

On the phonetic realization and variation of consonant geminates in Sakha

Aini Li, Jianjing Kuang. Department of Linguistics

liaini@sas.upenn.edu, kuangj@ling.upenn.edu



Introduction

- Gemination**, also called consonant length contrast, is defined as the articulation of a consonant for a longer period of time than that of a singleton consonant, and by convention, it is represented by a doubled letter (e.g., /C/ vs. /CC/).
- Gemination has been reported as a distinctive feature for many languages such as Arabic, Finnish, Japanese, Italian, Swedish, Malayalam, among many others (e.g., Khatlab 2007, Issa 2005, Payne 2005, 2006)
- Sakha**, an under-documented Turkic language spoken in Yakutia, displays a rich inventory of consonant geminates at the word medial position, i.e., VCV vs. VCCV, unusually covering a wide range of manners of articulation (Krueger 1962). Vowel length is also phonemically contrastive in Sakha.



- However, **how geminates** of different consonant types are **phonetically realized** and **how consonant geminates coordinate with surrounding vowels** temporally in Sakha have not been understood.
- This study** examines these questions using **geminates of different manners of articulation** (/t/ vs. /tt/; /k/ vs. /kk/; /tʃ/ vs. /tʃtʃ/; /l/ vs. /ll/; /n/ vs. /nn/; /x/ vs. /xx/) in Sakha, with the goal to contribute to a better understanding of the cross-linguistic variation of consonant gemination.

Sakha

- Vowel inventory** of Sakha

		Front		Back	
		unrounded	rounded	unrounded	rounded
High	Short	i	y	u	u
	Long	i:	y:	u:	u:
Low	Short	ɛ	œ	ɑ	ɔ
	Long	ɛ:	œ:	ɑ:	ɔ:
Diphthongs: ie, yø, uo, uɑ					

- Consonant inventory** of Sakha

	Labial	Alveolar	(Alveo)Palatal	Velar	Uvular	Glottal
Plosive	p(pp) b	t(tt) d		k(kk) g		
Nasal	m(mm)	n(nn)	ɲ	ŋ(ŋŋ)		
Trill						
Tap		r				
Fricative		s z			χ(χχ) ʁ h	
Affricate			tʃ(tʃtʃ) ʧ			
Approximant		l(ll)	j			

Method

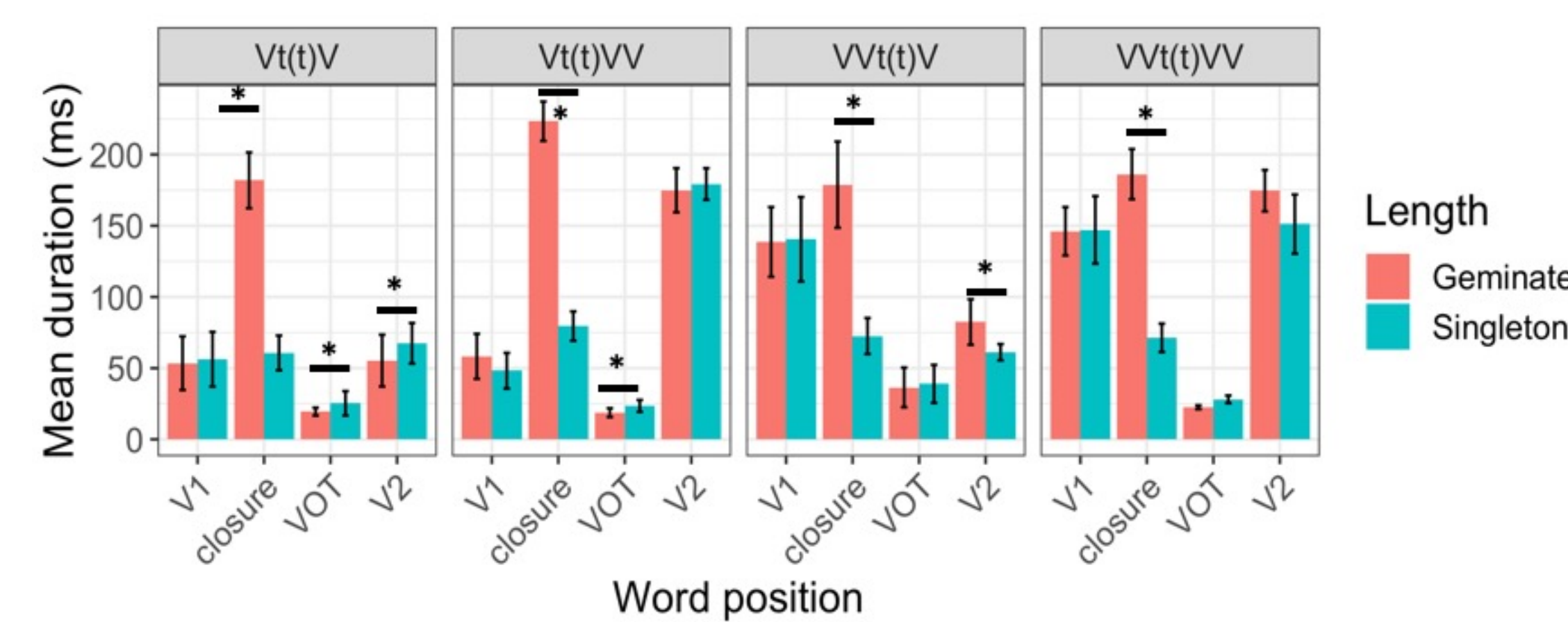
- Speaker**
A female native speaker of Sakha, with no known speech disability, served as the speaker for this study.
- Materials**
For each consonant type, word pairs in different temporal arrangements were constructed in which the vowel preceding and the vowel following the consonant alternated between short-short (VCV vs. VCCV), short-long (VCVV vs. VCCVV), long-short (VVCV vs. VVCCV) and long-long (VVVV vs. VVCCVV).
- Elicitation**
Data was collected through more than 10 individual elicitation sessions with the speaker. Each elicitation lasted between 10 to 20 minutes. The speaker was asked to repeat each word in a carrier sentence "biligin ___ dien tuluu et" (Please say the word ___) for three times in a conversational way.
- Recording**
All the recordings took place over Zoom. The speaker was recorded using the built-in microphone of Macbook air 2017 model through the local recording of Zoom. Recordings were digitized at a sampling rate of 32,000kHz and 32 bit sample width. Recordings of 1361 tokens were further analyzed using Praat (Boersma, 2006)

Results

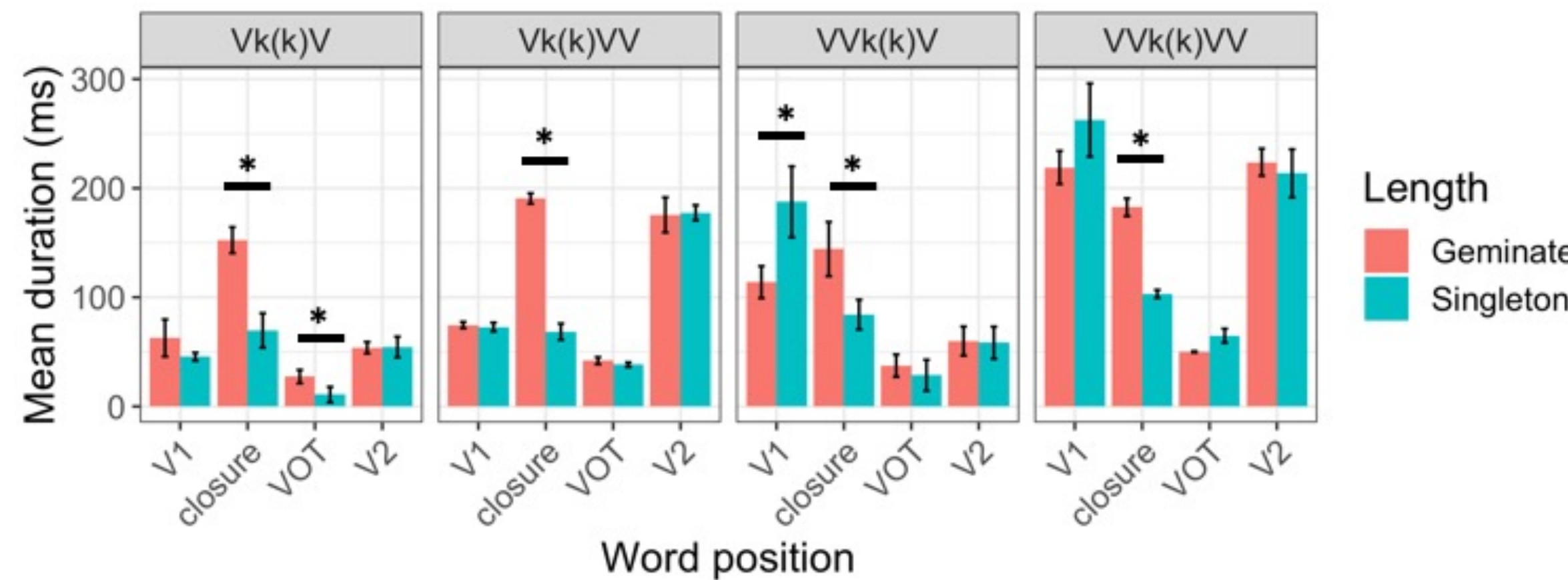
- Analysis**
Welch two-sample t-tests were conducted to compare durational differences for each pair type.

- /t/ vs. /tt/**

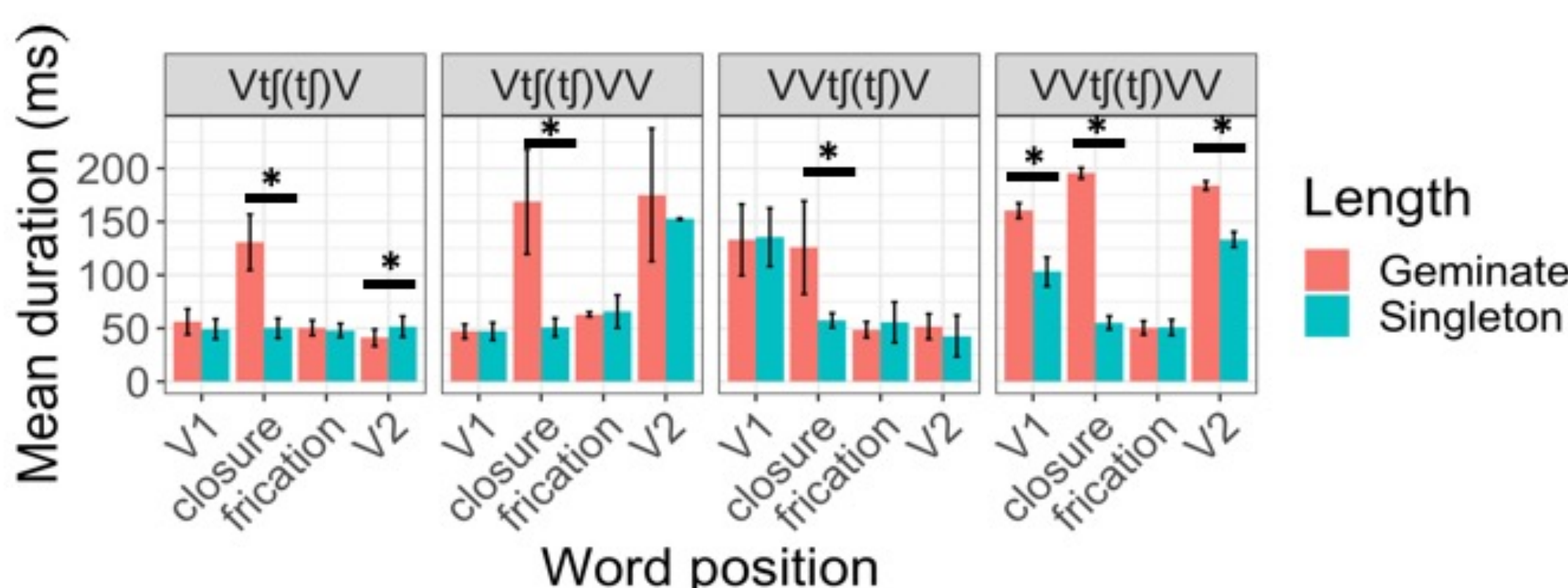
"*" marks statistically significant comparisons



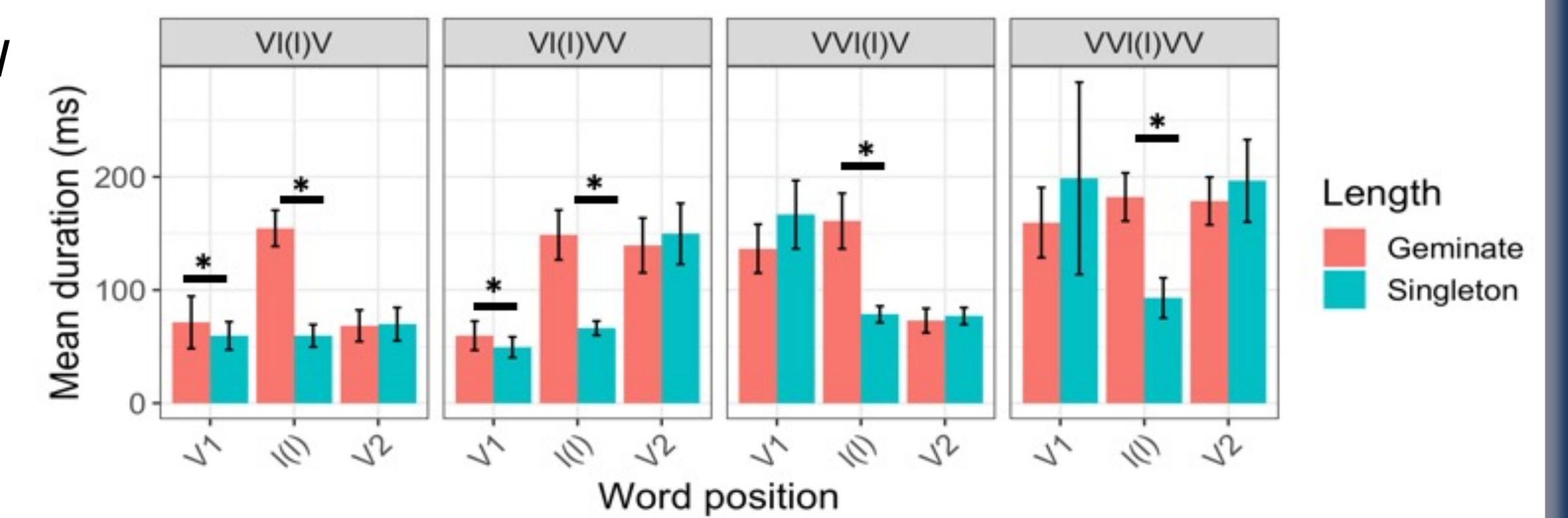
- /k/ vs. /kk/**



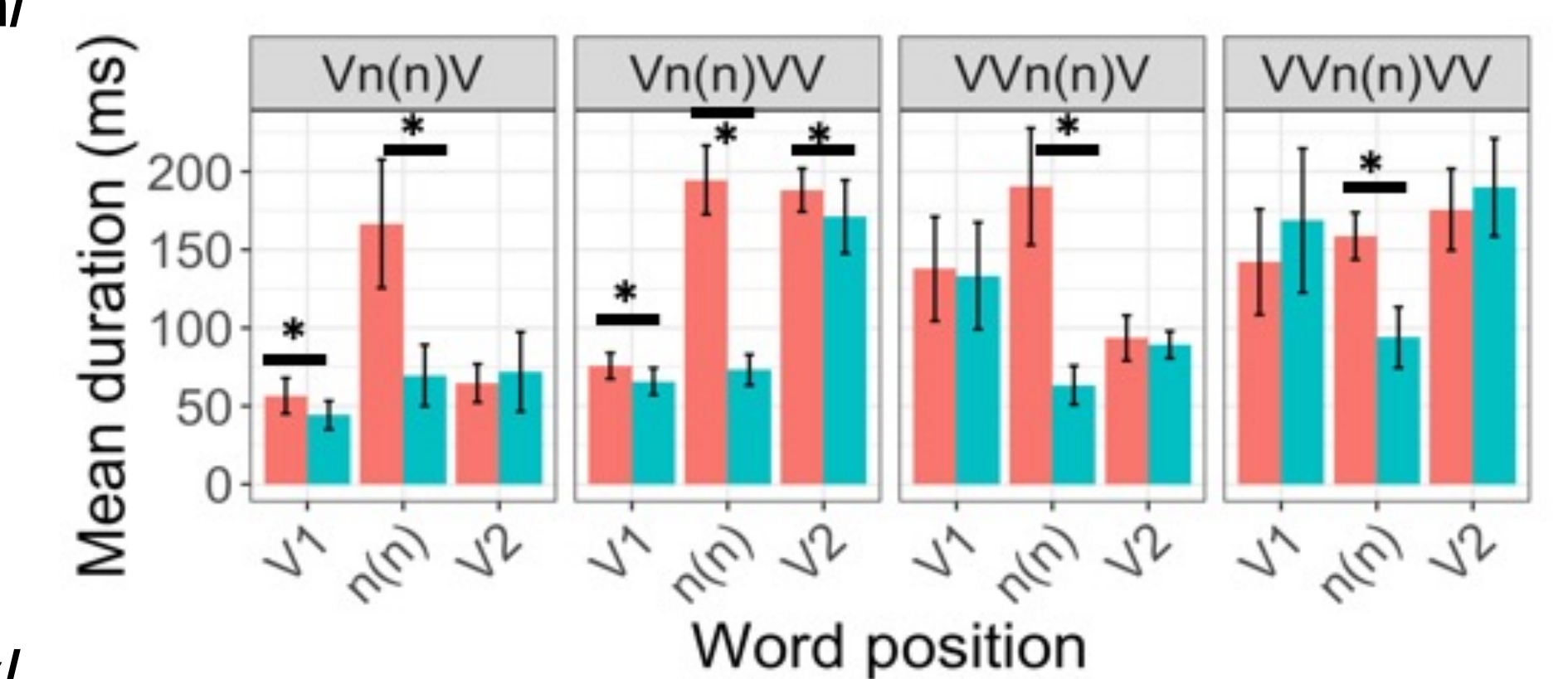
- /tʃ/ vs. /tʃtʃ/**



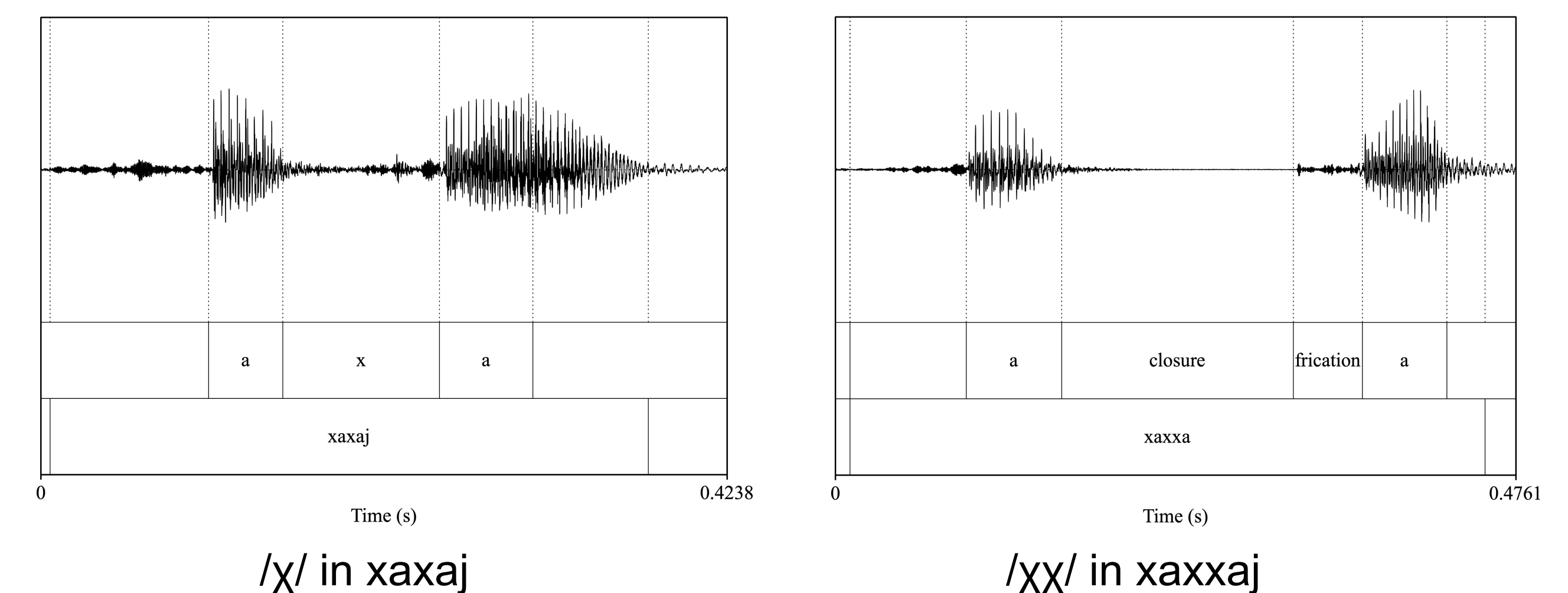
- /l/ vs. /ll/**



- /n/ vs. /nn/**



- /x/ vs. /xx/**



Discussion & Conclusion

- In Sakha, geminates differ from their singleton counterparts mainly by showing a longer overall consonant duration.
- Gemination is realized differently for consonants with different manners of articulation:
 - For stops and affricates, significant longer closure duration is the most reliable cue.
 - For uvular fricatives, the singleton fricative becomes an affricate when geminated.
- Taken together, geminates in Sakha are produced with stronger articulation and greater constriction. Moreover, geminates coordinate with their surrounding vowels temporally. Short vowels preceding the geminates are likely to be longer, while short vowels that follow tend to be shorter. Vowel length thus is an enhancement cue for geminates.

References

Khatlab, G. (2007). A phonetic study of gemination in lebanese arabic. *ICPhS XVI Proc*, pages 153–158. Krueger, J. R. (1962). Yakut Manual. Uralic and Altaic Series, Volume 21. ERIC. Issa, A. (2015). On the phonetic variation of intervocalic geminates in libyan arabic. In *ICPhS*. Payne, E. M. (2005). Phonetic variation in italian consonant gemination. *International Phonetic Association. Journal of the International Phonetic Association*, 35(2):153. Payne, E. M. (2006). Non-durational indices in italian geminate consonants. *Journal of the International Phonetic Association*, pages 83–95. **Acknowledgement:** Thanks to our language consultant Ayyyna Sleptsova for the precious data. We thank Julie Anne Legate, June Choe, May Chan, Daoxin Li, Hassan Munshi, Lea Mangifesta, Christine Soh, Ruicong Song and Ugurcan Vurgun for comments and feedback. All the remaining errors are very much our own.