

F0 influence in the perception of Korean initial stops, affricates, and fricatives: A Comparison between Native Speakers and Japanese Learners

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ABSTRACT

This study examines F0 influence on perception of Korean initial lax, aspirated, and tense consonants by Japanese learners of the Korean language. Stimuli consisted of monosyllabic sounds (/ta, tsa, t^ha, ts^ha/) with interchanged F0s, including lax and aspirated consonants. Results from recognition testing of the stimuli found that both beginning and advanced learners paid less attention to stimuli F0 in comparison to native speakers from Seoul. In cases where stimuli included a tense stop (/t^ha/), a tense affricate (/ts^ha/), and a non-tense¹ and a tense fricative (/sa, s^ha/), F0 had no significant influence on recognition for the native speakers. In contrast, both the beginners and advanced learners focused on changes in F0, evaluating consonants by the changes.

In the acquisition of Korean initial consonants (lax, aspirated, tense), Japanese learners are liable to adopt inaccurate judgment methods of either "insufficient focus on F0" or "excessive focus on F0", with learning experience showing no significant effect on acquisition.

Keywords: Korean, lax, aspirated, tense, Japanese Learners.

1. INTRODUCTION

Han [4] reported the rate of correct identification of lax, aspirated, and tense initial stops and affricates (/ta, t^ha, t^ha, tsa, ts^ha, ts^ha/) was approximately 90% for both a group of 10 beginners who learned Korean for the first time as a general academic subject at a Japanese university for less than 1 year and a group of 10 advanced learners who had stayed in Seoul for more than 1 year and had passed the level 5 Korean Language Proficiency Test (TOPIK). In a similar study, Koga [9] reported a correct identification rate of about 70% for 6 students who majored in Korean language at a Japanese university for 2 or 3 years.

Although Japanese learners may be able to differentiate the sounds of the three types of initial consonants regardless of their learning experiences, the methods of identification they employ are

reported to be different from that of native Korean speakers.

There have been investigations about what factors may contribute to selection of evaluation methods (Kim and Kim [8], Han [4]).

Kim and Kim [8] investigated the effect of F0 and VOT on 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 discriminate between phonemic contrasts based on F0. In contrast, 26 Japanese learners who studied from 3 months to more than 5 years in language courses at a South Korean university were able to discriminate between the phonemic contrasts based primarily on VOT information. The research conducted by Han [3] which used 6 test sounds (/ta, t^ha, t^ha, tsa, ts^ha, ts^ha/) given to 6 native speakers (F0) and 10 native speakers (VOT), corresponded with the results of Kim and Kim [8] concerning lax and aspirated consonants. In contrast, the stimuli created from monosyllabic sounds (/t^ha, ts^ha/) including tense consonants were consistently judged as tense regardless of changes in VOT and F0. Han [4] examined the effect of VOT with 10 beginners and 10 advanced level Japanese learners of the Korean language. The Japanese learners focused on VOT when stimuli consisted of monosyllabic sounds (/t^ha, ts^ha, ts^ha/) including aspirated and tense consonants. Consonants tended to be judged as tense when VOTs of the stimuli were short and as aspirated when VOTs of the stimuli were long. This tendency was prominent in the case of advanced learners. This suggested that advanced learners focused on the intensity of the VOT section in addition to the VOT when the stimuli had high F0. Consequently, VOT seemed to influence the judgment of the consonants by Japanese learners. As Han [4] pointed out, however, it did not seem to be the only cue. Japanese learners may employ different judgment methods for initial consonants than native speakers.

On the other hand, the percentage of correct identification of judgment of fricatives (/sa, s^ha/) by beginners was relatively low (65%) whereas the advanced learners obtained a correct identification rate of almost 90%, which suggests that the beginners occasionally mistake tense for non-tense

in the judgment of fricatives (Han [4]). It is also established that native speakers do not adopt F0 as a cue for the distinction of the non-tense fricative (/sa/) and the tense fricative(/s'a/) (Chang [1], Han [3]). However, the effect of F0 for the perception of fricatives by Japanese learners has not yet been investigated.

In this paper, I will investigate the effect of F0 on the perception judgment of initial lax, aspirated, and tense consonants including a tense stop (/t'a/), affricates (/tʃa, tsʰa, ts'a/), and fricatives (/sa, s'a/), which were not tested in Kim and Kim [8]. Furthermore, I will consider a difference in the learning level, which Kim and Kim [8] did not strictly control, by comparing beginners and advanced learners.

2. METHODS

2.1. Stimuli

The samples used for the perception test were manipulated from the author's voice (a Seoul-born female in her 20's at the time of recording). The stimuli made from monosyllabic sounds including lax, aspirated, and tense consonants (/ta, tʰa, t'a, tʃa, tsʰa, ts'a, sa, s'a/).

In order to verify the effect of F0, F0 values were manipulated as follows with Praat (5.2.17). F0 values for lax (/ta, tʃa/), which showed lowest F0 value in the prior production test, were raised to match the aspirated F0. In contrast, the aspirated (/tʰa, tsʰa /) F0, which showed 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 intermediate-high F0 value in the prior production test, were manipulated to match either the highest F0 value for aspirated or the lowest value for lax F0. In cases of non-tense and tense for fricatives, stimuli F0 were manipulated in two stages (180Hz and 300Hz).

All participants were instructed to identify stimuli by choosing one of the 8 choices (/ta, tʰa, t'a, tʃa, tsʰa, 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.

Table 1: F0 of original sounds (Hz)

	stops	affricates	fricatives
lax	223	235	214
aspirated	295	301	
tense	270	273	229

2.2. Participants

12 native speakers of Seoul Korean (8 females and 4 male) and 24 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) were university students who had learned Korean for the first time as a general academic subject at a Japanese university for less than 1 year. The 12 advanced learners (9 females and 3 males) had stayed in Seoul for more than 1 year and had passed the level 5 Korean Language Proficiency Test (TOPIK). All participants were in their 20s and 30s. Hereafter, the Korean native speakers will be referred to as "K", the beginners as "JB", and the advanced learners as "JA".

3. RESULTS

3.1. Stops and Affricates

The results showed that group K judged stimuli as aspirated virtually 100% when lax (/ta, tʃa/) F0 was high. When aspirated (/tʰa, tsʰa/) had low F0 they tended to judge the stimuli as lax (Table 2, 3). Consequently, F0 is considered to be a major cue for the K. This result is consistent with Kim and Kim [8] and Han [3]. Difference in judgment between the K, JB, and JA for lax (/ta, tʃa/) recognition frequency (max. 60 times) with raised F0 as aspirated and aspirated (/tʰa, tsʰa/) recognition frequency (max. 60 times) with lowered F0 as lax were assessed with the Bonferroni multiple comparison procedure (Table 4). In the case of Japanese learners, both the JB and the JA were affected by F0, however, to a lesser degree than the K (Table 2,3). These results are consistent with Kim and Kim [8].

Regarding stimuli constructed from tense (/t'a, ts'a/), F0 had no significant influence on the recognition of the K (Table 5,6). These results are consistent with Kim [7] and Han [3]. The difference 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 7). 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 the changes in F0.

Table 2: Stimuli with raised lax (/ta, tsa/) F0

stimuli	Groups	response (%)		
		lax	aspirated	tense
Test 1 /ta/ 295Hz	K	0	100	0
	JB	53	43	3
	JA	13	75	12
Test 2 /tsa/ 301Hz	K	0	97	3
	JB	57	40	3
	JA	52	37	12

Table 3: Stimuli with lowered aspirated (/t^ha, ts^ha/) F0

stimuli	Groups	response (%)		
		lax	aspirated	tense
Test 3 /t ^h a/ 223Hz	K	70	30	0
	JB	43	38	18
	JA	35	62	3
Test 4 /ts ^h a/ 235Hz	K	85	15	0
	JB	57	28	15
	JA	43	53	3

Table 4: Results of Bonferroni's multiple comparison test (p<0.0175)

	Test 1	Test 2	Test 3	Test 4
K	60	58	42	51
JB	26	24	26	34
JA	45	22	21	26
K vs JB	<u>0.000</u>	<u>0.000</u>	<u>0.008</u>	<u>0.003</u>
K vs JA	<u>0.001</u>	<u>0.000</u>	<u>0.000</u>	<u>0.000</u>
JB vs JA	<u>0.000</u>	1.000	1.000	0.338

Table 5: Stimuli with lowered tense (/t'a, ts'a/) F0

stimuli	Groups	response (%)		
		lax	aspirated	tense
Test 5 /t'a/ 223Hz	K	8	0	92
	JB	0	17	83
	JA	0	3	97
Test 6 /ts'a/ 235Hz	K	2	0	98
	JB	30	3	67
	JA	17	5	78

Table 6: Stimuli with raised tense (/t'a, ts'a/) F0

stimuli	Groups	response (%)		
		lax	aspirated	tense
Test 7 /t'a/ 295Hz	K	0	0	100
	JB	0	55	45
	JA	0	20	80
Test 8 /ts'a/ 301Hz	K	0	0	100
	JB	0	40	60
	JA	0	7	93

Table 7: Results of Bonferroni's multiple comparison test (p<0.0175)

	Test 5	Test 6	Test 7	Test 8
K	55	59	60	60
JB	50	40	27	36
JA	58	47	48	56
K vs JB	0.351	<u>0.000</u>	<u>0.000</u>	<u>0.000</u>
K vs JA	1.000	<u>0.011</u>	<u>0.011</u>	0.770
JB vs JA	0.038	0.263	<u>0.000</u>	<u>0.000</u>

3.2. Fricatives

In the case of stimuli consisting of fricatives (/sa, s'a), F0 had no significant influence on recognition for the K (Table 8 and 9). This result is consistent with Chang [1] and Han [3]. Accordingly, the difference in frequency (max. 60 times) between the K, JB, and JA in judgment of stimuli as original sounds was assessed with the Bonferroni multiple comparison procedure (Table 10).

Although there were significant differences to results for the K in tests 10 and 11, the JA were generally less affected by F0 than the JB. The JB, however, tended to recognize the stimuli as tense when F0s of the stimuli were high, or as non-tense when the F0s of the stimuli were low, as in tests 10 and 11.

Table 8: Stimuli made from a non-tense fricative (/sa/)

stimuli	Groups	response (%)	
		non-tense	tense
Test 9 /sa/ 180Hz	K	100	0
	JB	90	10
	JA	97	3
Test 10 /sa/ 300Hz	K	100	0
	JB	43	56
	JA	73	27

Table 9: Stimuli made from a tense fricative (/s'a/)

stimuli	Groups	response (%)	
		non-tense	tense
Test 11 /s'a/ 180Hz	K	0	100
	JB	57	43
	JA	32	68
Test 12 /s'a/ 300Hz	K	0	100
	JB	3	96
	JA	7	93

Table 10: Results of Bonferroni's multiple comparison test ($p < 0.0175$)

	Test 9	Test 10	Test 11	Test 12
K	60	60	60	60
JB	54	26	26	58
JA	58	44	41	56
K vs JB	0.023	<u>0.000</u>	<u>0.000</u>	0.930
K vs JA	1.000	<u>0.001</u>	<u>0.000</u>	0.130
JB vs JA	0.224	<u>0.000</u>	<u>0.002</u>	0.930

4. DISCUSSION

(1) There was little difference between judgments made by the JB and JA in the majority of the 12 tests conducted in the study.

(2) In the case of lax (/ta, tsa/) and aspirated (/t^ha, ts^ha/) stimuli, the Japanese learners paid less attention to F0 than the K. As mentioned in Han [4], this suggests that the Japanese learners focus on the VOT as well as the intensity of the VOT sections of the test sounds as well as F0.

(3) In the case of tense stop (/t'a/), tense affricate (/ts'a/), and non-tense and tense fricative (/sa, s'a/) stimuli, the JB in particular judged consonants according to changes in F0. Contrary to results for the JB, F0 had no significant influence on recognition for the K. It has been reported that there are differences in intensity and F1 in following vowels of tense and other consonants (Han [3], Han [5]). The intensity (Han [3]) and the F1 (Han [5]) for following vowels are additional possible acoustic features which may be related to the distinction between tense and others. As the Japanese learners do not focus on those acoustic features, it is believed that they focused on F0.

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 the acquisition of Korean initial consonants (lax, aspirated, tense) Japanese learners are liable to adopt an inaccurate judgment method. The JB judged stimuli with either an "insufficient focus on F0" or "excessive focus on F0". The JA in particular judged stimuli with an "insufficient focus on F0". In short, it is concluded that there was little difference between JB and JA in the judgment of the three consonants discussed here.

In the acquisition of Korean initial consonants (lax, aspirated, tense), Japanese learners rely on

multiple cues for judgment, as with the K. Their strategy of selecting cues, however, differs from that of the K. Although as learning experience increases and JA become more similar to the K, the "fossilisation" of judgment methods become more apparent.

6. REFERENCES

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¹ Opinions on the categorization of Korean /s/ differs among existing literature, having been categorized both as lax (or plain or lenis) and as aspirated (Cho, Jun, and Ladefoged [2], Kagaya [6]). In this study /s/ is classified as non-tense.