Syllabification of word-medial clusters in Moroccan Arabic

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Recent work has provided evidence that syllables consist of schemes of organization expressed in terms of characteristic temporal coordination patterns. Word-initial clusters in languages like English show a stable pattern of timing associated with the onset consonants and the subsequent vowel whereby the vowel appears to be timed globally to the preceding consonantal cluster (the so-called C-Center effect, Browman & Goldstein 1988). English is a language which permits syllables with complex onsets; both "lay", "play" are monosyllables. The conjecture has therefore been put forward that the C-Center effect embodies the temporal basis of complex onsets (Browman & Goldstein 1988). In contrast, Shaw *et al*. (2009) show that for word-initial clusters in Moroccan Arabic (MA), the C-Center of the prevocalic consonantal cluster is perturbed as consonants are added, from CV to CCV to CCCV. MA thus exhibits a different 'local' timing pattern: it is the interval delimited by the immediately prevocalic C and the vowel which shows stability. This is a 'local' timing pattern because stability holds over the adjacent gestures of the CV string to the exclusion of extra consonants that may exist before the immediately prevocalic C. MA is also a language in which complex onsets are disallowed (Dell & Elmedlaoui 2002); in [kra] 'rent', [k] is in a different syllable from [ra]. Therefore, there appears to be a correspondence between syllable structure and temporal stability patterns. In MA, but not in English, since only the immediately prevocalic consonant is in the same syllable with the subsequent vowel, their timing relation should remain stable when another consonant is added, as shown by the data reported so far. However, both the MA and the English data heretofore concern word-**initial** clusters. If the timing patterns found in MA are characteristic of syllable-initial as opposed to word-initial clusters, then that same timing pattern should also be found for MA word-**medial** clusters, since in both word positions the syllabification is claimed to be the same. In our present work, we show that word-medial clusters do indeed show the same temporal properties as word-initial clusters. Herein, we report data from one MA speaker, recorded using Electromagnetic Articulography; we expect to report results from a second speaker by the time of the meeting. A subset of our stimuli, which included a wide variety of clusters so that we can robustly test for generality, are in Table 1. Following past work, we quantified the durations of the Left Edge (LE) to the acoustic offset of the Vowel (henceforth, V), the C-Center-to-V, and the Right Edge (RE)-to-V intervals across word-medial clusters of one (VCV), two (VCCV), and three C's (VCCCV). As in past work, the LE is the timestamp of the target achievement of the first consonant in a cluster, the C-Center is the mean of the midpoints of the plateaus of all consonants in a cluster, and the RE is the timestamp of the release of the final consonant in a cluster. Our results (Table 1) indicate that the RE-to-V interval shows the highest degree of stability in contrast to the C-Center-to-V and the LE-to-V intervals. Figure 1 shows interval means as a function of cluster size: the RE-to-V is the most stable interval. In contrast, the LE and the C-Center are perturbed by an increasing number of prevocalic consonants. In sum, we have shown that the timing patterns previously reported for word-initial clusters in MA extend to the word-medial position. Overall, our results so far support the broad hypothesis that the syllabic organization of speech is reflected in patterns of temporal coordination.

	LE-to-V			**C-Center-to-V**			**RE-to-V**		
Stimuli	*Mean*	*SD*	*RSD*	*Mean*	*SD*	*RSD*	*Mean*	*SD*	*RSD*
daba~galba~maglba	252.22	75.88	30.08	202.10	36.29	17.96	159.84	8.23	**5.15**
daba~nadba~makdba	268.75	77.31	28.77	211.99	40.18	18.95	161.81	8.47	**5.23**
taza~dabza~madbza	260.64	79.21	30.39	206.32	40.14	19.45	153.56	11.21	**7.30**
kasha~kamsha~makmsha	281.93	78.18	27.73	215.81	37.93	17.58	140.47	10.40	**7.40**
gasa~gabsa~malbsa	248.51	59.57	23.97	207.52	52.26	25.81	151.49	8.79	**5.80**
hama~hasma~mabsma	260.76	72.99	27.99	207.16	40.54	19.57	155.76	8.70	**5.59**
hala~hamla~manmla	241.83	68.74	28.42	189.87	38.51	20.28	134.12	10.79	**8.04**
hala~hamla~magmla	251.64	79.19	31.47	192.87	41.29	21.41	137.68	15.15	**11.00**
jana~jabna~galbna	241.17	56.96	23.62	193.97	31.03	16.00	141.60	8.55	**6.04**
baka~maska~mamska	254.38	58.88	23.15	211.12	34.15	16.17	161.99	9.61	**5.93**
naga~sabga~manbga	266.22	56.64	21.28	215.80	33.04	15.31	163.10	12.99	**7.97**
jana~jabna~majbna	256.75	73.87	28.77	201.10	28.34	19.07	143.83	8.46	**5.88**
TOTAL	257.06	69.79	**27.15**	204.64	38.64	**18.88**	150.44	10.11	**6.72**

Table 1 *Interval durations of the LE, C-Center, and RE-to-V of C, CC, and CCC clusters: mean (in ms), standard deviation (SD in ms), and relative standard deviation (RSD in %). In all cases, the minimum in variability (the maximum in stability) is seen for the RE-to-V interval.*

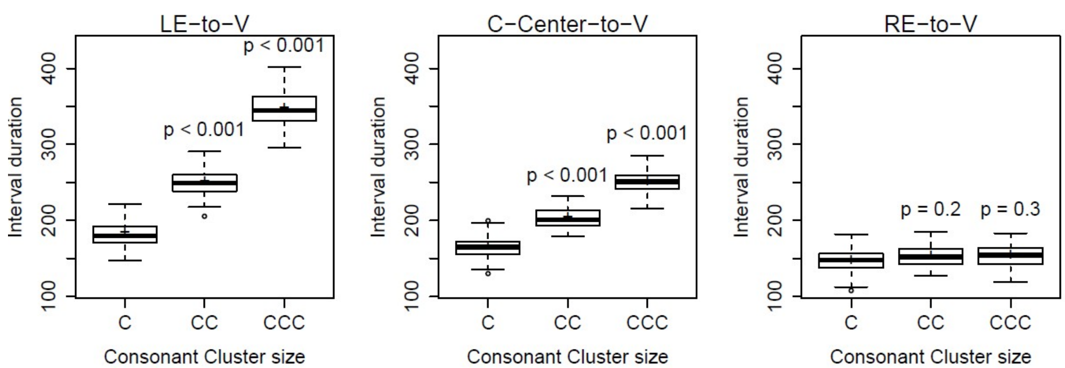

Figure 1 *Interval duration of the LE, C-Center, and RE-to-V as a function of cluster size (C, CC, CCC). The p-values assess the significance of the difference between the population represented by each boxplot and the unperturbed C condition (left).*

Selected References

Browman, C. P. and L. Goldstein. (1988). Some Notes on Syllable Structure in Articulatory Phonology. *Phonetica*, **45**, 140-155.

Dell, F. and M. Elmedlaoui. (2002). *Syllables in Tashlhiyt Berber and in Moroccan Arabic*. Dordrecht, Netherlands, and Boston, MA: Kluwer Academic Publishers.

Shaw, J. A., Gafos, A., Hoole, P. and C. Zeroual. (2009). Syllabification in Moroccan Arabic: evidence from patterns of temporal stability in articulation. *Phonology*, **26**, 187-215.