Initiation of nucleus vowels in English syllables with complex onsets

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Syllable structure and temporal stability patterns seem to be strongly linked to each other. Languages like English allow complex onsets and codas in their syllables. Depending on their position in the syllable, segments or combinations of segments seem to display different temporal organizational patterns. Specifically, previous studies have shown that English syllable initial clusters are timed with the vowel in the pattern known as the C-center effect (Browman & Goldstein, 1988, Marin & Pouplier, 2010). The C-center is the mean of the temporal midpoints of the onset consonants. The C-center effect refers to the fact that this timepoint seems to maintain a stable relation to the vowel. However, in an analysis of X-ray microbeam data, Goldstein et al. (2009) report that the C-center effect is dependent on segmental properties of the consonants that partake in the syllable. The dependence shows up most clearly in the temporal relation between the prevocalic consonant and the vowel. In the typical C-center pattern, the prevocalic consonant is expected to overlap more with the vowel in a CCV context than in a CV context, because in the former context the addition of a consonant causes adjustment of the local timing relations in the CCV string so as to maintain the global timing pattern (C-center stability). This expectation is met for /p/ when an initial /s/ is added to the syllable, but it does not seem to be met for /l/ which resists overlap with the vowel when an initial /p/ is added. Using Electromagnetic Articulography, the aim of the present work is to assess whether the results of Goldstein et al. (2009) can be replicated and to elaborate on any effects using more vocalic contexts and converging measurements. Representative results of pooled data across three speakers are shown in Fig. 1. The figure shows interval durations from the prevocalic consonant to the vowel, so-called CV lags, for the clusters /sp/ and /pl/ and their respective singletons. In agreement with the Goldstein et al. results, it can be seen that the difference between /pV/ and /spV/ is bigger than the difference between /lV/ and /plV/. In addition to these interval measurements, we report for the first time on measures of vowel articulatory initiation across CV and CCV, which more directly assesses the extent to which the prevocalic consonant overlaps with the vowel. Fig. 2 derives from measurements carried out with respect to the targets of the prevocalic consonant and the vowel (plateau onset, maximum constriction) and with respect to the target of C with the gestural onset of V. This figure allows us to see when the vowel begins in relation to the prevocalic consonant in /sp/ and /pl/ onsets. The vowel in /pl/ is initiated after the target of the prevocalic /l/, while in /sp/ the gestural onset of the vowel precedes the target of /p/. There is therefore, a substantially larger amount of overlap between the prevocalic consonant and the vowel in the /sp/ cluster than in /pl/ cluster, which may facilitate the timing of the vowel with the C-center of /sp/. We also report results on word-medial clusters as well, which we expect to pattern as in word-initial clusters since the syllabification is presumed to be the same across the initial and medial position (e.g. <u>sp</u>end and su<u>sp</u>end). By the time of the meeting, we will present a statistical assessment of our results. In conclusion, we provide further evidence that complex onset clusters in English have cluster-specific timing patterns. We furthermore quantify these timing patterns also by vowel initiation measures for the first time.

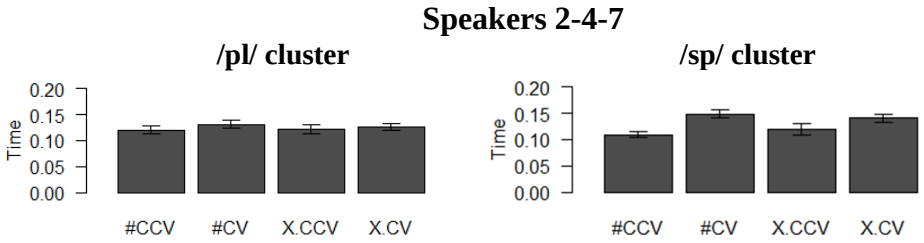

Fig. 1. CV lags across CV and CCV. The bars represent the interval from the maximal constriction of the prevocalic C to the maximal constriction of the V. The leftmost two bars (#CCV, #CV) show the interval's duration for the word-initial and the rightmost two bars (X.CCV, X.CV) the interval's duration for the word-medial position. For /sp, p/, the prevocalic consonant approaches the vowel in the complex cluster case compared to the singleton case (compare the height of the #CCV and #CV bars). For /pl, l/, no such effect is seen.

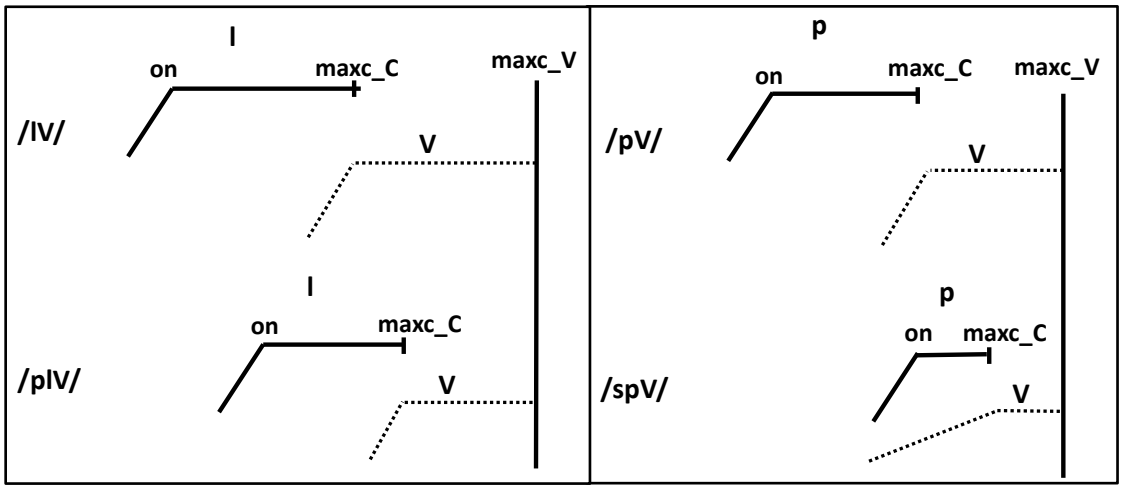

Fig. 2. Vowel initiation patterns. Gestural initiation of the vowel in the spV context, as shown by the start of the rise in the dotted line representing vowel movement in the diagram on the lower right corner, occurs substantially earlier than in all other contexts (/pV, lV, plV/). The landmarks *on* and *maxc* correspond to the plateau onset and the maximum constriction of the gesture respectively. The /lV/ sequence (left graph) across the CV and CCV contexts maintains the same relative timing pattern and is also shorter in the CCV context. The /pV/ sequence (right graph) changes both in duration and in relative timing in the CCV context in comparison to the CV context. /p/ is shorter in duration in CCV compared to CV; the vowel is also compressed (shorter plateau duration) and its gesture is elongated so that its initiation precedes the target of /p/.

References

Browman, C. & Goldstein, L. (1988). Some notes on syllable structure in articulatory phonology. *Phonetica* 45: 140-155.

Goldstein, L., Nam, H., Saltzman, E. & Chitoran, I. (2009). Coupled oscillator planning model of speech timing and syllable structure. In Gunnar Fant, Hiroya Fujisaki, & Jiaxuan Shen (eds.), *Frontiers in Phonetics and Speech Science*, 239-250. Beijing: The Commercial Press.

Marin, S. & Pouplier, M. (2010). Temporal organization of complex onsets and codas in American English: Testing the predictions of a gestural coupling model. *Motor Control* 14: 380-407.