Timing effects on successive alveolar consonants in Swedish

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Abstract: The duration of a consonant is potentially affected by various factors related to the phonetic nature of the segment and its phonetic environment. This study addresses the concurrent effects of prominence, syllable structure, and manner of articulation in inter-vocalic /s/+alveolar consonant, and alveolar consonant+/s/ clusters in Swedish. Six real words, imbedded in a carrier sentence, were repeated five times with, and five times without focal accent by ten native speakers of standard Swedish. Results show that the duration of a cluster, and the duration of its constituent consonants, are longer with focal accent than without focal accent. Consonant clusters with /s/ as the first member do not differ in duration from consonant clusters with /s/ as the second member. Clusters containing an alveolar stop are shorter than clusters with an alveolar nasal or alveolar liquid. The duration of /s/ is always longer than the duration of any adjacent alveolar stop, nasal or liquid. A number of interactions were found between prominence, cluster structure and manner of articulation indicating clear differences between the patterns of cluster internal timing for the investigated cluster pairs. These differences will be presented, compared with data on American English, and discussed.

BACKGROUND

The duration of a consonant is potentially affected by various factors related to the phonetic nature of the segment and its phonetic environment. This study addresses the concurrent effects of prominence, syllable structure, and manner of articulation in inter-vocalic /s/+alveolar consonant and alveolar consonant+/s/ clusters in Swedish.

The phonetic realization of prominence in Standard Swedish includes a temporal component (1), and a tonal rise (2). Consonant clusters are typically longer with focal accent than without focal accent (3, 4, 5, 6). Stressed syllables tend to have longer segment durations than unstressed syllables (e.g. 7, 8).

Previous research has shown that the overall duration of Swedish /s/+stop and stop+/s/ is not affected by the order of the /s/ and stop consonant within the clusters (5). However, consistent with the phonotactics of Standard Swedish, both the duration of the /s/ and the stops /p, t, k/ are systematically longer in the first position within a post-vocalic cluster than in the second position (5, 9).

How a consonant’s manner of articulation affects its duration is difficult to survey from the literature, partially because different measurement criteria have been used with respect to the stop: closure only, (e.g. 10, 11) and closure+burst (e.g.12); and the position of the consonant within the test word: initial, (e.g. 10, 11); and initial, inter-vocalic and final, (e.g. 13). However, in general, single fricative consonants are longer than stops, which in turn are longer than sonorants (Dutch: 12, English: 11, French Canadian: 10, Norwegian: 13). Although stops were found to be longer in the first than in the second position within French clusters (10), fricatives were consistently shorter in the first than in the second position. For English, the duration of /s/ is known to be shorter preceding a stop than in any other phonetic environment (11). In Swedish, the duration of a stop tends to be shorter than the duration of an /s/ regardless of their relative position within a two-element cluster (9).

AIM

The purpose of this investigation is to find out the extent to which the following factors affect the segmental durations in inter-vocalic /s/+alveolar and alveolar+/s/ consonant clusters (/st, sn, sl/ and /ts, ns, ls/ respectively):

1. prominence: focal accent vs. non-focal accent
2. cluster structure: /s/+alveolar vs. alveolar+/s/
3. manner of articulation: alveolar: stop vs. nasal vs. liquid.
These findings can then form a solid foundation for comparisons with other related investigations (e.g. 3, 4, 5, 6, 9), and lead to a better understanding of the pattern of timing within clusters.

**METHOD**

Six real Swedish words *pasta-satsa*, *Tessla-valsa*, *lessna-dansa* (pasta-to bet, female name-to waltz, sad-to dance), imbedded in a carrier sentence, were repeated five times with, and five times without, focal accent by ten native speakers (five males and five females) of Standard Swedish. The duration of /s/-frication, /t/- and /n/-closure, and the /l/ were measured. In addition, the overall duration of clusters was calculated. The statistical analysis included a three-factor analysis of variance (prominence * cluster structure * manner of articulation).

**RESULTS**

As expected, the duration of a cluster, and the duration of its constituent consonants are longer with focal accent than without focal accent (1, 3, 4, 5, 6).

Consonant clusters with /s/ as the first member do not differ in duration from consonant clusters with /s/ as the second member, indicating a general tendency to keep cluster durations constant (5). However, the duration of the /sn/-cluster is longer than the duration of the /ns/-cluster, which may be due to the laryngeal co-articulation. Consistent with earlier findings in Swedish (5, 9), the duration of a consonant in the first position within a post-vocalic consonant cluster is always longer than the duration of the same consonant in the second position. In this respect, Swedish differs from other languages (e.g., French: 10, English: 11).

Clusters containing an alveolar stop are shorter than clusters with an alveolar nasal or alveolar liquid. The duration of /s/ is always longer than the duration of any adjacent alveolar stop, nasal or liquid. The general tendency, that single fricatives are longer than single stops, which in turn are longer than single sonorants (10, 11, 12, 13) seems to also be valid within consonant clusters.

The duration of /s/ preceding the stop /t/ and the nasal /n/ is longer than preceding the liquid /l/. Also, in the first cluster position the durations of /t/ and /n/ are longer than the duration of /l/. This might be due to the close articulatory relationship between stops and nasals. However, the duration of /s/ following the stop /t/ is shorter than following the nasal /n/, which in turn is shorter following the liquid /l/. In the second cluster position the duration of /t/ is shorter than the duration of /n/, which in turn is shorter than the duration of /l/. Altogether, the intrinsic duration of consonants produced in different ways varies depending on their position within a cluster.

A number of interactions were found between prominence, cluster structure and manner of articulation indicating clear differences between the patterns of cluster internal timing for the investigated cluster pairs. These differences will be presented and discussed in detail.

**REFERENCES**