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Phonological Development of Korean: A Case Study

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1 Introduction

Studies on child phonology suggest that there exist phonological universals in the timing of phonological events and the order of acquiring phonological categories. According to Jakobson (1941/1968), voiceless (unaspirated) stops are acquired earlier than voiced or aspirated ones, and front consonants are acquired earlier than back consonants (i.e., bilabial > alveolar > velar). With regard to the manner of articulation, stops are claimed to be acquired before nasals, nasals before fricatives, fricatives before affricates, and affricates before liquids. These universals have been supported by data from many studies, but not always (see Vihman 1996, ch. 2). Studies on cross-linguistic data have found that the acquisition of speech sounds is influenced by the language-specific aspects of the ambient language and the frequency of the sound in child-directed speech (Macken 1980, Macken & Ferguson 1981, Lust, Flynn, Chien, & Clifford 1980, Vihman 1996, Vihman *et al.* 1998, Beckman *et al.* 2003; also see Zamuner *et al.* 2004 for phonotactic probability data arguing for the importance of considering the input in children's acquisition of phonology).

Though there are many studies on the acquisition of Korean, most of them are on the acquisition of morpho-syntax (e.g., acquisition of case markers, relative clauses, negation, word order, pronouns, wh-questions; see Y.-J. Kim 1997 for detailed reviews), and only a few are on the acquisition of phonology, especially the sound pattern of a child and the acquisition of phonological rules (e.g., Kang 1991, Cho 2002; see Yoko 1997 for detailed reviews). To my knowledge, no studies so far have examined the order of acquiring consonants and vowels and the acquisition of prosody based on instrumental investigations.

The goal of this paper is to investigate the phonological development of a Korean child based on acoustic analysis of naturalistic data. Special attention is given to the acquisition of the Korean three-way manner contrast (tense, aspirated, lenis) and the acquisition of prosody.

Background

Cross-linguistic data (e.g., English, French, Spanish, Thai, Taiwanese, Japanese, and Hindi) on the acquisition of stop voicing confirmed Jakobson's generalization that voiceless unaspirated stops are acquired before either aspirated or voiced stops. Kewley-Port and Preston (1974) suggest that this universal is phonetically grounded in that the aerodynamic requirements (i.e., timing of oral release and glottal adduction) of voiceless unaspirated stops are easier to satisfy than those of voiced or aspirated stops.

Korean tense stops are voiceless unaspirated. However, Korean tense stops are not that simple articulatorily. They are typologically rare in that they require special aerodynamic manipulations and tension in the vocal track. Unlike other voiceless consonants, Korean tense is produced with high air pressure but *low* air flow (e.g., Dart 1987, T. Cho *et al.* 2002). This difficulty in articulation may suggest that Korean tense would be acquired later than other manners. However, based on informal observations, a few studies (e.g., Kim 1997, Cho 2002, Shin & Davis to appear) note that Korean children acquire the tense stops the earliest. A three- way manner contrast in Korean obstruents is manifested in multiple acoustic dimensions – segmentally (e.g., VOT (Voice Onset Time)) and suprasegmentally (e.g., f0 at vowel onset). VOT values are shortest in tense, medium in lenis, and longest in aspirated. The average VOT value (based on 11 previous studies taken from Han (1998) and T. Cho *et al.* (2002)) is 10ms for tense, 39ms for lenis, and 106 ms for aspirated. F0 at vowel onset is 20-80Hz lower after lenis than after tense and aspirated (Jun 1996, J.-I. Han 1996, N. Han 1998, T. Cho *et al.* 2002, M.-R. Kim *et al.* 2002). This f0-segment connection, however, is fully realized when the segment is at the beginning of a small phrase, known as an Accentual Phrase (AP). This is true in both Seoul and Chonnam dialects. Figure 1 shows the prosodic structure and the tonal association of Seoul and Chonnam Korean (Jun 1989, 1993, 1998). Both dialects have the same prosodic structure: an AP is smaller than an Intonation Phrase (IP) and larger than a Word. The tonal pattern of an AP is also the same between the two dialects except for the AP final tone (i.e., H in Seoul and L in Chonnam). The tone of an AP-initial syllable (=T) is H (High) when the AP begins with a tense, aspirated consonant, /h/, or /s/. Otherwise, (i.e., when the AP begins with a lenis consonant, a vowel, or a sonorant consonant), it is L (Low). The tone of an AP-second syllable is H in both dialects. But when the AP has fewer than 4 syllables, this initial H is often not realized in Seoul dialect (thus, LLH, or LH patterns for L-initial, and HH or HLH patterns for H-initial AP, but when the initial H is realized, a LHH pattern is shown).

In both dialects, an IP is the highest prosodic unit, and it includes one or more APs. The end of an IP (the last syllable of an IP) is lengthened and is marked by a boundary tone (e.g., rising H% or LH%, falling L% or HL%, rising-falling LHL%, or falling-rising-falling HLHL%) which delivers different pragmatic meanings (e.g., insisting, annoyance) and sentence-type information (e.g., declarative, interrogative, imperative). When a word is focused, it is produced with expanded pitch range, while post-focus words are produced in a reduced pitch range and often dephrased (=deletion of an AP boundary).

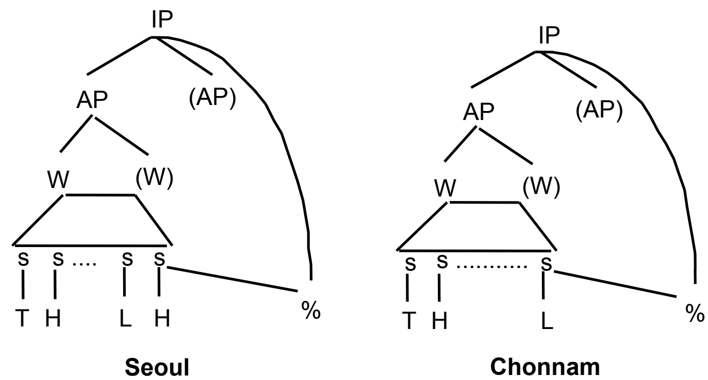

Figure 1. Prosodic structure and the tonal association of Seoul and Chonnam dialects of Korean. (IP=Intonation Phrase, AP=Accentual Phrase, W=Prosodic Word, s=syllable, T=H when s begins with aspirated/tense C, /h, s/. Otherwise, T=L, %=intonation phrase boundary tone.)

Studies on the acquisition of prosody (i.e., rhythmic and durational regularities and tonal patterns of an utterance represented in terms of pitch, amplitude, and duration) show that infants produce utterance-final syllable lengthening before six months (e.g., Laufer 1980) and produce a longer word-final syllable in disyllabic words than non-final syllables (Mack & Lieberman 1985). Studies (see Vehiman 1996, ch. 8, Golinkoff 1983) also found that infants can produce a rising pitch contour late in the first year and use falling, rising, or falling-rising pitch to cue pragmatic meanings before they start talking. Similarly, studies on tonal languages and pitch-accent languages have demonstrated that prosodic features (tone, pitch accent) are acquired earlier than segmental features (phonemic distinctions). Li & Thompson (1977) and Tse (1978) found that Mandarin and Cantonese children acquired high and low level tones between 14 and 16 months, the beginning of the single-word stage, and acquired falling and mid tones between 17 and 20 months, still within the single-word stage. Rising tones were acquired the last, at 21 months, after the onset of the word combination stage (also see Clumeck 1980). The timing of acquiring lexical pitch accent was found to be similar. Engstrand, Williams, and Strömqvist (1991) found that Swedish word accent was produced at about 17 months, and Hallé, Boysson-Bardies, and Vihman (1991) found that Japanese pitch accent was acquired between 15-23 months. However, the influence of ambient language on the acquisition of prosodic features has also been shown in various prosodic categories: final-lengthening and pitch contours (Allen 1983, Levitt & Wang 1991, Hallé *et al.* 1991) and stress (Hochberg 1988).

The acquisition of Korean prosody, especially the production of prosody, has not been studied yet, to my knowledge. But studies of the acquisition of the perception of Korean prosody have been done recently. Choi (2003) and Choi & Mazuka (2001, 2003) investigated whether preschool aged (3-5 years) Korean children are sensitive to and utilize prosodic information, especially prosodic phrasing, in processing syntactically ambiguous sentences. They found that preschoolers *are* sensitive to prosodic cues in interpreting the meaning of a sentence. But how early Korean children acquire this sensitivity to prosody is unknown.

2 Data collection method and analysis

Data: Recordings were made of a Korean baby girl (YP) from 2 months to 22 months. YP was born in America (Columbus, Ohio) but was raised by Korean (Chonnam dialect) speaking parents and a babysitter speaking the same dialect. Recordings were made at the child's home by the mother (the author) using a SONY professional cassette recorder. A lapel microphone was clipped onto the child's shirt. Recordings were made two times a month, with each session in two-week intervals, except for five sessions (4, 6, 10, 12, and 15 mo.). '4 and 6 mo.' sessions were collected two months after the previous session and the other three sessions were collected once each month. Total recording time was 19 hours and 32 minutes, and each session was 15-70 minutes long (average 60 min/month).

Analysis: Recordings were digitized at 22kHz using *PCQuirer* (Scicon R & D). The child's utterances were transcribed in IPA, based on the acoustic data (i.e., spectrograms, waveforms, and f0 tracks) and auditory criteria. The parents' utterances were transcribed in Korean orthography to provide information on the child-directed speech input.

3 Results

3.1 Development stages

Table 1 provides an outline of the phonological development of Child YP from 2 to 22 months. As shown in Table 1, Child YP started a 10-word stage around 16 months and a 50-word stage around 18 months, similar to the divisions proposed in Flax *et al.* (1991). She produced her first word at 10 months and 50 words at 18 months. At the end of 19 months. she had acquired about 180 words and started the two-word combination stage. Babbling, which was first found at 6 months, continued until 18 months, overlapping with the word-stage. The syllable structure of babbling was CV or VCV at 6 months, and became reduplicative (CVCVCVC…) at 7 months. Around 9 months, variegated babbles appeared, but babbling was substantially reduced after she acquired her first word, i.e., 10 months. Towards the end of the silent stage (14 mo), YP used linguistic prosody (pitch for communicative purposes) and started to mimic segments and intonation contours of her parents.

Table 1. An outline of Phonological Development

```
month
2  4  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20  21  22
------            ------------------------------      ------------------------------
cooing            reduction of babbling               talking
      |------------------ - - - - - - - - - - -| - - -   -   -   -   -   -
       babbling (cv, vcv)                 use of ŋ̩ or m̩ with various f0
          reduplicative babble (e.g., nananana)-|word-like pitch contour
                                                  (e.g., kkekkekkeŋ)
                variegated babble (e.g., ntatppatta, njatechi)
                  |--------------------------------|---------|--------|--------------------
                  first word (Mommy, Daddy)   10-wds  50-wds 180-wds
                                          |---------------------- - - - - - - - - - - - - - -
                                           repeat segments/words
                                           repeat intonation
                                                        |------------|-------------------
                                                        voluntary wd productions
                                                        answer to wh-Q
                                                              wd combinations
                                                              sentence intonation
```

3.2 Acquisition of Segments

In the following, the ‘month of acquisition’ is the month when several “good” (close to the adult form) tokens of each category were found for the first time from the production of a single word. Therefore, this does not mean that all tokens of each category are adult-like by this month.

The order of acquisition of vowels, during the babbling stage, was as follows: [a] > [e] > [ə, u, i] (6 months) > [ɨ] (9 months) > [o] (13 months). The order of acquisition for consonant place and manner of articulation is shown in Table 2. The order of acquisition not expected from Jakobson’s universal pattern is italicized. The acquisition of fricative (9 months for babble and 14 months for words) was based on /h/ data. /s, ss/ were acquired much later.

During babbling, voiced and voiceless unaspirated stops appeared about the same time, earlier than voiceless aspirated stops. During the word stage, tense stops were acquired first, confirming the previous observations. Between aspirated and lenis, aspirated stops were acquired earlier.

Table 2. The order of acquisition of consonant place and manner of articulation

Consonants: Place of articulation	
babbling	bilabial, *velar (6 mo.) > alveolar (7-8 mo.)*
The ‘word’ stage	bilabial (10 mo.) > alveolar (13 mo.) > velar (15 mo.) NB. In each place, *nasal > stop* stops: bilabial > *velar > alveolar (18 mo.)*

Consonants: Manner of articulation:	
Babbling	stop, nasal (6 mo.) > affricate, fricative (9 mo.). stops: *vd, v-less unaspirated* > v-less aspirated (9 mo.)
the 'word' stage	nasal, stop (10 mo.) > affricate, fricative (14-16 mo.) stops: tense (wd-medial: 10 mo., wd-initial: 17 mo.) > aspirated (18 mo.) > lenis (20 mo.)

Phonetic realizations of stops

To examine the phonetic realizations of stops, VOT and f0 at vowel onset were measured at stops produced at the beginning of a word (and the beginning of an Accentual Phrase). The following data are from stops produced at 17 months and later. A few stops were produced before 17 months, but they were all word-medial.

Tense Cs: The left panel of Figure 2 shows the duration of VOT (in millisecond) by age in month. The VOT duration at 17 months varied between 7ms to 253ms, but half of the data show very short, adult-like VOT values. Similarly, half of the f0 values at vowel onset after tense stops (see the right panel in Fig. 2) were higher than 350Hz, the average f0 value after voiceless stops during babbling (see Table 3). However, from 18 months, most tense tokens showed adult-like realizations, i.e., short VOT (< 50ms) and high f0 (> 350Hz). As shown in Table 3, the f0 values during babbling were similar across segment types though they were slightly higher after nasal consonants. But, during the word-stage, the f0 values increased after tense stops and decreased after nasals (average 310Hz) and vowels (average 313Hz). See Figure 3.

Table 3. Average f0 values of phrase-initial sounds in babbling

Word/phrase-initial sound category	F0 mean (sd)	# of tokens
Voiceless stop	347 (59.12)	11
Vowel	347 (48.9)	24
Nasal	374 (75.9)	17
Voiced stop	346 (38.7)	7

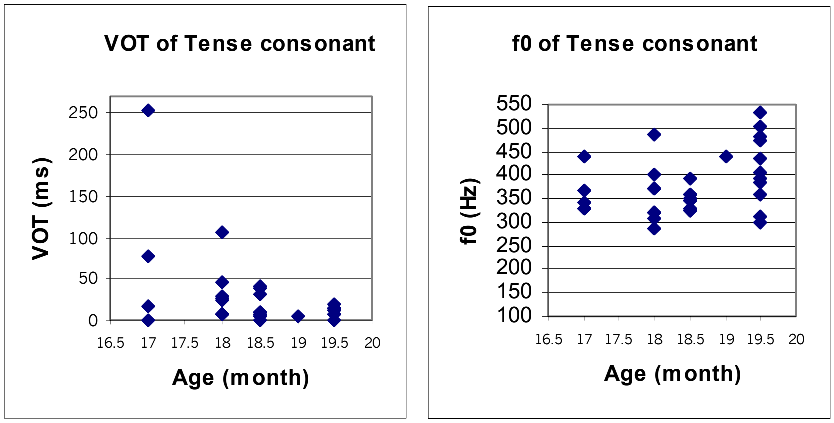

Figure 2. VOT (ms) and f0 (Hz) of word-initial Tense Cs by Age (17-19 mo.)

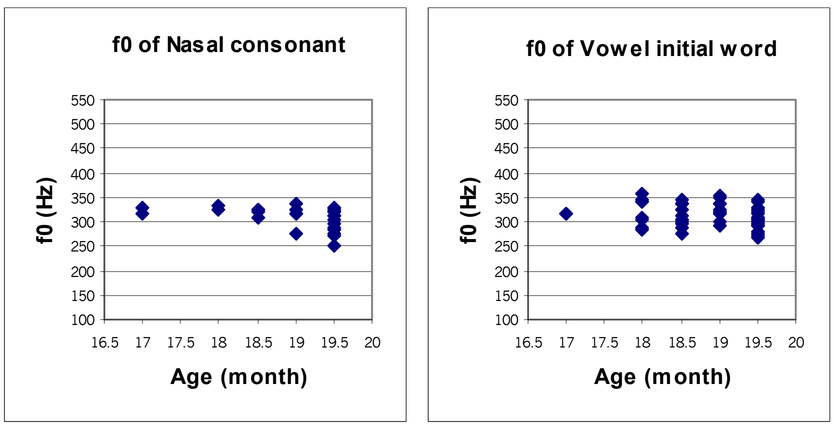

Figure 3. f0 (Hz) of word-initial nasal Cs and vowels by Age (17-19 mo.)

Lenis and Aspirated Cs: As shown in Figure 4, Lenis and Aspirated Cs showed similar VOT and f0 values at 17 months. At 18-19 months, longer VOT values were found in both manner categories, and they were not significantly different. But, at 20 months, the Lenis C's VOT was significantly shorter than that of the Aspirated Cs (58ms vs. 81ms on average. $F (1, 31) = 7.348$, $p <.01$).

In f0, however, Lenis Cs differed from Aspirated Cs from 18 months. See Figure 5. The majority of Lenis Cs were lower than 350Hz while the majority of Aspirated Cs were higher than 350Hz. The difference is statistically significant (328 vs. 411 Hz on average; $F (1, 34) = 19.887$, $p <.0001$). For ease of reference, a horizontal line is drawn at 350Hz. This suggests that Child YP acquired suprasegmental properties (f0 dimension) *before* segmental properties (VOT dimension) of Korean obstruents. (Please note that this is true for only word-initial, phrase-initial, stops. Word-medial lenis stops were rarely produced by this age except for the case where a lenis stop is after a nasal consonant.)

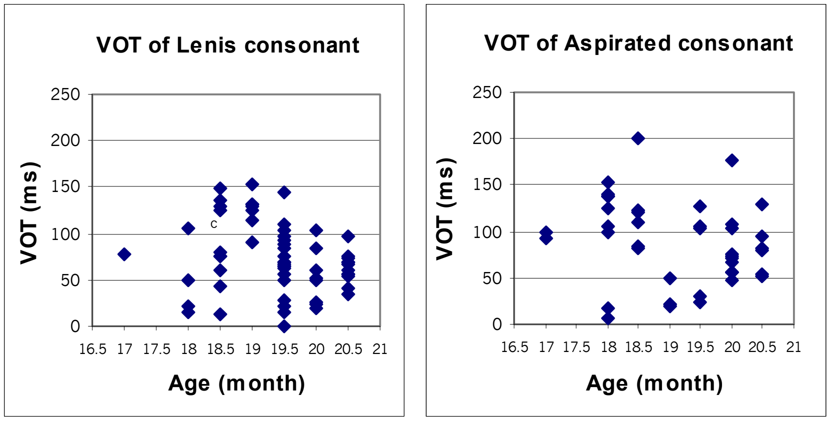

Figure 4. VOT duration of word-initial Lenis and Aspirated Cs by Age (17-20 mo)

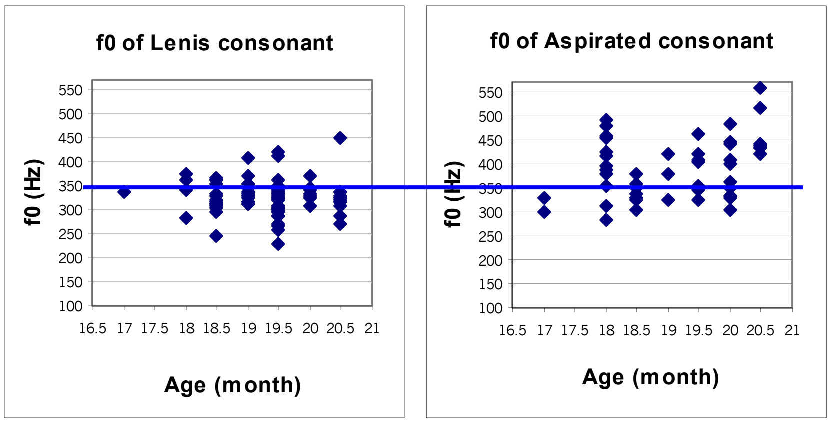

Figure 5. f0 values of word-initial Lenis and Aspirated Cs by Age (17-20 mo). A horizontal line is drawn at 350Hz, the average f0 value after voiceless stops during babbling

3.3 Acquisition of Prosody

Babbling stage: Between 14 and 17months (the transition period from babbling to speech), Child YP dominantly produced a syllabic nasal (m or ŋ) with various pitch contours signaling pragmatic meaning. She used rising pitch (LH%) to request the naming of an object and falling pitch to indicate her agreement with the parents' response. This supports Golinkoff's (1983) claim that pragmatic development has clear antecedents in the prelinguistic period. An example dialogue between Mother and YP (14 mo) is given below.

(1) Mother: [juna ibidʒi, kəgi]LHL% "It's Yuna's mouth, over there, right?"

YP:	[m̩] HL%	(meaning "Yes.")
YP:	[m̩] LH%	(meaning "What is this?")
Mother:	[nun] LH%	"An eye."
YP:	[m̩] LH%	(meaning "How about this?")
Mother:	[kəgido nun] LH%	"That's an eye, too."

At 16 months, YP produced nonsense jargon, multiple CV sequences, with speech-like f0 contours (e.g., [ccececcekkitta]HLHLH%, [kkakkakka]LHL%). Figure 6 shows a pitch track of [kkekkekkeng]HLH%. The final H is higher than the word-initial H, triggering the perception of a High boundary tone (H%).

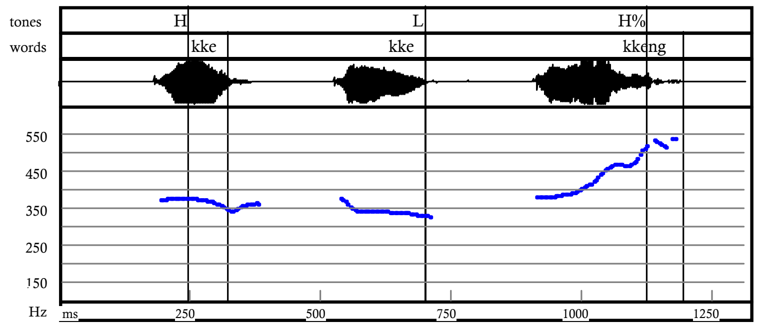

Figure 6. Pitch track of nonsense jargon with a HLH contour (YP, 16 mo.)

Single word stage: When a single word was produced in isolation, YP often used a L% boundary tone, similar to adults' production of single words in isolation. In producing multi-syllabic words, she lengthened the word-final syllable and often produced a HL tone on the last syllable, mimicking the HL% intonation phrase boundary tone, commonly found in the parents' input utterances. During this stage, her production of a segment was influenced by its location within a word: most stop sounds were produced word-initially, but in bi-syllabic words, lenis stops were often not produced word-initially and medially. When the target word was longer than 3 syllables, she often produced a one or two syllable word, by keeping only the first and/or the last syllable of the target word. This is probably because the edge of a word is more prominent than the middle of a word in Korean.

Phrase stage: When producing multi-word utterances, each word formed one AP most of the time and the whole utterance formed one IP (and sometimes two IPs, as in Figure 7). When the utterance was a Noun Phrase, she often used a L% boundary tone, but when it was a statement sentence, she used HL% most often.

Child YP also produced other boundary tones delivering various sentence types and meanings. H% for a question is shown in Figure 8 and LH% for requesting is shown in Figure9. LHL% meaning 'annoyance and irritation' is shown in Figure 10 and the same contour meaning 'insisting' is shown in Figure 11. Figure 11 also illustrates 'focus' prosody. Here, the word *Daddy* is focused (contra *baby*). She produced higher pitch on *Daddy*, higher than the preceding H, and lower pitch on *kangaroo*, and no AP boundary between *Daddy* and *kangaroo*, i.e., dephrasing. This is how adults produce focus in Korean.

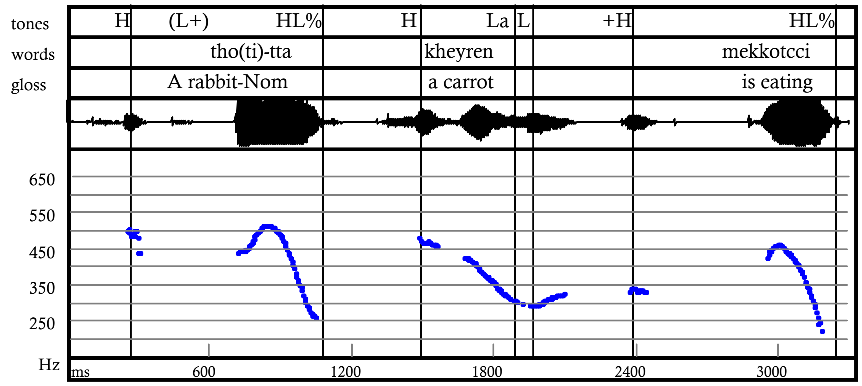

Figure 7. An utterance (21 mo.) produced in two IPs: (A rabbit)HL% (is eating a carrot)HL%. 2nd IP has two APs. 1st HL%: Topic-like marker. 2nd HL%: seeking an agreement. The first two APs begin with H due to [t^h, k^h], respectively, and the last AP begins with L due to [m]. Non-IP-final AP ends in a Low tone (La), a characteristic of Chonnam dialect.

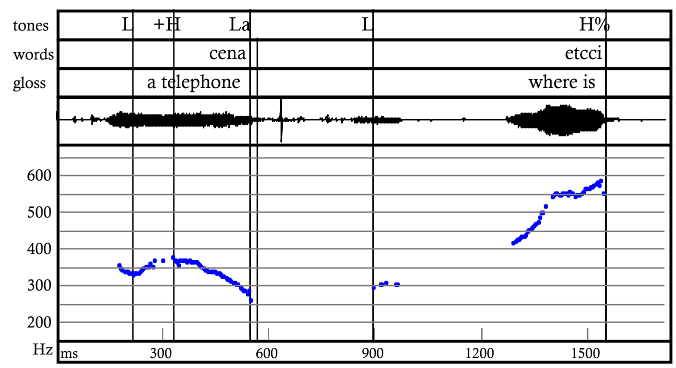

Figure 8. A question utterance (21.5 mo.) 'Where is a telephone?' with H%. Each word forms an AP, beginning with a Low tone (due to the lenis affricate, 'c', and the vowel-initial word, respectively).

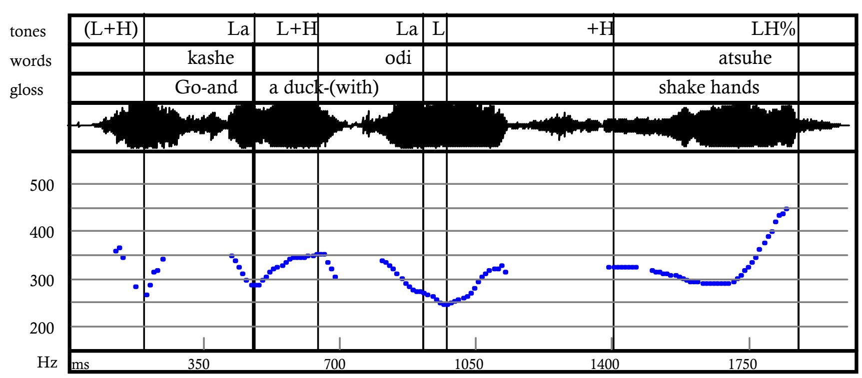

Figure 9. "Requesting" utterance (22 mo.) 'Please go and shake hands with the duck' LH%. Each word is in one AP (beginning with L). The whole sentence in one IP with a rising pitch (LH%) on the last syllable, [-he].

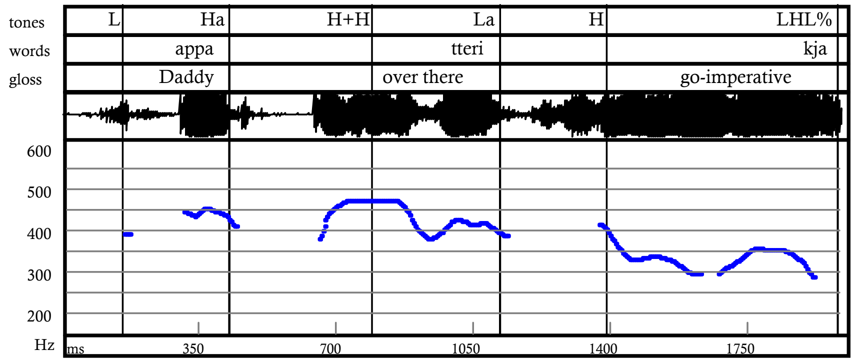

Figure 10. Utterance expressing "annoyance and irritation" (22mo.). 'Daddy, go away!' LHL%. Each word forms one AP and the whole sentence forms one IP.

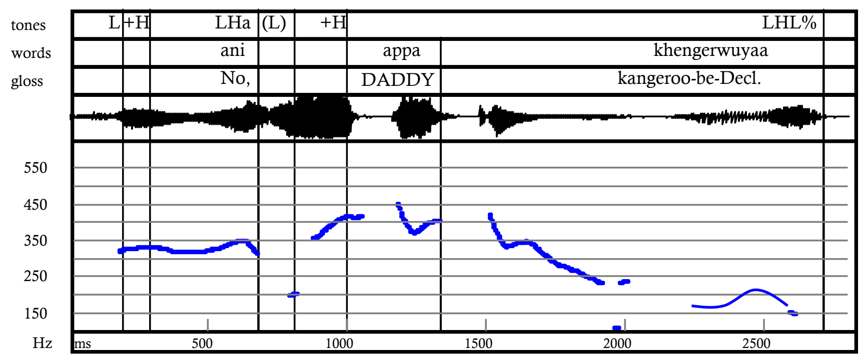

Figure 11. "Focus" on DADDY (21.5 mo.) 'No, it's a DADDY kangaroo (not a BABY kangaroo)'. No AP boundary after 'DADDY'. LHL% means "insisting".

4 Discussion and Conclusion

Data show that among the three manners of obstruents, Child YP acquired tense first. Why tense first? Tense stops are surely not easy to articulate. Then, is it because Child YP heard this category more frequently? Beckman *et al.* (2003) claim that the order of acquisition can be influenced by the frequency of the sound inventory in the child-directed speech.[1] However, as shown in Table 4, the frequency of word-initial consonant types in the child-directed speech by parents (during YP's first year) does not provide an answer. The percentage of words beginning with tense consonants was smaller than that of aspirated or lenis consonants. To our surprise, the most common category was Lenis.

Table 4. Frequency of word-initial consonant *types* in the child-directed parents' speech during the child's 1st year.

	Tense	Aspirated	Lenis	Nasal	Vowel/glide	s/s'	h
Freq	19	25	61	34	50	18	10
%	8.7	11.5	28.1	15.66	23.0	8.29	4.6

The next question is, then, “Does Child YP know more words with word-initial tense consonants than other categories?” The answer was “No.” The frequency of consonant types in her word inventory was similar to that shown in Table 4: Lenis (29.3%) > Aspirated (13.8%) > Tense (8.8%).

The role of perception and the frequency of sound *tokens*

Instead, the order of acquisition seem to depend on the frequency of sound *tokens* (how often the child hears the sound) and the perceptual saliency of the sound (how salient the acoustic cues are perceptually).

Though tense-beginning word types had low *type* frequency and were found in only 8.7% of the parents' input, most of these words had high *token* frequency; in other words, they were used very often in every day interactions (e.g., appa ‘daddy’, ppoppo ‘kiss (baby term)’, ppaippai ‘bye bye’, kkakkung ‘peek-a-boo’, kkakka ‘cookie’, ccicci ‘dirt’ (‘milk’ in Seoul)). But the token frequency itself would not explain the whole story. If not perceptually salient, high token frequency did not help. Child YP was not able to produce the word-medial lenis affricate until 21 months even though her first name has this sound and she heard it many times every day (But she produced word-medial *aspirated* affricate from 14 months). This is probably due to the weak perceptual saliency of the word-medial lenis affricate: often voiced, short, low pitch, and weak frication.

Perceptual saliency of tense consonants (due to the strong amplitude and the high pitch of the vowel immediately following the consonant, and the long closure of the stop) has been utilized in adult phonology. Tense consonants deliver an emphatic meaning in onomatopoeia (e.g., tallangtallang ‘jingle jingle’ vs. ttallangttallang ‘louder than tallangtallang’, pungpung ‘honk-honk’ vs. ppungppung ‘louder than pungpung’). Tense consonants are also used in intensified expressions by replacing the lax consonant (e.g., caluta vs. ccaluta ‘cut’, kamta vs. kkamta ‘wash hair’, kwa vs. kkwa ‘(academic) department’, casik vs. ccasik ‘vulgar term for ‘a lad’). It is probably this perceptual saliency that led to the development of baby terms to include a tense consonant. As in motherese where segmental and prosodic features are exaggerated, Korean parents may choose to use perceptually salient tense segments to help the babies acquire their language.

Another possible reason for acquiring the tense category earlier than others could be due to the absence of aspiration. Since voiceless unaspirated stops are articulartorily easier than aspirated (cf. Kewley-Port & Preston 1974), it might be easier to learn Korean tense stops which are unaspirated than aspirated or lenis stops which are aspirated. It is possible that Child YP may have produced a typical voiceless unaspirated stop, as found in the unaspirated stops in Spanish or French, at the beginning stage of stop production, and later acquired other segmental/suprasegmental features specific to Korean tense stops. Further study is needed to investigate whether the child's production of tense stops shows other acoustic and aerodynamic features of Korean tense stops.

Covert contrast: Lenis vs. Aspirated

Studies on children's VOT acquisition and substitution errors (e.g., producing [teIk] for 'cake /keIk/') found that children can distinguish two seemingly neutralized phonemes 'covertly'. That is, children's production of the two seemingly neutralized (to adults' ear) sounds show acoustically measurable differences (Macken 1980, Macken & Barton 1980, Macken & Ferguson 1981, Gibbon 1990, Baum & McNutt 1990, Forrest *et al.* 1990, Edwards *et al.* 1997, Beckman *et al.* 2003). These studies suggest that children do not learn to produce phonological contrasts in a strictly categorical way as they may appear in studies based on adult judgments only. Sound categories are learned gradually and one acoustic dimension of the sound category can be acquired earlier than other acoustic dimensions. For this reason, it is important to examine children's production instrumentally and in many acoustic dimensions. Without examining various acoustic data, we would not have found the covert contrast between lenis and aspirated stops in Korean -- Child YP distinguished lenis vs. aspirated by f0 at 18 months, but not by VOT (which she utilized at 20 months).

This means that acquiring a category could take a few months (or years). The incomplete realization of the category during the process of acquisition would cause inconsistent labeling by a transcriber and a higher rate of discrepancy among transcribers. For example, YP's production of the lenis category at 18-19 months was often ambiguous between lenis and aspirated, and the same token of a lenis sound was sometimes perceived as lenis and at other times perceived as aspirated, depending on the acoustic feature focused on. Thus, it is important to examine instrumental data before determining children's sound categories.

Acquisition of intonation before segments

YP's production of pitch contour for communicative purposes started at 14 months, the beginning of the single-word stage. The timing is the same as when Mandarin children started to produce a level tone (high or low), again at the beginning of the single-word stage. YP acquired the basic pattern of intonation at 18 months by learning the tone-segment mapping at a phrase-initial position and a boundary tone at the end of a phrase (since she produced only a single word at that time, each word formed one phrase). At 20 months when she produced multi-word sentences, her intonation contour was adult-like, producing a sequence of APs and different IP boundary tones. This suggests that the timing of acquiring the post-lexical property of pitch, i.e., intonation, is about the same as the timing of acquiring the lexical property of pitch such as tone and lexical pitch accent. As mentioned earlier, contour tones were acquired by Mandarin children between 17 and 21 months, and the pitch accent was acquired by Swedish children at 17 months and by Japanese children between 15-23 months. However, it is well known that children do not produce many segments correctly by age two. In sum, the current and previous studies show that children acquire prosodic features, whether lexical or post-lexical, before segments.

Finally, we need to examine more data of children's acquisition of Korean to generalize the current findings.

Notes

1. They found that Japanese children acquired velar before alveolar, the opposite of the universal pattern claimed in Jakobson and commonly found in other languages. They claimed that this is due to the language-specific frequency effect. They found that Japanese words directed to children have more k-initial than t-initial sounds. A similar pattern was found in YP's data. As shown in Table 2, Child YP acquired velar before alveolar, and her parents' word inventory directed to YP had more velar-initial than alveolar-initial words, supporting Beckman *et al*.'s claim.

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