Stress Patterns in Intra-word Code-switching

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This pilot study examines the phonology of intra-word switches in Kazakh–Russian, presenting an acoustic analysis from a production experiment.

We find evidence of convergence in word-internal switches, with hybrid patterns emerging from the interaction of stress placement (longer duration, greater intensity) and vowel reduction as a secondary effect of stress.

We also analyze this pattern within an Optimality-Theoretic framework.

Phonology of Intra-word CS

Intra-word code-switching is the phenomenon of combining the elements of different languages within **a single word**, for example:

English root + Spanish affixes (MacSwan, 2005):

(1) /it-eando/	(2) /it-ará/
eat-DUR	eat-FUT/3SG
"eating"	"will eat"

How do the phonological systems of two languages interact in intra-word code-switching? Does the phonology of L1 or L2 dominate? Or do hybrid patterns emerge?

- Stefanich et al. (2019) **note** mixed views on intra-word CS phonology and limited acoustic/experimental data.
- This study focuses on a specific case of Kazakh-Russian code-switching.

Stress in Kazakh vs. Russian

Kazakh: final syllable is prominent (Mukhamedova, 2015)
Acoustic correlates: duration (McCollum & Chen, 2021)

- al.**má** - *'apple'*
- al.ma.**lár** – *'apple-PL'*
- al.ma.lar.**də́** – *'apple-Pl-ACC'*

Russian: has lexical stress (Jouravlev & Lupker, 2014)
duration & intensity & vowel quality (Chrabaszcz et al., 2014)

- **zá**.mok *'castle'* vs. za.**mók** *'lock'*
- stra.**ná** *'country'* vs. **strá**.ny *'countries'*
- ko.le.**só** *'tire'* vs. ko.**lé**.sa *'tires'*

In a **Kazakh-Russian CS context**, Russian nouns with different stress patterns are often inflected with Kazakh suffixes:

(1) pól'za-men	(2) stená-da	(3) ópɨt-qa	(4) seló-ny
benefit-INST	wall-LOC	experience-DAT	village-ACC
'with benefit'	'on the wall'	'on experience'	'the village'

Does the addition of Kazakh suffixes to Russian stems affect the stress pattern?

Hypotheses

H1: Kazakh dominant.	H2: Russian dominant.	H3: Hybrid stress.
The stress switches to the last syllable (suffix).	Inserted Russian stems keep the original stress.	The Russian stress is retained; a Kazakh-style final stress may also emerge.

/ópɨt/ + /qa/
/stená/ + /da/

H1	H2	H3
[opɨtqa:]	[ópətqa]	[ópətqa:]
[stenada:]	[stɛnáda]	[stɛnáda:]

Production Experiment

Participants. 4 Kazakh–Russian bilinguals (2F, 2M), residing in Irvine, CA; *Kazakh:* native proficiency; *Russian:* understanding 10/10, speaking 9.5/10, reading 9.5/10 *(LEAP-Q)*.
Stimuli. 40 disyllabic nouns (Kazakh & Russian), elicited in **unsuffixed** and **suffixed** forms.
Carrier phrase (Kazakh). *Bul matinnin ishinde ___ sozi bar.*
"This text contains the word ___."
Methods & measures. Syllables and vowels hand-annotated; extracted: syllable duration (ms), intensity (dB), pitch (f0); vowel formants F1 & F2.

Analysis Framework

Model Stress Correlates

- Predictors: Stress Placement; Word Form; Language Context
- Dependent Variables: Syllable Duration; Syllable Intensity

Model Vowel Reduction

- Predictors: Vowel Stress; Vowel Type; Language Context
- Dependent Variables: F1-F2 Dispersion

Stress Correlates in CS: duration and intensity

We found that **Russian stress remains fixed on the root** (Figure 1 & 2), signaled most reliably by *duration* and *intensity*, while **Kazakh-style final lengthening** is also **present** (Figure 2 & 3), illustrating a nuanced **hybrid prosodic integration** in intra-word CS.

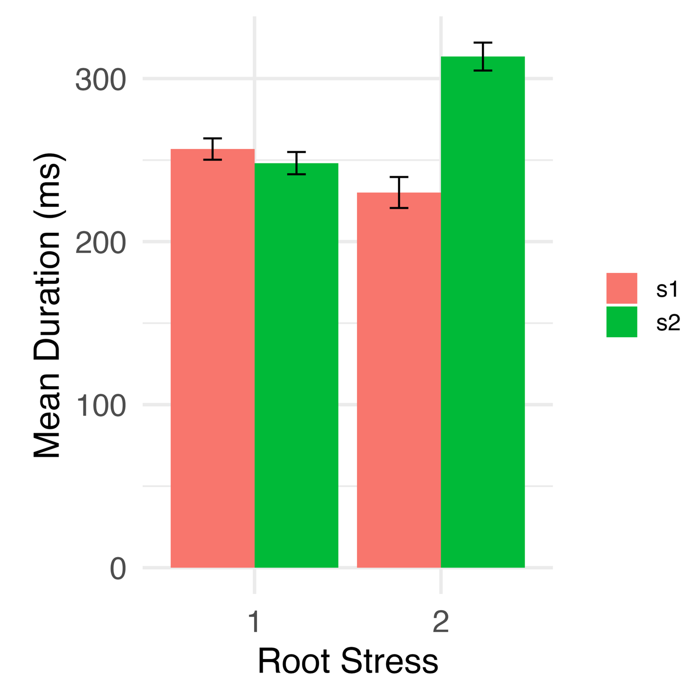

Figure 1: Mean duration in unsuffixed Russian tokens, plotted by root stress position (1 = stress on s1; 2 = stress on s2).

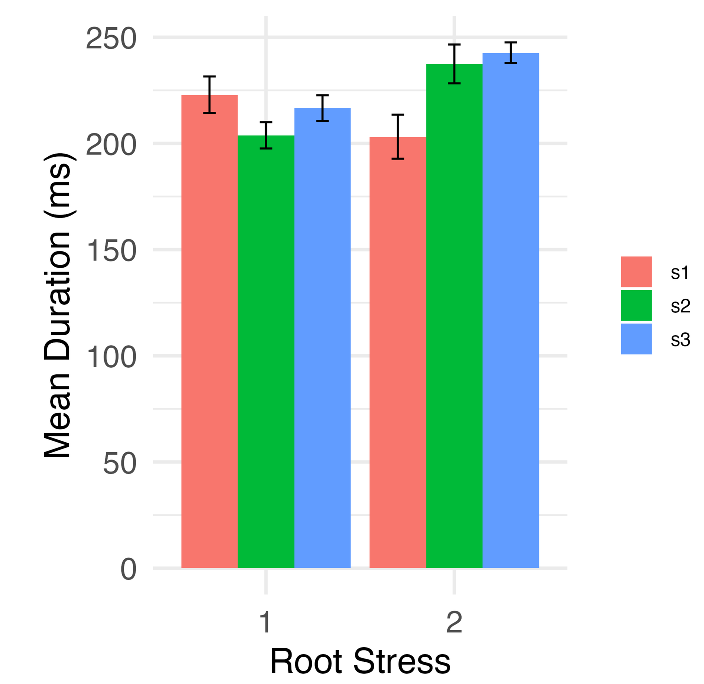

Figure 2: Mean duration in suffixed CS tokens, grouped by root stress position (1 = stress on s1; 2 = stress on s2).

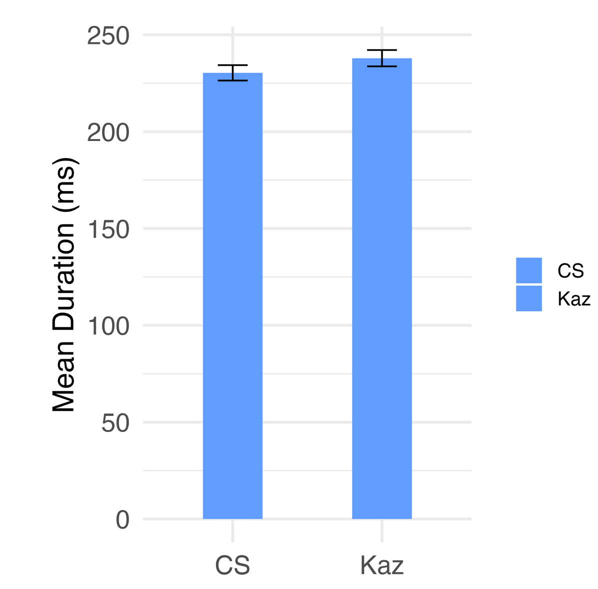

Figure 3: Mean duration of the final syllable (s3) in suffixed Kazakh (non-CS) and CS tokens.

Russian stressed syllables are significantly longer than **unstressed** ones in both unsuffixed and suffixed CS tokens. The same pattern holds for **intensity**: stressed Russian syllables show **higher intensity in both conditions.**

There is **no significant difference** in the **duration** of final syllables (**s3**) in suffixed **non-CS** and **CS** tokens; the same holds for **intensity.**

Vowel Reduction in Russian vs CS

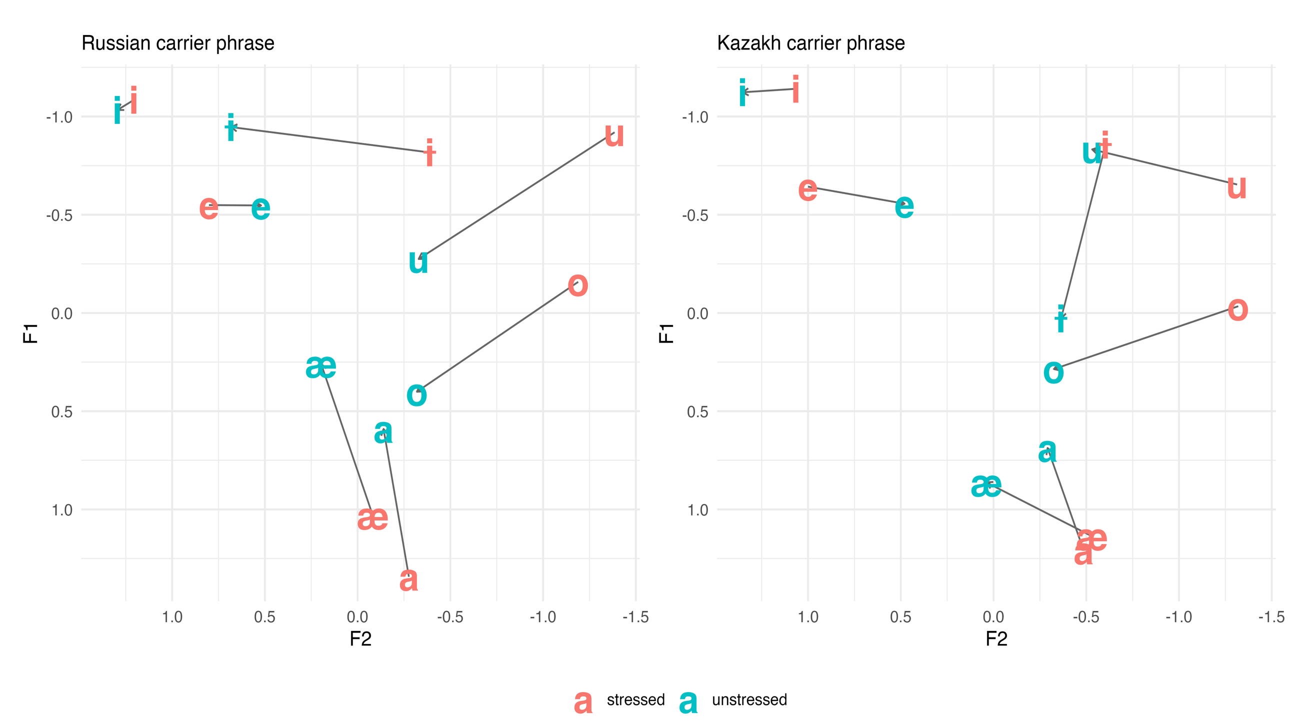

Figure 4: Russian and CS vowel space showing normalized mean F1 and F2 values by vowel category, separated by stress condition.

- **Vowel reduction occurs** in both **Russian** and **code-switched CS tokens** (Russian: $\beta = -0.22$, $p < .001$; CS: $\beta = -0.29$, $p < .001$).
- Russian stress is characterized by vowel quality: unstressed vowels undergo reduction (Crosswhite, 2000; Padgett & Tabain, 2005).
- Vowel dispersion was measured as *Euclidean distance* from the center of each speaker's F1–F2 vowel space (Wright et al., 2004).

Context vs Stress

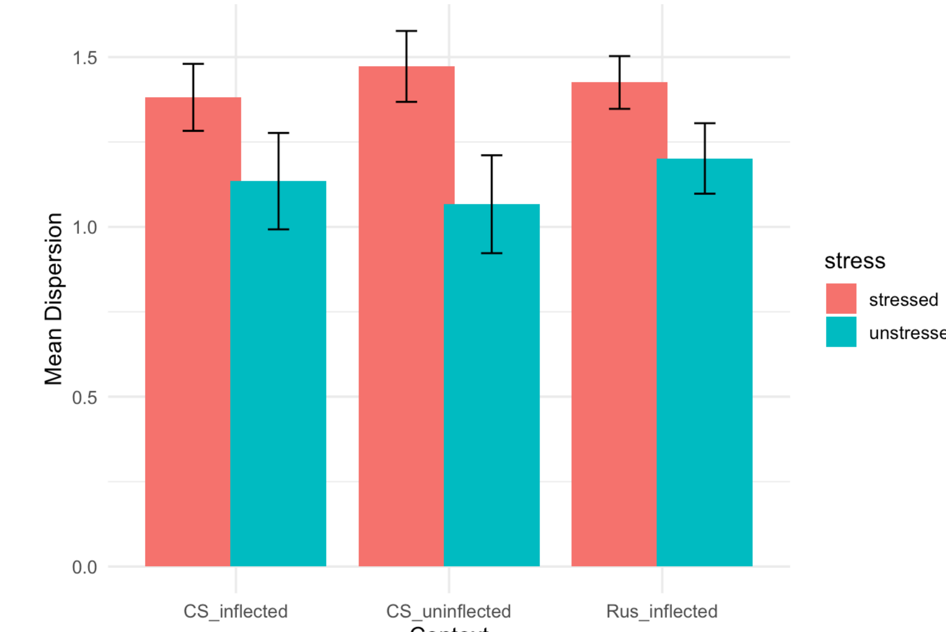

Figure 5: Mean dispersion for stressed and unstressed vowels by context.

- **Context** (CS vs. Russian) **did not significantly affect vowel space distance**, suggesting that *phonetic realization is stable* across monolingual (Russian) and mixed CS tokens.
- **Significant stress effect:** unstressed vowels had reduced dispersion vs. stressed vowels ($\beta = -0.26$, $p < .001$).

Phonological Analysis

Strata OT for Kazakh–Russian Code-Switching (Kiparsky, 2000)

- **Constraints:**
  ID(Head-σ) preserve stressed syllable; *FullV(root) ban full vowels in unstressed root syllables; ID(root) root faithfulness; AGREE Kazakh vowel harmony; *Struc(Ft) avoid extra feet.
- **Cycle 1: Russian stem (/ópit/):**
  Ranking: ID(Head-σ) » *FullV(root) » ID(root) » *Struc(Ft)*
  → **[ópət]** (stress preserved; σ2 vowel reduced).
- **Cycle 2: Kazakh word-level (/ópət/ + /qA/):**
  Ranking: *ID(root) » AGREE » *Struc(Ft) » ID(Head-σ)*
  → **[ópətqa]** (root unchanged; suffix harmonizes; no new stress).
- **Post-lexical:**
  FINAL-LENGTHENING **{DUR+} → [ópətqa:]**
  lengthening only; no phonemic vowel length in Kazakh.

Cycle 1: **Russian**

/ ópɨt/ 'experience'	ID(Head-σ)	*FullV(root)	ID(root)	*Struc(Ft)
☞ **[ópət]**			*	*
[ópɨt]		*!		*
[opɨ́t]	*!	*		*
[opɨt]	*!	**		
[opət]	*!	*	*	

Cycle 2: **Kazakh**

/ ópət / + / qA / 'on experience'	ID(root)	AGREE	*Struc(Ft)	ID(Head-σ)
☞ **[ópətqa]**			*	
[opətqa]	*!			*
[ópətke]		*!	*	
[opə́tqa]	*!		*	*
[opətqá]	*!		*	*

Post-lexical: FINAL-LENGTHENING {DUR+} → [ópətqa:]

Selected References:

Chrabaszcz, A., Winn, M., Lin, C. Y., & Idsardi, W. J. (2014). Acoustic cues to perception of word stress by English, Mandarin, and Russian speakers. *Journal of Speech, Language, and Hearing Research, 57*(4), 1468–1479. **Crosswhite, K. M. (2000).** Vowel reduction in Russian: a unified account of standard, dialectal, and 'dissimilative' patterns. *University of Rochester Working Papers in the Language Sciences, 1*, 107–172. **Jouravlev, O., & Lupker, S. J. (2014).** Stress consistency and stress regularity effects in Russian. *Language, Cognition and Neuroscience, 29*(5), 605–619. **Kiparsky, Paul. 2000.** Opacity and cyclicity. In S. Inkelas & K. Hanson (eds.), The Nature of the Word: Essays in Honor of Paul Kiparsky, 161–183. MIT Press. **MacSwan, J. (2005).** Codeswitching and generative grammar: A critique of the MLF model and some remarks on "modified minimalism". *Bilingualism: Language and Cognition, 8*(1), 1–22. **McCollum, A. G., & Chen, S. (2021).** Kazakh. *Journal of the International Phonetic Association, 51*(2), 276–298. **Mukhamedova, R. (2015).** *Kazakh: A comprehensive grammar*. Routledge. **Padgett, J., & Tabain, M. (2005).** Adaptive dispersion theory and phonological vowel reduction in Russian. *Phonetica*, *62*(1), 14-54. **Stefanich, S., Cabrelli, J., Hilderman, D., & Archibald, J. (2019).** The morphophonology of intra-word codeswitching: Representation and processing. *Frontiers in Communication, 4*, 54. **Wright, R., Local, J., Ogden, R., & Temple, R. (2004).** Factors of lexical competition in vowel articulation. *Papers in Laboratory Phonology VI*, 75–87.

In intra-word CS,
Russian stress is **preserved**
while **Kazakh-style** final **lengthening** applies.