

## Allophony Modulates Perceptual Epenthesis

Keywords: Perceptual Epenthesis, Phonology and Speech Perception, Korean and English.

Perceptual epenthesis of illusory vowels has been claimed to be sensitive only to phonologically contrastive features, and not to allophonic features (Kabak & Idsardi, 2007). In fact, we will show that it is also crucially modulated by allophonic features of a language.

Native speakers perceive illusory vowels when presented with sound sequences that do not respect the phonotactic constraints of their language (Dehaene-Lambertz, Dupoux, & Gout, 2000; Dupoux, Kakehi, Hirose, Pallier, & Mehler, 1999). More specifically, when a native speaker is presented with a word-medial consonant sequence that violates the phonotactic constraints in their language, an illusory vowel is perceptually induced in between such sequences thereby creating an illusory sequence that respects the syllable structure constraints of the language. For e.g., when a Japanese listener is presented with [ebzo], they may actually perceive [ebuzo] given that [bz] is an illicit consonant sequence in Japanese. More recently, it has been argued that these perceptual illusions are also modulated by the phonetic characteristics of the stimuli, such as presence of stop bursts (Davidson & Shaw, 2012).

Kabak & Idsardi (2007) argue that the relevant phonotactic constraints that drive such perceptual illusions are the syllable-structure constraints of the language. They further argue that it is only constraints on the phonologically contrastive features that trigger the perceptual illusions. In Korean, voicing in stops is not contrastive, and is allophonically conditioned - voiced stops never appear in coda positions. Kabak & Idsardi argue that this syllable-structure constraint in Korean does not trigger illusory vowels, while coda constraints prohibiting contrastive phonological features (e.g., [strident], [spread glottis]) do trigger illusory vowels. In this paper, we show evidence contrary to this above claim.

Inspired by Bayesian models of speech perception (Feldman & Griffiths, 2007; Sonderegger & Yu, 2010), we claim that the task of the listener in speech perception is to identify the phonemic parse that best maps to the acoustic input given the phonological grammar of the language. Therefore, both contrastive and non-contrastive phonological features are expected to trigger perceptual epenthesis in an illicit phonotactic environment, along with the phonetic characteristics of the language. We show that voiced stops in illicit phonotactic contexts in Korean do trigger perceptual epenthesis, just as other phonological features. Therefore, the lack of effect in the original study could be because of either task-specific/stimulus-specific reasons.

We ran an identification task on 16 native Korean speakers, and 23 native American English speakers as controls, to ensure the effect was not driven by specific phonetic properties of the tokens themselves. We presented participants with pairs of nonce words of the form  $eC_1V_1ma$  [where,  $C_1 = p / b / d / t / k / g$ ;  $V_1 = i / u / \emptyset$  (Null)]. All the tokens had stress on the first vowel, and were natural recordings by a trained phonetician.

For native Korean speakers, we predict that the phonotactically illicit voiced stops in coda positions ( $eC_{[voiced]}ma$ ) trigger illusory vowels to a much higher degree than voiceless stops in a similar syllabic context ( $eC_{[voiceless]}ma$ ). The expected illusory vowel in such context is the *default vowel* [u] (Durvasula & Kahng, 2012). In contrast, for English speakers, since both voiced and voiceless stops are phonotactically licit in coda positions, we predict little to no perceptual epenthesis in such contexts.

In Figure 1 below, we show the percentages of misidentification of the no-vowel contexts as [u]. As can be seen, the Korean subjects are much more likely to perceive an [u] after voiced codas than after voiceless codas. On the other hand, the English speakers are at ceiling with all the relevant stimuli [Note: The percentages and error bars are mostly zeroes for the English speakers because of the ceiling effects].

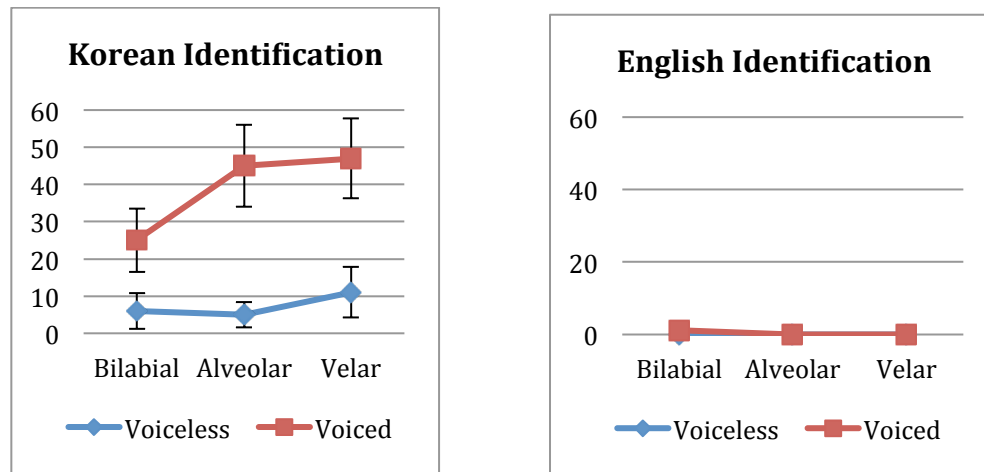


Figure 1. Percentages of erroneous [u] vowel identification for eCma stimuli, in Korean (left) and English (right) groups. Error bars represent standard errors.

Separate Repeated Measures ANOVAs for each language were run, with voicing, and place of articulation as factors. For the Korean speakers, as predicted, there was a main effect of voicing [ $F(1, 15) = 14.51, p = .002, \eta_p^2 = .49$ ]. There was also an unexpected main effect of place of articulation [ $F(2, 30) = 3.43, p = .046, \eta_p^2 = .19$ ], and an interaction of voicing by place of articulation [ $F(2, 30) = 4.15, p = .026, \eta_p^2 = .22$ ]. These unexpected effects do not detract from the main predictions, but do require further research. For the English speakers, as expected, there were no significant main effects of voicing [ $F(1, 22) = 1.00, p = .328, \eta_p^2 = .04$ ] or place of articulation [ $F(2, 44) = 1.00, p = .376, \eta_p^2 = .04$ ], and there was no significant interaction effect [ $F(2, 44) = 1.00, p = .376, \eta_p^2 = .04$ ].

Contrary to Kabak and Idsardi (2007), phonotactically illicit voiced stops in Korean trigger more illusory vowels than their voiceless counterparts in the same environment. More generally, we show that the phenomenon of perceptual epenthesis is also modulated by non-contrastive allophonic features.

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