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Korean EFL Learners' Identification of English Consonant Contrasts in Word-final Position

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ABSTRACT

The Journal of Studies in Language 35.3, 375-388. The study investigated whether Korean EFL learners' identification of English consonant contrasts in word-final position was affected by the types of contrasting consonants and by vowel contexts. The study also examined whether Korean EFL learners' identification accuracy had a correlation with their English listening comprehension test scores. To that end, 123 Korean high school students completed an English consonant identification task with English nonce words. The nonce word stimuli consisted of 8 types of English consonant minimal pairs (/p-f/, /b-v/, /t-ɵ/, /d-ð/, /s-ʃ/, /z-ʒ/, /s-ɵ/, /z-ð/) combined with one of three vowels (/i, a, u/). The results showed that both the types of contrasting consonants and vowel contexts had a great impact on Korean high school students' identification of English consonant contrasts in word-final position. Korean high school students' ability to identify English consonant contrasts was also correlated with their English listening comprehension test scores. Based on the findings of the study, some implications for the teaching and learning of English consonant contrasts for Korean EFL learners were drawn. (Korea University)

Keywords: English consonant identification, types of contrasting pairs, vowel contexts, correlation, L2/ foreign language sound learning

1. Introduction

The ability to identify phonemes (i.e., consonants and vowels) of a second (L2)/ foreign language is an integral part of L2/ foreign language learning, especially for effective listening comprehension (Ahn, 2009; Samuels, 1988). Previous research has found that vowels are more strongly connected to prosodic information while consonants to word identification (Kolinsky et al., 2009). Mehler et al. (2006) found that consonants provide more useful information relative to vowels when speech streams are segmented into words. Due to the

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important role of consonants in word identification, previous studies have investigated Korean EFL learners' ability to identify English consonant contrasts but most of the studies have focused on university level students' identification of English consonant contrasts. Moreover, not many studies have considered the effect of vowel contexts or the types of contrasting pairs (i.e., voicing, the manner and place of articulation) on the identification of English consonant contrasts in word-final position. The current study purports to investigate Korean high school students' ability to identify English consonant contrasts in word-final position, taking into account factors such as the types of contrasting pairs, vowel contexts, and Korean high school students' English listening comprehension ability in order to provide educational implications for English consonant teaching and learning.

1.1 Models of L2 Sound Acquisition

The most discussed models of L2 sound acquisition, the Speech Learning Model (SLM) (Flege, 1995) and the Perceptual Assimilation Model (PAM)/ PAM-L2 (Best, 1995, Best and Tyler, 2007) estimate L2 learners' extent of success in perceiving L2 speech sounds based on the perceived phonetic distance between L1 and L2 speech sounds. The SLM does not clearly define the properties of the perceived phonetic distance between the sounds in L1 and L2, although the model depends on the notion of "positional allophones in the L2 to the closest positionally defined sound in the L1" (p. 238). PAM-L2 defines the perceived phonetic distance between L1 and L2 speech sounds in terms of gestural similarities/dissimilarities. However, both the models predict that L2 learners would have more difficulty perceiving L2 sounds if the perceived phonetic distance between the sounds in L1 and L2 reduces.

More specifically, the SLM postulates that L1 and L2 speech sounds coexist in the same phonological space and that the mechanisms of speech learning remain active throughout one's life. The SLM aims to account for L2 learning based on the assumption that L2 learners are able to develop a new L2 sound category if they perceive phonetic discrepancies between an L2 speech sound and the nearest L1 speech sound. Thus, age is an important factor in accounting for L2 learning in the SLM as young L2 learners' L1 sound categories may have not been firmly developed, which helps them perceive phonetic similarities/ differences between L1 and L2 speech sounds. Accordingly, young L2 learners are more likely to develop a new L2 sound category compared to adult L2 learners. PAM-L2 theorizes that L2 learners exhibit one of the following patterns of perceptual assimilation in L2 sound learning: If L2 learners assimilate two contrasting L2 speech sounds into two L1 speech sounds, their perception of the L2 speech sounds is predicted to be fairly good (two category assimilation). If L2 learners assimilate two L2 speech sounds into a single L1 speech sound (single category assimilation), their perception is predicted to be good only when the learners perceive one of the two distinctive L2 speech sounds to be a better match of the L1 speech sound (category goodness assimilation). When L2 learners perceive an L2 speech sound as an uncategorizable L1 speech sound, they judge the L2 speech sound to lie in between particular L1 speech sounds. Thus, patterns of perceptual assimilation predict L2 learners' discrimination of L2 speech sounds (Best and Tyler, 2007; Flege, 1995; Guion et al., 2000).

1.2 Korean EFL Learners' Identification of English Consonants

English has a larger number of obstruents compared to Korean, contrasted in terms of the places of articulation,

manners of articulation and voicing. Table 1 presents the inventories of obstruents in English. Several previous studies investigated Korean EFL learners' identification of English consonants with respect to the postulations of the SLM and PAM-L2 (Cho and Lee, 2007; Yun, 2014 among others).

Table 1. Inventories of obstruents in English (based on Ladefoged, 2006; Park and de Jong, 2017:17)

Manner \ Place		Bilabial	Labio-dental	Inter-dental	Alveolar	Palato-alveolar	Velar	Glottal
Stop	Voiceless	p			t		k	
	Voiced	b			d		g	
Fricative	Voiceless		f	θ	s	ʃ		h
	Voiced		v	ð	z	ʒ		
Affricate	Voiceless					ʧ		
	Voiced					ʤ		

Cho and Lee (2007) explored how Korean consonant categories are used in English consonant category perception by Korean EFL learners. In particular, they examined Korean learners' perception of English anterior obstruents in different prosodic locations: /p, b, f, v, θ, ð, t, d, s, z/ in initial onset, intervocalic before stress, intervocalic after stress, and final coda position. The target obstruents were combined with the vowel /a/ (e.g., /ba/, /abá/, /ába/, /ab/) and the target stimuli were produced by 4 American English speakers. Participants in Cho and Lee were instructed to choose the English consonants they heard from the 13 Korean consonants (/p^h, p, p', t^h, t, t', s, s', ʧ^h, ʧ, ʧ', h, l/) provided in terms of Korean orthography. Cho and Lee reported that English voiceless stops were in general mapped onto Korean aspirated stops, whereas English voiced stops onto Korean lenis stops. English voiceless fricatives were mainly mapped onto Korean aspirated stops but also onto Korean fortis stops sometimes. On the contrary, English voiced fricatives were generally mapped onto Korean lenis stops. Importantly, prosodic position was an important factor in accounting for the Korean learners' perception of English consonants. For example, English /t/ was labelled with Korean /t^h/ at a rate of 97.5% in initial onset position but at a rate of 77.1% in final coda position. English /d/ was dominantly labelled with Korean /t/ (84.4%) and also with /t'/ (13.8%) in initial onset position. However, English /d/ was mapped onto Korean /t/ only at the rate of 41.3% in final coda position due to its mapping onto other Korean consonants in addition to /t/ (e.g., /s/: 15.6%, /p/: 10.6%, /t^h/: 8.8%). Cho and Lee further noted that the Korean learners showed more diverse mapping patterns for English fricatives compared to English stops. For instance, English /p/ was dominantly labelled with Korean /p^h/ (93.1%) in initial onset position, while English /f/ was mapped onto several Korean consonants (/p^h/: 53.5%, /p'/: 22.5%, /p/: 8.1%, /h/: 5%) (pp. 738-739). Thus, the results showed that the Korean learners' perceptual mapping patterns varied according to the prosodic position in which the target English consonants were located as well as the voicing, manner, and place features of the target consonants. Based on the findings, Cho and Lee argued that some of the hypotheses of the SLM and PAM/ PAM-L2 should be modified in order to take into account aforementioned factors.

Yun (2014) investigated Korean university students' identification of English minimal pairs using English words and nonce words. Yun used several pairs of consonants contrasting in manner and voicing features in word-initial and word-final position: /p/-/b/, /t/-/d/, /k/-/g/, /s/-/z/, /f/-/v/, /ʧ/-/ʤ/, /l/-/r/, /p/-/f/, /b/-/v/, /s/-/θ/, and /d/-/ð/ (but /s/-/θ/ and

/d/-/ð/ only in word-initial position). In particular, Yun examined whether PAM-L2 could account for Korean students' identification of English consonant contrasts in terms of two category assimilation and category goodness assimilation. For example, the contrast between /p/ and /b/ and /f/ and /v/ (e.g., *cap-cab*, *safe-save*) was regarded as two category assimilation, while the contrast between /p/ and /f/ and /b/ and /v/ as category goodness assimilation (e.g., *pin-fin*, *bet-vat*, p. 182).[1] Yun's categorization of the assimilation patterns was based on previous studies such as Park and de Jong (2008) and de Jong and Cho (2012) among others. For instance, Korean participants in Park and de Jong (2008, p. 709) mapped English /p/ onto Korean /p^h/ at the rate of 95% while English /b/ onto Korean /p/ and /p'/ at the rate of 41% and 46%, respectively. The Korean participants also labelled English /f/ with Korean /p^h/ at a rate of 54%. Accordingly, Yun categorized /p/ and /b/ as two category assimilation but /p/ and /f/ as category goodness assimilation. Yun found that the participants in his study identified consonant contrasts in the two category assimilation type more accurately than those in the category goodness assimilation type in supportive of the predictions of PAM-L2. Yun, however, reported that not all sound contrasts within the same assimilation type (e.g., category goodness assimilation) showed the same levels of identification difficulty, thus contending that other factors such as consonants' voicing and manner features should be considered to supplement the PAM-L2 model.

Bae (2007) examined Korean university students' perception of English consonant minimal pairs in word-initial and word-final position: /p/-/f/, /s/-/z/, /k/-/g/, /ɵ/-/t/, /ɵ/-/s/, /p/-/b/, /ʃ/-/ʧ/, /t/-/d/, /n/-/l/, /v/-/w/, /f/-/ɵ/, /ʤ/-/j/, /ʃ-ʧ/, /d-ð/ in word-initial position vs. /p-f/, /s-z/, /k-g/, /ɵ-t/, /ɵ-s/, /p-b/, /ʃ-ʧ/, /t-d/, /n-l/ in word-final position. The target contrasts were presented in pairs of sentences with pictures. Bae found that Korean students had most difficulty in perceiving the /d-ð/contrast in word-initial position, while the /p-f/ contrast in word-final position. By contrast, the Korean students perceived most accurately the /p-b/ contrast in word-initial position and the /t-d/ and /n-l/ contrast in word-final position. Bae partly attributed his findings to the phoneme inventory differences between English and Korean. That is, Bae claimed that Korean students considered the English /d-ð/ contrast as allophones of a single Korean phoneme, resulting in a low identification score.

Recently, Park and de Jong (2017) examined whether Korean EFL learners' English-to-Korean consonant mapping patterns and English consonant identification were affected by prosodic contexts. Park and de Jong administered a consonant mapping task and an English consonant identification task to 40 Korean university students using English consonants (/p, b, t, d, f, v, ɵ, ð/) located before /ɑ/. The stimuli were presented in intervocalic before stress, intervocalic after stress, and final coda position. The results showed that prosodic contexts had a great impact on the Korean university students' mapping and identification results. For example, English /p/ was dominantly mapped onto Korean /p^h/ (89%) and it was also identified as English /p/ at the rate of 76% in intervocalic before stress position. By contrast, the same English consonant was labelled with Korean /p^h/ only at the rate of 24% and its identification accuracy was also low (22%) in coda position (pp. 20, 22-23). Based on the results, Park and de Jong contended that consonant learning should be assessed "in terms of position-by-position variants" (p. 12).

As for the effect of Korean EFL learners' English listening comprehension ability on their identification accuracy of English sounds, Ahn (2009) examined whether Korean high school students' English phoneme identification ability was correlated with their English listening comprehension test scores. Ahn used 6 minimal pairs for vowels (/ɪ-i/, /ʊ-u/, /oʊ-ɔ/, /æ-ɛ/, /ɑ-ʌ/, /ɝ-ɔ/) and 7 minimal pairs for consonants (/p-f/, /b-v/, /d-ð/, /ɵ-f/, /s-ɵ/, /v-ð/, /l-r/) embedded in

1) Yun (2014) also examined 3 English vowel contrasts (/i/-/ɪ/, /ɛ/-/æ/, /u/-/ʊ/), which were regarded as single category assimilation.

sentences (e.g., "What's a 'pool' / 'fool'?", p. 264). The results showed that Korean high school students had more difficulty in identifying vowels than consonants (mean accuracy: 57.14% vs. 76.24%) and also consonants in coda position than those in onset position (75.01% vs. 76.87%) (p. 253). The results further showed a strong correlation (r=.630, p<.001) between Korean high school students' phoneme identification scores and their English listening comprehension test scores, in particular a stronger correlation between the identification of consonant phonemes and the listening comprehension scores (r=.634, p<.001) than between the identification of vowel phonemes and the listening comprehension scores (r=.256, p<.001) (p. 255). Kim (2012) also investigated whether Korean high school student's English listening comprehension scores and their ability to identify English consonant contrasts (e.g., /p/-/f/, /b/-/v/, /d/-/ð/) were correlated. As opposed to Ahn's (2009) findings, Kim did not find any correlation between Korean high school students' English listening comprehension scores and their identification accuracy of English consonants.

Concerning the effect of vowel contexts on the identification of consonants, previous research has documented that the identification of vowels and consonants is affected by the consonant context and by the vowel context, respectively, even though the degree of the vowel context influence shows variation across the languages investigated (Dubno and Levitt, 1981; Ladefoged, 2006; Kalaiah and Bhat, 2017). For instance, Kalaiah and Bhat examined native Kannada speakers' recognition of Kannada consonants using CV syllables. The CV syllables consisted of 14 consonants including obstruents (e.g., /p/, /d/, /s/, /ʃ/, /ʧ/, /ʤ/) and one of the /a/, /i/, /u/, /e/, and /o/ vowels. The results showed the effect of vowel contexts on the recognition of consonants since the recognition accuracy was the highest when the following vowel is /o/ whereas it was the lowest when the following vowel is /i/. Woods et al. (2010) examined the identification of English consonants using CVC tokens in noise. The target tokens consisted of diverse English consonants both in onset and coda position (i.e., stops, fricatives, affricates, liquids, and nasals) and one of three vowels (/a/, /i/, or /u/). Woods et al. reported that initial consonants were more accurately identified than final consonants and that vowel contexts significantly affected the identification of consonants. For instance, initial consonants were more accurately identified in the /a/ vowel context while final consonants in the /i/ vowel context. English nasals were also found to be better identified in the /a/ vowel context (Dubno and Levitt, 1981).

1.3 The Present Study

The studies reviewed in the previous section mostly focused on Korean university students' identification of English consonants (Cho and Lee, 2007; Bae, 2007; Yun, 2014; Park and de Jong, 2017) or a correlation between Korean high school students' listening comprehension and their identification of English sounds (Ahn, 2009; Kim, 2012). However, as previous studies have documented, factors such as the types of contrasting consonants, vowel contexts, and EFL learners' listening comprehension scores should be considered in order to provide a more comprehensive understanding of the identification of English consonants. Accordingly, the study looks into Korean high school students' identification of English obstruents in word-final (syllable-final) position, taking into account the aforementioned factors. The study focuses on English obstruents in word-final position since most previous studies found that Korean EFL learners had more difficulty in identifying obstruents in word-final (syllable-final) position than in word-initial (syllable-initial) position. Specifically, the study investigates the following questions: 1) Is Korean high school students' identification accuracy of English obstruents in word-final position affected by the types of contrasting

consonants (e.g., places and manners of articulation, voicing)?; 2) Is Korean high school students' identification accuracy of English obstruents in word-final position influenced by the vowel contexts?; 3) Is Korean high school students' identification accuracy of English obstruents correlated with their English listening comprehension test scores?

2. Experiment

2.1 Participants

The participants were 123 Korean female students at a high school in Daegu (mean age: 19 years old). Table 2 presents the students' average listening comprehension test scores from College Scholastic Ability Mock Tests. As can be seen in Table 2, more than two thirds of the students received (somewhat) high scores, given that there were 17 questions in total.

Table 2. The range of the participants' English listening comprehension test scores

Range: 0~17	Number of students: 123
16~17	40
14~15	44
12~13	20
10~11	12
7~9	7

2.2 Stimuli

The target stimuli were 8 types of English consonant minimal pairs: /p-f/, /b-v/, /t-ɵ/, /d-ð/, /s-ʧ/, /z-ʤ/, /s-ɵ/, /z-ð/. Each token in the stimuli set was a monosyllabic nonce word. The target consonants are located in word-final (syllable-final) position following one of the three vowels (/i, a, u/) and intial consonants include a variety of consonants. More specifically, 4 contrasts were voiced consonant minimal pairs differed in terms of the manner and/or place features (/b-v/, /d-ð/, /z-ʤ/, /z-ð/) and the other 4 contrasts were voiceless consonant minimal pairs also differed in terms of the manner and/or place features (/p-f/, /t-ɵ/, /s-ʧ/, /s-ɵ/). A full set of the stimuli is presented in Table 3. The stimuli were recorded by 4 native American English speakers. The native English speakers consisted of 2 males and 2 females and their mean age was 34 years (range: 25~45 years). The native English speakers produced the stimuli in the carrier structure of "Say _____ again" 3 times. Specifically, the native English speakers were requested to produce final consonants as clearly as possible. For example, final stop consonants such as /p/, /b/, /t/, and /d/ in the stimuli were produced with the air exploded with the release of the stop closure. Only the best recordings were used as the stimuli in the experiment. The recordings were made in a sound attenuated room at a 44.1 kHz sampling rate. Samsung EO-EG920BW microphone and a window movie maker program were employed in the recording and editing of sound files.

Table 3. Stimuli used in consonant identification

Contrasting pairs	/p/-/f/	/b/-/v/	/t/-/ɵ/	/d/-/ð/
Voiceless vs. Voiced	Voiceless	Voiced	Voiceless	Voiced
Place and Manner / Vowel type	Bilabial/ Stop vs. Labiodental/ Fricative	Bilabial/ Stop vs. Labiodental/ Fricative	Alveolar/ Stop vs. Interdental/ Fricative	Alveolar/ Stop vs. Interdental/ Fricative
/i/	zeep/zeef geep/geef meep/meef teep/teef	zeeb/zeev cheeb/cheev sheeb/sheev theeb/theev	zeet/zeeth reet/reeth veet/veeth geet/geeth	zeed/zeethe cheed/cheethe veed/veethe jeed/jeethe
/a/	zop/zof thop/thof gop/gof vop/vof	zob/zov chob/chov thob/thov tob/tov	zot/zoth vot/voth fot/foth chot/choth	kod/kothe vod/vothe chod/chothe fod/fothe
/u/	zoop/zoof voop/voof thoop/thoof joop/joof	zoob/zoov shoob/shoov thoob/thoov soob/soov	joot/jooth choot/chooth voot/vooth koot/kooth	vood/voothe zood/zoothe chood/choothe jood/joothe

Contrasting pairs	/s/-/ʧ/	/z/-/ʤ/	/s/-/ɵ/	/z/-/ð/
Voiceless vs. Voiced	Voiceless	Voiced	Voiceless	Voiced
Place and Manner / Vowel type	Alveolar/ Fricative vs. Palato-alveolar/ Affricate	Alveolar/ Fricative vs. Palato-alveolar/ Affricate	Alveolar/ Fricative vs. Interdental/ Fricative	Alveolar/ Fricative. Interdental/ Fricative
/i/	zees/zeech shees/sheech mees/meech hees/heech	leez/leedg sheez/sheedg reez/reedg veez/veedg	rees/reeth chees/cheeth fees/feeth jees/jeeth	meez/meethe leez/leethe reez/reethe veez/veethe
/a/	fos/foch shos/shoch zos/zoch hos/hoch	roz/rodg hoz/hodg voz/vodg foz/fodg	nos/noth jos/joth pos/poth tos/toth	moz/mothe boz/bothe loz/lothe choz/chothe
/u/	koos/kooch hoos/hooch voos/vooch doos/dooch	gooz/goodg pooz/poodg tooz/toodg sooz/soodg	roos/rooth shoos/shooth choos/chooth loos/looth	mooz/moothe nooz/noothe gooz/goothe kooz/koothe

2.3 Procedure

Korean high school students completed a consonant identification test in classrooms at a high school in Daegu. The students listened to one of the two consonants in each minimal pair played from a sound recorder on a computer through loud speakers. The study gathered the data through "the open-field experimentation" (Park and de Jong, 2017, p. 17) instead of collecting data in controlled lab settings because the open-field experimentation more closely reflects the English learning situation in Korean EFL environments. The students were instructed to choose the consonant they heard between the presented contrasting consonants on an answer sheet. The interstimulus interval was 3 seconds and each target consonant was played only once. There were 96 trials for each student (8 contrasting consonants × 3 vowels × 4 tokens), resulting in a total of 11,808 responses (96 trials × 123 students). Before the experiment, the students were told that they were going to listen to English nonce words and to focus on the final consonant in a practice session.

2.4 Analysis

The accuracy of the Korean students' consonant identification was calculated and analyzed with respect to two main factors of the types of contrasting consonants (8 types) and vowel contexts (3 vowels). Also, the correlation between the students' identification accuracy and their English listening comprehension scores was examined. The analyses were conducted by IBM SPSS Statistics 21.

3. Results

3.1 Effects of Types of Contrasting Consonants and Vowel Contexts

The Korean students' mean identification accuracy was 74.1% (Standard Deviation: 9.95). The identification accuracy of each consonant contrast across 3 vowels was shown in Figure 1 along with the total mean accuracy. In order to find out whether the students' identification accuracy varied according to the types of contrasting consonants and vowel contexts, a two-way ANOVA was performed with contrasting consonant types and vowel contexts as fixed factors and students' identification accuracy as a dependent variable. The results were presented in Table 4.

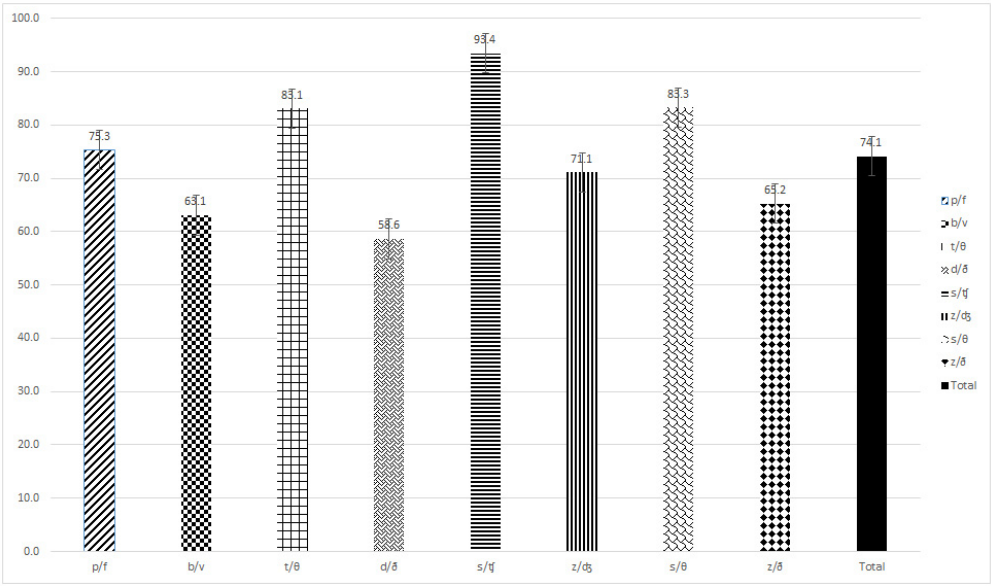

Fig. 1. Mean percentage correct of identification by contrasting consonant types across vowels

Table 4. Results of a two-way ANOVA

	F	df	*p*
Contrasting consonant type	112.434	7	.000
Vowel context	21.100	2	.000
Contrasting consonant type × Vowel context	15.423	14	.000

As shown in Table 4, there were significant main effects of contrasting consonant type (F[7, 2928]=112.434, p <.001) and vowel context (F[2, 2928]=21.100, p<.001) and also a significant interaction between contrasting consonant type and vowel context (F[14, 2928]=15.423, p<.000). Pair-wise Bonferroni adjusted post hoc tests for contrasting consonant type indicated that the mean differences between all the pairs of each consonant contrast were significant (all p<.001 or p<.010) except the following pairs of consonant contrast: /p/-/f/ vs. /z/-/ʤ/, /b/-/v/ vs. /d/-/ð/, /b/-/v/ vs. /z/-/ð/, /t/-/ɵ/ vs. /s/-/ɵ/. The results indicate that the types of contrasting consonants had an impact on Korean high school students' identification of English consonant contrasts. That is, Korean high school students identified more accurately voiceless consonant contrasts than voiced ones. Also, minimal pairs consisting of fricative and affricate sounds were more accurately identified than those consisting of only fricative sounds, which were in turn more accurately identified than minimal pairs containing stop and fricative sounds. As for the place of articulation, minimal pairs consisting of alveolar and palato-alveolar sounds were more accurately identified than those consisting of other places of articulation.

As for the effect of vowel contexts, Korean high school students' identification accuracy of consonant contrast was the highest in the vowel /u/ (77.1%) while it was the lowest in the vowel /i/ (70.8%) when all the pairs of contrasting consonants were combined for each vowel. Pair-wise Bonferroni adjusted post hoc tests for vowel contexts showed that the mean differences between /i/ and /a/, /i/ and /u/, and also /a/ and /u/ were all significant (p<.001 for /i/ vs. /a/ and /i/ vs /u/, p<.05 for /a/ vs. /u/). However, due to a significant interaction between contrasting consonant type and vowel context, even the identification accuracy of the same consonant contrast varied depending on a preceding vowel. For instance, the identification accuracy of /s/-/ʧ/ was the highest in the /i/ vowel context (97%) among the 3 vowels, even though its mean accuracy was the highest across the 3 vowels among the pairs of contrast investigated. The identification accuracy of /d/-/ð/ was overall the lowest among all the consonant contrasts examined in the study, but it showed a vowel context effect in that its accuracy following /i/ was the lowest (39.6%), whereas its accuracy following /u/ was 70.1%. Mean identification accuracy of each consonant contrast for each vowel was presented in Table 5.

Table 5. Mean identification accuracy of each consonant contrast for each vowel

Consonant contrast	Vowel	Mean accuracy
/p/-/f/	/i/	78.25
	/a/	74.39
	/u/	73.37
/b/-/v/	/i/	65.45
	/a/	56.30
	/u/	67.48
/t/-/ɵ/	/i/	85.16
	/a/	77.44
	/u/	86.59
/d/-/ð/	/i/	39.63
	/a/	66.06
	/u/	70.12
/s/-/ʧ/	/i/	96.95
	/a/	90.24
	/u/	93.09

Table 5. Mean identification accuracy of each consonant contrast for each vowel (Continue)

Consonant contrast	Vowel	Mean accuracy
/z/-/ʤ/	/i/	62.60
	/a/	71.75
	/u/	79.07
/s/-/ɵ/	/i/	80.89
	/a/	87.60
	/u/	81.30
/z/-/ð/	/i/	57.72
	/a/	72.15
	/u/	65.85

3.2 Correlation between Identification Accuracy and Listening Comprehension

The study also explored whether the Korean students' identification accuracy was correlated with their English listening comprehension test scores. The results of the correlation analysis (Pearson correlation coefficient) showed that there was a moderate correlation between the students' identification accuracy and their English listening comprehension scores (R=.436, p<.001). This indicates that the students' identification accuracy tended to increase as they received high scores on the English listening comprehension test, as shown in Figure 2.

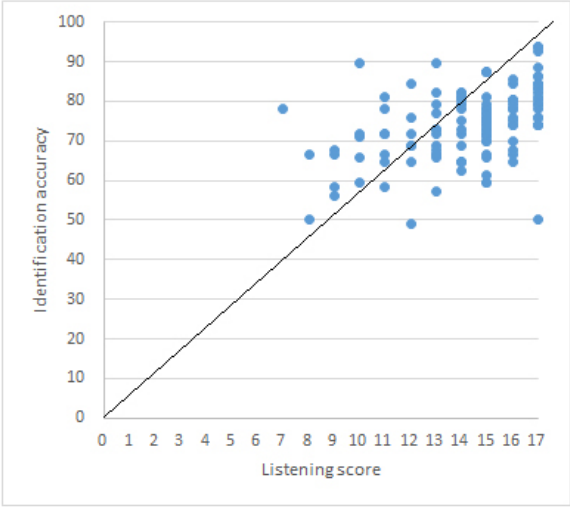

Fig. 2. Correlation between identification accuracy and English listening comprehension (Each filled circle represents individual students.)

As can be seen in Figure 2, for example, Korean students whose identification accuracy was over 70% tended to get somewhat high English listening comprehension scores. However, there were students who got high identification accuracy (around or over 80%) but not high scores on English listening comprehension and also there was one student whose identification accuracy was low (around 50%) but got a perfect score on English listening comprehension. Thus,

the corelation between the identification accuracy and English listening comprehension scores was moderate, although the correlation was statistically significant.

4. Discussion and Implication

The study explored whether Korean high school students' identification of English consonant contrast in word-final position was affected by the types of contrasting consonants and by vowel contexts. The study also examined whether Korean high school students' identification accuracy was correlated with their English listening comprehension test scores. To that end, 123 Korean high school students completed an English consonant identification task with English nonce words. The results showed that both the types of contrasting consonants and vowel contexts affected Korean high school students' identification of English consonant contrast in word-final position.

First, the Korean students identified more accurately voiceless consonant contrasts than voiced ones across all the vowels. Korean does not distinguish between voiceless and voiced obstruents at the phonemic level unlike English (Sohn, 1999; Park and de Jong, 2017). Moreover, it is well-documented that less marked L1 and L2 sounds are acquired before more marked sounds. Accordingly, less marked voiceless obstruents would be acquired before more marked voiced ones (Eckman and Iverson, 1994; Major and Faudree, 1996). Given that Korean does not have voiced obstruents at the phonemic level and voiced obstruents are more marked than voiceless ones, it is understandable that the Korean high school students identified more accurately voiceless consonant contrasts than voiced ones.

As for the manner of articulation, the Korean students identified more accurately when the contrasting pairs consisted of fricatives and affricates (i.e., /s/-/ʧ/, /z/-/ʤ/) than those consisted of only fricatives (i.e., /s/-/ɵ/, /z/-/ð/). The Korean students in general had most difficulty in identifying consonant contrasts when the contrasting pairs contained stops and fricatives (i.e., /t/-/ɵ/, /d/-/ð/, /p/-/f/, /b/-/v/). The same pattern was obtained for both the voiceless and voiced obstruents. English /s/-/ʧ/ and /z/-/ʤ/ contrast may be regarded as two category assimilation and category goodness assimilation, respectively under the PAM-L2 model. According to Cho and Lee (2007, 2016) Korean speakers tended to map English /s/ onto Korean fortis alveolar /s'/ and English /z/ onto Korean lenis palato-alveolar /ʧ/, lenis alveolar /s/, and fortis alveolar /s'/ (in coda position). English /ʧ/ was mainly labelled with Korean aspirated palato-alveolar /ʧ^{h}/ and English /ʤ/ with Korean lenis palato-alveolar /ʧ/, which might explain why Korean high school students identified more accurately the target consonant in the fricative-affricate pairs than that in other pairs. As for stop and fricative pairs, the English /b/-/v/ contrast showed the second lowest identification accuracy among the contrasting pairs examined. Park and de Jong (2017, p. 20) reported that both the English /b/ and /v/ were mainly mapped onto Korean lenis bilabial stop /p/ at a similar rate in coda position (49% and 51%, respectively), which was considered as single category assimilation and thus would pose a great difficulty to Korean students. Concerning the English /d/ and /ð/ contrast, Yun (2014, p. 167) reported that both the consonants were assimilated to Korean lenis alveolar stop /t/ with a slightly different percentage (84% and 78%, respectively), which could account for Korean high school students' difficulty in perceiving the consonant contrast.[2)] The perceptual difficulty also may be due to the fact that the voiced dental fricative /ð/ exhibits somewhat weaker noise energy (Ladefoged, 2006). Thus, the Korean high school students might have had most difficulty in perceiving the /d/

2) However, Park and de Jong (2017, p. 20) reported that English /d/ was mainly labelled with Korean lenis alveolar stop /t/ (41%) while English /ð/ with Korean lenis bilabial stop /p/ (31%).

and /ð/ contrast due to the weak acoustic cues of /ð/ and also due to the absence of the contrast in Korean. Yun also found that the participants in his study had most difficulty in identifying the English /d/ and /ð/ contrast when the stimuli were nonce words. Further, Park and de Jong (2017) showed that voiceless stop and fricative pairs such as /t/-/ɵ/ and /p/-/f/ tended to be mapped onto two different Korean categories with somewhat diverse mapping patterns in coda position, and this may account for why the Korean high school students had less difficulty with these contrasting pairs than their voiced counterparts. The overall results, thus, support the PAM-L2 model's postulation that single category assimilation causes much perceptual difficulty to L2 learners unlike two category assimilation or category goodness assimilation.

Concerning the place of articulation, pairs consisting of alveolar and palato-alveolar sounds were more accurately identified than those consisting of either alveolar and interdental sounds or bilabial and labiodental sounds. Korean does not have obstruents in the labiodental or interdental place unlike English, whereas it distinguishes obstruents between the alveolar and palato-alveolar place. Accordingly, Korean students' relative high identification accuracy of the alveolar and palato-alveolar sound contrast might partly be attributed to the place of the articulation distinction between alveolars and palato-alveolars, although palato-alveolars are neutralized into a lenis alveolar stop in coda position in Korean due to Coda Neutralization.[3)]

As for the effect of vowel contexts on the identification of consonant contrast, the identification accuracy of the same pairs of contrasting consonants tended to vary depending on vowel contexts. As discussed earlier, the identification accuracy of English /s/-/ʃ/ was the highest following /i/ (97%) among the 3 vowels. However, the identification accuracy of /d/-/ð/ was the lowest following /i/ (39.6%), but its accuracy was not low following /u/ (70.1%). Similarly, the English /b/-/v/ and /t/-/ɵ/contrast showed rather lower identification accuracy in the /a/ vowel context compared to other vowels, whereas the /z/-/ʤ/ and /z/-/ð/ contrast exhibited lower accuracy in the /i/ vowel context relative to other vowel contexts. The results showed that somewhat different degrees of vowel context effects emerged according to the type of contrasting consonants, although the Korean high school students' identification accuracy was the highest in the /u/ vowel context when all the contrasting pairs were combined. The result was different from that of Woods et al. (2010) because English speakers in Woods et al. identified final consonants more accurately in the /i/ vowel context. Moreover, as discussed earlier, Kalaiah and Bhat (2017) also reported that native Kannada speakers showed vowel context effects in consonant recognition in that Kannada speakers obtained the highest recognition score for Kannada consonants before the /o/ vowel, whereas they obtained the lowest recognition score before the /i/ vowel. The effect of vowel context on consonant identification, thus, might vary according to the speakers' or L2 speakers' native languages as well as the type of consonants investigated.

Further, the results from the study indicated that the Korean students' identification accuracy was moderately correlated with their English listening comprehension test scores. Namely, the students' identification accuracy tended to increase as they received high scores on the English listening comprehension test. The results of the present study corroborate the findings of previous studies (e,g., Ahn, 2009) in that Korean students' identification accuracy of English consonant contrast was correlated with their English listening comprehension ability to some extent.

The findings of the study have some implications for L2/ foreign language sound teaching/ learning. As discussed

3) Korean stops and affricates exhibit a three-way contrast between aspirated, lenis, and fortis in onset position but this contrast is neutralized in coda position (Sohn, 1999; Park and de Jong, 2017). Also, Korean fricatives exhibit a two-way contrast between lenis and fortis in onset position but this contrast is neutralized in coda position, too.

earlier, the ability to identify phonemes of an L2 or a foreign language is an important factor for effective listening comprehension in L2 or foreign language learning (Ahn, 2009; Samuels, 1988). Accordingly, it is necessary to draw some implications for the teaching/ learning of L2 sounds based on the findings of the present study. First of all, it is important to focus more on voiced obstruent contrasts than voiceless ones when teaching English consonant contrasts to Korean EFL learners. Native English speakers depend on the duration of a preceding vowel when they identify word-final voiced vs. voiceless obstruents because obstruents, especially stops in word-final coda position may not be released in North American English; vowels tend to be lengthened before voiced obstruents (Ladefoged, 2006: Celce-Mercia et al., 2010). Accordingly, English teachers in Korea may ask Korean EFL learners to pay attention to the duration of vowels when they identify word-final obstruents. Secondly, the study also found that Korean students' identification of English consonant contrast was affected by the types of contrasting consonants and preceding vowels. In particular, the Korean students had most difficulty in identifying the English /d/-/ð/ contrast followed by the /b/-/v/ contrast and the /z/-/ð/ contrast in that order. English teachers in Korea can focus on these problematic contrasting pairs using minimal pairs: /d/-/ð/: *breed* vs. *breathe*, *load* vs. *loathe*; /b/-/v/: *curb* vs. *curve*, *dub* vs. *dove*; /z/-/ð/: *breeze* vs. *breathe*, *close* vs. *clothe*, etc. Listening exercises using minimal pairs can also be done at the sentence level (e.g., *Do you know how to spell* (*load/ loathe*)?) (Celce-Mercia et al., 2010; Mojsin, 2009). Moreover, listening exercises or activities using minimal pairs should be done in diverse vowel contexts.

The study has some limitations in that it only examined Korean high school students' identification of English obstruent contrast without looking into English liquid, nasal, and vowel contrasts. It also used only English nonce words in the experiment. Thus, future studies should investigate the identification of other consonant contrasts as well as vowel contrasts in English using both English words and nonce words. Also, future studies should examine the identification of English sound contrasts with more diverse populations including Korean elementary and middle school EFL learners.

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