

# Laterals in simplex vs. complex syllable codas: a comparison of four languages

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**Introduction.** The present paper investigates coda coordination patterns as a function of /l/ darkness in Russian, English, Romanian and Georgian. Since first described within the framework of Articulatory Phonology (Browman & Goldstein, 1988) syllable level coordination patterns have been the focus of many studies. More attention has been given to cross-linguistic differences in gestural coordination in onsets, which are hypothesized to have a global coordination pattern (i.e., consonant gestures are synchronically timed with the vowel gesture). To our knowledge, far fewer studies have looked at between language differences of coordination patterns in codas, which are hypothesized to have a local organization (i.e., the vowel nucleus and coda consonants are sequentially timed). Coda clusters involving the lateral consonant in American English (and the rhotic trill in Romanian) have been found to exhibit a diverging global coordination pattern in coda position (Marin & Pouplier, 2010; 2014). Marin and Pouplier (2014) suggest that the articulatory characteristics of the liquids trigger the global coordination patterns found in coda position. The coda lateral in American English is a dark /l/, and is produced with a double lingual gesture: a vocalic tongue dorsum (TD) retraction that precedes a consonantal tongue tip (TT) raising. Similar to the dark /l/, the rhotic trill is also produced with a double gesture (Proctor, 2009): a vocalic tongue root (TR) gesture that precedes and acts as an anchor for the consonantal TT trilling gesture. Thus, the common gestural specifications of the American English /l/ and the Romanian /r/, the cases where coda global organization was found, both share the presence of a double lingual gesture and an earlier occurring vocalic gesture. We therefore suggest that global organization in coda position occurs because of the existence of an earlier vocalic gesture that triggers gestural competition between the vowel nucleus and the vocalic gesture of the liquid.

To test this hypothesis, the present paper compares coda coordination patterns in four languages that differ in their gestural synergies of their coda lateral consonant: Russian (coda dark /l/ - Recasens, 2012), English (coda dark /l/ - Sproat & Fujimura 1993), Georgian (clear /l/ in front vowel contexts and coda dark /l/ in back vowel contexts – Robins & Waterson, 1952, Chigogidze, 2011) and Romanian (coda clear /l/ - Recasens, 2012). Unlike dark /l/, clear /l/ lacks an earlier TD retraction (Sproat & Fujimura, 1993) and is therefore not expected to trigger a global organization in coda position. We test our hypothesis on acoustic data. The acoustic effect of global coordination patterns in coda position is a shortening of the vowel in cluster tokens compared to their singleton counterpart.

**Methods.** A total of 22 native speakers of Russian (5), American English (6), Georgian (5) and Romanian (6) native speakers were recorded producing three repetitions of target singleton-cluster pairs (C)CVL - (C)CVLC with varying front/back vowel contexts embedded in their respective carrier phrase. Formant values (F1, F2, F3) were extracted at the midpoint of the lateral. The darkness degree was determined based on the F2-F1 measure. Two duration measures were considered: (i) vowel + lateral (VL) sequences, and (ii) the interval between the midpoint of the vowel and the midpoint of the lateral (V50-L50) adapting the measure proposed by Durvasula (2023) for onsets. Raw duration measures were normalized dividing the duration by the articulation rate, calculated as the number of phones per second. The duration measure used as a dependent variable in the statistical models was the duration ratio between the cluster and singleton pairs ( $\text{duration-VL}_{\text{cluster}} / \text{duration-VL}_{\text{singleton}}$ ). Ratios close to 1 indicate lower degrees of shortening in the cluster token. To compare the degrees of shortening in clusters vs. singletons we compare each language to a hypothetical language (H) which has no shortening. Data for H was generated as a normal distribution of mean=1 and standard deviation equal to the mean standard deviation of the duration ratios found in our data. Linear mixed effects models with *Language* and *Vowel\_position* as fixed factors and *Participant* and *Repetition* as random effects with random intercepts were run for each of the two duration measures. An interaction term between *Language* and *Vowel\_position* was also included.

**Predictions** We expect shortening of VL and V50-L50 sequences between clusters and singletons in the case of Russian, English, and back-vowel Georgian codas (dark /l/ in coda). No shortening is expected in Romanian and front-vowel Georgian codas (clear /l/ in coda).

**/l/-darkness results** show that the degree of lateral darkness is a gradual feature across languages. Russian has the darkest lateral of the four considered languages. Mean values do not significantly differ as a function of vowel position (front:  $\text{mean}_{F2-F1} = 434$ , back = 393). English has the second darkest lateral exhibiting a significant difference in F2-F1 values depending on the vowel context: coda /l/ is darker in back vowel contexts ( $\text{mean}_{F2-F1} = 466$ ) than in front vowel contexts ( $\text{mean}_{F2-F1} = 585$ ). The third darkest lateral in our data appears in Georgian back vowel contexts ( $\text{mean}_{F2-F1} = 727$ ). Coda /l/ in Georgian front vowel contexts is much clearer ( $\text{mean}_{F2-F1} = 1171$ ), confirming the vowel-dependent allophony reported for Georgian. Romanian has clear /l/, independent of the quality of the preceding vowel (front V:  $\text{mean}_{F2-F1} = 1281$ ; back:  $\text{mean}_{F2-F1} = 1230$ )

**Duration results** only partially confirm our prediction (Fig. 1), and cross-measure differences (VL vs. V50-L50) are found. The VL duration ratio results show that, as expected, English and Russian both show significantly higher degrees of shortening. Romanian shows no differences in shortening compared to the non-shortening hypothetical language in both front and back vowel contexts. Going against our predictions, Georgian exhibits significant shortening in the front vowel context (clear /l/s) and no shortening for back vowel contexts (dark /l/s). The V50-L50 results show the same patterns as well as an additional unpredicted significant shortening for Romanian in front vowel context (i.e., Romanian has significant shortening when compared to the non-shortening hypothetical language only in the context of front vowels). The V50-L50 measure is probably less reliable in our case because of the difficulty of identifying the acoustic boundary between the vowel and the lateral coda, especially in back vowel - dark /l/ and front vowel – clear /l/ sequences.

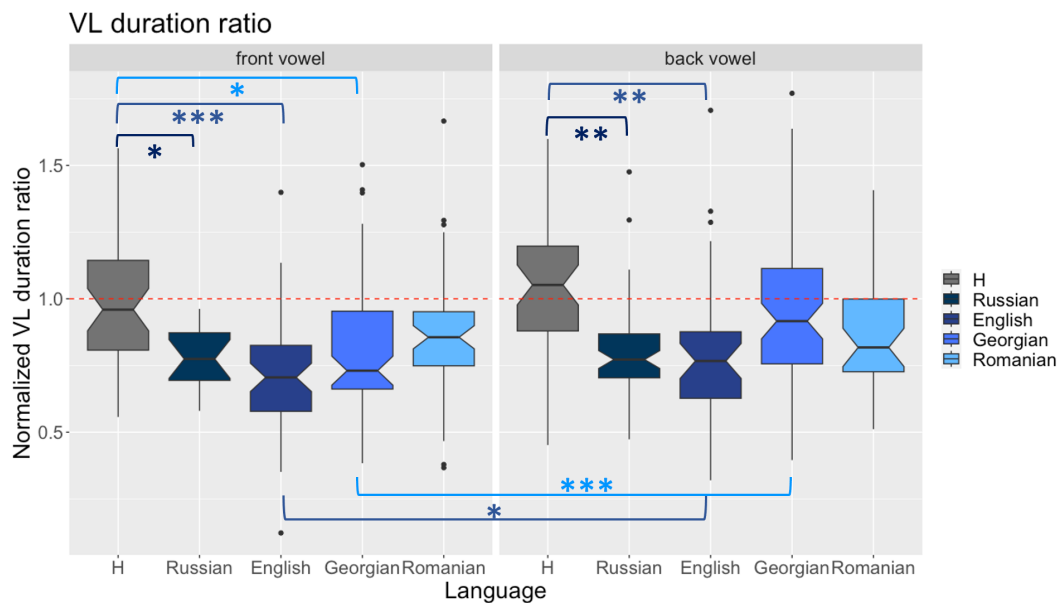


Figure 1: *VL duration as a function of Language and Vowel position.*

*Significance levels indicate differences between the four experimental and the hypothetical non-shortening language H*

**Discussion.** The present paper investigated the hypothesis that global coordination patterns in coda position are triggered by the earlier occurring vocalic gesture present in the production of dark /l/ by comparing four languages that differ in their type of coda lateral. Predictions were confirmed for all languages except Georgian that shows the reverse pattern than the predicted one. One possible explanation for this unexpected pattern is that the degree of darkness could play a role. In our data Georgian dark /l/ is significantly clearer than Russian and English dark /l/. In order to better understand the relationship between /l/ darkness and coda coordination patterns, articulatory data is needed to precisely compare the timing of the articulatory gestures in the lateral coda rime as a function of degree of darkness.

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