Temporal patterns and syllable structure in Greek: a c-centers perspective

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The syllable structure of Greek constitutes a phonological challenge, since it allows an extensive set of prevocalic consonant sequences, including sonority rises /fl kl θr pr xn pn/, but also sonority plateaus /sθ fθ kt mn/ and reversals /sp ft/. While Greek lacks substantial phonological evidence favoring a particular syllabification, cf. *raddoppiamento fonosintattico* in Italian, it is generally considered an open syllable language (Setatos, 1987), which maximizes onsets (Kappa, 1997) and disfavors codas – with the exceptions of /s/ and, only word medially, /n l r/ (Tzakosta, 2012). Earlier endeavors to formalize the tautosyllabicity of these sequences have not succeeded in providing a unified account; language-specific sonority scales exclude certain phonemes (Kappa, 1995) or overgenerate clusters (Tzakosta, 2012), while skeletal interpretations cannot account for sonority plateau patterns (Malikouti-Drachman, 2001). More recently, studies have shifted to experimentally-oriented means to study the syllable (Gratsouni & Topintzi, 2020; Harris & Chiu, 2023). This paper follows this line of research and seeks to further explore the syllable structure of Greek through a *c-center*s experimental design.

C-centers originate in the framework of *Articulatory Phonology* (Browman & Goldstein, 1988), which proposes that different syllabic organizations are identifiable through temporal relationships between articulatory landmarks. The c-center landmark refers to the temporal midpoint of a consonant, or the mean of respective midpoints in a consonant sequence. When a language admits complex onsets (e.g., English: Browman & Goldstein, 1988), the durational distance between a c-center and a later landmark, the *anchor*, i.e., the c-center of a post-vocalic consonant (Shaw et al., 2009), remains stable across CVC and CCVC sequences. When the consonantal sequence is not tautosyllabic and a simple onset is formed with only the prevocalic consonant (e.g., Moroccan Arabic: Shaw et al., 2009), the *c-center-to-anchor* duration significantly increases from CVC to CCVC. Crucially, what remains stable in this case is the interval between the release of the prevocalic consonant (*right edge*) and the *anchor* (*right-edge-to-anchor*). Recent studies on English and Jazani Arabic (Durvasula et al., 2021) and Moenat Ladin (Walker & Yang, 2022) illustrate that using comparable *acoustic* landmarks can approximate these temporal stability patterns effectively.

In order to explore these relationships in Greek, we constructed an *acoustic c-centers* design targeting 28 consonant sequences attested in Greek, specifically: /pl kl pr kr tr xl fl θl xr fr θr sf sx sθ sp sk st fθ xθ pt kt ft xt ps ks ts pn mn/, in two word settings: word-initially and -medially. Four nonwords were constructed for each target sequence. For [st] the nonwords were ['tasa] and ['stasa] for the word-initial condition, and [pa'tas] and [pa'stas] for the word-medial condition. The nonwords containing singletons acted as controls of time stability, i.e., the minimally tautosyllabic sequence (Durvasula et al., 2021). The nonwords were included in the carrier sentence ['pite _ pa'du] '*say _ everywhere*'. As /s/ is the only accepted word-final coda in Greek, an across-word-boundaries condition was added for the sequences including /s/ as C_1, i.e., /sf sx sθ sp sk st/. For this condition, the carrier sentence became ['ipes_ pa'du] '*you said _ everywhere*' and included the nonwords with a word-initial singleton, to create a consonantal sequence across word boundaries, i.e., ['ipe**s** '**t**asa pa'du]. 10 native speakers of Greek aged 20 - 36 produced 8 repetitions of each sentence, amounting to a corpus of 6560 items.

We found a *c-center-to-anchor* stability pattern for obstruent + /l/ clusters, but only word-initially, as well as for /ts/ word-initially and -medially. Every other combination produced a *right-edge-to-anchor* pattern across word contexts, pointing to heterosyllabicity of

the segments. These results highlight the discrepancy of onset organization word-initially and -internally (Broselow, 2003) and the special status of the Greek affricate (Tzakosta & Vis, 2009). Importantly, they also challenge the relevance of the *maximal onset* to Greek (Kappa, 1997), as well as its status as an open syllable language (Setatos, 1987). Rather, they agree with more recent findings suggesting that speakers are more tolerant of obstruent codas, at least word-medially (Gratsouni & Topintzi, 2020). Finally, our findings suggest that Greek resembles the hybrid onset system of Italian (Hermes et al., 2013) and Moenat Ladin (Walker & Yang, 2023) in admitting both complex and simple onsets.

References

Broselow, E. (2003). Marginal phonology: phonotactics on the edge. *The Linguistic Review* 20, 159-193

Browman, C. P., & Goldstein, L. (1988). Some notes on syllable structure in articulatory phonology. *Phonetica 45*(2-4), 140-155.

Durvasula, K., Ruthan, M. Q., Heidenreich, S., & Lin, Y. H. (2021). Probing syllable structure through acoustic measurements: case studies on American English and Jazani Arabic. *Phonology* 38(2): 173-202.

Gratsouni, D., & Topintzi, N. (2020). On the Syllabification of ON (Obstruent-Nasal) Clusters in Greek. *Studies in Greek Linguistics 40*, 105-113.

Harris, J., & Chiu, F. (2023). #sC in stereo: A dichotic-listening study of initial clusters in Cypriot Greek. In F. Breit, Y. Yoshida, C. Youngberg (Eds.), *Elements, Government and Licensing* (pp. 98-111). UCL Press. https://doi.org/10.2307/jj.332955.16

Hermes, A., Mücke, D., & Grice, M. (2013). Gestural coordination of Italian word-initial clusters: the case of 'impure s'. *Phonology,* 30(1), 1-25.

Kappa I. (1995). *Silbenphonologie im Deutschen und Neugriechischen*. [Doctoral dissertation], University of Salzburg.

Kappa, I. (1997). A first approach to the optimal Codas in Modern Greek. In G. Drachman, A. Malikouti-Drachman, J. Fykias, S. Klidi (Eds.), *Greek Linguistics '95. Salzburg 22–24 September 1995* (pp. 25-33). W. Neugebauer.

Malikouti-Drachman, A. (2001). Greek phonology: A contemporary perspective. *Journal of Greek Linguistics* 2(1): 187-243.

Setatos, M. (1987). *Από τα Αρχαία στα Νέα Ελληνικά: Φωνολογικές αλλαγές* [From Ancient Greek to Modern Greek: Phonological changes]. *Studies in Greek Linguistics* 8: 187–193.

Shaw, J. A., Gafos, A. I., Hoole, P., & Zeroual, C. (2009). Syllabification in Moroccan Arabic: evidence from patterns of temporal stability in articulation. *Phonology 26*(1), 187-215.

Tzakosta, M., & Vis, J. (2009). Phonological representations of consonant sequences: the case of affricates vs. 'true' clusters. In M. Baltazani, G. K. Giannakis, T. Tsangalidis, & G. J. Xydopoulos (Eds.), 8th International Conference of Greek Linguistics: Ioannina, Greece, Augustus 30th-September 2nd 2007 (pp. 558-573). University of Ioannina

Tzakosta, M. (2012). Manner, place and voice interactions in Greek cluster phonotactics. In P. Hoole, L. Bombien, M. Pouplier, C. Mooshammer & B. Kühnert (Eds.), *Consonant Clusters and Structural Complexity* (pp. 93-118). De Gruyter Mouton. https://doi.org/10.1515/9781614510772.93

Walker, R.& Yang, Y. (2023). Temporal coordination and markedness in Moenat Ladin consonant clusters. In Elkins, N., Hayes, B., Jo, J., & Siah, J. (Eds.), *Supplemental Proceedings of the 2022 Annual Meeting on Phonology*. Linguistic Society of America. https://doi.org/10.3765/amp.v10i0.5443