

Sonority, order, and overlap in Georgian syllable onsets

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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 of the sonority shape of complex syllable onsets and the order of place of articulation of constituent consonants with articulatory overlap between these consonants in Georgian. Specifically, we ask how the sonority profile of a syllable onset affects aspects of consonant overlap, 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.

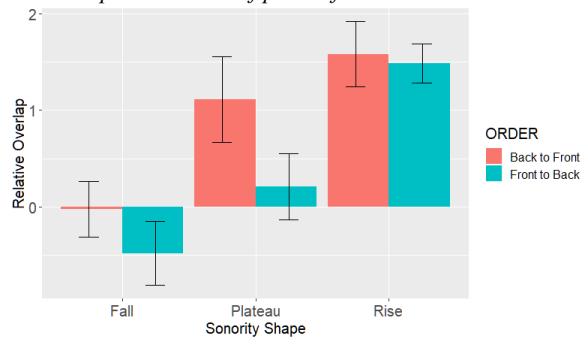
We use electromagnetic articulography (EMA) to examine the movements of the tongue, lips and jaw during the production of fourteen Georgian onset clusters consisting of two consonants (C1 and C1) that cross three sonority shapes (rise, fall and plateau) with front-to-back and back-to-front orders of place of articulation, known to affect overlap [2] (e.g., [blep^{hi}] vs. [glexi]; [p^{ht}ila] vs.]t^hbeba]; and [rbena] vs.[rgeba]). We report here results from three native speakers (two female). A total of 472 tokens were analyzed, all embedded in a carrier phrase. For one speaker the carrier phrase was *k'idev* _____ *vtkvi* ('I said _____ again'). For the two other speakers the carrier phrase was *kalma* _____ *momts'era* ('She wrote _____ to me'). Consonant constriction gestures were labelled using custom software (Mark Tiede, Haskins Laboratories). Two measures of overlap were calculated: 1) Relative overlap: at what point in C1's plateau C2 is initiated (C2 Onset-C1 Plateau Onset/C1 Plateau)[2][4]; and 2) Plateau overlap: 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 Shape and their interaction as the fixed effects and a random effect of Speaker.

Analysis of the target words shows that both Sonority ($F(2)=17.56$, $p<.0001$) and Order ($F(1)=4.45$, $\beta=-.53$, $SE=.25$, $p<.05$, with back-to-front as the baseline) are significant in the overall model for the measure of relative overlap. Each pair of sonority shapes is significantly different from one another ($\beta=-.89$, $SE=.31$ $p<.01$ for Plateau vs Rise; $\beta=-.99$, $SE=.35$, $p<.01$ for Fall vs Plateau; $\beta=-1.89$, $SE=.35$ $p<.001$ for Fall vs Rise). Fall are the most overlapped, and rises the least. This means that in falls, C2 started earlier relative to C1 than in other sonority shapes. For the measure of plateau overlap, only the interaction of Order and Sonority is significant ($\chi^2(2) = 6.34$, $p<.05$). Plateaus and falls are significantly different ($\beta=-.53$, $SE=.25$ $p<.05$). For plateaus back-to-front clusters are less overlapped; the reverse is true for falls.

Taking the results of both measurements together we can see a larger picture emerge. As predicted, sonority rises are less affected by changes in order of place of articulation. They are more stable, and this stability translates in reduced plateau overlap and late C2 onset relative to C1. If we consider sonority rises to be the “default” sonority shape by virtue of their being the most common cross-linguistically, then we can say that the “default” pattern of overlap in Georgian onsets is one that has low overlap and therefore less obscuring of perceptual cues. This language-specific (cf. [1][9]) low plateau overlap works in concert with the higher degree of

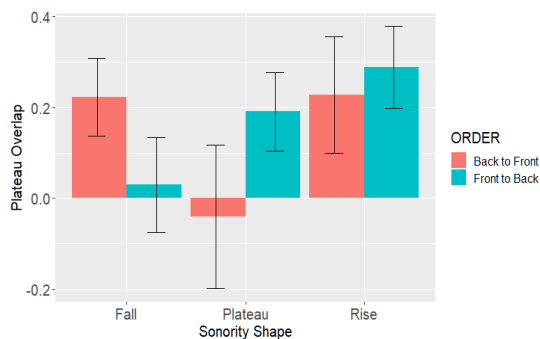
overlap early in the cluster. Together, they allow a tautosyllabic parse of falling sonority CC sequences, and the unhindered perception of both members of the cluster.

Figure 1a. Relative overlap (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 articulation



Negative values indicate plateau lag

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