

PREASPIRATION IN ITALIAN VOICELESS GEMINATE AND SINGLETON STOPS

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ABSTRACT

This study is the first to explore from a cross-regional perspective acoustic phonetic features of preaspiration in both voiceless geminate and singleton stops in Italian, a language for which preaspiration is most typically associated with voiceless geminate stops. Frequency of preaspiration occurrence and duration are investigated in a controlled production experiment involving twelve speakers from two regional areas with different dialect substrata. Results reveal that preaspiration occurs for both geminates and singletons in both regions, with area-specific differences in frequency possibly linked to regional differences in phonetic voicing patterns of intervocalic singletons. We conclude that preaspiration in Italian stops may be best associated with phonetic voicing status, not phonological length.

Keywords: Preaspiration, voiceless stops, gemination, Veneto Italian, Roman Italian.

1. INTRODUCTION

1.1. What is preaspiration?

Preaspiration has been defined broadly as “a period of (usually glottal) friction that occurs between a vocalic and a consonantal interval” [10], as in [V^hC]. Initially believed to be a very rare or even extremely rare phenomenon (e.g., [16], [17], [20], [21]), preaspiration has been more recently associated with phonetically voiceless obstruents in a number of languages. [6] reports eighty-six languages across eighteen rather diverse language families that have been claimed to exhibit preaspiration, although [6] also points out that different definitions of the phenomenon are adopted across studies. The definitions of preaspiration mostly vary as to whether: (a) it only concerns voiceless stops or also fricatives and affricates; (b) it is realized as purely glottal [h̥] or supraglottal (e.g., [ϕ θ x ç]) friction; (c) it can involve vocal fold vibration alongside glottal (or supraglottal) friction. Where vocal fold vibration is present, preaspiration is generally labelled breathy voice/voicing or breathiness, whereas where only friction noise and no glottal periodicity is detected,

it is labelled voiceless (glottal) friction [4], [10]. This latter type of preaspiration, particularly when purely glottal, has been referred to as e.g., “prototypical” [4], “archetypal” [23], “genuine” [17], or “true” [10]. It is this type in particular that is believed to be rare across the world’s languages [17].

1.2. Italian

Italian is one of the languages for which preaspiration has been observed. It displays a word-medial phonological contrast between short (or singleton) and long (or geminate) consonants, as in /'fato/ ‘fate’ vs. /'fat:o/ ‘fact’ [2]. This contrast concerns the entire stop series including voiceless /p t k/. Italian is mainly spoken in Italy, a linguistically diverse country where different regional varieties of Standard Italian (SI) are found across its various geographic regions. On the one hand, SI is a prestigious, idealized form of Italian, spoken by a small number of educated people [2]. On the other hand, the regional varieties, or “accents” [2], are typically influenced by the local, co-existing Italo-Romance dialects and display distinctive phonetic characteristics, among other things [3]. Despite this fragmentation, the varieties can be broadly grouped into Northern and Central/Southern (cf. [14]). One of the differences between Northern and most Central/Southern varieties is that in the latter intervocalic singleton /p t k/ are frequently realized with some degree of phonetic voicing, as in /la pa'tata/ > [la p̥a'tata] ‘the potato’ [3, pp. 55–56], with some exceptions. The most notable exception concerns the Tuscan varieties, where these consonants remain voiceless but are typically spirantized instead (see below).

1.3. Preaspiration in Italian stops

Among the Italian voiceless stop series, optional preaspiration has been extensively reported for geminate /p t k/ [18]–[21], [23]–[25], whereas only one known study has reported it for singleton /p t k/ [22]. Like most earlier acoustic-phonetic studies on Italian preaspiration, [22] focussed on Siene Italian, a Tuscan (Central) variety that typically spirantizes voiceless singleton /p t k/ as [ϕ θ h] in intervocalic position (as in /la pa'tata/ > [la p̥a'taθa] ‘the potato’) [20, p. 341]. The preaspiration of singletons reported

for Sieneese was interpreted as a variety-specific weakening of these spirantized stops. In later cross-regional studies this spirantization, as well as the assumed widespread lenition of voiceless singleton stops in other varieties, were considered problematic for a “straightforward duration-based analysis” of preaspiration [18, p. 22]. This possibly led to the decision to overlook singletons, something which was later reinforced by the hypothesis that preaspiration is employed by speakers to reinforce articulatorily [18], [19] or “maximize the perception” [21, p. 60] of Italian geminates. With time, the hypothesis that preaspiration characterised Italian voiceless geminate stops exclusively has become an underlying assumption [25].

1.4. Aims

This study investigates frequency of occurrence and duration of preaspiration in both geminates and singleton voiceless stops in Italian. Given the expected differences in singleton stop realization between Northern and Central/Southern varieties (cf. §1.2), one variety for each broader area is examined – namely, the Italian spoken in the Veneto region in the North-East (Veneto Italian) and the Italian spoken in the city of Rome, in the Centre-South (Roman Italian). As a Northern variety, Veneto Italian is expected to realize all phonologically voiceless stops as phonetically voiceless. Roman Italian, on the other hand, should optionally voice these consonants to different degrees, as previously reported [11]. Therefore, if preaspiration is to be associated with phonetic voicelessness and if it were to occur in singleton stops, it is expected that its frequency of occurrence for singletons would be lower in Roman than in Veneto Italian.

2. METHODS

2.1. Participants

Twelve adult speakers (age range: 32–68) were recruited for the study. Six were from the Veneto and six from Rome, with three males and three females for each area. All the Veneto participants were recorded in the area south-west of Vicenza, in Central Veneto, where they had lived all their lives. The Roman participants were recorded in Melbourne, Australia, although they had all grown up and lived in Rome for most of their lives.

2.2. Materials and procedure

A controlled acoustic phonetic experiment was designed whereby the participants were asked to read

out a series of carrier sentences containing a list of real Italian experimental words, shown in Table 1.

Target /p p: t t: k k:/ consonants were embedded in the experimental words and flanked preferably by low vowels or alternatively mid vowels. To test the effect of lexical stress, the consonants either directly followed (post-stress) or preceded (pre-stress) the stressed vowel, as in /'fato/ vs. /pa'tata/. Post-stress words were disyllabic and pre-stress words trisyllabic paroxytones. The effect of position in the phrase was also tested, with experimental words in either phrase-final (“*Ho detto WORD*”, ‘I said WORD’) or phrase-medial (“*Ho detto WORD prima*”, ‘I said WORD before’) position. The words were all nuclear accented; to ensure this, the participants were asked to read the sentences as if they were answering a question that placed the focus on the experimental word: “*Che hai detto?/Che hai detto prima?*”, ‘What did you say?/What did you say before?’.

Phon	Post-stress		Pre-stress	
	Sing	Gem	Sing	Gem
/p/	<i>Papa</i> /'papa/ ‘Pope’	<i>pappa</i> /'pappa/ ‘mush’	<i>Papato</i> /pa'pato/ ‘Papacy’	<i>pappato</i> /pap'pato/ ‘gobbled up’
/t/	<i>fato</i> /'fato/ ‘fate’	<i>fatto</i> /'fatto/ ‘fact’	<i>patata</i> /pa'tata/ ‘potato’	<i>dettato</i> /det'tato/ ‘dictation’
/k/	<i>paca</i> /'paka/ ‘he/she calms’	<i>pacca</i> /'pakka/ ‘pat’	<i>pacato</i> /pa'kato/ ‘placid’	<i>paccato</i> /pak'kato/ ‘let down’ (p.p.)

Table 1: List of experimental words. /VC(C)/ sequences are in bold.

The carrier sentences were displayed one by one on a computer screen in random order. Each of the twelve experimental words was repeated four times for each of the two position-in-the-phrase conditions by each of the twelve speakers. One token was discarded due to background noise, for a total of 1151 tokens. The Veneto speakers were recorded through a professional, portable solid-state recorder in a quiet, noise-reduced room while the Roman speakers were recorded in a sound-proof recording studio. The recordings for both groups were sampled at 44100 Hz with 16-bit quantization.

2.3. Analysis

The phonetic annotation of the experimental words was carried out manually in EMU-SDMS [26]. Where present, breathy voice in the vowel (BV) and voiceless glottal friction (GF) were identified and labelled separately. In line with [15], the onset of BV was placed where the waveform began to appear more sinusoidal (and/or visibly jagged, cf. [5]) and

the formants more blurred in the spectrogram; its offset coincided with either the onset of GF where present or the onset of stop closure. The onset of GF was placed where increased energy in the higher frequency range of the spectrogram was visually observed along with a clear reduction in amplitude, or cessation altogether, of periodicity as visible from the waveform. An example is shown in Figure 1.

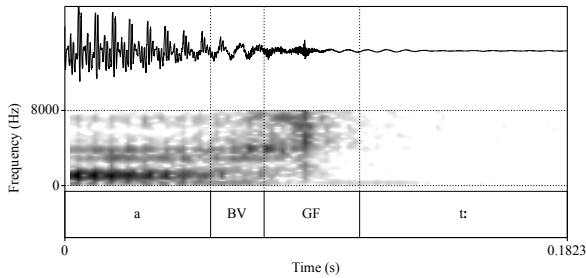


Figure 1: Labelled example of a token /fatto/ displaying both BV and GF, produced by a female Roman speaker.

Previous studies of Italian preaspiration (cf. §1.3) adopted the broader definition of the phenomenon as BV, GF, or both (henceforth, BV+GF). This study also seeks to investigate the distribution patterns of GF alone in line with recent investigations on other languages (e.g., [9]). Thus, the tokens displaying BV+GF and the tokens displaying GF alone were counted separately. The duration of BV+GF was also measured. Tokens displaying no preaspiration were excluded from the durational analysis (cf. [8]).

The data were extracted through emuR [27]. Statistical analyses testing the effect of controlled fixed factors on frequency of occurrence and duration of preaspiration were conducted within the statistical environment R. The fixed factors are as follows:

- (a) AREA (Rome/Veneto);
- (b) SPEAKER SEX (female/male);
- (c) GEMINATION (singleton/geminate);
- (d) STRESS CONDITION (post-stress/pre-stress);
- (e) POSITION (IN THE PHRASE) (phrase-final/phrase medial);
- (f) PLACE OF ARTICULATION (bilabial/denti-alveolar/velar), henceforth PoA.

SPEAKER and WORD were treated as random factors. For frequency of occurrence, two Mixed-Effects Binomial Logistic Regression Models (glmer function, part of [1]) were utilized to predict the effect of all the fixed factors and the interaction of factors (a) and (c) on the probability of occurrence of BV+GF and GF, respectively. Both models had by-SPEAKER and by-WORD varying intercepts. For duration, a Linear Mixed-Effects (LME) model [12] was employed to identify the effect of the fixed factors and their interaction on BV+GF duration. The LME model was at first maximally specified and then step-

reduced (through the step function [12]) to obtain the best-fitting model. The final model had by-SPEAKER varying intercepts and varying (d) slopes. The emmeans function [13] was used for post-hoc tests.

3. RESULTS

3.1. BV+GF frequency and duration

Overall, BV+GF was observed in 794/1151 (69%) tokens. It was frequently displayed by both geminates (462/575, 80%) and singletons (332/576, 58%). It was also more frequent in post-stress (451/576, 78%) than in pre-stress (343/575, 60%) tokens. Figure 2 shows that BV+GF frequency increased with more posterior PoA, with 130/384 (34%) bilabial, 308/384 (80%) denti-alveolar, and 356/383 (93%) velar BV+GF tokens. It also shows that for geminates BV+GF occurred with similar frequency across areas, while for singletons it was less frequent for Roman than for Veneto speakers. The results are confirmed by the statistical analysis, with significant main effects of gemination (logit = 2.723, $z = 8.601$, $p < .001$), PoA (logit = 4.601, $z = 12.923$, $p < .001$), stress condition (logit = -1.669, $z = -6.889$, $p < .001$), and a significant interaction between area and gemination (logit = -1.334, -3.520, $p < .001$). Post-hoc tests confirm somewhat greater differences in singleton vs. geminate BV+GF probability of occurrence for the Roman variety (logit = -2.723, $z = -8.601$, $p < .001$) than the Veneto variety (logit = -1.388, $z = -4.445$, $p < .001$). Speaker sex and position did not reach statistical significance.

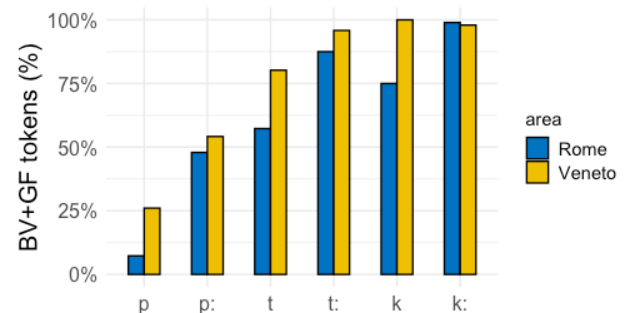


Figure 2: Frequency of occurrence of BV+GF tokens by area, PoA, and gemination types.

As for preaspiration duration, Figure 3 shows no clear effect of gemination on the distribution of non-zero BV+GF values. Overall, higher values were found for post-stress ($\mu = 38$ ms, $\sigma = 26$ ms) than pre-stress tokens ($\mu = 23$ ms, $\sigma = 14$ ms). Furthermore, the values increased with posteriority of PoA: bilabial: $\mu = 18$ ms, $\sigma = 11$ ms; denti-alveolar: $\mu = 25$ ms, $\sigma = 17$ ms; velar: $\mu = 43$ ms, $\sigma = 26$ ms. The statistical analysis only found significant main effects

of stress condition ($\beta = 39.968$ ms, $t = 3.721$, $p < .001$) and PoA ($\beta = 16.716$ ms, $t = 2.882$, $p < .01$).

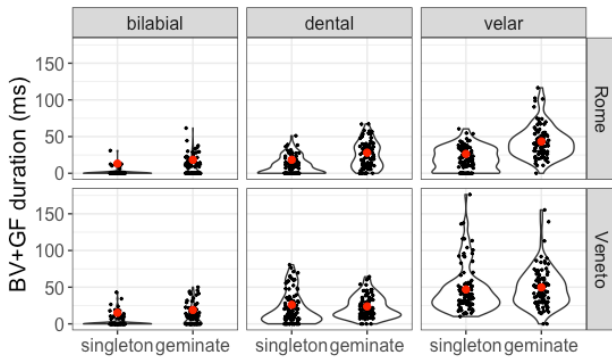


Figure 3: Distribution of BV+GF duration values by area, PoA, and gemination types. Red dots indicate mean non-zero values.

3.2. GF frequency

A clearly different pattern in frequency of occurrence emerges when GF alone is considered. Apart from lower overall frequency (548/1151, 48%), striking cross-regional differences are observed for GF within singletons. As Figure 4 shows, Veneto singleton GF rates of occurrence are comparable to those of geminates (singletons: 152/288, 53%; geminates: 182/288, 63%), while for Rome singletons these are much lower (singletons: 34/288, 12%; geminates: 180/288, 63%). Furthermore, across regions post-stress GF tokens (293/576, 51%) were somewhat more frequent than their pre-stress counterparts (255/575, 44%). Finally, bilabial GF tokens (30/384, 8%) were less frequent than denti-alveolars (233/384, 61%) and velars (295/383, 77%).

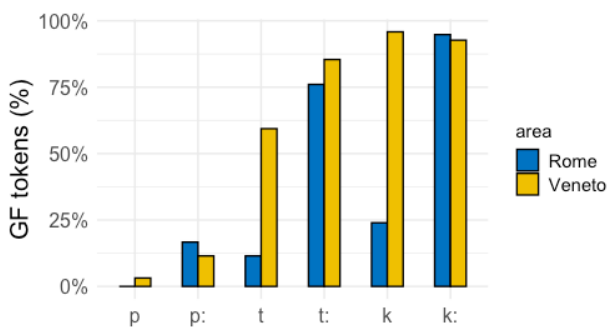


Figure 4: Frequency of occurrence of GF tokens by area, PoA, and gemination types.

Statistically significant main effects of gemination (logit = 4.210, $z = 11.246$, $p < .001$), area (logit = 3.293, $z = 9.069$, $p < .001$), and a significant interaction between gemination and area (logit = -3.260, $z = -8.098$, $p < .001$) were found. This time, post-hoc tests found considerably greater differences

in singleton vs. geminate GF probability of occurrence for the Roman variety (logit = -4.210, $z = -11.246$, $p < .001$) than the Veneto variety (logit = -0.950, $z = -2.937$, $p < .05$). In other words, GF was nearly as likely to occur in Veneto singletons as in geminates, while it was much less likely to occur in Roman singletons than geminates. The model also found a highly significant main effect of PoA (logit = 5.226, $z = 13.341$, $p < .001$) and a significant main effect of stress condition (logit = -0.559, $z = -2.070$, $p < .05$). Speaker sex and position were not significant.

4. DISCUSSION AND CONCLUSION

The main finding of this study is that preaspiration occurrence in Italian voiceless stops is not confined to geminates as generally thought (but see [22]) – on the contrary, it is also frequent in singletons. As proposed in §1.4, the results also suggest that cross-regional differences may be due to variety-specific variation in the surface realization of underlyingly voiceless singleton stops. Northern varieties of Italian do not typically voice or lenite these stops, and in fact our Northern speakers exhibited comparable: (a) frequency of occurrence and duration of preaspiration; and (b) frequency of occurrence of GF, between singletons and geminates. Conversely, Roman speakers, who are expected to variably voice intervocalic singletons, showed less frequent preaspiration for singletons than for geminates, particularly when only GF was considered. This indicates that preaspiration in our study may be better associated with (phonetic) voicelessness (as alternatively hypothesized by [21]) than phonological length, although future investigations including degree of voicing are necessary to validate this hypothesis. Frequency of GF in singletons appears to be a robust discriminator between varieties (cf. §3.2). Thus, this “prototypical” preaspiration may be more reliably associated with phonetic voicelessness of stops than preaspiration as more broadly defined.

Regarding stress condition and PoA, this study confirms previously reported trends. Post-stress stops display more frequent, longer preaspiration than pre-stress stops, and preaspiration frequency and duration increase with posteriority of PoA [19], [24]. The overall frequency of occurrence of preaspiration as broadly defined, however, is much higher in this study (69%) than in previous ones (ca. 30-40% [18]–[21], [23]–[25]), probably due to all the tokens being in nuclear accented position within the sentence in this study. This explanation would corroborate a proposed association of Italian preaspiration with fortition [18]. Finally, in line with previous investigations [24], speaker sex does not seem to affect the occurrence or duration of preaspiration.

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