

The Korean Fricatives in Acquisition: A Case Study

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ABSTRACT

Korean has a pair of voiceless fricatives, whose laryngeal manifestation comes in parallel to stops and affricates with a three-way lexical contrast. Prior phonetic studies by Kagaya (1974), Iverson (1983), and Kang (1999, 2000) point out /s/ is associated with multiple characteristics of the larynx shared with not only the lax but also the aspirated series, whereas /s'/ carries a laryngeal distinction typical of the tense consonants. The complex dual nature of /s/ is again supported by a psycholinguistic study by Kang (2004), as /s/ was found to interact with /c^h/ (17% of the time) as well as /c/ (57%) in speech errors. In addition, a recent work by Cho and Lee (2003) notes an interesting chain shift case in the acquisition of the fricatives. Although they observed a significant phonological pattern between child English and Korean, Cho and Lee's description of acquiring fricatives is far from being precise from the perspective of phonetics.

From a longitudinal study of recorded tapes by two children at 1;7-3;8 and 1;7-2;1 respectively, I found that /s'/ was usually substituted into tense noncontinuants in young children's early production as predicted, whereas /s/ having both lax and aspirated-like glottal properties revealed a complicated pattern of substitutions into lax, tense, and aspirated noncontinuants with a varying degree of preference relative to the subjects. The current acquisition study supports the previous claims concerning fricatives in other languages, showing that their acquisition comes after stops. Besides, it also notes that Korean fricatives are subject to a series of phonological processes called stopping, affricating, tensifying and palatalizing during the transitional period of phonological development by young children. Moreover, between the two voiceless types, /s/ was acquired earlier than /s'/ as the unmarked segment.

Keywords: Korean fricatives, lax fricative, tense fricative, acquisition

1. Introduction

Unlike the stops and affricates, Korean fricatives have only two phonemic types, so-called the 'lax' and tense. Considering that the affricates, whose release part conveys a fricative-like friction, are distinguished three-folds, the lack of one phoneme in the alveolar fricatives casts intriguing questions about the nature of the Korean fricatives. However, a relatively less

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attention has been paid to investigate the phonetic and phonological properties of the fricatives, and almost little attempt made to characterize the acquisition of them.

In fact, Cho and Lee (2003) reports an important finding that the child in their case study showed difficulty in producing alveolar fricatives: The glottal fricative [h] was found to be substituted for the target coronal fricative [s], and the velar stop [k] was used as a substitute for the target glottal fricative [h] in early phonology, as schematized in (1).

(1) Chain shift in child Korean (Cho and Lee 2003)

/k/ → [k]

/h/ → [k]

/s/ → [h]

Observing a different chain shift pattern from English, Cho and Lee (2003) conclude that both universal (fricatives tend to be replaced by stops due to their marked nature) and language-specific aspects (least marked segments such as [h] in Korean and [f] in English may vary depending on languages) should be incorporated in the language acquisition research.

However, the prior study on acquiring fricatives gives an impression of oversimplifying the substitution pattern of fricatives in order to be fit in the theoretical approach called Comparative Markedness by McCarthy (2002). In addition, a sole dependence on the native speaker's perception of recorded tokens could miss minute variations that a precise acoustic analysis might capture.

Therefore, the purpose of the study lies in that how Korean fricatives are acquired by young children from the perspective of acoustic phonetics, and that how the acquisitional facts are related to the previous research on the fricatives within the frameworks of phonetics, phonology and psycholinguistics.

2. Phonetic, phonological and psycholinguistic characteristics

There have been no disagreements on the status of the tense fricative /s'/, as its phonetic and phonological characteristics go perfectly well with the tense stops and affricate (Kagaya 1974, Kang 1999). However, as for the lax fricative /s/, Kagaya (1974) reported that the glottal width of a Korean /s/ is comparable to that of the aspirated series in initial position, and voicing does not occur intervocally unlike lax stops and affricates. Based on fiberoptic measurements, he labeled the /s/ as aspirated in contrary to the general view of /s/ as lax. He found that the degrees of glottal width of /s/ were around 20 on an arbitrary scale in /CV/ environment when the frication started off. Such a wide glottis of initial /s/ was fairly similar

to the aspirated affricate at the moment of articulatory release. In /CVC/ context, however, the lax fricative revealed a considerable amount of glottal reduction by 10 or more on a scale depending on the following vowel, but with a slightly larger glottal width than the tense counterpart. By contrast, glottal widths of initial tense fricatives were around 10 at the moment of frication onset, and the degrees of glottal width were almost invariable in intervocalic position. Furthermore, as it was the case with tense stops and affricates, /s'/ exhibited a constant delay of vocal fold vibration for the following vowel when the vocal processes were in complete contact, presumably due to its stiff vocal folds.

In supplement to Kagaya's (1974) significant fiberoptic study, Iverson (1983) points out that although /s/ behaves like an aspirated in terms of glottal width and possibly VOT in initial position, the observed marked reduction of glottis by 10 or 15 on the glottal width scale for a medial /s/ in Kagaya's data is rather parallel to that for medial lax stops and affricates, except that the latter become voiced due to total adduction of the vocal folds. He suggests that the Korean /s/ shares laryngeal features with both the lax and aspirated categories. Having the features [-stiff vocal folds] and [+spread glottis] respectively, /s/ is aligned with phonetic properties regarded not only as the lax but also as the aspirated series, as in Table 1. Nevertheless, for the phonological assignment, Iverson (1983) claims that /s/ be categorized as the lax, as the psycho-phonological evidence from Kim-Renaud (1974) indicates that it undergoes both the intersonorant slackening process and tensification, applied to the lax category only.

Table 1: Glottal feature assignment of Korean obstruents (Iverson 1983: 195)

	Fortis	Lax	s	Aspirated
Spread glottis	-	-	+	+
Constricted glottis	+	-	-	-
Stiff vocal folds	+	-	-	+
Slack vocal folds	-	-	-	-

However, Kang (1999) questions the application of slackening process to /s/ by observing that a word-medial /s/ was never subject to the voicing rule unlike lax stops and affricates. Furthermore, the VOT of /s/ was not reduced as much as that of lax stops and affricates. Rather, the VOT reduction of lax fricatives was found to be more analogous to the aspirated obstruents. In Kagaya's fiberoptic data, an aspirated affricate and alveolar stop before /i/ also showed a marked glottal reduction of about 10 on a scale when placed in medial position. Therefore, a significant reduction of glottis is not a distinctive characteristics of medial lax consonants. As an alternative account, she proposes to use the feature [\pm long] instead of [-stiff vocal folds] from the speculation that the former highlights the temporal aspect of duration that

plays a direct role in the sound structure of Korean obstruents.

Korean alveolar fricatives differ in that /s/ is produced with a moderate amount of aspiration and short frication period, while /s'/ with a fairly short aspiration and long frication. The VOT and duration seem to be interpreted as redundant values reflected by the glottal properties in phonology. However, they function as primary phonetic parameters indicating crucial temporal aspects, which can be used distinctively in phonology.

Comparing with alveolar stops, Kang (2000) insisted that the fricatives /s, s'/ behave like the aspirated and tense stops with respect to VOT and Fo, but that durational properties associated with /s/ are more similar to the lax category, as in Table 2.

Table 2: Phonetic characteristics of Korean alveolar fricatives and stops (Kang 2000); word-initial/-medial

		Fricatives		Alveolar Stops		
		Lax	Tense	Lax	Tense	Aspirated
VOT		long	short	med/short	short	long
Duration	Total	long/short	long	short	long	long
	Following v.	short/long	long	long	long	short
	Preceding v.	long	short	long	short	short
Fo		high	high	low	medium	high

One evidence showing that the intersonorant /s/ does not voice in difference to the corresponding lax stops and affricate is originated from words in loan phonology. Voiced stops and affricates of the source language are translated into homorganic lax stops and affricates in Korean, as given in (2). However, a voiced fricative /z/ of English is regarded as /c/ in Korean, as in /k^ha.ci.no/ 'casino' and /ti.ca.in/ 'design' in (2b). If the Korean /s/ allows voicing in intervocalic position, then such a word like design in English would be represented as */ti.sa.in/ in Korean. If the Korean /s/ is used to represent /z/ of the input language, then the voiceless fricative /s/ would play an ambiguous role of referring to either /s/ or /z/ of the source language intervocalically. However, the reason that the voiced fricative /z/ of a foreign language is referred to as /c/, rather than /s/ in Korean, is attributed to the Korean /s/'s association with a positive amount of aspiration and thus expected lack of voicing even in an intersonorant environment.

(2) word-medial obstruents

a. [s]		b. [z]		c. [ɟ̞]/[ʒ]	
/s/s'a.in/	sign(ature)	/pa.ca/	bazar	/e.nə.ci/	energy
/em.s/s'i/	emcee	/pi.ra.cil/	Brazil	/p ^h i.ro.cek.t ^h i/	project
/s/s'ən.kil.la.si/	sunglasses	/le.i.cə/	laser	/ta.u.con.si/	Dow-Jones

/si.we.ten/	Sweden	/k ^h a.ci.no/	casion	/ti.ci.t ^h al/	digital
/pəsi/	bus	/ti.ca.in/	design	/le.cə/	leisure

Another evidence for the Korean /s/'s association with [+spread glottis] comes from the speech error data in Kang (2004), as given in (3). None of the lax stops and affricates were replaced or substituted for the heterorganic aspirated obstruents. For example, /p, t, k, c/ patterned together with /p^h, t^h, k^h, c^h/ of the same place of articulation in substitution errors, but never with an aspirated varying the articulatory place or manner like /t/ versus /p^h, k^h, c^h/. However, the lax fricative /s/ was substituted and replaced with /c^h/ in 9 instances of 59 errors relevant to aspirated consonants, corroborating the hypothesis that the Korean /s/ is an aspirated segment.

(3) Errors indicating /s/ ↔ /c^h/ (from Kang 2004)

Target	Errors	Gloss
a. <u>sal</u> .lim-il c ^h a.ryəs'.sip.ni.ta	c ^h al.lim-il c ^h a.ryəs'..	living-Obj prepared
b. ki.c ^h o co.sa	ki.c ^h o co.c ^h a	basic examination
c. noŋ-c ^h uk.san-mul	noŋ-c ^h uk.c ^h an-mul	agriculture-livestock-product
d. 24 c ^h iŋ ok.saŋ	24 c ^h iŋ ok.c ^h aŋ	24th floor top
e. c ^h əŋ.nyən sil.əp-i	səŋ.nyən sil.əp-i	youth unemployment-subj
f. ca.doŋ.c ^h a hye.t ^h ək-il	ca.doŋ.sa hye.t ^h ək-il	car benefit-Obj

The 4 errors in (3a) through (3d) indicate that /s/ was often replaced with /c^h/ when the aspirated affricate lay in the neighboring context. For example, in (3a), the initial segment /s/ in the target word /sal.lim-il/ 'living-Obj' was mispronounced as [c^h] in the anticipation of the initial counterpart of the adjacent word /c^ha.ryəs'.sip.ni.ta/ 'prepared,' and by result a nonsense word [c^hal.lim-il] was produced instead. The rest of the slips in (3e) and (3f) show that the /s/ was also substituted for /c^h/ not only when it was placed in the vicinity of /c^h/ but also when absent in the neighborhood.

However, the pair of /s/-/c^h/ took a minor part of all the errors relevant to /s/. Of the 53 errors concerning /s/, the substitutions between /s/ and /c/ were counted as many as 30, taking up almost 57 percent of the total, as in (4). Substitutions of /s/-/c^h/ were numbered 9, as mentioned before, constituting 17% of the errors of /s/. The remaining 12 errors of /s/ were concerned with lax stops, fricatives /s', h/, and alveolar sonorants /n, l/, ranging from 1 to 4 errors in frequency, as in (5).

(4) Errors indicating /s/ ↔ /c/ (from Kang 2004)

Target	Errors	Gloss
a. hu.sok.in.sa-ka ən.çe-c'im	hu.sok.in.ca-ka ən.çe-c'im	reshuffle-Sub when-about
b. hoŋ.su-ii paŋ.cu	hoŋ.cu-ii paŋ.cu	flood-Poss ark
c. çe.su-i-n.te	çe.cu-i-n.de	sister-in-law-is-but
d. mun.çe-ka-twel ki.sa.-lil	mun.çe-ka-twel ki.ca.-lil	problematic article-Obj

(5) Errors indicating /s/ ↔ stops, nasal, fricatives, and liquid (from Kang 2004)

Target	Errors	Gloss
a. yən.in.til-ii mo.sip-e.sə	yən.in.til-ii mo.tip-e.sə	lovers-Poss appearance-from
b. tan-ki.kan yən.su-tə.səŋ	tan-ki.kan yən.ku-tə.səŋ	short-term training-object(s)
c. sa.mo.nim-in	sa.mo.sim-in	(superior's) wife-Top
d. s'a.u-ko	sa.u-ko	fight-and
e. hwe.sa-ka pal.həŋ.han	hwe.sa-ka pal.səŋ.han	company-Subj issued
f. ko.sok-to.ro-e	ko.rok-to.ro-e	high speed-road-Loc

When placed word-medially, /s/ was more likely to be substituted or replaced with /c/. A total of 20 errors (67%) of [s]-[c] erroneous substitutions occurred in medial position. However, it was also the case that substitution errors between /s/ and /c^h/ occurred more often word-medially (67%). A low percentage (33%) of substitution errors between [s] and [c^h] in initial position indicates that substitutions between /s/ and the affricates is not a function to its placement within the word structure. To put it differently, phonetic resemblance between /s/ and /c^h/ does not vary greatly depending on the position in a word. The high percentage of substitution errors in word-medial position seem more or less to be a reflection of a larger possibility of occurrence in medial position for multisyllabic words. Therefore, irrespective of the VOT reduction in medial position, /s/ interacts with /c^h/ as well as /c/.

Although the errors showing a /s/-/c^h/ interaction evidence for the presence of the feature [+spread glottis] on the part of /s/, the majority of errors concerning /s/ were involved with /c/. Given that less than one fourth of the overall errors were involved with aspirated consonants, the small number of /s/-/c^h/ interactions seem to be predictable in a sense. Nevertheless, the majority of /s/-/c/ substitutions corroborate that there needs to be a feature linking /s/ to the lax series in the phonological representation of /s/, and that the feature would play a crucial role to distinguish the lax from the rest of fortis consonants.

For such a feature, Iverson (1983) proposes to use an additional laryngeal feature [±stiff vocal cords]¹⁾, whereas Kang (1999, 2000) suggests a feature [±long] to assert that consonants

1) In order to distinguish the Korean voiceless obstruents with ternary contrast of the larynx, Iverson (1983:197) hypothesized that glottal abduction in obstruents is enhanced somewhat by

in the lax series contrast with the fortis by having significantly short durations. However, if a long duration is a natural consequence by the stiffness of the vocal folds, then [stiff vocal cords] would be the feature required for the laryngeal distinction of Korean obstruents including fricatives (see also Ladefoged and Meddieson 1996, Kang 2004).

3. The Case Study

3.1 Methods

The case study of Korean fricatives in acquisition is based on twelve hour length audiotaped recordings of mother-child interactions in a natural context. The children (my daughters) have been raised in the Metropolitan City of Busan, a Southeastern area of Korea, speaking a standard dialect more often than a Kyungsang one. None of the subjects had a speaking or hearing problem. The original data were collected on an almost biweekly basis, but for the sake of maximizing the discriminability for the current study, I selected part of the data as in the following:

(6) The data collection

Tape No.	Child 1	Tape No.	Child 1	Child 2
1	1;7	7	3;0	
2	1;8	8	3;3	1;7
3	2;0-2;1	9	3;5	1;9
4	2;4	10	3;7	1;11
5	2;7	11	3;8	2;0
6	2;10	12	3;8	2;0-2;1

The first tape recording was taken in February, 2002 when the first child was 1;7 years old, while the last one in April, 2004 when the children were 3;8 and 2;0-2;1 respectively. Each session was recorded in the use of a SONY TCM-20DV recorder, and conducted in a similar way, composed of spontaneous and imitation speech. Each recording was focusing on word elicitation using picture books or objects.

As the child utterances often carried obscure and unintelligible pronunciations, some of the

the specification of neutral vocal fold stiffness, but is inhibited somewhat by the specification of vocal fold slackness. That is, aspirated consonants are assumed to have the maximum width on the glottal width scale due to their association with [+spread glottis] and [+stiff vocal folds]. On the contrary, the Korean /s/ results in intermediate aspiration with a wider glottis than lax stops and affricates, but with a smaller glottis than aspirated, as it is [+spread glottis] but [-stiff vocal folds].

tokens in the data needed a careful acoustic measurement. For such comparative acoustic characterizations of the samples, I used the Praat, a sound analyzing software distributed freely from the Internet (see Yang 2003 for further information). The spectrograms in section 4 were generated under the following conditions: i) view range [Hz]: 0-5000, ii) window length [s]: 0.005, and iii) dynamic range [dB]: 25-30.

3.2 General characteristics of phonological processes in child Korean

The language acquisition literature has pointed out that there are common phonological processes of substitution, assimilation and syllable structure modification in various child languages including English (Smith 1973, Ingram 1976, 1986, etc.). In line with cross-linguistic similarities, the child Korean was found to manifest the following general tendencies:

(7) Stopping

- | | | |
|------|---|---|
| C 1: | [təgi] 'over there' /cəki/ (1;8) | [kik ^h a] 'a train' /kic ^h a/ (1;8) |
| | [k'at'o] /k'əŋc ^h oŋ/ (1;8) | [it'ak] 'this way' /ic'ok/ (2;0) |
| C 2: | [odi] 'a duck' /o.ri/ (1;11) | [padi] 'pants' /paci/ (1;11) |
| | [t ^h ɛ][c ^h ɛ] 'a book' /c ^h ɛk/ (2;0) | [p'at'a] /p'anc'ak/ (2;0) |

(8) Gliding

- | | | |
|------|-------------------------------------|---|
| C 1: | [pak'aya] 'a toe' /palkarak/ (1;8) | [oye] 'for a long time' /ore/ (2;7) |
| C 2: | [p'a(y)] 'a foot' /pal/ (1;9) | [k'owa] 'a koala' /k ^h oalla/ (1;11) |
| | [p'uyu] 'Blue'(a name) /pillu/(2;0) | [howai] 'a tiger' [horaŋi] (2;0) |

(9) Tensification

- | | | |
|------|---|---|
| C 1: | [p'a] 'rice' /pap/ (1;7) | [k'o] 'nose' /k ^h o/ (1;7) |
| | [t'ajo] 'an ostrich' /t ^h aco/ (1;8) | [k'ine] '(That's) big' /k ^h ine/ (2;4) |
| C 2: | [ap'ə] '(it's) hurt' /ap ^h ə/ (1;9) | [t'at'ə] 'five' /tasəs/ (1;11) |
| | [p'ɛ] 'stomach' /pɛ/ (2;0) | [kic'i] 'kimchi' /kimc ^h i/ (2;0) |

(10) Consonant harmony

- | | | |
|------|---|---|
| C 1: | [p'op'a] 'a sofa' /s(yo)p ^h a/ (1;7) | [k ^h op ^h i] 'a fork' /p ^h ok ^h i/ (1;9)* |
| | [pɛŋgiŋ] 'penguin' /pɛŋkwin/ (2;0) | [yamma] 'socks' /yaŋmal/ (2;0) |
| C 2: | [k'ak'aŋ] 'candy' /sat ^h aŋ/ (1;11) | [jimma] 'shoes' /sinpal/ (1;11) |
| | [kigiŋ][kigiŋ] 'geraffe' /kirin/ (2;0) | [naki] 'butterfly' /nabi/ (2;1) |

(11) Deletion of final consonants

- | | | |
|------|---------------------------------------|--------------------------|
| C 1: | [k'ə] 'cup' /k ^h əp/ (1;7) | [mu] 'water' /mul/ (1;7) |
|------|---------------------------------------|--------------------------|

	[k'o] 'flower' /k'oc ^h / (1;8)	[t'ak ^h oŋ] 'peanuts' /t'anŋk ^h oŋ/ (1;10)*
C 2:	[anyə] 'bye' /annyəŋ/ (1;9)	[ma] 'horse' /mal/ (1;9)
	[jəjəni] 'teacher' /sənsəŋnim/ (2;0)	[mo] 'neck' /mok/ (2;0)

(12) Monophthongization

C 1:	[ki] 'ear' /kwi/ (1;7)	[pe] 'star' /pyəl/ (1;8)
	[talgel] 'egg' /talkyal/ (2;7)	[pyəŋəŋ] 'a clinic' [pyəŋwəŋ] (2;10)
C 2:	[ki] 'ear' /kwi/ (1;9)	[ankə(ŋ)] 'glasses' /ankyəŋ/ (2;0)
	[koəŋiya] '(It's) a cat' /koyəŋiya/ (2;1)	

(13) Reduplication

C 1:	[cucu] 'juice' /cyusi/ (1;7)	[pubu] 'a tofu' /tupu/ (1;10)*2)
C 2:	[t'ət'a] 'fell off' /t'əracəssta/ (1;9)	[pepe] 'a pillow' /pekε/ (1;11)
	[p'ap'a] 'onion' /yanp ^h a/ (1;11)	[(na)nana] 'a banana' /panana/ (2;0)

(14) Syllable Reduction

C 1:	[koma] 'sweet potato' /kokuma/ (1;7)	[noni] 'a recorder' /nokimki/ (1;8)
	[p'ap ^h i] (1;9)*	[p'/p ^h anep ^h i] (2;0) 'pineapple' /p ^h ainep ^h il/
C 2:	[p ^h ino] 'a piano' /p ^h iano/ (1;11)	[ait'i] 'icecream' /aisik ^h rim/ (1;11)
	[k'ik'ə] 'a cake' /k ^h eik ^h i/ (2;0)	[t ^h ikə] 'a sticker' /sit ^h ik ^h ə/ (2;0)

First of all, the children showed frequent substitutions of alveolar stops for palatal affricates, liquids, and fricatives (see section 4), and sometimes velar stops for the affricates when there was a velar stop as the neighboring segment.

Although liquids were often replaced with an alveolar stop /t/ or /d/ in the utterances of the children, their substitutions into glides /y, w/ also occurred fairly often. Most of the gliding process for the liquid were involved with the palatal glide /y/. At the back of a round back vowel, the target liquid was sometimes replaced with /w/ when followed by another back vowel like /a/.

The tensification process, namely the substitution of tense (=voiceless unaspirated) consonants for lax (=moderately aspirated or voiced intervocalically) and aspirated sounds, was found to be common and widespread in the Korean children's speech. Besides, in relation with neighboring consonants, consonant harmony reflecting a strength hierarchy in the order of velar > labial > alveolar (Menn 1975) was also observed. Although the strength hierarchy between velars and labials sometimes went the reversed order, as velars assimilated to labials in

2) The asterisk mark indicates the example was provided from a longitudinal diary rather than the recorded tapes.

adjacent context. dentals or alveolars were usually replaced with either velars or labials in the vicinity as a result of assimilation.

Lastly, with respect to syllable structure, children with immature phonological capability showed a strong preference to the basic CV structure by means of deleting a final consonant, avoiding a complex vowel with a glide in it, or repeating the same CV syllable form consecutively to fill the structural gap. The children also tended to shorten multisyllabic words by disregarding intermediate syllables and highlighting the ones at both edges of the word structure.

3.3 Phonological processes of early fricatives

Fricatives are generally acquired later than stops, as the former requires more delicate specification of articulatory movement throughout the production. Thus, when children with the age of 1;6 to 4;0 undergo a significant development in their phonological ability (Ingram 1986), they are expected to reveal interesting patterns of fricative substitution with respect to the glottal, manner, and place features.

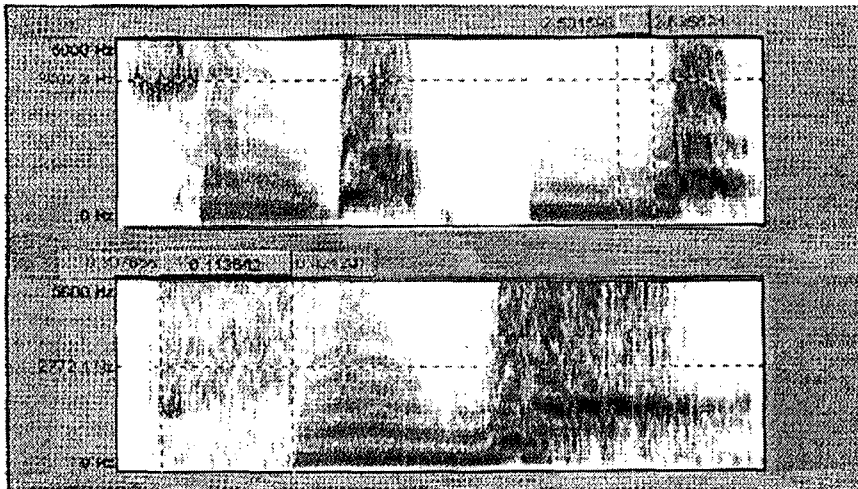


Figure 1: *Top* - Mother : /supak/ 'water melon', Child 2 (2;0) : [ubak]
Bottom - Child 1 (3;8) : [jubak]

As shown in Figure 1, the production of /s/, which is realized by an intensive random noise at the highest frequency region around 4,000 Hz (see Ladefoged 1982), could be too difficult to imitate by a young child at the beginning phrase of early development. For instance, the child 2 at 2;0 disregarded the initial /s/ segment of the word /supak/ 'a watermelon', as starting to produce the word with a round back vowel instead. In contrast, the child 1 (3;8) at the latest

development stage produced a postalveolar fricative /ʃ/ for the target /s/ in her utterance with an accompanying noise at a slightly lower frequency about 2,500 Hz in the spectrogram.

Phonological processes relevant to Korean fricatives can be further classified into 4 different types, i.e. stopping, affricating, tensifying, and palatalizing. The stopping process seems to occur earlier than affricating and palatalizing, as stop consonants are relatively easier and richer from the input to be learned than affricates.

(15) Stopping

C 1: [k ^h ɛ] 'bird' /sɛ/ (1;7)	[tot'e] 'younger sibling'/tonʃɛn/ (1;8)
[cut'əyo] 'gave (it)' /cwəssəyo/ (2;4)	
C 2: [pat'u] 'clapping' /paksu/ (1;11)	[c ^h it'o] 'toothbrush'/c ^h issol/ (1;11)
[to][t'o] 'hand' /son/ (2;0)	[t ^h at ^h ʌŋ] 'a candy' /sat ^h ʌŋ/ (2;1)

The children in focus typically produced an alveolar tense stop for /s/ during their early speech. Reflecting the phonetic aspect that /s/ carries a considerable amount of aspiration, the subjects made an occasional substitution of aspirated stops for /s/ in initial position, as in [k^hɛ] 'bird' /sɛ/ (C1, 1;7) and [t^hat^hʌŋ] 'a candy' /sat^hʌŋ/ (C2, 2;1). The spectrograms in Figure 2 further illustrate the extent of how the lax fricative is replaced with other segments like /h/, /k^h/, and /c/.

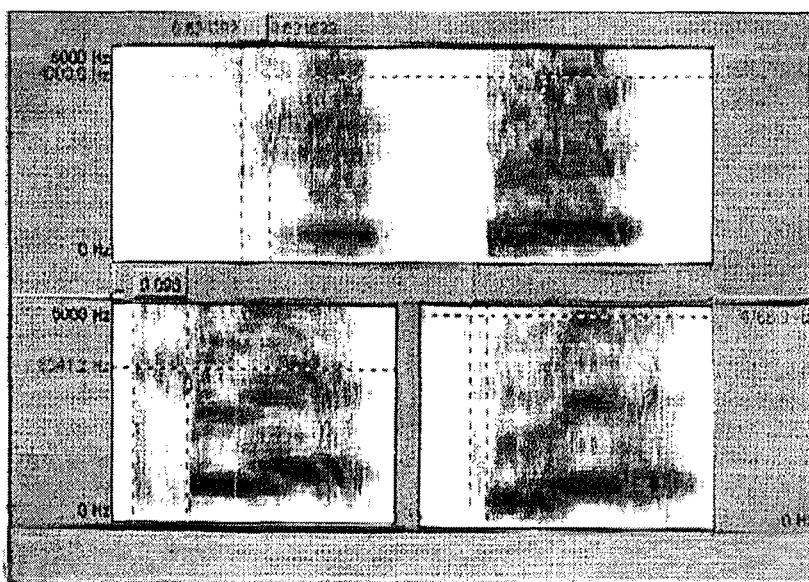


Figure 2: *Top* - Mother : /sɛ/ 'bird', Child 2 (1;11) : [hɛ]
Left - Child 1 (1;8) : [k^hɛ] *Right* - Child 2 (1;11) : [cɛ]

In the affricating process, the lax fricative /s/ was often replaced with a lax or aspirated affricate, while /s'/ with a tense counterpart /c'/, as given in (16). Some of the medial /s/ interacted with a voiced affricate /j/ presumably due to the application of voicing in a sonorant context.

(16) Affricating

- C 1: [p'ac'i] 'bus' /pəsi/ (1;8) [c'ec'ə] 'fish' /səɲsən/ (1;8)
 [habujeyo] 'do it (polite way)/həboseyo/ (2;4)
 [ij/sa kas'əyo] 'He moved out' /isa kassəyo/ (2;10)
- C 2: [c^hɛda] '3 years old' /sesal/ (1;9) [cuk'aya] 'spoon'/sutkarak/(2;0)
 [majit'a] 'delicious' /mas.iss.ta/[majit'a] (2;1)

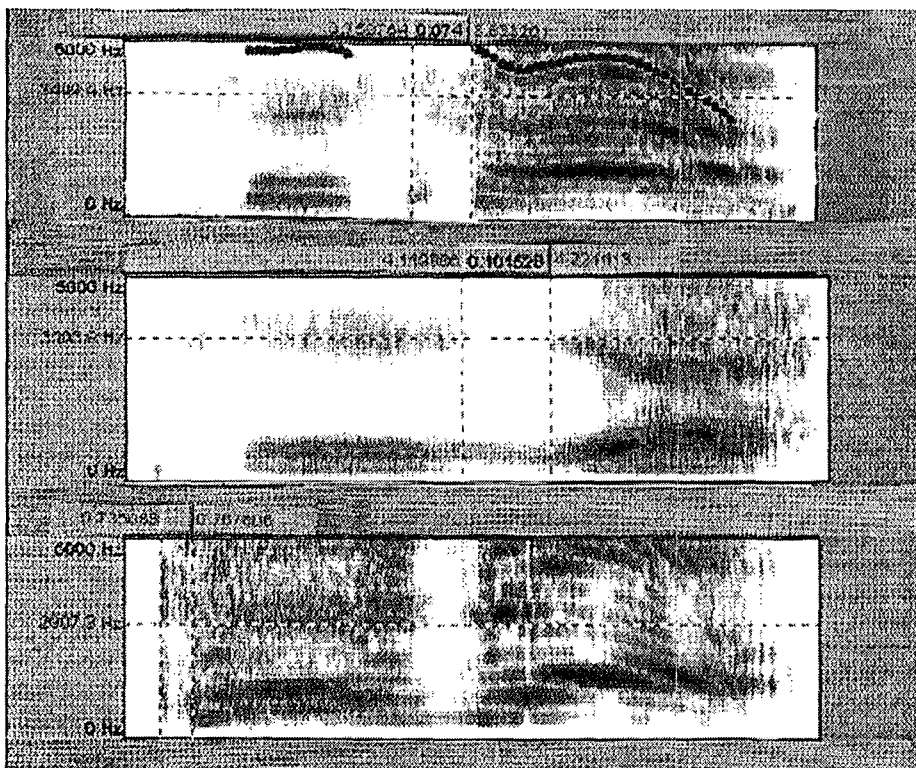


Figure 3: *Top* - Child 1 (1;8) : [c^hec^ha] 'a 3 years old' /sesal/
Middle - Child 2 (1;11) : [tʰɛja] *Bottom* - Child 2 (2;0) : [tʰɛda]

Between the two subjects, the child 1 showed preference to the aspirated affricate /c^h/ for /s/, whereas the child 2 substituted /c/ for /s/, as expected. This individual variation in affricating was found to be correlated with the individual difference in the degree of tensifying

and palatalizing for the fricatives, which will be discussed later. The spectrograms for the words /sesal/ 'a three years old' in Figure 3 exemplify the ways of replacing an /s/ with affricates of multiple distinction in relation to its position within a word structure.

Although the children did tensify and palatalize the target fricatives in their utterance, the varying extents of individual preference also arise with respect to these two processes. The child 2 showed a consistency in replacing /s/ or sometimes /s'/ with a tense stop and affricate, whereas she rarely produced a palato-alveolar fricative /ʃ/ in substitution of /s/. However, the child 1 made a few substitutions of tense segments for /s/ in an early stage, while she continued to replace /s/ with a postalveolar counterpart for relatively a long period.

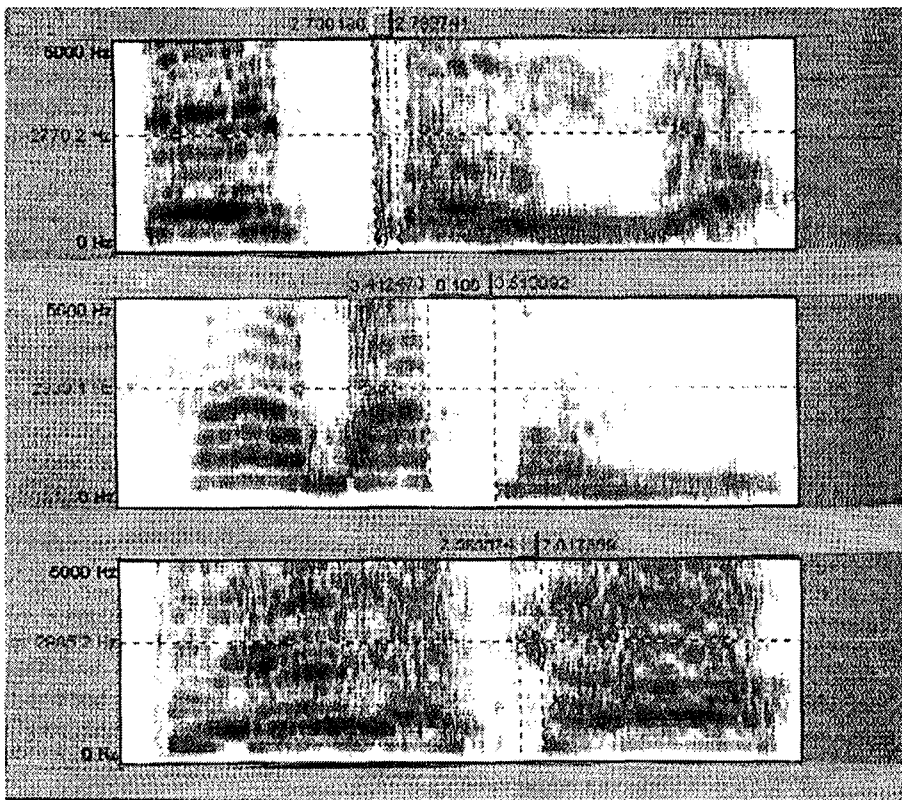


Figure 4: Verbs spoken by Child 1 (2;4)

Top - [t'ɛit'əiyo] 'hit (me)' /t'ɛryəssəyo/

Middle - [ʃawat'əyo] '(They) fought' /s'awəssəyo/

Bottom - [tiyəkafə] 'as entering' /tirəkasə/

(17) Tensifying

C 1: [k'ek'an] 'a candy' /sat^han/ (1;9)* (cf. [c^hak^han] (1;9))

C 2: [cut'u] 'juice' /cyusi/ (1;11) [mɛc'/ji] 'green plum' /mesil/ (2;0)

[kak'u] 'the chest' /kasim/ (2;0) [nunt'ə] 'eyebrow' /nuns'əp/ (2;1)

(18) Palatalizing

- C 1: [p^(h)ufə] 'balloon' /p^huŋsən/ (2;0)* [ʃanmul] 'cold water' /c^hanmul/ (2;0)*
 [ʃac'a](1;8) [ʃaca](2;4) 'lion'/saca/ [ʃo] 'cow' /so/ (2;4)
 [ʃawat'əyo] '(they) fought' /s'awəssəyo/ (2;4)
 C 2: [p^hayaʃe] 'blue color' /p^ha.lansək/ (2;0)

Nevertheless, the persistent palatalizing doesn't mean that there appeared no instance of /s/ in the child's production. On the contrary, the child 1 produced adult-like /s/ sounds gradually along with /ʃ/, with an ever increasing percentage of the former's actual occurrence during the whole transitional period. I provided additional evidence of tensifying and palatalizing from the utterances of verbal forms by the child 1 at 2;4 in Figure 4.

3.4 Data analysis

The percentages of segmental substitutions for /s/ from the children's speech are tabulated in (19).

(19) Percentages of each phone for /s/ from the utterances by Child 1 & Child 2

	Child 2			Child 1					
	1;11	2;0	2;1	1;7-8	2;0	2;4	2;7	3;0	3;8
s	29	38	44	33	62	51	82	83	98
ʃ/ç	0	0	0	13	29	40	14	10	2
c	22	24	12	0	0	6	3	3	0
t ^h	1	11	7	7	3	0	0	0	0
c ^h	0	0	12	33	6	3	1	0	0
k ^h	0	0	0	7	0	0	0	0	0
t'	32	6	12	7	0	0	0	1	0
c'	6	9	7	0	0	0	0	2	0
	(n=69)	(n=47)	(n=43)	(n=15)	(n=34)	(n=68)	(n=130)	(n=105)	(n=45)

As shown in (19), the lax fricative has been replaced with various types of phones in an early speech by the Korean children under approximately 2;4. The child 1 produced lax postalveolar fricatives and aspirated noncontinuants in place of /s/ during the earliest stage around 1;7-1;8. However, she quickly adjusted to pronounce lax fricatives such as /s, ʃ, or ç/ for the target /s/ since 2;0. In contrast, the child 2 produced a lax affricate and tense coronals more often than aspirated segments for /s/, and never substituted a palatal fricative for /s/.

The tense fricative /s'/ was typically replaced with the tense stop /t'/ or sometimes with [s]

or another tense [c'] until the child 1 started to articulate [s'] correctly above the chance at 3;0. Figure 5 and 6 demonstrate a relatively simple pattern of segment substitutions for /s'/ in relation to the age of the subjects. The usual substitution of [t'] for /s'/ in an early stage of phonological development was also observed from the child 2, but in her case, tense affricates were also frequently used as an alternative sound for /s'/.

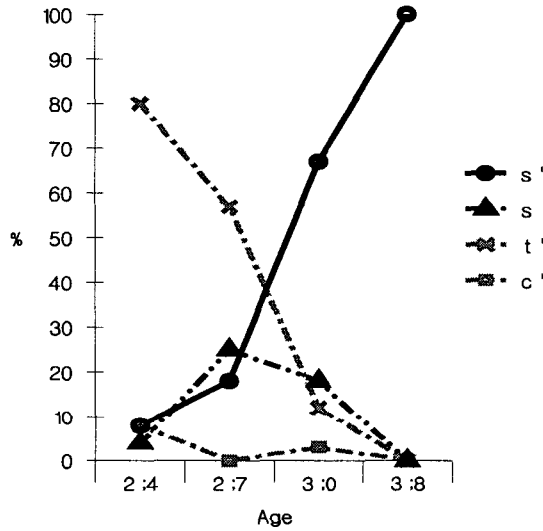


Figure 5: Percentages of phones for /s'/ in the utterances by Child 1

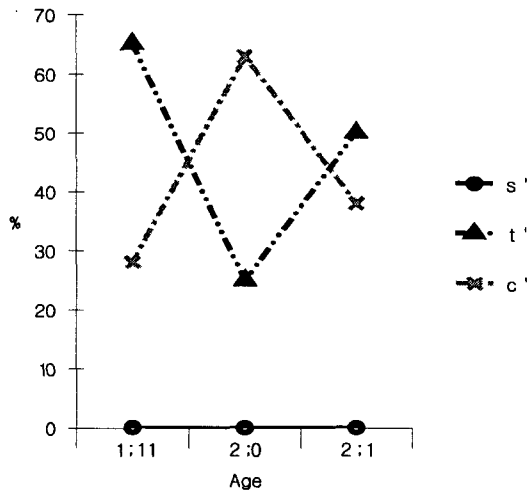


Figure 6: Percentages of phones for /s'/ in the utterances by Child 2

The actual percentages of segmental occurrences for the Korean fricatives confirm that the early acquisitional pattern of /s/ is more complicated than /s'/, as the former involves to use not only lax but also aspirated and tense segments as substituting elements. Nevertheless, the earlier production of /s/ even before the age of 2;0 implicates that /s/ is an unmarked fricative sound, acquired earlier than the tense counterpart.

4. Summary and Conclusion

The acquisition of the Korean fricatives have received little attention from linguists until a recent work by Cho and Lee (2003) notes an interesting chain shift phenomenon (/s/→h/→k/) in the acquisition of the fricatives. Although they observed an important phonological pattern between English and Korean, Cho and Lee's description of acquiring fricatives is too coarse to be precise from the perspective of phonetics.

From a longitudinal study of the child 1 (1;7-3;8) and child 2 (1;7-2;1), it was found that the tense fricative, whose glottal property lies well matched with tense stops and affricate, was usually substituted into tense noncontinuants in young children's early production, whereas /s/, which shares with the lax and aspirated series in the glottal setting (Iverson 1983, Kang 1999 & 2000), manifested a complicated pattern of substitutions into lax, tense, and aspirated noncontinuants with a varying degree of individual preference. The current acquisition study corroborates the previous claims concerning fricatives in other languages, demonstrating that they are acquired later than stops, being subject to a series of phonological processes called stopping, affricating, tensifying and palatalizing during the period of phonological development (1;6 through 4;0) by young children. In addition, between the two voiceless types, the lax fricative seems to be an unmarked segment and acquired earlier than /s'/, as the former appeared well before the age of 2;0 whereas /s'/ hardly did so even at the age of 2;4.

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