On inter-consonantal coordination patterns in French and the interpretation of gestural overlap

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The present paper reports on the articulatory coordination patterns in complex phonetic consonant sequences in word initial position in French. The central question addressed is whether, and to what extent, certain quantitative measures that are common in current speech timing analysis allow us to derive claims about the properties of underlying speech planning.

The background to this research are several principles that are hypothesized in some recent accounts to underlay the relative stability of inter-articulatory timing in word- and/or syllable-initial consonant sequences. All proposals are more or less further developments of the earlier model of Articulatory Phonology [1]. A key assumption thereby is that the relevant units of articulation are dynamically defined *gestures*, which supposedly capture both, the phonological and physical properties of speech. As a consequence, the information about the temporal relationships between gestures for a given lexical entry is viewed as being part of the lexicon. Examples of accounts, which propose detailed principles of the relative timing specification in a lexical item, are the Phase Window Model [2,3], the Bonding Strength Model [4,5] or Gestural Coordination Constraints [6].

A crucial role in these as well as numerous other empirical studies on the spatio-temporal organization of articulator activity is played by the notion of 'overlap' among articulatory gestures. One common way to evaluate gestural overlap is to examine the measured intervals between some key properties of observable articulatory movements, and, drawing on the theoretical assumptions of the given framework, to indirectly uncover some general principles of the underlying temporal specification and control strategies.

The data to be presented is taken from 3D electromagnetic recordings (Carstens AG500) of lip, jaw and tongue movements of three French speakers. The corpus consisted of French mono- and bi-syllabic words with all phonotactically legal singleton consonants as well as bi- and tri-consonantal clusters in initial position. Whenever possible, the onset consonant(s) were followed by the vowel /i/ and /a/. The kinematics of articulator movement

were analyzed by measuring durational characteristics, amplitude and maximal velocity. The temporal organization between component consonants was examined via different measurements of gestural overlap, assessing the relative timing of (observable) gesture initiation as well as (observable) gesture target achievement.

A series of selected data will be used to illustrate how, as to be expected, the phonetic details of intra- and intergestural timing can be affected by a multitude of factors. Among those are, most notably, the manner of the consonants (e.g. word-initial stop vs. word-initial fricative sequences), the order of the place of articulation of the component consonants (e.g. labial-alveolar vs. velar-alveolar sequences), the voicing of the consonant clusters, and the nature of following vocalic context. We will present the peculiarities of the timing patterns and explore their possible origins, by making an attempt to relate some of the coordination regularities to the underlying principles proposed in the literature. The discussion will focus primarily upon a set of questions rather than answers. How can we assess gestural overlap in face of compound trajectories, reflecting the adjustment of a movement to two or more phonetic objectives at a given time [7]? Should / can we apply the same measures of speech timing across a variety of sounds? Or are the various patterns of results partially an indication that the commonly used articulatory landmarks, such as closure or constriction duration, imply diverse events depending on manner, place and voicing? Finally, to what extent can we distinguish between aspects of the data that are to be attributed to lower-level physical structures and those resulting from higher-order organizational factors of speech movement control?

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