On the phonetic contrast between fortis and non-fortis fricatives in Korean: interaction with prosodic position effect and vowel coarticulation

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The three-way contrast between stops and two-way contrast between fricatives typical of Korean has attracted a great deal of attention in the phonetics and phonological literature. Regarding the fricatives, on which this study is focused, much of the debate is concerned by the definition of the counterpart of the fortis fricative /s*/: a lenis fricative for some [1, 2], an aspirated fricative for others [3, 4, 5, 6], or an aspirated-lenis fricative for others [7, 8, 9]. Our interest in the present study is not in the definition of this fricative (that we will call non-fortis /s/, by simplification), but in the way factors of variation do interplay with the phonetic realization of the contrast between /s/ and /s*/. Reported cues to this contrast include properties at the onset of the following vowel (intensity, spectral tilt, voice quality, F1…), but also properties of the fricative per se (longer duration, higher frequency noise, more linguopalatal contact, higher airflow resistance, smaller glottal area for /s*/) [8, for a review]. It seems therefore interesting to question this contrast with a new lens: how is it affected by factors which also could affect these specific acoustic dimensions? Here we will look at prosodic position and following vocalic context effects.

Prosodic position refers to the position of the fricative relative to prominences and boundaries. It is well known by now that the phonetic make-up of segments is affected by the prosodic organization of the utterance they are in, and that segments at strong prosodic positions (under accent or close to strong boundaries) are strengthened spatially and/or temporally. A long-standing idea regarding prosodic strengthening is that it contributes to reinforcing the contrastive attributes of the segments in strong positions [10, for a review]. For instance, studies in Korean have shown that the three-way contrast between fortis, aspirated and non-fortis stops is enhanced in strong prosodic position, with a longer VOT for the non-fortis and aspirated stops but not for the fortis [11, 12, 13]. As far as fricatives are concerned, only a few studies have looked at prosodic position effects, and the results are inconsistent. Kim [14] reported a higher centroid frequency (hereafter, CoG) for the fortis fricative in higher prosodic domains, but results were inconsistent across subjects. On the other hand, Jang [15] found the reverse results: fricatives in stronger prosodic position had a lower CoG value. Since the expected effects of prosodic position, in terms of duration, glottal opening or oral articulation, are targeting phonetic features at play in the phonetic contrast between /s*/ and /s/, further data on this topic are awaited. Regarding our second factor of variation, vowel-dependent variation has also been discussed concerning the aspiration-related cues which can be found at the onset of the post-fricative vowel. Larger differences between /s/ and /s*/ have been found before low vowels than high vowels [8, 16]. Here, we will look at the effect of two anticipatory phenomena which should affect the frequency of the fricative noise: anticipatory labialization in the context of /u/ and the well-known palatalization of /s/ and /s*/ in the context of /i/.

Eight Female native Seoul Koreans aged from 22 to 35 y.o were recorded while producing tests sentences containing /V_1#CV_2/ target sequence with V_1=/a/, C=/s/ or /s*/ and V_2 =/i/ or /ɯ/ or /u/, and # =prosodic boundary. The CV2 target sequence was either positioned at the beginning of an IP (IPi), or phrase-internally at a Word boundary (Wi). Measurements include the durations of V_1, C, V_2, and measurements of the frication noise at three time point (first, mid and last 25.6 window) in the fricative: the four spectral moment, frequency of the peak amplitude in the mid frequency (3-7KHz) and its drop towards the end of the fricative, dynamic amplitude (amplitude differences between the mid frequency band and lower or higher ones) [17].

Preliminary results show the expected longer duration and higher CoG for /s*/ vs. /s/. No difference in the other 3 spectral moments are observed, but interesting results are shown by the mid frequency peak amplitude: higher for the /s*/ at the onset, middle et last portions of the fricative, but with an increased distinction between the two fricatives toward the end of the fricative. This is due to a larger drop of this peak at the fricative offset for /s/, while the friction remains more stable over

time for /s*/. Dynamic amplitude, which intends to capture the degree of sibilance in the fricative, is also higher in /s*/ throughout the three time points.

As expected, prosodic boundary effects were found to increase the duration of both fricatives in IPi position. Interestingly, the CoG of both fricatives was found to lowered in IPi compared to Wi (as found by [15]), with interaction with consonant type in the mid portion of the fricative. Indeed, the lowering of CoG in IP is greater for /s*/, than for /s/, showing an unexpected reduction of the CoG contrast in IPi.

CoG values of the frication noise are also dependent on V2 contexts, with a lowering of CoG in the palatalized (/i/) and rounded (/u/) contexts. Interestingly, this effect of V2 depends on the consonant type, with more V_2-induced noise frequency lowering for the fortis fricative. The measure of peak frequency in the mid frequency band (3-7 Khz) is particularly sensitive to the increase of front cavity length due to the anticipatory rounding of /u/. This lowering of peak frequency from the middle part of the fricative to its end, neutralize this acoustic distinction between /s*/ and /s/.

Taken together, these results show that the contrast between /s*/ and /s/ tend to be more reliably marked by acoustic duration, since both prosodic and contextual influences tend to reduce the spectral distinctions between the fricatives' noise. Speaker specific ways of marking the acoustic contrast between /s/ and /s*/ will also be discussed at the conference.

(1a) IP-initial /V_1 # CV_2/, the target word is in bold.
[mina]$_{IP}$ [hanbʌni aniɾa]$_{IP}$ # [**s*uta**ɾɯl yʌl pʌn sʷ*ɯsejo]$_{IP}$. (7^{th} of the 16 syllables in total)
Translation: Mina, not one time, write s*uta ten times.

(1b) Wd-initial /V_1 CV_2/, the target word is in bold.
[hanbʌni aniɾa]$_{IP}$ [toŋsa **s*uta**ɾɯl yʌl pʌn sʷ*ɯsejo]$_{IP}$. (7^{th} of the 16 syllables in total)
Translation: Not one time, write the verb s*uta ten times.

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