Effects of L1 Prosodic System on the Perception of English Stress: a Case Study of Korean EFL Learners*

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This study investigates the effect of L1 prosodic system on the perception of L2 stress. For the purpose, an English stress perception experiment is conducted on two groups of Korean EFL learners with different L1 prosodic systems, namely, speakers of Standard Korean, with a non-stress, non-tonal language background, and speakers of the North Kyungsang dialect of Korean, with a tone language background. The results of the experiment suggest that cross-linguistically both groups rely heavily on prominence in pitch, rather than other phonetic correlates such as duration and intensity, when identifying English stress. Language-specifically the North Kyungsang Korean group relies significantly more on pitch prominence than the Seoul Korean group. Based on both cross-linguistic and language-dependent features, the conclusions reached (1) that the heavy reliance on pitch is a feature of L2 stress perception by EFL learners with either a tonal background or a non-stress background, and (2) that the degree of reliance on pitch varies in relation to the extent of the language-specific phonological use of pitch at the lexical level.

Keywords: L2 stress perception, L1 prosodic system, reliance on pitch, cross-linguistic features, language-dependency features

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1. Introduction

The term 'stress' refers to the relative prominence of a unit of spoken language; it is achieved by various phonetic correlates such as higher pitch, greater duration and greater intensity in the stressed syllable than in adjacent unstressed syllables (Bright 1992). Languages which use stress contrastively to differentiate meaning of words are referred to as 'stress languages'. English is a typical example of stress language.

Unlike stress languages, some languages rely primarily on pitch to lexically mark certain syllables in a word to differentiate meanings. These languages are referred to typologically as tone languages (e.g. Chinese) or pitch accent languages (e.g. Japanese). In tone languages, pitch height and contour shape are used to distinguish one word from another. Mandarin Chinese, for instance, contains four lexically contrastive tones. The syllable *tong* means 'to open up' when its pitch is high, 'copper' when it is rising, 'tub' when it is low, and 'to ache' when it is falling.[1] Pitch-accent languages, on the other hand, use pitch lexically, but more restrictedly, so one syllable per word is made prominent by means of pitch. In Japanese, the word *ikoo* means 'after' when its pitch accent occurs on the first syllable, but means 'go' when its pitch accent falls on the second syllable. There are also languages which use neither stress nor pitch lexically. Languages with fixed stress (e.g. French) belong here.

The prosodic system of L1 (that is, the native language) may influence its speakers' perception of prosodic contrasts in another language and further affect their acquisition of a new phonological contrast (Best 1994, Brown 1998). Investigating this issue, researchers found that speakers with a non-stress background had difficulties identifying English stress. Peperkamp and Dupoux (2002) reported that French learners of English, with a fixed-stress background, have difficulties perceiving English stress contrasts. Chinese learners of English were also found to have problems in acquiring English lexical stress (Chao 1968, Juffs 1990, Archibald 1997). Wang (2008) and Ou (2009) discovered that pitch, rather than intensity or duration, has a decisive ef-

1) In Mandarin Chinese, the low tone corresponds to the low falling-rising (214) with 5 representing the highest pitch and 1 the lowest.

fect on Chinese speakers' stress judgment. Ou (2010) also found that Japanese speakers heavily relied on pitch when identifying English stress, while Spanish speakers, with a stress background, did not show such a tendency to rely on pitch. Based on these findings, she argued that the heavy reliance on pitch by EFL learners when identifying English stress is an effect of L1 prosodic properties, that is, the lexical use of pitch.

Prosodic systems could differ not only across languages but also across dialects. Korean has dialects with different prosodic systems. For instance, Standard Korean (SK, henceforth), which is spoken in Seoul, uses neither stress nor tone lexically, while the North Kyungsang dialect of Korean (NKK, henceforth), which is spoken in the northern part of the Kyungsang province in south eastern Korea, uses lexical tone to differentiate meaning of words. Chung (2011), in the study of English stress by SK and NKK EFL learners, reported that there seemed to be a tendency for NKK speakers to rely more on pitch than SK speakers.

Previous studies (Chao 1968, Juffs 1990, Archibald 1997, Wang 2008, Ou 2009, 2010) thus suggested that L1 prosodic system affects the perception of L2 (that is, the second language) stress and that the heavy reliance on pitch by EFL learners, either with a tonal background or a pitch-accent background, when identifying English stress, be an effect of L1 prosodic systems.

The current study further investigated the effect of L1 lexical prosodic system on the perception of L2 stress. More specifically, the current study tried to answer the following questions: (a) Is the heavy reliance on pitch when identifying L2 stress exhibited only by speakers with a tonal language background? Do speakers with a non-stress, non-tonal background also rely heavily on pitch when identifying L2 stress? (b) Is there cross-linguistic difference in the perception of L2 stress between speakers with a non-stress, non-tonal language background and those with a tonal language background? For the purpose, the current study conducted an English stress perception experiment on two groups of Korean EFL learners with different prosodic systems, namely, SK EFL learners and NKK EFL learners.

2. English, Seoul Korean and North Kyungsang Korean

Stress in English involves multiple phonetic correlates, namely, duration, intensity, pitch, and vowel quality (Fry 1958, Lehiste 1970, Adams and Munro 1978). English stressed syllables tend to have longer duration, greater intensity than those of unstressed syllables, but the pitch of English stressed syllables can be higher or lower than that of unstressed ones, depending on the type of utterance melody. For instance, the stressed syllable can have higher pitch than the unstressed one in affirmative statement with falling intonation, while the stressed syllable can have lower pitch in a yes/no question sentence with rising intonation. The following examples illustrate how the pitch of the stressed syllable can change depending on the type of utterance melody. For instance in falling intonation (of affirmative statement), which is represented by a pitch accent H*, followed by a phrase accent L- and a boundary tone L% (Beckman and Pierrehumbolt 1986), the stressed syllable can have higher pitch than that of the unstressed one since the pitch accent H* is realized on the stressed syllable and the boundary tone L% on the unstressed one, as in (1).

(1) H* L-L%[2)]

I am slénder.

In contrast, in rising intonation (of yes/no question sentence), which has a pitch accent L*, followed by a phrase accent H- and a boundary tone H%, the stressed syllable can have lower pitch than that of the unstressed one since the pitch accent L* is realized on the stressed syllable and the boundary tone H% on the unstressed one, as in (2).

(2) L* H-H%

Are you slénder?

2) Phrase accent could be either L- or H-, depending on the type of utterance melody. I arbitrarily chose L-L% for falling intonation, which shows a continuously falling plateau, and H-H% for rising intonation, which shows a continuously rising contours. Phrase accents are not realized on a particular syllable, but realized over a number of syllables covering all the syllables right after the nuclear pitch accented word until the phrase final syllable (Beckman & Pierrehumbolt 1986).

In sum, pitch of English stressed syllables can be either higher or lower than that of unstressed syllables according to the type of utterance melody, while other acoustic correlates such as intensity and duration do not exhibit such a variance.

Whether there is lexical stress in SK has been a controversial issue. Even the linguists who believe that word-level stress exists do not agree regarding its location (Choi 1937, Huh 1985). Though it has also been known that there are no fixed acoustic properties of stress, researchers have found that stress is detectable based on duration, amplitude and pitch (Fry 1958, Lea 1977, Beckman & Pierrehumbolt 1986). Investigating these phonetic properties, Jun (1995) argued that Korean does not have a word-level stress but a phrase-level stress. Following her, I assume that SK does not have lexical stress. SK also does not have lexical tone; tone in this language is part of phrase or sentence intonation.

NKK, unlike SK, uses tone at the lexical level to differentiate word meanings. For instance, *kaci* means 'a kind' when a high tone falls on the first syllable, but means 'a branch' when a high tone falls on the second syllable. However, tone is more restrictedly used in NKK than in Chinese and thus in NKK a word has one or two (consecutive) high-toned syllables and the remaining syllables are low-toned (Chung 1991, Kim 1999).

To recapitulate, English is a stress language, SK uses neither lexical stress nor lexical pitch, and NKK uses lexical pitch.[3)]

3. Perception Experiment

Ou (2009, 2010) investigated the reliance on pitch by EFL learners when identifying English stress by using variant pitch prominence of the stressed syllable. If the subjects rely primarily on prominence in pitch, rather than duration or intensity, when identifying stress, they will have more difficulties as the stressed syllable has less prominence in pitch than that of the unstressed one. I adopted her experimental method because this design allows us to discover how much L2 learn-

3) Though it is not controversial that NKK uses lexical tone to differentiate meanings of words, it is not agreed on totally among researchers whether NKK is a tone language or a pitch-accent language.

ers rely on pitch when identifying stress.

3.1. Materials

Fifteen pairs of di-syllabic nonsense English words[4] were created, each pair consisting of words differing only in the location of stress, namely, one trochaic word and one iambic word (e.g. *dórken* vs. *dorkén*). Each syllable has one coda and one onset consonant, and the vowel was chosen from four vowels, [ɑ, ɛ, ɪ, o].

In order to manipulate the pitch of the stressed syllable, each pair of non-sense words were imbedded in two intonation patterns, falling intonation (i.e. *I am dórken* vs. *I am dorkén*) and rising intonation (i.e. *Are you dórken?* vs. *Are you dorkén?*). In falling intonation, the stressed syllable can have higher pitch than that of the unstressed one since pitch accent H* realized on the stressed syllable, as in (3).

(3) (a) H* L-L%
I am dórken.

(b) H* L-L%
I am dorkén.

In contrast, in rising intonation, the stressed syllable can have lower pitch than that of the unstressed one since pitch accent L* is realized on the stressed syllable, as in (4).

(4) (a) L* L-H%
Are you dórken?

(b) L* L-H%
Are you dorkén?

For convenience's sake, the stimulus type containing a trochaic word carried in falling intonation as in (3a) will henceforth be referred to as Type 1; one containing an iambic word carried in falling intonation as in (3b), as Type 2; one containing a trochaic word carried in rising intonation as in (4a), as Type 3; one containing an iambic word carried in rising intonation as in (4b), as Type 4.

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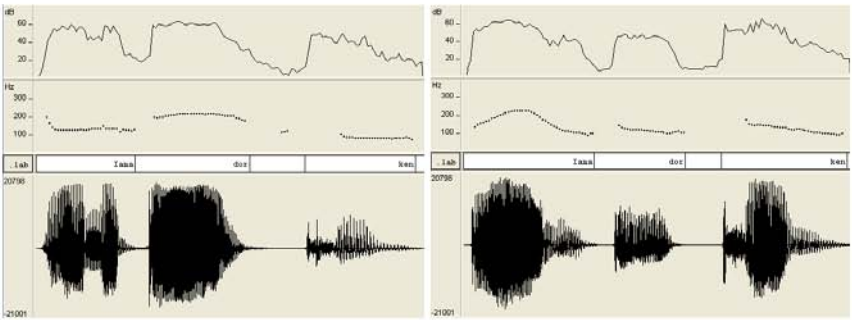
4) Fifteen English non-sense words used in the experiment were *dorken, pentok, lipmon, wimsit, mercet, siltong, rompet, ringcot, conpil, sankop, doktip, binsil, yongkep, neptor*, and *rompet*.

Figure 1 presents the wave forms, pitch contours and intensity of an instance of the non-sense word pair carried in falling intonation, that is, Stimulus Type 1 and Type 2.



I am **dórken**. (Stimulus Type 1) I am **dorkén**. (Stimulus Type 2)

Figure 1. Waveforms, pitch contours and intensity of *I am dórken.* and *I am dorkén.* in falling intonation.

Table 1 lists the means for F0, duration and intensity of *dórken* and *dorkén* in falling intonation.

Table 1. Phonetic measures of the stressed and unstressed syllables of *dórken.* and *dorkén* in falling intonation[5)]

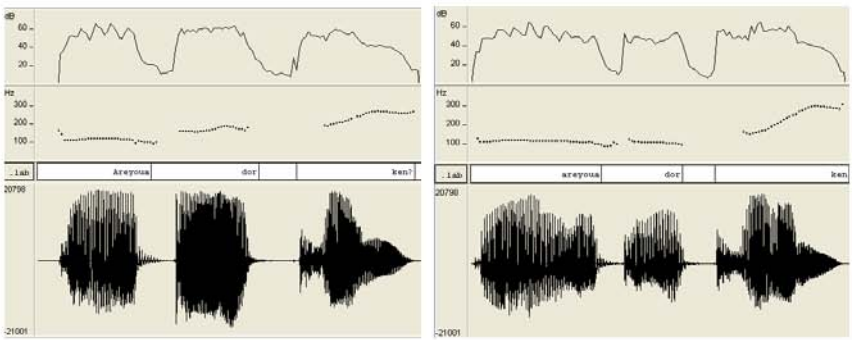
	***dórken* (Stimulus type 1)**			***dorkén* (Stimulus type 2)**		
	[or] of *dór*	[e]	[en]of *kén*	[or] of *dor*	[e]	[en] of *kén*
F0 average (Hz)	210.0	87.2	86.7	112.4	137.0	119.7
Duration (ms)	0.32	0.16	0.26	0.16	0.17	0.37
Intensity (db)	53.2	39.0	33.2	44.7	54.3	41.4

In falling intonation, the three phonetic cues, namely, pitch, duration and intensity, of the stressed syllable are more prominent than those of the unstressed syllable; the first syllable of *dórken*, a trochaic word, has higher F0 (210 Hz vs. 87.2 Hz or 86.7 Hz), longer duration (0.32 ms vs. 0.16 ms or 0.26 ms) and greater intensity (53.2 db vs. 39.0 db

5) The phonetic measures of the vowel as well as the rime (the vowel plus the coda consonant) were provided because it is not certain which has more decisive effect on stress judgment, the vowel or the rime.

or 33.2 db) than those of the second syllable. On the other hand, in *dorkén*, an iambic word, the second syllable has higher pitch (112.4 Hz vs. 137 Hz or 119.7 Hz), longer duration (0.16 ms vs. 0.17 ms or 0.37 ms), and greater intensity (44.7 db vs. 54.3 db or 41.4 db) than those of the first syllable.

Figure 2 presents wave forms, pitch contours and intensity of an instance of the non-sense word pair embedded in rising intonation, that is, Type 3 and Type 4.



Are you **dórken***?* (Stimulus Type 3) Are you **dorkén***?* (Stimulus Type 4)

Figure 2. Waveforms, pitch contours and intensity of *Are you dórken?* and *Are you dorkén?* in rising intonation.

Table 2 lists the phonetic measures of stressed and unstressed syllables of *dórken* and *dorkén* in rising intonation.

Table 2. Phonetic measures of the stressed and unstressed syllables of *dórken* and *dorkén* inrising intonation.

	***dórken* (Stimulus type 3)**			***dorkén* (Stimulus type 4)**		
	[or] of *dór*	[e]	[en]of *kén*	[or] of *dor*	[e]	[en] of *kén*
F0 average (Hz)	167.3	214.8	242.3	70.6	181.9	244.8
Duration (ms)	0.23	0.14	0.28	0.13	0.15	0.31
Intensity (db)	57.9	53.8	47.0	44.97	54.9	45.1

In rising intonation the three phonetic cues of the stressed syllable are more prominent than those of the unstressed syllable with one exception, namely, pitch of the stressed syllable of Stimulus Type 3. As

the measures in the shaded area in Table 2 show, the stressed syllable of *dórken* of Stimulus Type 3 is less prominent than the unstressed syllable in pitch (167.3 Hz vs. 214.8 Hz or 242.3 Hz) while it is more prominent in duration (0.23 ms vs. 0.14 ms or 0.28 ms) or intensity (57.9 db vs. 53.8 db or 47.0 db).

The sixty stimuli constructed in this manner were recorded by a trained male native speaker from North America. The recorded sentences were tested on ten American English native speakers for the confirmation of the correctness. Only stimuli which achieved 85% or higher accuracy rate were used for the experiment. Fourteen of Type 1, twelve of Type 2, twelve of Type 3 and fourteen of Type 4 satisfied this criterion.

3.2. Participants

Two groups of Korean speakers participated in the experiment, namely, the SK group and NKK group. Both groups consisted of college students, aged between 21 and 24, majoring in English and English Literature. They had no experience staying in English speaking countries.

The average scores of the English test of CSAT (College Scholastic Ability Test) ranged between 2nd and 3rd level for both groups. However, since the CSAT English test mainly focused on evaluating the proficiency in reading comprehension, similar CSAT English test scores do not guarantee that the two groups had similar proficiency in English stress perception. Thus, in the current experiment, a preliminary screening test was conducted on the subjects to secure similar proficiency in English stress perception. In the test, the subjects listened to ten pairs of di-syllabic real English words, each pair consisting of words differing only in the location of stress (i.e. *ínsult* vs, *insúlt*). The same screening test was given twice for the purpose of informing the subjects of their tasks. Only those who achieved 95% or higher success rate were used for further analysis. Forty SK speakers and fifty-four NKK speakers satisfied this criterion.

3.3. Procedure

The experiment was conducted in Seoul and Daegu at intervals of two days. The record players used in both experiments were of the

similar quality. Each participant was provided with a sheet on which the words they would listen were printed. The participants were asked to indicate the place of stress by marking either 1st syllable or 2nd syllable in response to the audio presentation of the stimuli. The auditory items were presented randomly and the interval between the items was five seconds. The whole experiment took around 25 minutes.

4. Results and Discussion

4.1. Results

A total of 2,080 responses of the SK participants (40 SK speakers × 52 tokens) and 2,808 responses of the NKK (54 NKK speakers × 52 tokens) were analyzed. The responses of each group were divided into four classes according to the type of stimuli, Stimulus Types 1, 2, 3, and 4. Table 3 shows the overall accuracy rates of the SK and NKK groups for each stimulus type.

Table 3. Accuracy rates of the SK and NKK groups

Speakers	Stimulus type	Intonation pattern	Stress location	Accuracy rate
SK speakers	Type 1	Falling	Trochaic	97.5%
	Type 2	Falling	Iambic	82.5%
	Type 3	Rising	Trochaic	46.5%
	Type 4	Rising	Iambic	91.5%
NKK speakers	Type 1	Falling	Trochaic	99%
	Type 2	Falling	Iambic	80.4%
	Type 3	Rising	Trochaic	29.6%
	Type 4	Rising	Iambic	94.9%

The accuracy rates of both groups are presented in bar graphs in Figure 3.

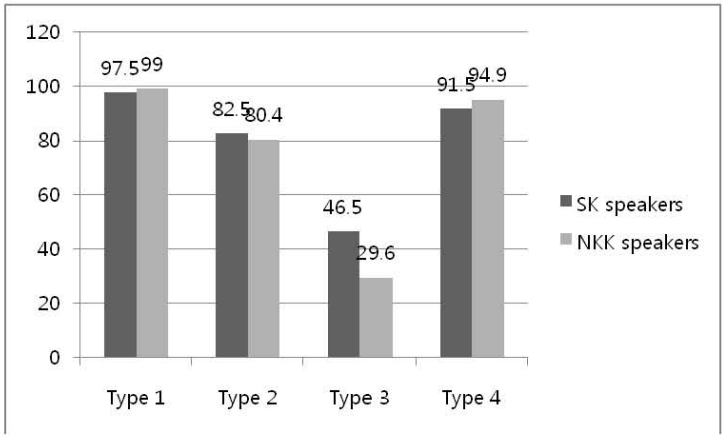


Figure 3. Overall performance on the stress contrast by the SK and NKK groups.

The results showed not only cross-linguistic features but also language-dependency features. Cross-linguistically, though there was slight difference between the two groups, both SK and NKK groups attained relatively high accuracy rates for Stimulus Types 1, 2, and 4. The highest accuracy rates were attained by both groups for Stimuli Type 1 (97.5% for SK and 99% for NKK), the second highest for Type 4 (91.5% for SK and 94.9% for NKK), and a slightly lower accuracy rate for Type 2 (82.5% for SK and 80.4% for NKK). On the other hand, the accuracy rates for Stimuli Type 3, as compared to those for the other stimulus types, were considerably low for both SK and NKK groups, the SK group attaining 46.5% and the NKK group 29.6%.

Language-specifically, the NKK group was distinguished from the SK group for Stimulus Type 3, attaining much lower accuracy (that is, 29.6%) than that of the SK group (that is, 46.5%). A statistical analysis using SAS 9.2 showed that the difference in the accuracy rate between the SK and NKK groups was significant for Stimulus Type 3 ($p = 0.0022 < 0.05$), but not for Stimulus Types 1 ($p = 0.2228 > 0.05$), Type 2 ($p = 0.9534 > 0.05$) and Type 4 ($p = 0.3270 > 0.05$), as shown in Table 4.

Table 4. Statistics of the results of the performance of the SK and NKK groups for Stimulus Types 1, 2, 3 and 4

Variable	Group	N	Mean	s.d.	Median	p-value
Type 1	SK	40	0.9750	0.0760	1.0000	0.2228
	NKK	54	0.9907	0.0477	0.9907	
Type 2	SK	40	0.8250	0.1387	0.8180	0.9534
	NKK	54	0.8047	0.1856	0.8180	
Type 3	SK	40	0.4650	0.2515	0.5333	0.0022
	NKK	54	0.2963	0.2659	0.2667	
Type 4	SK	40	0.9156	0.1398	1.0000	0.3270
	NKK	54	0.9491	0.0859	1.0000	

4.2. Discussion

First, the cross-linguistic feature that both groups attained much lower accuracy rates for Stimulus Type 3 than for the other stimulus types will be discussed. A comparison of pitch, duration, and intensity of the stressed syllable of Stimulus Type 3 and Stimulus Types 1, 2 and 4 reveals that the accuracy rate is closely associated with relative prominence in pitch, rather than duration and intensity, of the stressed syllable to the unstressed one. Table 2 shows that the stressed syllable is more prominent than the unstressed one in pitch, duration, and intensity in Stimulus Types 1, 2 and 4, while the stressed syllable of Stimulus Type 3 is more prominent than the unstressed one both in duration and intensity, but not in pitch; the pitch of the stressed syllable in Stimulus Type 3, as can be seen in the shaded area of Table 2, is much less prominent than that of the unstressed one (167.3 Hz vs. 214.8 Hz or 242. 3 Hz). The fact that both groups attained a much lower accuracy rate for Type 3 thus indicates that the relative prominence in pitch, rather than duration or intensity, was the most effective factor on the perception of English stress.

The accuracy rates are different not only between Stimulus Types 3 and Stimulus Types 1, 2 and 4, but also within Stimulus types 1, 2 and 4, namely, lower accuracy for Type 2 (SK 82% and NKK 80%), and higher accuracy for Type 1 (SK 97% and NKK 99%) and Type 4

(SK 91% and NKK 94%). A comparison of phonetic measures of Stimulus Types 1, 2 and 4 shows that pitch of the stressed syllable is less prominent in Type 2 (119.7 Hz for the unstressed vs. 112.4 Hz for the stressed) while it is more prominent in Type 1 (210 Hz for the stressed vs. 86.7 Hz for the unstressed) and Type 4 (244.8 Hz for the stressed vs. 70.6 Hz for the unstressed). That is, the less the relative prominence of the stressed syllable was, the lower accuracy the subjects attained. The difference in the accuracy rate between Stimulus Types 1, 2 and 4 thus supports that the accuracy rate is associated with relative pitch prominence of the stressed syllable to the unstressed one.

The finding that it is relative prominence in pitch, rather than duration or intensity, that has a decisive effect on stress judgment by both SK and NKK groups leads to the following question: why do they rely on pitch, not duration or intensity? Ou (2010) argued that the heavy reliance on pitch is not a universal feature of L2 stress perception but an effect of L1 tonal system, based on the findings that Spanish speakers, with a stress background, performed as well as English native speakers in the English stress perception test (81% accuracy for Spanish and 91% accuracy for English natives), while Taiwanese and Japanese speakers, with tone and pitch accent language backgrounds respectively, had a lot of difficulties and relied heavily on pitch when perceiving English stress (49% accuracy for Taiwanese and 47% accuracy for Japanese).

The heavy reliance on pitch by the NKK group can be an effect of L1 tonal system as in the case of Taiwanese and Japanese speakers. However, the SK group's heavy reliance on pitch cannot be an effect of L1 tonal system because SK is neither a tone language nor a pitch-accent language. Rather, the fact that the SK group relied heavily on pitch as well as the NKK group indicates that the heavy reliance on pitch is a feature of L2 stress perception by speakers with either a tonal background or a non-stress background.

Secondly, in the experiment not only the SK and NKK groups exhibited cross-linguistic similarities in stress judgment, but also the NKK group exhibited distinguished language-dependency features different from the SK group. The language-dependency feature involves the stress judgment for Stimulus Type 3; the NKK group attained 29.6% accuracy, as compared to SK group attaining 46.5% accuracy and this difference is statistically significant as Table 4 above shows.

The more the subjects rely on prominence in pitch, rather than duration or intensity, the more difficulties they will have with Stimulus Type 3 because the stressed syllable of Type 3 is less prominent than the unstressed one in pitch with duration and intensity being more prominent. The fact that the NKK group attained a significantly lower accuracy rate for Stimulus Type 3 therefore indicates that the NKK group relied significantly more on pitch prominence than the SK group when identifying English stress. Provided that NKK uses tone at the lexical level, and SK uses neither lexical tone nor lexical stress, it can be said that speakers with a tonal background relied significantly more on pitch than speakers with a non-stress, non-tonal background when identifying stress. The heavier reliance on pitch by speakers with a tonal background can be an effect of L1 prosodic system.

In sum the results of the experiment suggest that the heavy reliance on pitch be a feature of L2 stress perception by speakers with either a tonal background or a non-stress background, and that the degree of reliance on pitch vary in relation to the language-specific use of pitch at the lexical level.

5. Conclusion

This study investigated effects of L1 prosodic system on L2 stress perception. For the purpose, an English stress perception experiment was conducted on two groups of Korean EFL learners with different L1 prosodic systems, namely, SK speakers, with a non-stress, non-tonal background, and NKK speakers, with a tonal background. The results showed that cross-linguistically both SK and NKK groups had little difficulties perceiving English stressed syllables when the stressed syllables were more prominent in pitch, rather than duration or intensity, than the unstressed syllables; when the pitch of the stressed syllables was less prominent than that of the unstressed ones, however, both groups had a lot of difficulties identifying English stress. Language-specifically, the NK group had significantly more difficulties when the stressed syllables had less prominent pitch than that of the unstressed ones. These results suggest that both SK and NKK groups heavily relied on pitch when perceiving English stress, and the NKK group relied on pitch more than the SK group. Given that SK is a

non-stress, non-tonal language and NKK is a tone language, it is argued first that the heavy reliance on pitch is a feature of L2 stress perception by speakers with either a tonal background or a non-stress background and secondly that the degree of reliance on pitch varies in relation to the language-specific use of pitch at the lexical level.

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