GEMINATION IN DOGRI AND PUNJABI:
EVIDENCE OF DEVIATION AMONG 'LIKE' LANGUAGES

Pranav Badyal

Institute of Phonetics, Charles University
Pranav.Badyal@ff.cuni.cz

ABSTRACT

This study (i) investigates the timing properties of Dogri singleton and geminate voiceless stops in CVCV word form, and (ii) compares the findings with a related Indo-Aryan language, Western Punjabi.

LMER tests for part (i) confirm that the lengthened duration of the intervocalic consonant (C2) and contraction in the duration of the preceding vowel (V1) among geminates serve as the primary phonetic cues in differentiating Dogri geminate from a singleton.

The comparison of singleton – geminate distribution between Dogri and Punjabi in part (ii) reveals that the main cue of difference between the two languages lies in the flanking vowels. Whereas the contracted V1 duration appears promising in Dogri, Punjabi, instead, relies upon reducing the duration of V2. The study concludes that different treatment to maintain singleton – geminate contrast in the two genealogically related languages is due to the respective phonotactics that governs the distribution of duration across segments.

Keywords: gemination, double consonant, length, phonetics, speech production

1. INTRODUCTION

Dogri (ISO-639-3 dgo) and Punjabi are geographically and genealogically related languages that belong to the north-western sub-group of Modern Indo-Aryan (henceforth Indic) languages. In traditional Indian linguistics, a geographical belt comprising of related languages often leads to a situation, which is referred to as '*Kshetra'*, meaning, "linguistic area". Kshetra is a linguistic situation marked by plurality of languages in a given geographical area that show striking similarities [12].

The Kshetra distribution of languages in India has led to the problem of under-representation of minority languages, giving more proclivity and recognition to the non-minority languages. In case of Dogri, it is at times identified as a dialect of Punjabi, as pointed out by several authors [12, p. 271], [18], [14, p. 582].

In light of Kshetra, both Dogri and Punjabi have a similar syllable structure, and a similar phonological distribution of vowel length comprising of three short vowels /ɪ, ə, ʊ/ and seven long vowels /iː, eː, ɛː, ɑː, ɔː, oː, uː/ [8], [1], [4, p. 70], [11] and exhibit gemination.

In the context of gemination, earlier study on Dogri shows a lengthened duration of the word-medial consonant and contracted duration for the preceding vowel among geminates in CVCV singleton – geminate contrasting words [8]. Punjabi (Western, ISO-639-3 pnb), on the other hand, is reported to show no change in the duration of the preceding vowel but in the following vowel, the latter being contracted among geminates. The preceding vowel which is reported to show no durational change in a singleton – geminate pair places Western Punjabi in the category of languages like Estonian [6], Polish, Lebanese Arabic and Hungarian [9], and not with the Indic group.

Despite the fact that Dogri and Punjabi are genealogically as well as geographically related, yet both languages show different timing patterns for the pregeminate (preceding) vowel. Thus, it was deemed warranted to include Punjabi in contrast with Dogri.

2. METHODS

2.1 Participants

Participants included six speakers (all females) who reported Dogri as their L1. The language background of the participants was multilingual, in Dogri, Hindi and English. The educational background of all participants was at least Bachelor's or higher. All of them reported being residing in Jammu and Kashmir for at least 10 years. All participants reported having learned Dogri before Hindi and English. The age group ranged from 30 to 69 years. None of the participants reported a speech or hearing disorder.

2.2 Materials

A total of five minimal word pairs in singleton – geminate CVCV form were considered wherein,

- the word-initial consonant (C1) was either of the following: /t̪, b, s, k/,
- the preceding vowel (V1) was always /ə/,

- the word-medial consonant (C2) was either a singleton or a geminate: /p, t̪, ʈ, tʃ, k/, and
- the word-final vowel (V2) was always /ɑː/

These words were fitted in between a fixed carrier phrase (CP), ʊs _____ sʊneːjɑː, meaning *he/she* (third person) _____ *listen* (simple past).

2.3 Procedure

Recording sessions took place at Department of Dogri at University of Jammu, and All India Radio (AIR) studio, Jammu. All participants were shown the set of sentences in advance for a brief period.

A 20-inch monitor screen driven by a desktop PC computer was used to display sentences. An AudioTechnica ATR 1200 microphone was used for all recording purposes. The sentences were presented on a Microsoft PowerPoint slide, typed in Devanagari script in font size of 18. The sentences presented were manually controlled by the participants, by pressing the keyboard space-bar key in a self-paced fashion.

Each participant spoke each test-word five times except for VG who uttered 52 items. Thus, a total of 302 test-words were recorded. As far as the speaking rate is concerned, the participants were asked to read the material at a normal rate, in a relaxed and natural manner.

2.4 Acoustic segmentation

Broadband spectrograms and visual displays of their corresponding waveforms for each test-word embedded in a fixed phrase were generated and analysed using Praat software package [2]. After the manual inspection of waveforms and their corresponding spectrograms, the measurement criteria were set. An illustration of segmentation of a Dogri test-word is given in Fig.1.

C1: The onset for C1 was defined as the time interval from the appearance of frication noise of [s] and of start of the voicing in case of [b] in the spectrogram to the point where the amplitude for the following segment (the vowel) in the waveform would suddenly increase.

V1: The onset of V1 was defined at the point where higher formants of the vowel were observed. The end of V1 was defined as the point where the amplitude in the waveform would suddenly decrease or the F2 formant structures in the spectrogram would disappear.

C2: The closure duration of C2 was defined as the time interval from the offset of V1 until the point where a sudden release of energy would appear in the spectrogram.

V2: The onset for the word-final vowel was defined as the point from the offset of C2 until the point where the amplitude in the waveform would suddenly decrease, and the F2 formant structures in the spectrogram would disappear.
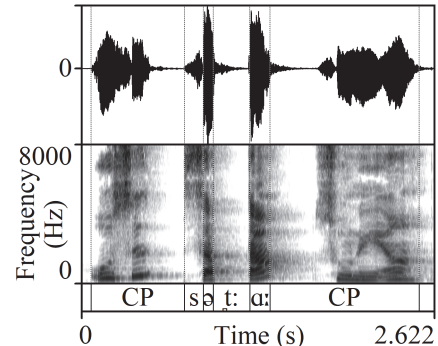

Figure 1: Acoustic waveform showing the segmentation of Dogri geminate test-word, sət̪ːɑː.

3. RESULTS

R [16] and lme4 [5] were used to perform a linear mixed effects analysis of the relationship between the phonemes (C1, V1, C2, V2) and consonant type (singleton/geminate). As fixed effects, consonant type (singleton/geminate) and place of articulation were entered (also with interaction term) into the model. As random effect, we had intercepts for subjects, as well as by-subject random slopes for the effect of consonant type. Visual inspection of residual plots did not reveal any obvious deviations from homoscedasticity or normality. The p value threshold was set at 0.05. P-values were obtained by likelihood ratio tests of the full model with the effect in question against the model without the effect in question. The independent mean duration for four segments grouped by place of C2 articulation in singleton-geminate word pairs is presented in Table 1.

Concerning C1, it was anticipated that C1 duration would differ for singleton and geminates. It was found that consonant type did not affect C1 duration, ($\chi^2(1) = 0.5136$, $p = 0.4736$). However, the place of articulation affected C1 duration significantly ($\chi^2(2) = 107.31$, $p < 0.0001$) indicating that C1 duration varied across all five places of articulation. There was also no interaction effect to be found between consonant type and place, ($\chi^2(2) = 0.4142$, $p = 0.8129$). Duration distribution of C1 among singleton and geminates across five places of C2 articulation is shown in Fig. 2.

Test-words having dental [t̪] and velar [k] as C1 were though segmented in Praat but these were not included in the analyses for estimating C1 duration because estimating onset boundaries of voiceless consonants accurately is not attainable.

Place	Consonant	Consonant type	C1	V1	C2	V2	Total word duration
Bilabial	pː	G	158 (41)	58 (11)	224 (32)	204 (42)	644
	p	S	155 (39)	73 (18)	125 (16)	211 (48)	564
Dental	t̪ː	G	150 (38)	67 (13)	238 (30)	213 (47)	668
	t̪	S	154 (35)	80 (22)	113 (18)	214 (45)	561
Palatal	tʃː	G	183 (56)	72 (10)	266 (40)	244 (49)	765
	tʃ	S	174 (61)	83 (15)	130 (28)	234 (56)	621
Retroflex	ʈː	G	97 (34)	71 (9)	213 (30)	216 (48)	597
	ʈ	S	103 (38)	97 (28)	115 (22)	218 (63)	533
Velar	kː	G	155 (32)	64 (14)	243 (24)	232 (56)	694
	k	S	156 (38)	85 (20)	117 (19)	214 (51)	572

Table 1: Mean durations (in ms) for C1, V1, C2, and V2 in singleton – geminate CVCV words across five places of articulation. The values in the parentheses represent standard deviation.
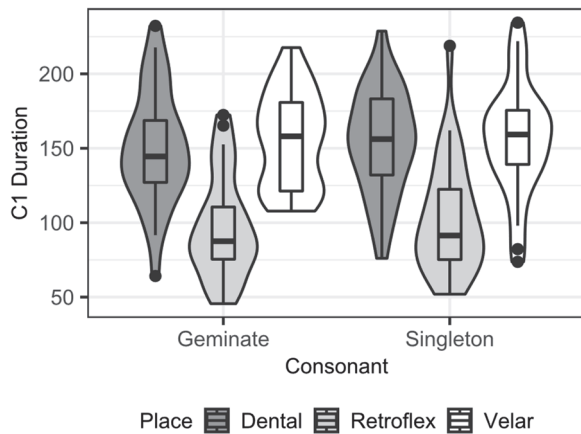

Figure 2: C1 duration (in ms) among Dogri singleton and geminates across all places of C2 articulation.

With regard to V1, there was significant effect of consonant type on the vowel, ($\chi2(1) = 4.9788$, p = 0.02566). Also, the place of articulation affected the V1 duration significantly ($\chi2(4) = 87.246$, p < 0.0001). However, no interaction effect could be established between place and consonant type on V1 duration, ($\chi2(4) = 9.4077$, p = 0.05168). Duration distribution of C1 among singleton and geminates across five places of C2 articulation is depicted in Fig. 3.
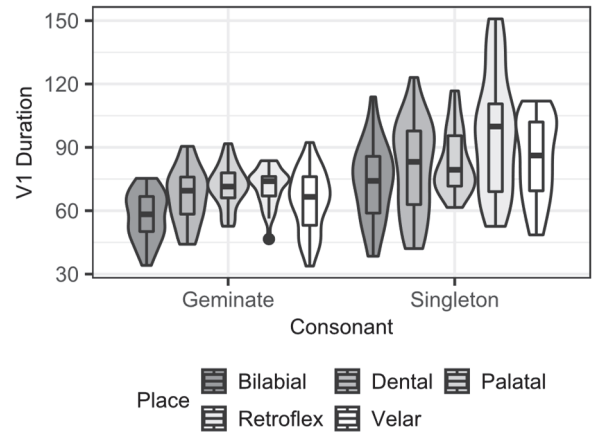

Figure 3: V1 duration (in ms) among Dogri singleton and geminates across all places of C2 articulation.

Regarding C2, consonant type affected C2 duration, ($\chi2(1) = 21.383$, p < 0.0001), lowering it by about 117.2 ms ± 8.6 (standard errors) at average in the case of singleton. The place of articulation affected C2 duration significantly, ($\chi2(4) = 78.903$, p < 0.0001), indicating that C2 duration varied at different places of articulation. There was also a significant effect between place and consonant type, ($\chi2(4)=23.348$, p = 0.0001). Duration distribution of C2 among singleton and geminates is shown in Fig. 4.
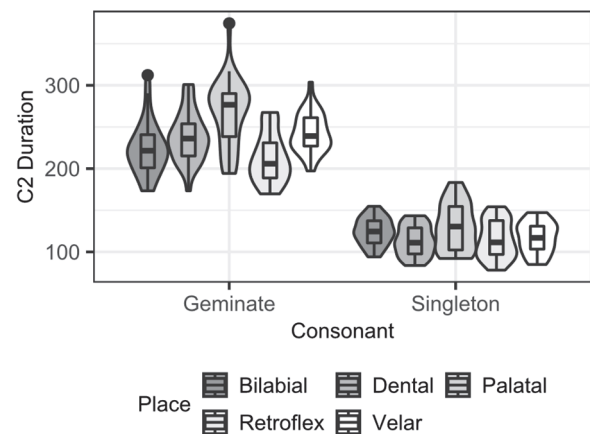

Figure 4: C2 duration (in ms) among Dogri singleton and geminates across all places of C2 articulation.

With respect to V2 duration, the results showed no significant effect of consonant type, ($\chi2(1) = 0.9101$, p = 0.3401). However, the place of articulation affected the V2 duration significantly, ($\chi2(4) = 66.372$, p < 0.0001), indicating that V2 duration differed across all places. As far as interaction effect between place and consonant type on V2 duration is contemplated, the results output remained insignificant, ($\chi2(4) = 6.4542$, p = 0.1677). Duration distribution of V2 is shown in Fig. 5.
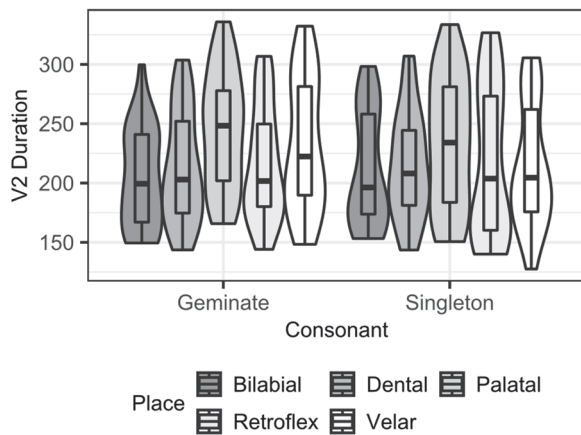
Figure 5: V2 duration (in ms) among Dogri singleton and geminates across all places of C2 articulation.

4.   DISCUSSION AND CONCLUSIONS

This study aimed to appose linguistic differences between Dogri and Punjabi by gathering the congregated evidence in the existing literature, and by contributing new knowledge about the phonetics of Dogri and Punjabi from the view of gemination. It is found that the duration of the intervocalic consonant serves as the primary cue in distinguishing singleton and geminates in both Dogri and Punjabi (for all statistical values for Punjabi, cf. [10]).

The difference in C2 duration between singleton and geminates in Dogri at all five places of articulation, namely bilabial, dental, palatal, retroflex, and velar, are recorded to be 99, 125, 138, 98, and 126 ms respectively (cf. Table 1). On average, at five places of articulation, C2 is found to be 117 ms longer than their Dogri singleton counterparts. These mean durations suggest that Dogri voiceless geminate stops are almost double the duration in comparison to a singleton, thereby maintaining a ratio of 2:1. In contrast, Punjabi geminates are recorded to be on average 39 ms longer than their singleton counterparts at all five places of articulation, $[F(4, 16) = 13.359; p < .001]$ [10].

The r e s u l t s   presented for Dogri for V1 among singleton – geminate attest that V1 duration serves as the second primary cue in distinguishing voiceless geminate stops from their singleton counterpart at five places of articulation. On average, V1 is 17.2 ms shorter among geminates in comparison to singleton. These durational findings for the preceding vowel in Dogri geminates places Dogri in the category of languages that exhibit shortening of the vowel, as earlier attested in [8], also see [13, 19, 15] for a similar distribution among other Indic languages, and [7, 17] for other non-Indic languages. I n t e r e s t i n g l y , Punjabi, in versus, is not reported to show any durational difference in

V1 by consonant type, $[F(1, 4) = 1.106; p = .352]$, or by place of C2 articulation, $[F(4, 16) = 1.765; p = .185]$.

Concerning the distribution of duration of the word-initial consonant in Dogri, no consonant lengthening is observed among geminates. Punjabi, in this respect, is also reported to show no significant difference in duration of the consonant in a singleton-geminate pair, $[F(1, 4) = 4.203; p = .110]$. This behaviour in speech is in opposition to the notion that the lengthening effects among geminates is due to mental anticipation, and to an articulatory effect that geminates are spoken with a "more energetic articulation" [2 0 , p . 1 6 1] .

The following vowel is found to be statistically similar in duration among Dogri singleton and geminates by consonant type (singleton/geminate) at all places of articulation. In contrast, Punjabi, interestingly, is reported to show shortened V2 duration among geminates in comparison to the singleton counterpart, $[F(1,4) = 170.844; p < .001]$. However, the effect of place on V2 duration was not found to be significant, $[F(4,16) = 1.873; p = .165]$.

From the discussion above, it is observed that besides a lengthened C2 among geminates in comparison to singletons, the V1 and the V2 serve as additional cues in the distinction of geminates from singleton in Dogri and Punjabi respectively. For geminates, Dogri maintains a shortened duration for V1 whereas Punjabi is reported to show a shortened duration for V2. It is however noted that though the distribution of duration among vowels in both languages is spread differently in a geminate, yet there is a similarity in their durational nature, i.e., there are contractions in the duration of the respective vowels (V1 for Dogri and V2 for Punjabi).

To speak briefly, there are though contractions observed in the respective vowels (V1 for Dogri, and V2 for Punjabi), but the location of the affected vowels is swapped for the two languages. The difference in the location of these contracted vowels for both languages could be attributed to separate phonotactics.

The study submits that geographically and genealogically related languages can be perceived very similar, yet phonetics provides evidence of deviation among the two.

In future research, it would be interesting to explore geminates in Eastern Punjabi (spoken in India) in parallel with Western Punjabi, to see if the former behaves akin to Western Punjabi or to Dogri. If the durational pattern for geminates in Eastern Punjabi does not correspond with that in Western Punjabi, it would suggest towards a possibility of language change on the part of Western Punjabi.

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