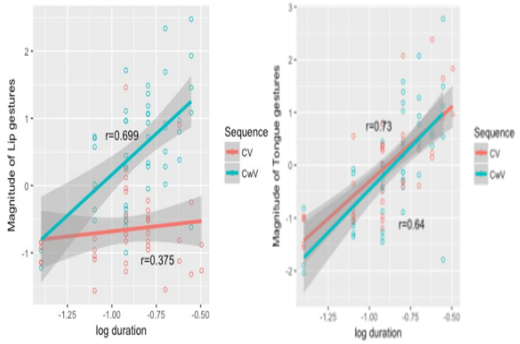
**Categorical and gradient effects in segmental deletion:**
**the case study of /w/-deletion in Seoul Korean**

**Introduction** In Seoul Korean, /w/ is variably deleted after a consonant (e.g. *sa.kwa→sa.ka* 'apple') and /w/-deletion is constrained by various linguistic and social factors (Silva, 1991; Kang, 1997; Kwon, 2016). /w/-deletion has been regarded as a categorical alternation of /w/ and zero only, hence the phonetic variability of /w/ has rarely been discussed in the literature. This study examines the effects of categoricity and gradiency on /w/-realization, using articulatory data.

**Methods** Three female speakers participated in the ultrasound recording. Midsagittal images of the tongue were recorded using the EchoB ultrasound machine with a 5-8 MHz convex-curved transducer (87fps for 70mm depth; 70% FOV). Also, the side-view video of the participants' face was videotaped to record lip rounding. The speakers participated in the semantic differential task of explaining the difference between 14 minimal pairs of words containing CV and CwV sequence (e.g. *tweji* 'pig' vs. *teji* 'earth'), which elicited 465 tokens. To quantify the amount of movement of articulators, Optical Flow Analysis (OFA), a video-based motion analysis tool measuring the magnitude of movement (MM) of two articulators, lips and tongue (Barbosa et al., 2008), was used. Mixed-effects regression models were fit to the normalized values of MM to examine the effects of DURATION and CATEGORY (CwV vs. CV).

**Figure1: The magnitude of lip (left) and tongue (right) gestures against log duration**




**Results & discussion** Several mixed effects models were constructed for the magnitude of lip and tongue gestures, respectively, and compared to each other in terms of their goodness-of-fit. For lip gestures, the model including DURATION and CATEGORY together with their interaction provides the best fit. Based on this model, CATEGORY has significant main effects ($p<0.001$); and more importantly, there is a significant interaction between CATEGORY and DURATION ($p<0.01$). Once the interaction is added, the sole effect of DURATION generates a non-significant p-value, highlighting how duration plays a bigger role in conditioning CwV than CV. In Figure 1, the correlation lines for CV and CwV diverge from each other, indicating a significant effect of CATEGORY. CwV exhibits a strong positive correlation between the magnitude of lip gestures and duration, with a Pearson's value of $r=0.699$ ($p<0.001$) while CV has a much weaker but significant value of $r=0.375$ ($p<0.001$). The amount of gestures for CwV is much more strongly correlated with duration than that of CV, which suggests that /w/ exhibits a wide range of temporal and gestural variability. The categorical distinction between CwV and CV is mediated by the gradient factor – DURATION: the longer the duration, the more robust the categorical distinction between the two. For tongue gestures, by contrast, both CwV and CV show a strong correlation with duration and do not show much difference from each other: tongue's contribution to making acoustic and perceptual cues for /w/ in Seoul Korean appears minimal. The findings demonstrate that the realization of /w/-deletion in Korean is subject to gradient phonetic effects as well as effects of category. The results are discussed in terms of how phonological processes evolves diachronically discussed (Bermudez-Otero 2015; Kiparsky 1995). This study also provides important methodological implications for research analyzing phenomena understood only as categorical processes.

**References**

Bermúdez-Otero, R. (2015). Amphichronic explanation and the life cycle of phonological processes. In *The Oxford handbook of historical phonology* (pp. 374-399). Oxford University Press.

Kiparsky, P. (1995). The phonological basis of sound change. The Handbook of Phonological Theory, edited by John Goldsmith.