Stop (de)gemination in Veneto Italian: The role of durational correlates

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Abstract

This preliminary study investigates a long-assumed but previously untested degemination of stops in the regional variety of Italian spoken in the Veneto, in North-East Italy. The durational parameters known to be affected by gemination in Italian – i.e., consonant duration, duration of the preceding vowel and the ratio between the two – are considered. The entire Italian stop series is investigated through an acoustic-phonetic production experiment involving six speakers reading a set of carrier sentences designed to elicit different prosodic patterns. Partial degemination is observed for most speakers in terms of (a) decreased geminate-singleton consonant duration differences compared to previous studies on other Italian varieties, and (b) considerable overlap between geminate and singleton consonant-to-vowel duration ratio categories. Possible sociophonetic effects are discussed.

Index Terms: gemination, degemination, duration ratio, regional Italian, Veneto Italian.

1. Introduction

1.1. Background

1.1.1. Stop gemination and its primary acoustic correlates in Italian

Italian displays a phonological contrast word-medially between long (or geminate) and short (or singleton) consonants. This length contrast involves the entire Italian stop series /p pː t tː k kː b bː d dː g gː/, as in *fato* /fato/ 'fate' vs *fatto* /fatːo/ 'fact' [1]-[3]. Gemination is realized phonetically primarily by increased consonant (C) duration and decreased duration of the preceding (stressed) vowel (V1) for geminates in this language [4]-[6]. Italian vowels are predictably long in word-medial position when the stressed syllable is open, e.g., in [ˈfaː.to], and short in the same position when the stressed syllable is closed, e.g., [ˈfat.to]. Vowels in unstressed syllables, on the other hand, are short regardless of whether the syllable is open (e.g., in *fatina* [fa.ˈtiː.na] 'fairy') or closed (e.g., *fattore* [fat.ˈtoː.re] 'factor') [14]. Another proposed acoustic correlate of Italian gemination is the ratio between the duration of the consonant and that of the preceding vowel (C/V1) [7]. Variation in C/V1 has been claimed to be a more stable correlate of gemination across speaking rates than variation in absolute C duration values. In particular, for Italian post-stress stops a C/V1 ratio lower than 1.00 would indicate a singleton and the same ratio higher than 1.00 a geminate; for pre-stress stops, on the other hand, the cut-off ratio would be 2.00 [7].

The available empirical knowledge about Italian gemination derives from previous laboratory-based studies mostly concerning the Tuscan and other Central-Southern (mainly Roman) regional varieties of Italian which are historically strongly associated with Standard Italian (see § 1.1.2). In terms of phonetic C duration, the previous findings point towards a clear-cut distinction between phonological length types, with geminate stops found to be roughly twice as long as singletons in nuclear accented position within an intonational phrase [3], [6]-[10]. For V1 duration, on the other hand, substantial inter-speaker variation in the magnitude of stressed pre-geminate vowel shortening (roughly between 20 and 50% of total V1 duration) has been reported across a number of studies (e.g., [4]-[7], [11]-[14]), suggesting that this phenomenon may be more variable in nature. It has also been proposed that V1 duration may be directly linked with the phonetic duration of C rather than its phonological length, with C and stressed V1 duration appearing to be in an inverse linear relationship [15]. This would explain the less 'categorical' gemination-triggered behavior of V1 duration as opposed to that of C duration reported in the literature.

1.1.2. Cross-regional differences and Northern degemination

It is important to note that Italian is not a homogeneous language at the phonetic level, particularly from a geographic perspective. Indeed, notable cross-regional differences exist between Northern varieties on the one hand, and Central-Southern varieties on the other in this respect [1]. The Central-Southern varieties are said to comply with Standard Italian pronunciation norms in terms of consonant length, with clear duration differences between geminates and singletons reported in the numerous studies focusing on these varieties. On the other hand, the Italian spoken in Northern Italy, and particularly in the Veneto Region in North-East Italy (henceforth, Veneto Italian), has often been associated with consonant degemination [16], [17]. According to these claims, Northern Italian geminates are generally produced with shorter duration [18] or virtually no duration difference from singletons [17]. However, these claims stem from impressionistic auditory descriptions and as such have mostly not been backed by experimental acoustic evidence (cf. [19] for a discussion). Indeed, in the only large-scale, cross-regional study on Italian gemination [19] no significant geminate-to-singleton C duration differences between Northern and Central-Southern varieties of Italian were observed.

1.1.3. Veneto Italian stop (de)gemination

To our knowledge, no relevant empirical acoustic information on stop gemination can be extracted from studies specifically addressing Veneto Italian, as this variety has been particularly understudied in terms of experimental phonetic research. This is striking considering the claims strongly associating this variety with degemination, e.g., [16]-[18]. These claims may stem from the fact that many Veneto speakers are likely to show a relatively strong influence of the locally spoken Romance dialect (which lacks a consonant quantity distinction) on their Italian, as regional dialect is more widely spoken in the Veneto compared to other areas in Italy [20]. Indeed, many Veneto speakers are said to be bilectal, i.e., actively speaking both Italian and the dialect to different degrees [20].

1.2. Aims

In the first instance this study aims at providing some experimental durational acoustic findings on stop gemination for Veneto Italian, a regional variety for which they are lacking. Another aim is to test whether the claims regarding degemination hold true for this variety. This is done by considering the established durational acoustic cues to gemination for Italian (C, V1 duration) and their ratio (C/V1).

2. Methods

2.1. Participants

The participants were three females and three males all born, raised, and living in the south-western part of the province of Vicenza, in central Veneto, at the time of the experiment. They were all active speakers of the local dialect. Unusually, VenS3F had studied Standard Italian elocution not long before the experiment. The list of participants with relevant sociophonetic information is listed in Table 1. The 'Relative Italian-dialect bilectalism' column provides information as to whether the dialect or Italian was predominant, or whether the participants made a balanced used of both lects.

Table 1. *List of participants with related sociophonetic information.*

Participant ID	Sex	Age	Level of Schooling	Rel. Italian-dialect bilectalism
VenS1F	F	68	Elem. school	Dialect
VenS2F	F	43	Sec. school	Balanced
VenS3F	F	44	Uni. degree	Balanced
VenS1M	M	50	Uni. degree	Balanced
VenS2M	M	34	Sec. school	Balanced
VenS3M	M	35	Sec. school	Balanced

2.2. Material and procedure

An acoustic phonetic experiment was set up to collect the data, namely C and V1 duration values. C covered all Italian stop phonemes while V1 included only mid or low vowels. The entire experiment was conducted in Italian. The phones of interest were embedded in real Italian target words forming part of read carrier sentences, with the words either in sentence-final (*ho detto WORD*, 'I said WORD') or sentence-medial (*ho detto WORD prima*, 'I said WORD before') position. The participants were asked to read the carrier sentences as if they were answering a question which placed the focus on the target word (*Che hai detto?/Che hai detto prima?*, 'What did you say?/What did you say before?). Both positions were designed to elicit nuclear accented target words. The target words also had two different stress conditions (post-stress or pre-stress) based on the position of the target consonant relative to that of lexical stress. The words were all paroxytones; post-stress words were disyllabic and pre-stress words trisyllabic. This means that V1 was stressed in post-stress words and unstressed in pre-stress words. The resulting twenty-four target words are listed in detail in Table 2 below. Target /V1-C(C)/ sequences are in bold.

The carrier sentences were presented on a computer screen in random order and repeated by each of the six speakers four times, for each of the twenty-four target words, and for each of the two position-in-the-phrase conditions. The total number of tokens was therefore 1152. The sentences were recorded through a professional solid-state recorder, sampled at 44100 Hz with 16-bit quantization.

Table 2. *List of experimental words.*

Phon	Post-stress		Pre-stress	
	Sing	Gem	Sing	Gem
/p/	*Papa* /ˈp**ap**a/ 'Pope'	*pappa* /ˈp**app**a/ 'mush'	*Papato* /p**a**ˈ**p**ato/ 'Papacy'	*pappato* /p**ap**ˈ**p**ato/ 'gobbled up'
/t/	*fato* /ˈf**at**o/ 'fate'	*fatto* /ˈf**att**o/ 'fact'	*patata* /p**a**ˈ**t**ata/ 'potato'	*dettato* /d**et**ˈ**t**ato/ 'dictation'
/k/	*paca* /ˈp**ak**a/ 'he/she calms'	*pacca* /ˈp**akk**a/ 'pat'	*pacato* /p**a**ˈ**k**ato/ 'placid'	*paccato* /p**ak**ˈ**k**ato/ 'let down' (p.p.)
/b/	*roba* /ˈr**ɔb**a/ 'stuff'	*gobba* /ˈg**ɔbb**a/ 'hump'	*Babele* /b**a**ˈ**b**ɛle/ 'Babel'	*dabbene* /d**ab**ˈ**b**ɛne/ 'respectable'
/d/	*cade* /ˈk**ad**e/ 'he/she falls'	*cadde* /ˈk**add**e/ 'he/she fell'	*badato* /b**a**ˈ**d**ato/ 'looked after'	*laddove* /l**ad**ˈ**d**ove/ 'whereby'
/g/	*lega* /ˈl**eg**a/ 'he/she ties'	*legga* /ˈl**ɛgg**a/ 'read' (pr.sub.)	*pagato* /p**a**ˈ**g**ato/ 'paid'	*taggato* /t**ag**ˈ**g**ato/ 'tagged'

2.3. Analysis

The phonetic annotation of the target words was done manually in EMU-SDMS [21] and the duration of the target segments was extracted and analyzed through emuR [22]. For voiceless stops, V1 onset and offset were placed at the start and end of V1, respectively – i.e., where periodicity and glottal pulses were visible in the waveform and spectrogram. C onset coincided with V1 offset and C offset with the onset of phonation in the following vowel. Thus, the release phase (indicated as [h] in Figure 1) was included in C duration (as in e.g. [3], [9]). Voiced stop onset and offset boundaries were placed where a sudden (a) drop and (b) rise of amplitude and F2 energy were visible in the waveform and spectrogram, respectively [3]. A release burst, where present, was included in C duration. An example of annotation for singleton /fato/ is shown in Figure 1 below.

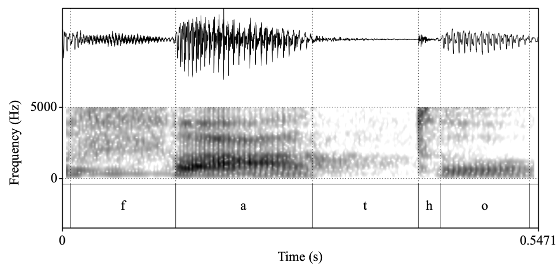

Figure 1: *Example of annotation of token /fato/ uttered by VenS3F. V1* = [a]; *C* = [t^h].

Average C and V1 duration values, and C/V1 duration ratios were calculated for each length type and each speaker, with the aim of observing differences between length types. To attest the statistical significance of the results, quantitative data analyses on the raw data were performed in R through Linear Mixed-Effects Models using the lmerTest package [23]. Three models were run – one for each of the dependent variables: i) C duration; ii) V1 duration; and iii) C/V1 ratio. Each of the three dependent variables was modeled as a function of gemination and other fixed-effects factors, namely voicing, stress condition, position in the phrase, place of articulation, and speaker sex, as well as their interactions. The models where initially maximally specified and subsequently step-reduced (through the step function that is part of [23]) to obtain the best-fitting models. The participants were treated as a random-effect factor with by-speaker varying intercepts and varying gemination slopes. The models found significant effects for various factors; however, due to the limited space available, only the results for gemination and relevant interactions are reported. The emmeans function (part of [24]) was employed to conduct post-hoc tests so as to investigate differences between levels in interactions.

3. Results

3.1. C duration

The results for C duration are summarized for each speaker in Table 3 below. They support the partial degemination claims, although not for all speakers. Overall, the geminate-to-singleton (CC/C) duration ratio is 1.76, which is lower than the ratio of 2.00 reported in the literature for similar experimental settings concerning the central varieties. However, VenS3F – the speaker who had previously studied Standard Italian elocution – produced a ratio greater than 2.00.

The statistical analysis confirmed the presence of a significant main effect of gemination on the mixed-effects model across speakers and conditions (β = -92.90 ms, SE = 13.01 ms, t = -7.14, $p < .001$).

Table 3. *Mean duration (in ms), SD (in parentheses), and counts (n) of geminate and singleton C for each speaker across conditions. CC/C ratios are also provided.*

Participant ID	Geminate	n	Singleton	n	CC/C ratio
VenS1F	189 (51)	96	117 (41)	96	1.62
VenS2F	134 (25)	96	86 (26)	96	1.56
VenS3F	201 (33)	96	93 (23)	96	2.16
VenS1M	171 (28)	96	104 (29)	96	1.64
VenS2M	166 (26)	96	93 (26)	96	1.78
VenS3M	150 (27)	96	84 (26)	96	1.79
All	169 (40)	576	96 (31)	576	1.76

3.2. V1 duration

Table 4 shows the results for stressed V1. As expected, the geminate-singleton durational differences for pre-stress vowels were found to be non-significant. Therefore, only the results for the post-stress condition are reported.

Pre-geminate stressed V1 shortening occurred for all speakers, although to varying degrees. On average, the magnitude of the shortening was -28%, as revealed by the overall pre-geminate-to-pre-singleton vowel (Vcc/Vc) duration ratio reported in Table 4. Again, there is considerable variation across speakers.

The model found a significant overall effect of gemination on V1 duration across speakers (β = 51.14 ms, SE = 9.23, t = 13.83, $p < .001$). However, as mentioned above, post-hoc tests found significant geminate-singleton differences only for post-stress (β = -44.91 ms, SE = 3.67 ms, $p < .001$) and not for pre-stress (β = -8.72 ms, SE = 3.67 ms, $p = 0.213$) tokens.

Table 4. *Mean duration (in ms), SD (in parentheses), and counts (n) of stressed pre-geminate and pre-singleton V1 for each speaker. Vcc/Vc ratios are also provided.*

Post-stress condition (stressed V1)					
Participant ID	Geminate	n	Singleton	n	Vcc/Vc ratio
VenS1F	139 (22)	48	195 (35)	48	0.71
VenS2F	110 (14)	48	134 (19)	48	0.82
VenS3F	126 (18)	48	188 (21)	48	0.67
VenS1M	121 (19)	48	156 (15)	48	0.78
VenS2M	95 (13)	48	145 (21)	48	0.66
VenS3M	105 (17)	48	146 (22)	48	0.72
All	116 (23)	288	161 (32)	288	0.72

3.3. C/V1 ratio

Table 5 reports the results for C/V1 ratio. The effect of gemination on the model was significant across speakers and conditions (β = -0.77, SE = 0.23, t = -3.30, $p < .05$), although less highly so than for the previous two models based on actual durations.

Table 5. *Mean geminate and singleton C/V1 ratios, SD (in parentheses), and counts (n) for each speaker for the post-stress (top) and pre-stress (bottom) conditions.*

C/V1 ratios – Post-stress condition				
Part. ID	Geminate	n	Singleton	n
VenS1F	1.55 (0.56)	48	0.70 (0.38)	48
VenS2F	1.34 (0.33)	48	0.71 (0.27)	48
VenS3F	1.74 (0.50)	48	0.55 (0.14)	48
VenS1M	1.53 (0.51)	48	0.73 (0.24)	48
VenS2M	1.87 (0.50)	48	0.69 (0.32)	48
VenS3M	1.58 (1.17)	48	0.61 (0.23)	48
All	1.60 (0.67)	288	0.66 (0.27)	288

C/V1 ratios – Pre-stress condition				
Part. ID	Geminate	n	Singleton	n
VenS1F	2.64 (0.98)	48	1.53 (0.65)	48
VenS2F	2.29 (0.43)	48	1.31 (0.43)	48
VenS3F	3.09 (0.78)	48	1.11 (0.37)	48
VenS1M	2.87 (0.76)	48	1.50 (0.65)	48
VenS2M	3.39 (1.27)	48	1.62 (0.61)	48
VenS3M	2.41 (0.64)	48	1.33 (0.57)	48
All	2.78 (0.93)	288	1.40 (0.58)	288

At first glance the C/V1 ratio results seem to confirm those reported by [7] in that for post-stress tokens there appears to be a geminate-to-singleton cut-off ratio of 1.00 and for pre-stress tokens of 2.00. However, the SD values suggest that there might

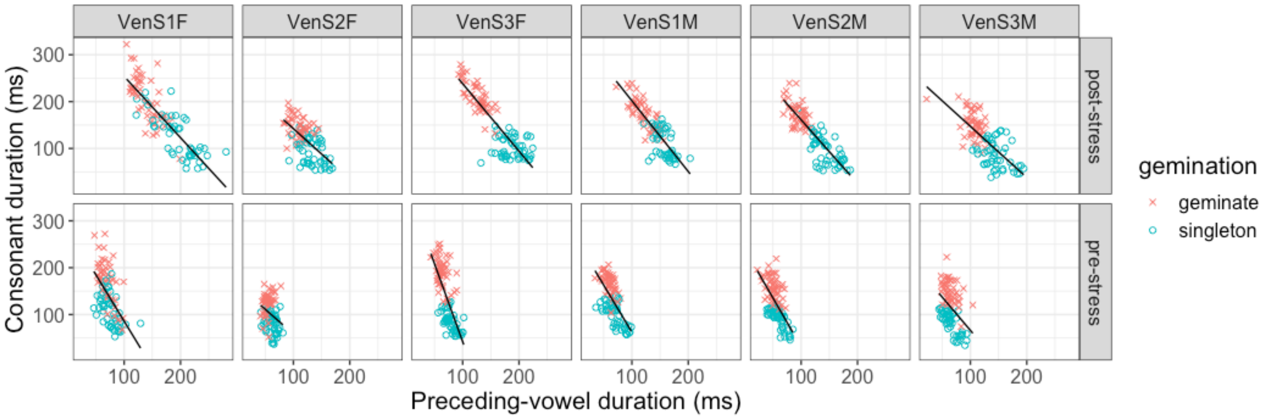

Figure 2: *C duration as a function of V1 duration by participant and stress condition. Lines of best fit are superimposed.*

be some overlap between categories for some speakers at around the assumed cut-off ratios. In fact, in contrast with the Roman variety [7], the relationship between C and V1 durations in this study appears to be linear and gradient for all our Veneto Italian speakers. Indeed, negative repeated-measures correlations [25] between the parameters were found for both stress conditions: very strong for the post-stress condition ($r = -0.814$, $p < .001$) and moderate-to-strong for the pre-stress condition ($r = -0.566$, $p < .001$). Figure 2 shows the particularly gradient nature of the C/V1 relationship found for this variety, with the data points roughly aligning around the line of best fit and the two data clusters appearing to merge into each other. This is in contrast with the strikingly more bimodal relationship observed in [7] for the Roman variety, where the data points form two clearly separated clusters with very little gradience and almost no overlap between length types. To give a better idea of the degree of overlap in this study, Table 6 shows how many of the singleton tokens would be categorized as geminate and vice-versa if the cut-off C/V1 ratios of 1.00 for post-stress and 2.00 for pre-stress tokens proposed by [7] were adopted.

Table 6. *Proportions of singleton tokens that would be categorized as geminate and vice-versa if the proposed cut-off C/V1 ratios were adopted.*

Participant ID	Sing. categorized as gem.	Gem. categorized as sing.
VenS1F	21/96 (21.9%)	26/96 (27.1%)
VenS2F	7/96 (7.3%)	16/96 (16.7%)
VenS3F	1/96 (1.0%)	6/96 (6.3%)
VenS1M	16/96 (16.7%)	13/96 (13.5%)
VenS2M	22/96 (22.9%)	4/96 (4.2%)
VenS3M	6/96 (6.3%)	17/96 (17.7%)
All	73/576 (12.7%)	82/576 (14.2%)

4. Discussion

In this study there is evidence of partial stop degemination for some Veneto Italian speakers. Partial degemination was measured in two ways: i) by comparing the observed CC/C ratios with those reported for the central varieties in similarly designed experimental settings; and ii) by looking at the amount of overlap in C/V1 ratios between length categories.

The above results also highlight noticeable speaker-specific differences which emerge more clearly when C/V1 is considered. Indeed, Figure 2 and Table 6 show a considerable degree of overlap between data points for most speakers except VenS3F. Recall that this speaker had been trained in Standard Italian pronunciation – something that becomes particularly evident here. By contrast, VenS1F exhibited particularly striking overlapping between length types. Recall that she was the oldest speaker and strongly favoured the use of the dialect. Furthermore, VenS1M – the second oldest participant – showed somewhat more overlap than the other two younger male speakers. It seems, therefore, that the sociophonetic factors listed in Table 1 may play a part in the phonetic realization of stops in Veneto speakers. However, only a purposely designed, large-scale sociophonetic experiment could provide more reliable information in this regard.

The differences between the findings of this study and those reported in [7] for the Roman variety suggest that the phonetic realization of gemination may vary between the two varieties more in terms of the relative contributions of C and V1 duration than in terms of absolute C duration. Whereas in the Roman variety geminate consonants are consistently longer and pre-geminate vowels consistently shorter, in this study the contrast between the two length categories appears to be more blurred. The consonants exhibited greater durational variability and the duration of the preceding vowels co-varied accordingly in a particularly gradient fashion. This resulted in a distinctly gradient inverse relationship between C and V1 durations which does not allow for a reliable clear-cut distinction between geminates and singletons based on C/V1 ratios, as is the case with the Roman variety and presumably other Central-Southern varieties. Furthermore, it is possible that the blurriness between length categories due to gradient C/V1 ratio distribution may contribute to listeners' perception of degemination in Veneto Italian, although this would have to be investigated in a future perceptual experiment.

5. Conclusion

This study suggests that partial degemination may be the norm for adult Veneto Italian speakers, with speaker-specific differences possibly linked to sociophonetic factors such as speaker age, educational background, and level of Italian-dialect bilectalism. It appears that older, less educated Veneto Italian speakers who more strongly favour the use of the dialect may be particularly prone to exhibiting relatively higher degrees of degemination.

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