Motivation

- V-to-V coarticulation offers insight into the (in)dependence of units of production, including internal coherence of syllables of different structure.
- Articulatory Phonology [1, 2] suggests different C & V coordination for onset vs. coda; while carrier models [3] suggest no difference.
- Most studies only deal with CV syllables, except [4].
- We investigate V-to-V coarticulation in English syllable sequences involving the homorganic /st/ cluster:

  - onset /rst/ → heterosyllabic /s/t/ → coda /st/ (syllable boundary)
  - Experiments show that syllable onset and coda differ:
    - acoustically: onset Cs are longer and cohere more with syllabically than with the word. Contrary to expectation, only weak evidence to support heterosyllabic /s/t/.
    - perceptually: onsets are more distinct than codas in noise [6]. VC syllables are heard as CV under some conditions [10]; adaptation is position specific [11].

Hypothesis

Since coda is more variable than onset, we predict:

- Degree of V-to-V coarticulation:
  - onset > coda > syllable.
  - (*no clear prediction for heterosyllabic cases*)

Design

- Vowel sequence: /aɪ/ (sil) /st/ /iɪ/ (sil)
- Onset CV # silVC /stV/ # silVC
- Heterosyllabic CV's /stV/ # silVC
- Coda CV's /stV/ # silVC
- /aɪ/ Bar Stressed Pass Tart Pass Art
- /ɪ/ Bee Stressed Pass Tart Beat Art
- /aɪ/ Boo Stressed Pass Tart Beat Art
- /ɪ/ Boo Stressed Pass Tart Beat Art

Measurements

- Intervocalic duration: [s] = [t] closure + [t] burst + aspiration
- F1, F2, F3 freq. at 3 locations (25 ms Hannings windows):
  - offset: centered 12.5 ms before periodicity offset
  - onset: centered 12.5 ms after periodicity offset
- onset 2: 26 ms after the [t] burst, for heterosyllabic sequences only (this is a compatible place to onset 1 in terms of opening trajectory, when VOT is long)

Results

- **Intervocalic duration**
  - longest intervocalic duration for heterosyllabic sequence in both contexts (F[2,10] = 13.04, p = 0.002)
  - onset > coda in anticipatory context (t[5] = 13.66, p < 0.0001)
  - onset > coda in carryover context (t[5] = 0.21, p = 0.84)

- Formant Frequencies
  - Degree of V-to-V coarticulation:
    - /aɪ/ onset > heterosyllabic
    - /ɪ/ onset > /aɪ/ onset
    - /aɪ/ onset > /ɪ/ onset
    - /ɪ/ onset > /aɪ/ onset

Discussion

- Contrary to expectation, only weak evidence to support the effects of syllable structure on V-to-V coarticulation:
  - coda > onset > heterosyllabic
  - Thus word/syllable boundaries in heterosyllabic s/t/ may reduce the degree of V-to-V coarticulation.

- Onset and Coda conditions have similar F2 frequency, intervocalic duration and degree of V-to-V coarticulation in target vowels. Contrary to the literature. Why?
- Stressed syllables can ‘attract’ both onset and coda consonants [12]. Did stress placement increase similarity between onset and coda?
- onset V vs. s/t/ → (ambisyllabic Vst/) similar to coda Vst/V
- Only if s/t/ release → similar to s/t/ release

- The tongue is strongly constrained in an /st/ cluster which may reduce its freedom to coarticulate [13].

Theoretical significance:

- Articulatory Phonology [1, 2] assumes gestures are timed and coordinated with respect to each other. Only Cs are phased with the V as a unit (the c-centre effect) while only the start of a coda cluster is phased with the V.

- Öhman’s [3] carrier model of coarticulation suggests that V forms a continuous diphthongal movement with Cs being superimposed onto it — onset and coda should not affect V-to-V coarticulation.

- Results seem more compatible with carrier model of coarticulation, but further investigations are needed to verify this conclusion, since V/C coordination patterns are presumably language-specific [14].

References


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Syllabification of the /st/ cluster and vowel-to-vowel coarticulation in English