Acoustic correlates of articulation-based distinctive features in perception: Evidence from Korean

Hyunsoon Kim, Hongik University Seoul Korea
(hyunskim@hongik.ac.kr or hyunsoonkim@hotmail.com)

The present study is concerned with the direct relationship of articulation-based phonological distinctive features, through their acoustic correlates, to perception, based on recent articulatory, acoustic and perception experiments on the three-way laryngeal contrast in Korean consonants.

The recent MRI studies (Kim, et al. 2005, 2010a, 2011) have shown that, in parallel to glottal position (or height), lip closure or linguo-palatal contact/constriction, pharyngeal width and tongue movement show the same variation in the order of lenis < aspirated (<) fortis consonants with the latter two series being longer than the former in Korean. Based on these findings, Kim, et al. (2010a, 2011) have proposed that not only glottal position (or height) but also lip closure or linguo-palatal contact/constriction, pharyngeal width and tongue movement are incorporated into the feature [tense] and that the feature is defined as the tensing of both the primary articulator (lips, tongue blade or dorsum) and the vocal folds in Korean consonants. The feature [tense] in Kim, et al. (2010a, 2011) is newly modified from the traditional feature [tense] in Jakobson, Fant and Halle (1952), Jakobson and Halle (1956) and C.-W. Kim (1965), according to whom the tension of the overall vocal tract is incorporated into the feature [tense]. In addition to the tensing of both the primary articulator and the vocal folds, Kim, et al. (2005, 2010a, 2011) have found the other independent parameter of glottal opening in the production of Korean consonants, in that the glottis opens from small to large in the order lenis (<) fortis < aspirated consonants in both word-initial and word-medial positions. This has led to the proposal that the parameter of glottal opening is incorporated into the feature [spread glottis] in line with Halle and Stevens (1971). Thus, aspirated and fortis consonants are specified as [+tense] and lenis as [-tense] in terms of the tensing of the primary articulator and the vocal folds, and aspirated consonants as [+s.g.] and lenis and fortis as [-s.g.] in terms of glottal opening, as shown in (1). The acoustic correlate of the feature [s.g.] is aspiration or Voice Onset Time (VOT) (i.e., the time between the release of a consonant and the onset of voicing in a following vowel), in that aspirated consonants, whose glottal opening is larger than lenis and fortis ones, are expected to have longer VOT than the other series in both word-initial and word-medial positions in Korean. The acoustic and aerodynamic correlates of the feature [tense] are oral closure or constriction duration, F0 and intraoral air pressure (Kim, et al. 2010b).

(1) The laryngeal feature specification of Korean consonants (Kim, et al. 2005 2010a, 2011)

	lenis	aspirated	fortis
[tense]	-	+	+
[spread glottis]	-	+	-

The acoustic correlates of the articulation-based laryngeal features [tense] and [s.g.] have been found to play a role in Korean adaptation of English and French words and also in Korean speakers' perception of Japanese voiced and voiceless plosives. First, the Korean adaptation of the English and French [s] shows that the L2 [s] is borrowed as either /s/ or /s'/ under the two conditions: (a) the single fricative [s] is borrowed as the fortis /s'/ and (b) the [s] in consonant clusters as the lenis /s/ into Korean, as in (2). Phonetic studies of the English and French [s] report that oral constriction duration is shorter in [s] in consonant clusters than in the single [s]

(Klatt1974 for English; O'Shaughnessy 1981 for French). In Korean, the fortis fricative /s'/ is longer in constriction duration than its lenis /s/ both word-initially and -medially (Kim, et al. 2010b, 2011; Kim and Park 2011), and the difference in constriction duration between the two types of fricatives is perceived distinctively by Korean speakers in some recent perception studies (S. Kim1999; Lee and Iverson 2006). Given the phonetic and perception studies as well as the laryngeal feature [±tense], we suggest in line with H. Kim (2009) that the subphonemic constriction duration difference in the English and French [s] is interpreted in Korean adaptation in terms of the feature [±tense]. Therefore, the long duration of the single [s] in English and French is parsed for a cue to the [+tense] fricative /s'/, and the short one of [s] in consonant cluster as a cue to the [-tense] fricative /s/.

(2) Korean treatment of the English and French [s]

a. the single [s] into the fortis /s'/

i. English words	Korean adapted forms
salad	**s'**æl.lʌ.t**i̱**
tissue	t^{h}i.**s'**ju
bus	pʌ.**s'i̱**

ii. French words	Korean adapted forms
Sartre	**s'**a.l**i̱**.t^{h}**i̱**.l**i̱**
Essentiel	ɛ.**s'**aŋ.**s'**i.ɛl
Provence	p^{h}**i̱**.lo.paŋ.**s'i̱**

b. the [s] in consonant clusters into the lenis /s/

English words	Korean adapted forms
sky	**s**i̱.k^{h}a.i
disco	ti.**s**i̱.k^{h}o
test	t^{h}ɛ.**s**i̱.t^{h}**i̱**

French words	Korean adapted forms
Strasbourg	**s**i̱.t^{h}**i̱**.la.**s**i̱.pu.l**i̱**.k**i̱**
Pasteur	p^{h}a.**s**i̱.t^{h}wɛ.l**i̱**
Jospin	tso.**s**i̱.p^{h}ɛŋ

Second, the Korean treatment of the voicing contrast in Japanese plosives (H. Kim 2008) provides further evidence for articulation-based distinctive features via their acoustic correlates in perception. In a recent perception experiment (H. Kim 2013) where 160 Korean speakers participated, Japanese voiceless plosives in word-medial position were mostly perceived as either aspirated or fortis in free variation, and voiced ones as lenis, as shown in (3). This suggests that the difference in closure duration between Japanese voiced and voiceless plosives is parsed for cues to the Korean feature [±tense]. Thus, long closure duration of word-medial Japanese voiceless plosives is categorized as either aspirated or fortis ([+tense]), and short closure duration of Japanese voiced plosives as lenis ([-tense]).

(3) Korean treatment of word-medial Japanese (a) voiceless and (b) voiced plosives

	Japanese words	Korean adapted forms	
a.	[kjoo.**t**o]	kjo.**t'**o ~ kjo.**t^{h}**o	'Kyoto'
	[too.**k**joo]	to.**k'**jo ~ to.**k^{h}**jo	'Tokyo'
b.	[ka.**b**u.ki]	ka.**p**u.k'i ~ ka.**p**u.k^{h}i	'Kabuki play'
	[ha.ne.**d**a]	ha.nɛ.**t**a	'Haneda (Airport)'
	[ta.ma.ne.**g**i]	ta.ma.nɛ.**k**i	'onion'

Third, the same perception experiment (H. Kim 2013) has also shown that the difference in VOT between word-initial Japanese voiced and voiceless plosives is parsed for cues to the Korean feature [s.g.] with the secondary role of F0 in terms of the feature [tense]: Japanese voiceless plosives were perceived as aspirated ([+s.g., +tense]) and voiced ones as lenis.

Selected references

Kim, H., Maeda, S., Honda, K., 2010a. Invariant articulatory bases of the features [tense] and [spread glottis] in Korean: New stroboscopic cine-MRI data. *Journal of Phonetics* 38, 90-108.

Kim, H., Maeda, S., Honda, K., 2011. The laryngeal characterization of Korean fricatives: Stroboscopic cine-MRI data. *Journal of Phonetics* 39, 626-641.