

## What can be an illusory vowel in perceptual epenthesis?

### Category: Phonetics/ Phonology, Psycholinguistics

Perceptual epenthesis of illusory vowels has been claimed to be driven purely by surface phonotactics and phonetic characteristics of segments (Dupoux et al. 2011). In fact, as we will show, it is also crucially modulated by the phonological alternations in a particular 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 et al. 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 phonotactic 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. Furthermore, Kabak & Idsardi (2007) argue that the relevant phonotactic constraints that drive such perceptual illusions are the syllable structure constraints of the language. With respect to the quality of the illusory vowel, Dupoux et al. (2011) argue that it is the phonetically minimal element, or the shortest vowel, in the language (/u/ in Japanese, and /i/ in Brazilian Portuguese). Their claim predicts that there can be at most one illusory vowel in a language. However, a more generous interpretation of their claim results in the prediction that there can be at most one illusory vowel per phonetic context. In this paper, we falsify both these predictions. We show that in some contexts, it is possible to induce more than one illusory vowel.

We claim that the quality of the illusory vowels in Korean listeners is predicted straightforwardly by the phonological alternations in the language. While it is surely true that surface phonotactics and phonetic characteristics of segments have an effect on perceptual epenthesis, we propose that the quality of the illusory vowel also depends on the phonological alternations in the language. Korean has a morpho-phonological process of /u/ deletion in certain environments during morphological concatenation (Sohn 1999). This allows /u/ to be a good vowel for perceptual repairs because it sometimes maps to Ø (Null) in the surface representations. Furthermore, Korean has a process of palatalization of alveolar consonants before /i/ - the phonemes /t/ and /c/ neutralize to [c], and the phoneme /s/ surfaces as [ʃ]. Therefore, when the perceptual system encounters a [c], there are two possible phonemic parses - it can either be from the phoneme /t/, or from the phoneme /c/. If the perceptual system infers the phoneme to be a palatal /c/, given the illicit syllabic context, the /u/ vowel is induced for reasons mentioned above; however, if the perceptual system infers the phoneme to be an alveolar /t/, then an /i/ vowel is induced in the illicit syllabic context, because the only way to get a surface [c] from an underlying /t/ is to have a following /i/. Given this, we expect that the same illicit palatal [c] coda can induce both an illusory /i/ and an illusory /u/. In contrast, phones that do not have similarly ambiguous phonemic sources should trigger just one epenthetic vowel (/u/ by [t] and [s]; and [i] by [ʃ].)

We ran an AX discrimination task on 20 native Korean speakers, and 19 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<sub>1</sub>V<sub>1</sub>ma** [where, C<sub>1</sub> = t / s / c / ʃ; V<sub>1</sub> = i / u / Ø (Null)]. All the tokens had stress on the first vowel, and were natural recordings by a trained phonetician.

We take confusability between pairs of words with and without vowels, indicated by lower A', to suggest the induction of an illusory vowel (A' is a measure of discriminability. A' ≈ 0.5 reflects no discriminability; A' ≈ 1 reflects little to no confusion between pairs). Therefore, if [etmo] and [etumo] have an A' < 1, then the participant is probably inferring an illusory vowel in [etmo], at least some of the time.

A mixed ANOVA of A' revealed a main effect of language [ $F(1, 37) = 16.042, p < .001$ ], a main effect of word pair [ $F(11, 407) = 5.020, p < .001$ ], and an interaction of word pair by language [ $F(11, 407) = 7.809, p < .001$ ]. We ran planned t-tests to compare A' values for each relevant word-pair between the two language groups (Figure 1). [NOTE: x-axis labels below represent the C<sub>1</sub>V<sub>1</sub> portion of the word-pairs. When V<sub>1</sub> = Ø, word is represented with just C<sub>1</sub>. Also, ch = [ç], sh = [ʃ], u = [u].]. Contrary to our expectations, the A' for the Korean listeners for the eʃma/eʃuma pair ("sh/shu" in Figure 1) is highly significant too, compared to English controls; however, a hierarchical cluster analysis of the word pairs (not presented here) shows that the "sh/shu" pair does not pattern like the other significant differences.

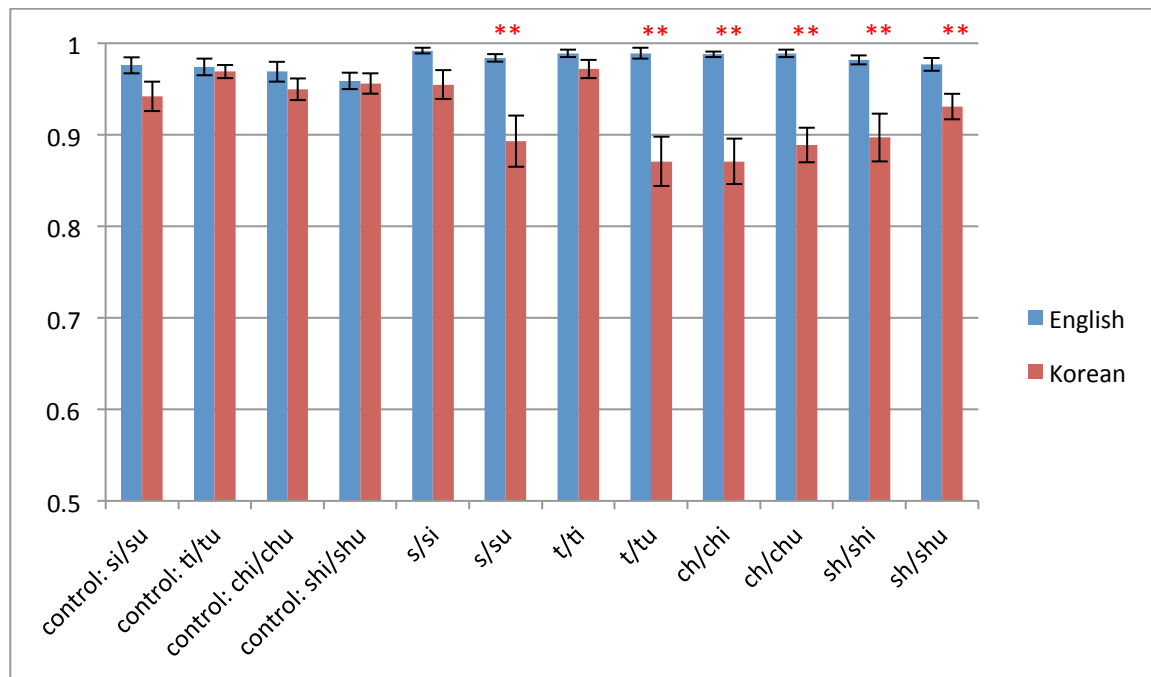


Figure 1: Average A' values for English and Korean listeners (error bars = 1 S.E.; \*\* =  $p < 0.01$ )

Contrary to Dupoux et al.'s (2011) predictions, and in support of our predictions, when presented with phonotactically illegal palatal [ç] codas, Korean speakers perceived both illusory /u/ and /i/. More generally, we show that phonological alternations, and by extension underlying representations, are crucial to the phenomenon of perceptual epenthesis.

## References

- Dehaene-Lambertz, G., E. Dupoux & A. Gout. 2000. Electrophysiological Correlates of Phonological Processing: A Cross-linguistic Study. *Journal of Cognitive Neuroscience* 12(4). 635–647. doi:10.1162/089892900562390.
- Dupoux, E., K. Kakehi, Y. Hirose, C. Pallier & J. Mehler. 1999. Epenthetic vowels in Japanese: A perceptual illusion? *Journal of Experimental Psychology-human Perception and Performance* 25(6). 1568–1578.
- Dupoux, E., E. Parlato, S. Frota, Y. Hirose & S. Peperkamp. 2011. Where do illusory vowels come from? *Journal of Memory and Language* 64(3). 199–210.
- Kabak, B. & W. J. Idsardi. 2007. Perceptual distortions in the adaptation of English consonant clusters: Syllable structure or consonantal contact constraints? *Language and Speech* 50. 23–52.
- Sohn, Ho-Min. 1999. *The Korean Language*. Cambridge, UK: The Cambridge University Press.