

The C-Center and Syllabification in Moroccan Arabic

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Browman and Goldstein (1988) introduce the hypothesis that syllables reflect schemes of organization which are embodied in characteristic patterns of temporal coordination. Preliminary evidence in support of this hypothesis comes from the stable pattern of coordination, referred to as the “C-Center,” identified in the timing of onset clusters in English, whereby the onset of the articulatory gesture corresponding to the vowel begins at the midpoint of the onset cluster, regardless of the number of onset consonants (see 1). Recent cross-linguistic data from Georgian and Tashlhiyt Berber provide evidence suggesting that the “C-Center” can be used as a diagnostic for syllable affiliation (Goldstein, Chitoran, Selkirk 2007). In this paper, we apply the C-Center diagnostic to new articulatory data for Moroccan Arabic, a language for which onset syllabification remains a contentious issue, producing evidence against onset clusters and in support of the syllable parse advanced in Dell and Elmedlaoui (2002).

Goldstein *et al.* (2007) show that the “C-Center” pattern of timing characteristic of English onset clusters (Browman and Goldstein 1988, Honorof and Browman 1995, Byrd 1995) describes the timing of initial clusters in Georgian, but not in Tashlhiyt Berber. This result concurs with independent phonological arguments claiming that English and Georgian allow complex onsets whereas Tashlhiyt Berber disallows them. In order to evaluate the presence of “C-Center” timing, Goldstein *et al.* (2007) measure the latency from achievement of target of the consonant to achievement of target of the vowel and show that for Georgian, this value decreases with the addition of consonants while, in Berber, it is unaffected (see results in 2).

Previous theoretical analyses of Moroccan Arabic disagree as to whether strings such as *glīh* ‘to grill’ contain one syllable (*glīh*) (Heath 1987, Benkirane 1997), as they would in English and Georgian, or two (*g.līh*), as in Tashlhiyt Berber (Dell and Elmedlaoui 2002 argue this to be the case also for Moroccan). To investigate the syllabic affiliation of word-initial consonants in Moroccan, we conducted 3D Electromagnetic Articulometry (EMA) with one speaker of the Oujda dialect. The stimuli set consisted of words differing in the number of initial consonants, e.g. *bulha* ‘urine’, *sbulha* ‘ear’, *ksbulha* ‘to own for her’. Ten repetitions per token and a total of 92 tokens were analyzed.

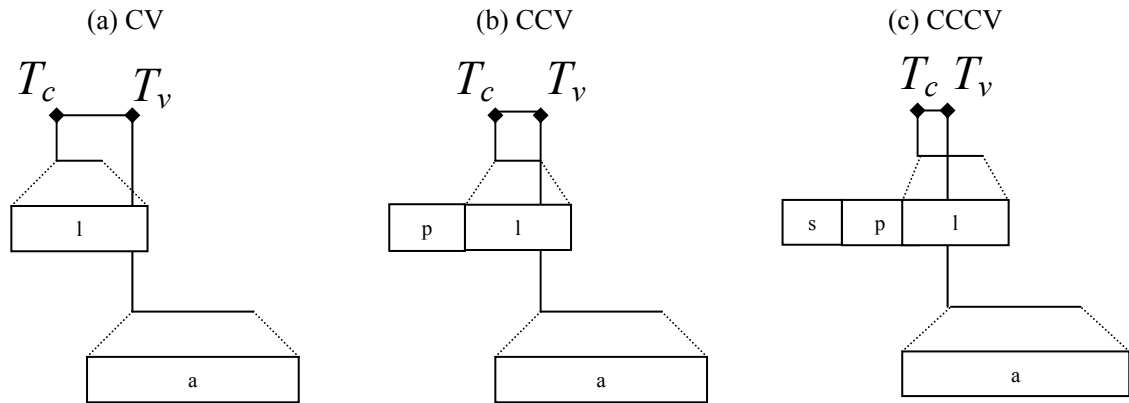
Absolute measures of mean latency between target CV sequences across the three conditions (one, two and three consonants) trended in the direction of a C-center effect in that the latency value decreased with the addition of a consonant (see 2). The magnitude of the effect is much weaker than that reported for Georgian (and English) and reaches statistical significance for C vs. CC but never for CC vs. CCC. The figure in (2) shows mean latencies by condition for Moroccan against the data for Georgian and Berber. At first, this seems to provide evidence contra Dell and Elmedlaoui’s (2002) proposal on syllabification in Moroccan Arabic.

Further analysis of our corpus reveals, however, additional factors which influence the absolute latency measures and lead us eventually to interpret the data as evidence for a bi-syllabic parse of initial clusters. Primary amongst these is an effect of prosodic word boundary on consonant timing (Fougeron and Keating 1997, Keating *et al.* 2004, Byrd *et al.* 2005). The achievement of target landmark used to calculate latencies was earlier relative to the point of maximum constriction in consonants at word boundaries. Thus, the drop in latency in (2) from the C to the CC condition is due in part to the influence of the word boundary which affects the C-to-V latency measure only in the C condition. Subtracting the average effect of the prosodic word boundary on the closing duration of a consonant from the latency value in the C condition yields a corrected latency value which is not significantly different from the other conditions (CC and CCC). We are then left with consistent evidence across all conditions for a hetero-syllabic parse of initial clusters, in agreement with Dell and Elmedlaoui’s (2002) analysis.

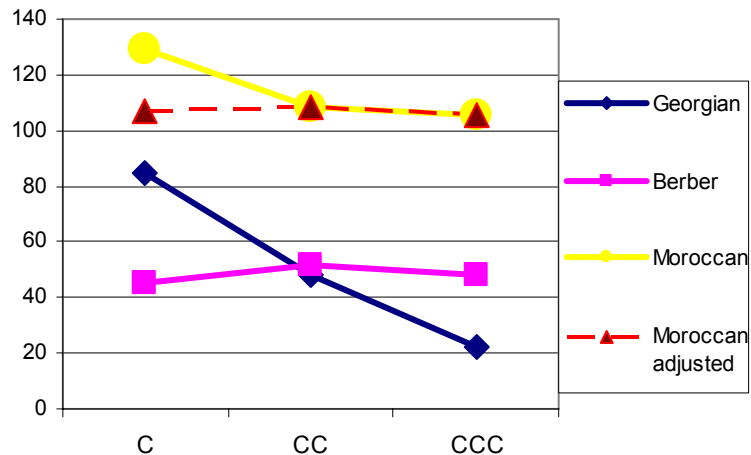
In sum, if independent influences on timing are properly factored out, it is possible to recover grammatical influences on temporal coordination from articulatory kinematics. Specifically, the present results allow us to tentatively conclude that (at least) certain aspects of syllable structure may be reflected in the temporal organization of consonants and vowels.

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(1) C-center timing: the distance between the *achievement of target landmark* T_c in the consonant closest to the vowel and the *achievement of target landmark in the vowel*, T_v , decreases as consonants are added to a syllable.



(2) Latency measures (y-axis): distance from T_c to T_v in (1) by condition (C, CC, CCC).



Selected References

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