Asymmetric Processing of Consonant Duration in Swiss German

Lara Ehrenhofer (University of Maryland, College Park),
Adam C. Roberts (Nanyang Technical University),
Allison Wetterlin (University of Oxford/University of Agder),
Sandra Kotzor (University of Oxford) and
Aditi Lahiri (University of Oxford)

In languages which encode a phonological contrast in consonant length, listeners extract durational information from the speech stream in order to both identify phonemes and build syllable structure. We investigated the interaction between these two aspects of durational processing in lexical access in Swiss German using the N400, an electrophysiological component which offers a fine-grained measure of the success of lexical processing. In our cross-modal semantic priming study, we tested whether words with phonetically distorted consonant duration (and therefore, an incorrect syllable structure) could trigger lexical access. We reveal a striking asymmetry in the toleration of manipulation: adding durational information is tolerated, but subtracting it is not. We argue that abstract syllable structure plays a decisive role in lexical access in quantity-sensitive consonant systems, and that the observed processing asymmetry indicates a bias towards parsing acoustic input into CV syllables.

Swiss German uses duration to encode an underlying quantity contrast in consonants word-initially, medially, and finally. Nearly all consonant types display this contrast, and all geminates and singletons (except sonorants, Kraehenmann, 2003)) can appear after underlyingly long or short vowels. Despite its gradability, duration is perceived as categorical in geminate-singleton discrimination (Abramson, 1986, 1987; Kraehenmann, 2003), just as it can contribute to segment identification on a featural level (e.g. voice onset time cues stop identity in English, Abramson, 1977). Contrary to feature-level distinctions, geminate durational information cannot be fully exploited until structural and prosodic information becomes available (Lahiri & Marslen-Wilson, 1992; Tagliapietra & McQueen, 2010). Our cross-modal semantic priming study pits segmental-level against syllable-level identification by presenting participants with primes whose medial consonant duration had been switched (see table). Singleton duration maps onto just one onset position within the syllable (CV.**CV**), whereas geminate duration maps onto a coda and an onset (CV**C.CV**), so manipulating consonant duration alters the prime's syllable structure.

Reaction times (RTs) and event-related brain potentials (ERPs) show that responses to

condition	prime		target		priming?
singleton word	[fɑtə]	*thread*	SCHNUR	*string*	yes
geminate nonword	*[fɑt:ə]				yes
geminate word	[rɑp:ə]	*penny*	FRANKEN	*franc*	yes
singleton nonword	*[rɑpə]				no

lengthened singleton nonword primes do not differ from responses to their original-duration counterparts (there is significant priming in both, i.e. lexical access has proceeded). However, the priming effect was significantly smaller in responses to shortened geminate nonword primes than in responses to their unmanipulated counterparts (i.e. lexical access was slowed; see Roberts, Kotzor, Wetterlin, & Lahiri, 2014 for similar results in Bengali). Structural information is thus as important as featural information in mapping acoustic input to word representation. These results suggest that the default is to parse input into CV syllables (the processing correlate of the Maximal Onset Principle), as priming occurs even in the geminate nonword condition: any amount of durational information suffices to build a CV.CV template and trigger lexical access. However, when a non-default CVC.CV template is required, the

initial CV parse can only be revised when there is sufficient durational information, so lexical access fails in the singleton nonword condition.

Geminates straddle two levels of representation in word recognition. Feature-level acoustic information is extracted in order to identify a segment, but durational information is required to situate it within the syllable template, the pivot of lexical access in Swiss German. We therefore argue that syllable-level representations are a powerful yet hitherto underestimated component of word recognition, especially in systems which encode underlying contrasts in phonological length.

References

Abramson, A. S. (1977). Laryngeal timing in consonant distinctions. *Phonetica*, *34*, 295–303.

Abramson, A. S. (1986). The perception of word-initial consonant length: Pattani Malay. *Journal of the International Phonetic Association*, *26*(1), 8–16.

Abramson, A. S. (1987). Word-initial consonant length in Pattani Malay. *Haskins Laboratories Status Report on Speech Research*, SR-91, 143–147.

Kraehenmann, A. (2003). *Quantity and prosodic asymmetries in Alemannic: synchronic and diachronic perspectives*. Berlin: Mouton de Gruyter.

Lahiri, A., & Marslen-Wilson, W. D. (1992). Lexical processing and phonological representation. In R. D. Ladd & G. J. Docherty (Eds.), *Papers in Laboratory Phonology II: Gesture, Segment, Prosody* (pp. 229–254). Cambridge: Cambridge University Press.

Roberts, A. C., Kotzor, S., Wetterlin, A., & Lahiri, A. (2014). Asymmetric processing of durational differences - electrophysiological investigations in Bengali. *Neuropsychologia*, *58*, 88–98.

Tagliapietra, L., & McQueen, J. M. (2010). What and where in speech recognition: Geminates and singletons in spoken Italian. *Journal of Memory and Language*, *63*(3), 306–323.