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The effects of non-native listeners' L1 background and L2 proficiency on the perception of foreign accent for pitch-manipulated native and Chinese accented English speech*

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Xue. Xiaokiao and Joo-Kyeong Lee. 2014. The effects of non-native listeners' L1 background and L2 proficiency on the perception of foreign accent for pitch-manipulated native and Chinese accented English speech. *Linguistic Research* 31(2), 275-303. This study reports a perception experiment of foreign accent where both native and non-native Chinese and Korean listeners participated in judging the foreign accent of native and Chinese accented English speech, but unlike many previous studies, pitch was manipulated to increase and decrease at the peak in statements and at the valley in yes-no questions to find out if non-native listeners' sensitivity to pitch conforms to native listeners. Moreover, the current study attempts to find the effects of non-native listeners' L1 background and L2 proficiency in the extent to which the agreement occurs between native and non-native listeners' ratings. Results showed that the prosodic system pertaining to pitch in their L1 influenced L2 listeners' responses to the synthesized changes of pitch in L2 speech. Non-native Chinese and Korean listeners' perception of foreign accent was also different between statement and yes-no question stimuli as pitch serves as a distinctive function in two syntactic structures of their L1. This all provides the evidence for the effect of non-native listeners' L1 background. Non-native listeners' L2 proficiency also turned out to contribute to the foreign accent judgment only for Chinese high talkers' yes-no question stimuli, which serves as the evidence for the effect of L2 proficiency. However, it held true only when the listeners did not share their L1 with the talkers. **(University of Seoul)**

Keywords foreign accent, pitch, synthesized speech, L1 background, L2 proficiency

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1. Introduction

A great number of studies on L2 speech have been focusing on the segmental aspects of accented speech (Flege, 1991; Flege, 1995; Flege, Munro & MacKay, 1995; Flege, Takagi & Mann, 1995; Flege, Takagi & Mann, 1996; Flege, Bohn and Jang., 1997; Munro, Flege & MacKay, 1996; Kuhl, 1991; Pallier et al., 1997; Takagi & Mann, 1995; Tsukada et al., 2004; Yamada & Tohkura, 1992). They have paid particular attention to the perception and production of L2 vowels and consonants, suggesting that L1 functions as a sieve in the perception of L2 vowels (Flege, 1995; Flege, Bohn and Jang, 1997) and that the production of L2 consonants reflects the acoustic details of the corresponding L1 consonants (Flege, 1987, 1991) and Flege and Eefting (1988). Moreover, it is claimed that the production and perception of L2 segmental contrasts might be correlated with the positionally different phonetic/allophonic features of L1 sounds (Flege, Takagi & Mann, 1995, 1996; Takagi & Mann, 1995; Yamada & Tohkura, 1991 among others). Their concern has been extended to the perception of foreign accent; many studies show that the degree of foreign accent is strongly related to segmental errors such as substitution, deletion and insertion (Anderson-Hsieh, Johnson & Koehler, 1992; Lee & Xue, 2013).

L2 speech researchers have recently changed their attention to prosodic features as they acknowledge that prosody has been long ignored even though it makes an equal contribution to speech. Assuming that human speech is composed of both segmental and prosodic components, they brought up some curiosity about whether prosody played a role as much as segments in the perception and production of L2 speech, and which prosodic parameter, if so, made the most significant contribution to making phonological deviances of L2 from L1 (Anderson-Hsieh, Johnson & Koehler, 1992; Derwing et al., 1998; Isaacs, 2008; Lee & Liu, 2012; Levis & Pickering, 2004; Magen, 1998; Munro, 1995; Munro & Derwing, 1998; Pickering, 2004; Van Els & De Bot, 1987). It has been reported that native listeners relied on segmental information relatively much over prosody (Lee & Liu, 2012) when they judged foreign accent. On the other hand, there have been also some studies which reported their empirical finding that suprasegmentals contributed more to the assessment of foreign accent than segmental (Anderson-Hsieh, Johnson & Koehler, 1992; Kang, 2010; Munro, 1995; Taniguchi, 2001; Van Els & De Bot, 1987; Wennerstrom, 1994 among others). For example, pitch information or intonation was

an important factor in the assessment of foreign accent. On the other hand, Trofimovich and Baker (2007) contended that speech rate was the most prominent attribute to foreign accent.

The current study assumes that tonal features play a significant role in foreign accented speech as exemplified in many previous studies and attempts to manipulate the tonal values of English L2 speech to see both native and non-native listeners' sensitivity to tonal changes. More specifically, in the perception experiment, native listeners evaluated the foreign accent of the pitch-manipulated L2 Chinese speech. This enabled us to separate out the pitch alone from L2 speech and observe its independent role in L2 speech. Along with native listeners, non-native Chinese and Korean listeners also participated in the foreign accent ratings of the same stimuli. Two different L1 backgrounds of the listeners might not produce invariable responses in their judgment of foreign accent as pitch plays a different role in their L1 prosodic systems.

Foreign accent has been usually demonstrated from the perspective of native English listeners responding to foreign accented speech. It has been long assumed as a unique and privileged measure which is merely assessable by native listeners. However, as pointed out in many studies, native listeners' perception of foreign accent is not inherently more valid and meaningful than that of non-native listeners (Flege, 1988; Lee and Xue, 2013; MacKay, Flege and Imai, 2006; Munro, Derwing, and Morton, 2006; Smith & Bisazza, 1982). More specifically, Munro, Derwing and Morton (2006) claimed that there was no prior reason to assume that native listeners' responses were representative of the reactions that might come from the target linguistic community because significant numbers of L2 speakers interacted with non-native speakers themselves as well as native speakers.

Concerning non-native listeners' evaluation of foreign accented speech, their L1 backgrounds and L2 proficiency had a considerable effect as demonstrated in the previous studies (Flege, 1988; Lee and Xue, 2013; Munro, Derwing and Morton, 2006). Chinese listeners were found to scale the accent of Chinese speakers in the same way that native English listeners did (Flege, 1988). This indicated that the same L1 background listeners performed a native-like evaluation of foreign accent. In Lee and Xue (2013), both Chinese and Korean listeners agreed with native listeners in judging the foreign accent of Chinese talkers' L2 English speech only when they were high-proficient in English. The Chinese listeners did not, however,

take advantage of sharing their L1 with the Chinese talkers as their ratings were not significantly different from those of Korean listeners. This was interpreted as indicating that non-native listeners' L2 proficiency is strongly correlated with foreign accent ratings regardless of their L1 backgrounds. This is not consistent with Flege (1988), however.

Furthermore, Munro, Derwing and Morton (2006) showed that Japanese listeners rated Japanese-accented English speech as least accented among 4 different listener groups including native listeners. This suggested that speaking with or being familiar with a particular accent led to better understanding of and ultimately favorable ratings of that accent. Their study did not, however, compare native and non-native listeners' ratings and examine the consistency between them, but simply found out that L2 listeners rated the same L1 background L2 speech favorably as less accented.

Non-native listeners' L2 proficiency did not seem to be taken into consideration in Munro, Derwing and Morton's study because the non-native listeners' proficiency was impressionistically judged as high intermediate by the authors. Moreover, Flege's finding was not consistent with Lee and Xue's concerning the effect of L1 backgrounds. The previous studies shed light on an extended examination of the role of L2 proficiency and L1 backgrounds in both native and non-native listeners' perception of foreign accent, yet using more sophisticated L2 stimuli where pitch information was manipulated in a scalar manner.

There have been some previous studies which focus on the role of pitch or intonation in L2 speech since the importance of prosody was brought up in the investigation of L2 speech. Van Els and DeBot (1987) was a pioneering work; that is, they found that native Dutch and Dutch L2 utterances were less successfully recognized for foreign accent when pitch information was removed than when pitch was retained. Anderson-Hsieh, Johnson and Koehler (1992) investigated the correlation between foreign accent ratings and deviances in segmentals, intonation, and syllable structure and showed that intonation had the strongest effect on native listeners' perception of foreign accent. Munro (1995) used low-pass filtered L2 speech stimuli where segmental information was removed and fundamental (low) frequency was merely retained. He reported that English native listeners still could successfully judge foreign accent from the speech where only pitch information was available.

While these studies highlighted the role of pitch/intonation through various

perception tasks, Wennerstrom (1994) conducted a production test and measured the intonational features in native and non-native English utterances. Both native and non-native talkers were asked to do the oral reading and free speech tasks designed to elicit contrasts between high and low pitch accents in information structures. The results revealed that the native talkers used significant pitch contrasts to signal meaning, but it was not the case for the non-native Spanish, Japanese and Thai talkers.

Another production test of Wennerstrom (1998) recorded the spontaneous lectures from 18 Mandarin Chinese talkers of English who were preparing for an examination of teaching assistants at an American university. The pitch values of content words, function words and phrase boundaries and the pitch ranges were measured. Most importantly, Chinese talkers had more compressed pitch ranges than native speakers. This was consistently found in the studies of Slovak EFL learners (Timkova, 2001), Japanese learners of English (Taniguchi, 2001), Finnish speakers of English (Toivanen, 2003), and Saudi EFL learners (Binghadeer, 2008).

Similarly Kang (2010) showed that a pitch range best predicted foreign accent in her perception study. She examined the effects of the individual suprasegmental features including speech rate, pauses, stress and pitch range on native listeners' perception of L2 foreign accent. The results demonstrated that the overall pitch range best predicted the non-native talkers' accentedness in such a way that listeners judged the English L2 speech with less pitch variations as more accented.

A more advanced technology was adopted to investigate the significance of pitch in L2 speech. The natural stimuli used for the perception of accentedness entailed both segment and prosody information in the previous studies; therefore, the relations observed in the measures of prosody and foreign accent were always indirect because the accentedness evaluation was not about prosody alone but the whole speech containing both prosody and segments. Munro (1995) attempted to explore rather an exclusive role of pitch in the judgment of foreign accent and utilized a more advanced synthetic technology 'a low-pass filtering'. He compared both low-pass filtered and unfiltered speech of L2 Mandarin and L1 Canadian talkers for native American English listeners' perception of foreign accent. Surprisingly native listeners correctly judged that Mandarin talkers' speech was more strongly accented even when the intonation information was only available. This suggests that prosody alone, especially pitch contour, is sufficient for the identification of foreign accent. A

similar methodology was used in Jilka (2000), in which the low-pass filtered speech of German and American English was presented to both native German and American English listeners for the identification of language and accent. The listeners could successfully differentiate German from English based on pitch information alone.

Assuming that pitch makes a considerable contribution to the perception of foreign accent, the current work manipulates the pitch information of non-native talkers' speech and investigates both native and non-native listeners' sensitivity to synthetically higher and lower pitch values with everything else kept intact. Of particular concern here is that the listeners' ratings of foreign accent are examined as a function of pitch change, seeking for the answer to the question of whether non-native listeners' ratings agree with those of natives. In the light of the claim that pitch is an important attribute to detecting foreign accent as evidenced in many previous studies, the present study manipulated the pitch of native English and Chinese accented English speech to see how both native and non-native listeners would respond to the pitch changes in the perception of foreign accent. In addition, the listeners' ratings were statistically analyzed to observe the extent to which non-native listeners agreed with native listeners, whereby the correlation coefficients would be exerted to indicate the effects of non-natives' L1 background and L2 proficiency on the perception of foreign accent. In other words, more native-like or more equivalent rating patterns to natives would be attributed to an interactive effect of non-natives' L1 phonological structures and L2 proficiency. Here are two research questions for the current study;

(1) Do non-naitve listeners agree with native listeners in the evaluation of foreign accent for the pitch-manipulated L1 and L2 English statements and yes-no questions?
(2) Do non-native listeners' L1 backgrounds and L2 proficiency affect the perception of foreign accent especially in pitch synthesized speech?

2. Experiment

2.1 Talkers and listeners

Nine talkers including three English native talkers (NT), three high proficiency non-native Chinese talkers (CHT) and three low proficiency Chinese talkers (CLT) took part in the recordings. All the talkers were females in order to have a unified standard for pitch manipulations. Two of the native talkers were instructors at a university in Seoul, and the other one was an exchange student from America. Their ages ranged from 21 to 35 years.

Non-native talkers came from China, and their English proficiency was determined in an Accentedness Rating task. Ten Chinese female students were recruited at a university in Seoul and were asked to read an English passage consisting of 5 sentences.

[1]Their recordings were presented to five English native listeners to rate the degree of foreign accent on a 9-point Likert scale (1=native-like; 9=strong foreign accent). None of these listeners were talkers or listeners in the perception experiment of pitch manipulated stimuli. The results of the Accentedness Rating task are shown in Figure 1. Talkers 1, 2 and 10, whose rating scores were higher than 7, were sorted out as low proficiency talkers. On the other hand, talkers 4, 5 and 6, who showed their rating scores lower than 3, were determined to be high proficiency talkers.

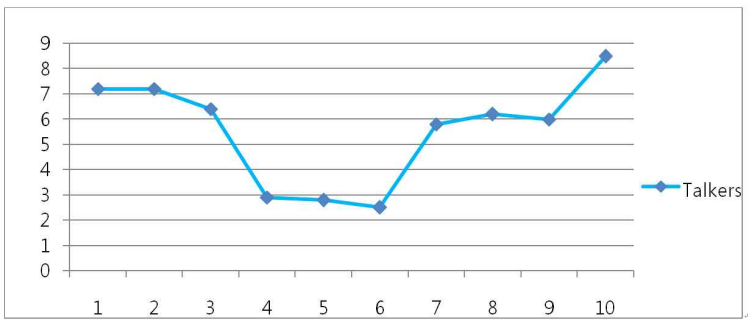

Figure 1. Accent ratings for ten potential Chinese talkers.

[1] See Appendix 1.

As for the listeners, five different groups participated in the perception experiment, each of which consisted of 10 listeners: English native, non-native Chinese high and low proficient and non-native Korean high and low proficient listeners. The native English listeners (EL) were four male and six female exchange students at a university in Seoul, and they were 20 to 25 years old. They had lived in Korea for about six months, and none of them learned Chinese before.

Non-native Chinese and Korean listeners were divided into high and low proficiency in the same Accentedness Rating task as the non-native talkers did. In order to collect ten high and ten low proficient Chinese and Korean listeners, 29 Chinese speakers and 25 Korean speakers were recruited and were asked to read the same English passage as the Chinese talkers read (Appendix 1). Their recordings were submitted to the same five raters as in the Accentedness Rating task for selecting the Chinese talkers, and the recording stimuli were rated for foreign accent in the 9-piont Likert scale. Those who received lower than 3 were categorized as high proficiency listeners, and those who received higher than 7 were determined to be low proficiency listeners. As shown in Figure 2, ten subjects in the solid box were chosen for Chinese high proficiency listeners, and ten subjects in the dotted box were selected as Chinese low proficiency.

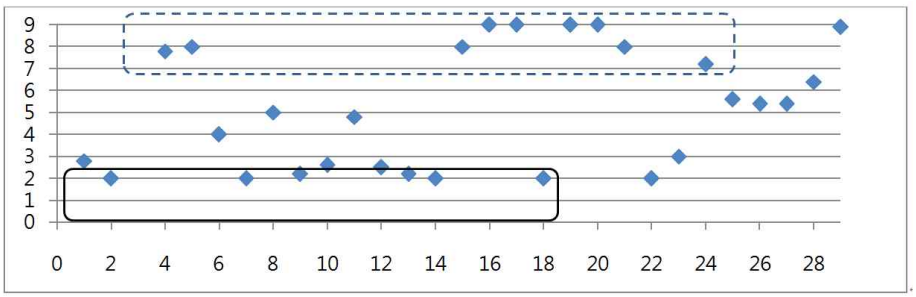

Figure 2. Accent ratings for 29 potential Chinese listeners

Figure 3 shows the results of accent ratings for 25 potential Korean listeners. Ten of them received their rating scores lower than 3, and they were labeled as Korean high proficiency listeners. However, there were 13 subjects in the score range between 7 to 9 who satisfied the requirement of low proficiency. In order to balance the number of subjects in the listener groups, potential listeners 19, 20, 21

whose scores were the lowest, were excluded.

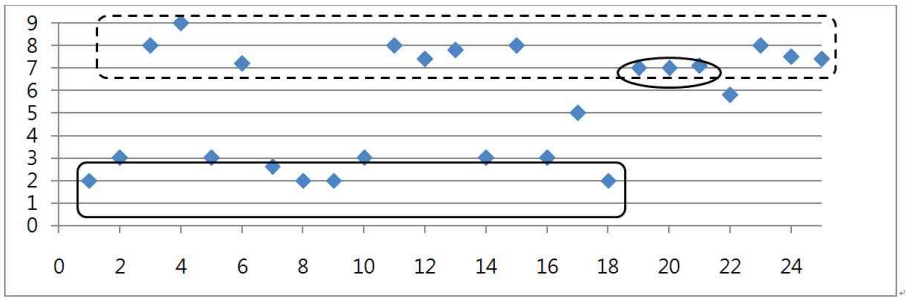

Figure 3. Accent ratings for 25 potential Korean listeners

2.2 Stimuli

Three native and six Chinese talkers were asked to read a sentence list containing three English statements and three yes-no questions.[2] These two sentence types are a representative English structure of final lowering and rising intonation, respectively. Since the pitch was manipulated to increase and decrease at both the high pitch accent (H*) and the low pitch accent (L*) in the stimuli, generating different degrees of lowering and rising, we assumed that it would be more reliable to examine listeners' perception of pitch changes in two distinctive tonal patterns. Each statement was intended to have only one high pitch accent so that its tonal peak could be simply manipulated to go higher and lower, and each yes-no question was intended to have only one low pitch accent so its tonal valley could be solely controlled to go higher and lower. All the recordings were carried out in a sound attenuated room using the Praat program. In total, 54 natural stimuli had been acquired for pitch manipulation.

27 statements produced by three native talkers and three Chinese high and low proficient talkers were synthesized in the Praat program. As shown in Figure 4, the pitch value of the high pitch accent in each statement was raised up by 20 Hz up to 100Hz. In addition, the peak pitch was also lowered by 20Hz down to 100Hz. There were ten synthesized statement stimuli produced and one original statement speech; therefore, 297 statement stimuli (11 stimuli * 3 statements * 9 talkers) were

[2] See Appendix 2.

served to one listener in the perception experiment.

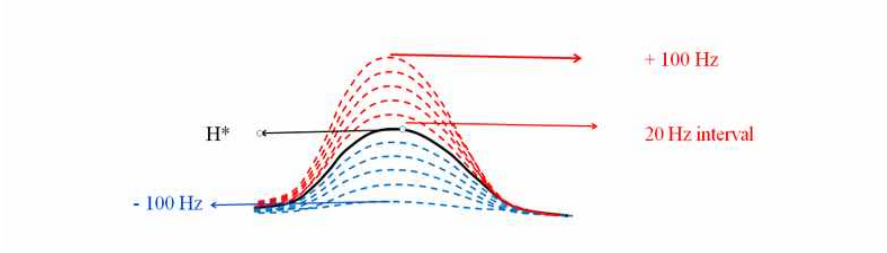

Figure 4. Pitch manipulations of the high pitch accent in a statement

In order to manipulate the pitch of yes-no questions, similarly to the manipulation of the statements, the f0 of the low pitch accent in each question was synthesized to increase up to 100Hz and decrease down to 100Hz in 20Hz intervals. Consequently, there were 10 synthesized question stimuli generated and one original recording. There were 297 yes-no question stimuli (11 stimuli * 3 statements * 9 talkers) used for the judgments of foreign accent. In total, 594 audio stimuli including statements and yes-no questions were randomized and presented to the listeners in the perception experiment.

2.3 Procedure

Fifty participants (ten native and forty non-native Chinese and Korean listeners) were asked to rate foreign accent for 594 stimuli including 540 synthesized and 54 original speech. Before they actually began the judgment experiment, they had a short trial session whereby they went through ten pitch-manipulated statements which did not belong to the stimuli set. This trial session was intended to help participants simply acquire a general sense of coherent criteria for judging the foreign accent. Participants were instructed that they would hear a speech sound first and then see the numbers from 1 to 9 on the computer screen. They were asked to press a number on the keyboard for the foreign accent of the audio stimulus that they had just heard. Since this was a forced-choice task, the next audio stimulus would not proceed to be heard unless they chose a number. The listeners wore an AKG K240 headphone, and the perception task was carried out in the software SuperLab Pro (version 4.5). The listeners participated in the task individually in a quiet room, and

the program was designed to have two 3-minute breaks to avoid any exhaustion due to an excessive amount of inputs. It took about 30 minutes to finish all 594 stimuli.

3. Results

Due to the fact that the pitch values of the accentual peaks were not invariant from sentence to sentence among nine talkers, 20Hz-interval increases and decreases from the peaks would be all different. For example, even though a peak pitch increased by 20Hz in a talker's statement, it should not result in the identical pitch value of another talker's manipulated peak in the same sentence. Therefore, accent ratings could not be analyzed in association with pitch values but they were rather examined in accordance to the incremental/decremental scales of pitch synthesis. That is, accent ratings were compared between native and non-native listeners at ten different synthetical pitch scales and one original 0 (zero) point to see how native listeners' rating were correlated with those of non-native listeners as pitch increased and decreased.

Prior to the statistical analysis, we examined the inter-rater reliability within each group. This was mainly to see if the raters were consistent enough to have coherent criteria for judging the foreign accent. As the Spearman-Brown correlation value of each group were 0.876 for native listeners, 0.890 for Chinese high proficiency listeners, 0.851 for Chinese low proficiency listeners, 0.930 for Korean high proficiency listeners, and 0.90 for Korean low proficiency listeners ($p<0.05$), the inter-rater reliability turned out to be statistically significant.

As seen in Figure 5, the average foreign accent ratings for Chinese high proficiency talkers' statements were displayed according to the pitch manipulation scales and compared among 5 groups of listeners. Native listeners show downward ratings as the pitch values at the peak increased, and Chinese high and low listeners (CHL and CLL) marked by filled and empty circles respectively show a similar trend. Both Korean high and low listeners (KHL and KLL) marked by filled and empty triangles, on the other hand, exhibit a bit increasing ratings toward the higher pitch values at the H* peak.

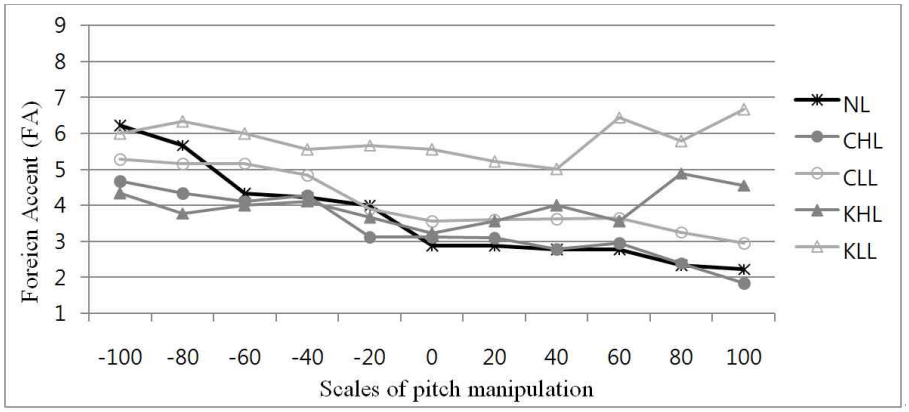

Figure 5. Foreign accent ratings of native and non-native listeners for the pitch manipulated English statements of Chinese high proficiency talkers (NL: native listeners, CHL: Chinese high proficiency listeners, CLL: Chinese low proficiency listeners, KHL: Korean high proficiency listeners, and KLL: Korean low proficiency listeners)

Table 1 presents a statistical result of Figure 1, showing how closely correlated native and non-native listeners' ratings were as the pitch scales increased and decreased. The ratings of the Chinese high and low proficiency listeners were significantly correlated with those of native listeners in the foreign accent judgment for Chinese high talkers' pitch-synthesized speech. However, Korean listeners, either low or high, did not significantly agree with native listeners.

Table 1. Pearson Correlations between native and non-native listeners' foreign accent ratings for Chinese high proficiency talkers (statements)

	CHL vs. NL	CLL vs. NL	KHL vs. NL	KLL vs. NL
Pearson Correlation	.252*	.221*	.043	.151
Sig. (2-tailed)	.026	.032	.710	.186

Figure 6 shows the average foreign accent ratings at eleven pitch points of the H* peak (ten synthesized and one original). It is easily recognized that the ratings were overall higher than in Figure 1 as the speech stimuli presented in this task were obtained from low proficiency talkers who had a stronger accent and more deviant segmental features than high talkers. Due to the influence of the segmental and other prosodic features, the overall ratings turned out to be higher (stronger accent).

Korean high proficiency listeners marked by filled triangles showed the most distinctive pattern from native listeners because most of their rating scores are more distant from those of native listeners than the other three non-natives' scores except the first two pitch values -100 and -80. Korean low proficiency listeners marked by empty triangles seem to be next distinctive from native listeners; the downward rating pattern drastically changed at 0 (original pitch), showing higher scores than native listeners. On the other hand, both Chinese high and low proficiency listeners represented with filled and empty circles appear to similar to native listeners along with all pitch scales. Overall native listeners showed the descending scores as the pitch values increased. Chinese listeners seem to have rated the Chinese L2 stimuli in a similar way unlike Korean listeners.

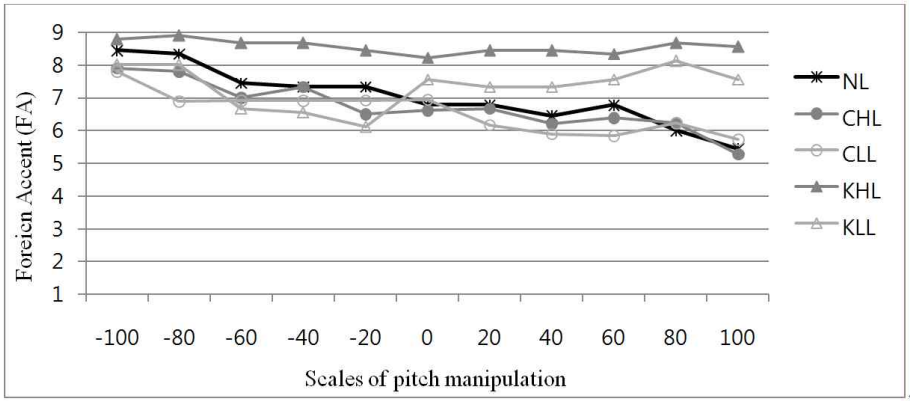

Figure 6. Foreign accent ratings of native and non-native listeners for the pitch manipulated statements of Chinese low proficiency talkers

Table 2 shows the statistical result of Figure 6. Chinese high and low listeners' ratings were significantly correlated with those of native listeners while Korean listeners, either high or low, did not show a significant agreement with native listeners. The graphical illustrations in Figure 6 were consistently reflected in the statistical consequence of Table 2; only Chinese listeners' rating patterns were significantly similar to those of native listeners.

Table 2. Pearson Correlations between native and non-native listeners' foreign accent ratings for Chinese low proficiency talkers (statements)

	CHL vs. NL	CLL vs. NL	KHL vs. NL	KLL vs. NL
Pearson Correlation	.388*	.234*	.133	.134
Sig. (2-tailed)	.000	.000	.190	.120

The non-native Chinese and Korean listeners' rating data were sorted by the background and proficiency factors and resubmitted to the Pearson Correlation in order to see the independent and separate role of L1 background and L2 proficiency. As seen in Table 3, the effect of L1 background held true for both high and low proficiency Chinese talkers' speech; Chinese listeners' ratings were significantly correlated with those of natives for both high and low talkers' stimuli. However, listeners' L2 proficiency did not play a role because either high or low listeners did not conform to native listeners.

Table 3. Pearson Correlations between native and non-native listeners' foreign accent ratings sorted by L1 background and L2 proficiency (statements)

	L1 background		L2 proficiency	
	CL vs. NL	KL vs. NL	HL vs. NL	LL vs. NL
High talkers	.496*	-.076	.176	.092
Low talkers	.220*	.165	0.056	0.033

$p < 0.01$

The listeners' foreign accent ratings for native talkers' statement stimuli are shown in Figure 7. The scores are remarkably lower than for the Chinese talkers' stimuli; they are all between 1 and 3. All the listener groups responded considerably steadily whether the peak of the high pitch accent (H*) went up or down in the statements. In other words, native or non-native listeners did not seem to be sensitive to pitch changes when they listened to native speech.

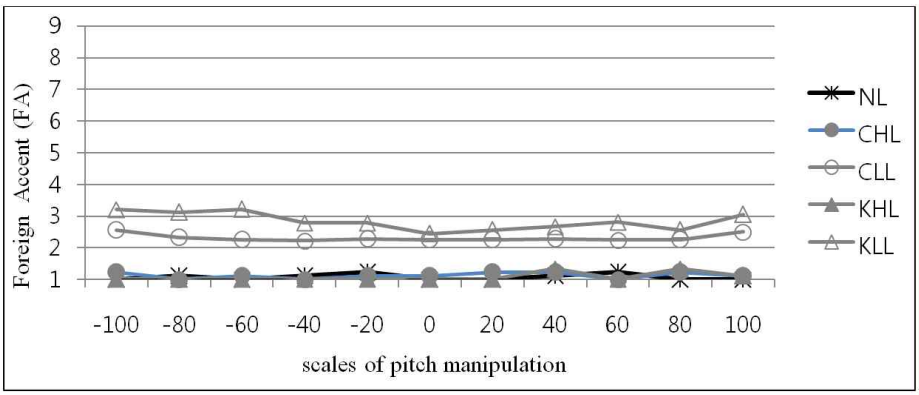

Figure 7. Foreign accent ratings of native and non-native listeners for the pitch manipulated statements of native talkers

The foreign accent scores were submitted to the Pearson Correlation statistics and presented in Table 4. Both Chinese and Korean listeners agreed with native listeners when they rated native talkers' statement stimuli. That is, non-native listeners, regardless of their proficiency, judged foreign accent in a significantly similar way to native listeners.

Table 4. Pearson Correlations between native and non-native listeners' foreign accent ratings for native talkers (statements)

	CHL vs. NL	CLL vs. NL	KHL vs. NL	KLL vs. NL
Pearson Correlation	.558*	.224*	.532*	.234*
Sig. (2-tailed)	.000	.000	.000	.000

Moving onto the results of yes-no questions, Figure 8 shows native and non-native listeners' judgments for the pitch-manipulated stimuli of Chinese high proficiency talkers' yes-no questions. As opposed to the responses to the statement stimuli, native listeners' ratings increase as the manipulated pitch values increase even though a relatively drastic change occurs at the point of 60. That is, native listeners evaluated the L2 Chinese high talkers' yes-no questions as stronger foreign accent as the valley of the low pitch accent (L*) went swallow. The most similar to natives' upward change were Korean high proficiency listeners while the other three listener groups do not show a consistent ascending pattern.

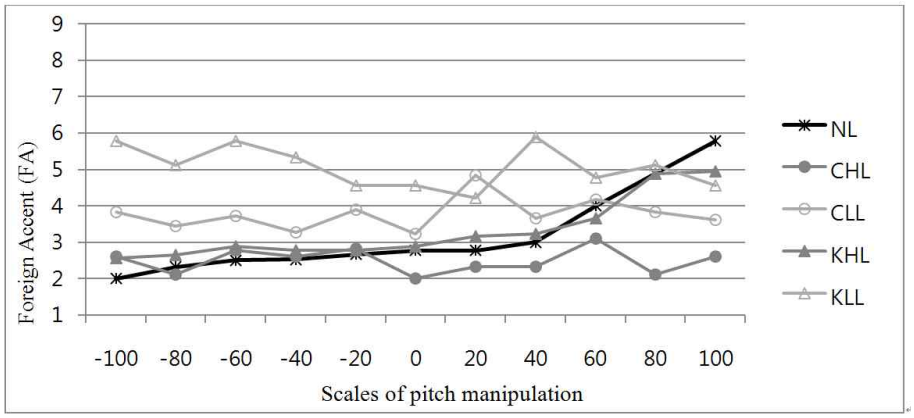

Figure 8. Foreign accent ratings of native and non-native listeners for the pitch manipulated yes-no questions of Chinese high proficiency talkers

The graphical illustrations shown in Figure 8 are statistically verified in Table 4. Korean high listeners only showed a significant correlation with native listeners. Chinese high and low and Korean low listeners' ratings did not, however, significantly agree with those of native listeners in the responses of yes-no question stimuli. This is exactly opposite to the case of statement stimuli as presented in Tables 1 and 2. The Chinese listeners judged foreign accent in a statistically similar way to native listeners, while Korean listeners did not.

Table 5. Pearson Correlations between native and non-native listeners' foreign accent ratings for Chinese high proficiency talkers (yes-no questions)

	CHL vs. NL	CLL vs. NL	KHL vs. NL	KLL vs. NL
Pearson Correlation	.171	-.082	.359*	.063
Sig. (2-tailed)	.090	.422	.000	.537

Figure 9 shows the foreign accent responses to Chinese low talkers' yes-no question stimuli. Native listeners responses decrease as the original pitch goes down (-20 to -100) though the score at -100 slightly increases. The rating scores seem to be steady with little change from the original pitch value 0 to 100. That is, native listeners evaluated the Chinese low talkers' yes-no questions as weaker foreign accent if the valley of the low pitch accent (L*) altered deeper. However, the rating

scores were steadily between 8 and 9 even when the valley became swallower. None of L2 listeners' foreign accent scores appear to be graphically similar to native listeners' scores; the increasing (-100 to 0) and then steady (0 to 100) pattern is not clearly observed in non-native listeners' ratings.

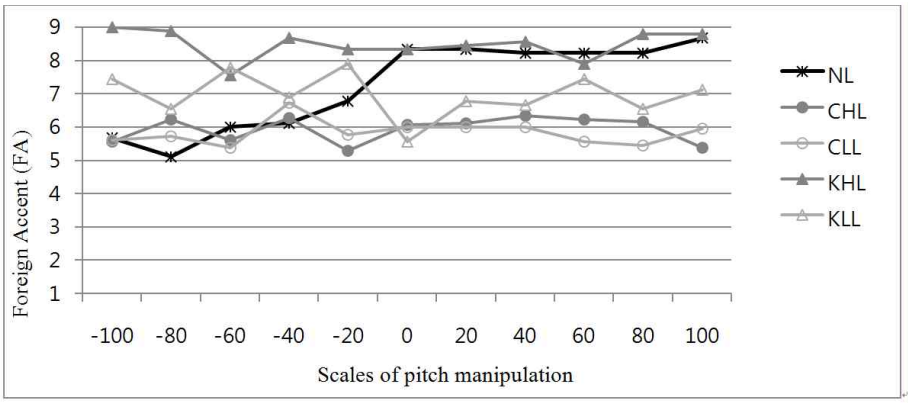

Figure 9. Foreign accent ratings of native and non-native listeners for the pitch manipulated yes-no questions of Chinese low proficiency talkers

As presented in Table 6, no groups of non-native listeners showed significant correlations with native listeners. Either Chinese or Korean listeners' ratings did not agree with those of native listeners, indicating that non-naitve listeners had different sensitivity to pitch changes when they listened to Chinese low talkers' yes-no questions.

Table 6. Pearson Correlations between native and non-native listeners' foreign accent ratings for Chinese low proficiency talkers (yes-no questions)

	CHL vs. NL	CLL vs. NL	KHL vs. NL	KLL vs. NL
Pearson Correlation	.037	.047	-.067	.134
Sig. (2-tailed)	.718	.642	.512	.185

The non-native Chinese and Korean listeners' rating data for yes-no question stimuli were also sorted by the background and proficiency factors and resubmitted to the Pearson Correlation in the same way as Table 3. Table 7 shows that Korean

listeners were only significantly correlated with native listeners, and this provides the evidence for the effect of L1 background. In addition, non-native high listeners' scores agree with those of native listeners while low listeners did not show such an agreement. Therefore, non-natives' L2 proficiency also turned out to hold true.

Table 7. Pearson Correlations between native and non-native listeners' foreign accent ratings sorted by L1 background and L2 proficiency (yes-no questions)

	L1 background		L2 proficiency	
	CL vs. NL	KL vs. NL	HL vs. NL	LL vs. NL
High talkers	.030	.206*	.269*	.002
Low talkers	.042	-.093	0.005	0.057

$p < 0.01$

Finally, let's look at Figure 10. Similarly to the responses to native talkers' statements, no noticeable change is observed over the 11 step scales; the scores were merely between 1 and 3, indicating that all the groups of listeners judged native talkers' yes-no questions as extremely low accent.

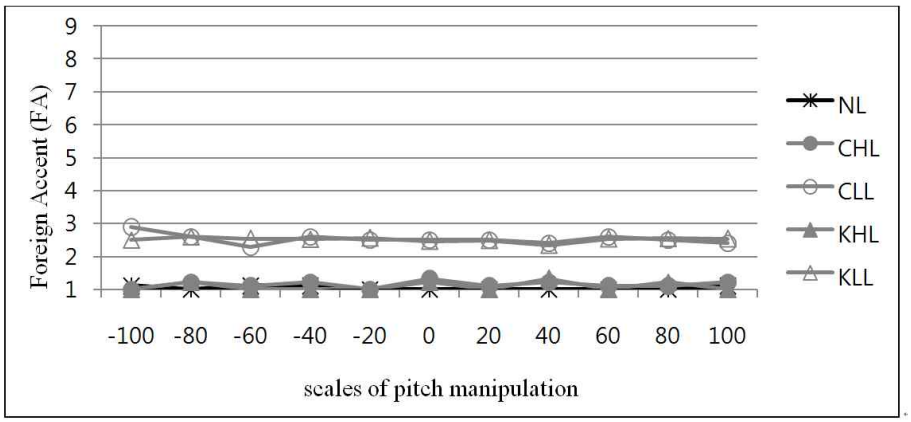

Figure 10. Foreign accent ratings of native and non-native listeners for the pitch manipulated yes-no questions of native talkers

As presented in Table 8, all groups of the non-native listeners revealed significant correlations with native listeners though high proficiency listeners showed

stronger correlations than low listeners. Both Chinese and Korean listeners judged foreign accent in a considerably similar manner to native listeners when they listened to the pitch-manipulated stimuli of native talkers' yes-no questions.

Table 8. Pearson Correlations between native and non-native listeners' foreign accent ratings for native talkers (yes-no questions)

	CHL vs. NL	CLL vs. NL	KHL vs. NL	KLL vs. NL
Pearson Correlation	.321*	.238*	.284*	.187*
Sig. (2-tailed)	.000	.000	.000	.000

4. Discussion

We have seen native and non-native Chinese and Korean listeners' rating patterns of foreign accent for pitch-manipulated Chinese-accented and native English statements and yes-no questions. As previous studies have shown that listeners' response to L2 speech might be influenced by non-natives' proficiency and L1 background (Flege, 1988; Lee and Xue, 2013; Munro, Derwing and Morton, 2006), we also considered these two factors in the current study as their findings were not still reliably consistent. The non-native listeners were divided into talkers' same L1, Chinese and different L1, Korean, and the non-native talkers and listeners were varied into high and low proficiency. The listeners' rating scores were submitted to the Pearson Correlation statistics to see how comparable native and non-native listeners would be to each other and which factor, L1 background or L2 proficiency, would contribute more to producing native-like rating patterns.

As shown in Figure 5 and Table 1, we found statistically significant correlations between Chinese listeners and native listeners for Chinese high talkers' stimuli ($r = 0.252$ for high listeners, and $r = 0.221$ for low listeners, $p < 0.05$). Similarly Chinese listeners' scores were significantly correlated with natives' scores in the perception of Chinese low talkers' stimuli as presented in Figure 6 and Table 2 ($r = 0.388$ for high listeners, $p < 0.01$, and $r = 0.234$ for listeners, $p < 0.05$). That is, both high and low proficiency listeners of Chinese agreed with native listeners when they judged foreign accent for both high and low Chinese talkers' stimuli. Concerning the

graphical structure of the mean scores, native and Chinese listeners consistently showed the decreasing ratings (lower accent) as the height of the accentual peaks increased as seen in Figures 5 and 6. This configuration was supplemented by the statistical results presented in Table 3; Chinese listeners' responses were only significantly correlated with those of native listeners, while Korean listeners did not show a statistically meaningful correlation with natives. This provides the evidence for the effect of listeners' L1 background, but the effect of L2 proficiency did not hold true. That is, Chinese listeners, regardless of their proficiency, had a similar sensitivity with native listeners toward the pitch changes in English statements, but Korean listeners did not.

What phonological features effective only to Chinese then played a role in making more native-like rating patterns of foreign accent? Why did Korean listeners not respond to the pitch changes of 20Hz in a similar way to native listeners? We may need to consider the substantial differences of pitch-related prosodic systems among the listeners' L1, English, Chinese and Korean. Both Chinese and English listeners have their L1 where pitch plays an important role. Lexical tones are phonologically distinctive features faithfully realized in the surface intonation in Chinese. Moreover, lexical stress manifests its prominence in the pitch contour of utterance in English. Even though duration and intensity of the stressed syllable may be intensified, pitch has been appreciated to be the most important attribute of lexical stress because it is realized as a pitch accent in utterance. Therefore, both Chinese and English listeners were familiar with pitch increase and decrease in speech and equally sensitive to the pitch modifications in the perception task.

Korean listeners, however, did not respond correctly to the manipulated pitch. As illustrated in Figure 5, they were not as sensitive to pitch increase/decrease because their responses merely ranged between 3 and 5 if they were high proficiency and 5 and 7 if they were low proficiency. On the other hand, native listeners' scores were between 2 and 7. Looking at Figure 6, you can find that Korean listeners' scoring ranges were even smaller for Chinese low talker; 8 to 9 in the case of Korean high listeners and 6 to 8 in the case of low listeners. For the same stimuli, native listeners showed a range of 5 to 9. Korean listeners' L1 prosodic system does not involve a critical role of pitch equivalent to stress-associated pitch accents in English or lexical tone-associated pitch contours in Chinese, but merely concerns the surface intonational configurations which are mostly related with semantic and/or syntactic

structures.[3] Consequently, the pitch-related prosodic systems of listeners' L1 turned out to play a significant role in the perception of foreign accent. How similar non-native listeners' ratings are to native listeners seems to be closely affiliated with how effectively the particular prosodic parameter under control functions in the non-native listeners' L1.

Recall Figure 7 and Table 4 where the correlations were presented for native talkers' statement stimuli. Both Chinese and Korea non-native listeners showed significant correlations with native listeners. Rating scores did not noticeably change even when the pitch values of the peak increased or decreased in Figure7. Given the fact that the scores were all between 1 and 3, the listeners did not seem to be influenced by the pitch changes, though non-native low proficiency listeners rated it slightly higher. This should not be because they were not sufficiently susceptible to pitch as it was already seen before that English and Chinese listeners respectively had their own pitch associated features in their L1s which were successfully activated in the process of the stimuli perception. Then what brought about such invariable rating scores? Native talkers' segmental information, that is, unaccented articulations of segments, might perceptually mask the pitch changes by 20 Hz intervals. The listeners seemed to judge the foreign accent of natives' stimuli, mostly relying on segmental information. The additional increase/decrease in pitch did not seem to enhance/deteriorate the overall impression of foreign accent probably due to the precise articulation of segments.

Turning our attention to the results of yes-no questions, Figure 8 and Table 5 showed that Korean high proficiency listeners only had a significant correlation with native listeners for the Chinese high proficiency talkers' stimuli. Both native and Korean high listeners judged the foreign accent as higher (stronger accent) as the pitch values of the valley increased at the low pitch accent (L*). On the other hand, Chinese listeners and Korean low listeners did not show such consistent patterns. What is worth noting here is that Chinese listeners' ratings did not agree with those of native listeners unlike the case of the statement stimuli. What might be the factor which drove the Chinese listeners confused with the pitch changes in yes-no

[3] The smallest tone bearing phrase is Accentual Phrase (AP) in Korean. Basically it has a structure of LHLH, but it may be modified according to the number of syllables in it. The boundary tone of Intonational Phrase (IP) is simply either rising or falling in association with sentence types; the falling contour commonly occurs in the statements, and the rising contour is occurs in both yes-no and wh-questions.

questions? As mentioned before, non-native listeners' perception of foreign accent is to some extent affected by their L1 prosodic structure and function. The lexical tones intrinsically installed in words interact with the final rising in a complicated way in Chinese (Liu, 2009). For example, a lexical falling tone is realized as a rise-fall contour in the final position of a yes-no question, yet the falling is stiffer than in the statement counterparts. Because the lexically installed falling tone interacts/combines with the structurally assigned rising tone, the final tone first rises due to the structure tone and then falls due to the lexical tone. The rising is more extensively higher, resulting in a stiffer falling configuration in the end of the yes-no question. Therefore, such interactions/combinations between lexical and structural tones in Chinese L1 implement phonetically various final tones in Chinese yes-no questions; that is, the final tone is not simply rising. This might cause the Chinese listeners to fail to detect the constant rising correctly, again suggesting that non-native listeners' perception of foreign accent reflected their L1 prosody structure and function pertaining to the stimuli.

On the other hand, Korean high proficiency listeners only conformed to native listeners in yes-no questions. As mentioned in the results of the statements, pitch is not a lexical associate, but merely implemented onto the surface flow of utterance in standard Korean. Pitch prominence is not realized on a specific syllable, either lexically stressed in English or tonally designated in Chinese, but the overall pattern is determined by the tonal frame of accentual phrase (AP) rather than lexically. That might be the reason why Korean listeners did not respond to the pitch changes of statements in a similar way to English native and Chinese listeners in statements. However, the same results were not found in the case of yes-no questions. Korean high listeners were as sensitive to the final rising of yes-no questions as native listeners. Focusing on the pitch patterns of Korean questions, all of them including yes-no questions have a final rising; that is, Korean listeners should be familiar with the final rising pattern in English. Consequently they could successfully judge the rising contour even when the extent of rising was controlled. This shows that non-native listeners' perception of L2 may differ in sentence types, especially when a phonological feature like pitch is manifested globally as opposed to locally.

Then why did Korean low proficiency listeners fail to recognize the final rising similarly to natives? The phonological features in their interlanguage should be more dissimilar from native norms than high proficiency listeners due to their strong

accent. Such deviant features - not only segmental but also prosodic – sometime lead to inadequate phonetic production and perception. For instance, the final upstep rising (H-H% according to the ToBI transcription system) was mistakenly replaced with a slight rising (L-H%) in the English yes-no questions produced by many Korean learners (Lee, 2008). Along the same line, they were not correct in the perception as shown in Figure 8. This suggests that listeners' proficiency contributes to the perception of foreign accent, but only in the case of Korean listeners. Such a difference in non-native proficiency did not occur to Chinese listeners either in statement or yes-no question. According to Munro, Derwing and Morton (2006), non-native listeners evaluated non-native talkers who shared the same L1 more generously as less accented, which might be attributed to their famiriarity with the talkers' segmental and prosodic features in L2. This finding is extensively associated with the studies on interlanguage speech intelligibility benefit (ISIB) where non-native talkers were more intelligible to the non-native listeners who shared the same L1 due to their interlangauge (Bent and Bradlow, 2003; Hayes-Harb, et al, 2008; van Wijngaarden, et al.; 2002 among others). Event though Chinese low listeners may have more dissimilar phonological/phonetic featuers from natives than Chinese high listeners, Chinese talkers might share more similar sound features with Chinese low listeners than Korean low listeners. This might be the substantial reason why L2 proficiency did not have an effect on Chinese listeners' perception of Chinese accented speech.

As summarized in Table 7, it was clearly seen that both L1 background and L2 proficiency played an equal role in the perception of yes-no question stimuli. The difference in L1 background between Chinese and Korean should be attributed to the different tonal configurations of yes-no questions in their L1s. That is, the prosodic system pertaining to pitch in their L1 influenced L2 listeners' sensitivity to pitch in L2 speech. In addition, non-native listeners' L2 proficiency turned out to contribute to the foreign accent judgment only for Chinese high talkers' yes-no question stimuli. The same effect did not hold true in the perception of statements stimuli, but this does not seem to be attributed to the difference in syntactic structure. When native-like ratings occurred to the non-native listeners whose L1 is the same as the non-native talkers, their L2 proficiency did not seem to play a considerable role, because they commonly share Chinese accented L2 phonological/phonetic features in their interlanguage regardless of their L2 proficiency. When the listeners did not

share their L1 with the talkers, that is, when they did not take advantage of their interlanguage, high proficiency listeners could succeed to perform a correct judgment of foreign accent only for high talkers' speech because they may share more L1-like sound features regardless of their L1 backgrounds.

What happened if Chinese low proficiency talkers' yes-no question stimuli were presented? Looking at Figure 9 and Table 6 together, there was no case of significant correlations between native and non-native ratings. Even high proficiency Korean listeners did not conform to native listeners. This might be ascribed to more dissimilar/less native-like phonological features in the interlanguage of Chinese low talkers than high talkers. Such strongly accented and deviant segmental information might perceptually mask the prosodic changes in pitch. As seen in Figure 9, Korean high listeners' ratings marked by filled triangles were consistently between 8 and 9 except for a slight decrease to around 7.5 at the pitch scale of -80. That is, the listeners were not sensitive enough to pitch probably due to the perceptual masking of strongly accented segmentals onto the scalar changes in pitch.

This kind of perceptual masking occurred in Figure 10 and Table 8 in the perception of native talkers' yes-no question stimuli. Overall the ratings were almost invariable between 1 and 3 in all the groups of listeners, which is almost identical to the results of the native statement stimuli in Figure 7. Again, this does not indicate that they were not sufficiently susceptible to pitch. Native talkers' segmental information, that is, almost precise and unaccented articulations of segments, perceptually masked the pitch changes, resulting in far lower accent scores (weaker accent). The perceptual masking process of segments onto pitch seemed to take place when the segments were strongly accented/least native-like or highly unaccented/most native-like. Given the fact that segments contribute more to the perception of foreign accent than prosody (Lee & Liu, 2012; Lee, 2014; Liu & Lee, 2012), a small change in pitch might not effectively and/or sufficiently alter the listeners' judgments of foreign accent when the segmental information already determines the overall impression of the accented speech if it is too deviant to be supplemented by prosody or it does not need to be augmented by prosody.

The results presented in the current perception task suggest that pitch plays different roles in non-native listeners' evaluation of foreign accent depending on their L1 backgrounds and L2 proficiency. Non-native Chinese and Korean listeners' perception of foreign accent was also different between statement and yes-no

question stimuli as pitch serves a distinctive function in two syntactic structures of their L1. This all provides the evidence for the effect of non-native listeners' L1 background.

5. Conclusion

We have presented a perception experiment of foreign accent where both native and non-native Chinese and Korean listeners participated to judge foreign accent for the pitch manipulated Chinese accented English statements and yes-no questions. The results showed that the prosodic system pertaining to pitch in their L1 influenced L2 listeners' sensitivity to the synthesized changes in pitch of L2 speech. Both listeners' L1 background and L2 proficiency contribute to the perception of pitch-manipulated speech, whereby the effect of L2 proficiency holds true only if non-native listeners and talkers did not share their L1.

Appendix 1: The paragraph used for the Foreign Accentedness Task

When Frank was young, his job was to repair bicycles and at that time he used to work fourteen hours a day. He saved money for years. And in 1958 he bought a small workshop of his own. In a few years the small workshop had become a large factory which employed seven hundred and twenty-eight people. Frank smiled when he remembered his hard early years and the long road to success.

Appendix 2: Underlined and bold sentences were used for pitch-manipulations.

(A) Statements: The words assigned with H* denotes an accentual peak

1. Q: How many apples did you buy?
   H*
   A: **I bought eleven apples.**
   H*
2. Because I don't like coffee, **I ordered lemonade**.
   H*
3. My uncle isn't a teacher, **but he's a lawyer.**

(B) Yes-no questions: The words assigned with L* denotes an accentual valley.

L*

1. **Do you need an orange**?

L*

2. **Are you married?**

L*

3. **Is it raining?**

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