From aerodynamically constrained sound sequences to sound change:

Examples from English, Spanish and Italian

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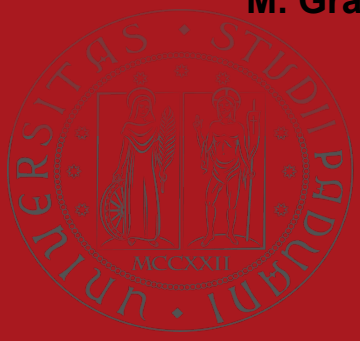

UNIVERSITÀ DEGLI STUDI DI PADOVA

Presentation based on:

Aspects of Consonant Cluster Mutations: The case of /sr/ clusters in Italian

- Invited paper at: *Experimental Phonetics and Sound Change (with special reference to the Romance languages)*, Salamanca, March 20th, 2012

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Outline

- Introduction
- Production of /sr/ clusters in Spanish and Italian
  - Experiment
  - Results and Discussion
- Conclusions

Sources of sound change

Two well-recognized components:

- Phonetic variation in the speech signal (due to coarticulation)
- Listener's perceptual mechanisms (processing of the variation)

What is not well understood….

- How is the perception of coarticulated speech influenced by language-specific coarticulatory patterns?

May explain different outcomes of the same sound sequence

About speech variation

- Essential component of speech
- Sources for speech variation
  - universal factors governing speech production and perception
- Use of empirical methods is important to address phonological questions and study speech variation

Aim of this presentation:

- Show how universal factors governing speech production and perception create:
  - the conditions for variation leading to sound change

  due to:
  - incompatibility of sound sequences

About lingual fricatives and apical trills

Narrowly constrained articulatory and aerodynamic constraints:

•Conflicting tongue-tip configuration

•Antagonistic stiffness requirements

•For both frication and trilling, considerable pressure drop across the glottis and across the articulator are required

(Solé 2002)

Another example….

…of conflicting articulatory and aerodynamic constraints leading to sound change:

/sr/ sequences in Romance

A comparison between Spanish and Italian

Realizations of lingual fricatives + apical trills (i.e., /SR/) in Ibero-Romance

- The fricative is normally weakened or lost before trills in colloquial speech
  - /z, s, ʒ, ʃ / + /r/ > [r:] or [ɹr:]
- Production of both segments is possible only after intervening pause/ boundary(Solé 2002)

Examples:

Castilian Spanish:

/s(#)r/	*las rojas*	[la roxas]	'the red ones'
/sr/	*Israel*	[irael]	'Israel'

Catalan:

/s(#)r/	*has rebut*	[ə rəβut̪]	'you received'

Portuguese:

/ʃ(#)r/	*dos reis*	[du ʁɐjʃ]	'of the kings'
	Israel	[iʁɐɛɬ]	'Israel'

(Sources: Bradley 2006; Recasens 1993; Solé 2002)

Realizations of /sr/ clusters in Italian

- The fricative is preserved
- Is this due to the insertion of an epenthetic sound at the release of the fricative that would prevent the gestural overlap between /s/ and /r/? (Solé 2002)

Scattered evidence for ‘d’ epenthesis in /sr/ clusters in Italian

Isdraele is:…

- Found as a last name
- Frequent spoken form
- Recurrent form in writings of previous centuries (ex.: Zucconi’s *Lezioni Sacre* 1741)
- Common spelling in Youtube & the Internet

Paralles with Latin > Romance

Latin			
**dis-roteolus*	>	It.	*sdrucciolo;*
		Sp.	*esdrújulo;*
		Port.	*esdrúculo*
**s-ra(d)iare*	>	It.	*sdraiare*

(Source: Meyer-Lübke, 1901)

The present study

- Phonetic examination of the production of /sr/ clusters in Italian

Aims:

- Search for the acoustic cues that may trigger perception of ‘d’ epethensis and result in sound change

Speech Material

4 test sequences:
- /V#rV/, /Vs#rV/, /VzrV/, /Vz#rV/

3 control sequences:
- /Vr:V/, /VzdrV/, /VstrV/

2 contexts:
- 13 words in a list + 13 words in a sentence

Speakers:
- 7 northern Italian speakers
- 7 southern Italian speakers
  - 5 readings/speaker

About Northern vs Southern Italian

Features in S.I, but not in N.I.

- Raddoppiamento fonosintattico (post lexical gemination process)
- Longer geminate consonants
- Reduction of word-final unstressed vowels leading to increased complexity of consonant clusters (Russo & Barry 2004)

Data Analysis

- Study of /sr/ configurations
- Analysis of the pressure data for one speaker
- Acoustic measures of the clusters

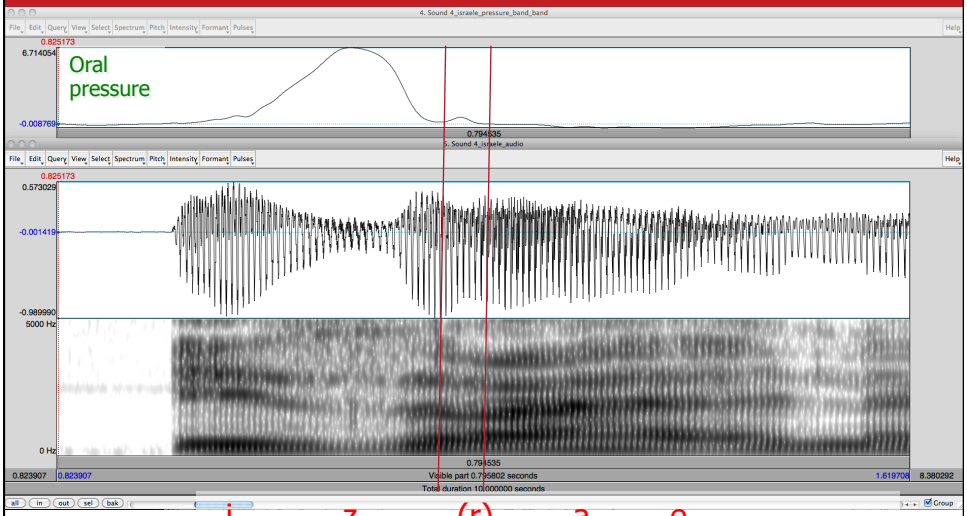
Results

1. Categorization of the observed variability in the production of rhotics
2. Some acoustic characteristics of the segments in the /sr/ clusters
3. Relation between segment duration and /d/ epenthesis

Categories for the observed rhotics

1. Trill
2. Tap + long fricated burst
3. Tap
4. Strident Approximant
5. Approximant
6. Extremely reduced rhotic ('perceptual tap' - Willis & Bradley 2006)

An extremely reduced rothic (‘perceptual tap’)



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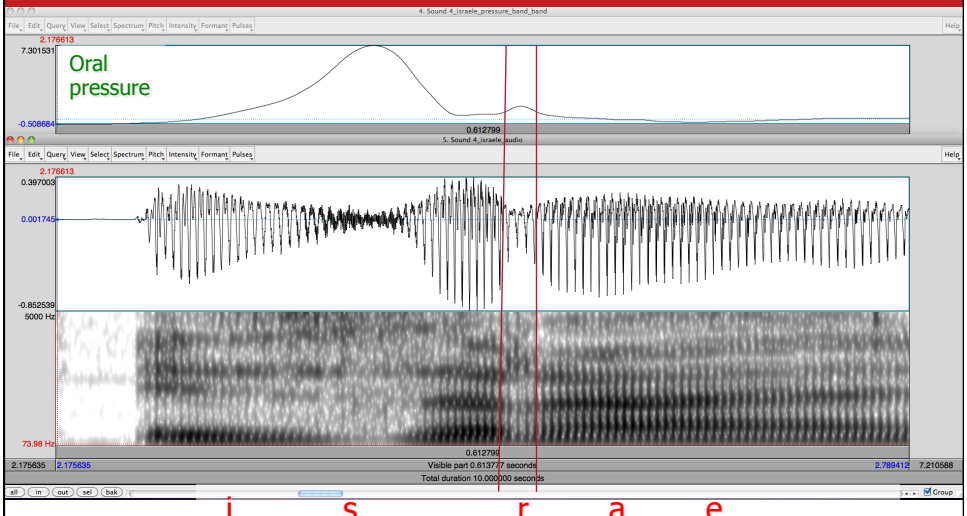
An Approximant



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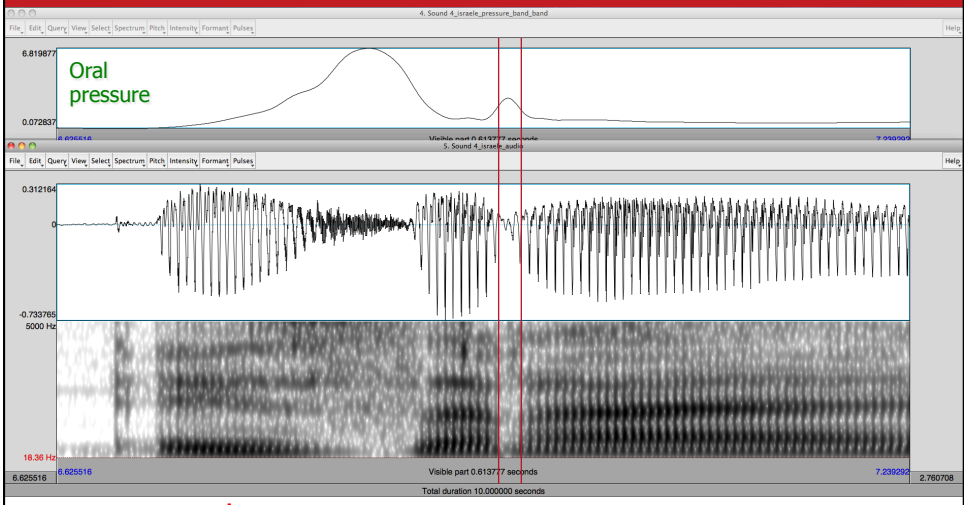
A tap



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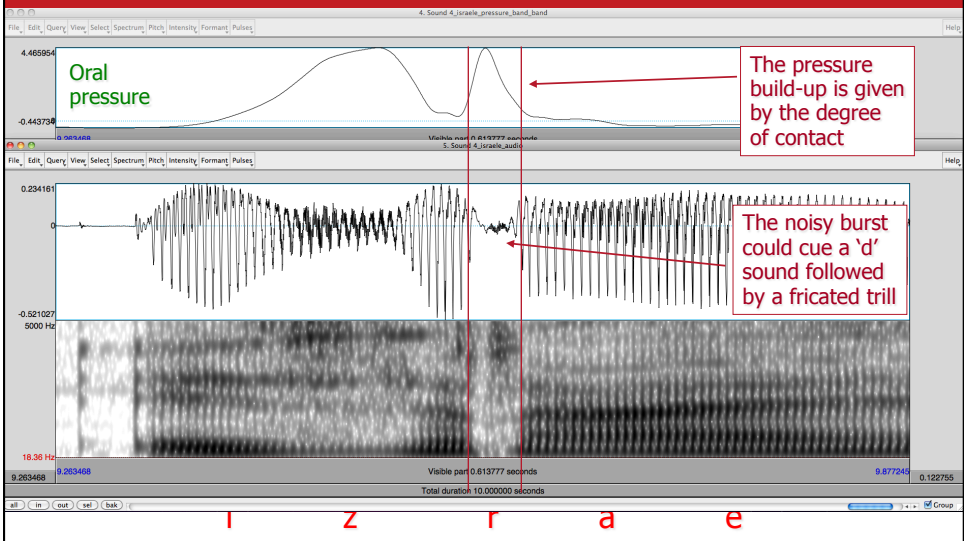
A tap with a long contact & fricated release



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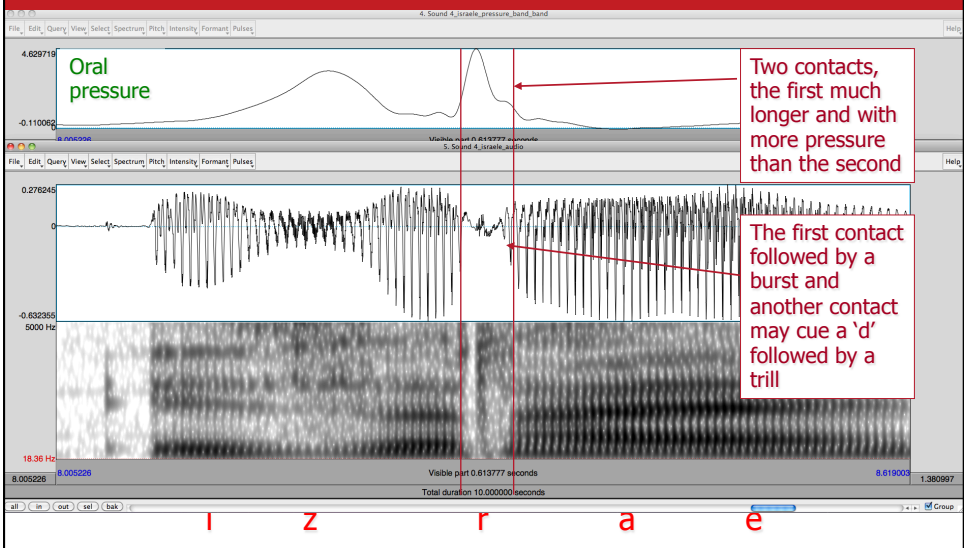
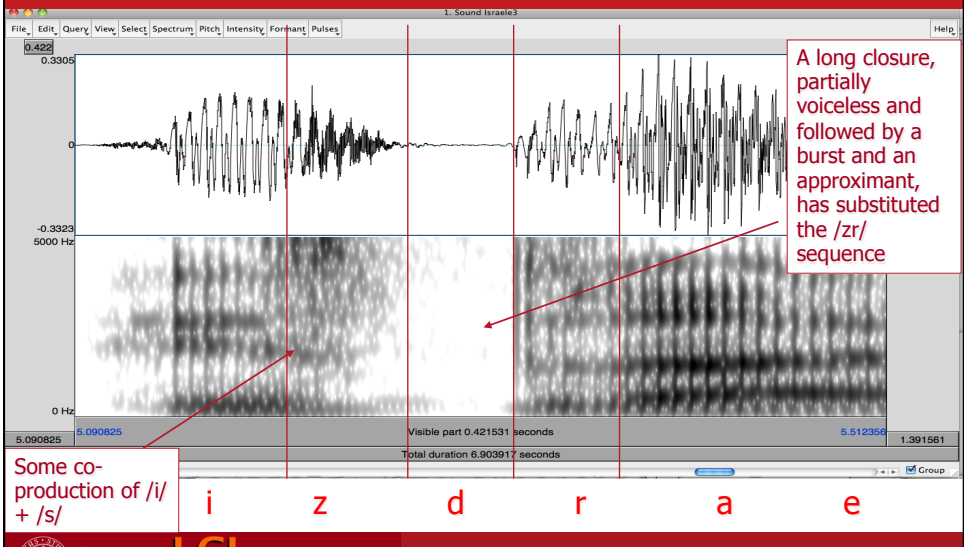
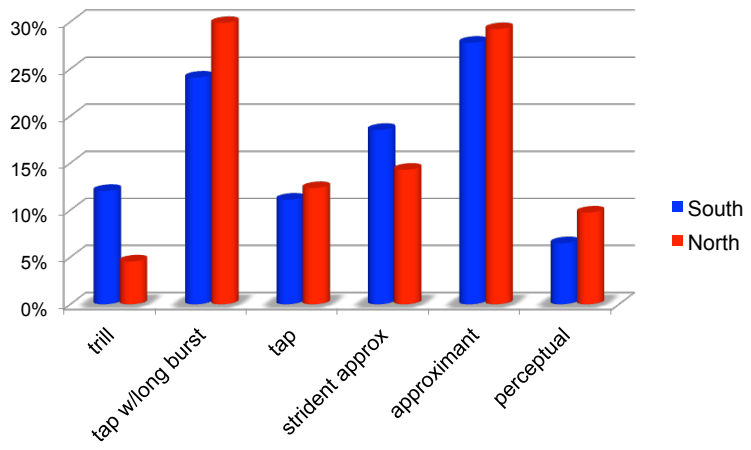
A 2-contact trill leading to intepretation of /d/



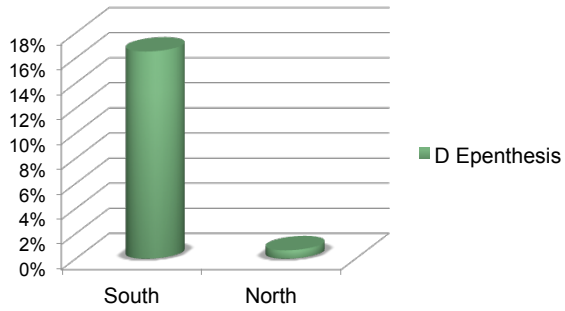
Evidence of sound change



Frequency of rothics by category

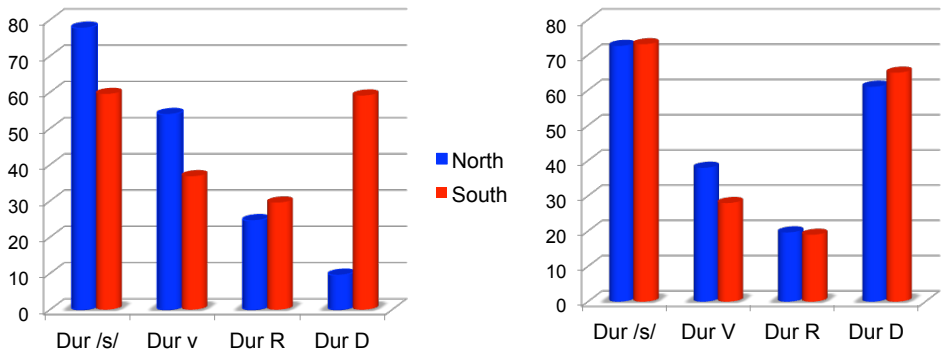


Evidence of /d/ epenthesis for S.I and N.I.



Percentage of occurrence of /d/ epenthesis relative to all /sr/ sequences (S.I. =115; N.I. = 150)

Relation with segmental durations



Mean duration (in ms.) of segments in /sr/ (left) and /sdr/ (right) sequences for North and South Italians

Summing up the results and discussion

- In Italian /s/ and /r/ are maintained
- Evidence of co-production is limited
- After the /s/, a short shwa allows resetting the articulators for the trill/tap+burst
- Epenthetic /d/ may be cued by longer closure of contact + fricated release
- More epenthesis in S.I. than N.I. may be related to differences in syllable structure

Conclusion

- Synchronic production patterns in Italian and Ibero-Romance reflect historical sound change
- Differences in synchronic variation may be related to differences in:
  - articulatory timing?
  - phonetic details of /s, z/, /R/?
  - Other?
- Perceptual interpretation is affected by language-specific coarticulatory patterns