The Perception of Word Boundaries by Korean College EFL Learners

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Um, Hye-Young. 2006. The Perception of Word Boundaries by Korean College EFL Learners. *The Linguistic Association of Korea Journal, 14*(3), 51-70. This paper investigates the perception of English word boundaries by Korean college EFL learners and compares it to that of English native speakers. Thirty five Korean speakers and 10 English native speakers participated in an English perception task in which the subjects were asked to choose whether they heard, e.g., *keep stalking* or *keeps talking*. The stimuli include three types of phrases: 1) aspiration of stop consonants, 2) glottal stop and/or laryngealization and 3) allophones of lateral phoneme 'l' as well as glottal stop serve as word boundary cues. It was found that Korean speakers had difficulty segmenting the stream of speech on the basis of the kinds of acoustic-phonetic cues available to native English speakers. But it was also found that some stimuli were easier than others for participants to segment. In addition, there was a correlation between the perception of word boundaries and speakers' English proficiency level, showing the possibility of the improvement of perception.

Key Words: aspiration, second language, perception, acoustic cues, allophonic variations

1. Introduction

In order to understand speech, the listener needs to segment the continuous stream of incoming speech into words. Various kinds of information may play a role in the segmentation process, including syntactic information, lexico-semantic information and acoustic-phonetic information.

The native speakers of English can usually hear the difference between two phrases such as *'no notion'* and *'known ocean'*, even though the sequence of segmental phonemes in these phrases is identical. Since they can distinguish these phrases even out of context, there must be cues in the speech that divide these phrases into words.

With respect to these acoustic-phonetic cues, there are different kinds of acoustic-phonetic characteristics that can serve as cues for syllable and word boundaries in a language. These include phonotactic constraints, allophonic variations, durational cues and prosodic cues such as rhythmic patterns and word intonation (recited from Altenberg 2005). In their study of locus of segmental cues for word juncture, Nakatani and Dukes (1977) found that the strong cues for juncture in English were glottal stops, laryngealizaton, aspiration on voiceless stops and distinct /l/ and /r/ allophones.

To comprehend the target language speech successfully, second language learners need to be able to use the same kind of acoustic phonetic cues that native speakers of that language use to segment speech. In fact, there are actual reported cases in which incorrect segmentation resulted in miscommunication. Therefore, the ability to correctly segment the second language (L2) speech using the acoustic phonetic cues is important when learning a second language.

Altenberg (2005) studied the English word boundary perception by native speakers of English and Spanish learners of English, using an adaptation of Nakatani and Dukes (1977) design that uses pairs of phrases in which the sequence of segmental phonemes is identical, but the location of juncture is different. Participants of the experiment hear a stimulus, for example, *keeps talking*, and indicate whether they hear *keeps talking* or *keep stalking*. She found that Spanish speakers are significantly worse than native speakers of English at using acoustic phonetic cues.

In order to explore the ability of Korean learners of English to use acoustic-phonetic information in L2 speech perception, I conducted the similar experiment for Korean learners of English using Altenberg's (2005) method and compared the perception of English word boundaries by 35 Korean speakers with that of 10 native speakers. Korean learners of English are examined classified into advanced and intermediate groups in order to see if there is a correlation between the perception of word boundaries and learners' English proficiency level, In this paper, I will present the findings of the perception experiment. The result can give us some suggestions to the English teaching of listening comprehension and pronunciation.

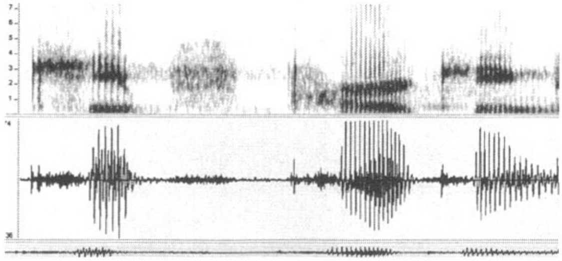
2. Phonetic Background

As mentioned earlier, in their experiment of the locus of perceptual cues for juncture, Nakatani and Dukes (1977) found that the strong cues for juncture in English were glottal stops, laryngealizaton, aspiration on voiceless stops and distinct /l/ and /r/ allophones. According to them, qualitative features such as burst, frication and silence that correspond to a distinct articulatory gesture provided strong cues for juncture, while the quantitative cues such as duration, amplitude and rate of formant transitions did not provide strong juncture cues in English. Christie (1974) also showed that aspiration on a voiceless stop in English was a primary cue in English speech segmentation.

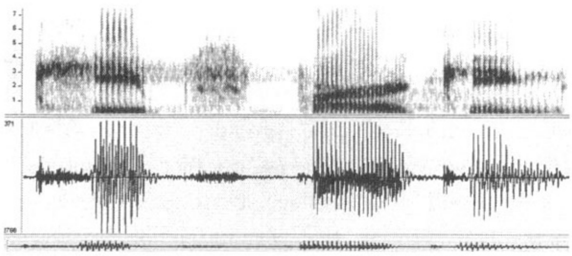
In this section, the acoustic-phonetic characteristics that serve as the word boundary cues will be examined as discussed in Nakatani and Dukes (1977) whose adaptation is used in the present study.

Voiceless stops become aspirated when they are syllable-initial, while they are unaspirated after /s/ at the beginning of a syllable (Ladefoged 1982 among others). Therefore, when a native speaker of English hears a phrase such as *keepstalking,* he or she is expected to segment it before *talking* if aspiration is heard, and before *stalking* if no aspiration is heard. According to Ladefoged (1982), the physical scale corresponding to the feature aspiration is the length of time from the release of a stop until the start of vocal cords vibration. Figure 1 shows the spectrograms and waveforms of the phrases *keeps talking* and *keep stalking*.

Figure 1. The Spectrograms and Waveforms of *keeps talking* and *keep stalking*



(a) keeps talking



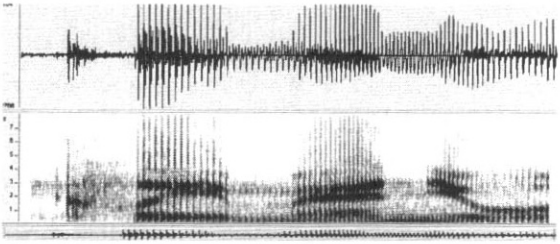
(b) keep stalking

In the waveform of *talking*, there is a spike indicating the burst occurring when the stop closure is released, followed by a period of random vibrations during the aspiration before the vocal colds vibration for the vowel begins. In this particular utterance, the duration of aspiration was 59 msec. In *stalking*, there is just a somewhat irregular waveform before the start of the vowel, of which duration in this particular utterance was 27 msec.

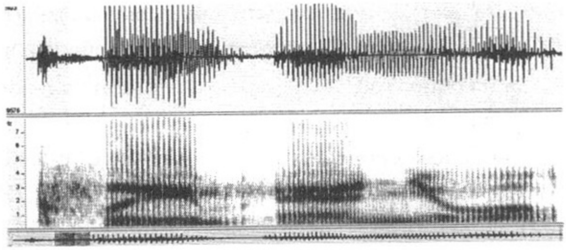
There are other cues, of course, that indicate juncture. Borden et al. (2003) point out that internal juncture can be cued by a number of acoustic features, such as silence, vowel lengthening, and the presence or absence of phonation or aspiration. For example, in English, the phrase *keeps talking* can be distinguished from *keep stalking* by 1) the presence of aspiration in *talking*, 2) a longer /s/ in *stalking* than in *keeps*, 3) a longer closure of the lips in *keep* than in *keeps*, and 4) higher amplitude of the /s/ in *stalking* than in *keeps* (recited from Altenberg 2005). Whatever the strongest acoustic cue to influence the word boundary perception, the native speakers of English are successful in segmenting the phrase.

In the phrase such as *seen either*, glottal stop and/or laryngealization (creaky voice), often inserted before word-initial vowels in English, is a strong cue for juncture perception (Nakatani and Dukes 1977). That is, the presence or absence of glottal stop and/or creaky voice, provides a strong segmentation cue for native speakers of English. Articulatorily, glottal stop has either a period of complete glottal closure, creaky voice on adjacent articulations, or a combination of closure and creaky voice (Um 1998). Acoustically, the glottal stop is identified by a drop in amplitude, abruptly changed periodicity, and disruption of vocalization (Olive et al. 1993). Figure 2 shows the spectrograms and waveforms of the phrases *clay manual* and *claim annual*.

Figure 2. The Spectrograms and Waveforms of *clay manual* and *claim annual*



(a) clay manual

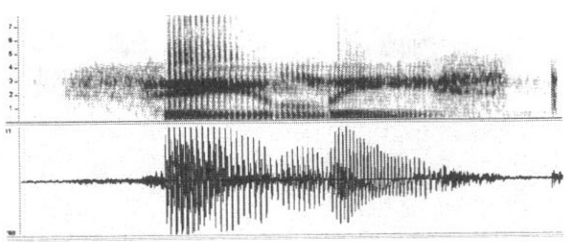


(b) claim annual

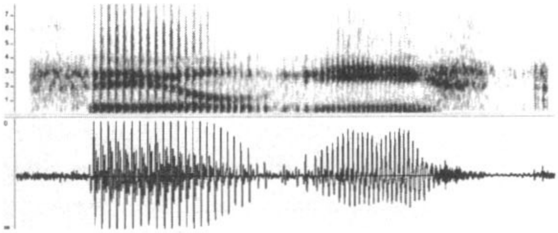
The spectrogram and waveform of *claim annual* show a disruption between *claim* and *annual*. The creaky voice (laryngealization) is observed from the later part of 'm'.

According to Nakatani and Dukes (1977), the allophones of /l/ and /r/ are particularly strong juncture cues for native speakers of English. /l/ becomes velarized - that is, the back of the tongue is considerably raised toward the soft palate - when after a vowel and before another consonant or the end of a word (Ladefoged 1982). This sound is more like some kind of back vowel in the speech of some English speakers. Figure 3 shows the spectrograms and waveforms of *say least* and *sail east*.

Figure 3. The Spectrograms and Waveforms of *say least* and *sail east*



(a) say least



(b) sail east

In *sail east*, vowel-like 'dark l' as well as creaky voice expanding from the later part of *sail* until the first part of the following vowel, which is due to the inserted glottal stop, is quite evident. In this case, the allophonic variation of /l/ and the presence of glottal stop make it distinguishable from *say least*.

In the next section, I will present the perception experiment where we can see if these acoustic phonetic characteristics are available to the listeners.

3. Method

3.1. Materials

The stimuli are presented in Appendix 1[1]. They were mostly selected from Altenberg (2005) and some of them were reconstructed[2]. Of the

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1) There is a possibility that the non-native participants' lexical knowledge may influence their segmentation task, although they are instructed to pay attention to the sound, not the content. In addition, the word or sound frequency may affect this kind of perception task. Altenberg (2005) says that it is not likely that the frequency plays a role in the subjects' decision. For further discussion on this issue, refer to Altenberg (2005).

2) Altenberg (2005) used pairs like *grey pin* and *grape in*, but I excluded this type of stimuli in which another factor, namely whether the consonant is exploded or not, is involved, because my main concern in this experiment with regard to the aspiration stimuli is to see if the learners are sensitive to the difference between the aspirated and unaspirated consonants in onset position, namely the difference in VOT (Voice Onset Time)..

23 pairs of phrases, 14 consisted of phrases such as *lace peach* and *lay speech*, in which the presence or absence of aspiration provides a strong segmentation cue for the native speakers of English (Nakatani and Dukes 1977). Four pairs consisted of phrases such as *see neither* and *seen either*, in which the presence or absence of glottal stop, inserted before word-initial vowels, and/or creaky voice (Borden et al. 2003), provides a strong segmentation cue. There were also 5 pairs where both presence or absence of glottal stop and allophones of a lateral phoneme - dark or clear 'l'- provide juncture cues, e.g. *say least* and *sail east*. The three groups of stimuli will be referred to as the aspiration stimuli, the glottal stop stimuli, and allophonic 'l' stimuli, respectively.

The aspiration stimuli are divided into three groups; 1) the one in which /s/+C comes after a vowel, 2) the one in which /s/+C comes after a consonant and 3) the one in which /s/+C comes after a consonant and is followed by another consonant /r/, forming the longest syllable-initial cluster according to English phonotactics.

For the glottal stop stimuli, only the phrases for which the glottal stop is inserted after a nasal /m/ or /n/ were used in order to avoid the case where the factor other than the glottal stop provides a strong boundary cue. For example, in *grape in* and *grey pin*, the allophones of the consonant /p/ can also work as a strong boundary cue, which might cause confusion in the interpretation of the result.[3]

As for the allophonic 'l' stimuli, it was intended to examine how the subjects use the distinct allophonic variations of lateral phoneme as juncture cue, but since the glottal stop is inserted before the word beginning with a vowel, this type of stimuli inevitably involves two kinds of strong cues, allophones of 'l' and the presence or absence of glottal stop/creaky voice.

In presenting the results of the experiment, the terms positive and

3) Of course, word-final vowels and diphthongs are longer than those in other positions, and there might be a difference in the length of consonants depending on where they occur. However, according to Nakatani and Dukes (1977:719), quantitative features such as duration, amplitude and rate of formant transitions are weak cues for juncture.

negative, aspiration and glottal stop will be used to designate subsets of the stimuli with regard to the strong cues of aspiration and glottal stop (Suomi 1985). Thus, stimuli in which the presence of aspiration serves as a cue for native English speakers (e.g. *keeps talking*) will be referred to as the positive aspiration stimuli; stimuli such as *keep stalking*, in which its absence is a cue, will be referred to as the negative aspiration stimuli.

One male native speaker of English who has been teaching English at a university in Korea recorded the stimuli. The 46 stimuli (23 pairs) were recorded in a random order. Each phrase was placed within the carrier phrase, 'Say ______ again', which has frequently been used in controlled speech studies in order to maximize naturalness of the stimuli and to maintain the similar intonation pattern for each stimuli. The speaker was instructed to speak as naturally as possible, maintaining the same level of word stress on both words in each phrase, so that the prosodic cues are not available.

In order to compare the acoustic characteristics of the members of each pair, the stimuli were analyzed by WaveSurfer to get the waveforms and spectrograms for each phrase. The duration of the release burst of the stop consonant in consideration - from the release of the stop closure to the beginning of the following vowel (voice onset) - was measured. The mean duration of the release burst in the positive aspiration stimuli was 69.9 milliseconds and that of the negative aspiration stimuli was 30.8 msec. (See Table 1.) In case of the glottal stop stimuli, the length of glottal stop and/or creaky voice was measured. The average duration was 68.8 msec.

Table 1. Mean length of release burst (milliseconds), from the release of stop closure to the beginning of voicing

Positive aspiration		Negative aspiration	
Format	Mean	Format	Mean
Vs#C[4]	64.7	V#sC	20.7
Cs#C	79.8	C#sC	27.3
Cs#CC	65.3	C#sCC	44.5
Total	69.9	Total	30.8

3.2. Subjects

Ten native speakers of English, 6 male and 4 female, ranging in age from 34 to 43 served as a native speaker control group. They were all English instructors at a university in Korea.

A total of 35 Korean college EFL learners, 27 female, 8 male, ranging in age from 21 to 29, participated in the perception experiment. They were all students at a university in Korea. They were classified into two groups based on their TOEIC scores. Eleven students whose TOEIC score is over 700 were classified as advanced and 24 students whose TOEIC score is lower than 600 as intermediate[5].

3.3. Procedure and Analysis

Participants were asked to choose what they have heard in the sentence "Say __________ again." They were given two choices on their answer sheet. The correct response was the first choice on the answer sheet half of the time, and the second choice half of the time. The participants were informed that they were not to pay attention to the meaning of the words or phrases, but to listen carefully and pay attention only to the sound. This instruction was intended to encourage

4) The symbol # represents the word boundary.

5) Among the advanced group, 7 students' scores were between 700-800 and 4 students' were over 800.

attention to the form rather than the content of the utterance. Subjects heard each phrase once and had 6 seconds between stimuli.

The collected test scores were entered into the SPSS for ANOVA analysis.

4. Results

The mean percentages of correct responses for native and non-native speakers on the word boundary perception task are presented in Table 2. The results indicate that there was a significant effect of participant group: t=11.360, p<.001. That is, the native speakers had significantly more correct responses than the non-native speakers on the task.

Table 2. Native and non-native speakers, mean percentage of correct responses (Overall)

Native speakers		Non-native speakers	
Mean	SD	Mean	SD
95.22	5.68	67.19	7.16

Table 3 reports the mean percentages of correct responses for each stimulus type. An ANOVA analysis showed that there was a significant main effect of stimulus type: F=25.274, p<.001. Post-hoc analysis indicates that the mean percentages correct for the glottal stop and allophonic 'l' stimuli were significantly higher than those of the aspiration stimuli. A significant interaction effect between stimulus type and group was also found (F=14.443, p<.001): for the native speakers, there was no significant difference among the three stimulus types; for the non-native speakers, glottal stop and allophonic 'l' stimuli were easier to perceive than aspiration stimuli. No significant difference between the glottal stop and allophonic 'l' stimuli was found.

Table 3. Native and non-native speakers, mean percentage of correct responses for each stimulus type

Stimulus type	Native speakers (N=10)		Non-native speakers (N=35)	
	Mean	SD	Mean	SD
Aspiration (n=28)	93.57	7.67	54.26	11.35
Glottal stop (n=8)	96.25	6.38	82.86	13.92
Allophonic 'l' (n=10)	99.00	3.16	86.86	11.32

A significant difference was found between the intermediate and advanced learners on the overall percentage of correct responses: t=3.259, p<005. The mean was 64.82 % for the intermediate group and 72.33 % for the advanced group.

Table 4 reports the mean percentages of correct responses for each stimulus type perceived by non-native speakers. A significant main effect of stimulus type was confirmed: F=59.542, p<.001. However, there was no significant interaction effect between stimulus type and proficiency level: F=1.908, p>.05.

Table 4. Intermediate and advanced non-native learners, mean percentage of correct responses for each stimulus type

Stimulus type	Intermediate learners (N=24)		Advanced learners (N=11)	
	Mean	SD	Mean	SD
Aspiration (n=28)	50.68	11.06	62.66	6.26
Glottal stop (n=8)	82.81	14.66	82.96	12.83
Allophonic 'l' (n=10)	85.42	11.41	90.00	10.95

Analyses were also conducted comparing native and non-native speakers' responses to positive stimuli, i.e. stimuli in which the strong cue of aspiration or glottal stop/creaky voice was present (e.g. *keeps parking, seen either*), with their responses to negative stimuli, i.e., stimuli in which the strong cue was absent (e.g. *keep sparking, see neither*). The results are presented in Table 5.[6] An ANOVA analysis showed that there were significant main effects of group (F=104.517, p<.001) and positive/negativeness (F=9.076, p<.01). A significant interaction effect between positive/negativeness and group was also found (F=6.272, p<.05): for the native speakers, there was no significant difference between positive and negative stimulus types; for the non-native speakers, positive stimuli were identified more accurately than negative stimuli. Both in aspiration and glottal stop stimuli, the perception of positive stimuli was better. Mean percentages of each stimulus type are provided in Table 5.

Table 5. Native and non-native speakers, mean percentage of correct responses, positive vs. negatives

Stimulus type - positive/negative	Native speakers (N=10)		Non-native speakers (N=35)	
	Mean	SD	Mean	SD
Positive aspiration (n=14)	93.57	7.11	63.67	13.79
Positive glottal stop (n=4)	100	0.00	90.71	13.67
Total positive (n=18)	95.00	5.52	69.68	11.06
Negative aspiration (n=14)	93.57	9.19	48.57	21.69
Negative glottal stop (n=4)	92.50	12.08	75.00	3.83
Total negative (n=18)	93.33	9.00	51.59	16.48

When only the non-native speakers are considered, a significant interaction effect between positiveness/negativeness and group was also found (F=14.443, p<.001). An interesting point is observed in the comparison between the advanced and intermediate learners with regard to the perception of negative and positive cues. The advanced learners did better than the intermediate learners in the perception of the negative cues (t=3.527, p<.01), while no such difference was found in the perception of positive cues (t=.366, p>.05). This suggests that the

6) For these analyses, results of only aspiration and glottal stop stimuli, not those of allophonic 'l' stimuli were considered, since in the perception of allophonic 'l' stimuli a factor other than the presence or absence of glottal stop, which cannot be categorized as positive or negative, namely an allophonic variation of 'l' is involved.

significant difference between advanced and intermediate learners is due to their difference in the perception of the negative stimuli. The comparison between the advanced and intermediate groups in relation with positiveness/negativeness is presented in Table 6.

Table 6. Intermediate and advanced learners, mean percentage of correct responses, positive vs. negatives

Stimulus type - positive/ negative	Intermediate learners (N=24)		Advanced learners (N=11)	
	Mean	SD	Mean	SD
Positive aspiration (n=14)	62.80	13.81	65.58	14.22
Positive glottal stop (n=4)	91.67	14.12	88.64	13.06
Total positive (n=18)	69.21	11.23	70.71	11.14
Negative aspiration (n=14)	43.45	22.48	59.74	15.41
Negative glottal stop (n=4)	73.96	24.98	77.27	17.52
Total negative (n=18)	45.83	14.86	64.14	12.76

Another analysis of variance was conducted to examine the three formats of the aspiration stimuli, as they are grouped in Table 7. The overall difference among the three types of aspiration format was not significant: $F=1.710$, $p>.05$. The interaction between subject group and stimulus type was not significant either: $F=.438$, $p>.05$. That is, non-native speakers have difficulty with all aspiration subgroups in a similar degree.

Table 7. Native and non-native speakers, mean percentage of correct responses, aspiration stimuli formats

Aspiration format	Native speakers (N=10)		Non-native speakers (N=35)	
	Mean	SD	Mean	SD
VsC (n=12)	95.83	8.10	55.48	18.41
CsC (n=8)	97.50	5.27	54.64	20.58
CsCC (n=8)	86.25	18.11	51.43	16.26

The comparison between the advanced and intermediate learners with regard to the perception of aspiration in the three types of aspiration format was shown in Table 8. Although overall performance of the subjects in the advanced group was better than those in the intermediate group ($F=11.781$, $p<.01$), there was no significant difference among the three types of aspiration format ($F=.323$, $p>.05$). No significant interaction effect between proficiency level and aspiration format was found either ($F=.84$, $p>.05$).

Table 8. Intermediate and advanced speakers, mean percentage of correct responses, aspiration stimuli formats

Aspiration format	Intermediate learners (N=24)		Advanced learners (N=11)	
	Mean	SD	Mean	SD
VsC (n=12)	52.08	20.30	62.88	10.78
CsC (n=8)	50.52	20.68	63.64	18.08
CsCC (n=8)	46.88	16.17	61.36	11.80

5. Discussion and Conclusion

The results of the study show that Korean learners have difficulty segmenting English phrases into words using acoustic- phonetic cues, segmenting only 67.19% of the time correctly, compared to 95.22 % for native speakers. Thus, Korean learners of English seem to be unable to fully use the kinds of acoustic-phonetic information available to native English speakers to segment speech and retrieve words.

However, Korean learners of English did significantly better in the perception of glottal stop stimuli and allophonic 'l' stimuli than aspiration stimuli. In other words, the stimuli in which the presence or absence of glottal stop/creaky voice is a strong juncture cue were better perceived than the stimuli for which the presence or absence of aspiration is a strong cue. Discussion on L1 transfer does not seem to be relevant here, since Korean does not have glottal stop in its phoneme inventory and unlike in English glottal stop is not usually inserted before a word beginning with a vowel. In addition, Korean has both aspirated and unaspirated consonants in its phonemic inventory, but both types of consonants occur in syllable-initial position. This means that their position in syllable does not provide any clue in distinguishing them. Therefore, in the perception of both glottal stop stimuli and aspiration stimuli, the learners' first language (L1) phonemic and/or phonetic structure are not likely to interfere or help their perception.

Instead, the difference in the ease or difficulty can be explained in terms of the quality or phonological importance of the cue. The glottal stop is a full segment which is quite audible. Its average length in the stimuli of the present experiment was 68.8 milliseconds. In addition, its presence tends to affect the neighboring segments, making them creaky voiced. On the other hand, the difference between aspirated and unaspirated consonants is in their VOTs, which was 39.1 msec. on the average in the stimuli in the present experiment. In addition, they are not phonemically different. The results indicate that Korean learners might not be sensitive to the allophonic difference of the consonants or at least they are not sensitive to the distributional difference of the allophones of the same phoneme.

Considering that allophonic'l' stimuli have two kinds of strong cues - the presence or absence of glottal stop and allophonic variations of 'l', it can be expected that subjects do better in these strong double cue stimuli. However, although the perception of allophonic 'l' stimuli was better than the perception of glottal stop, the difference was not significant. According to Han (2003), the results of /l/ production in word-final position indicate that learners have difficulty catching the allophonic difference between the word-final 'l', namely dark l and clear l variants. The result of the experiment in this study can be interpreted as non-native speakers' insensitivity to the allophones of 'l', but further research is necessary to conclude the result this way.

Looking at the results of the kinds of stimuli in terms of positiveness/negativeness, non-native participants were better at segmenting stimuli with a positive strong cue than a negative one. This might not be surprising, considering that the presence of a cue is perceptually more salient than its absence.

Comparing the results of the experiment among non-native speakers, overall performance of the advanced learners was significantly better than the intermediate learners. This suggests that there is a possibility of improvement in this area of second language perception. In particular, when comparing the perception of the negative cues in advanced and intermediate groups, learners in the advanced group did significantly better, segmenting 64.14 % of the time correctly, compared 45.83 % for intermediate learners. In other words, the intermediate learners have more difficulty perceiving the negative cues than advanced learners. In fact, responses by learners in the intermediate group to the negative stimuli were below 50%, which suggests that they might have depended on guessing. In particular, they did only 43.45% of the time correctly in the negative aspiration stimuli. This result makes it doubtful that the acoustic phonetic cues to distinguish unaspirated consonants from aspirated consonants are available to intermediate learners.

As for the results in terms of different aspiration formats, both the native speakers and non-native speakers (both intermediate and advanced learners) did not show any significant difference in perceiving word boundaries in three different formats, although the scores were a little lower in the case of CsCC format in both groups of participants. Since the difference of aspirated and unaspirated consonants in the duration of the release burst in the CsCC format was the least, it can be hypothesized that the participants do worse in this format than in the other formats. However, no such significant difference was found. It seems that the participants are not sensitive to this kind of subtle phonetic difference. Further research with the selection of more systematically organized stimuli would be necessary to come to a more definitive conclusion on this matter.

To conclude, although Korean learners of English did not seem to be successful in using the acoustic phonetic cues that the native speakers of English use in the word boundary perception task, the difference between advanced and intermediate learners show the possibility of the improvement of perception in such low-level phonetic details. Future research with more advanced non-native speakers would be interesting to see if non-native learners of English can attain native-like proficiency in this kind of perception task. Further research testing the effect of the formal instruction in this kind of task will also be interesting.

References

Altenberg, E. (2005). The perception of word boundaries in a second language. *Second Language Research, 24*(4), 325-358.

Borden, G., Harris, K. and L. Raphael. (2003). *Speech Science Primer,* 4th edition, PA: Lippincott, Williams and Wilkins.

Christie, W. (1974). Some cues for syllable juncture perception in English. *Journal of the Acoustical Society of America, 55,* 819-21.

Han, J. (2003) Controlled phonetics: evidence from the processing of non-phonemic contrasts in non-native language. *Korean Journal of Linguistics, 29*(4), 507-525.

Ladefoged, P. (1982). *A Course in Phonetics,* New York: Harcourt Brace Jovanovich.

Nakatani, L. and K. Dukes. (1977). Locus of segmental cues for word juncture. *Journal of Acoustical Society of America, 62,* 714-19.

Olive, J., A. Greenwood and J. Coleman. (1993). *The Acoustics of*

American English Speech: A Dynamic Approach, NY: Springer-Verlag.

Suomi, K. (1985). On detecting words and word boundaries in Finnish: a survey of potential word boundary signals. *Nordic Journal of Linguistics*, *8*, 211-31.

Um, H. (1998). *Laryngeals and Laryngeal Features*, Ph.D. dissertaion, Hankuk Publisher.

Appendix 1. Stimuli for the word boundary perception task

<u>Aspiration stimuli: VsC</u>

lay speech	lace peach
lay stable	lace table
lay scar	lace car
Lou spills	loose pills
Lou stops	loose tops
Lou skis	loose keys

<u>Aspiration stimuli: CsC</u>

keep sparking	keeps parking
keep stalking	keeps talking
chief school	chief's cool
chief sport	chief's port

<u>Aspiration stimuli: CsCC</u>

cook sprints	cook's prints
cook struck	cook's truck
cook screams	cook's creams
top strains	tops trains

<u>Glottal stop stimuli</u>

see neither	seen either

a nice man	an ice man
tea mat	team at
clay manual	claim annual

Allophonic 'l' stimuli (allophones of 'l' + glottal stop)

say least	sail east
I learn	I'll earn
see love	seal of
he lies	heal eyes
D lies	deal eyes

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