, Grabe, & Nolan, 2000), Thai, Malaysian, and Japanese English (Bond & Fokes, 1985). The findings in these studies revealed that the rhythm of non-native English learners is distinct from that of native English speakers. However, there is not so much research on the comparison of the rhythm of different language types for the same speakers. It would be very interesting to explore whether the rhythmic pattern of the speaker's L1 is transferred to L2, or whether it would be accommodated to L2.

Because English is a typical stress-timed language, the vocalic variability is greater than the syllable-timed languages such as Chinese and Korean. Chinese and Korean speakers are expected to show similar characteristics with their L1s in terms of speech rhythm when they speak English. On the other hand, the L1 of Chinese speakers and Korean speakers have different intrinsic phonological characteristics, so different L1 backgrounds could have an effect on the English rhythm regardless of the same syllabic structure. Therefore, based on measuring the duration of vowels, this study aims to explore two issues: 1) Does L1 background affect the rhythm of

read speech in English?; 2) Do the language types affect the rhythm of read speech? It is significant for this study to find the impact of native language on second language acquisition, deduce rhythmic differences, and explore ways that Chinese and Korean speakers can get closer to the pronunciation of native English speakers.

II. LITERATURE REVIEW

1. Rhythm Metrics

It would be quite difficult to adequately quantify the duration of segments (Arvaniti, 2009; Dauer, 1983; Roach, 1982), because it is affected by various factors. In order to obtain objective data to identify their reliability, many researchers proposed acoustic measurement, which can simulate the characteristics of the speech rhythm by applying modern computer technology.

Ramus, Nespor, and Mehler (1999) studied eight languages and measured the duration of vocalic intervals and consonantal intervals. A vocalic interval is the part between the onset and the offset of a vowel, or of a cluster of vowels. A consonantal interval is the part between the onset and the offset of a consonant, or of a cluster of consonants. Three variables related to rhythm metrics are proposed:

(1) %V: the proportion of vocalic intervals within the sentence
(2) ΔV: the standard deviation of vocalic intervals with each sentence
(3) ΔC: the standard deviation of consonantal intervals within each sentence

These measurements showed that the acoustic properties of speech intuitively reflect stress-timing and syllable-timing dichotomy. However, three rhythm metrics were extremely influenced by speech rate (Dellwo & Wangner, 2003). Dellwo (2006) thus proposed the rate-normalized metric VarcoC in order to monitor relative %V and ΔC variation across speech rates.

(4) Calculation formula: $VarcoC = \frac{\Delta C \times 100}{meanC}$

The results found that VarcoC provides clearer evidence than ΔC on the classification of rhythm. By the same token, White and Mattys (2007) utilized the rate-normalized metric VarcoV in order to monitor relative ΔV variation across speech rates.

(5) Calculation formula: $VarcoV = \frac{\Delta V \times 100}{mean C}$

VarcoC and VarcoV focus on the degree of durational contrast between adjacent vocalic intervals and consonantal intervals but do not measure the global variability of the utterance. Low et al. (2000) proposed a new metrics, namely, the Pairwise Variability Index (PVI), which may be a better metrics than %V, ΔV, and ΔC. The PVI measures the durational differences between successive syllables of the vocalic and intervocalic interval. At the same time, the raw Pairwise Variability Index (rPVI) was also proposed, used for the calculation of the intervocalic intervals but inappropriate for the normalization of speech rate.

(6) Calculation formula: $rPVI = \sum_{k=1}^{m-1} |d_k - d_{k+1}| / (m-1)$

Then Low et al. (2000) found that because the difference in the calculation of the intervocalic interval is the result of the syllabic structure of the language itself, the calculation of the intervocalic interval is unnecessary.

In addition, in order to avoid being affected by the speech rate variation, based on the rPVI, Low et al. (2000) proposed a vocalic normalized Pairwise Variability Index (nPVI-V) in measurements. The nPVI-V is used for calculating the variability of durations between each pair of successive vocalic intervals (excluding pauses). Even the pattern of vowel durations between the two are radically different, nPVI-V would give the same standard deviation of the two.

(7) Calculation formula: $nPVI = 100 \times \left[\sum_{k=1}^{m-1} \frac{|d_k - d_{k+1}|}{(d_k + d_{k+1})/2} / (m-1) \right]$

(Where *m* is the number of intervocalic or interconsonantal intervals in a passage of speech and *d* is the duration of the *k*th interval.)

2. Research on Speech Rhythm of Chinese and Korean Learners of English

Some studies used various timing metrics to investigate the rhythm of Chinese English learners and Korean English learners. In terms of Chinese English learners, Guo's (2018) study found that the nPVI of Chinese English learners is lower than that of native English speakers. The reason is that Chinese students cannot produce vowels correctly, and the duration of vowels is longer. Jian (2004) investigated the

difference in speech timing between American English and Taiwanese English based on pairwise variability index. It indicated that the pairwise variability index is able to express the rhythmic variability. Liu and Lee (2012) investigated the contribution of prosody to foreign accents in Chinese speakers' production of English by examining the synthesized speech of prosody and segments across native and non-native speakers. The results found that the duration of the speakers significantly impacts the foreign accent of Chinese speakers. Low and Grabe (2002) measured vocalic nPVI of 18 languages. Mandarin showed the lowest vocalic nPVI of all languages. The results showed that the vocalic nPVI provided acoustic evidence for rhythmic diversity among languages. Mairano and Romano (2011) studied the rhythm of speakers from 21 countries. The results indicated that Mandarin Chinese speakers (from Chao Yang and Hong Kong) were classified as syllable-timed. Mok and Dellwo (2008) investigated the speech rhythm of Cantonese, Beijing Mandarin, Cantonese-accented English and Mandarin-accented English. The results confirm the syllable timing impression of Cantonese and Mandarin.

In terms of Korean English learners, Jang (2009) investigated the rhythm of spoken Korean and compared them to Spanish, French, English, and Dutch that are based on White and Mattys (2007). Results showed that the %V and nPVI-V seem to verify the hypothesis that the Korean is a language with syllable-timing. Moreover, the values from these metrics do not vary significantly when speech rate changes. Kim (2008) analyzed the speech rhythm of Korean English learners by examining the rhythm of native English speakers, speakers of standard Korean, and advanced Korean learners of English. The perception experiment and the acoustic measurement were carried out for this study. The first experiment found that the rhythm of most Korean speakers tends to sound like Korean rhythm. At the same time, many listeners responded that they were neither like English nor Korean rhythm while recognizing the interlanguage characteristics between English rhythm and Korean rhythm. The second experiment revealed that nPVI turned out to faithfully reflect the rhythmic differences among the three language groups: Korean has syllable-timed than English, while the English of advanced Korean learners in between-scale. Lee and Kim (2005) investigated Korean learners' speech-timing of English before and after instruction in comparison with a native speech by using PVI. It concludes that the difference between the native speakers and learners in PVI conforms to the traditional distinction of speech-timing in that English is more stress-timed, whereas L2 speech is interfered by the syllable-timing of L1.

Most studies showed that the measurement of vocalic nPVI is more suitable for capturing non-native language speech rhythm. However, few studies have focused on speech rhythm of Chinese and Korean English learners.

III. METHOD

1. Read Speech in English (Experiment 1)

This experiment compared the rhythm of read speech in English of native, Chinese, and Korean speakers to investigate if different L1 backgrounds affect the rhythm of read speech in English.

1) Participants

The first experiment of this study selected three groups of 26 participants: Ten from H University in China (referred to as CS1-CS10), 10 from K University in South Korea (referred to as KS1-KS10), and 6 native English speakers (NS1-NS6) (Appendix A).

The background information questionnaire showed that the average age of Chinese and Korean students is 23 years old. They were from different grades and majors. And they had been learning English for an average of over ten years. None of the students had been to any English-speaking countries, except for KS4 who had been to the UK for three months of language training. CS2, KS5, KS6, KS9, and KS10 self-assessed their English proficiency as intermediate, and the other students passed an intermediate language proficiency level in their respective countries.

When it comes to native English speakers, six speakers participated in the recording, two from the USA, two from the UK, and the other two from Canada. All speakers live in their own countries, except for NS1, who has lived in Korea for 25 years as an English teacher trainer at a Korean university.

2) Materials

The reading material used in this study is "*The North Wind and the Sun*." This passage was used because it is not only the standard text used by the International Phonetic Association for phonetic research on English (International Phonetic Association, 1999), but has also been used for phonetic research on different languages, including Chinese (Lin & Wang, 2007; Yu, 2013), Japanese (Nishio & Niimi, 2006), and Malay (Deterding, 2011). The sentences in the passage include simple vocabularies and compound sentences, the segments in the sentences are phonetically balanced, and the passage contains a total of 113 words and 141 syllables (Appendix B). It was recorded by the native English speakers, Chinese speakers, and Korean speakers.

2. Read Speech in L1 (Chinese and Korean) (Experiment 2)

To investigate whether language types affect the rhythm of read speech, this chapter will acoustically analyze the Chinese and Korean's L1, aiming to investigate whether the rhythm of their L1 differs from the rhythm of read speech in English.

1) Participants

The Chinese and Korean participants in the second experiment were the same as the first experiment. The participants selected in this study speak the standard accent in their L1.

2) Materials

In experiment 2, "*The North Wind and the Sun*" has been translated into the two languages. The Chinese translation (Appendix C) included 185 syllables and the Korean one (Appendix D) had 168 syllables.

3. Data Collection and the Procedures

Participants were first asked to fill out a background information via e-mail. The reading scripts were then resent to the participants. An English script was sent to the native speakers of English and both English script and translation were sent to the Chinese and Korean speakers, respectively. Guidance on the recording method was also given to them. Before the recording, each participant had enough time to read the passage to familiarize themselves with it. When getting ready, the participants read the passage aloud at a natural speed using their smartphones. After the recording met satisfaction, they sent the recorded files to the researcher's e-mail. Finally, the researcher converted the files into wav format.

4. Data Analysis

To measure the durational variability between adjacent vowels, this study used the normalized vocalic PVI (nPVI-V) proposed by Low et al. (2000), which can analyze the temporal succession of segments, specifically vowels in this study.

$$nPVI = 100 \times \left[\sum_{k=1}^{m-1} \frac{|d_k - d_{k+1}|}{(d_k + d_{k+1})/2} / (m-1)\right]$$

(Where m is the number of intervocalic or interconsonantal intervals in a passage of speech and d is the duration of the kth interval.)

nPVI-V calculates the difference in duration between each pair of successive measurement, taking the absolute value of the difference and dividing it by the mean duration of the pair, and then the average of the difference is multiplied by 100. For acoustic measurement, the nPVI-V for the duration of intervals between vowels is expected to be close to 0 in a perfect isochrony of syllable-timing, where there is no duration difference between successive vowels. On the contrary, the value should be significantly greater in stress-timing.

To measure the duration of vowels of the read speech, the sound file was loaded in the object window of the speech analysis software Praat (version 6.1.33). For the English data, the annotation was performed by Praat and Python scripts. For the Chinese data, the annotation was done manually, because the researcher does not have an automatic labeler. And the Korean data, the annotation was carried out by using Praat and kPhonetica Version 2.08 (Seong, Gim, & Kwon, 2018). Once nPVI-V was calculated, the values were put into the SPSS for statistical analyses.

IV. RESULTS

1. Analysis of Rhythm of Native, Chinese, and Korean Speakers' English

First, vocalic PVI (nPVI-V) was calculated using Praat and Python scripts. Then, a one-way ANOVA was carried out to compare the difference in means among native, Chinese, and Korean speakers. The nPVI-V values of the three groups were taken as dependent variables. The L1 backgrounds (native, Chinese, Korean) of the three groups were taken as independent variables. NS represents native English speakers; CS represents Chinese speakers; KS represents Korean speakers.

Table 1
The Overall Means of nPVI-V for Native, Chinese, and Korean Speakers' English

	N	*Mean*	*SD*	Std. Error Mean	Sig.
NS	6	70.02	5.09	2.08	
CS	10	64.32	7.19	2.28	.007
KS	10	58.65	5.97	1.89	
Total	26	63.45	7.52	1.47	

The overall means of nPVI-V for native, Chinese, and Korean speakers' English utterances are shown in Table 1. It was found that the means of the three groups were significantly different, $F(2, 23) = 6.240$, $p < .01$. NS had a higher mean score

of 70.02 than the CS (64.32) and KS (58.65), respectively.

Table 2
Pairwise Comparisons

		Mean Difference	Std. Error Mean	Sig.
NS	CS	5.69767	3.25873	.238
	KS	11.36967*	3.25873	.008
CS	NS	-5.69767	3.25873	.238
	KS	5.67200	2.82214	.156
KS	NS	-11.36967*	3.25873	.008
	CS	-5.67200	2.82214	.156

Scheffe post hoc tests indicated that NS and KS were statistically different: NS had a higher score than KS ($p < .01$). There were no significant differences between NS and CS, and CS and KS.

2. Analysis of Rhythm of Native, Chinese, and Korean Speakers' L1

To investigate whether the rhythm of read speech is different among languages, a one-way ANOVA was used to compare the values of nPVI-V of native, Chinese, and Korean speakers' L1. The nPVI-V values of the three groups in L1 were taken as dependent variables. The L1 (English, Chinese, Korean) of the three groups were taken as independent variables. (NS) English represents native speakers' English reading; (CS) Chinese represents Chinese speakers' reading of Chinese translation; (KS) Korean represents Korean speakers' reading of Korean translation.

Table 3
The Overall Means of nPVI-V for Native, Chinese, and Korean Speakers' L1

	N	*Mean*	*SD*	Std. Error Mean	Sig.
(NS) English	6	70.02	5.09	2.08	.000
(CS) Chinese	10	52.26	4.88	1.54	
(KS) Korean	10	50.31	5.39	1.71	
Total	26	55.60	9.48	1.86	

The overall means of nPVI-V for native, Chinese, and Korean speakers' L1 utterances are shown in Table 3. It was found that the values of the three languages were significantly different, $F(2, 23) = 31.088$, $p < .001$. English had a higher mean score at 70.02 than Chinese and Korean scores at 52.26 and 50.31, respectively.

Table 4
Pairwise Comparisons

		Mean Difference	Std. Error Mean	Sig.
(NS) English	(CS) Chinese	17.75967*	2.65110	.000
	(KS) Korean	19.70767*	2.65110	.000
(CS) Chinese	(NS) English	-17.75967*	2.65110	.000
	(KS) Korean	1.94800	2.29592	.702
(KS) Korean	(NS) English	-19.70767*	2.65110	.000
	(CS) Chinese	-1.94800	2.29592	.702

Scheffe post hoc tests indicated that English and Chinese, English and Korean were statistically different: English had a higher score than Chinese and Korean ($p < .001$; $p < .001$, respectively), but there was no significant difference between Chinese and Korean.

3. Analysis of Rhythm According to Language Types: Chinese Speakers

A paired samples *t*-test was used to compare the nPVI-V of Chinese speakers' reading of the translated script and English. The nPVI-V values of the Chinese speakers in L1 and in English were taken as dependent variables. The L1 and English of the Chinese speakers were taken as independent variables. (CS) Chinese represents Chinese speakers' reading of Chinese translation; (CS) English represents Chinese speakers' English reading.

Table 5
The Overall Means of nPVI-V for Chinese Speakers' L1 and English

	N	*Mean*	*SD*	Std. Error Mean	Sig.
(CS) Chinese	10	52.26	4.88	1.54	.000
(CS) English	10	64.32	7.19	2.28	

The overall means of nPVI-V for the Chinese speakers' Chinese and English are shown in Table 5. It was found that the (CS) Chinese and (CS) English means were significantly different ($t(9) = -5.371$, $p < .001$). (CS) English had a higher mean score at 64.32 than (CS) Chinese at 52.26.

4. Analysis of Rhythm According to Language Types: Korean Speakers

A paired samples *t*-test was used to compare the nPVI-V of Korean speakers' reading of the translated script and English. The nPVI-V values of the Korean speakers in L1 and in English were taken as dependent variables. The L1 and English of the Korean speakers were taken as independent variables. (KS) Korean represents Korean speakers' reading of Korean translation; (KS) English represents Korean speakers' English reading.

Table 6
The Overall Means of nPVI-V for Korean Speakers' L1 and English

	N	*Mean*	*SD*	Std. Error Mean	Sig.
(KS) Korean	10	50.31	5.39	1.71	.034
(KS) English	10	58.65	5.97	1.89	

The overall means of nPVI-V for the Korean speakers' Korean and English are shown in Table 6. It was found that the (KS) Korean and (KS) English means were significantly different ($t(9) = -2.491$, $p < .05$). (KS) English had a higher mean score at 58.65 than (KS) Korean at 50.31.

V. DISCUSSION

Figure 1 shows the nPVI-V in English of native, Chinese, and Korean speakers in experiment 1, and the nPVI-V in L1 of Chinese and Korean speakers in experiment 2.

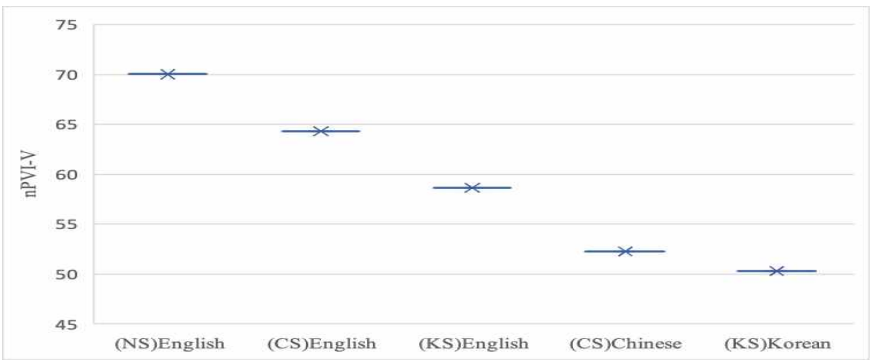

Figure 1
nPVI-V in English of Native, Chinese, and Korean Speakers, and nPVI-V in L1 of Chinese and Korean Speakers (Vocalic nPVI values are plotted on the vertical axis.)

As can be seen from the nPVI-V data in Figure 1, the results indicate that the rhythm of (KS) English is more syllable-timed than that of (NS) English, while (CS) English is intermediate between (NS) English and (KS) English. It can be concluded that speech rhythm can be quantified in terms of the nPVI-V among (NS) English, (CS) English, and (KS) English. In comparison with the (NS) English, the nPVI-V of (KS) English is significantly smaller.

In addition, (NS) English has a higher value of nPVI-V than that of (CS) Chinese and (KS) Korean. As revealed in previous studies such as Li and Kim (2005) and Lin and Wang (2007), the findings in this study also support the traditional classification that Chinese and Korean are close to syllable-timing.

It was expected that rhythm of English utterances read by Chinese and Korean speakers would show similar tendency to their reading in L1 due to L1 interference. The results of this study reveal that the rhythm in L1 is not projected to that in the target language, which means that L1 interference is not prominent in rhythm.

Moreover, the means of nPVI-V of (KS) English and (KS) Korean, and (KS) English and (NS) English were statistically different. This reflects that the rhythm of (KS) English is intermediate between those of (NS) English and (KS) Korean. This implies that although L1 interference is not so significant when Korean speakers read English, the rhythm in English read by Korean speakers is yet to be close to the native's. In contrast, (CS) English and (CS) Chinese was statistically different, while there was no significant difference between (CS) English and (NS) English. This would suggest that the rhythm of the Chinese speakers is quite close to the native's when they read English.

One of the main factors to explain the different rhythmic patterns among the native, Chinese, and Korean speakers' L1 can be found in the phonological differences in three languages. The syllabic structure of English is more complex than that of Chinese and Korean. English allows multiple clusters in onset and coda positions, while it is not the case in Chinese and Korean. The simpler syllabic structures in Chinese and Korean would make the rhythm in these languages less variable than in English. In addition, the vowel reduction in Chinese and Korean, specifically in Korean, is not as common as in English. Lim (2005) found that some post-lexical phonological processes such as weakening, deletion and contraction are the causes of unnatural pronunciation of Korean English learners. That's why nPVI-V of Chinese and Korean's L1 is smaller than the native's.

The reason for the higher nPVI-V in Chinese and Korean's English reading than that in L1 can be attributed to selective lengthening (Chung & Arvaniti, 2012; Mok & Dellwo, 2008). Some difficult words and even some simple words were selectively lengthened in some speakers. Such selective lengthening could contribute

to a higher degree of pairwise variability in their reading in English.

Both Chinese and Korean are considered syllable-timed in terms of subjective impression. When Chinese and Korean speakers read English, only the rhythm of Chinese speakers' English is close to that of the native's. The similar rhythmic pattern between the native's and Chinese' English reading might be derived from some degree of vowel reduction that can be found in Chinese (Chao, 1968).

V. CONCLUSION AND IMPLICATIONS

This study investigated the difference of the rhythm among native, Chinese, and Korean speakers of English. In the first experiment, the comparison was conducted to analyze the rhythm of their reading in English. In the second experiment, readings in their L1 were compared. The findings in this study are partially consistent with the previous studies in that vocalic normalized PVI of native English speakers and that of Korean speakers of English are distinct. The rhythm of the Chinese speakers' English is not statistically different from that of the native's. Although Korean speakers of English managed to improve the rhythm of their reading in English, there is still some way to go for them to acquire the rhythm of the native's. Pronunciation habits such as lack of vowel reduction and vowel insertion to the consonant clusters might have contributed to less stress-timed pattern of Korean speakers' English. On the other hand, Chinese speakers seemed to have acquired English rhythm properly when they read English.

The rhythm of native English speakers is quite distinct from that of Chinese and Korean speakers' L1. It was revealed that Chinese and Korean have different rhythmic pattern from English, while the rhythm of both languages is similar. Based on nPVI-V, it was found that both languages are less stress-timed or more syllable-timed than English. The difference in speech rhythm among the three languages can be attributed to the difference of the syllabic structure and the degree of vowel reduction. Various types of syllabic structure in English make the variability of vowel duration bigger, while the same variability is less common in Chinese and Korean.

Rhythm exists in all aspects of speech production, and it can change the linguistics output. In the teaching of English language in China and South Korea, EFL teachers rarely mention the rhythm of speech. One of the reasons for this neglect is the lack of knowledge on rhythm. Because rhythm involves subjective impression, the teachers have difficulty in describing and applying it to English teaching. So it is necessary to equip the teachers with proper knowledge on rhythm

and help them develop efficient methods and techniques to teach English rhythm.

EFL teachers can also use computer technology to subjectively evaluate and analyze the rhythm of the students. Some free speech analysis softwares such as Praat, SFS, and wavesurfer are very useful to identify the acoustic characteristics of stressed and unstressed syllables, long and short vowels, and loud and weak sounds.

When it comes to learners, most of the students who participated in the recording of this study are non-English majors and do not have any prior knowledge on English pronunciation. It might be difficult for them to spend enough time to systematically acquire English rhythm. So mini lessons for English rhythm could be designed to teach them intrinsic characteristics and difference of English rhythm and the rhythm in their L1.

With the accelerated development of globalization, English is not only for native English speakers but for people worldwide. Thus, EFL teachers and students should be given chances to experience the variances of English, which is of great significance for strengthening mutual intelligible pronunciation of World Englishes (Chung, 2010).

Even though some important findings are obtained from this study, this study also has some limitations. First, the number of speakers for each L1 does not exceed ten. So it might be difficult to generalize the results of this study. Secondly, measures other than nPVI might be used to analyze the rhythm. For example, distribution of vowels in a vowel formant chart is one of the important indicators whether the vowels are properly reduced in unstressed syllables. Speaking rate and articulation rate could also be used to measure the rhythm of speech. These measures could be used in the future study.

Nevertheless, this study managed to describe the rhythmic characteristics of English learners in China and South Korea. Some realistic suggestions to teach English rhythm were also given.

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APPENDIX A

Background Information of Chinese and Korean Speakers

ID	Grade	Learning English (year)	Proficiency		Major /Profession
			Self-assessment	Test	
CS1	Junior	9		CET6-500	English Education
CS2	Freshman	13	Intermediate		Primary Education
CS3	Junior	10		CET6-449	Preschool Education
CS4	Junior	12		CET4-480	Primary Education
CS5	Sophomore	11		CET4-465	History Education
CS6	Sophomore	12		CET4-451	Primary Education
CS7	Junior	11		CET4-426	Primary Education
CS8	Junior	15		CET4-509	Preschool Education
CS9	Junior	10		CET4-429	Physics Education
CS10	Junior	15		CET6-507	Pharmacy
KS1	Junior	15		TOEIC-900	English Education
KS2	Junior	15		TOEIC-940	History Education
KS3	Sophomore	10		TOEIC-900	Korean Education
KS4	Junior	18		TOEIC-940	English Education
KS5	Senior	13	Intermediate		French Education
KS6	Junior	10	Intermediate		German Education
KS7	Junior	12		TOEIC-810	Primary Education
KS8	Sophomore	10		TOEIC-975	Biology Education
KS9	Sophomore	10	Intermediate		Ethical Education
KS10	Sophomore	10	Intermediate		Physics Education

CET4=College English Test Band 4; CET6=College English Test Band 6

Background Information of Native English Speakers

ID	Age	Nationality	Major/Profession
NS1	52	USA	English Teacher
NS2	40	USA	Financial Analyst
NS3	24	UK	Actor, Writer
NS4	26	UK	English Teacher
NS5	26	Canada	Piano Teacher
NS6	24	Canada	Research Assistant

APPENDIX B

The North Wind and the Sun

The North Wind and the Sun were disputing which was the stronger, when a traveler came along wrapped in a warm cloak. They agreed that the one who first succeeded in making the traveler take his cloak off should be considered stronger

than the other. Then the North Wind blew as hard as he could, but the more he blew the more closely did the traveler fold his cloak around him; and at last the North Wind gave up the attempt. Then the Sun shone out warmly, and immediately the traveler took off his cloak. And so the North Wind was obliged to confess that the Sun was the stronger of the two.

APPENDIX C
北风和太阳

有一回，北風跟太陽在那儿爭論誰的本事大，爭來爭去就是分不出高低來。這時候，路上來了个走道儿的，他身上穿着件厚大衣。他們倆就說好了，誰能先叫這个走道儿的脫下他的厚大衣，就算誰的本事大。北風就使勁儿的刮起來了。不過，他越是刮的厲害，那个走道儿的把大衣裹的越緊，后來，北風沒法儿了，只好就算了。過了一會儿，太陽出來了，他火辣辣的一晒，那个走道儿的馬上就把那件厚大衣脫下來了，這下，北風只好承認他們倆当中還是太陽的本事大。

APPENDIX D
바람과 해님

바람과 해님이 서로 힘이 더 세다고 다투고 있을 때, 한 나그네가 따뜻한 외투를 입고 걸어 왔습니다. 그들은 누구든지 나그네의 외투를 먼저 벗기는 이가 힘이 더 세다고 하기로 결정했습니다. 북풍은 힘껏 불었으나 불면 불수록 나그네는 외투를 단단히 여몄습니다. 그 때에 해님이 뜨거운 햇빛을 가만히 내려 쬐니, 나그네는 외투를 얼른 벗었습니다. 이리하여 북풍은 해님이 둘 중에 힘이 더 세다고 인정하지 않을 수 없었습니다.

Applicable Levels: College

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