Ageing nuclei

A formal approach to vowel (dis)appearance in Lunigiana dialects

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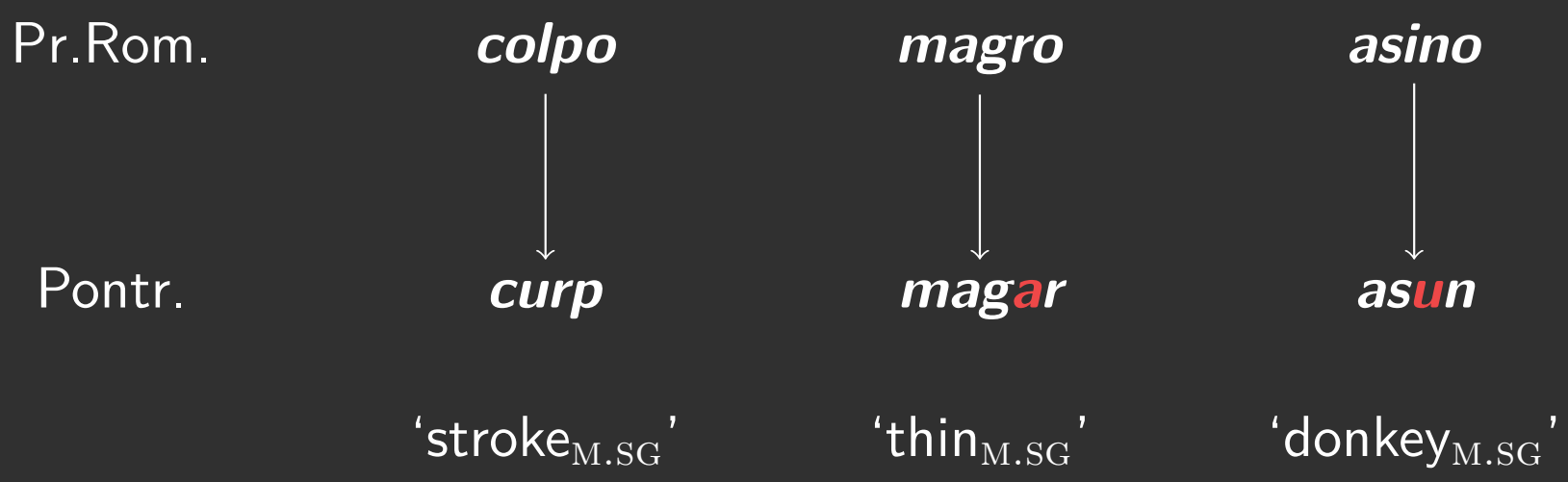
Pr.Rom.
colpo
magro
asino
Pontr.
curp
magar
asun
‘stroke$_{\text{M.SG}}$’
‘thin$_{\text{M.SG}}$’
‘donkey$_{\text{M.SG}}$’

Pr.Rom. NP inflection (simplified)

- $\sqrt{} + o_{\text{M.SG}}/a_{\text{F.SG}}/i_{\text{M.PL}}/e_{\text{F.PL}}$

$\sqrt{magr}$-$o_{\text{M.SG}}$	$\Rightarrow$	*magro*	$\sqrt{asin}$-$o_{\text{M.SG}}$	$\Rightarrow$	*asino*
$\sqrt{magr}$-$a_{\text{F.SG}}$	$\Rightarrow$	*magra*	$\sqrt{asin}$-$a_{\text{F.SG}}$	$\Rightarrow$	*asina*
$\sqrt{magr}$-$i_{\text{M.PL}}$	$\Rightarrow$	*magri*	$\sqrt{asin}$-$i_{\text{M.PL}}$	$\Rightarrow$	*asini*
$\sqrt{magr}$-$e_{\text{F.PL}}$	$\Rightarrow$	*magre*	$\sqrt{asin}$-$e_{\text{F.PL}}$	$\Rightarrow$	*asine*

Pontr. NP inflection

- $\sqrt{} + \varnothing_{\text{M.SG/F.PL}} / a_{\text{F.SG}} / i_{\text{M.PL}}$
  - If WF-C = N then $\text{M.PL} \Rightarrow \varnothing$

$\sqrt{magr}$-$\varnothing_{\text{M.SG}}$	$\Rightarrow$	*magar*	$\sqrt{asn}$-$\varnothing_{\text{M.SG}}$	$\Rightarrow$	*asun*
$\sqrt{magr}$-$a_{\text{F.SG}}$	$\Rightarrow$	*magra*	$\sqrt{asn}$-$a_{\text{F.SG}}$	$\Rightarrow$	*asna*
$\sqrt{magr}$-$i_{\text{M.PL}}$	$\Rightarrow$	*magri*	$\sqrt{asn}$-$\varnothing_{\text{M.PL}}$	$\Rightarrow$	*asun*
$\sqrt{magr}$-$\varnothing_{\text{F.PL}}$	$\Rightarrow$	*magar*	$\sqrt{asn}$-$\varnothing_{\text{F.PL}}$	$\Rightarrow$	*asun*

- *a* and *u* repair word-final clusters violating SSG (*gr#*, *sn#*)

_a_ and _u_ are epenthetic

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Research questions

- What happened between Pr.Rom. and Pontr.?
- How do epenthetic vowels appear?
- How con we best formalize these changes?

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Hypotheses

- Diatopic microvariation can provide an answer
  - Neighbouring dialects display the various stages of a diachronic change
  - Wave Theory (Schmidt 1872)
- Phonetic and phonological analysis of Pontr. and Carr.
  - Carr. = vocoid intrusion
  - Pontr. = vowel epenthesis
- BiPhon allows for the formalization of these changes/patterns
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  - Life cycle of phonological processes (Bermúdez-Otero 2015)

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Structure of the talk

1. Dialectological overview
2. Results
3. Analysis
4. Conclusion
5. Discussion
   - The place of variation
   - Vowel reduction

Dialectological overview

Wave theory & the life cycle of phonological processes

- Wave Theory (Schmidt 1872)
  - Gradual diffusion of a process from a center towards the periphery
  - Different synchronic statuses of the process
    - Center: systematic and categorical behavior ⇒ phonological process
    - Periphery: optional and gradient [illegible] phonetic [illegible]
- The life cycle of a phonological process (Bermúdez-Otero 2015)
  - Diachronically, ph processes climb up the grammar architecture

*"a phonetic phenomenon that is at first exhaustively determined by **extragrammatical factors** [gets] embedded in the grammar of a language, first as a **language-specific gradient process of phonetic implementation**, later as a **categorical phonological rule** applying in increasingly narrow morphosyntactic domains, until it eventually escapes phonological control altogether"*

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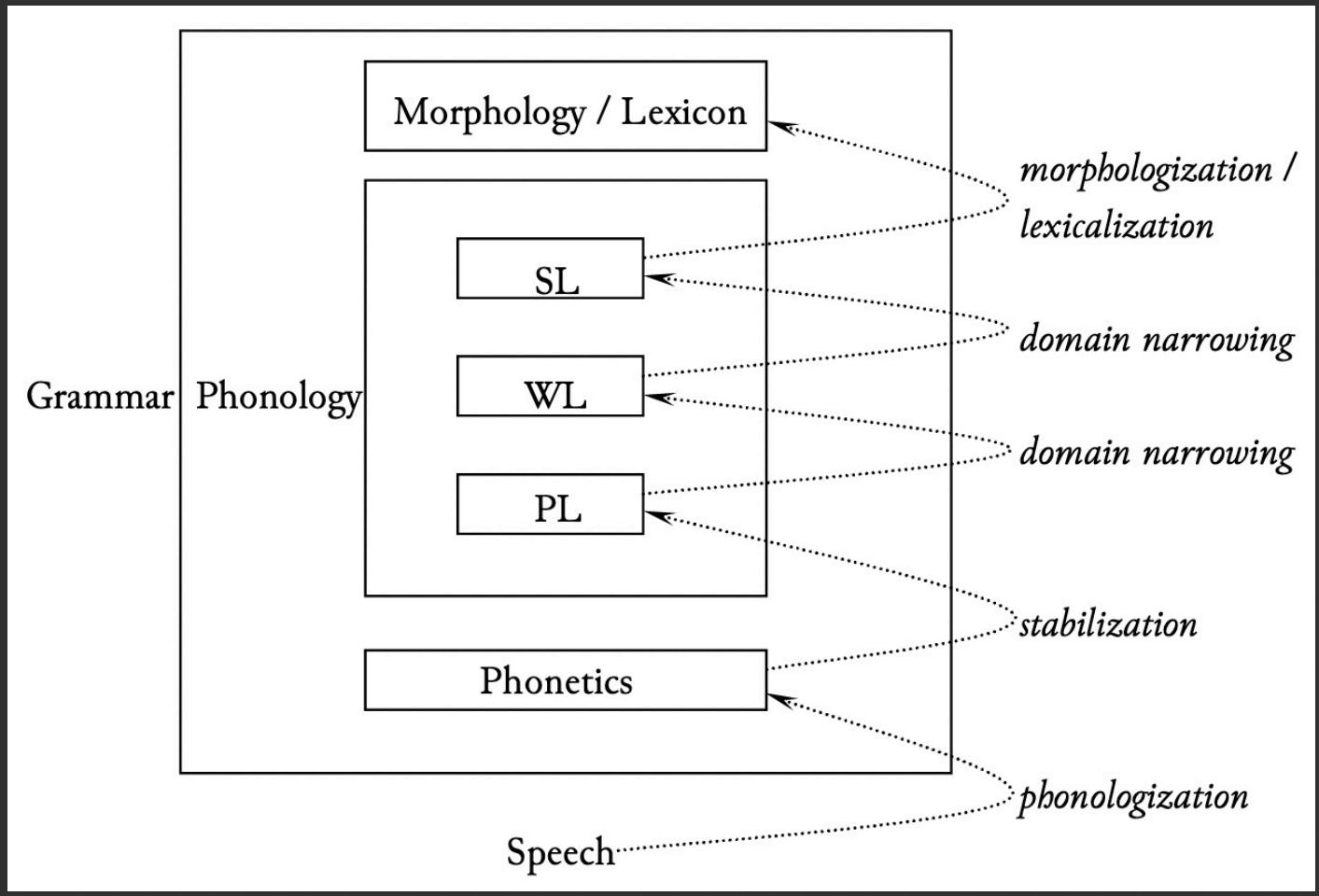
The life cycle of phonological processes



- **Phonologization**: mechanical phonetic effect reanalysed as a cognitively controlled, language-specific, gradient process of phonetic implementation
- **Stabilization**: categorical phonological rule applying across the board at the phrase level

Wave theory, life cycle & epenthesis

- Peripheries display older stages of a process
  - Center: **vowel epenthesis**
  - Periphery: **vocoid intrusion**
- Lunigiana dialects offer a great case study!

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Lunigiana

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"no other region of the Peninsula can present the scholar with so many phonetic varieties in such a small area [where] the phonetic laws of a village differ [...] from the ones of nearby villages"

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Case study

Pontremolese

- North, closer to the Emilian border
- Stronger VR
- Vowel epenthesis

Carrarese

- South, closer to the Tuscan border
- Milder VR
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Case study

Diachrony

i	No reduction	ˈmagro	Pr.Rom.
ii	Reduction I	ˈmagrə	
iii	Reduction II	ˈmagr(ə)	
iv	Reduction III & Intrusion I (I)	ˈmag(ə)r	Carr.
v	Intrusion II (E)	ˈmagər	
vi	Intrusion III (E)	ˈmagar	Pontr.

Fieldwork

- Paroxitones and proparoxitones
- Clusters abiding by or violating SSG
- 42 carrier sentences with /CC∅/
  - /_ ||/
  - /_ # C-,V-/
  - /_ + V/
- 5 speakers per dialect
  - Age: 59-85
  - 9 male, 1 female
- Acoustic analysis
  - Formant normalization (Lobanov z-score)
  - Praat
  - Formant structure and duration (longer F1/F2 steady state)

Forms

	$'\sigma\sigma$	$(\sigma)'\sigma\sigma\sigma$
C1=C2		*selvatico* 'wild$_{\text{M.SG}}$' *tiepido* 'lukewarm$_{\text{M.SG}}$'
C1>C2	*colpo* 'stroke$_{\text{M.SG}}$' *forno* 'oven$_{\text{M.SG}}$' *merlo* 'blackbird$_{\text{M.SG}}$'	*stomaco* 'stomach$_{\text{M.SG}}$' *manico* 'handle$_{\text{M.SG}}$'
C1<C2	*libro* 'book$_{\text{M.SG}}$' *magro* 'thin$_{\text{M.SG}}$' *quattro* 'four'	*giovane* 'young$_{\text{M.SG}}$' *libero* 'free$_{\text{M.SG}}$' *tenero* 'tender$_{\text{M.SG}}$' *asino* 'donkey$_{\text{M.SG}}$'

Results

SGG-abiding paroxitones

Pr.Rom.	Pontr.	Carr.
colpo 'stroke$_{\text{M.SG}}$'	[kurp]	[kolp]

- Pr.Rom. WF-*o* drops systematically
  - $\text{M.SG} \Rightarrow \varnothing$ in Pontr. and Carr.
- No 'SSG violation' & no 'repair'

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C1=C2 proparoxitones

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selvatico 'wild$_{\text{M.SG}}$'	[sɐrˈvadgø]	[səlˈvatəkə]
	[sɐrˈvadgə]	[səlˈvatək]
	[sɐrˈvadgə]	[səlˈvatək]
		[səlˈvatkə]
		[səlˈvatk]

- Pontr.
  - $\text{M.SG} \Rightarrow \varnothing$
  - Insertion of a vocoid $\neq$ E in WF position
  - SSG sensitivity
- Carr.
  - $\text{M.SG} \Rightarrow \varnothing$
  - Optional vocoid insertion
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SGG-violating (pro)paroxitones

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		[librᵊ]
		[libr]

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Pontremolese E

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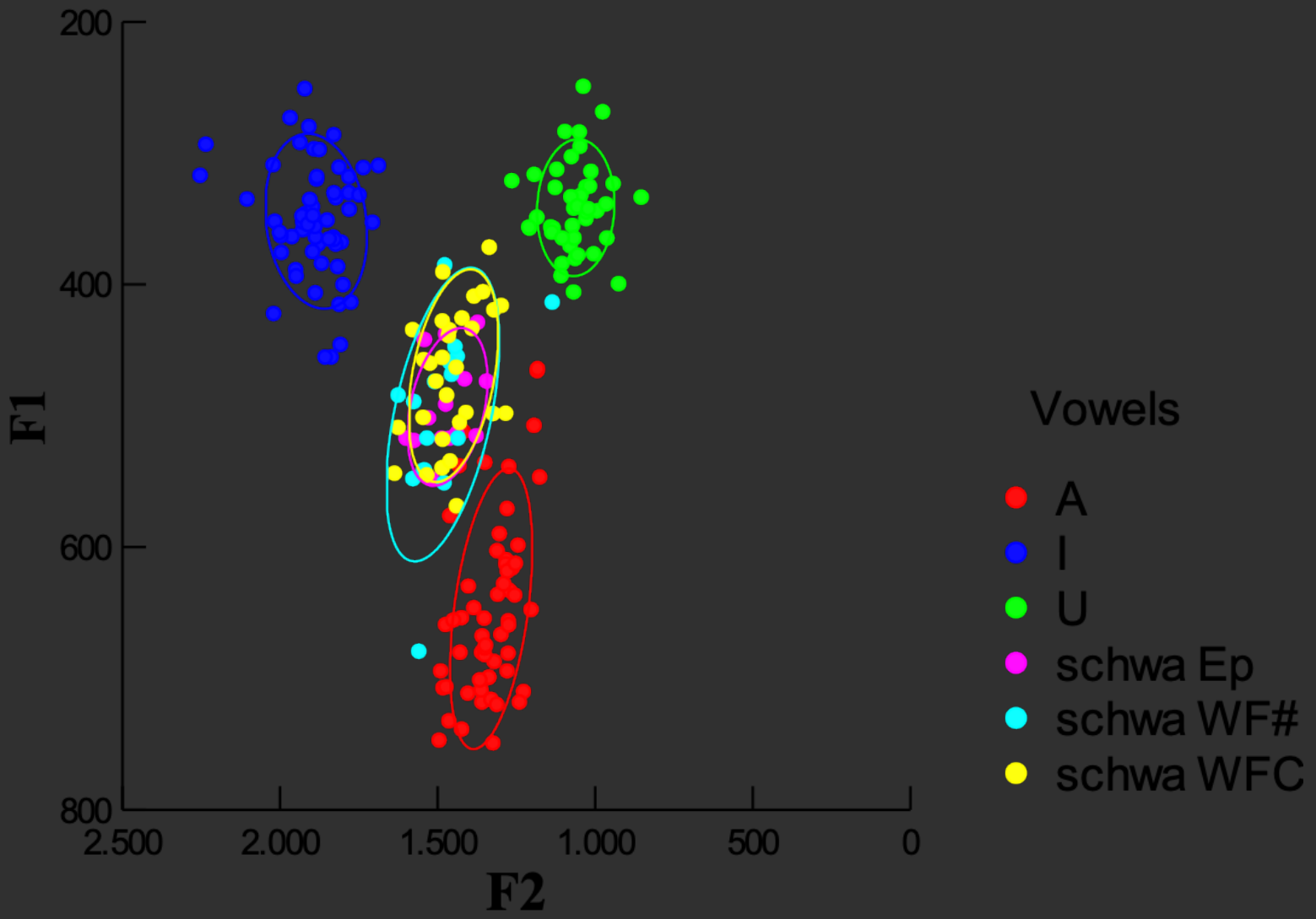
magro 'thin$_{\text{M.SG}}$'	[ˈmagɐr]
asino 'donkey$_{\text{M.SG}}$'	[ˈasʊŋ]

- ɐ (/a/) before /r, l/
- ʊ (/u/) before [ŋ] (/n/)

Carrarese I


200
400
600
800
F1
2.500
2.000
1.500
1.000
500
0
F2
Vowels
A
I
U
schwa Ep
schwa WF#
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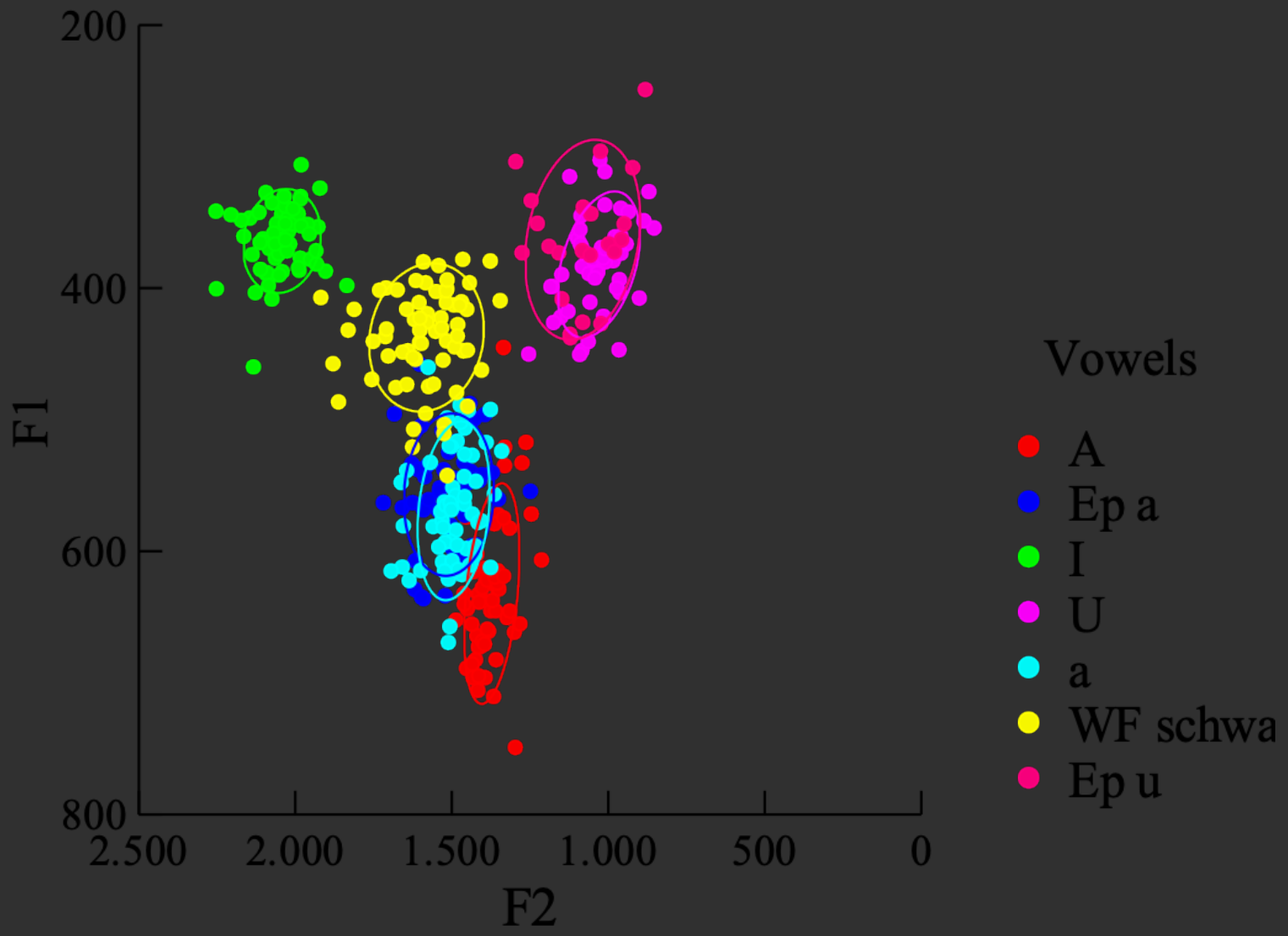
Pontremolese E



I *vs* E (Hall 2011)

Intrusive vocoids

- Optional, variable duration, disappear at fast speech rates
- No markedness-repairing function
- By-product of consonantal gestures' timing
- **No features & no N projection**

Epenthetic vowels

- Independent on speech rate
- Markedness-repairing function
- Phonologically similar to lexical V
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Explanandum: I-to-E

- Initial stage - Carr. I

PH	O	N_1	O		O	N_2
	m	a	g		r	$\varnothing_{\text{M.SG}}$
ph	ˈm	a	g	(ə)	r	

- Final stage - Pontr. E

PH	O	N_1	O	N_E	O	N_2
	m	a	g	A	r	$\varnothing_{\text{M.SG}}$
ph	ˈm	a	g	ɐ	r	

Analysis

Ingredients

- Diachronic change as sequence of **synchronic** grammars
  - Interpretation of percepts drives change (Ohala 1981; Hamann 2009)
  - **Production** and **perception** grammars
- Life cycle of phonological processes
  - From extra-grammatical (I) to grammatical (E)
    - I: open transition (Bloomfield 1933), excrescent vowel (Levin 1987), by-product of the consonantal gesture phasing (Hall 2006)
    - E: phonological object (contentful nucleus)
- Bidirectional modular grammar: **BiPhon** (Boersma 2011)
  - One grammar for speech production (lexicon-to-articulation) and perception (percept-to-lexicon)

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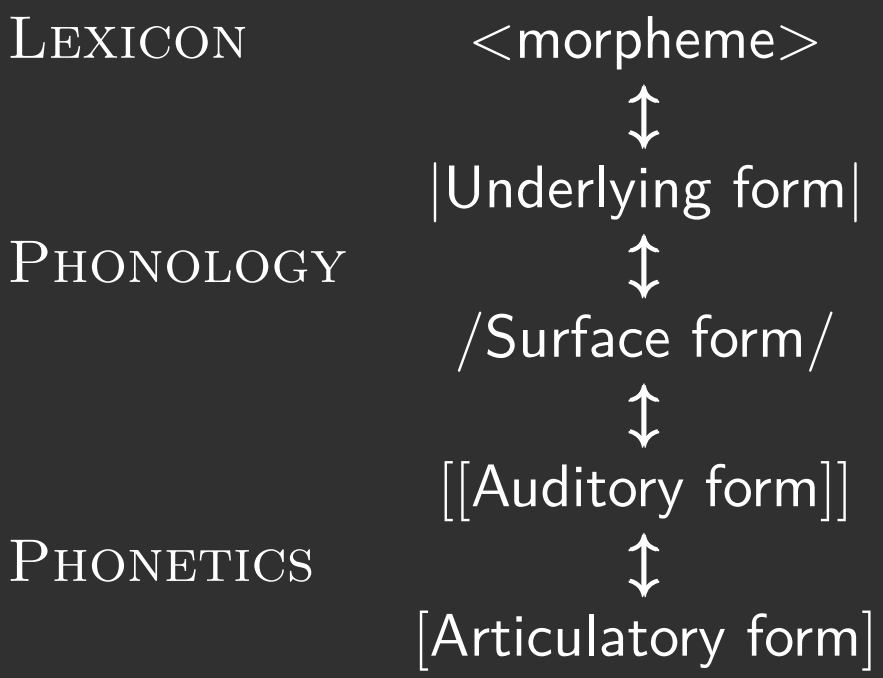
BiPhon modular architecture



Representational levels (Boersma 2011)

Phonetics

Articulatory form

- "a sequence of gestures by the multiple articulatory muscles"
  - *Non-linguistic* motor system knowledge that can be resorted to for linguistic purposes

Auditory form

- "a sequence of events on auditory continua"
  - Pitch, noise, spectral peaks and valleys, silences, their durations ...

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Surface form

- Discrete representations of PH objects after operations applied
  - Elements (Backley 2011), O, N

Underlying form

- Discrete representation of PH objects stored in the Lexicon

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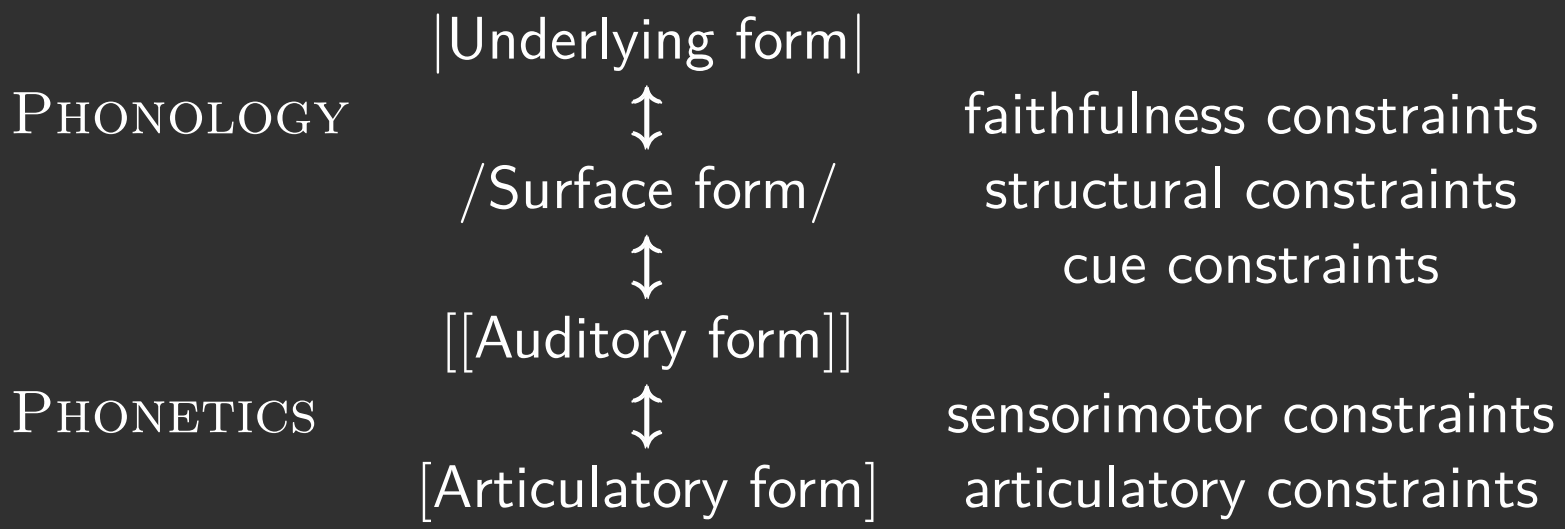

Computation

Phonetics

$$\begin{array}{ccc} [[\text{Auditory form}]] & & \\ \updownarrow & \leftarrow & \text{Sensorimotor constraints} \\ [\text{Articulatory form}] & \leftarrow & \text{Articulatory constraints} \end{array}$$

Articulatory constraints

- Favouring minimum effort (Lindblom 1983)
  - Fast and/or casual speech = high-ranking of articulatory constraints

Sensorimotor constraints

- "how to articulate a given sound and [how] a certain articulatory gesture will sound like"
  - Fixed, universal, or speaker-specific relative ranking

Computation

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Sensorimotor constraints

- "how to articulate a given sound and [how] a certain articulatory gesture will sound like"
  - Fixed, universal, or speaker-specific relative ranking

Computation

Phonetics-Phonology

/Surface form/
↕
[[Auditory form]] ← Cue constraints

Cue constraints

- "Knowledge of [the] relation between auditory form and phonological surface form"
- Learnt, arbitrary, and language-specific
  - Substance-free phonology

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Phonetics-Phonology

/Surface form/
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Computation

Phonology

$$
\begin{array}{cc}
|\text{Underlying form}| & \\
\updownarrow & \leftarrow \quad \text{Faithfulness constraints} \\
/\text{Surface form}/ & \leftarrow \quad \text{Structural constraints}
\end{array}
$$

Structural constraints ($\sim$ markedness)

- Evaluate phonological surface forms

Faithfulness constraints

- Evaluate UF-SF mapping

Specific constraints

Phonetics

Articulatory constraints

- CoArt — adjacent articulations must overlap

Sensorimotor constraints

- [[ə Hz]] [ə] — an acoustic ə-like formant structure is produced by a ə articulatory configuration
- [[x ms]] [x ms] — an acoustic structure of a given duration is produced by a gesture of the same duration
- [[ ]] as *normalized* values

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Phonetics-Phonology

Cue constraints

- /A/ [[a Hz]] an element A corresponds to a [a]-like formant structure
- /U/ [[u Hz]] an element U corresponds to a [u]-like formant structure
- Nuc [[ə Hz]] a nucleus corresponds to a [ə]-like formant structure
- /•/ [[• ms]] a segment corresponds to a *short* acoustic periodic structure
- Against *silent* (production) and *intrusive* (perception) segments

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Specific constraints

Phonology

Structural constraints

- SSG — between any member of a σ and the σ's peak, a sonority rise or plateau must occur (*TR)
- Agree — two adjacent segments must be melodically similar (spreading)

Faithfulness constraints

- Dep — each SF segment corresponds to a UF segment (no epenthesis)

Explanandum: I-to-E

- Initial stage - Carr. I

PH	O	N_1	O		O	N_2
	m	a	g		r	$\varnothing_{\text{M.SG}}$
ph	ˈm	a	g	(ə)	r	

- Final stage - Pontr. E

PH	O	N_1	O	N_E	O	N_2
	m	a	g	ɐ	r	$\varnothing_{\text{M.SG}}$
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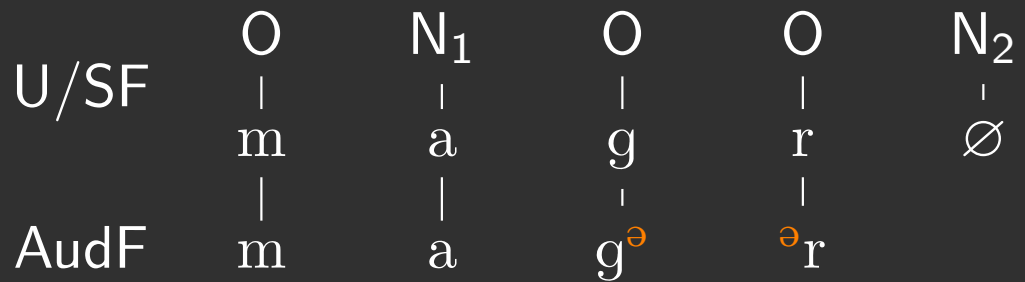
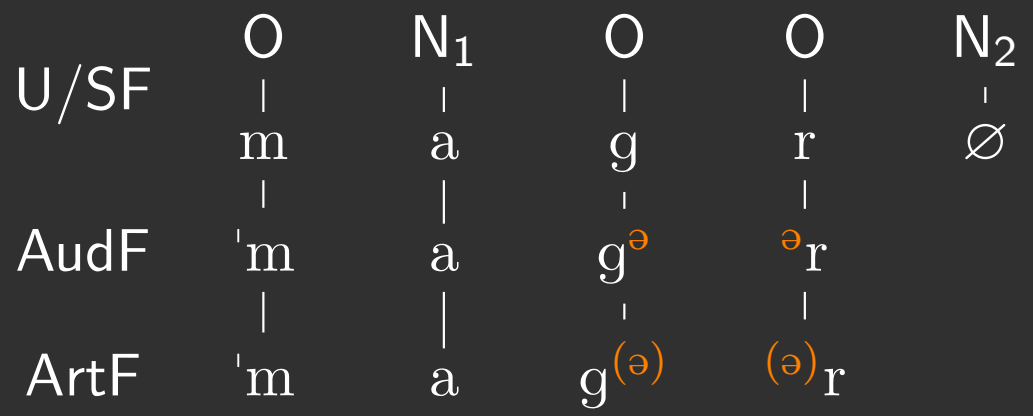
Initial stage

Initial stage (Carr.)

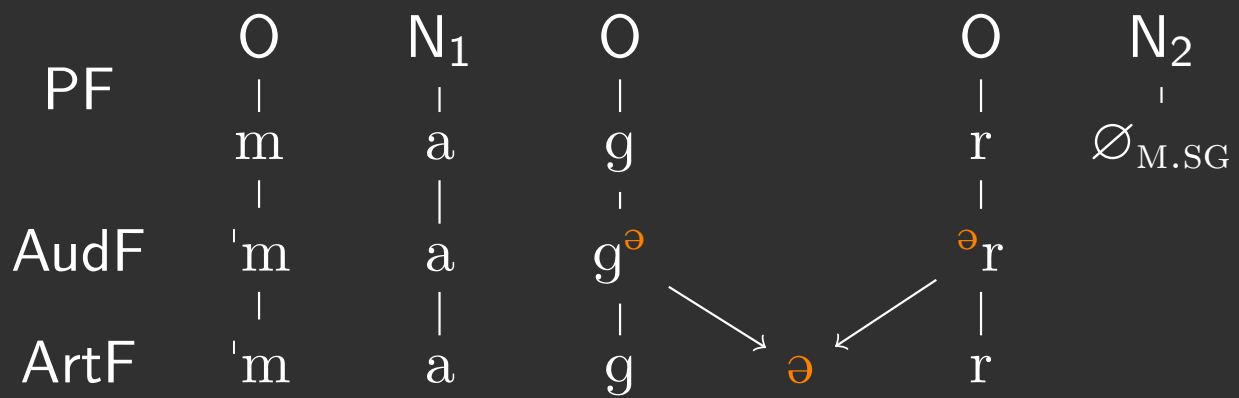


Initial stage - Production, fast/casual speech (Carr.)



- No I
  - ə = /g/'s release & /r/'s formant structure

Initial stage - Production, slow speech (Carr.)



- Low degree of overlap of two consonantal gestures (Hall 2006)
  - "integration of a short vocal tract opening period occurring between the two consecutive consonants" (Recasens 2014)
- Expression of the place info of the preceding C (Hall 2006)
  - Enhancement of the first 'vocalic element' of /r/ (Savu 2013)
- Acoustically similar to a short ə
  - F2 value conditioned by flanking consonants

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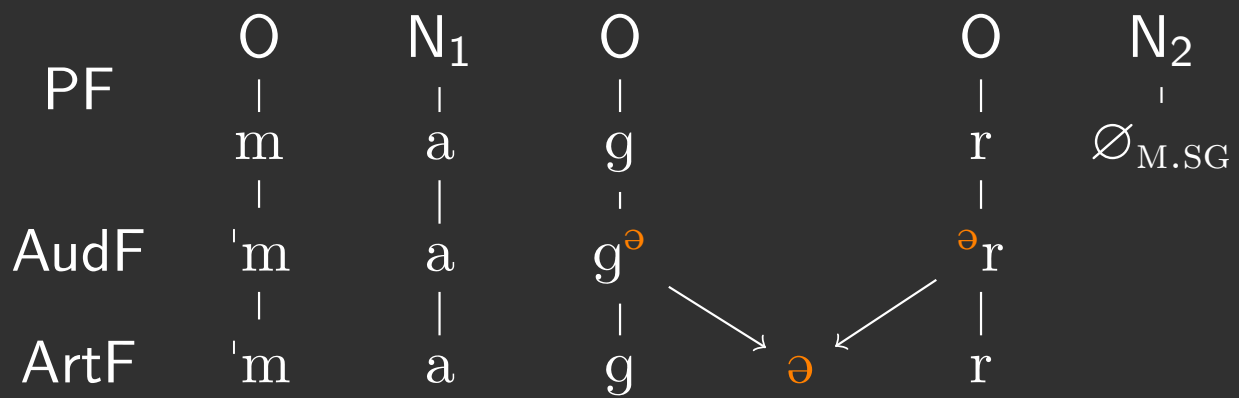

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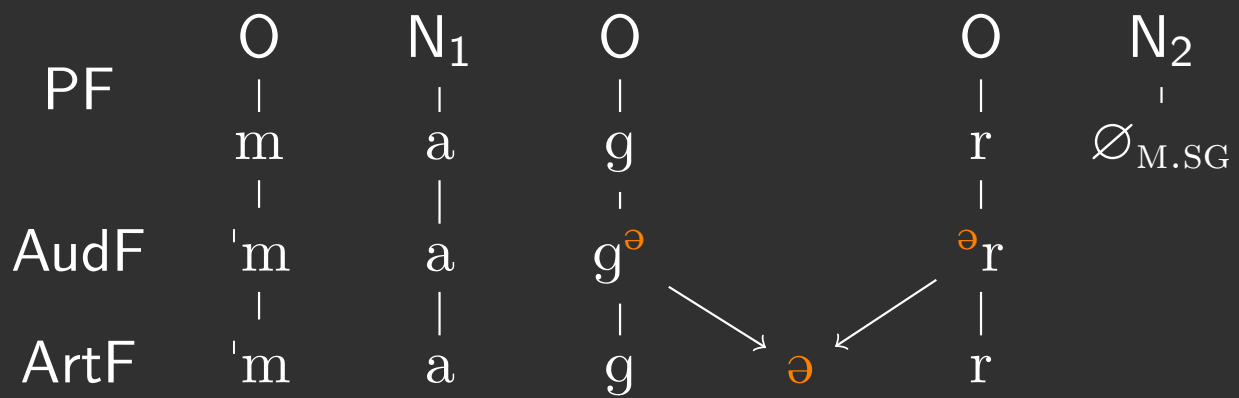

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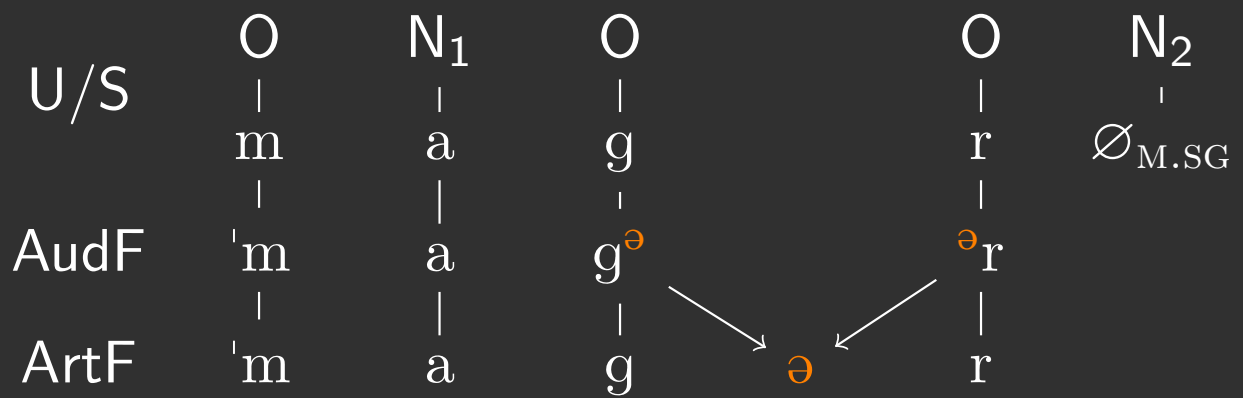
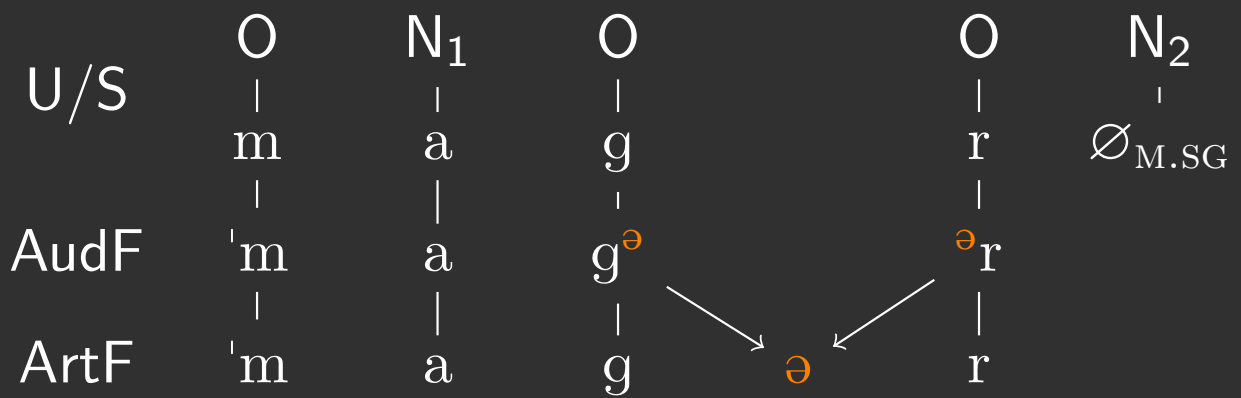


- The articulatory configuration corresponds to no auditory target
  - Violation of
    - [[ə Hz]] [ə Hz]
    - [[x ms]] [x ms]
  - No violation of
    - Nuc [[ə Hz]]
    - /•/ [[x ms]]

Initial stage - Production (Carr.)

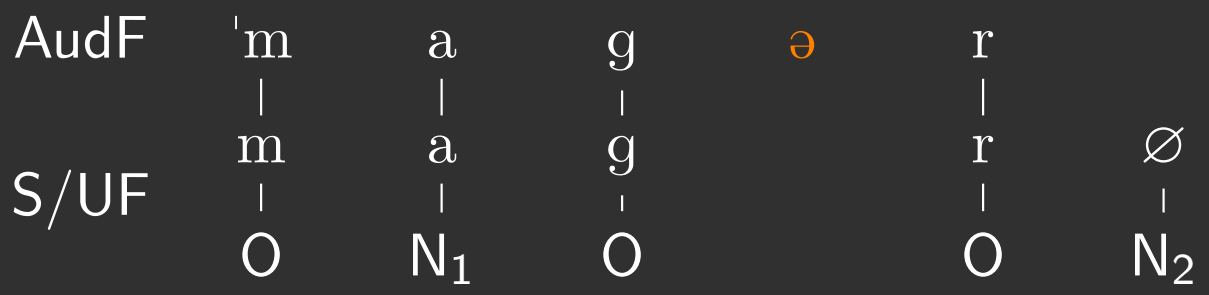


- /ˈmagr/ [[ˈmagr]] is OK ⇒ no ‘repair’ required
  - SSG violation
  - No DEP violation

Initial stage - Perception (Carr.)

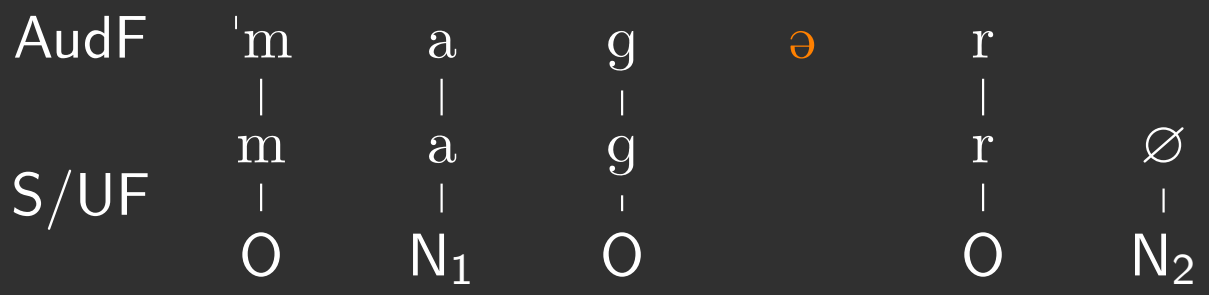
AudF	ˈm	a	g	ə	r

Initial stage - Perception (Carr.)



- The auditory input corresponds to no phonological object
  - Forms such as [ˈmagər] are considered monosyllabic
    - Poetry: verse metrical structure
    - Transcription: never transcribed

Initial stage - Perception (Carr.)



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Crucial constraint ranking

DEP >> /•/ [[x ms]], NUC [[ə Hz]]

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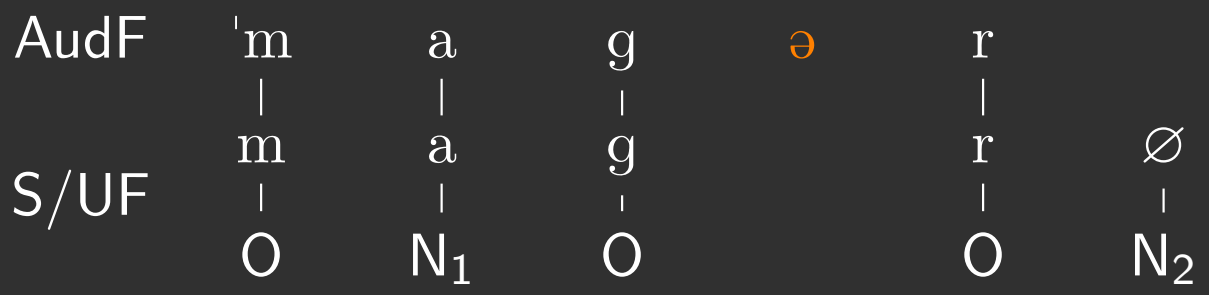

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Intermediate stage I - Reinterpretation

- Importance of perception/the listener
  - "[The] insertion process [resulting from] the **integration** of a short vocal tract opening period occurring between the two consecutive consonants [can be interpreted] as an **independent vowel by the listeners**" (Recasens 2014)
    - "[T]he '**segmentalisation**' [...] of intrusive vowels is likely a case of listener-initiated sound change [...]. If intrusive vowels become acoustically too similar to segmental vowels, speakers may reanalyze them as segments." (Hall 2006)
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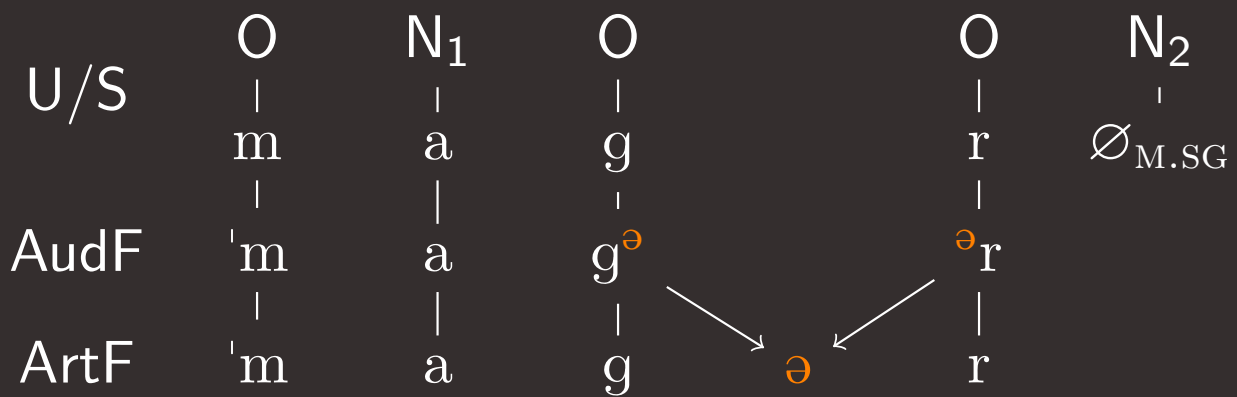

Perception

Intermediate stage I - Perception

- The auditory input corresponds to a phonological object
  - [[ə Hz]] is mapped on /ə/
  - Promotion of /•/ [[x ms]] over Dep
- [[ˈmagər]] ∼ [[ˈmagri]]/[[ˈmagra]]/[[ˈmagre]]
  - /ə/ ∼ ∅ as synchronic phonological process
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- /ə/ ∼ ∅ as synchronic phonological process: two options
  - Option I
    - Epenthesis of empty N
    - [[ə]] = pronunciation of an empty N (Harris 1994; GP)
    - "insertion of a maximally unspecified segment to satisfy FAITH" (Uffmann WoE)
  - Option II
    - Epenthesis of $N_{/ə/}$
    - Donceto (Repetti & Cardinaletti 2008)
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Intermediate stage II - Production, ə-coloring

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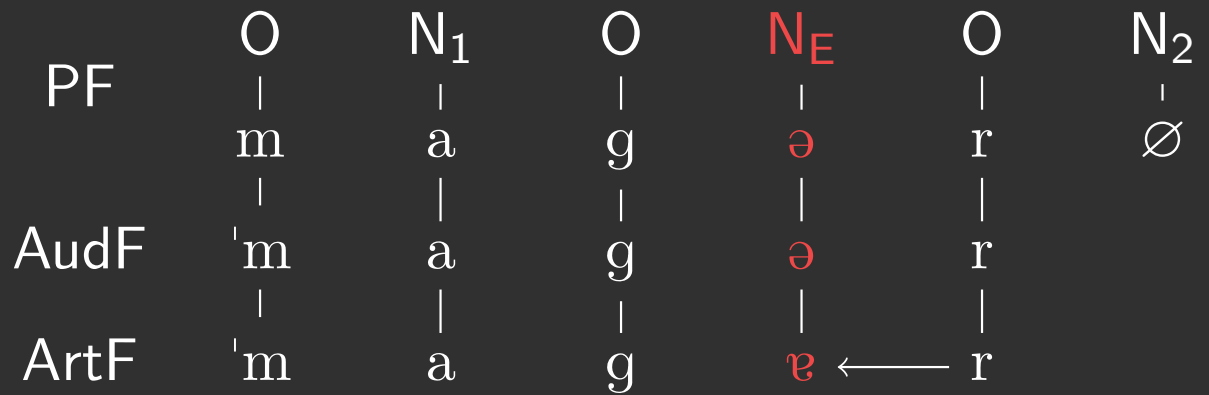

- Coarticulation (Recasens 2014: 52)
  - [[ər]] → [ar]
    - "Anticipatory tongue dorsum lowering and backing for [r] [and [l]]"
  - [[əŋ]] → [uŋ]
    - "[anticipatory] tongue postdorsum [raising] toward the velar zone"
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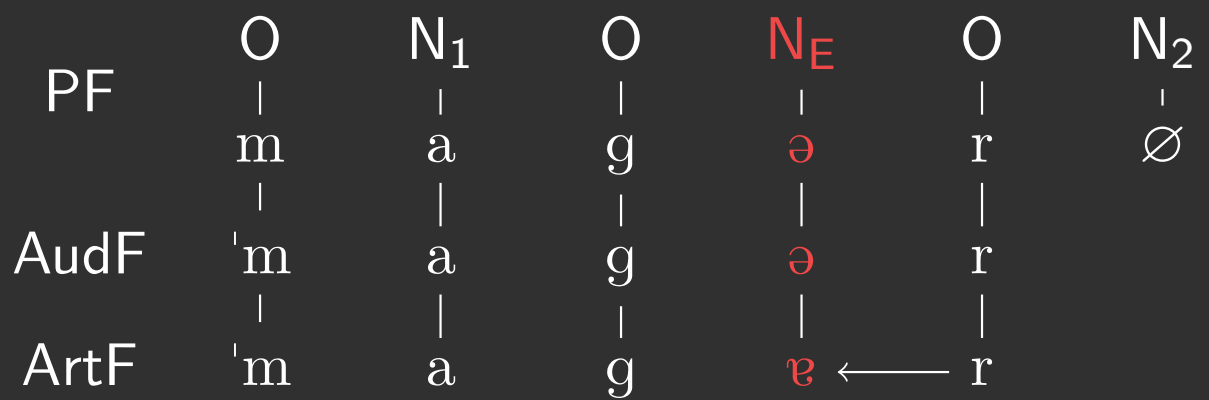

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Production

Perception

Final stage - Perception (Pontr.)

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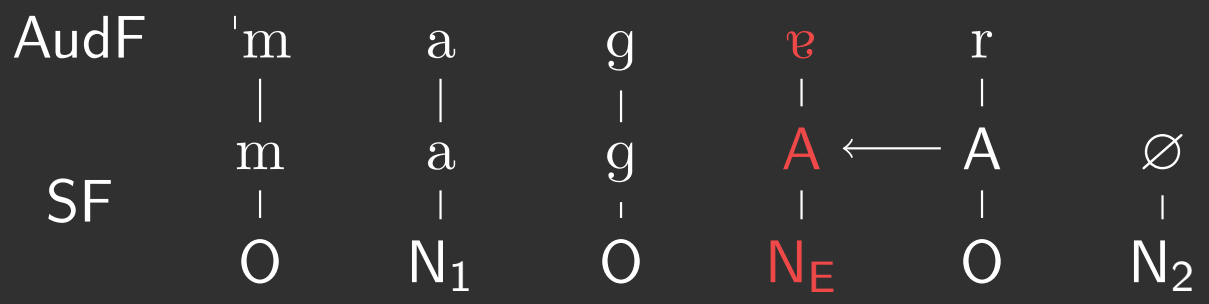

- Coarticulation as assimilation
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  - |A|, |U| spread to N_E
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    - Spreading over feature-insertion
  - CoArt's effect → Agree's effect

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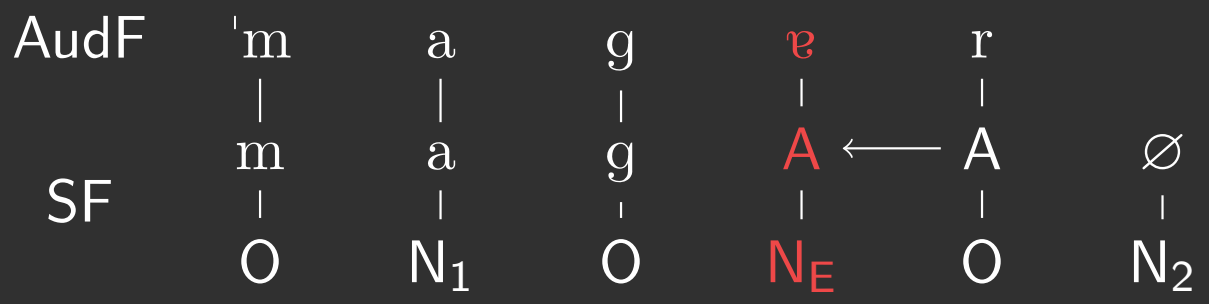

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- UR

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	m	a	g	r	∅

- Epenthesis of N_E: SSG >> Dep

PF	O	N_1	O	N_E	O	N_2
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- Spreading of A: SSG >> Dep, Agree >> Nuc [[ə]]

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UF

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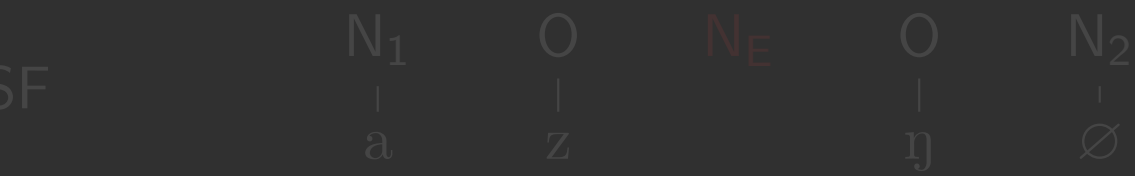
SF



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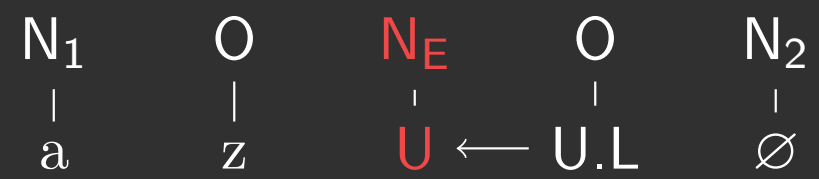

Conclusion

- I-to-E phonologization os due to learners reinterpreting low-level phonetic processes as phonological
  - Integration of T's release and R's vocalic content $\rightarrow$ presence of N
  - Coarticulation as assimilation (ə-coloring)
- BiPhon allows for an explicit modeling of
  - the necessary perception grammars
  - the interaction between phonetics and phonology
  - the I-E diatopic variation/change

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Discussion

The place of variation

- Representation
  - Substance-free, acquired, language-specific
- Computation
  - Underlying-to-surface form mapping
  - Acquired, language-specific

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Micro-diachronic variation

- Languages constantly change also at the intra-speaker level (Harrington et al. 2000, Sankoff & Blondeau 2007, Kwon 2014, Tamminga et al. 2016, MacKenzie 2019)
  - "Peer influence during adolescence exerts an especially strong effect on linguistic patterns" (Foulkes & Vihman 2013)
  - "Adults' abstract phonological systems [...] are different from what they were in childhood or at puberty. Change is dramatic in childhood, but it does not stop there" (Sankoff & Blondeau 2007: 584)
  - L1 attrition in heritage languages (Tordini et al 2018)

Micro-diachronic variation

- Our synchronic models should be granted the possibility to change also within one and the same speaker
- Series of different grammars with no constraint violation
  - However, if (hard) constraints are universal, we cannot just assume that once they are no more necessary they simply vanish away
- One changing grammar
  - The constraints a speaker complied with at a specific stage, at a subsequent stage could be no more complied with
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- One and the same computational procedure > variation in the representation (à la Borer & Chomsky)

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Representational variation

- Variation resides in the phonological representation side of LI
  - Computation follows from representation
  - Ideally exceptionless $>$ no principles/hard constraints parametrization
  - Refinement of empty categories (Cavirani & van Oostendorp 2017, 2019; Cavirani 2022)

Representational variation

- Too static and possibly simplistic/unrealistic
  - Changes in lexical representation are the endpoint of a grammaticalization process starting from the bottom of language architecture...
  - ...climbing up through the phonetic-phonology interface via the *cue constraints*...
  - ...which interact with phonological constraints *structural constraints*
  - Given that an individual's phonology varies through time, the possibility for them to be reranked must be assumed

Step 1: Proto-Romance undershoot - production

- Constraints
  - *ART — minimize gestures stiffness and duration
  - [[x Hz]] [x] — an acoustic x-like formant structure is produced by an articulatory configuration x
  - [[x ms]] [x ms] — an acoustic structure of a given duration is produced by a gesture of the same duration
- Crucial ranking
  - *ART >> sensorimotor constraints

Vowel reduction

	O | k	ˈN | |A|	O | p	NΦ | |AU|	*ART	[[ə Hz]] [ə]	[[u Hz]] [u]	[[x ms]] [x ms]
a)	O	ˈN	O	NΦ				
	|	|	|	|				
	|	|A|	|	|AU|				
☞	|	|	|	|	****(ˈN) *(N)		*	*(ˈN) *(N)
	[[k	a:	p	o]]				
	|	|	|	|				
	[k	aˑ	p	ɔ]				
b)	O	ˈN	O	NΦ				
	|	|	|	|				
	|	|A|	|	|AU|	**W** ****!*(ˈN) *!**(N)		**L**	**L**
	|	|	|	|				
	[[k	a:	p	o]]				
	|	|	|	|				
	[k	a:	p	o]				
c)	O	ˈN	O	NΦ				
	|	|	|	|				
	|	|A|	|	|AU|	**W** ****(ˈN) *!*(N)	**W** *	**L**	*(ˈN) *(N)
	|	|	|	|				
	[[k	a:	p	o]]				
	|	|	|	|				
	[k	aˑ	p	u]				

Step 1: Proto-Romance perception

- Constraints
  - EXPRESS-M.SG — M.SG elements must be present in the phonological representation (M.SG = φ)
- Crucial ranking
  - EXPRESS-φ >> *N/STR/

[[k a· p ə]]					EXPRESS-Φ	*N |STR|	|X| [[x ms]]	|A| [[ə Hz]]	|U| [[u Hz]]
a)	O	'N	O	N_Φ					
	|	|	|	|					
☞	|	|A|	|	|AU|		***	*		*
	|	|	|	|					
	[[k	a·	p	ə]]					
b)	O	'N	O	N_Φ					
	|	|	|	|	**W**	**L**			**L**
	|	|A|	|	|A|					
	|	|	|	|	*!	*	*		
	[[k	a·	p	ə]]					
c)	O	'N	O	N_Φ					
	|	|	|	|	**W**	**L**		**W**	
	|	|A|	|	|U|					
	|	|	|	|	*!	**	*	*	*
	[[k	a·	p	ə]]					
d)	O	'N	O	N_Φ					
	|	|	|	|	**W**	**L**	**L**	**W**	**L**
	|	|A|	|	| |					
	|	|	|	|	*!*			*	
	[[k	a·	p	ə]]					

Figure: Proto-Romance perception

Step 2: Proto-Romance perception (hypoarticulation)

- Speaker undershoot as hypoarticulation
  - "Part of planned speech behaviour rather than an accidental by-product of vocal-organ inertia" (Harris 2005: 132)
- Constraints
  - 'Unpacked' *N/STR/
- Crucial ranking
  - Promotion of *N/XY/
  - *N/XY/ >> EXPRESS-ϕ
- M.SG restructuring: /AU/ > /A/

[[k a· p ə]]					*N |XY|	EXPRESS-Φ	*N |X|	*N |X|	*N | |
a)	O	'N	O	N⋄					
	|	|	|	|					
☞	|	|A|	|	|A|		*		*	
	|	|	|	|					
	[[k	a·	p	ə]]					
b)	O	'N	O	N⋄					
	|	|	|	|	W	L		L	
	|	|A|	|	|AU|	*!				
	|	|	|	|					
	[[k	a·	p	ə]]					
c)	O	'N	O	N⋄					
	|	|	|	|			W	L	
	|	|A|	|	|U|		*	*!		
	|	|	|	|					
	[[k	a·	p	ə]]					
d)	O	'N	O	N⋄					
	|	|	|	|		W		L	W
	|	|A|	|	| |		*!*			*
	|	|	|	|					
	[[k	a·	p	ə]]					

Figure: Proto-Romance perception (hypoarticulation)

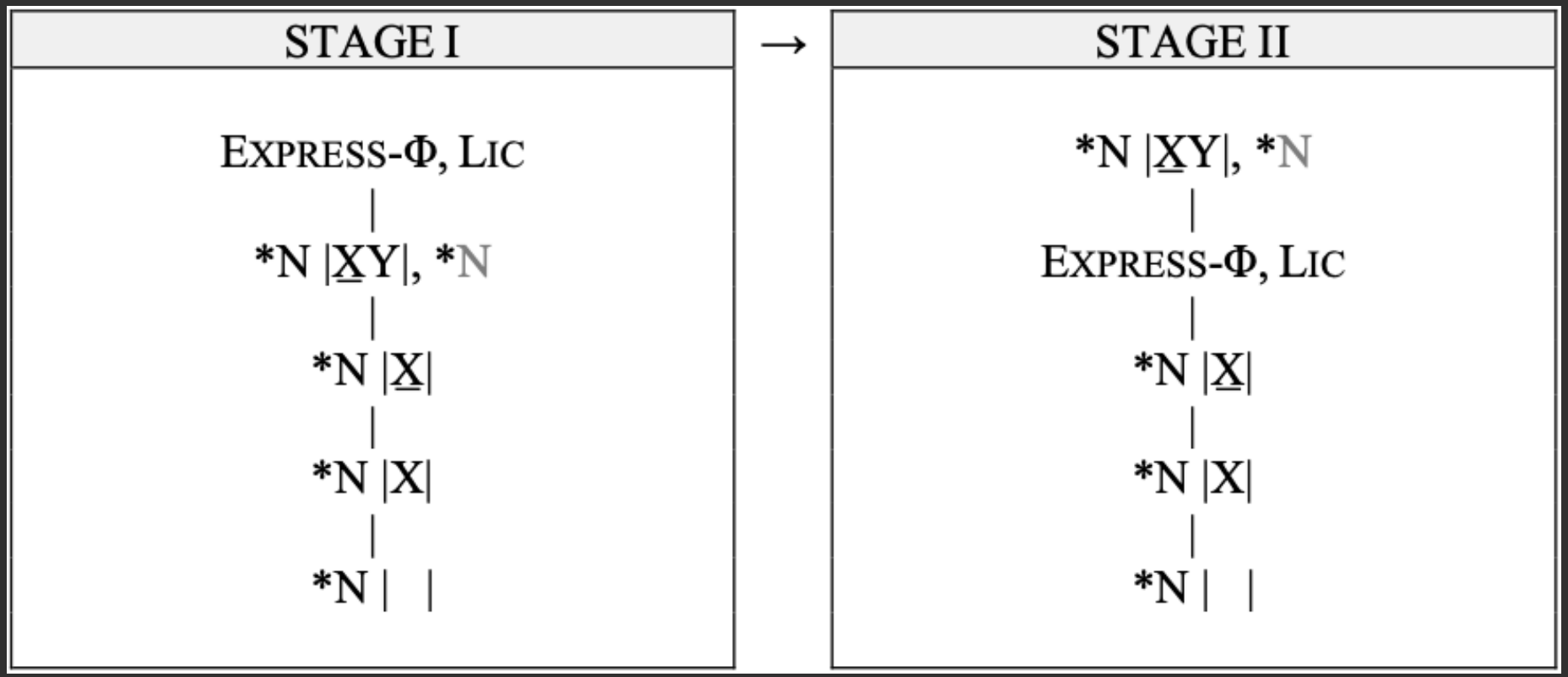

Figure: Grammar change

Step 3: Another round of undershoot - production

- Crucial ranking
  - Promotion of *ART
  - *ART >> sensorimotor constraints

O | k	'N | |Δ|	O | p	N_Φ | |A|	*ART	[[x ms]] [x ms]
a)	O | | | [[k | [k	'N | |Δ| | a: | a·	O | | | p | p	N_Φ | |A| | ə]] | ɔ]	****('N) *(N)	*('N) *(N)
b)	O_R | | | [[k | [k	$'N_R$ | |Δ| | a: | a:	O_R | | | p | p	N_Φ | |A| | ə]] | ə]	**W** ****!*('N) **(N)	**L**

Figure: Undershoot

Step 4: Perception (hypoarticulation)

- Crucial ranking
  - Promotion of *N/X/
  - *N/X/ >> Express-ϕ
- Speaker undershoot as hypoarticulation
- M.SG restructuring: /A/ > / /
- *N/X/ forces the violation of (all the) Lic constraint(s)

[[k a· p ɔ]]					*N |X|	EXPRESS-Φ	LIC	*N | |
a)	O	'N	O	N_Φ				
	|	|	|	|				
☞	|	|A|	|	| |		*	*	*
	|	|	|	|				
	[[k	a·	p	ɔ]]				
b)	O	'N	O	N_Φ				
	|	|	|	|	**W**	**L**	**L**	**L**
	|	|A|	|	|A|				
	|	|	|	|	*!			
	[[k	a·	p	ɔ]]				

Figure: Perception (hypoarticulation)

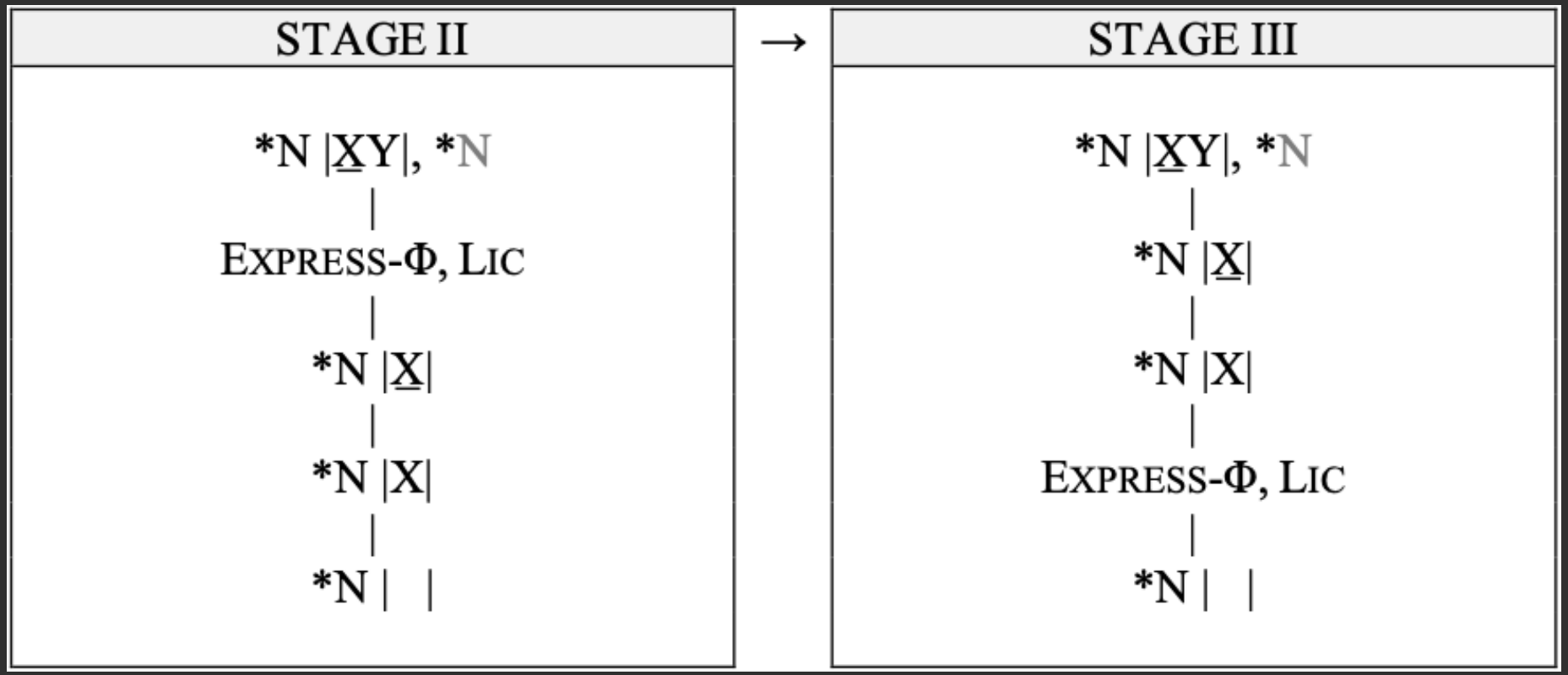

Figure: Grammar change