The Role of L1 Phonological Feature in the L2 Perception and Production of Vowel Length Contrast in English*

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ABSTRACT

The main goal of this study is to examine if there is a difference in the utilization of a vowel length cue between Korean and Japanese L2 learners of English in their perception and production of postvocalic coda contrast in English. Given that Japanese subjects' performances on the identification and production tasks were much better than Korean subjects' performance, we may support the prediction based on the Feature Hypothesis which maintains that L1 phonological features can facilitate the perception of L2 acoustic cue. Since vowel length contrast is a phonological feature in Japanese but not in Korean, the tasks, which assess L2 leaners' ability to discriminate vowel length contrast in English, are much easier for the Japanese group than for the Korean group. Although the Japanese subjects demonstrated a better performance than the Korean subjects, the performance of the Japanese group was worse than that of the English control group. This finding implies that L2 learners, even Japanese learners, should be taught that the durational difference of the preceding vowels is the most important cue to differentiate postvocalic contrastive codas in English.

Keywords: vowel length contrast, phonological feature, feature hypothesis, L2 speech perception and speech production

1. Introduction

It has been widely observed that English vowels are longer before voiced consonants than before their voiceless counterparts (House & Fairbanks, 1953; Peterson & Lehiste, 1960; House, 1961; Naeser, 1970). According to Walsh and Parker (1981), this voicing-conditioned vowel lengthening should be considered a phonological rule in English, which is triggered by the feature [+voice] specified in the following obstruents. Some studies of speech perception have shown that the difference of the preceding vowel length serves as an important perceptual cue

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to the voicing contrast in the following obstruent. Denes (1955), indicates that listeners are more likely to perceive a word-final “voiceless” sound /s/ as a “voiced” sound /z/ with an increase in vowel length.

With regard to the study of L2, Chang (2006) found that Korean L2 learners of English failed to utilize the vowel length cue to identify and produce English word-final consonants correctly, even though they were able to simply discriminate the acoustic difference of the vowel length. In terms of methodology, this study replicates Chang’s (2006) experiments, but this study is not intended to compare L1 and L2 performances on English postvocalic contrast. Instead, I tried to compare two different L2 groups’ performances: Korean and Japanese L2 learners of English. There are two reasons why Korean and Japanese speakers were compared. First, there is a difference in relevant laryngeal features between Korean and Japanese: Glottal Width for Korean vs. Glottal Tension for Japanese (Avery and Idsardi, 2001). Second, the phonological status of vowel length in Korean is different from that of the Japanese language. While vowel length is a phonological feature in Japanese, it is no longer a phonological feature in Korean. It thus can be predicted that Japanese L2 learners will perceive and produce the difference of vowel length before voiced and voiceless consonants in English more successfully than Korean L2 learners.

In what follows, I first review the relevant laryngeal feature in Korean and Japanese by observing their obstruent system, and subsequently examine Korean and Japanese vowels to determine whether or not vowel length is an important phonological feature. Furthermore, I conduct three experiments (AX discrimination, ABX identification, and production tasks) to figure out if Korean and Japanese L2 learners of English employ vowel length cue differently in their perception and production of postvocalic coda contrast in English. Since it turns out that the Japanese group shows better performance than the Korean group, I conclude that L1 phonological features can be useful in discriminating acoustic difference in L2 perception and production tasks.

2. Obstruents and Vowel Length in Korean and Japanese

This study is primarily concerned with Korean and Japanese speakers’ perception and production of English word-final contrast related to the duration of preceding vowels. Before conducting the experiments, I will briefly introduce some basic properties of Korean and Japanese obstruents and vowel length.

2.1 Korean obstruents and vowel length

2.1.1 Laryngeal features in Korean obstruents

Korean stops are classified as plain (lenis), tense (fortis), and aspirated. This three-way contrast in stops is characterized by two laryngeal features: spread glottis and constricted glottis, as in <Table 1>.

Table 1. Phonemes in Korean stops

segments	phonation contrast	laryngeal feature
p, t, k	plain (lenis)	unmarked
p', t', k'	tense (fortis)	constricted glottis
p^h, t^h, k^h	aspirated	spread glottis

The phonetic influence on developing these phonological features can be immediately grasped by considering the fact that laryngeal features are relevant to the status of glottal width. Notice that constricted glottis and spread glottis represent the narrow and wide opening of the glottis, respectively, In addition, the unmarked case is equivalent to the neutral status of glottis. Crucial evidence for these laryngeal features can be found in some fiberoptic studies of Korean stops (Kim, 1965, 1970; Kagaya, 1974). Upon observing the larynx, they asserted that the vocal folds are substantially abducted for aspirated stops, but nearly adducted for tense stops. Unlike these two extreme laryngeal adjustments, plain stops have an intermediate range of vocal fold opening. Since Korean stops are clearly classified into three distinctive categories in terms of the condition of glottal width, laryngeal features, which relate to glottal width, must be distinctive features in Korean stops.

Contrary to stops, Korean fricatives have a two-way contrast: a plain (lenis) fricative and a tense (fortis) fricative. The difference of the phonological representations between the two fricatives has been well documented by Avery and Idsardi (2001: 56). While the plain fricative bears one consonant timing node with spread glottis, the tense fricative carries two consonant timing nodes with spread glottis, as illustrated in <Table 2>. Accordingly, the distinctive feature within Korean fricatives is the length of the fricatives themselves.

Table 2. Phonemes in Korean fricatives

segments	phonation contrast	distinctive feature
s	plain (lenis)	shorter
s'	tense (fortis)	longer

Up to this point, we have examined that the distinctive features are different between stops and fricatives in Korean: laryngeal features for stops vs. segment duration for fricatives. It must also be noted that the plain and aspirated stops in Korean correspond with the English stop distinction in that English stops can be divided into unmarked (voiced) cases and marked (voiceless) cases with Glottal Width (GW), proposed by Avery and Idsardi (2001) and Chang (2007). Specifically, plain stops in Korean are equated with plain stops that are traditionally considered voiced stops in English due to the fact that both of them are unmarked. Likewise, aspirated stops in Korean are equivalent to stops marked with GW in English, which are traditionally classified as voiceless stops. On the contrary, the fricatives in Korean that are contrastive in their length do not correspond to the GW contrast in English fricatives.

2.1.2 Phonological status of Korean vowel length

Most Korean dictionaries denote that there is a phonemic contrast between long and short vowels (e.g. [nu:n] 'snow' vs. [nun] 'eye'). However, it has been reported that the length contrast in vowels is no longer found in younger generations (Lee, 1971) and the modern standard Seoul dialect (Kim & Han, 1998). The experimental study (Park, 1994) suggests that the neutralization of vowel length (i.e. shortening of long vowels) has been established quite early. In his experiment, the Korean people showed no sign of the distinctive use of vowel length. In other words, even the older generations were not able to employ the distinction of contrastive vowel length correctly, let alone the younger generations. It is probable that most speakers living in contemporary Korea can no longer employ contrastive vowel length in their grammar.

2.2 Japanese obstruents and vowel length

2.2.1 Laryngeal features in Japanese obstruents

According to Shibatani (1990) and Tsujimura (1996), a [±voice] distinction is contrastive in Japanese obstruents. A crucial piece of evidence for voicing distinction in Japanese involves some well-known phonological rules in Japanese compounds, such as *Rendaku* and *Lyman's Law*, which operate on voiced consonants. When two words are combined, a word-initial voiceless consonant of the second member of a compound becomes voiced (e.g. [ama] + [**t**era] → [ama**d**era]) This is known as *Rendaku*. On the other hand, *Rendaku* is blocked when the second member of a compound already contains a voiced obstruent (e.g., [hitori] + [**t**a<u>b</u>i] → [hitori**t**abi]/*[hitori**d**abi]), and this blocking effect is known as *Lyman's Law*. That is, the existence of an already present [voice] in the second word of a compound prevents another specification of the [voice] within the compound word. Thus far, we have seen that Japanese obstruents should be marked with [voice], supporting that Japanese is a voicing system.

2.2.2 Phonological status of Japanese vowel length

A great deal is known about the phonological status of Japanese vowel length; moras in Japanese are regularly timed, and long vowels are distinguished from short vowels by the number of moras (i.e. two moras for long vowels vs. one mora for short vowels). Unlike contemporary Korean vowels, Japanese has a phonemic contrast between long and short vowels: [su:] 'number' vs. [su] 'vinegar' (see e.g. Tsujimura, 1996). The first word contains a long vowel, whereas the second word has a short vowel. The first and second words are minimal pairs in which the different selection of vowel length makes the meanings of words different. In other words, prolonging a short vowel generates another phoneme in Japanese, which in turn supports that Japanese has phonemic long vowels.

3. Three Experimental Studies

The following three experiments (two perception tasks and one production task) investigate how the L1 grammars of Korean and Japanese speakers affect their L2 acquisition of English word-final voicing contrast.

3.1 Predictions

Crucial to the predictions we can make in this study is establishing a link between L1 phonological grammar and the perception and productions of a non-native contrast by L2 learners. According to the Feature Hypothesis, it is proposed that L2 phonetic properties that are not employed to signal phonological contrasts in L1 grammar will be more difficult for L2 learners to perceive or produce accurately than those that are used to signal phonological contrasts in the grammar of their native language. That is, L2 acoustic properties can be acquired only if they are used to signal phonological contrasts in L1 grammar (McAllister, Flege & Piske, 2002; Gottfried & Suiter, 1997; Lee, Guion & Harada, 2006).

More specifically, the experiments in this study were designed to explore three related issues: (i) Can both Korean and Japanese L2 learners perceptually discriminate the final voicing contrast? (ii) Do Korean and Japanese L2 learners use the vowel length cue to distinguish the final voicing contrast in their own production? (iii) Do Japanese L2 learners perceive and produce vowel length difference in English successfully? That is, can we support the Feature Hypothesis?

Following the Feature Hypothesis, we can reasonably expect that Japanese subjects may successfully perceive and produce voicing-conditioned vowel length in English by virtue of the fact that Japanese has a phonemic distinction of vowel length, whereas Korean subjects may not. This prediction, in fact, can be supported by the previous research (Strange et al., 2001) about Japanese speakers' perception of English vowels in which Japanese speakers are more likely to perceive English vowels before voiced consonants as two-mora (long) categories and English vowels before voiceless consonants as one-mora (short) categories.

On the other hand, the grammar of L2 learners' native language may negatively impact their performance in the tasks. Comparing Korean and English stop categories, we find that the set of stop categories in Korean does not coincide with that in English (three categories in Korean vs. two categories in English). Worse still, the fricative contrast is different between Korean and English: Korean fricatives contrast in length (e.g. /s/ vs. /ss/), whereas English fricatives contrast in Glottal Width (e.g. /s/ marked with GW vs. /z/ unmarked). Let us now consider Japanese obstruents, comparing them with English obstruents. It is noteworthy that phonological contrasts in Japanese and English are entirely different in both stops and fricatives. In Japanese, both stops and fricatives contrast in [voice], while English counterparts contrast in Glottal Width (see Iverson & Salmons, 1995; Avery & Idsardi, 2001).

In sum, the fact that vowel length is a phonological contrast in Japanese may facilitate Japanese subjects' perception and production of different vowel length before codas bearing contrastive laryngeal specifications in English. With regard to the coda in itself, Glottal Width in Korean stops alone corresponds to the phonological feature in English stops even though there is a mismatch in the number of categories between Korean and English.

Based on these facts, we can predict that Japanese subjects will show better performance than Korean subjects overall. Within the Korean group, it may be possible that English stops are better perceived and produced by Korean subjects than English fricatives.

3.2 Methods

Exploring whether or not L2 learners employ the vowel length cue to distinguish word-final contrast in their perception, I first prepared test materials for discrimination and identification tasks. These stimuli consisted of 18 minimal pairs exhibiting the final "voicing" contrast, which are limited to monosyllable words, as illustrated in <Table 3>. I then asked a thirty-year-old native speaker of American English to pronounce a list of sentences that contained the target minimal pairs of words.

Table 3. Target words (Chang 2006: 111)

stop	rip	cap	cup	feet	cot	cat	back	tack	snack
	rib	cab	cub	feed	cod	cad	bag	tag	snag
fricative	safe	leaf	half	peace	face	loose	mouth	teeth	teeth
	save	leave	have	peas	phase	lose	mouth(V)	teethe	teethe

A list of 36 sentences, containing the target words at the end of each sentence, was then constructed (see Table 4), and the native speaker of English pronounced a randomized list of 36 sentences.

Table 4. A list of recorded sentences (Chang 2006: 119-120)

Minimal pairs differing in stop	Minimal pairs differing in fricative
My pants have a rip. This building resembles a rib	The missing child was found safe. It is prudent to save.
She sometimes wears a cap. I want to take a cab.	A fallen keaf is a dead leaf. The old professor has gone on leave.
I am fond of the cup. A lion gave birth to a cub.	No goals were scored in the first half. It is a sandwich that I want to have.
You must learn to stand on your own feet. She has a large family to feed.	After fighting, the people longed for peace. This is the soup made of dried peas.
On a ship, we usually sleep on a cot. My favorite food is fresh cod.	His ambition was to meet her face to face. The child is going through a difficult phase.
We've got three dogs and a cat. He's no gentleman, he's a cad.	The fierce dog has broken loose. There is not a moment to lose.
It takes me an hour to walk there and back. Today, we got a new bag.	From time to time, she's got a big mouth. Those are curses that they silently mouth.
It would be unwise to change tack. I realize that I lost my name tag.	Finally the employers showed their teeth. Babies chew something when they teethe.
I just want to have a snack. There must be a snag.	Finally the employers showed their teeth. Babies chew something when they teethe.

As shown in <Table 4>, the last pair of sentences containing dental fricatives (teeth/teethe) was repeated twice. This occured because I found only these two examples with this contrast. The pronounced sentences were recorded and then converted to WAV files at a 22 kHz sampling rate. The targets were then edited using the Praat program. For the AX discrimination task, stimuli were constructed with uniform intervals (i.e. an “interstimulus interval” (ISI) of 1500 milliseconds and an “intertrial interval” (ITI) of 3000 milliseconds). For the Identification task, the ITI was also 3000 milliseconds. To construct the manipulated condition in a part of the AX discrimination task, I shorten the vowels before the “voiced” (unmarked) consonants to match them with the vowels before the “voiceless” consonants marked with GW, in terms of vowel length. More specifically, the steady-state portion of the vowel, which excluded initial and final transition information, was pitch-marked. The vowel continuum was then constructed by simultaneously excising a glottal pulse from each end of the steady-state vowel. Boundary points for excision were at zero crossings in the stimulus waveform. The purpose of including the manipulation of vowel length in this task is to investigate whether or not vowel length is a significant perceptual cue for discrimination of English word-final "voicing" contrast, even in L2 learners of English.

With regard to participants, twenty-five native Korean speakers, twenty-five native Japanese speakers, and seven native speakers of English as the control group participated in both perception and production experiments. The Korean and Japanese groups consisted of people who had learned English as their only second language. The subjects in the Korean group were between twenty and twenty-four years of age, and only four of them had resided in North America no longer than one to three months. In the case of the subjects in the Japanese group, they were between nineteen and twenty-two years of age, and five of them had resided in North America no longer than three to six months. In the control group, all five subjects are monolingual speakers of American English, and they are in their mid-twenties. All subjects had no reported history of either speaking or hearing disorders.

3.3 Procedure

The discrimination task was designed to test whether subjects could successfully discriminate minimal pairs in coda. After they listened to a pair of words through headphones, the subjects were asked to respond to each trial by circling either 'same' or 'different' on a response sheet. This auditory task is intended to assess the subjects' ability to discriminate sounds at the phonetic level. Subjects heard 102 pairs of words, as summarized in <Table 5>.

Table 5. Types of stimuli in the discrimination task (Chang 2006: 112)

Contrasts	coda condition	Examples	Number
coda and length	Different	[kʰæp]vs.[kʰæ:b] [pʰis]vs.[pʰi:z]	36 trials (18 pairs)
coda and length	Same	[kʰæp]vs.[kʰæp] [kʰæ:b]vs.[kʰæ:b] [pʰis]vs.[pʰis] [pʰi:z]vs.[pʰi:z]	36 trials
coda (length neutralized)	Different	[kʰæp]vs.[kʰæb] [pʰis]vs.[pʰiz]	18 trials (18 pairs)
other (controls)	Different	[kʰæp]vs.[kʰat]	12 trials (6 pairs)

The upper two rows in the table, which show contrasts in both coda and the preceding vowel length, are the normal condition. For the normal condition, 72 trials (half of them for the different trials and half for the same trials) were presented in total. On the different trials, there were two types of trials. For each pair of stimuli (e.g. X and Y), half of the different trials were in XY order, but the order of stimuli was switched in half of the different trials, as YX.

Likewise, each stimulus was presented on half of the same trials so that half of the same trials were XX and half of them were YY. Another category of trials was the manipulated condition where only a coda showed the contrast as the result of the neutralization in vowel length. Finally, six pairs of non-minimal paired words were included as controls with two repetitions.

In the identification task, the subjects were presented with one word of a minimal pair and had to find the correct word between the two words given on a response sheet. Since the identification task was aimed to examine how subjects identify the words they hear, this task was somewhat harder than the discrimination task.

In addition to two types of perception tasks, a production task was also conducted to investigate if L2 learners of English can pronounce preceding vowel lengths of a minimal pair in different ways. As for speech production, the subjects were asked to pronounce 36 sentences twice, and each sentence contained one target word (see the list of sentences in Table 4).

3.4 Results

For each subject's performance in the perception tasks, a sensitivity measure (*d'*) was computed through the application of signal-detection theory (Wickens, 2002). One crucial advantage of employing *d'* is that it shows us perceptual distance as well as the subjects' biases toward one response or the other. The computed *d'*-values for perception tasks were then applied to statistical analysis in the JMPIN software: a Repeated Measures paired t-test and a Repeated Measures ANOVA. As for the production task, all of the vowel lengths of the target words were measured, and the average vowel length across all speakers in each group was calculated.

3.4.1 AX Discrimination Task

Since a sensitivity measure (*d'*) is based on *z*-transformed scores of hit and false-alarm rates, we estimated the number of correct rejection, misses, false-alarms, and hits beforehand, as shown in <Table 6>.

Table 6. The table employed to calculate the d'-value for the discrimination task

Stimuli / Response	Same	Different
Same	A. the number of *correct rejection*	B. the number of *misses*
Different	C. the number of *false-alarms*	D. the number of *hits*

Based on signal-detection theory, the numbers in <Table 6> were converted to conditional proportions, such as the hit rate [D / (D + B)] and false-alarm rate [C / (C + A)]. These rates were then automatically converted to z-scores in the EXCEL program. Finally, the *d'* numbers were defined by the subtraction of the z-score for the false-alarm rate from the z-score for hit rate: z (hit) - z (false alarm). The average d' for the Korean and Japanese group are 3.43 and 2.88, respectively. The average d' for the English control group is 3.56. The higher d' value indicates that the perceptibility of the distinction between minimal pair words is higher. Thus, English listeners perceive word-final contrast most distinctively.

The overall performance shows that there is no discernible difference between the Korean and English groups. However, the Japanese group shows a slightly poorer performance than the others. A Repeated Measures ANOVA comparing d' for all three groups reveals no significant difference: $F(2,54) = 2.56$, $p = 0.087$. This finding is not consistent with what is predicted by Feature Hypothesis; the Feature Hypothesis is NOT supported in this auditory task.

Furthermore, interesting differences are detected in Korean group when the testing pairs were divided into two different coda types: stops and fricatives. As for the Korean listeners, the average d' for target words containing word-final stops is 4.19; however, the average d' for target words containing word-final fricatives is 3.36, at the most. A paired t-test comparing d' for stops and fricatives denotes a significant difference: $t(24) = 3.51$, $p < 0.01$. A possible explanation for this is that both Korean and English stop systems are related to Glottal Width (see 2.1.1). In particular, Korean stops have only one extra contrast compared with English stops, which means the Korean stop system is a superset of the English one. To perceive English stops correctly, Korean subjects only need to suppress the contrastive use of [constricted glottis]. On the contrary, the Korean fricative system employs a different contrast than the English fricative system (e.g. length in Korean vs. GW in English), which makes Korean listeners' perception of the English fricatives difficult.

Under the manipulated condition, d' of all groups dramatically drops, compared with their performance under the normal condition. First, for the Korean groups, the average d' is 3.43 under normal condition and 2.84 under manipulated condition, which turns out to be significantly different from each other: $t(24) = 8.51$, $p < 0.01$. Second, the Japanese group shows that the average d' is 2.88 under the normal condition and 2.54 under the manipulated condition. A paired t-test demonstrates that there is a significant difference between these two numbers: $t(24) = 5.65$, $p < 0.01$. Finally, according to the English control group, the mean d' for normal condition is 3.56, whereas the manipulated condition is 3.17; A paired t-test comparing d' for normal and manipulated conditions reveals a significant difference: $t(6) = 4.27$, $p < 0.01$. Although this finding supports the idea that vowel length is a major cue in discriminating minimal pairs containing word-final contrast, the positive d' value for manipulated condition implies the distinction between minimal pair words is still perceptible.

3.4.2 Identification Task

In this task, 'hit' is the probability of the subjects' correctly identifying consonants marked with GW as the ones marked with GW, and 'false alarm' is the probability of the subjects' falsely identifying unmarked consonants as the ones marked with GW. A senstivivity measure (*d'*) for the identification task is calculated in the same way with the discrimination task, using the table in <Table 7>.

Table 7. The table employed to calculate the d'-value for the identification task

Response \ Stimuli	Unmarked	GW
Unmarked	A. the number of *correct rejection*	B. the number of *misses*
GW	C. the number of *false-alarms*	D. the number of *hits*

The average *d'* across Korean listeners is 1.62, which is the lowest among all listeners of three groups, and Japanese listeners' average *d'* is 1.74. Notice that Japanese listeners perform higher in identifying coda contrasts than Korean listeners, and the difference is somewhat significant: $t(24) = -2.17$, $p = 0.04$ (< 0.05). This difference between the two groups might be due to the fact that only Japanese has a phonemic vowel-length contrast, which may thus support the Feature Hypothesis.

Comparing these L2 groups' results with the average *d'* of the English control group (i.e. *d'* = 2.98), we notice that L2 learners of English in the Korean and Japanese groups did significantly worse than native speakers of English in the control group: $F(2,54) = 120.56$, $p < 0.01$.

Let us now turn our attention to the mean *d'* for the stimuli broken down by stops and fricatives in each group. The difference of the average *d'* values between stops and fricatives is the greatest in the Korean group (e.g. 2.35 for stops and 1.39 for fricatives in the Korean group; 2.94 for stops and 2.48 for fricatives in the Japanese group; 3.93 for stops and 3.84 for fricatives in the English control group) As we predicted in section 3.1, Korean speakers perform higher in identifying the contrast of the postvocalic stops than that of the postvocalic fricatives. The repeated paired *t*-test indicates this difference in the Korean group is significant: $t(24) = 6.08$, $p < 0.01$. However, no significant difference of *d'* between stops and fricatives is found in the other two groups: $t(24) = 1.56$, $p = 0.13$ for the Japanese group; $t(6) = 0.15$, $p = 0.89$ for the English control group.

3.4.3 Production Task

The overall results across all three groups show that vowels are longer before unmarked ("voiced") consonants than before "voiceless" ones marked with GW, as summarized in <Table 8>.

Table 8. Mean duration of vowel in Korean and English speakers' production

Postvocalic coda condition	Korean group	Japanese group	English group
Unmarked ("voiced")	177.1 ms	195.3 ms	236.9 ms
GW ("voiceless)	163.8 ms	149.6 ms	151.4 ms
difference	13.3 ms	45.7 ms	85.5 ms

With regard to the mean duration of vowels before unmarked consonants, it is the shortest in the Korean group; however, the mean duration of vowels before the consonants marked with GW is the longest in the Korean group. This implies that Korean speakers do not differentiate the vowel length before unmarked codas from the one before GW-marked codas in their production. Specifically, the greatest difference in vowel duration is detected in the English control group (236.9 ms - 151.4 ms = 85.5 ms). Within the L2 groups (between the Korean and Japanese groups), the difference in vowel length is much greater for the Japanese group than for the Korean group (45.7 ms for Japanese group vs. 13.3 ms for Korean group).

Comparing the vowel length before unmarked consonants with the one before GW- marked counterparts, we discover that even the Korean group shows the difference is significant: $t(24) = 17.25$, $p < 0.01$. In other words, vowels before unmarked codas are significantly longer than those before GW-marked codas in all three groups.

Crucial to these findings is that Japanese speakers performed higher than Korean speakers, even though all of the Japanese and Korean speakers showed a poor performance compared with the native speakers of English. As predicted based on the Feature Hypothesis in section 3.1, Japanese speakers can employ a durational cue of the preceding vowels more successfully in their production than Korean speakers. This is due to the fact that vowel length is a phonological feature in Japanese but not in Korean. Nevertheless, Japanese speakers did not lengthen the vowels before unmarked consonants as much as English speakers did.

4. General Discussion

In this article, I conducted three different experiments: an auditory task, an identification task, and a production task. The basic assumption was that L2 learners will perceive and produce a contrast in a target language more successfully when the contrast is a phonological feature in their native language. Given that vowel length is an important cue to determine the type of postvocalic consonants in English, I compared Japanese L2 learners of English whose native language do have vowel length contrast and Korean L2 learners of English whose native language lacks vowel length difference.

In the auditory task, it is first found that vowel length is an essential cue to discriminate between different types of word-final consonants in English based on the fact that all groups show significantly poorer performance when vowel length is neutralized. In the normal condition, no major difference in their performances were found among the Korean, Japanese, and English groups, which does not conform to the prediction that I made according to the Feature Hypothesis. Following the Feature Hypothesis, I expected that the phonological contrast of vowel length in Japanese grammar would help Japanese listeners discriminate between longer vowels before unmarked ("voiced") consonants and shorter vowels before "voiceless" ones marked with GW. According to the AX discrimination task, such a pattern was not found. Instead, Korean listeners also performed high on the auditory task, which was not predicted by the Feature Hypothesis.

On the contrary, the Korean group did perform significantly worse than the Japanese group, and the Japanese group, in turn, did significantly worse than the English control group on the identification task. What is important is that Japanese listeners performed higher than Korean listeners in identifying vowel length and coda contrasts. This finding coincides with the prediction and supports the Feature hypothesis. Given that Japanese has a phonemic distinction of vowel length, Japanese listeners, to some extent, can utilize L1 grammar to distinguish L2 vowel length. That is, Japanese listeners benefited from the existence of vowel length as a phonological feature in their native language when they identified the durational difference of the vowels before contrastive codas. In contrast, Korean listeners were not able to identify this length difference of vowels depending on the coda condition because vowel length is not a phonemic contrast in Korean.

Furthermore, the production task provides additional evidence that supports the Feature Hypothesis in that the durational difference between vowels before unmarked ("voiced") codas and vowels before GW-marked codas is substantially shorter in the Korean group than in the Japanese group. Given the shorter durational difference in the Japanese group compared with the one in the English control group, Japanese speakers did not fully acquire the vowel length cue to discriminate English voicing contrast in coda. This experimental study shows that L1 phonological features can be useful in discriminating acoustic difference in L2, but they do not have a significant influence on the acquisition L2 context-sensitive phonological rules. This implies that L2 learners, even Japanese learners, should be taught that the durational difference in preceding vowels is the most important cue to discriminate the postvocalic coda contrast in English.

To summarize, we have confirmed, through the identification and production tasks, that the difference in vowel length before contrastive codas in English can be identified and produced accurately by the L2 learners of English whose L1 grammar has a phonemic vowel length contrast. More interestingly, we have investigated that the Feature Hypothesis was no longer valid in the auditory task, which implies the auditory task makes contact with a different layer of perception (Chang, 2006). While the identification and production tasks probe the phonological status of vowel length, the auditory task simply assesses the auditory and phonetic level of vowel length.

5. Conclusion

Let me summarize three crucial aspects of these experimental results. First, while both Korean and Japanese listeners demonstrated high performances on the auditory task, the Korean listeners perform significantly worse than the Japanese listeners on the identification task. Second, Korean speakers did not show much difference in vowel length to discriminate contrastive codas, compared with Japanese and English speakers. Third, on the basis of the Korean subjects' poor performances on the identification and production tasks, we can support the Feature Hypothesis.

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