

Production and Perception of English Tense/lax Vowel Contrasts by Korean EFL Learners

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1. Introduction

Each language has its own set of phonological contrast. For contrasts to be perceived and produced, certain articulatory and perceptual skills must be mastered (Scobbie 1998). English vowel system has tense and lax vowel contrasts. Native English (NE) speakers know the linguistic properties that signal the contrasts, and these properties are manifested in their everyday performance. Then, how about Korean EFL (KE) learners? Do they discriminate English tense and lax vowels as NE speakers do?

The ability to accurately produce foreign language sounds might be influenced by the learners' first language (L1). In their feature hypothesis, McAllister, Fledge, and Piske (2002) suggests that L2 phonetic features that are not used to signal phonological contrasts in learners' L1 will be more difficult to acquire than those that are used. Additionally, they postulate that the learners' perceptual system is tuned only to phonologically meaningful features in their L1, and the phonetic features that are not phonologically meaningful will be underattended. This difficulty in perceiving phonetic features that are not phonologically meaningful will be reflected in low production accuracy of these features in the L2 (Flege 1995).

The main purpose of the present study is to investigate KE learners' production and perception of English tense/lax vowel contrasts. This study examines not only the phonetic properties of KE learners' production of English tense/lax vowels but the KE learners' perception as to whether or not they discriminate English tense/lax vowel contrasts.

The rest of the paper is organized as follows. Section 2 reviews the background for this study and the empirical research examining L2 perception and production. Section 3 presents the methods of the study in detail. The results and discussion of the study are provided in Section 4. Finally, Section 5 offers a summary and conclusion.

2. Literature review

For both theoretical and empirical reasons, comparing phoneme inventories does not necessarily show the relationship among sounds of different languages (Ladefoged 1978). However, I may start by noting that English has tense/lax vowel contrasts, which are not found in Korean vowel system. The tense vowels /i/, /u/ and the lax vowels /ɪ/, /ʊ/ of English differ in terms of spectral quality and duration. The primary difference is spectral, whereas the duration difference may be quite small (House 1961).

The target features of this study are /i/-/ɪ/, /u/-/ʊ/ contrasts, which are considered to be some of the most difficult sounds for KE learners based on the fact that the Korean vowel system does not share tenseness and laxness as factors to characterize the vowel sounds (Avery and Ehrlich 1992, Han 2001, Tench 2003). Figure 1 and 2 illustrate American (Californian) English vowel system and Korean vowel system, respectively.

Korean is traditionally regarded as having a distinction between phonemically long and short vowels. However, phonemic length distinctions are subject

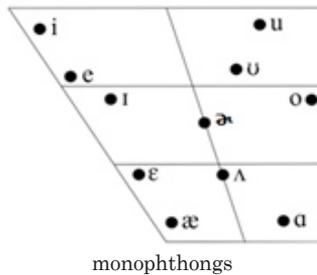


Figure 1. American (Californian) English vowel system (from *Hand book of the IPA* 1999: 42)

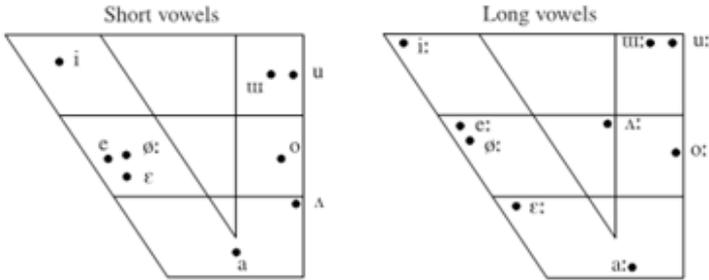


Figure 2. Korean vowel system (from *Hand book of the IPA* 1999: 121).

to idiosyncratic and dialectal variation in Korean (Colhoun and Kim 1976), and are not maintained by many young Koreans from Seoul (Magen and Blumstein 1993). Although length distinctions are not maintained in modern Korean, the distinctions may be something that KE learners can rely on when distinguishing non-native sounds. Some predictions can be made from the fact that Korean vowel system lacks a tense/lax distinction of English vowel system. For example, it can be predicted that the KE learners might have the greatest difficulty producing and perhaps perceiving the distinction between English /i/-/I/ and /u/-/U/ contrasts. In fact, KE learners are explicitly taught in school that these English vowels are distinguished by duration, with being oblivious of spectral quality. Additionally, we can conjecture that KE learners will make greater perceptual use of vowel duration than do NE speakers because duration is a more important perceptual cue to vowel identity in Korean than in English.

A number of studies have been devoted to the production and perception of non-native sounds. In his L2 speech research, Rochet (1995) concludes that some L2 errors are the consequence of the target phones having been assigned to an L1 category. Flege (1995) suggests that L2 production accuracy is limited by perceptual accuracy. That is, he postulates that the production of an L2 phonetic segment will be no more native-like than its perceptual representation. These studies indicate an enormous L1 influence on L2 speech learning and close connections between L2 perception and production.

Most approaches to L2 perception also suggest that the L1 background has

a strong influence in the way the sounds of the target language are perceived (Ingram and Park 1997). Perceptual Assimilation Model, or PAM (Best 1995) assumes that non-native perception is filtered by linguistic experience. In other words, new sounds will get assimilated, in one way or another, to the categories that already exist in the speakers' L1. According to this model, discrimination of two non-native sounds will be maximized when each is assimilated to a different native phoneme category. When non-native sounds are assimilated as uncategorizable speech sound, then the non-native sound is assimilated within native phonological space, but not as a clear example of any particular native category. PAM suggests that the patterns of perceptual assimilation will predict the discriminability of non-native sounds.

Following the PAM's patterns of assimilation, we can make a specific prediction regarding the discriminability of English tense/lax contrasts by KE learners. The English tense/lax contrasts are an example of the uncategorizable type for KE learners. Thus, these vowels fall within native phonological space but in between specific L1 categories. There might be two possibilities of assimilation for the vowels that form the contrast. Here, I suggest KE learners' possibilities of L2 assimilation to L1 categories. Table 1 illustrates the possibilities of L2 assimilation to L1 categories according to PAM.

The first possibility suggests that the sounds may be assimilated to a single category in the L1. And the second possibility is that when we consider KE learners' English vowel contrasts, both sounds could be deviant. That is, NE speakers primarily discriminate the vowel contrasts based on vowel quality (or, spectral features), whereas KE learners' discrimination of the contrasts might rest on durational information. Regarding this discussion, Fox et al. (1995) suggests that Spanish speakers do not have durational information accessible, whereas spectral information seems to have the strongest effect in NE speakers' L1 vowel discrimination. Far from following Spanish speakers'

Table 1. Possibilities of L2 assimilation to L1 categories according to PAM

	First Possibility	Second Possibility
NE speakers	/i/ /ɪ/ /u/ /ʊ/	/i/ /ɪ/ /u/ /ʊ/
KE learners	/i/ /u/	/i:/ /i/ /u:/ /u/

path, however, KE learners seem to rely on durational information based on the fact that it is more readily accessible to KE learners. Is this really the case for KE learners? I will deal with this issue later in the results and discussion section.

With this background in mind, the present study hypothesizes that the acoustic characteristics of English high vowels produced by KE learners are deviant from those spoken by NE speakers in terms of duration and vowel quality. Particularly, the study hypothesizes that KE learners will make greater use of vowel duration than do NE speakers to differentiate English tense/lax vowel contrasts. KE learners' low discriminability of the English tense and lax vowel contrasts might be derived from their exclusive attention to durational information in perception.

Thus, my research questions in the present study are as follows:

In production

How are the acoustic characteristics of English tense/lax vowels produced by KE learners different from those produced by native English speakers? Do KE learners rely solely on durational information? Is there any difference between /i-/I/ and /u-/U/ contrasts?

In perception

Are English tense/lax vowel contrasts assimilated as uncategorizable speech sounds for KE learners? Is there any difference between /i-/I/ and /u-/U/ contrasts?

3. Method

3.1 Participants

For the purpose of the production test, 4 KE learners (4 males) with a mean age of 33.5 years (range = 26–38 years) who had never lived in an English-speaking country participated in the experiment. Three of the Korean participants were graduate students and one of them was an undergraduate student in Seoul National University (SNU). Three native speakers of Canadian English (NE) served as a control group (2 males, 1female) with a mean age of 39 years (range = 33–48 years). Two of the NE speakers were graduate students in SNU and one of them worked for a language institute in SNU.

The Korean participants' level of English proficiency was controlled to include only advanced learners. The participants' level of proficiency was objectively confirmed by the standardized test, TEPS. The scores of TEPS (Test of English Proficiency developed by Seoul National University) of the participants are all above 800 (M=851.25, range=810–897). According to the grade description provided by the organizing committee of TEPS, the learners' holistic score above 801 is described as having near-native level of communicative competence. The reason to control the participants' level of English proficiency to include only advanced learners is to show that the difference in acoustic measures can be attributed not to the lack of English competence, but to the effect of the learners' L1.

3.2 Stimuli

In the production test, the Korean participants were presented consonant-vowel-consonant (CVC) English words in a written form: *boat, mass, bit, save, pill, zip, could, safe, sip, beat, coin, coed, math, bite, bill, cane*. They were given the 16 words in random order and read aloud each word five times in a carrier phrase (I'll say ____). Among these 16 words, target words were *beat* and *bit* to test the /i/-/I/ contrast, and *coed* and *could* to test the /u/-/U/ contrast. Quite a few fillers were included so that the participants were unable to figure out what they were tested on and lest the production test have an influence on the perception test.

In the perception test, the target sounds for the discrimination test were English high vowel /i/-/I/, and /u/-/U/ contrasts. Six minimal pairs of /i/ and /I/, and another six minimal pairs of /u/ and /U/ (in total 24 words) were selected among those commonly used in daily life, and were those expected to cause confusion when they are mispronounced and misperceived.

The vowel stimuli, shown in Table 2, were produced by 2 male and 1 female native speakers of Canadian English, who also participated in the production test. The speakers were asked to read a randomized list of words in isolation. The stimuli were recorded individually in a quiet room, using a Zoom H4 recorder at 16 bit/ 44.1kHz sampling rate.

Table 2. List of vowel contrasts used in perception test

/i/	/ɪ/	/u/	/ʊ/
least	list	pool	pull
feet	fit	Luke	look
leave	live	fool	full
sheet	shit	wooded	wood
heat	hit	suit	soot
deed	did	who'd	hood

3.3 Procedure

Recording and the tests were performed in a quiet room after completing a language background questionnaire. The perception test was conducted in a subsequent manner after the production test using a laptop computer. Instructions were administered in English to the NE speakers and in Korean to the Korean participants.

In the perception test, the KE learners participated in a Categorical Discrimination Test (CDT) (cf. Guion, Flege, Akahane-Yamada, and Pruitt 2000) with the English vowel contrasts listed in Table 2. The CDT has a triadic format, where a subject hears three stimuli in each trial, and chooses one stimulus that includes a categorically different vowel from the other two. The three CVC stimuli presented on each trial were always produced by three different speakers. A total of 72 trials tested each of the two contrasts. That is, a single contrasting pair (e.g., /bit/-/bIt/) has 6 change trials and 6 no-change trials (12 x 6 contrasting pairs = 72 trials for each contrast). The odd item appeared equally in all three possible positions. Half of the trials, called *change trials* (e.g., /bit/ /bit/ /bIt/) included an odd item out. However, the remaining half contained three physically different instances of a single vowel category, which was called *no-change trials* (e.g., /bit/ /bit/ /bit/). The interstimulus interval between the three stimuli was 1,000 ms. The motivation of including change and no-change trials was that the formation of a phonetic category will increase sensitivity to differences between members of the new category and other categories but bring about a decrease in sensitivity to differences among members of the new category. In the CDT, the change trials tested the participants' ability to distinguish vowels from two different categories.

The vowels in no-change trials differed physically, but not in a phonetically relevant manner. Thus, the no-change trials tested the participants' ability to ignore audible but phonetically irrelevant within-category differences (Flege and MacKay 2004).

3.4 Measurements and analysis

For the production test data, the recordings were analyzed using *Praat*. The formant frequencies (F1 and F2 in hertz) were measured for the vowels in the 4 target words. F1 and F2 were measured on the assumption that they are the acoustic correlates of vowel quality. Duration (in milli seconds) was also measured for the present study. The reason why duration was measured was to examine durational difference between two groups in terms of English tense/lax vowel contrasts.

In the perception test, the stimuli were presented via headphones at a self-selected comfortable level. After receiving instructions and completing a practice session, participants began the experimental session. The participants were told to focus on the vowels in the three CVC words presented on each trial. They were instructed to select from the numbers "1–3" on the answer sheet to indicate the serial position of the odd item out, if they heard one. They were told to select "same" if they heard three different instances of one vowel.

A-prime (A') scores were calculated for each of the 2 tense/lax contrasts examined. The A' scores were based on the proportion of *hits* (correct selection of the odd item in change trials) and *false alarms* (incorrect selections of an odd item in no-change trials), using the formula provided by Snodgrass, Levy-Berger, and Haydon (1985).¹⁾ The A' scores provide an unbiased measure of perceptual sensitivity by considering the responses to the change trials and

1) H = Hits (i.e., the proportion of change trials in which the odd item was correctly selected), FA = False Alarms (i.e., the proportion of no-change trials in which an odd item was incorrectly selected)

(1) If $H > FA$ then $A' = 0.5 + [(H - FA)(1 + H - FA)] / [4H(1 - FA)]$

(2) If $H = FA$ then $A' = 0.5$

(3) If $H < FA$ then $A' = 0.5[(FA - H)(1 + FA - H)] / [4FA(1 - H)]$

the no-change trials. An A' score of 1.0 indicates perfect discrimination of a contrast (i.e., correct responses to all 20 change and all 20 no-change trials). An A' score of 0.5 or lower indicates insensitivity to a contrast (Guion, Flege, Akahane-Yamada, and Pruitt 2000).

4. Results and discussion

This section describes KE learners' production of English tense/lax vowel contrasts in terms of vowel quality (F1 and F2) and duration. In addition, it describes the results from the CDT with regard to the KE learners' perception of English tense/lax contrasts.

4.1 Production test

The descriptive statistics of the production test are presented in Table 3.

A considerable difference between NE speakers and KE learners are noticed both in vowel quality and vowel duration. To evaluate whether the mean difference between English tense/lax contrasts of the two groups is statistically significant, an independent sample t -test was implemented. Table 4 presents the results.

The t -test results demonstrate that for the NE speakers vowel quality (F1 and F2) differences were significant ($p < 0.05$) but duration was not statistically significant between /i/ and /I/, whereas for KE learners F1, F2, duration differences were not significant between /i/ and /I/. Between /u/ and /U/, the F1, F2, and duration differences of the NE speakers were not significant, but the duration difference of the KE was statistically significant. It should be

Table 3. Descriptive statistics (mean). Standard deviations are in parentheses.

		/i/	/I/	/u/	/U/
F1 (Hz)	NE	287 (41)	495 (36)	309 (35)	463 (74)
	KE	303 (47)	315 (14)	329 (13)	356 (31)
F2 (Hz)	NE	2512 (242)	1893 (210)	1044 (196)	1431 (111)
	KE	2225 (135)	2230 (92)	1005 (134)	1086 (195)
Duration (ms)	NE	142 (26)	134 (11)	234 (17)	150 (45)
	KE	140 (69)	93 (23)	177 (24)	118 (20)

Table 4. Independent samples t-test

		/i-/I/			/u-/U/		
		<i>t</i>	<i>df</i>	<i>p</i> -value	<i>t</i>	<i>df</i>	<i>p</i> -value
F1 (Hz)	NE	-6.464	3.931	0.0031*	-3.2374	2.884	0.0507
	KE	-0.499	3.538	0.6471	-1.7883	4.158	0.1455
F2 (Hz)	NE	3.347	3.923	0.0295*	-2.9747	3.17	0.0549
	KE	-0.064	5.283	0.951	-0.6877	5.314	0.5205
Duration (ms)	NE	0.510	2.777	0.6477	3.0326	2.567	0.0686
	KE	1.255	3.677	0.2832	3.7085	5.86	0.0104*

noted that although the NE speakers' F1, F2 differences between /u/ and /U/ were not statistically significant, their statistical significance differs from the KE learners'. This might be explicable by the fact that one of the NE speakers in the test was a female whose spectral value deviates from a male speaker, whereas all the KE participants were males in the test. Indeed, when t-test was implemented excluding the female participant, F1 difference between /u/ and /U/ was statistically significant ($p < 0.0309$).

4.1.1 Vowel quality

Based on the data in Table 3 and 4, it should be concluded that the KE

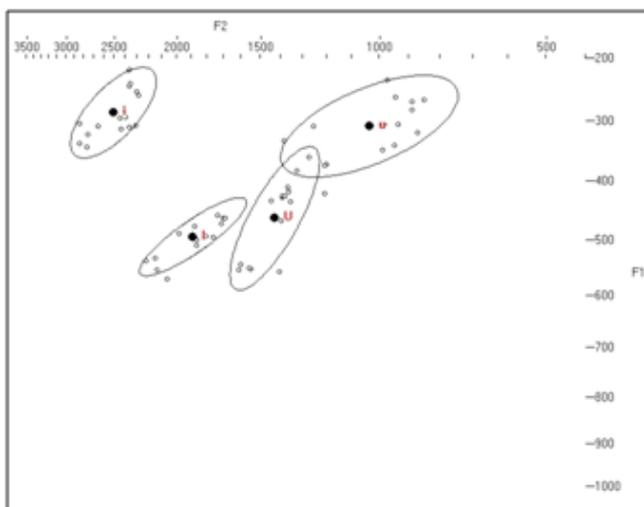


Figure 3. F1/F2 plots of NE speakers' production of English tense/lax contrasts.

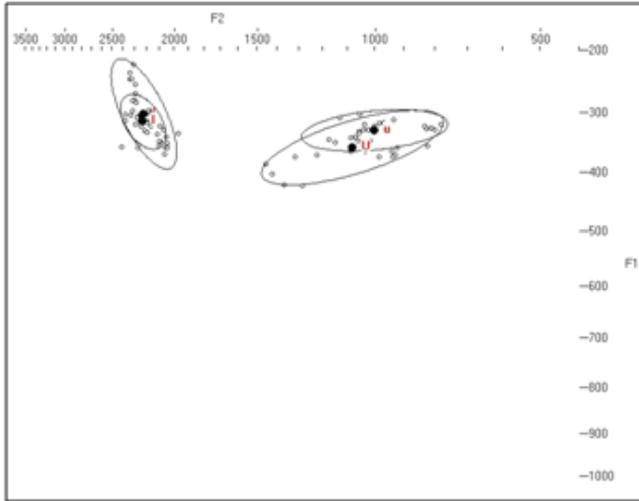


Figure 4. F1/F2 plots of KE learners' production of English tense/lax contrasts.

learners do not discriminate English tense/lax vowel contrasts in terms of spectral differences. The F1 and F2 of the participants' 5 repetitions of the production stimuli were measured, and plotted using PlotFormant program. Let us first consider Figure 3 and 4 below.

In Figure 4, as expected from Table 3, almost complete overlapping of areas is indicated from the KE learners between /i/ and /I/, /u/ and /U/, as opposed to well separated areas of Figure 3. Small overlapping of areas between /u/ and /U/ in Figure 3 might be explained by different F1 and F2 values between male and female speakers among NE speakers, as previously discussed in Table 4.

Mean F1 and F2 plots of English tense/lax contrasts by the NE speakers and the KE learners are shown in Figure 5. This time F1 and F2 are arranged in accordance with the Bark scale. The Bark scale represents perceptually equal intervals of pitch as equal distances along the scale (Ladefoged 2006). It is plotted here as a production reference in relation to the perception test in the present study.

Overall, it is readily noticeable that the KE learners' English tense/lax vowels do not contrast with each other in vowel quality. The KE learners' failure of discriminating the English tense/lax vowels may be due to the lack of tense/

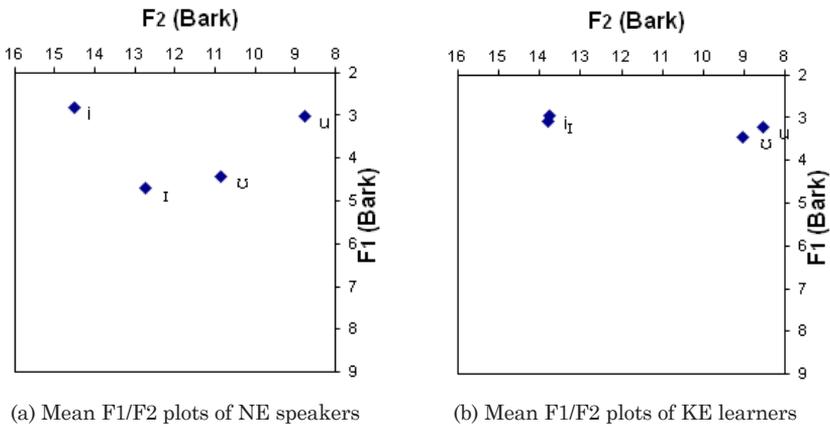


Figure 5. Mean F1/F2 plots of English tense/lax contrasts by the NE speakers and the KE learners.

lax distinction in their L1. That is, they assimilate these non-native sounds from English to their L1 categories in terms of vowel quality.

4.1.2 Vowel duration

In the preceding section, we have seen that the KE learners' English tense/lax vowels are not spectrally contrastive with each other. Does this imply that the KE learners assimilate English tense/lax vowels to a single L1 sound /i/, as expected as the first possibility in Literature review section, or do they attempt to differentiate English tense/lax vowels of their own way employing another strategy accessible to them? Let us now consider Table 5 below.

Table 5 presents the vowel duration of the vowel /i/-/I/ and /u/-/U/ produced by the two groups. A t-test examining the NE subjects' vowel duration differences between tense and lax vowels did not yield a significant effect of vowels. However, a t-test revealed that the KE subjects' vowel duration differences between tense and lax vowels were significant ($p < 0.05$) for /u/-/U/ contrast. And although a t-test did not show a significant vowel duration differences between /i/ and /I/ for the KE learners, the duration difference between /i/ and /I/ was considerable (47 ms) when compared to the difference for the NE speakers (8 ms).

Previously, this study hypothesized that KE learners will make greater

Table 5. The mean duration of English tense/lax vowel contrasts spoken by the subjects in two groups in ms. The /i/ vs. /I/ and /u/ vs. /U/ differences that were significant at the 0.05 level according to a t-test are marked by an asterisk.

Groups	beat vs. bit				cooed vs. could			
	/i/	/I/	Δ /i/-/I/	p-value	/u/	/U/	Δ /u/-/U/	p-value
NE	142 (26)	134 (11)	8	0.6477	234 (17)	150 (45)	84	0.0686
KE	140 (69)	93 (23)	47	0.2832	177 (24)	118 (20)	59	0.0104*

use of vowel duration than do NE speakers to differentiate English tense/lax vowel contrasts. Although we have different t-test results between /i/-/I/ and /u/-/U/ contrasts, the hypothesis is partially supported based on their duration differences between English tense and lax vowels.

I suggested two possibilities of L2 assimilation to L1 categories according to PAM earlier in this paper. The first possibility was a total assimilation of English tense/lax vowels to a single category in Korean, and the second possibility indicated KE learners' deviant English vowel contrasts based solely on duration differences. Taking both results from vowel quality and duration into account, the second possibility is surely supported. That is, the KE learners' production of the target vowels does not manifest quality differences between English tense/lax contrasts, but does reveal their exclusive reliance on vowel duration to differentiate English tense/lax vowel contrasts. As regards the duration reliance among L2 learners, Bohn (1995) put forward Desensitisation Hypothesis, which states that L2 learners will be less sensitive to spectral differences that only contain one vowel in their L1. As a result, they will use the duration cue, which is probably psychoacoustically salient, to discriminate between two L2 vowels that fall within the same native vowel category. The Bohn's hypothesis presumably explains the duration reliance of the KE learners.

4.2 Perception test

As described in method, an A' score of 1.0 reflects perfect discrimination,

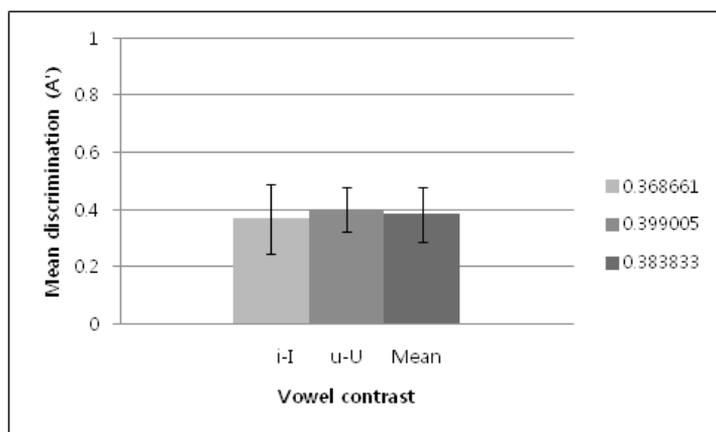


Figure 6. Mean discrimination (A') of English tense/lax vowel contrasts by the Korean learners (KL). Error bars represent standard errors.

whereas a score of 0.5 or lower indicates insensitivity to a contrast. The CDT results revealed the following KE learners' A' scores for each contrast: /i/-/I/ = 0.36; /u/-/U/ = 0.39; mean of both contrasts = 0.38. Figure 6 provides the KE learner' CDT results.

The KE learners' scores reveal that for both /i/-/I/ and /u/-/U/ contrasts, KE learners obtained lower A' scores than 0.5, indicating a lack of sensitivity to both contrasts. This contrasts sharply with the fact that the NE speakers obtained perfect or near-perfect scores for the English both /i/-/I/ and /u/-/U/ contrasts ($A' > 0.95$) (Flege and Mackay 2004, Frieda and Nozawa 2007). This suggests that the KE learners were not perceptually aware of differences between English tense/lax vowel contrasts.

To further examine whether discrimination sensitivity difference is significant between /i/-/I/ and /u/-/U/, an independent t-test was carried out. The t-test result indicates that A' score difference between /i/-/I/ and /u/-/U/ contrasts was not statistically significant ($p < 0.84$). That is, the KE learners experienced difficulty equally in discriminating English tense/lax vowel contrasts: /i/-/I/ and /u/-/U/.

The result of the perception test is consistent with the Flege (1995) which states that accurate L2 production to a large extent relies on accurate percep-

tion. Akahane-Yamada, Tohkura, Bradlow, and Pisoni (1997) also shares the same perspective such that although the relationship between speech perception and production is complex, it might be expected that cross-language differences in the perception of a set of foreign vowels will be mirrored in L2 learners' productions of those same vowels, and listeners who discriminate better among L2 vowels would be expected to produce them more accurately. With regard to the relationship between perception and production in the present study, the KE learners' lack of discrimination sensitivity in perception may explain why the KE learners do not differentiate English tense/lax vowel contrasts in production.

In sum, English tense/lax vowel contrasts prove to be problematic for KE learners in both production and perception. They experienced difficulty in accurately producing the contrasts in terms of vowel quality and duration. In addition, the results of the perception test suggest that English tense/lax contrasts are difficult for KE learners to discriminate because both members of each contrast tend to be uncategorizable and identified as instances of a single Korean vowel. One possible explanation of the KE learners' difficulties would be provided by the PAM's patterns of assimilation, namely, L2 assimilation to L1 categories. The KE learners' discrimination of the contrasts might rely on vowel duration because they are not sensitive to spectral differences in regions of vowel space originating from a lack of spectral differences in their L1. Consequently, they will use durational information to discriminate between two L2 vowels that fall within the same native vowel category.

Admittedly, the present perception test has some limitations. Above all, the number of subjects was small. Thus, it would be hard to generalize the results to a larger population. For a future study, it would be better if the number of participants is sufficient enough to yield more reliable results.

5. Conclusion

The present study investigated the production and perception of the English tense/lax vowel contrasts by KE learners. The study showed that the phonetic distinction between English tense and lax vowels that is not phono-

logically relevant to L1 is predicted to have low perception and production accuracy for KE learners.

The results reported in this study demonstrate that English tense/lax vowel contrasts prove troublesome for KE learners. They were found to have difficulty in accurately perceiving English tense/lax vowel contrasts as well as in accurately producing them in terms of vowel quality and duration. That is, KE learners were perceptually insensitive to English tense/lax contrasts and failed to make necessary vowel quality distinctions that were reflected in vowel formants (F1 and F2). The results of the production test confirmed that the KE learners relied solely on vowel duration in distinguishing the contrasts. The results of the perception test also implied that the KE learners' inaccurate discrimination might be because the KE learners made greater perceptual use of vowel duration based on the fact that duration is a more accessible perceptual cue to the KE learners. However, this explanation requires further research.

There still seems to remain some questions regarding this topic. L1 speakers of a language assign relative amounts of perceptual attention to the different acoustic cues that signal a contrast. Do KE learners weight the acoustic information in the same way that NE speakers do? For future research, the acoustic cue weighting in the perception of English tense/lax vowels by KE learners should be investigated to achieve a fine-grained result.

References

- Ahn, Mikyung (1997). The phonological interlanguage of Korean learners of English. Ph.D. dissertation., University of Wales, Cardiff.
- Avery, P. and Ehrlich, S. (1992). *Teaching American English Pronunciation*. Oxford: Oxford University Press.
- Best, C. T. (1995). Learning to perceive the sound patterns of English. In C. Rovee-Collier and L.P. Lippsitt (ed.). *Advances in Infancy Research*, Vol 9. Norwood, NJ: Ablex. 217-304.
- Bohn, O-S., and Flege, J. (1996). Perception and production of a new vowel category by adult second learners. In A. James and Leather (ed.). *Second-*

- language speech: Structural and process. Berlin: Mouton de Gruyter.
- Bradlow, A. R., Pisoni, D. B., Akahane-Yamada, R., and Tohkura, Y. (1997). Training Japanese listeners to identify English /r/ and /l/: IV. Some effects of perceptual learning on speech production. *Journal of the Acoustical Society of America*. 101: 2299-2310.
- Escudero, P. (2000). Developmental patterns in the adult L2 acquisition of new contrasts: the acoustic cue weighting in the perception of Scottish tense/lax vowels by Spanish speakers. Ms., University of Edinburgh.
- Escudero, P., Benders, T., and Lipski, S. C. (2009). Native, non-native and L2 perceptual cue weighting for Dutch vowels: The case of Dutch, German, and Spanish listeners. *Journal of Phonetics*. 37: 452-463.
- Flege, J. (1995). Second language speech learning: Theory, finding and problems. In Strange, W. (ed.). *Speech Perception and Linguistic Experience: Theoretical and Methodological Issues*. Baltimore: York Press. 233-277.
- Guion S.G., Flege J., Akahane-Yamada R., Pruitt J.C. (2000). An investigation of second language speech perception: The case of Japanese adults' perception of English consonants. *Journal of Acoustical Society of America*. 107: 2711-2724.
- Ingram, J.C.L., & Park, S.-G. (1997). Cross-language vowel perception and production by Japanese and Korean learners of English. *Journal of Phonetics* 25: 347-370.
- International Phonetic Association (1999). *Handbook of the International Phonetic Association: A guide to the use of the International Phonetic Alphabet*. Cambridge, Eng.: Cambridge University Press.
- Jia, G., Strange, W., Wu, Y., Collado, J., and Guan, Q. (2006). Perception and production of English vowels by Mandarin speakers: Age-related differences vary with amount of L2 exposure. *Journal of Acoustical Society of America*. 119: 1118-1130.
- Ladefoged, P. (2006). *A Course in Phonetics*. Boston: Thomson Wadsworth.
- McAllister, R., Flege, J. E., and Piske, T. (2002). The influence of L1 on the acquisition of Swedish quantity by native speakers of Spanish, English and Estonian. *Journal of Phonetics* 30: 229-258.
- Peterson, G. E., and Barney, H. L. (1952). Control methods used in a study of

- the vowels. *Journal of the Acoustical Society of America*. 24: 175-184.
- Rochet, B. (1995). Perception and production of L2 speech sounds by adults. In Strange, W (ed.). *Speech Perception and Linguistic Experience: Theoretical and Methodological Issues*. Baltimore: YorkPress. 379-410.
- Tench, P. (2003). Non-native speakers' misperceptions of English vowels and consonants: Evidence from Korean adults in UK. *IRAL*, 41: 145-173.
- Tsukada, K., Birdsond, D., Bialystok, E., Mack, M., Sung, H., & Flege, J. (2005). A developmental study of English vowel production and perception by native Korean adults and children. *Journal of Phonetics*. 33: 263-290.
- Wayland, P. Ratree (2007). The relationship between identification and discrimination in cross-language perception. In O-S Bohn and M.J. Munro (ed.), *Language Experience in Second Language Speech Learning*, (pp. 201-218).

ABSTRACT

Production and Perception of English Tense/lax Vowel Contrasts by Korean EFL Learners

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The purpose of this study is to investigate Korean EFL (KE) learners' production and perception of English tense/lax vowel contrasts. This study not only examines the acoustic properties of KE learners' production of English tense/lax vowels but it also looks into the KE learners' perception as to whether or not they discriminate English tense/lax vowel contrasts in a Categorical Discrimination Test (CDT). Four KE learners (experimental group) and three native speakers of English (control group) participated in the study. In Production test, the KE learners were asked to read aloud consonant-vowel-consonant English words in a carrier phrase. In Perception test, the KE learners participated in a CDT. The results suggest that English tense/lax vowel contrasts prove to be problematic for KE learners in both production and perception. They experienced difficulty in accurately producing the contrasts in terms of vowel quality and duration. In addition, the results of the perception test suggest that English tense/lax contrasts are difficult for KE learners to discriminate because both members of each contrast tend to be uncategorizable and identified as instances of a single Korean vowel.

Key Words speech production, speech perception, English tense/lax vowels

