# Geminate vs. Non-Geminate Consonants in Italian: Evidence from a Phonetic Analysis\*

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# **1** Introduction

It has been suggested that geminate consonants are longer than non-geminate consonants, which leads to a reciprocal length relationship with preceding vowels. For example, Hall (1948) and Chierchia (1982) attribute this to the lengthening of vowels in open syllables, whereas Maddieson (1985) and Josseln (1990) attribute this to the shortening of vowels in closed syllables. More interestingly, Hurch and Rhodes (1996) point out dialectal variation between Northern Italian and Southern Italian in terms of geminate vs. non-geminate consonants. For instance, they claim that all the Romance languages except for Sardinian and Southern (or central) Italian undergo degemination, which neutralizes the distinction between geminates and non-geminates in certain minimal pairs.

In this paper, I provide a phonetic characterization of non-geminate consonants and geminate consonants in two different Italian dialects, Northern Italian (NI) and Southern Italian (SI),<sup>1</sup> by measuring the duration of consonants themselves and the preceding vowel. Based on evidence from this phonetic analysis, I verify the previous assumption that degemination occurs in Northern Italian.

# 2 Syllable Structure

According to the previous assumption, the Southern dialect has the distinction between a non-geminate consonant and a geminate consonant in certain minimal pairs. An example of the minimal pairs is given in (1). In contrast, the Northern dialect does not show this distinction, as shown in (2).

- (1) Southern Italian
  - a. fato 'fate'
  - b. fatto 'fact'

<sup>\*</sup> I am grateful to Irene Vogel and Bill Idsardi for very useful feedback on this work.

<sup>&</sup>lt;sup>1</sup> Although one of the subjects is from Rome (a central dialect of Italian), I will refer to it as the southern dialect of Italian, for convenience' sake. This will not cause any problem because degemination occurs only in Northern Italian.

(2) Northern Italian

- a. fato 'fate'
- b. fatto 'fact' (fatto  $\rightarrow$  fato)

Since degemination neutralizes the distinction between geminates and non-geminates, the minimal pair in (2) becomes homophonous in Northern Italian.

To determine the correct analysis, let us briefly discuss the different properties between geminates and non-geminates. Goldsmith (1990) points out two phonological properties of geminate consonants, as shown in (3).

- (3) a. Geminate consonants close syllables and add syllabic weight
  - b. Geminate consonants cannot be split by epenthesis

In addition, Venneman (1988) proposes the weight law, which describes the relationship between accent and mora in syllables.

(4) <u>The Weight Law</u>: An accented syllable is the more preferred in stress accent languages, the closer its syllable weight is to two moras, and an unaccented syllable is the more preferred the closer its weight is to one mora. (The optimal stressed syllable is bimoraic, the optimal unstressed syllable is unimoraic) It can be said that every accented syllable has two moras, which cause the stress vowel in open syllable to be lengthened.

(Vennemann 1988: 30)

As shown in (4), the weight law suggests that the optimal stressed syllable is bimoraic, the optimal unstressed syllable is unimoraic. In other words, every accented syllable has two moras, which induce the stress vowel in open syllable to be lengthened.

Based on the properties of geminates and the weight law proposed by Goldsmith (1990) and Vennemann (1988), the syllable structure which contains an underlying non-geminate consonant can be derived as follows:



In this syllable structure, accent is placed in the first syllable, which causes a mora to be added in it by the weight law, as shown in (5b). Accordingly, the syllable structure of non-geminates in both NI and SI is given in (5b).

Furthermore, the syllable structure for geminate consonants such as in *fatto* is the same as that for non-geminates such as *fato* in NI because degemination occurs in this dialect. In contrast, the syllable structure which contains a geminate consonant in SI is given in (6).



Since the geminates are linked to two C-slots, the first C-slot can be linked to a mora in the coda position of the first syllable. Accordingly, the preceding vowel cannot have two moras by the weight law because the first syllable already has two moras. Therefore, this explains how the syllable structure of geminates in SI can be derived as in (6).

In sum, geminate consonants have the same syllable structure as nongeminate consonants in NI, as in (5b). In contrast, the syllable structure of geminates is different from that of non-geminates in SI, as in (6) and (5b).

### **3** Experiment

#### 3.1 Subjects

Two native speakers of Italian (one from Rome, mid-southern Italy, one from Udine, northern Italy) who teach at the University of Delaware participated in this experiment. Both of them are female.

#### 3.2 Test Materials

Eight minimal pairs of words were used as test materials. In addition to these target words, other eight words were included as foil words. I recorded minimal pairs of words over two days. On the first day I recorded the words which contain non-geminate consonants, and the next day I did the words

which contain geminate consonants. The materials were read by the two subjects separately in the following contexts: "Dico la parola \_\_\_\_\_\_ adesso." ('I say the word \_\_\_\_ now').

	Non-geminate	Geminate	
1	seta 'silk' setta 'sect'		
2	note 'known' notte 'night'		
3	ziti 'type of pasta' zitti 'quiet'		
4	bruto 'brute'	brutto 'ugly'	
5	dita 'fingers'	ditta 'company'	
6	tuta 'gym suit' tutta 'all'		
7	fato 'fate' fatto 'fact'		
8	sete 'thirst'	sete 'thirst' sette 'seven'	

Table 1: Minimal pairs

The prepared lists were recorded by the subjects in a sound-proof room. 128 utterances (16 target words and 16 non-target words with 4 repetitions) were elicited in random order. The test words were recorded onto a DAT tape using a Sony DAT PCM-2700 recorder and a stereo microphone. The microphone was placed on a table approximately 8 inches from the speaker's mouth.

### 3.3 Analysis

The test words were digitized at 11Khz sampling rate and 16 bit quantization) using WEDW software running on Windows 98. Vowel duration was measured from voicing onset to voicing offset; voicing offset was determined by the absence of glottal excitation corresponding to the onset of the closure for the final consonant. However, if the vowel follows the voiced consonant, I did not include the transition section between the preceding consonant and the following vowel into the vowel. The appearance of clear high formants, such as F2, F3, F4 and so on, was assumed as the beginning of vowel. Consonant duration was measured from the end of the first vowel to the beginning of the second vowel.

### 3.4 Prediction

Before discussing the results of this experiment, let us discuss some predictions from previous studies. First, since non-geminate and geminate consonants have the same syllable structure in NI, as in (5b), we may predict that the duration of non-geminate consonants should be the same as that of geminate consonants. We may also predict that the duration of preceding vowels in non-geminate consonants should be the same as that in geminate consonants in NI.

In contrast, since there are two different syllable structures in terms of non-geminates and geminates in SI, as in (5b) and (6), we may predict that geminate consonants should be longer than non-geminate consonants in SI, and that the preceding vowels in non-geminate consonants should be longer than those in geminate consonants in SI.

#### 3.5 Results

#### 3.5.1 Vowel Duration<sup>2</sup>

Table 2 and Figure 1 show that the duration of vowels followed by the geminates is much shorter than that followed by the non-geminates in both SI and NI without any exception.

	Non- geminates in South	Geminates in South	Non- geminates in North	Geminates in North
Seta/setta	183	123	161	123
Note/notte	198	122	202	153
Ziti/zitti	215	112	179	113
Bruto/brutto	194	109	151	120
Dita/ditta	166	129	153	119
Tuta/tutta	183	102	156	105
Fato/fatto	230	130	192	141
Sete/sette	164	118	153	120

Table 2: Vowel Duration (in milliseconds) followed by non-geminates or geminates in the context "Dico la parola \_\_\_\_\_ adesso."

 $<sup>^{2}</sup>$  Vowel duration used here corresponds with the average vowel duration of each word repeated by 3 times.

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Figure 1: Vowel Duration in Geminates vs. Non-geminates

# 3.5.2 Consonant Duration<sup>3</sup>

Table 3 and Figure 2 show that the duration of geminate consonants is much longer than that of non-geminate consonants in all minimal pairs of the southern dialect and the northern dialect.

	Non- geminates in South	Geminates in South	Non- geminates in North	Geminates in North
Seta/setta	162	379	152	243
Note/notte	171	327	154	251
Ziti/zitti	173	311	150	249
Bruto/brutto	167	308	137	247
Dita/ditta	173	310	137	250
Tuta/tutta	171	378	137	248
Fato/fatto	177	323	168	269
Sete/sette	175	335	163	275

Table 3: Consonant Duration (in milliseconds) in Geminates vs. Nongeminates in the context "Dico la parola \_\_\_\_\_ adesso."

 $<sup>^3</sup>$  Consonant duration used here corresponds with the average consonant duration of each word repeated 3 times.



Figure 2: Consonant duration in geminates vs. non-geminates

## 3.5.3 Total Average<sup>4</sup> of Vowel Duration

For the next step, let me show the total average of vowel duration followed by geminates and non-geminates in both dialects. Table 4 and Figure 3 show that the vowel duration followed by geminate consonants is significantly shorter than that followed by non-geminate consonants in both NI and SI. One way ANOVA test of variance on the duration of vowels showed a reliable difference between geminates and non-geminates in both NI and SI: NI (F(1,1) = 498.32, p < 0.0001), and SI (F(1,1) = 24.483, p < 0.0002).

	Non- geminates in South (SNG)	Geminates In South (SG)	Non-geminates in North (NNG)	Geminates in North (NG)
Mean duration	192	118	168	124

Table 4: Total mean duration (in milliseconds) of vowels followed by nongeminates and geminates

<sup>&</sup>lt;sup>4</sup> This value can be produced by the following process. After dividing words into the non-geminates and the geminates, all the average numbers shown in 3.5.1 and 3.5.2 were summed, regardless of the words. Finally, the summed number was divided by 8 which is the number of minimal pairs.



Figure 3: The average duration of vowel

### 3.5.4 Total Average of Consonant Duration

Let us now see the total average of consonant duration in geminates and nongeminates in both dialects. Table 5 and Figure 4 show that the duration of geminate consonants is significantly longer than that of non-geminate consonants in both dialects. One way analysis of variance on the duration of consonants showed a significant difference between geminates and nongeminates in both NI and SI: NI (F(1,1) = 244.38, p < 0.0001), and SI (F(1,1) = 313.47, p < 0.0001).

	Non- geminates in South (SNG)	Geminates in South (SG)	Non-geminates in North (NNG)	Geminates in North (NG)
Mean duration	171	334	150	254

Table 5: Total mean duration (in milliseconds) of consonants in nongeminates and geminates



Figure 4: The average duration of consonants

#### 3.5.5 Summary of Findings

Let me summarize what we have found so far. First, the duration of the preceding vowels in non-geminate consonants was significantly longer than that in geminate consonants, even in NI. Second, geminate consonants were significantly longer than non-geminate consonants, even in NI.

However, the important thing is that there was a significant difference between geminate consonant duration in NI and that in SI, as shown in Figure 5 (next page).

Specifically, geminate consonants in NI are significantly longer than non-geminate consonants in both dialects, but they are still significantly shorter than geminate consonants in SI.

### 4 Discussion

This experiment does not provide evidence for the previous assumption that degemination occurs in Northern Italian geminates. If degemination *does* occur in NI, the duration of non-geminate consonants and geminate consonants in NI should be the same, and the duration of geminate consonants in SI should be longer than that of geminate consonants in NI. In contrast, if degemination does not occur in the NI consonants, then the duration of geminate consonants should be longer than that of non-geminate consonants in both dialects.



Figure 5: Duration of non-geminate and geminates in SI and NI

Nevertheless, what I found from this experiment was that even though the duration of geminate consonants was longer than that of non-geminate consonants in both dialects, the difference between them in NI was less than that in SI.

This study provides important implications for theories of how people store words in their memory. The difference in the Italian dialects suggests that how people perceive words changes as they learn their language. People who speak NI need less of a difference to hear a consonant as long rather than short, and this can lead to misperceptions between speakers of different dialects.

## 5 Further Study

This study is no more than a pilot study. Accordingly, I am currently conducting a perception test in order to find out how Southern Italian speakers perceive the Northern Italian geminate and non-geminate consonants. It would be interesting to include this perception test because geminate consonants in NI are not as long as those in SI. In addition to this perception test, I am also conducting to test additional subjects for making a generalization of results that I found in this experiment.

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