

Order, sonority and overlap in Georgian syllable onsets

Caroline Crouch, Argyro Katsika

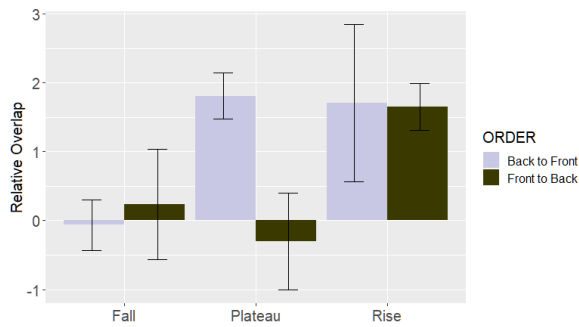
Sonority sequencing principles (e.g. [6][7][8]) can be used to meaningfully explain phonotactic and phonological processes across languages, especially with respect to syllable structure. However, there are few, if any, definite phonetic correlates of sonority beyond intensity[10]. This study investigates the relationship between the sonority shape of complex syllable onsets, the order of place of articulation of constituent consonants and articulatory overlap between these consonants in Georgian (Kartvelian, Georgia; geo). Specifically, we ask how the sonority profile of a syllable onset affects aspects of the overlap within an onset cluster, and directly test the hypothesis that sonority can be understood in articulatory phonetic terms by linking it to the degree of overlap [3]. We further address how place of articulation interacts with sonority, and postulate that sonority rises will show more stability—that is, less variation in overlap—across order conditions as a reflection of their being the most preferred sonority shape cross-linguistically.

We use electromagnetic articulography (EMA) to examine the movements of the tongue, lips and jaw during the production of fourteen Georgian onset clusters consisting of two consonants (C1 and C1) that cross three sonority shapes (rise, fall and plateau) with front-to-back and back-to-front orders of place of articulation, known to affect overlap[1]. We report here results from a pilot experiment with one speaker who produced each target word eight times in isolation and eight times in a carrier phrase for a total of sixteen tokens per word and 224 tokens overall. The carrier phrase was *k'idev* _____ *vtkvi* ('I said _____ again'). Analysis of data from more participants is underway. Consonant constriction gestures were semi-automatically labelled using custom software (Mark Tiede, Haskins Laboratories). Two measures of overlap were calculated: 1) at what point in C1's plateau C2 is initiated (C2 Onset-C1 Plateau Onset/C1 Plateau)[2][4]; and 2) the amount of plateau overlap (Offset C1 Plateau-Onset C2 Plateau/Onset C1 Plateau-Offset C2 Plateau)[5]. Data were analyzed in R[11] using a linear mixed effect model for each measure with Order, Sonority and their interaction as the fixed effects and a random effect of Word.

Analysis of the words in the carrier phrase shows that order of place of articulation and sonority shape affect both measures of overlap. For Measure 1, Order [$\chi^2(3)=14.656$, $p<.01$], Sonority [$\chi^2(4)=19.61$, $p<.001$], and their interaction [$\chi^2(2)=7.655$, $p<.01$] are significant in the model. Post-hoc pairwise comparisons using R's *relevel* function with a Bonferroni correction reveal all three sonority shapes are significantly ($p<.05$) different from one another. This could point to a mechanism to make the clusters more sonority-conforming by initiating the less sonorous segment closer to the beginning of the syllable. For Measure 2, Order [$\chi^2(3)=18.906$, $p<.001$], Sonority [$\chi^2(4)=20.028$, $p<.001$], and their interaction [$\chi^2(2)=18.563$, $p<.001$] are significant in the model. In all conditions there is plateau lag. Post-hoc pairwise comparisons found that order of articulation is significant within sonority falls and plateaux ($p<.01$); in falls there is more lag in front-back-clusters, while the reverse is true for plateaux.

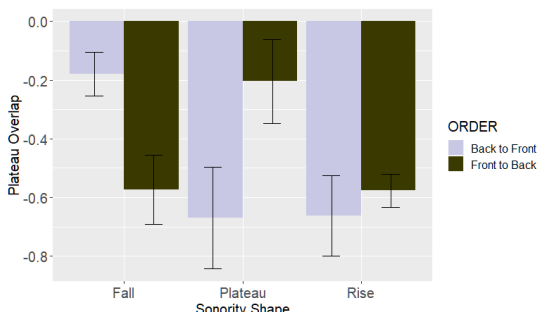
Taking the results of both measurements together we can see a larger picture emerge. All CC onsets in Georgian have plateau lag, which we can say is the "default" pattern of overlap in Georgian onsets; one that has low overlap and therefore less obscuring of perceptual cues. This naturally creates an environment for intrusive vocoids, which are found in our data in sonority rises only. In sonority falls the high degree of relative overlap serves to block intrusive vocoids in these sequences, which helps to ensure a tautosyllabic parse. By combining these two measures of overlap, we can draw novel conclusions about timing in Georgian, and begin to explain how Georgian allows and maintains syllable onsets of such diverse sonority shapes.

Figure 1a. Relative onset (Measure 1) across sonority shapes and order of place of articulation



Negative values indicate that C2 begins before C1 reaches its target

Figure 1b. Plateau overlap (Measure 2) across sonority shapes and order of place of articulation



All values are negative, indicating plateau lag in all

Table 1 Stimuli organized by experimental factor

	Front to back	Back to front
Sonority rise	bre lo ‘chaff’ p’ledi ‘rug’	tmaze ‘hair.in’ dmanisi (place)
Sonority plateau	mnaxe ‘see’ bk’ichi ‘raisin’ bgera ‘sound’	t’baze ‘lake.in’ k’bili ‘tooth’ kbena ‘sting’
Sonority fall	mtaze ‘mountain.in’ mdare ‘worthless’	rbena ‘running’ lp’eba ‘decaying’

Proceedings of the XVI International Congress of Phonetic Sciences, (pp. 1361-1364).

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