Russian palatalization as incomplete neutralization

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OVERVIEW: Previous studies have found small but significant phonetic traces of underlying contrasts for phonologically "neutralized" contrasts. This phenomenon, often called incomplete neutralization, has been found for final devoicing in many languages, e.g. German (Port & O'Dell, 1985), flapping in American English (Herd et al., 2010), vowel deletion in French (Fougeron & Steriade 1997), vowel epenthesis in Levantine Arabic (Gouskova & Hall, 2009), etc. The present study examines whether Russian palatalization also results in incomplete neutralizations. Russian contrasts plain and palatalized consonants, e.g. /p/ vs. /pʲ/ with the "plain" stops possibly having a secondary articulation, involving retraction of the tongue dorsum (velarization/uvularization, see Litvin, 2014; Roon & Whalen, 2019; Skalozub, 1963). However, Russian also has stop-glide sequences that form near-minimal pairs with palatalized stops: e.g., /pjot/ 'drink (3ps pres)' vs. /pʲok/ 'bake (3ps past).' In the environment preceding palatal glides, the contrast between palatalized and plain consonants is neutralized, due to the palatalization of the plain stop: /pjot/→[pʲjot] (derived palatalization). The purpose of the study is to explore whether the neutralization is complete. To do so, we conducted an electromagnetic articulography (EMA) experiment examining temporal coordination and the spatial position of the tongue body in derived and underlyingly palatalized consonants.

THE TEMPORAL COORDINATION: Shaw et al., (2019) hypothesized that complex segments have a temporal basis—two articulatory gestures, G_1 and G_2, belong to the same complex segment if the onset of G_2 is temporally coordinated with the onset of G_1. In contrast, two gestures belong to sequences of segments, if the onset of G_2 is temporally coordinated with the offset of G_1. These competing coordination relations were explored by investigating how the lag between the onset of G_1 and the onset of G_2 varied with G_1 duration. The key finding involved differences between English consonant-glide sequences, e.g., [bj], [mj], [pj], [vj], and Russian palatalized labials, e.g., [pʲ], and segment sequences, [br]. The Russian segment sequences and the English stop-glide sequences patterned together — as consonant duration increased, so too did the lag between consonant and glide gestures. Russian palatalized consonants were different. For palatalized consonants, variation in duration had no effect on lag, which is consistent with the hypothesized temporal basis for complex segments.

EXPERIMENT: Four native speakers of Russian (one male) participated. The materials included six closely matched pairs representing two conditions: (1) consonant-glide sequences vs. palatalized consonants (DERIVED vs. UNDERLYING condition; Table 1). Each word was produced between 15-30 times in the carrier phrase [ʌˈna ___ pəftʌˈrʲilʌ] 'She repeated _____'. Sensors, attached to the upper and lower lips, jaw, tongue tip (TT), tongue blade (TB), tongue dorsum (TD), left/right mastoids and nasion were tracked using the NDI Wave Speech Production System. Change in Lip Aperture was used to identify labial gestures and the TB sensor indexed the palatal gesture. Articulatory movements were parsed using the *findgest* algorithm in **mview** (Tiede, 2005), which identifies temporal landmarks of gestures with reference to the velocity signal. The two key temporal intervals computed from these articulatory landmarks were (1) stop consonant duration: G_1 duration = G_1offset – G_1onset; and, (2) the lag between the gestures: Onset lag = G_2onset – G_1onset.

RESULTS: Figure 1 plots the relation between G_1 duration (x-axis) and Onset lag (y-axis) across conditions. Variation in G_1 duration had essentially no effect on Onset lag—precisely the pattern predicted for complex segments. Notably, we observe this pattern for both conditions, indicating that plain consonants preceding glides are also palatalized. This suggests that the contrast between palatalized and plain consonants is neutralized in this context, as expected. However, there exists evidence of small yet significant underlying distinctions. The comparisons of linear mixed effects (LME) models of TB spatial position and Onset lag are summarized in Table 2. At the onset of the palatal gesture, TB position is further back (more posterior) in the DERIVED condition than in the UNDERLYING condition (Figure 2). This difference is consistent with the presence of a tongue dorsum retraction gesture for plain stops. It appears that some small residue of velarization/uvularization for plain stops persists in the DERIVED condition, in line with the previous observations of an active tongue dorsum retraction gesture in the "plain" stop series. In addition, Onset lag was significantly longer for the DERIVED condition than for the UNDERLYING condition (Figure 3). The increased Onset lag in the DERIVED condition might be attributable to the gestural blending of two secondary articulation gestures (palatalization and velarization/uvularization). To summarize, gestures in both of the conditions are coordinated as complex segments; however, there are differences

across conditions consistent with the residual presence of a tongue dorsum retraction gesture in the "plain" obstruents. We conclude that neutralization of the plain-palatal contrast in Russian is incomplete—consonants in the DERIVED condition exhibit inter-gestural coordination characteristic of palatalized consonants along with residual evidence of an underlying tongue dorsum retraction (velarization/uvularization) gesture.

Table 1: Stimulus items

Stop-glide sequence (DERIVED condition)		Palatalized stop (UNDERLYING condition)	
/pjot/	drink (3ps pres)	/pʲok/	bake (3ps past)
/bjut/	beat (3pp pres)	/bʲust/	bust
/fjord/	fjord	/fʲodor/	Fyodor (name)
/vjoʂ/	weave (2ps pres)	/vʲoz/	carry (3ps past)
/vjotsa/	weave (3ps pres refl)	/vʲodra/	bucket (pl)
/mju/	(a name)	/mʲu/	Greek letter

Figure 1: Onset lag by G_1 duration

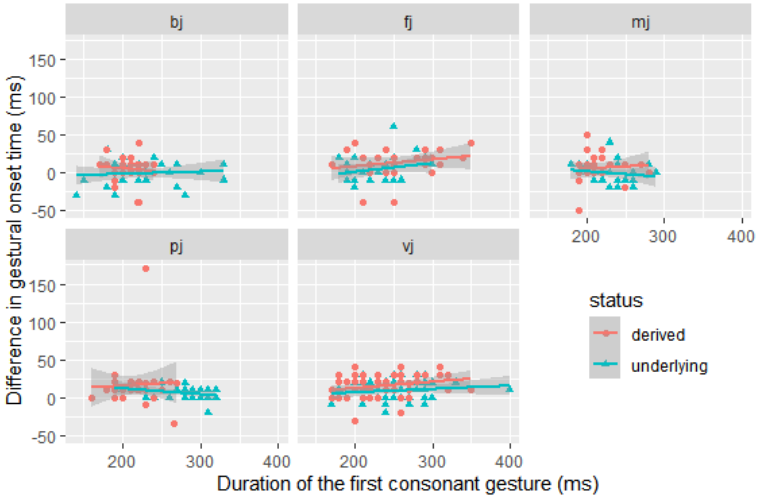

Figure 2: TB backness at palatal gesture onset

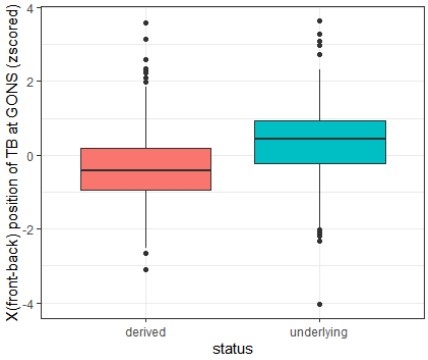

Figure 3: Onset lag

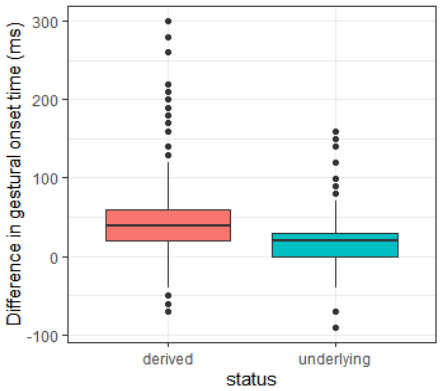

Table 2: LME Model comparisons		DF	AIC	LogLik	Chisq	Pr(>Chisq)
TB position	1 +(1|speaker) + (1| sequence)	4	3243.9	-1618.0	NA	NA
	1+status +(1|speaker) + (1| sequence)	5	3101.4	-1545.7	144.52	< 2.2e-16 ***
Onset lag	1 +(1|speaker) + (1| sequence)	4	11438	-5714.9	NA	NA
	1+status +(1|speaker) + (1| sequence)	5	11240	-5614.8	200.17	< 2.2e-16 ***

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