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Author(s)	Han, Heesun
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F0 influence on the perception of Korean initial stops, affricates and fricatives by Japanese learners of Korean

HAN Heesun

Abstract This study examines the influence of F0 on Japanese learners' perception of initial lax, aspirated, and tense consonants in Korean. Twelve native speakers of Seoul Korean in their twenties and thirties and 24 native Japanese speakers participated in the perception test. The native Japanese speakers included 12 beginner learners in their teens and twenties who had studied Korean for the first time as a general academic subject at a Japanese university for less than one year, and 12 advanced learners, ranging from their twenties to forties, who had lived in Seoul for more than one year and who had passed level 5 or higher in the Test of Proficiency in Korean.

Stimuli consisted of monosyllables with lax and aspirated consonants (/ta, tsa, t^ha, ts^ha/) with interchanged F0s. Results from recognition tests found that both beginner and advanced learners paid less attention to stimuli F0 compared with native speakers. In cases where stimuli included a tense stop (/t^{*}a/), a tense affricate (/ts^{*}a/), and non-tense and tense fricatives (/sa, s^{*}a/), F0 had no significant influence on recognition for native speakers. In contrast, both beginner and advanced learners evaluated consonants by changes in F0.

The results suggest Japanese learners acquiring Korean initial consonants are prone to either insufficient focus on F0 or excessive focus on F0, with learning experience showing no significant effect on acquisition. Although this survey is preliminary, the findings may have implications for the teaching of Korean to Japanese speakers.

Keywords: Korean, lax, aspirated, tense, Japanese learners of Korean

1. INTRODUCTION

Several studies have noted that Korean consonant acquisition is difficult for native Japanese speakers (Kim et al. 2002, Koga 2004, Kim & Kim 2010, Han 2010, Han 2011), but few have examined where the difficulty lies. This paper addresses this gap by investigating Japanese speakers' perception judgments of initial lax, aspirated, and tense consonants (/t'a, ts'a, s'a, tsa, ts^ha, ts'a, sa, s'a/), and how these compare to the judgments of native Korean speakers.

Korean stops and affricates display a three-way contrast between lax, tense, and aspirated. The stops occur at three places of articulation (bilabial, denti-alveolar, and velar) while the affricates occur at one place of articulation (alveolo-palatal). Korean denti-alveolar fricatives display a two-way contrast between non-tense¹⁰ (/s/) and tense (/s²/). Table 1 shows these stops, affricates

¹⁾ Opinions on how to categorize Korean/s/ differ, and researchers have treated it as either lax (or plain or lenis) or aspirated (Kagaya 1974, Cho, Jun & Ladefoged 2002). In this study/s/ is treated as non-tense.

	Stop			Affricate	Fricative
	Labial	Denti-alveolar	Velar	Alveolo-palatal	Denti-alveolar
Lax	/pul/ "fire"	/tal/ "moon"	/kul/ "cave"	/tsim/ "baggage"	/sal/
Aspirated	/p ^h ul/ "grass"	/t ^h al/ "mask"	/k ^h ul/ "cool"	/ts ^h im/ "needle"	"flesh"
Tense	/p'ul/ "horn"	/t`al/ "daughter"	/k'ul/ "honey"	/ts'im/ "steamed dish"	/s'al/ "rice"

Table 1. Minimal contrasts of Korean consonants in word-initial position

Table 2. Minimal contrasts of Japanese consonants

	Stop			Affri	Fricative	
	Labial	Denti-alveolar	Velar	Alveolo-palatal	Alveolo-palatal	Denti-alveolar
Voiceless	/papa/	/tata/	/ka/	/tura/	/ti/	/asa/
	"daddy"	"many"	"mosquito"	"face"	"blood"	"morning"
Voiced	/baba/	/tada/	/ga/	/dura/	/di/	/aza/
	"riding ground"	"free"	"moth"	"wig (slang)"	"hemorrhoids"	"bruise"

and fricatives contrasts in minimal triplets and pairs. Japanese stops and fricatives display a two-way contrast between voiced (/b, d, g, z/) and voiceless (/p, t, k, s/). Labial and velar stops (/p, b, k, g/) are realized as plosives before all five vowels (/a, e, i, o, u/), but alveolar stops (/t, d/) are realized as affricates ([tei, dzi, tstu, dztur]) when preceding high vowels (/i, u/). The fricatives (/s, z/) occur before all five vowels (/a, e, i, o, u/), but when preceding /i/ are palatalized and realized phonetically as alveolo-palatal fricatives ([tei, zi]). The voiced fricative /z/ is realized phonetically as a voiced affricate [dz, dz] in word-initial position or after the moraic-nasal consonant (/N/). Table 2 provides minimal pairs that show these contrasts in Japanese stops, affricates and fricatives. It seems Korean consonant acquisition is difficult for native Japanese speakers because of the phonological difference between Korean and Japanese.

1.1. The production of Korean lax, aspirated and tense consonants by Japanese learners

Kim et al. (2002) conducted an experiment on the production of initial lax, aspirated and tense consonants by eight Japanese learners who had learned Korean for less than one year and who had stayed in Korea for less than one year. The ages of the subjects ranged from 19 to 33 years old. The test words comprised 140 monosyllabic nonsense or sense words including lax, aspirated and tense consonants in initial position. Three native Korean speakers judged whether they recognized the recorded sounds as intended by the Japanese participants. The reported rate of correct pronunciation was about 50%. Koga (2004) discussed a similar study of six Japanese students who had majored in the Korean language at a Japanese university for two or three years, and whose reported rate of correct pronunciation was also about 50%.

1.2. The perception of Korean lax, aspirated and tense consonants by the Japanese learners

Han (2016a) conducted a study on the rate of correct identification of lax, aspirated and tense initial stops and affricates (/ta, t^ha, t'a, tsa, ts^ha, ts'a/) for a group of twelve beginners who had learned Korean for the first time as a general academic subject at a Japanese university for less than one year, and a group of 12 advanced learners who had stayed in Seoul for more than one year

and who had passed level 5 or higher in the Test of Proficiency in Korean (TOPIK). Han (2016a) reported the rate of correct identification of lax, aspirated and tense consonants ranged between 73 to 98% for the beginner group and 82% to 98% for the advanced learner group. In a similar study, Koga (2004) reported a correct identification rate of about 70% for six students who majored in the Korean language at a Japanese university for two or three years.

Although Japanese learners may be able to differentiate the three types of initial consonants regardless of their learning experience, the method of identification they employ are reported to be different from that of native Korean speakers (Han 2016a, Kim & Kim 2010).

Kim & Kim (2010) investigated the effect of F0 and voice-onset time (VOT) on the judgment of lax and aspirated consonants using a lax stop (/ta/) and an aspirated stop (/t^ha/). The results found that 24 native speakers were able to distinguish this phonemic contrast based on F0. In contrast, 26 Japanese learners who had studied from three months to more than five years at a South Korean university were only able to distinguish this phonemic contrast by using primarily VOT information. Han (2016a) used six test sounds (/ta, t^ha, t'a, tsa, ts^ha, ts'a/) with 12 native Korean speakers, and similar to Kim & Kim (2010), found they focused on F0 in distinguishing lax and aspirated consonants. In contrast, the Japanese learners focused on VOT when stimuli consisted of monosyllables (/t^ha, ts^ha, ts'a/) including aspirated and tense consonants. Consonants tended to be judged as tense when VOT was short and as aspirated when VOT was long. This tendency was prominent in the case of advanced learners. However, Han (2016a) pointed out it did not seem to be the only cue, as advanced learners also focused on the intensity of the VOT portion when the stimuli had high F0. Consequently, VOT seemed to influence the judgment of consonants by Japanese learners.

When speaking Japanese, Japanese speakers attend to VOT (Lisker & Abramson 1964, Shimizu 1996), F0 (Sato 1974, Klatt 1975) and F1 (Klatt 1975) when they judge whether a consonant is voiced or unvoiced. Of the three cues, VOT plays the most important role. Therefore, it is possible that Japanese learners judge Korean consonants in the same way they judge Japanese consonants rather than focusing on F0, as Korean speakers do. There are, however, few reports on the perceptual judgment of Japanese voiced consonants and unvoiced consonants by native Japanese speakers. Therefore, it is premature to assume Japanese speakers' perception of Japanese consonants influences their perceptual judgment of Korean consonants because there remain many uncertainties about their discrimination of Japanese consonants.

Han (2016a) also conducted an identification test of fricatives (/sa, s'a/). The rate of correct identification by beginners was relatively low, at 92% for /sa/ and 42% for /s'a/, whereas advanced learners achieved a much better identification rate of 98% for /sa/ and 80% for /s'a/. This suggests that beginners occasionally mistake tense for non-tense in the judgment of fricatives. Chang (2011) has previously established that native speakers do not use F0 as a cue for distinguishing non-tense fricative (/sa/) and the tense fricative (/s'a/). However, the effect of F0 for the perception of fricatives by Japanese learners has not yet been investigated.

This paper investigates the effect of F0 on the Japanese learners' perception judgments of initial lax, aspirated and tense consonants, including tense stops (/t'a, ts'a, s'a/), affricates (/tsa, ts^ha, ts'a/), and fricatives (/sa, s'a/), which were not tested by Kim & Kim (2010). Furthermore, this study takes into account the difference in the learners' prior experience, which Kim & Kim (2010) did not strictly control, by comparing beginners and advanced learners.

2. METHODS

2.1. Participants

Participants included 12 native speakers of Seoul Korean (8 females and 4 male) in their twenties and thirties who had lived in Seoul until 18 years of age and who were enrolled in undergraduate or graduate school at Osaka University in Japan. Twentyfour native Japanese speakers (19 females and 5 males) participated in the perception test. Among the native Japanese speakers, the 12 beginners (10 females and 2 males) in their teens and twenties were students who had learned Korean for the first time as a general academic subject at a Japanese university in the Osaka area for less than one year. The 12 advanced learners (9 females and 3 males), with ages ranging from their twenties to forties, had lived in Seoul for more than one year and had passed level 5 in the Test of Proficiency in Korean. They were either graduate students at Osaka University or worked in business. At the time of testing, all participants lived in Osaka, Japan. All participants had been learning English, but none had ever lived in an Englishspeaking country. The participants were acquaintances with the author or recruited on campus. All participants were interviewed prior to the experiment to check their suitability. They were paid for their participation. Hereafter, the native Korean speakers will be referred to as "K," the beginners as "JB," and the advanced learners as "JA," respectively.

2.2. Stimuli

The samples used for the perception test were manipulated from the author's voice (a Seoul-born female in her twenties at the time of recording). She read randomized lists which were written in Korean Hangul at a natural speaking rate. The monosyllabic stimuli included lax, aspirated and tense consonants (/ta, t^ha, t'a, tsa, ts^ha, ts'a, sa, s'a/). She read 8 test words 10 times in random order. The recordings were digitized at 44.1 kHz and conducted in an anechoic room at Osaka University.

Acoustic measures were taken using Praat (5.2.17). Averages of the ten repetitions of the test words were determined. Table 3 shows the F0 of the original recordings. To verify the effect of F0, F0 values were manipulated with Praat (5.2.17). F0 values for lax consonants (/ta, tsa/), which showed lowest F0 value in the prior production test, were raised to match the aspirated F0. In contrast, the aspirated (/t^ha, ts^ha /) F0, which showed the highest F0 value in the prior production test, were lowered to match the lax F0. F0 values for tense (/t^a, ts^a/), which showed an intermediate-high F0 value in the prior production test, were manipulated to match the lax F0. F0 value for aspirated or the lowest value for lax F0. For fricatives, the F0 for non-tense and tense consonants were equal and showed no significant differences. Non-tense and tense fricatives F0 were manipulated in two stages (180Hz and 300Hz). The F0 of the results were consistent with Kagaya (1974) and Cho et al. (2002).

VOT for aspirated (/t^ha, ts^ha/) and lax (/ta, tsa/) consonants were longer than tense consonants (/t'a, ts'a/). The VOT of lax consonants was of an intermediate length. As for the length of the fricative, the length of non-tense (/sa/) and tense consonants (/s'a/) were equal and showed no significant differences. For fricatives, no previous research (Umeda & Umeda 1965, Cho et al. 2002, Chang 2011), or the current study, showed a consistent trend.

	Stops	Affricates	Fricatives
Lax	223	235	21.4
Aspirated	295	301	214
Tense	270	273	229

Table 3. F0 of original sounds (Hz)

Intensity in the tense (/t'a, ts'a/) consonants' following vowels were stronger than aspirated (/t^ha, ts^ha/) and lax (/ta, tsa/) consonants' following vowels, while there was no significant difference between aspirated and lax. For fricatives, intensity for the tense consonant's following vowel (/s'a/) was stronger than for the non-tense consonant's following vowel (/sa/). F1 in the tense (/t'a, ts'a, s'a/) consonants' following vowels showed a sharp rise in the first half of the following vowels from a low starting point. This contrasted with F1 in the lax (/ta, tsa/), aspirated (/t^ha, ts^ha/) and the non-tense (/sa/) consonants, which showed a sharp fall from a high starting point in all of the following vowels. The VOT, intensity and F1 of the consonants' following vowels were consistent with previous studies (Cho et al. 2002, Han 2016b, Han 2016c).

2.3. Procedure

All participants were instructed to identify stimuli by choosing one of the eight choices (/ta, t^ha, t'a, tsa, ts^ha, ts'a, sa, s'a/) in each question, listed in Korean orthography on the answer sheets. The stimuli were randomly ordered and participants were asked to listen to each stimulus five times. Three randomized test sequences were constructed. Each sequence contained 20 trials (12 stimuli x 5 times = 60 stimuli) with an inter-stimulus interval of 3s.

Prior to each test sequence, listeners were presented with a familiarization series consisting of ten randomly chosen practice trials for that sequence; a short break was given following each test sequence. The testing session lasted about 20 min. The experiment was conducted in a soundproof room in Osaka University's Phonetics Laboratory. Participants were tested individually.

3. RESULTS

3.1. Stops and Affricates

The results showed that group K judged stimuli as aspirated almost 100% of the time when lax (/ta, tsa/)F0 was high. When the aspirated consonants (/t^ha, ts^ha/) had low F0, they tended to judge the stimuli as lax (Table 4 and 5). Consequently, F0 is considered to be a major cue for group K. This result is consistent with Kim & Kim (2010). Differences in judgment between the K, JB and JA for lax (/ta, tsa/) recognition frequency (max. 60 times) with raised F0 as aspirated, and aspirated (/t^ha, ts^ha/) recognition frequency (max. 60 times) with raised F0 as aspirated, and aspirated (/t^ha, ts^ha/) recognition frequency (max. 60 times) with the Bonferroni multiple comparison procedure (Table 6). In the case of Japanese learners, both the JB and the JA were affected by F0, though to a lesser degree than the K (Tables 4 and 5). These results are consistent with Kim & Kim (2010). For Test 1, there was a difference depending on the learner's level.

For stimuli constructed from tense consonants (*t*'a, ts'a/), F0 had no significant influence on the recognition by the K (Tables 7 and 8). These results are consistent with Kim (2004). The differences in judgment between the K, JB and JA for recognition frequency (max. 60 times) for tense (*t*'a, ts'a/) with manipulated F0 as tense were assessed with the Bonferroni multiple comparison procedure (Table 9). For Test 5, there was no significant difference among K, JA and JB. For Tests 6, 7 and 8, the JA results were divided. Although they responded similarly to the K in Tests 5 and 8, there was a significant difference between the K and JA in Tests 6 and 7. In contrast, the JB generally perceived stimuli as lax or aspirated according to changes in F0. For Tests 7 and 8, there was a difference depending on the learner's level.

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Stimesphere	Crosse	Response (%)			
Sumulus	Group	Lax	Aspirated	Tense	
Test 1	К	0	100	0	
/ta/ 295Hz	JB	53	43	3	
	JA	13	75	12	
Test 2	К	0	97	3	
/tsa/	ЛВ	57	40	3	
301Hz	JA	52	37	12	

Table 4. Stimuli with raised lax (/ta, tsa/) F0

(K = Korean participants, JB = Japanese beginners, JA=Japanese advanced learners)

• • • •					
ov: 1		Response (%)			
Stimulus	Group	Lax	Aspirated	Tense	
Test 3	K	70	30	0	
/t ^h a/	JB	43	38	18	
223Hz	JA	35	62	3	
Test 4	K	85	15	0	
/ts ^h a/	JB	57	28	15	
235Hz	JA	43	53	3	

Table 5. Stimuli with lowered aspirated $(/t^ha, ts^ha/)FO$

(K = Korean participants, JB = Japanese beginners, JA=Japanese advanced learners)

	Κ	JB	JA	K vs JB	K vs JA	JB vs JA
Test 1	60	26	45	<u><0.001</u>	<u>0.001</u>	<u><0.001</u>
Test 2	58	24	22	<u><0.001</u>	<u>⊲0.001</u>	1.000
Test 3	42	26	21	<u>0.008</u>	<u>⊲0.001</u>	1.000
Test 4	51	34	26	<u>0.003</u>	<u>⊲0.001</u>	0.338

 Table 6. Results of Bonferroni's multiple comparison test
 (p<0.017)</th>

(K = Korean participants, JB = Japanese beginners, JA=Japanese advanced learners)

Table 7. Stimuli with lowered tense (/t'a, ts'a) F0

Stimusha	Crosse	Response (%)			
Sumulus	Group	Lax	Aspirated	Tense	
Test 5	K	8	0	92	
/ť a/ 223Hz	ЛВ	0	17	83	
	JA	0	3	97	
Test 6	K	2	0	98	
/ts'a/	Ъ	30	3	67	
235Hz	JA	17	5	78	

(K = Korean participants, JB = Japanese beginners, JA=Japanese advanced learners)

Stimulus	Crown	Response (%)			
Sumuus	Group	Lax	Aspirated	Tense	
Test 7	К	0	0	100	
/ť a/ 295Hz	ЛВ	0	55	45	
	JA	0	20	80	
Test.8	K	0	0	100	
/ts'a/	лв	0	40	60	
301Hz	JA	0	7	93	

Table 8. Stimuli with raised tense (/t'a, ts'a/)F0

(K = Korean participants, JB = Japanese beginners, JA=Japanese advanced learners)

	K	JB	JA	K vs JB	K vs JA	JB vs JA
Test 5	55	50	58	0.351	1.000	0.038
Test 6	59	40	47	<u><0.001</u>	<u>0.011</u>	0.263
Test 7	60	27	48	<u><0.001</u>	<u>0.011</u>	<u>⊲0.001</u>
Test 8	60	36	56	<u><0.001</u>	0.77	<u><0.001</u>

Table 9. Results of Bonferroni's multiple comparison test (p<0.017)

(K = Korean participants, JB = Japanese beginners, JA=Japanese advanced learners)

3.2. Fricatives

In the case of stimuli containing fricatives (/sa, s'a/), F0 had no significant influence on recognition for the K (Tables 10 and 11). This result is consistent with Chang (2011). Accordingly, the difference in frequency (max. 60 times) between the K, JB and JA in judging the stimuli in their original forms was assessed with the Bonferroni multiple comparison procedure (Table 12).

For Tests 9 and 12, the Japanese learners' results were similar to those of K. In Tests 10 and 11, however, F0 had a significant influence on recognition for the Japanese learners, a different result from the K. In particular, the JB tended to recognize the stimuli as tense when the stimulus' F0 was high, and as non-tense when the stimulus' F0 was low.

Stimulus	Croim	Response (%)		
	Group	Non-tense	Tense	
Test 9	K	100	0	
/sa/	ЛВ	90	10	
180Hz	JA	97	3	
Test 10	K	100	0	
/sa/	JB	43	56	
300Hz	JA	73	27	

Table 10. Stimuli made from a non-tense fricative (/sa/)

(K = Korean participants, JB = Japanese beginners, JA=Japanese advanced learners)

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Stimeshaw	C	Response (%)		
Sumuus	Group	Non-tense	Tense	
Test 11 /s'a/ 180Hz	K	0	100	
	JB	57	43	
	JA	32	68	
Test 12 /s'a/	K	0	100	
	JB	3	96	
300Hz	JA	7	93	

Table 11. Stimuli made from a tense fricative (/s'a/)

(K = Korean participants, JB = Japanese beginners, JA=Japanese advanced learners)

Table 12. Results of Bonferroni's multiple comparison test (p<0.017)

	Κ	ЛВ	JA	K vs JB	K vs JA	JB vs JA
Test 9	60	54	58	0.023	1.000	0.224
Test 10	60	26	44	<u><0.001</u>	<u>0.001</u>	<u><0.001</u>
Test 11	60	26	41	<u><0.001</u>	<u><0.001</u>	0.002
Test 12	60	58	56	0.930	0.130	0.930

(K = Korean participants, JB = Japanese beginners, JA=Japanese advanced learners)

4. DISCUSSION

(1) In the case of lax consonant (/ta, tsa/) and aspirated consonant (/t^ha, ts^ha/) stimuli, the Japanese learners paid less attention to F0 than the K. These results are consistent with Kim & Kim (2010). Han (2016a) suggests that the Japanese learners focus on the consonantal portion as well as F0.

In Han (2016a)'s experiment with stimuli constructed from aspirated consonant syllables (/t^ha, ts^ha/), JB tended to judge the stimuli as generally (80%) aspirated regardless of the length of VOT (/t^ha/: 8 ms, 28 ms, 48 ms, 68 ms, 88 ms, 108 ms, 128 ms; /ts^ha/: 35 ms, 55 ms, 75 ms, 94 ms, 115 ms,135 ms). This means that JB paid more attention to other features existing in the consonantal portion of the stimulus than to the length of the VOT. Conversely, the JA judged stimuli constructed from aspirated consonant syllables (/t^ha, ts^ha/) more often as aspirated than as tense when the VOT was lengthened. This was particularly true of affricates versus stops. This means that JA paid attention not only to other features existing in the consonant portion, but also to the length of VOT. Thus, JA seemed to employ a more complex judgment procedure than JB.

Based on the result of the acoustic analysis in Han (2016a), one can infer that intensity would be one of the features existing in the consonant portion. Intensity for aspirated consonants was stronger than for lax and tense consonants (Han 2016a). The reason why neither JB nor JA paid attention to VOT in the stimuli made with lax consonant (/ta, tsa/) is possibly because of the weak intensity of lax consonants.

(2) In the case of tense stop $(/t^{\circ}a/)$, tense affricate $(/t^{\circ}a/)$, and non-tense and tense fricative $(/sa, s^{\circ}a/)$ stimuli, the JB in particular judged consonants according to changes in F0. In contrast, F0 had no significant influence on recognition for the K. The K results are consistent with Kim (2004) and Chang (2011). It has been previously reported that vowels following tense consonants show

different intensity and F1 than those following other consonants (Han 2016b, Han 2016c). According to Han (2016b) and Han (2016c), the intensity and the F1 for these vowels provide possible additional acoustic features that may help listeners distinguish between tense and other consonants. Intensity in tense (*t*'a, ts'a) consonants' following vowels were stronger than aspirated (*t*^ha, ts^ha/) and lax (*t*a, tsa/) consonants' following vowels, while there were no significant difference between aspirated and lax Regarding fricatives, intensity for the tense consonant's following vowel (*/s'a/*) was stronger than for the non-tense consonant's following vowel (*/s'a/*) was stronger than for the non-tense consonant's following vowel (*/s'a/*). F1 in the tense (*t*'a, ts'a, s'a/) consonants' following vowels showed a sharp rise in the first half of the vowel from a low starting point. In contrast, F1 in the lax (*/*ta, tsa/), aspirated (*/t*^ha, ts^ha/), and the non-tense fricative (*/sa/*) consonants showed a sharp fall from a high starting point in all of the following vowels. As the Japanese learners did not focus on those acoustic features, it is believed that they focused on F0. In addition, because the Japanese learners did not fully pay attention to the features of the consonants' following vowels, they seemed to focus on other clues in the consonantal portion when making their judgments. This aligns with Han (2016a), who found that Japanese learners paid attention to the consonantal portion when making their judgments. This aligns with Han (2016a), who found that Japanese learners paid attention to the consonantal portion when making their judgments. This aligns with Han (2016a), who found that Japanese learners paid attention to the consonantal portion when

In the case of fricatives, however, the Japanese learners did focus on the following vowel because there was no difference in length or intensity between the tense and non-tense fricatives. This is the case even though there is no difference in F0 in the vowel following the tense and non-tense fricatives recorded by native Korean speakers (Han 2016a), and F0 had no significant influence on recognition by the K in this study. Nevertheless, the Japanese learners tended to consider the tense fricative as high frequency and the non-tense fricative as low frequency. Once again, it was found that the Japanese learners' strategy for selecting cues differed from that of the K.

(3) The judgments made by the JB and JA mostly differed from those of the K in the 12 tests conducted in the study (JB: 9, JA: 8). There were also five differences in the 12 tests depending on the Japanese learners' level. The results of the test by JA were similar to those of the test by K. Although JA was somewhat better than JB in judging Korean consonants, it can be said that there is no noticeable difference between JB and JA.

These results are not yet generalizable due to the limited number of subjects in this study, and further research is needed to provide verification. However, considering the strictly controlled participant levels of this study, these preliminary findings may still have implications for the teaching of Korean to Japanese speakers.

5. CONCLUSION

This study examines F0 influence on the perception of Korean initial lax, aspirated and tense consonants by Japanese learners of the Korean language. In distinguishing Korean initial consonants (lax, aspirated, tense), Japanese learners are prone to adopting an inaccurate judgment method. The JB judged stimuli with either an insufficient focus on F0 or excessive focus on F0, whereas the JA tended to judge stimuli with an insufficient focus on F0. In short, there was little difference between JB and JA in their ability to judge these consonant distinctions.

In distinguishing Korean initial consonants (lax, aspirated, tense), Japanese learners rely on multiple cues for judgment, as do the K. Their set of cues, however, differs from those of the K. Although as learning experience increases and JA become more proficient, the "fossilization" of their non-native judgment methods becomes more apparent. This paper concludes that recognition of lax, aspirated and tense consonants is difficult for Japanese learners regardless of their level.

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