Modelling variation in sound change: social setting as a determinant of process application

Karolina Broś

University of Warsaw

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Sound change in phonological analysis

- diachronic variation (change in real time)
- diachronic variation (change in apparent time)
- cross-dialectal variation caused by social, political and/or geographical factors
- intra-dialectal inter-speaker variation pointing to change in progress

– Influence of external factors on even a single grammar of a dialect user (Labov 1972, 1990)
– Variation should be incorporated into the theory of grammar (Coetzee 2009, 2016)

Sound change in phonological analysis

- speech rate (Coetzee 2017)
- register (van Oostendorp 1997, different grammars as per register)
- style (Boersma & Hayes 2001)
- perception
- lexical frequency (Bybee 2000, 2001; Coetzee & Kawahara 2013)
- morphological status (Coetzee 2009)
- lexical idiosyncrasy (Goeman 1999, Coetzee 2009)
- social setting

All factors that contribute to grammatical structure should be included in formal representation

Purpose of the study

- Take different stages of sound change presented by the same speakers
- Moderate vs. more radical weakening depending on the situational context and the associated speech 'modality'
- Domain of application effects and between-modality systematicity

Speech modalities and generalisations

Language/variety: Spanish from Gran Canaria

Speakers: 6 natives recorded on 2 occasions

Data 1: read and repeated speech

Data 2: spontaneous speech

Data: weakening processes

Modality 1

/s/ -> [h/H] /_V	*prensa[h]idráulicas* ‘hydraulic presses’
/s/ -> [h] /_k	*chocolate[h]con* ‘chocolates with’
/s/ -> [∅] /_d	*pane[∅]de* ‘breads from’
/b d g/ -> [b d g] /V(C)_	*pane(s)[d]e* ‘breads from’
/b d g/ -> [B D G] /V_	*cinco[D]ulces* ‘five sweets’
/p t k/ -> [b d g] /V_	*cinco[b]anes* ‘five breads’

- *s* debuccalisation before voiceless consonants and vowels
- *s* deletion before voiced consonants (and pauses)
- *b d g* spirantisation after vowels, **blocked** in derived vocalic environments
- *p t k* voicing after vowels

Data: weakening processes

Modality 2

/s/ -> [h/H]/_V
/s/ -> [∅] /_C
/b d g/ -> [B D G] /V(C)_
/b d g/ -> [B D G] /V_
/p t k/ -> [b d g] /V_
/p t k/ -> [p t k] /V(C)_

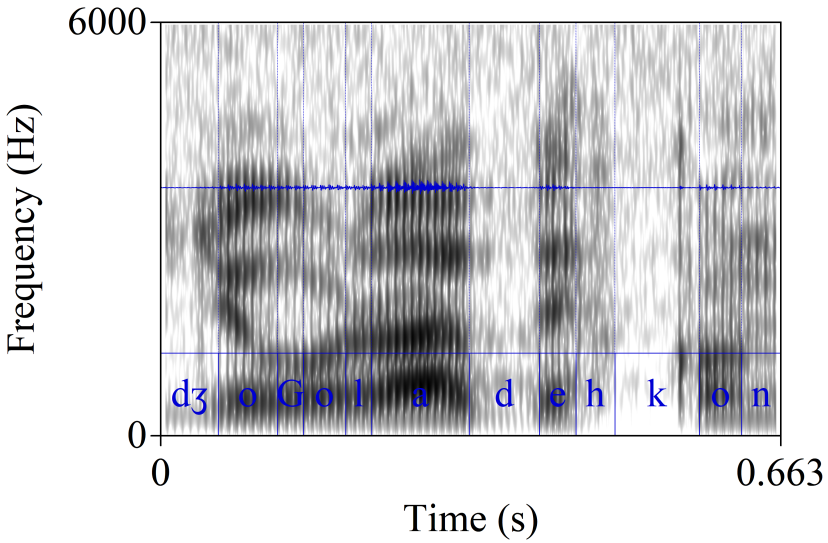
prensa[H]idráulicas 'hydraulic press'
chocolate[∅]con 'chocolates with'
pane(s)[D]e 'breads from'
cinco[D]ulces 'five sweets'
cinco[b]anes 'five breads'
chocolate(s)[k]on 'chocolates with'

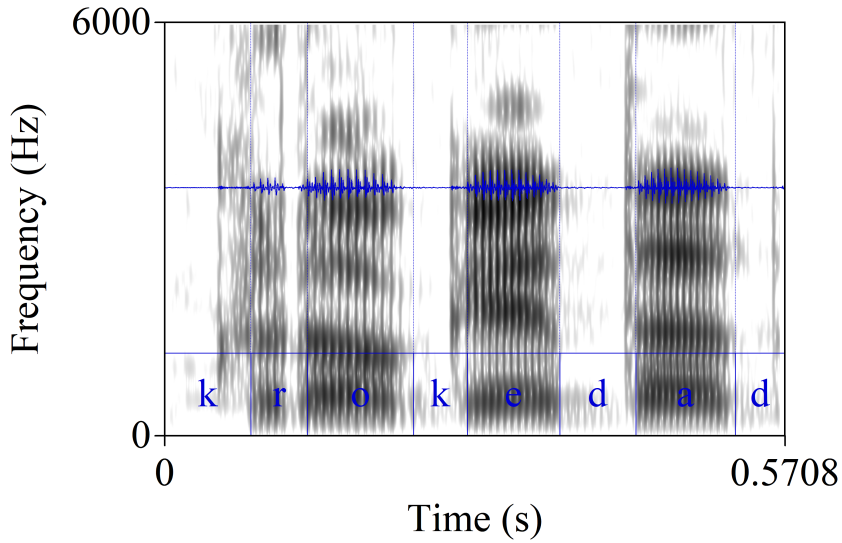
- *s* debuccalisation before voiceless consonants and vowels
- *s* deletion before **all** consonants
- *b d g* spirantisation in **all vocalic environments** (including derived)
- *p t k* voicing after vowels, **blocked** in derived vocalic environments

Processes and domains of application

1. Coda weakening (debuccalisation, voicing, elision). In spontaneous speech it also includes other consonants: /d/, /r/, /l/ (variation: optional).
2. Voiced stop weakening also applies (variably) after a non-deleted sonorant, and always after a non-deleted /s/ in spontaneous speech. Intervocalically very strong, incl. deletion. => Domain extension
3. Voiceless stop weakening applies both inside words and across word boundaries, but strictly after a vowel. It can be accompanied by approximantisation and occasionally occurs after deletion.

Spectrograms

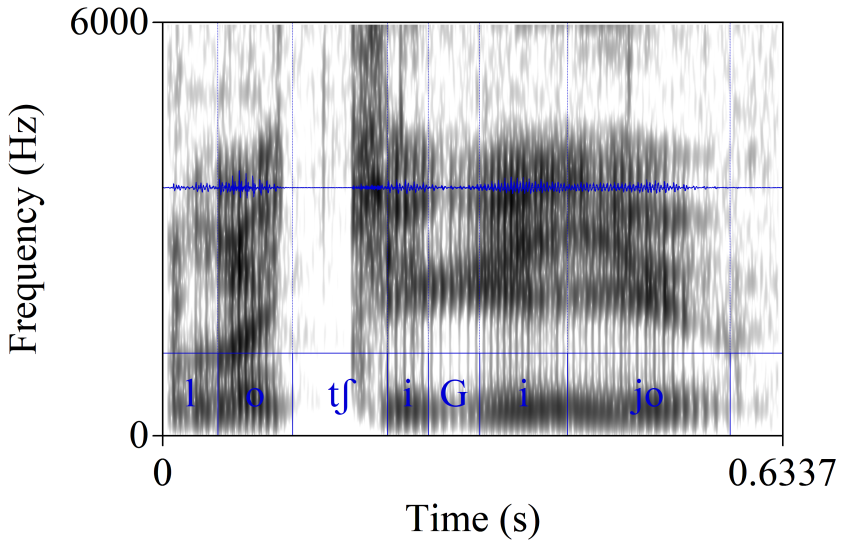


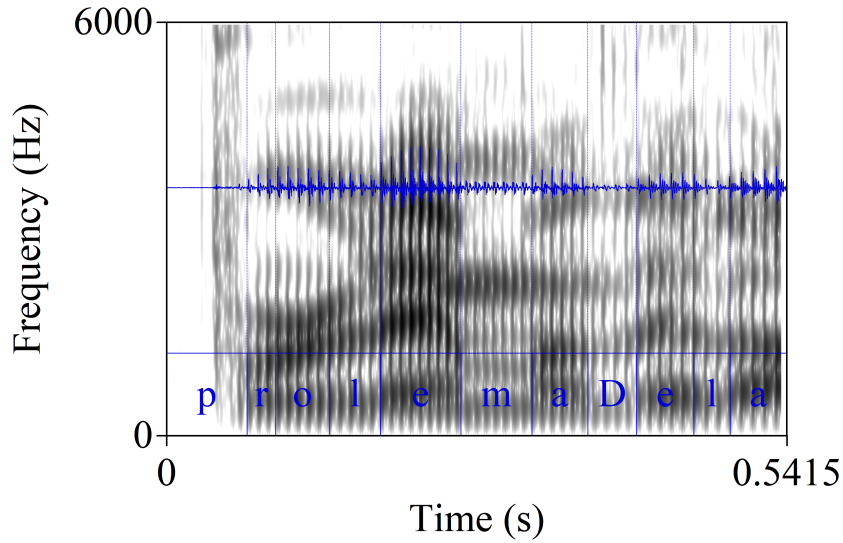


Controlled speech.

- Left: *chocolates con* 'chocolate with' presents no /s/ deletion before a voiceless stop and no voicing.
- Right: *croquetas de* 'croquettes with' presents deletion before a voiced segment but no spirantisation.

Spectrograms

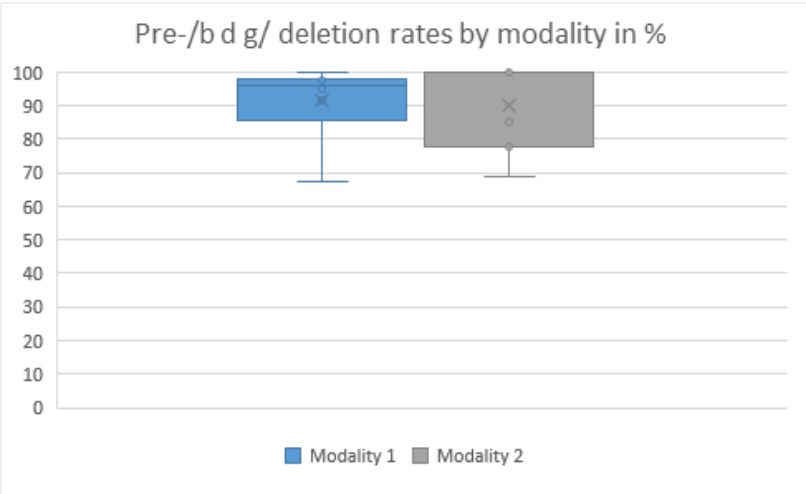


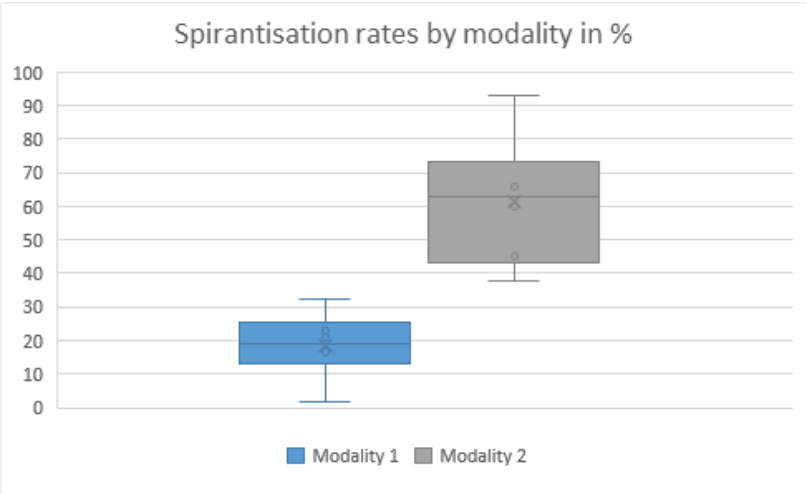


Spontaneous speech.

- Left: *los chiquillos* 'the guys' presents deletion before a voiceless sound and no voicing.
- Right: *problemas de la* 'problems with/about' presents deletion before a voiced sound and spirantisation.

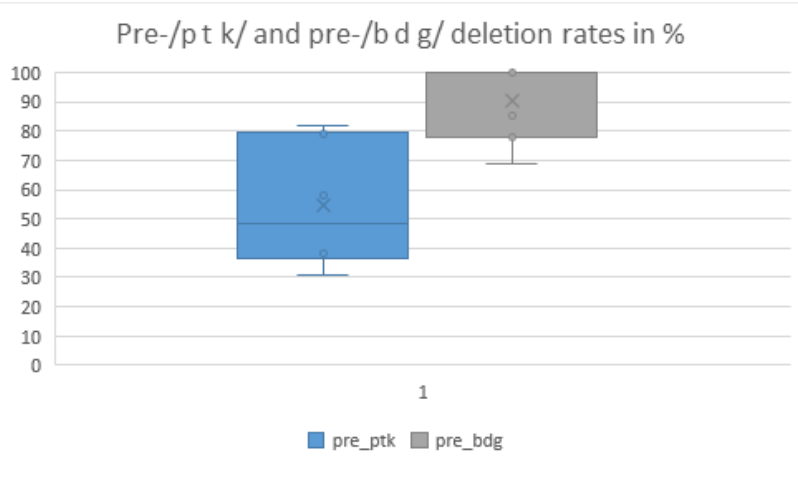
Frequency of occurrence – distribution graphs

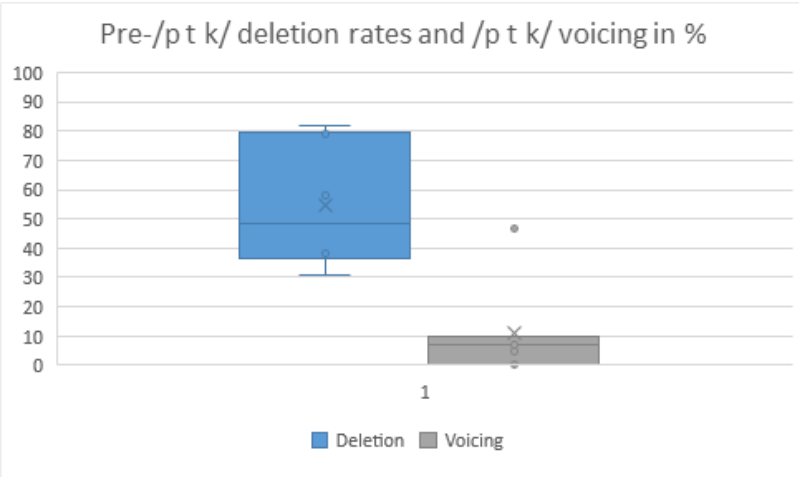




- Deletion rates before voiced segments the same across modalities.
- Occasional spirantisation in controlled speech, with gender differences.
- Twofold rise in spirantisation across speakers.
- Number of tokens uneven (rate expected to rise with more tokens).

Frequency of occurrence – distribution graphs





- The data are for Modality 2.
- In Modality 1, the pre-/ptk/ deletion rate is 0% hence no voicing.
- Rates of deletion before voiceless sounds include all consonants.

Theoretical assumptions and formal account

The data require a variationist approach:

- speaker productions are highly dependent on speech modality
- competition between two co-phonologies
- variation is a reflection of a change in progress: transition from one system to another

The lifecycle of phonological processes:

- the domains of application are gradually extended
- spirantisation inside words is now phonologised, across a word boundary the transition is not complete
- new rules alongside old rules
- the same trajectory applies to post-vocalic voicing, a much younger process at a different advancement stage

Problem 1: opacity

Different rankings for opaque /s/ aspiration across a word boundary, deletion dependent on phrase context.

a) *s]Coda, Max(C) » Ident(Place) at the word level

/panes/	*s]Coda	Max(C)	Ident(Place)
a. panes	*!		
☞ b. paneh			*
c. pane		*	

b) Onset, *s]Coda » Ident(Place), Max(C) at the phrase level

/paneh+en/	Onset	*s]Coda	Ident(Place)	Max(C)
☞ a. pane.hen				
b. pane.en	*!			*
c. pane.sen			*!	

Problem 2: different weakening stages

Positional and general markedness constraints : *ptk, *V_ptk, *bdg, *V_bdg

Problem 3: turbidity for selective blocking

Deleted segments leave a trace/block processes.
Positional faithfulness constraints are not violated as the segment is not erased from the phonological representation.

/paneh+de/	*h	*V_bdg	Max(C)	Ident(cont)
a. paneh.de	*!			
☞ b. pane(h).de		*		
c. pane(h).De		*	*!	

Problem 4: cross-modality variation

Coetzee's (2009, 2016) model incorporating external factors in computation

Stochastic approach: Noisy Harmonic Grammar (Coetzee & Pater 2011)

Coetzee's model

Stochastic parameters for the GLA

- pre-*b d g* deletion: 92%
- pre-*p t k* deletion: 24%
- general deletion: 58%

- post-deletion spirantisation: 44%
- pos-vocalic spirantisation: 100%
- general spirantisation: 72%

- post-deletion voicing: 5%
- post-vocalic voicing: 64%
- general voicing: 34%

Pair Distributions

pairs [1]:
string1 = "/Vs#d/"
string2 = "[V(s)#d]"
weight = 52
pairs [2]:
string1 = "/Vs#d/"
string2 = "[V(s)#D]"
weight = 40
pairs [3]:
string1 = "/Vs#d/"
string2 = "[Vh#d]"
weight = 8
pairs [4]:
string1 = "/Vs#k/"
string2 = "[Vh#k]"
weight = 76
pairs [5]:
string1 = "/Vs#k/"
string2 = "[V(s)#k]"
weight = 23

pairs [6]:
string1 = "/Vs#k/"
string2 = "[V(s)#g]"
weight = 1
pairs [7]:
string1 = "/V#k/"
string2 = "[V#g]"
weight = 64
pairs [8]:
string1 = "/V#k/"
string2 = "[V#k]"
weight = 36
pairs [9]:
string1 = "/V#g/"
string2 = "[V#G]"
weight = 100
pairs [10]:
string1 = "/V#g/"
string2 = "[V#g]"
weight = 0

Torres-Tamarit 2012:120-122

Step 2

At Step 2, Parse-Seg drives syllable projection

Torres-Tamarit 2012:120-122

Step 3

At Step 3, high-ranked *s]Coda mandates coda /s/ debuccalisation

Torres-Tamarit 2012:120-122

Step 4

At Step 4, the whole morphological word, including the prefix, is parsed

Torres-Tamarit 2012:120-122

Step 5

At Step 5, the debuccalised segment is parsed into the following syllable regardless of the prosodic word boundary

this is possible only with a reformulation of the Align-L(Stem, PWd) constraint, which must be active only if there are no input syllables

the same derivation applies to word sequences

Chilean double repair

(1) **word level**
pesca [peh.ka]
descargar [deh.kar.ɣar]
desarmar [de.sar.mar]

(2) **phrase level**
estas [eh.ta]
estas mesas [eh.ta.me.sa]
estas aguas [eh.ta.ha.ɣwa]

Rule-based solution

'these'	'these tables'	'these waters'	processes
estas	estas+mesas	estas+aguas	Underlying form
es.tas	es.tas.me.sas	es.tas.a.guas	Syllabification
eh.tah	eh.tah.me.sah	eh.tah.a.guah	Aspiration
eh.tah	eh.tah.me.sah	eh.ta.ha.guah	Resyllabification
eh.ta	eh.ta.me.sa	eh.ta.ha.gua	Deletion

Order of events

- 2 distinct repair strategies to satisfy the coda condition
- overlap of aspiration and deletion leads to opacity
- aspiration only in word-medial position and in opaque cases across a word-boundary
- /s/ is lost completely at word edges before a pause or a consonant

Chilean in HS

- Max(Seg) must be ranked below Ident(Pl) to enable deletion instead of aspiration before a consonant or a pause
- the sequence *estas aguas* 'these waters' must be parsed into prosodic words separately and only then prosodified further into a phonological phrase to enable resyllabification
- syllabification is blocked in Steps 1-3

HS derivation of the sequence *estas aguas* ‘these waters’

Step 1

the sequence is first parsed into prosodic words due to the high-ranked Align-L(Stem, PWd)

HS derivation of the sequence *estas aguas* 'these waters'

Step 2

at Step 2, the two words are syllabified separately, in accordance with the ranking (high position of Parse-Seg)

this is in line with Torres-Tamarit's evaluation of word- and phrase-level overapplication

HS derivation of the sequence *estas aguas* 'these waters'

Step 3

Step 3 presents a deviation: because deletion is a permitted strategy in Chilean, Max(Seg) has to be ranked low

with this ranking, aspiration will always be suboptimal

Observations

- aspiration cannot be generated at Step 3
  high-ranked *s]Coda constraint mandates a repair, but deletion is a better option against the ranking, and resyllabification is banned
- the two words of the sequence are parsed separately and hence are equally good candidates for deletion
  BUT the /s/ of the first word cannot be lost because there is no way of restoring it at a later stage
- the two words are not prosodically combined into a phonological phrase and are therefore evaluated separately, as stand-alone items
- parse the two words together?
  this requires a different ranking of Parse(PWd)

Step 4 evaluation of the input [(es)(tas)]#[(a)(guas)] with PARSE(PWD) » *S]CODA

Step 4

Observations

- HS is unable to account for the Chilean data as long as it cannot independently block resyllabification from applying
- There is no way of aspirating coda /s/ once it is syllabified as an onset because any operation on an onset /s/ would predict that all Chilean /s/ segments are marked and undergo weakening ([s]emana 'week', al[s]a 'growth', co[s]a 'thing'), as well as syllable- and word-final (esto 'this', cosas 'things')
- confusion between the two types of onsets (non-resyllabified and resyllabified) under HS
- addition of prosodification and hierarchical morphological structure that distinguishes between morphs can overcome the problem to some extent
- if a more invasive process is permitted by the ranking, it is enabled because it violates a lower-ranked constraint

Conclusion

Step-by-step prosodic structure building incorporated in a parallel, operation-by-operation evaluation is insufficient to account for complicated data showing double repairs

The superiority of the Stratal OT framework lies in the fact that its very design assumes serial prosodic structure building associated with morphophonological strata

Each stratum is based on different phonological predictions

Word edges are protected at the word level, while word-internal morpheme edges and morpheme-internal structures are subject to Contiguity

HS does not need to use an extended version of Contiguity, but it does reformulate alignment

Stratal OT solution

- In Stratal OT terms, Chilean speakers' behaviour confirms that an important distinction must be made at least between word and phrase level phonology
- Although misalignment between the stem and its prosodic structure is permitted (resyllabification), it does not take place inconsequently: opacity at word edges
- Out of the two repairs, aspiration is the only permitted one at word level: (MAX(Seg)»IDENT(Pl))
- Deletion is a phrase level process (informed by syntax): a crucial reranking is required, (IDENT(Pl)»MAX(Seg))

Word level evaluations of *estas* and *aguas*

Phrase level evaluation of the sequence *estas aguas* ‘these waters’

Prefixes and PWd Contiguity

Word-level evaluation

Preconsonantal

Prevocalic

Phrase level evaluation

Thank You!

Slides available at: *www.karolinabros.eu*

Step 3 evaluation of the input [(es)(tas)]#[(a)(guas)] with multiple loci

Step 3 evaluation of the input [(bes)]#[(ak)(tris)] with multiple loci

Crucially: discrepancies depending on the input string

Pathological prediction!