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Features of First Language Transfer in Korean Speakers' Production of English /l/*

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This study investigates how the phonetic properties of Korean /l/ affect Korean speakers' production of English /l/. Eight native speakers of Korean (experimental group: intermediate and advanced groups) and two native speakers of American English (control group) participated in the study. There were two main findings that differentiated the intermediate learner group from the advanced group in English /l/ production. First, the F2 mean of the intermediate group demonstrated a frequency of 400-600 Hz higher than the advanced group. Second, the F3 mean of the intermediate group in the back vowel context (/ɔ , ʊ) was significantly lower than the F3 mean in the front vowel context (/ɪ, ɛ/). The two phonetic features of English /l/ found in the intermediate learner group were attributed to the phonetic transfer of Korean /l/: a) Korean /l/ is characterized as having a F2 frequency of 600-700 Hz higher than English /l/, and b) Korean /l/ is realized as a retroflex lateral when the preceding vowel is /o, a, u/, and the acoustic correlate of the Korean retroflex lateral is a relatively lower F3 (Bo-Young Kwon, 2005). Drawing on these results, teaching implications are provided to improve the production of English /l/ by Korean speakers.

I. INTRODUCTION

This study explores how the articulatory and acoustic differences between Korean /l/[1] and English /l/ affect Korean speakers' production of

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[1] Throughout this paper, a phonemic notation for Korean /l/ was used to emphasize the fact that the Korean lateral is realized either as an alveolar lateral or as a retroflex lateral depending on the vowel context (phonetic notation [l] cannot capture this distinction). However, if the data are from other studies, the notation from the original study was used.

English /l/. In particular, this study examines the differences in formant frequencies of /l/ produced by native speakers of English and native speakers of Korean. Using spectrographic analysis, this study investigates whether the English /l/ produced by native speakers of Korean shares a common set of acoustic features with the English /l/ produced by native speakers of English. The quality of the vowels (/ɪ/, /ɛ/, /ɔ/, /ɑ/, /ʊ/)and English speaking proficiency of Korean speakers in terms of pronunciation (intermediate and advanced) are the independent variables for statistical analysis.[2] Based on the results from the experiment, it was determined where and to what degree transfer of native language phonetic features occurs in second language (L2, hereafter) acquisition of a new segment.

It has been generally assumed that Korean /l/ is an alveolar lateral and that the only difference between English /l/ and Korean /l/ lies in the fact that Korean /l/ has a certain positional restriction on its occurrence in a word (it does not occur word-initially or as a part of consonant clusters). For instance, See-Gyoon Park (1999) states that Korean /l/, which occurs in syllable-final and intervocalic position, is invariably realized as a clear alveolar lateral. Eun-kyoung Sung (2003) makes a similar statement: "The lateral [l] is always 'light' (the tongue tip touching the alveo-dental area) in Korean (p. 14).[3]

Consequently, much of the work on Korean speakers' acquisition of English /l/ has been devoted to examining the positional effects on Korean speakers' production and perception of English /l/. For instance, it was tested whether Korean speakers experience more difficulty in producing and perceiving English /l/ when it occurs in a word-initial position or as a part of consonant clusters (e.g., Ingram & See-Gyoon Park, 1998; See-Gyoon Park, 1999).

However, in contrast to the description of Korean /l/ in these previous studies, phonetic experimental literature on Korean /l/ (Hyun Bok Lee, 1980; Tsuzuki, 1992; Umeda, 1980) and the previous study on the acoustic characteristics of Korean /l/ in Bo-Young Kwon (2005) all reveal that the articulatory and acoustic characteristics of the Korean lateral are more complicated than warrant the simple labeling of it as an alveolar lateral or a clear lateral.

In terms of articulation, the findings of Hyun Bok Lee (1980), Tsuzuki (1992), and

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[2] Note that English speaking proficiency is measured only in terms of Korean speakers' pronunciation. For the sake of simplicity, "English speaking proficiency of Korean speakers in terms of pronunciation" is abbreviated as "English speaking proficiency" throughout the paper.

[3] In loanword phonology literature, the Korean lateral is also termed as "alveolar lateral" or "dental lateral" (Borim Lee, 2001).

Umeda (1980) demonstrate that the articulatory point or articulatory manner of the Korean lateral varies a great deal depending on the quality of the preceding vowels. For instance, Umeda (1980) observed that the articulatory point of syllable-final /l/ in Korean changes according to the preceding vowels. That is, the articulatory point of /l/ occurs at or before alveolar when the preceding vowel is a front vowel, while it occurs behind the alveolar ridge when the preceding vowel is a back vowel. Based on these results, Umeda (1980) concluded that syllable-final /l/ in a back vowel context is retroflexed. In a similar vein, Hyun Bok Lee (1980) found that /l/ in syllable-final position is realized as a retroflex lateral when the preceding vowel is /a/. The retroflexion of /l/ in a back vowel context is also observed in Tsuzuki (1992). Note that Hyun Bok Lee (1980), Umeda (1980), and Tsuzuki (1992) all employed an electro-palatographic analysis that shows the tongue-palate contact of sound in production.

Recently, Gick, Campbell, and Sunyoung Oh (2001) (cited in Sunyoung Oh, 2002) found that the production of Korean /l/ involves two gestures, tongue tip raising and tongue body raising. In contrast, the production of English /l/ involves tongue tip raising and tongue dorsal gesture. In terms of timing relation, the Korean lateral is not distinguished by a timing lag between tongue tip and tongue body gesture, while English /l/ has a considerable timing lag between tongue tip and tongue dorsal gesture in syllable-final position (and tongue dorsal retraction occurs before tongue tip raising in English /l/). Sunyoung Oh (2002) further suggests that the Korean lateral seems more consonantal than vocalic.

In terms of acoustics, differences also exist between Korean /l/ and English /l/. Bo-Young Kwon (2005) examined the acoustic characteristics of Korean /l/ with respect to those of English /l/. Note that in Bo-Young Kwon (2005) the native Korean speakers and native English speakers' age, weight, and height were approximately matched in order to control for physical conditions affecting the formant frequencies. In this experiment, Bo-Young Kwon (2005) observed that the F2 value for Korean /l/ is much higher than the F2 value for English /l/. On average, male Korean speakers have an F2 value that is 600 Hz higher than male English speakers. Similarly, female Korean speakers have an average F2 value of 700 Hz higher than female English speakers. Language dependent variation was also found in the F3 values. Although the F3 values for Korean /l/ and English /l/ were quite similar on average, there was vowel-context dependent variation for Korean /l/: the F3 mean for Korean /l/ demonstrates around 600 Hz lowering when the preceding vowel is a back vowel. This kind of vowel-context dependent variation for F3 was not observed in English /l/.

Bo-Young Kwon (2005) then correlates the F2 and F3 patterns of Korean /l/ with the articulatory configurations of Korean /l/. More specifically, drawing on Gick et al.'s (2001) observation that Korean /l/ involves tongue body raising along with tongue tip raising,

Bo-Young Kwon (2005) identifies the palatalization[4] and the lack of dorsal gesture in Korean /l/ as articulatory correlates of higher F2 for Korean /l/. Palatalization of /l/ has been shown to raise F2 value of /l/ (Fant, 1960) and in turn, dorsal gesture involved in English /l/ is reported to lower the F2 value (Stevens, 1998). As a result, the palatalization of Korean /l/ along with the lack of dorsal gesture is naturally correlated with a relatively higher F2 in Korean /l/.

Regarding the much lower F3 value in a back vowel context, Bo-Young Kwon (2005) proposed that the F3 lowering is the acoustic consequence of Korean /l/ being retroflexed in a back vowel context. It was found that during Korean /l/ configuration, the tongue tip touches the post-alveolar or palatal region when the preceding vowel is a back vowel (Hyun Bok Lee, 1980; Tsuzuki, 1992; Umeda, 1980). The volume of a back cavity is smaller in a back vowel context than that in a front vowel context, and the volume of a back cavity is associated with the F3 value: the smaller the back cavity, the lower the F3 value (Stevens, 1998).

It is important to note that the findings of Bo-Young Kwon (2005) are consistent with the previous studies on the acoustics of English /l/ and Korean /l/. Table 1 demonstrates the formant frequencies of English /l/ from Lehiste (1964) and Stevens (1998), and formant frequencies of Korean /l/ from Tsuzuki (1992).[5]

TABLE 1
Mean Formant Frequencies of Korean /l/ and English /l/ in Previous Studies

Reference	Gender	Vowel	F1	F2	F3	F2-F3
Lehiste (1964) (American English)	Male		295	980	2600	1620
Stevens (1998) (American English)	Male		360	900		
	Female		350	1180		
Tsuzuki (1992) (Korean)	Male	/illi/	347	1896	2742	846
		/elle/	561	1692	2823	1131
		/alla/	561	1335	2854	1519
		/ollo/	387	1172	2691	1519
		/ullu/	387	1376	1753	377
		Average	449	1494	2753	1078

Table 1 shows that Korean /l/ demonstrates higher F2 than English /l/, and F3 value for Korean /l/ becomes lower in the context of /o/ and /u/. To summarize, we have seen that phonetic characteristics of Korean /l/ are rather different from English /l/, contrary to the

[4] Gick et al. (2001) observed that palatalization, which involves tongue body raising, is a typical characteristic of Korean /l/.

[5] Note that Tsuzuki (1992) only provided formant values for one time occurrence of each token with a corresponding spectrogram (not an averaged value of each token).

description in many other previous studies.

The research questions for this study were motivated by these articulatory and acoustic differences between English /l/ and Korean /l/. The assumption for the proposed research is that, given the phonetic differences of /l/ in the two languages, Korean speakers' production of English /l/ is influenced by native language phonetic properties. The research questions in the current study are stated below.

1. Research Questions

1) What are the acoustic characteristics of /l/ produced by Korean speakers while speaking English? Are they more similar to the phonetic properties of English /l/ or Korean /l/?
2) What is the effect of English speaking proficiency on Korean speakers' production of English /l/? Will advanced learners of English acquire phonetic features of English /l/ (e.g., lower F2), while intermediate learners fail to do so?
3) Will there be a first language transfer effect for Korean learners of English such that English /l/ is realized as a retroflex lateral when the preceding vowels are /ɔ/, /ɑ/, or /ʊ/?

These questions are important to address since no studies, to my knowledge, acknowledge the phonetic features (articulatory and acoustic) as factors affecting Korean speakers' production of English /l/. The questions raised above are informed by examining Korean speakers' production of English /l/.

2. Hypotheses

Based on the discussion of the phonetic properties of Korean /l/ in relation to those of English /l/, there are two hypotheses regarding the production of English /l/ by Korean speakers. The assumptions underlying the two hypotheses are that the intermediate group is more likely to maintain the phonetic properties of Korean /l/ when they produce English /l/, while the advanced group moves towards the target phonetic properties of English /l/.

1) Hypothesis 1: The F2 mean of the intermediate group will be significantly different from that of the advanced group. In particular, the intermediate group will demonstrate higher F2 value than the advanced group due to the relatively higher F2 for /l/ in the learners' native language.

2) Hypothesis 2: The F3 mean of the intermediate group in a back vowel context (/ɔ/, /ɑ/, /ʊ/) will be significantly different from that in a front vowel context (/ɪ/, /ɛ/). In particular, the intermediate group will demonstrate lower F3 value in the context of the back vowels (/ɔ/, /ɑ/, /ʊ/) due to the retroflexion of /l/ in the learners' native language.

The rest of this paper is organized as follows. Section II presents the experimental design to test the hypotheses in the study. Section III provides and interprets results from the experiment. The result section is composed of three sub-sections: a) results for Hypothesis 1, b) results for Hypothesis 2, and c) features of first language transfer. Section IV provides teaching implications for target-like pronunciation of English /l/ for Korean speakers.

II. METHOD

1. Participants

Eight native speakers of Korean (four males and four females) participated in the experiment. Two native speakers of English (one male and one female) participated in the experiment as a control group. The eight native speakers of Korean in varying levels of English as a Second Language (ESL) classes and graduate degree programs were placed in the intermediate and advanced groups based on the following procedure of measuring their English pronunciation.

As a placement measure, participants were asked to read a short conversation between two friends. The conversation contains English segments that are assumed to be problematic for Korean speakers to produce (e.g., /l/, /r/, /v/). Reading a conversation is also assumed to serve as a good indicator of the participants' familiarity with English intonation. The participants read the conversation in Appendix A three times, and the third repetition of the speech was presented to two raters who are native speakers of English (L1 Eng). The two native English speakers (one male and one female) are graduate students in linguistics department at Michigan State University.[6] Three categories of evaluation were given to the raters: segmental accuracy, intonation, and overall fluency. The raters graded the recorded speech on a 1 to 10 scale in each category to determine participants' level of English speaking proficiency. Table 2 presents information about the participants and results from the English speaking proficiency test.

Pearson correlation test was conducted to check the inter-rater reliability of grading. The

[6] In addition to studying linguistics, the female rater reported that she worked as a SPEAK test rater.

correlation between scores of two raters for all three categories is statistically significant: segmental accuracy ($r=.789$, $p<.01$), intonation ($r=.629$, $p<.05$), and overall accuracy ($r=.755$, $p<0.01$). Because there is strong positive correlation, the inter-rater reliability is assumed to be high.

The original plan for the experiment was to divide 13 participants into two groups (6 advanced learners and 6 intermediate learners) based on the English speaking proficiency of the participants. However, as can be seen in the total points in the last column of Table 2, a middle group exists where the total point of the participant falls in between the lower group and the higher group (participants 5-9). Thus, only the data from the participants in the four highest scored (participants 10-13) and four lowest scored groups (participants 1-4) were used so that the two experimental groups could be clearly differentiated in terms of their English speaking proficiency.

TABLE 2
Results from the English Speaking Proficiency Test

	ID	Gender		S	I	F		S	I	F		Total
				Rater 1				Rater 2				
1	NR	F	ESL	5	7	6	18	3	6	5	14	32
2	DS	M	ESL	5	6	6	17	4	6	6	16	33
3	WJ	M	ESL	6	7	7	20	3	5	5	13	33
4	SI	F	GS	6	8	7	21	4	6	6	16	37
5	EK	F	GS	6	7	7	20	6	6	7	19	39
6	IJ	F	GS	7	7	7	21	5	7	7	19	40
7	EJ	F	Spouse	7	8	7	22	5	7	7	19	41
8	EY	M	ESL	7	8	7	22	6	7	7	20	42
9	CW	M	GS	7	9	8	24	5	7	7	19	43
10	EH	F	GS	8	8	8	24	7	7	7	21	45
11	MS	M	GS	9	9	9	27	6	6	7	19	46
12	MR	F	GS	9	9	9	27	6	7	8	21	48
13	JS	M	GS	9	10	9	28	7	8	9	24	52

(ESL = students in a language course, GS = graduate student, spouse = spouse of a graduate student, S = segmental accuracy, I = intonation, F = overall fluency)

2. Stimuli

1) English Stimuli

Seventy-five target items, which contained /l/ across the five phonological environments (word-initial, word-initial cluster, intervocalic, word-final, and word-final

cluster), were used as stimuli. The words in the stimuli were either existing English words or nonsense words. English words were incorporated into the stimuli so that participants were aware of the fact that they were reading English words (even though many of them were nonsense words). Every stimulus was a monosyllabic or disyllabic word and contained one of the lax vowels (/ɪ, ɛ, ɔ, ɑ, ʊ/). /h/ and /t/ were used as a single onset and coda respectively.

Seventy fillers, which rhyme with the target stimuli, were created. Fillers were also either nonsense words or English words. Each target item was followed by one filler.

2) Korean Stimuli

Korean words containing /l/ in intervocalic and syllable-final position were created. The data from these stimuli were used to directly compare each speaker's production of Korean /l/ and his/her English /l/. Note that /i/ and /ɛ/ are front vowels, /a/ is a central vowel, and /o/ and /u/ are back vowels in Korean (Byunggon Yang, 1990). Appendix B presents target stimuli and fillers in the experiment.

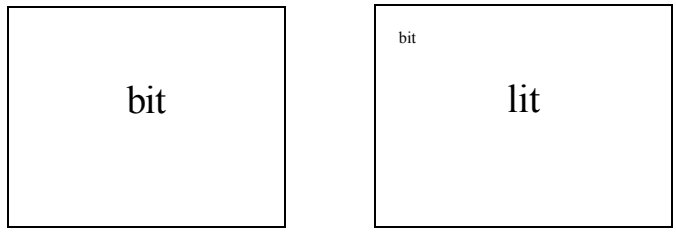
3. Procedure

The experiment was carried out in two sessions. In the first session, the participants read English stimuli, and in the second session, the participants (with the exception of the control group) read Korean words.

Participants were instructed that they would first hear a model English word and were supposed to read the word provided on the computer screen in a way that rhymed with the word that they heard. Participants were also instructed that they were supposed to use the same vowel as in the English words they heard in their production. This was done to ensure accurate vowel production in the words as to not interfere with the /l/ production. The model English words were recorded by an L1 English faculty member at Michigan State University.

Stimuli were presented in PowerPoint slides. The participants listened to the model English word five times before their production. The model English word stayed in the left upper side of the slide, while the target stimulus appeared in the center of the slide. The spelling of the model English word, which stayed in the left upper side of the slide, served as a reminder of the model English word. Participants were also allowed to ask the researcher to replay the model English word whenever it was necessary. The format of slides is presented in Figure 1. The first slide contained the model English word with sound, and the second one contained both a model English word (left upper side) and a target word (at the center). Participants read the stimuli twice and the second production was used for analysis.

FIGURE 1
The Format of a PowerPoint Slide



The experiment was recorded on a Marantz PMD 201 cassette recorder, and the recorded sounds were digitized through an Mbox at the Linguistics Lab at Michigan State University.

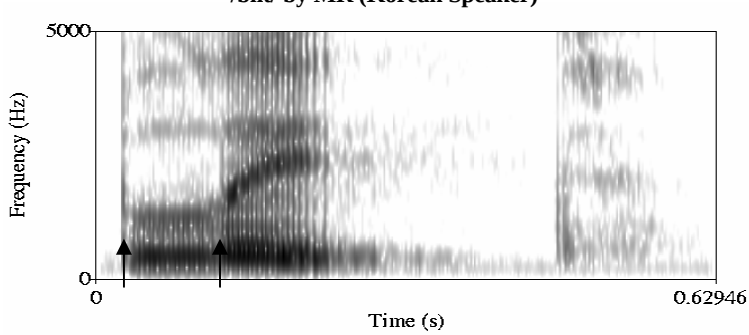
4. Measures

1) Determination of /l/ midpoint

The recordings were analyzed using Praat (version 4.3.18). Formant values at /l/ midpoint were examined to determine whether there were differences in /l/ quality depending on the English speaking proficiency of participants and vowel contexts. The justification for measuring formant values at /l/ midpoint is found in Huffman (1997), where she states that "Examination of spectrograms and LPC formant analysis indicated that most /l/'s had an identifiable steady state portion, so the midpoint values were representative of the formant extrema" (p. 124, fn).

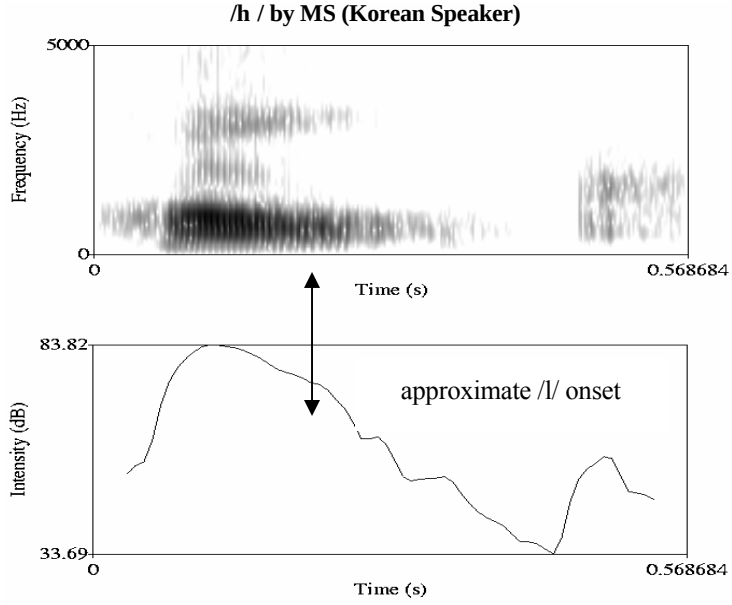
The onset and offset of English /l/ were relatively easily determined for most syllable-initial and intervocalic /l/ tokens, showing a fairly rapid shift in formant structure as is in Figure 2 (onset and offset of /l/ are indicated by an arrow).

FIGURE 2
/blit/ by MR (Korean Speaker)



However, it was rather difficult to determine the onset of /l/ itself for /l/ in syllable-final position. Nevertheless, it was not problematic for data coding since the end point of /l/ is very clear: syllable-final /l/ is either word-final or followed by an obstruent consonant in the stimuli, and therefore boundary from the syllable-final /l/ and the following consonant was quite clear. In addition, a rapid shift in formant amplitude was used as a cue for the starting point of /l/. Refer to Figure 3 for approximate /l/ onset in coda cluster and corresponding formant amplitude shift.

FIGURE 3
/h / by MS (Korean Speaker)



2) Non-applicable Tokens

There were three cases of non-applicable tokens in this study. First, there were some cases where participants failed to produce the target stimuli correctly (e.g., “hauled” was pronounced as [hɔlid] by two speakers). Second, there were cases where participants did not produce the word with the target vowel (e.g., there was confusion between /ɑ/and /ɔ/ in some cases). Third, the F3 value for /l/ was quite unstable in some of the tokens (in particular syllable-final /l/), while F1 and F2 formants for /l/ were relatively stable. In these cases, rather than guessing the formant value from the spectrogram, the F3 value of these tokens was not coded for analysis. Table 3 provides the total number of tokens in the study.

TABLE 3
Number of Tokens

Target tokens		Applicable tokens		Non-applicable tokens	
F1	750	F1	743	F1	7
F2	750	F2	743	F2	7
F3	750	F3	703	F3	47

3) Statistical Analysis

A one-way between groups analysis of variance (one-way ANOVA) was conducted to evaluate the mean difference of formant values for /l/ among the groups. Two types of independent variables were set for data analysis: a) English speaking proficiency and b) vowel context. English speaking proficiency was divided into three groups: native speakers of American English, intermediate Korean learners of English, and advanced Korean learners of English. Vowel context was divided into five groups: /ɪ/, /ɛ/, /ɔ/, /ɑ/, /ʊ/. Statistical difference at $p<.05$ level was measured. If a significant mean difference among groups was found, post-hoc comparison (Tukey HSD) was further conducted to isolate exactly where the significant differences were among groups.

III. RESULTS AND DISCUSSION

1. Results for Hypothesis 1

This section describes Korean speakers' production of English /l/ depending on their English speaking proficiency. Table 4 presents the F2 mean value for /l/ in each group.

TABLE 4
Means of F2 by Speaking Proficiency Group

			Mean	Std	N
F2	Male	Intermediate	1339.46	227.081	148
		Advanced	922.21	144.854	149
		Control	960.10	112.845	75
F2	Female	Intermediate	1736.28	299.083	146
		Advanced	1119.90	184.744	150
		Control	986.13	134.083	75

We can notice in the fourth column (labeled as *Mean*) of the table that the F2 mean differences between the intermediate and advanced group are relatively large. There is a

417 Hz difference between the intermediate male and advanced male group and a 617 Hz difference between the intermediate female and advanced female group. Also note that the F2 value is always lower in the advanced group, and the F2 value of the advanced group is closer to that of the control group (native speakers' of English).

To evaluate whether the mean difference among groups is statistically significant, ANOVA was implemented. The ANOVA results demonstrate that F2 mean differences were significant in all the groups (intermediate, advanced, and control): male $F(2, 369) = 232.582$, $p<.05$, female $F(2, 368) = 375.650$, $p<.05$.

TABLE 5
ANOVA: F2 by Speaking Proficiency Group

		df	F	Sig.
F2	Male	2, 369	232.582	.000*
	Female	2, 368	375.650	.000*

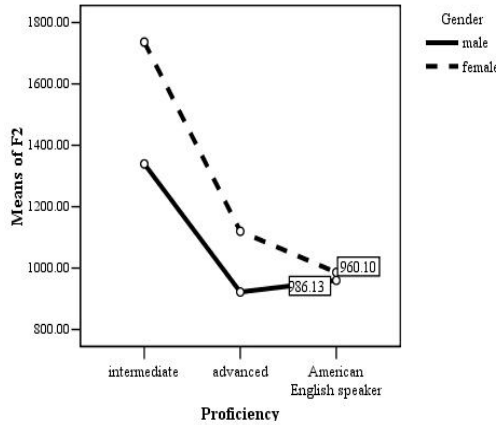
In addition, a post-hoc test (Tukey HSD) was conducted to determine exactly which means are significantly different within the three speaking proficiency groups. The post-hoc test results demonstrate that the F2 means of the intermediate groups (both male and female) are always significantly different from F2 of the advanced and control groups. Thus, the hypothesis 1, the F2 mean of the intermediate group will be significantly different from that of the advanced group, is supported in the experiment.

TABLE 6
Multiple Comparisons: F2 by Speaking Proficiency Group

Dependent Variable	(I) Speaking Proficiency	(J) Speaking Proficiency	Mean Difference (I-J)	Std. Error	Sig.
F2 (male)	Intermediate	Advanced	417.25634(*)	20.60119	.000
		Control	379.36760(*)	25.16106	.000
	Advanced	Intermediate	-417.25634(*)	20.60119	.000
		Control	-37.88874	25.13265	.289
	Control	Intermediate	-379.36760(*)	25.16106	.000
		Advanced	37.88874	25.13265	.289
F2 (female)	Intermediate	Advanced	616.38206(*)	26.68368	.000
		Control	750.14968(*)	32.60701	.000
	Advanced	Intermediate	-616.38206(*)	26.68368	.000
		Control	133.76762(*)	32.45913	.000
	Control	Intermediate	-750.14968(*)	32.60701	.000
		Advanced	-133.76762(*)	32.45913	.000

Figure 4 describes the general pattern of F2 means by speaking proficiency group.

FIGURE 4
Means of F2 by Speaking Proficiency Group



Note that the mean F2 values of the control group (i.e., native speakers of English) are given in Figure 4 to show how close the F2 means of the experimental groups (intermediate vs. advanced) are to the target F2 mean for American English /l/.

As was predicted by hypothesis 1, when it comes to the F2 mean value, the advanced learners' performance is very close to that of the control group: the F2 values of the control group = 960 Hz (male) and 986 Hz (female), and the F2 values of advanced learner group = 922 Hz (male) and 1119 Hz (female). On the other hand, the F2 mean value of the intermediate group is much higher than that of the control group: 1339 Hz (male) and 1736 Hz (female). However, the advanced groups behave rather differently depending on gender when it comes to the F2 mean difference with the control group. That is, the F2 mean of the advanced male group is not significantly different from that of the control male group (which is what is expected given the assumption that the advanced group produces a target-like English /l/). In contrast, the F2 mean of the advanced female group ***is*** significantly different from that of the control female group.

The difference between the advanced male and advanced female groups in relation to the F2 mean difference with the control group may give the impression that the advanced female group does not reach native-like production in terms of F2 value. However, the results should not be interpreted this way, since the established literature on English /l/ states that the average F2 value for females is around 1180 Hz (Stevens, 1998), which is actually close to the F2 mean of the advanced female group (1119 Hz) in the present study. In the present study, the difference is actually from the female speaker control. That is, the F2 mean of the control female speaker (980 Hz) is lower than the average F2 value of /l/ for female. This

limitation could be resolved by involving more participants in the control group.

To summarize, the results by English speaking proficiency group support Hypothesis 1: the F2 mean of the intermediate group is significantly different from that of the advanced group. In particular, we have seen that that the F2 mean of the advanced group (both male and female) is around 400-600 Hz lower than that of the intermediate group.

2. Results for Hypothesis 2

This section describes the influence of vowel context as determinants of /l/ formant values. The independent variables were the five vowels, /ɪ, ɛ, ɔ, ɑ, ʊ/, and dependent variable was the F3 value of /l/ by each English speaking proficiency group. The mean F3 values for each group are presented in Table 7.[7]

Table 7 shows that when it comes to the intermediate group, there is around 200-500 Hz difference between the mean F3 of front vowels and back vowels (the mean F3 in a back vowel context is lower than the mean F3 in a front vowel context). However, such difference is not observed in the advanced group. We can also notice that F3 value in the /ɑ/ context in the intermediate group is not as low as F3 value in the /ɔ/ and /ʊ/ contexts despite the fact that all three vowels are back vowels in American English. This asymmetry between /ɑ/ vs. /ɔ,ʊ/ can be explained by looking at the vowel quality of the corresponding Korean vowels. English /ɑ/ corresponds to Korean /a/, /ɔ/ corresponds to /o/, and /ʊ/ corresponds to /u/ in Korean.

Note that in Korean /a/ is a central vowel, while /o/ and /u/ are back vowels (Byunggon Yang 1990). In contrast, /ɔ, ɑ, ʊ/ are back vowels in English. In particular, Byunggon Yang (1996) identified the F2 values for American English /ɔ, ɑ, ʊ/ as /ɔ/ = 1026 Hz, /ɑ/ = 1121, /ʊ/ = 1331 for male speakers, and /ɔ/ = 1140, /ɑ/ = 1255, /ʊ/ = 1486 for female speakers. On the other hand, F2 values for Korean /o, a, u/ are /o/ = 945 Hz, /a/ = 1372, /u/ = 981 for male speakers, and /o/ = 1029, /a/ = 1794, /u/ = 1021 for female speakers. Notice that the F2 values for Korean /a/ is far higher than F2 for Korean /o/ and /u/, which indicates difference in tongue backness between /a/ and /o, u/.

Given the assumption that intermediate learners substitute the corresponding Korean vowel for the English vowel, it is not surprising that F3 in the /ɑ/ context behaves differently than that in the /ɔ/ and /ʊ/ contexts. Table 8 provides ANOVA results by vowel context.

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[7] The difference in the number of tokens (N) in Table 7 is due to the exclusion of the non-applicable tokens from the statistical analysis. Note also that homogeneity of variance was checked to see if the difference in the number of tokens affects the statistical measure used in the present study. The ANOVA analysis in the current study was found to be valid even though there is difference in the number of tokens.

TABLE 7
Means of F3 by Vowel Context

			Mean	Std	N
F3	Intermediate male	/ɪ/	2678.98	405.913	30
		/ɛ/	2554.80	362.985	30
		/ɔ/	2261.97	290.001	29
		/ɑ/	2384.10	246.628	29
		/ʊ/	2242.49	342.286	30
F3	Intermediate female	/ɪ/	2976.37	436.369	29
		/ɛ/	2985.77	618.904	29
		/ɔ/	2758.32	598.353	29
		/ɑ/	2925.27	490.553	29
		/ʊ/	2451.55	382.751	30
F3	Advanced male	/ɪ/	2701.24	270.553	30
		/ɛ/	2714.15	386.464	30
		/ɔ/	2732.79	242.116	29
		/ɑ/	2601.04	352.234	30
		/ʊ/	2705.90	248.146	30
F3	Advanced female	/ɪ/	3111.47	211.875	29
		/ɛ/	3114.04	254.761	27
		/ɔ/	3281.27	261.793	30
		/ɑ/	3252.04	249.836	30
		/ʊ/	3093.11	323.643	30
F3	Control male	/ɪ/	2812.79	118.923	15
		/ɛ/	2717.52	197.419	15
		/ɔ/	2805.27	284.413	14
		/ɑ/	2721.38	210.418	13
		/ʊ/	2824.06	276.666	15
F3	Control female	/ɪ/	2395.53	607.811	8

/ɛ/	2865.79	573.456	7
/ɔ/	2746.69	602.102	9
/ɑ/	3133.34	607.567	7
/ʊ/	2586.72	698.378	11

TABLE 8
ANOVA: F3 by Vowel Context

	df	F	Sig.
Intermediate male	4, 143	9.484	.000*
Intermediate female	4, 141	5.714	.000*
Advanced male	4, 144	.853	.494
Advanced female	4, 141	3.367	.012*
Control male	4, 364	.211	.932
Control female	4, 37	1.518	.217

ANOVA results in Table 8 show that the mean difference of F3 in five different vowel contexts was significant in three groups: intermediate male $F(4, 143)=9.484$, $p<.05$, intermediate female $F(4, 141)=5.714$, $p<.05$, advanced female $F(4, 141)=3.367$, $p<.05$.

At this point, it may be puzzling that F3 mean difference by vowel is also significant in the advanced female group. That is, hypothesis 2 predicted that the F3 mean of the intermediate group in a back vowel context would be significantly lower than that in a front vowel context due to the phonetic transfer from the learners' native language, and this hypothesis is supported in the present study. However, F3 results by vowel context show that the F3 mean difference is also significant in the advanced female group. Does this mean that phonetic transfer occurs in the advanced female group?

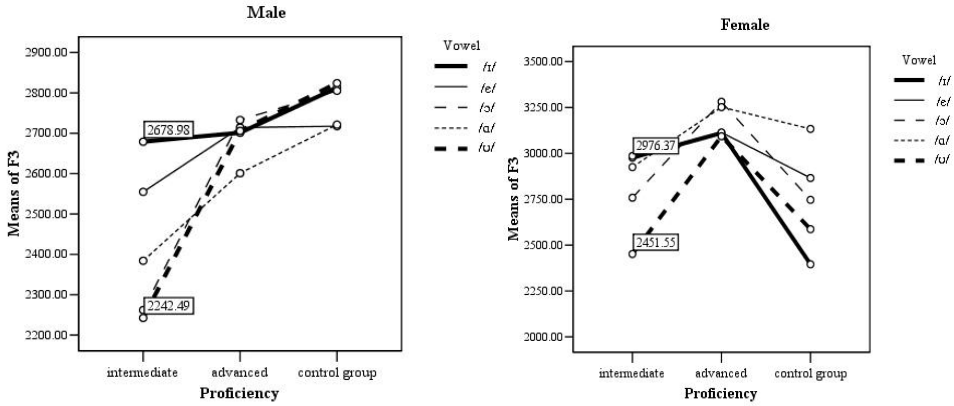
To answer this question, we need to look at the post-hoc results and see where the main interaction among five vowel contexts occurs. For space consideration, the post-hoc results are provided in Appendix C. Post-hoc results of F3 by vowel context show that the significant mean difference of the advanced female group patterns differently than that of the intermediate group. That is, the main interaction occurs between front and back vowels in the intermediate group (both male and female) as was expected, while the main interaction occurs between /ɔ/ and /ʊ/ in the advanced female group. Given that both /ɔ/ and /ʊ/ are back vowels, we can safely say that the F3 mean difference in the advanced female group is not influenced by native language transfer. In other words, if the advanced female group were influenced by the native language phonetic properties of /l/, the main interaction would occur between front vowels and back vowels (as is the case with the intermediate group), but the main interaction for the advance female group actually occurred between two back vowels.

To summarize, Hypothesis 2, the F3 mean of the intermediate group in the back vowel context (/ɔ,

ɑ, ʊ/) would be significantly different from that in the front vowel context (/ɪ, ɛ/), was supported except in the case of /ɑ/. Regarding the exceptional behavior of /ɑ /, it was proposed that there is less interaction between a front vowel and /ɑ/ due to the fact that the corresponding vowel to English /ɑ/ is a low central vowel /a/ in Korean. Lastly, Figure 5 presents F3 means by the five vowel contexts.

The F3 values in the context of /ɪ/ and /ʊ/ in the intermediate group are provided in Figure 5 so that they serve as landmarks of between groups and within group comparisons.[8] Figure 5 demonstrates that a larger F3 mean difference depending on vowel context occurs in the intermediate group. In particular, F3 is high in the front vowel context, while it becomes lower in the back vowel context.[9]

FIGURE 5
Means of F3 by Vowel Context



3. Features of First Language Transfer

The two hypotheses tested in this study were based on the acoustic properties of Korean /l/ observed by Bo-Young Kwon (2005): Korean /l/ has a relatively higher F2 value than English /l/, and vowel context dependent F3 variation occurs in Korean /l/.

This section intends to provide more direct evidence for the proposal in the present study that the

[8] F3 values in Figure 5 are 2678 Hz for /ɪ/, 2242 Hz for /ʊ/ (left figure) 2976 Hz for /ɪ/, 2451 Hz for /ʊ/ (right figure).

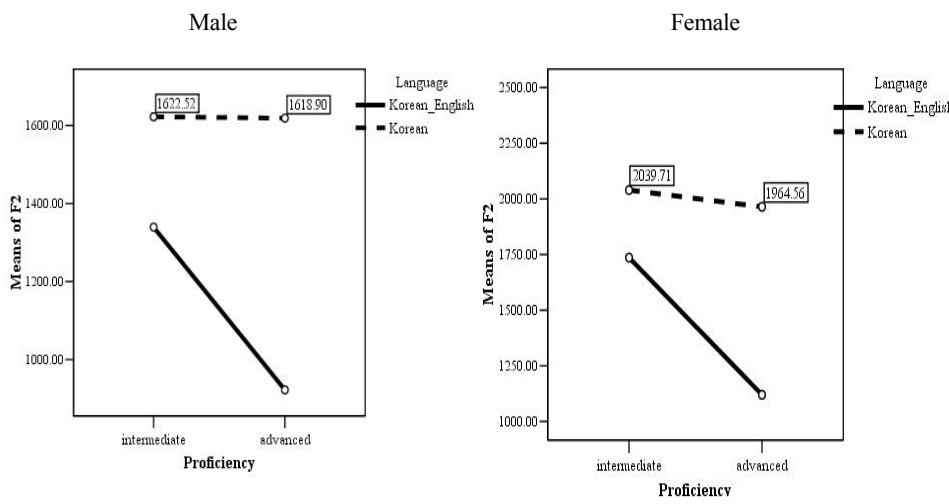
[9] The wide range of F3 values in the control female group may lead one to assume that there is larger F3 difference in this group. However, there was no significant F3 mean difference in the control female group. Yet, it should also be noted that many of the F3 values could not be coded in the control female group, and accordingly, there was a relatively small number of F3 values (e.g., control male F3 token = 72, control female F3 token = 42). Thus, it is suspected that this small number of token may have affected the pattern of F3 value (wide range of F3 value in Figure 5) in the control female group.

intermediate learner group is more likely to be affected by native language-specific properties of /l/. In so doing, this section compares F2 and F3 values of Korean /l/ with those of English /l/ produced by each speaking proficiency group. Since formant values for Korean /l/ were obtained from the same participants in the experiment, the comparison between the formant values for Korean /l/ and those for English /l/ will provide important insights into to what degree Korean learners of English in the experiment are influenced by the phonetic properties of Korean /l/ when they produce English /l/. Throughout this section, *Korean-English* indicates Korean speakers' production of English /l/, while *Korean* indicates Korean speakers' production of Korean /l/. Note that this section is not related to the hypothesis testing in the experiment, and therefore only the descriptive statistics are provided. Table 9 and Figure 6 describe the F2 mean values for Korean /l/ and Korean-English /l/.

TABLE 9
Means of F2: Korean /l/ vs. Korean-English /l/

Proficiency	Gender	Language	Mean	Std	N
Intermediate	Male	Korean	1622.5237	247.06583	60
		Korean-English	1339.4631	227.08145	148
	Female	Korean	2039.7125	323.57078	60
		Korean-English	1736.2837	299.08292	146
Advanced	Male	Korean	1618.8975	176.23964	60
		Korean-English	922.2068	144.85356	149
	Female	Korean	1964.5645	262.38066	60
		Korean-English	1119.9016	184.74399	150

FIGURE 6
Means of F2: Korean /l/ vs. Korean-English /l/



The F2 values for Korean /l/ and Korean-English /l/ demonstrate very interesting patterns. In Figure 6,

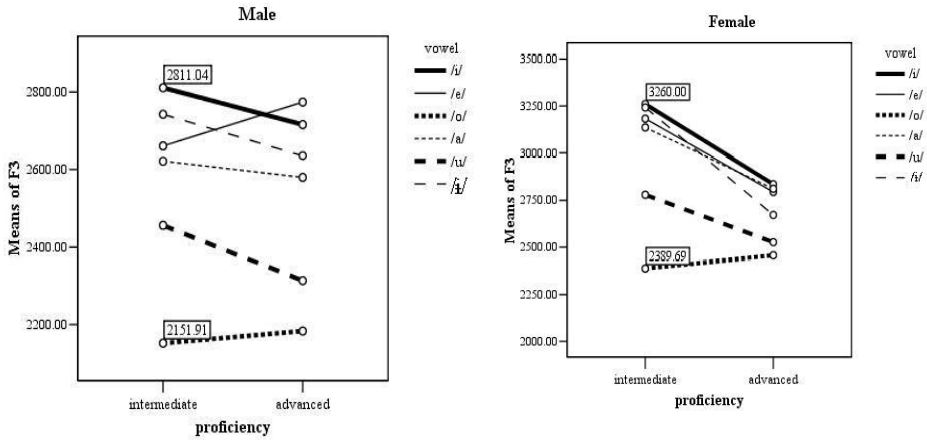
we can see that the F2 values for Korean /l/ are quite stable within male and female groups. In contrast, the F2 values for Korean-English /l/ demonstrate dramatic changes depending on the English speaking proficiency group.

The F2 values for Korean-English /l/ are, in general, lower than the F2 values for Korean /l/. More specifically, the F2 mean for Korean-English /l/ in the intermediate group resembles Korean /l/ more than the F2 mean for Korean-English in the advanced group. Actually, this pattern is what is expected given the general assumption in the present study that the intermediate learner group is more likely to be influenced by the phonetic properties of their native language when they learn sounds in the target language. It has also been assumed that transfer is greater when the learners' native language has the same sound in its sound inventory, and yet its phonetic properties are different from that of the target language sound (Flege, 1987, 1992, 1995, 2005; Flege & Hillenbrand, 1987; Flege, Takagi, & Mann, 1996). L2 learners simply substitute their native language sound for the target language sound even though phonetic differences exist in the L1 and L2. This situation occurs when Korean speakers learn English /l/, as was clearly demonstrated by the F2 pattern in Figure 6.

Figure 6 shows that the F2 values of the intermediate group are more influenced by the phonetic properties of Korean /l/, while the F2 values of the advanced group move towards that of target language /l/.

I will now discuss the pattern of the F3 value for Korean /l/ and Korean-English /l/ in the context of the preceding vowel. Figure 7 presents the F3 mean value for Korean /l/ by vowel context. [10]

FIGURE 7
F3 Means: Korean /l/ by Vowel Context



Note that in Figure 7 regardless of gender and speaking proficiency,[11] F3 becomes much lower in the

[10] Korean vowels in the legend of Figure 7 are /i, ɛ, o, a, u, ɨ/, respectively.
[11] The English speaking proficiency category does not serve as an independent variable here, since Korean speakers read words in their native language. However, the speaking proficiency category

context of /o/ and /u/. When comparing F3 for Korean /l/ in Figure 7 with that of Korean-English /l/ in Figure 5, it becomes evident that the intermediate learners are transferring phonetic properties of Korean /l/ when they produce English /l/. In other words, they lower the F3 in the back vowel context. In contrast, F3 lowering in a back vowel context does not occur in the advanced learner group, and we can safely say that advanced learners move away from the phonetic properties of Korean /l/ and produce more target like /l/ both in terms of F2 and F3 values.

IV. TEACHING IMPLICATIONS

What are the implications for the teaching of English /l/, given the results from the present study? The present study shows that the phonetic properties of English /l/ produced by intermediate Korean learners of English are influenced by the phonetic properties of the native language. Based on these results, we can assume that Korean learners of English may approximate the production of English /l/ based on the configuration of Korean /l/. In fact, the point of /l/ articulation is similar in Korean and English. In both languages, tongue tip touches an alveolar ridge during /l/ configuration. However, it should also be noted that the tongue tip position varies in Korean /l/ depending on the preceding vowel. When the preceding vowel is a front vowel /i, e/, tongue tip touches the alveolar ridge as is the case with English /l/, while when the preceding vowel is /a, o, u/, the tongue tip touches post-alveolar or palatal region (Hyun Bok Lee, 1980; Tsuzuki, 1992; Umeda, 1980). Bo-Young Kwon (2005) identified the acoustic correlates of Korean /l/ in a back vowel context as F3 lowering.

In addition, Korean /l/ is different from English /l/ in terms of the manner of articulation. The research by Gick et al. (2001) showed that Korean /l/ involves two gestures, tongue tip raising and tongue body raising, while in English /l/, tongue tip raising pairs with tongue dorsal gesture. Drawing on the study of Gick et al. (2001), Bo-Young Kwon (2005) attributed the relatively higher F2 value for Korean /l/ to the lack of dorsal gesture as well as the palatalization of Korean /l/. Most importantly, the present study shows that the phonetic properties of Korean /l/ are transferred to English /l/ when intermediate Korean learners produce English /l/.

I suggest, based on the results from the current study, that it may be worthwhile to teach how the point of articulation differs between Korean /l/ and English /l/. I believe that by being aware of the consequence of placing the tongue tip in a post-alveolar and palatal region (due to the influence of Korean /l/), Korean learners of English may be able to

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was intentionally kept to show that the same pattern occurs regardless of the English speaking proficiency level.

produce more target-like English /l/. The experimental results from Borim Lee and Sook-hyang Lee (2005) seem to support this proposal. Borim Lee and Sook-hyang Lee (2005) examined the correlation between native English speakers' perceptual judgments on the tokens of English /l/ produced by Korean speakers and phonetic characteristics of those English /l/ tokens. It was found in Borim Lee and Sook-hyang Lee (2005) that a strong correlation exists between misperception of /l/ as /r/ and F3 values of /l/ tokens. Given the results from the present study, it seems that F3 lowering of /l/ in a back vowel context may cause the misperception of /l/ as /r/ in Borim Lee and Sook-hyang Lee (2005). Note that the primary property of /r/ which differentiates it from /l/ is that there is a much lower F3 value for /r/ than for /l/.

In addition, from the perspective of teaching methodology, teachers may consider using spectrograms and articulatory diagrams to provide visual cues of English sounds along with auditory cues. There have been studies demonstrating that the addition of visual cues contributes to production and perception improvement. For instance, using videotapes, Hardison (1998) compared auditory-visual training with auditory-only training for Korean speakers' production and perception of English /l/ and /r/. She found that Korean learners of English perform better when both auditory and visual cues are used in the training.

In the same vein, Motohashi (2006) observed a performance difference in native English speakers' production and perception of Japanese geminates when visual-auditory and auditory-only training are used as independent variables. Note that Motohashi (2006) used spectrograms as visual cues in her study.

Furthermore, spectrograms show how the formant frequency and formant structures of English /l/ produced by Korean learners of English are different from or similar to those produced by native English speakers. Thus teachers may use the spectrographic analysis to determine the effect of the pronunciation drills conducted in class (pre-test vs. post-test).[12] Teachers may also use animated articulatory diagrams to vividly demonstrate how each sound in English is articulated.[13]

At this point, one may argue that given the results of the advanced group who demonstrated a target like production of /l/ at least in terms of F2 and F3, the explicit teaching of /l/ articulation may not be necessary. I agree with this idea in the sense that enough exposure to the target language may bring about better results than explicit teaching of how a certain segment is produced in the target language. However, it should also be noted that there were four graduate students who were assumed to be proficient in English given that the university requires certain level of TOEFL scores for admission of

[12] An ESL instructor at Michigan State University told me that spectrograms are actually used in some of the ESL classes in the U.S.

[13] Refer to http://www.uiowa.edu/~acadtech/phonetics for the possible sources of the articulatory diagram of English sounds.

graduate programs, but who end up being in the low or mid intermediate group in terms of their English pronunciation (refer to Table 2).

I think these cases demonstrate that for some speakers (e.g., participants in the advanced group) enough exposure to the English input is sufficient condition for the target-like production of /l/ in the target language, but for some speakers, explicit teaching of /l/ articulation may be useful, especially those who are in the intermediate level. Furthermore, those who learn English in an EFL (English as a Foreign Language) setting may not receive a sufficient English input necessary for phonological acquisition. It seems that the students who learn English in an EFL setting will benefit more from the explicit teaching of pronunciation.

It is also the case that recent studies on the acquisition of second language phonology have placed more emphasis on the improvement of suprasegmental aspects (rhythm, stress, and intonation) rather than segmental features. However, Gilbert (1993) observed that ESL learners noticed the improvement on their listening and pronunciation skills when individual sounds are sufficiently practiced before emphasizing suprasegmental aspects of a language. Needless to say, explicit teaching of the production of target language segments should go hand in hand with the sufficient exposure to the sound of the target language.

V. CONCLUSION

This study investigated Korean speakers' production of English /l/ from the perspective of how phonetic properties of Korean /l/ influence the performance of intermediate and advanced learners. Previous studies of Korean speakers' acquisition of English /l/ have been mainly devoted to examining the positional effects on Korean speakers' production and perception of English /l/. These previous studies were based on the assumption that Korean /l/ is an alveolar lateral and that the only difference between English /l/ and Korean /l/ lies in the fact that Korean /l/ has a certain positional restriction on its occurrence in a word.

This study started from questioning the assumptions underlying the previous studies on the phonetic properties of Korean /l/. It was shown in both Bo-Young Kwon (2005) and the current study that the acoustic properties of Korean /l/ are quite different from those of English /l/, contrary to the general assumptions in many other studies.

Based on the observation that there are phonetic differences between Korean /l/ and English /l/, and the differences will influence Korean speakers' production of English /l/, this study hypothesized that the intermediate group would behave differently than the advanced group when it comes to acquiring the F2 and F3 formant frequencies of English

/l/. This study set up two specific hypotheses, and these hypotheses were tested through the experimental study. The hypotheses were all supported in the study: intermediate learners seem to produce English /l/ based on the phonetic properties of Korean /l/, whereas the advanced group acquires the key phonetic properties of English /l/.

One of the limitations of this study is that there were only two participants in the control group (one male and one female), while there were four participants in each experimental group. It would have been better in terms of between-group comparison if the number of participants in each group was controlled in the experiment.

Another limitation of this study is that this study does not provide any information on how different the /l/ produced by the intermediate group is from the /l/ produced by the advanced group *in terms of native English speakers' perception*. Will the /l/ tokens produced by the intermediate learner group be correctly perceived as /l/ by native speakers' of English, or do they sound more like /r/ due to the F3 lowering? What is the threshold level of pronunciation in terms of F2 and F3 for when /l/ is misperceived as /r/? I leave these questions for future research.

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APPENDIX A
English Speaking Proficiency Test Script

Situation: *Two friends are going to watch a movie.*

A: Hurry, Kim, or we'll be late!

B: All right, all right! I'm almost ready.

A: I'm really looking forward to this movie, aren't you?

B: Yeah, I am. Jim told me that this movie is the major blockbuster this summer.

A: Right, I read a review of this movie last night, and it received excellent ratings in almost every area. And the synopsis sounds really interesting. The film is about the world taken over by the Matrix. In that world, humans are living in a computer-generated dream world, and they are being harvested like plants to be part of the Matrix, without even realizing that they are slaves of an evil system that has a false claim on the world.

B: Yeah, this movie must be good, and I always love sci-fi movies.

APPENDIX B
Stimuli

Note: The words in the shaded cells in Table B-2 were used as model English words. Participants were instructed that they were supposed to use the same vowel as in the model English words they heard in their production.

TABLE B-1
Target Stimuli

Phonetic Environment	Vowel			
Word-initial	/ɪ/	lit		
	/ɛ/	let		
	/ɔ/	laught		
	/ɑ/	lot		
	/ʊ/	lut		
Word-initial cluster	/ɪ/	blit	plit	klit
		glit	slit	split
	/ɛ/	blet	plet	clet
		glet	slet	splet
	/ɔ/	blaught	plaught	claught
		glaught	slaught	splaught
	/ɑ/	blot	plot	clot
		glot	slot	splot
	/ʊ/	blut	plut	clut
		glut	sloot	splut
Intervocalic	/ɪ/	pilla		
	/ɛ/	pella		
	/ɔ/	Paula		
	/ɑ/	polla		

	/ʊ/	pulla		
Word-final	/ɪ/	hill		
	/ɛ/	Hell		
	/ɔ/	haul		
	/ɑ/	hol		
	/ʊ/	hul		
Word-final cluster	/ɪ/	hilp	hild	hilt
		hilk	hils	hilz
	/ɛ/	help	held	helt
		helk	hels	helz
	/ɔ/	haulp	hauled	hault
		haulk	hauls	haulz
	/ɑ/	holp	hald	halt
		halk	hals	halz
	/ʊ/	hulp	huld	hult
		hoolk	huls	hulz

TABLE B-2
Fillers

/ɪ/	/ɛ/	/ɔ/	/ɑ/	/ʊ/
bit	set	caught	dot	foot
brit	bet	brought	cot	chut
fit	bret	fought	pot	kut
kit	fret	fraught	scot	put
mitt	get	naught	shot	skut
sit	jet	sought	snot	snut
spit	met	taught	spot	soot
wit	vet	thought	swat	sput

/ɪ/	/ɛ/	/ɔ/	/ɑ/	/ʊ/
hit	hen	haughty	hot	hook
hick	head	haud	hard	hood
hid	heb	haug	harm	hoof
him	hedge	haun	heart	hoom
hin	Hess	haunch	hog	hoon
hip	hem	haunt	hop	hoos
his	hemp	haup	hosp	hoov
hiss	het	hawk	hoss	hooz

/ɪ/	/ɛ/	/ɔ/	/ɑ/	/ʊ/
pitta	petta	pautta	potta	putta
pikka	pessa	paussa	possa	pukka

TABLE B-3
Korean Stimuli

Vowel				
/ i /, /ɨ/	/pillida/	'borrow'	/tillida/	'stop by'
	/killida/	'grow		
/ɛ/	/pɛllyəko/	'to cut'	/tɛllyəko/	'to provide'
	/kɛllyəko/	'to fold'		
/o/	/pollok/	'swollen'	/tollida/	'rotate'
	/kollida/	'tease'		
/a/	/pallanɛda/	'hull'	/tallida/	'run'
	/kallanɛda/	'sort out'		
/u/	/pullida/	'make it swollen'	/tullida/	'surrounded'
	/kullida/	'roll over'		
/ i /, /ɨ/	/pil/	'a roll of cloth'	/tɨl/	'field'
	/kil/	'road'		
/ɛ/	/pɛlsuit'a/	'can cut'	/tɛlsuit'a/	'provide'
	/kɛlsuit'a/	'fold'		
/o/	/pol/	'cheek'	/tol/	'stone'
	/kol/	'brain'		
/a/	/pal/	'foot'	/tal/	'moon'
	/kal/	'a study of'		
/u/	/pul/	'fire'	/tul/	'two'
	/kul/	'tunnel'		

APPENDIX C

Multiple Comparisons: F3 by Vowel Context

		(I) Vowel	(J) Vowel	Mean Difference (I-J)	Std. Error	Sig.
Intermediate	Male	/ɪ/	/ɛ/	124.17944	86.51436	.606
			/ɔ/	417.00929(*)	87.25699	.000
			/ɑ/	294.87673(*)	87.25699	.008
			/ʊ/	436.48964(*)	86.51436	.000
		/ɛ/	/ɪ/	-124.17944	86.51436	.606
			/ɔ/	292.82984(*)	87.25699	.009
			/ɑ/	170.69728	87.25699	.293
			/ʊ/	312.31020(*)	86.51436	.004
		/ɔ/	/ɪ/	-417.00929(*)	87.25699	.000
			/ɛ/	-292.82984(*)	87.25699	.009
			/ɑ/	-122.13256	87.99335	.636

			/ʊ/	19.48035	87.25699	.999
		/ɑ/	/ɪ/	-294.87673(*)	87.25699	.008
			/ɛ/	-170.69728	87.25699	.293
			/ɔ/	122.13256	87.99335	.636
			/ʊ/	141.61291	87.25699	.485
		/ʊ/	/ɪ/	-436.48964(*)	86.51436	.000
			/ɛ/	-312.31020(*)	86.51436	.004
			/ɔ/	-19.48035	87.25699	.999
			/ɑ/	-141.61291	87.25699	.485
Intermediate	Female	/ɪ/	/ɛ/	-9.40620	134.65001	1.000
			/ɔ/	218.04653	134.65001	.488
			/ɑ/	51.09513	134.65001	.996
			/ʊ/	524.81789(*)	133.52321	.001
		/ɛ/	/ɪ/	9.40620	134.65001	1.000
			/ɔ/	227.45273	134.65001	.444
			/ɑ/	60.50133	134.65001	.991
			/ʊ/	534.22408(*)	133.52321	.001
		/ɔ/	/ɪ/	-218.04653	134.65001	.488
			/ɛ/	-227.45273	134.65001	.444
			/ɑ/	-166.95139	134.65001	.728
			/ʊ/	306.77136	133.52321	.152
		/ɑ/	/ɪ/	-51.09513	134.65001	.996
			/ɛ/	-60.50133	134.65001	.991
			/ɔ/	166.95139	134.65001	.728
			/ʊ/	473.72275(*)	133.52321	.005
		/ʊ/	/ɪ/	-524.81789(*)	133.52321	.001
			/ɛ/	-534.22408(*)	133.52321	.001
			/ɔ/	-306.77136	133.52321	.152
			/ɑ/	-473.72275(*)	133.52321	.005
Advanced	Female	/ɪ/	/ɛ/	-2.57147	70.43136	1.000
			/ɔ/	-169.79670	68.58345	.102
			/ɑ/	-140.57010	68.58345	.248
			/ʊ/	18.35833	68.58345	.999
		/ɛ/	/ɪ/	2.57147	70.43136	1.000
			/ɔ/	-167.22523	69.86310	.123
			/ɑ/	-137.99862	69.86310	.283
			/ʊ/	20.92981	69.86310	.998
		/ɔ/	/ɪ/	169.79670	68.58345	.102
			/ɛ/	167.22523	69.86310	.123

	/ɑ/	29.22660	67.99975	.993
	/ʊ/	188.15503(*)	67.99975	.050
/ɑ/	/ɪ/	140.57010	68.58345	.248
	/ɛ/	137.99862	69.86310	.283
	/ɔ/	-29.22660	67.99975	.993
	/ʊ/	158.92843	67.99975	.139
/ʊ/	/ɪ/	-18.35833	68.58345	.999
	/ɛ/	-20.92981	69.86310	.998
	/ɔ/	-188.15503(*)	67.99975	.050
	/ɑ/	-158.92843	67.99975	.139

* The mean difference is significant at the .05 level.

Applicable level: secondary education, adult education
Key words: first language transfer, Korean speakers, English /l/, pronunciation teaching

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