

Some Challenging Facts of Brazilian Portuguese Vowel Phonology

Eleonora C. Albano

Lafape-IEL-Unicamp

Dinafon-CNPq

The Problem

- ❑ Object: *Brazilian Portuguese* (henceforth BP) *mid V's*.
- ❑ Challenge: unifying the account of *multi-layered vowel shifts* along the *opening* dimension.
- ❑ Facts: *mid V opening/closing processes*.
- ❑ Processes:
 - ❑ *Unstressed mid V closing harmony*;
 - ❑ *Unstressed mid V closing (raising)*;
 - ❑ *Stressed mid V opening (lowering)*.
- ❑ Layers:
 - ❑ *Phonetic detail*;
 - ❑ *Variable* (sociolinguistic) *categorical allophony*;
 - ❑ *Morphophonological processes*;
 - ❑ *Probabilistic phonotactic biases*.

Aims

- ❑ To give an **overview** of unpublished work in Portuguese on the first layer (**phonetic detail**) of **BP mid V opening/closing** phenomena;
- ❑ To take a closer look at its other 3 layers, relying on **lexical frequency data**;
- ❑ To focus on ongoing research on the 4th layer: **probabilistic phonotactic biases**;
- ❑ To **describe** the **facts** as accurately as possible;
- ❑ To point to **dynamic models** as a **promise** of explanation;
- ❑ To **attract interest** of this community in the phenomena described.

Background

□ *The BP Vowel System:*

- Stress dependant inventory:
 - **7 V's** under **stress**:
i, e, E, a, O, o, u.
 - **3/5/7 V's**
(*i, a, u / e, a, o*) in **unstressed** position, depending on **side** of **stress** and **dialect**.
- Stress assignment:
 - **Final**;
 - **Penultimate**;
 - **Antepenultimate**.
- **5 V's** (*i, e, a, o, u*) under **nasalization**.

□ *Its origin:*

- **Latin** vowels reorganized after **quantity loss**;
- **Quality** distinctions due to quantity partly **preserved** in **mid V's**: *e, o, E, O*;
- **E, O** most common under **stress**;
- Changes involving:
 - **Opening** (mostly in **stressed** position);
 - **Closing** (mostly in **unstressed** position).

Layer 1: Phonetic Detail

□ **CV co-articulation:** (Oliveira 2000):

- **No *F1*** effects;
- ***F2* effects** in agreement with *literature*.

□ Roces 2006, 2010:

- **No *F1*** effects;
- **No *F2* effects** in *mid V's* .

□ **V-to-V co-articulation** (Roces 2006, 2010):

- ***Mid V's* in *pre-stressed* position: *F1* effects agreeing with *stressed V*;**
- ***Mid V's* in *stressed* position: *F1* effects disagreeing with *pre-stressed V*.**
- Research agenda: ***Why such disharmony?***

Layer 2: Categorical Allophony

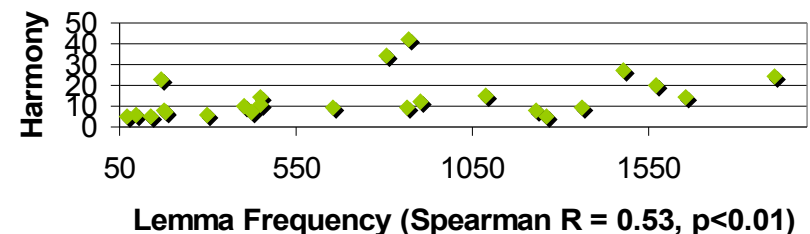
□ *Unstressed Mid V closing:*

- *Pre-stressed* mid V harmony, e.g., *m[i]nino*, *b[u]nito* (Bisol 1981);
- *Pre-stressed* Mid V “raising”, e.g. *p[i]queno*, *f[u]gão*, *c[u]meço* (idem);

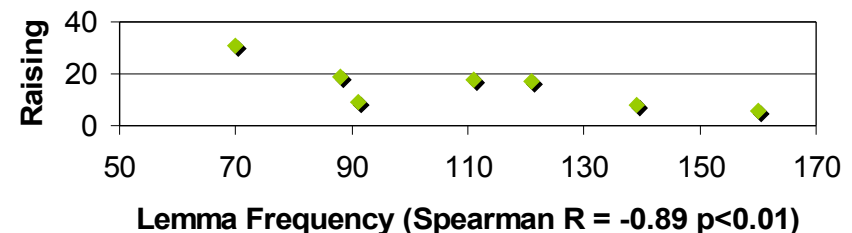
□ *Stressed mid V opening:*

- *Acronyms* and *foreign words*, e.g., CEP [*‘sEpl*], IBOPE [*l’bOpl*]; Sch[*E*]rer.
- *Innovative* pronunciation of *low frequency* words, e.g., *c[e]pa* > *c[E]pa*, *t[e]rso* > *t[E]rso*.

Bisol Closing Harmony x Lael Lemma Frequency



Bisol Raising x Lael Lemma Frequency



Note the *inverse correlations* spanning over different *ranges*.
Research Agenda: *Why lemma frequency matters?*

Layer 3: Noun Morphophonology

- ❑ **Gender/number** suppletive **stem V** alternations: **umlaut** or **ablaut**?
 - ❑ **Masculine** sing. **originated** in **umlaut**, e.g., **s[o]gro**;
 - ❑ **Feminine** sing./pl. **etymologically open**, e.g., **s[O]gra/s**;
 - ❑ **Masculine** pl. “immune” to **umlaut**, e. g., **s[O]gros**.
- ❑ **Synchronic ablaut** supported by occasional plural “analogies”, e.g. **b[O]lsos**, **alm[O]ços**, **pesc[O]ços**;
- ❑ **Feminine less innovative** than plural, except as below.
- ❑ In **regressive noun formation** from first conjugation verbs, **umlaut** is productive, though sporadic:
 - ❑ **Masculine close**: **ap[e]go**, **enr[e]do**, **tr[o]co**, **suf[o]co**;
 - ❑ **Feminine open**: **l[E]va**, **r[E]ga**, **tr[O]ca**, **p[O]da**.
- ❑ **Umlaut** or “**metaphony**” does not seem to be just a phonetic “fossil”, but a **lexical process**. Can **dynamics** explain?

Layer 3: Adjective Morphophonology

- ❑ Same **suppletive ablaut** pattern as in nouns, e.g., *n[o]vo, n[O]vos, n[O]va/s*;
- ❑ One highly **productive suffix**: ‘oso’, e.g., *gost[o]so, gost[O]sos, gost[O]sa/s* ;
 - ❑ **Non-etymological V**: *oso* < *ōsum*, with long V;
 - ❑ **Umlaut** traditionally attributed to **feminine**;
 - ❑ Obscure “**analogical**” origin of **masculine plural**;
 - ❑ Otherwise **similar to nouns**.
- ❑ But, **unlike** regressive **nouns**, first conjugation **reduced participles** are **not** subject to **umlaut**:
 - ❑ **Either** a **close V** is required in both masculine and feminine, e.g., *qu[e]do/a, p[e]go/a*;
 - ❑ **Or** an **open V** is required in both masculine and feminine, e.g., *p[E]go/a*, depending on dialect.
- ❑ **Ablaut** or “**apophony**” also seems to be a **lexical process**, perhaps in “dynamic” competition with umlaut.

Layer 3: Verb Morphophonology

- ❑ **Two** kinds of **ablaut** affect **mid V's** in **verb inflection**:
 - ❑ A **closing trend** originated in umlaut and spread by “analogy”:
 - ❑ In the unproductive conjugations in ‘**ir**’/‘**er**’, e.g., **s[i]nto**<**sentio**, **m[o]vo**<**moveo**;
 - ❑ An **opening trend** which acts as a **default** (the “elsewhere case”):
 - ❑ In the productive conjugation in ‘**ar**’, e.g., **l[E]vo/a**;
 - ❑ Or in forms of the other conjugations not originated in umlaut, e.g., **d[E]ve**, **m[O]rre**.
- ❑ **Abstract analyses** treat most of these cases as underlying “**harmony**” (Harris 1974, Mateus 1975), i.e., a **truncated theme V** leaving an opening/closing **trace** in the stem.
- ❑ Is there any way to **sort out** and **track down** these **trends**?
- ❑ **Phonotactics** gives a hint... **Preference** of **open stressed syllables** for **open mid V's**.

Assessing Phonotactic Biases

❑ **Data** from *public databases*:

- ❑ **Lael** (oral, ~45,000 words), available at: <http://www2.lael.pucsp.br>
- ❑ **Ceten** (written, ~60,000 words), available at: <http://www.linguateca.pt/>

❑ **Coding**:

- ❑ **Acronyms** and **foreign** words filtered **out**;
- ❑ Automatic **orthography to phone** conversion (Albano & Moreira 1996).

❑ **Sample size** selection:

- ❑ Comparison among different-sized **random samples**;
- ❑ Caveat: **small samples** are **unstable**.

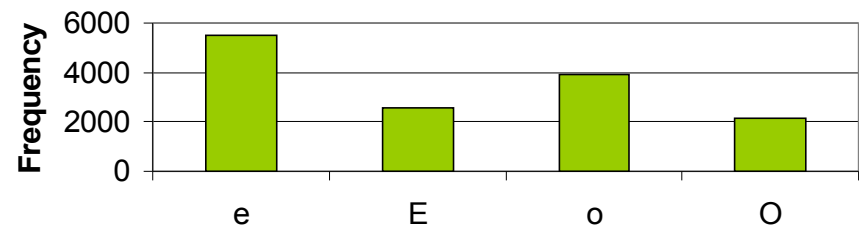
❑ **Statistics**:

- ❑ **Association**: **chi-square** (Pearson's and Likelihood Ratio);
- ❑ **Association Strength**: **Phi and Cramer's V**;
- ❑ **Cell significance**: **Sokal & Rohlf's (1995) test**.
- ❑ **Factor contribution**: **Log Linear Modeling**.

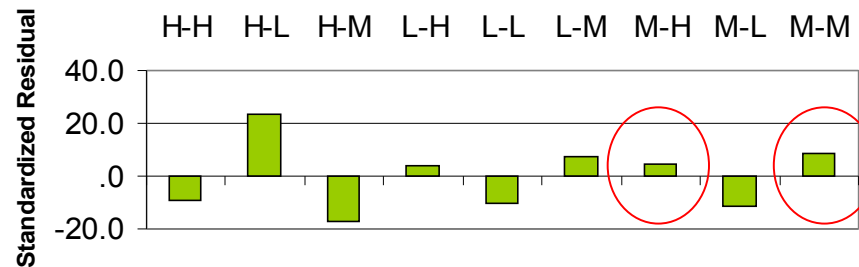
Layer 4: Probabilistic Phonotactics

- ❑ **Segment frequency fact:**
 - ❑ **Open mid V's** are **low frequency** (even under stress).
- ❑ **Co-occurrence frequency facts:**
 - ❑ **Pre-stressed mid V's** are weakly biased to co-occur with **high** and **mid stressed V's** (harmony);
 - ❑ **Antepenultimate** and **penultimate stressed mid V's** are biased to be **open**: **Cramer's $V = .27$** .

Stressed Mid V Frequency in Lael Types



Ceten Types: Prestressed x Stressed V's



A Glimpse into Diachrony: Latinate & Non-Latinate Words

Opening * Origin Crosstabulation						Chi-Square Tests					
			Origin		Total		Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
			latin	other		Pearson Chi-Square	802.822 ^a	1	.000		
Opening	close	Count	1457	119	1576	Continuity Correction ^b	799.183	1	.000		
		Expected Count	1236.7	339.3	1576.0	Likelihood Ratio	708.123	1	.000		
		Std. Residual	6.3	-12.0		Fisher's Exact Test				.000	.000
	open	Count	143	320	463	N of Valid Cases	2039				
		Expected Count	363.3	99.7	463.0	Symmetric Measures					
		Std. Residual	-11.6	22.1							
	Total	Count	1600	439	2039	Nominal by Nominal	Phi		.627	.000	
		Expected Count	1600.0	439.0	2039.0		Cramer's V		.627	.000	
							N of Valid Cases			2039	

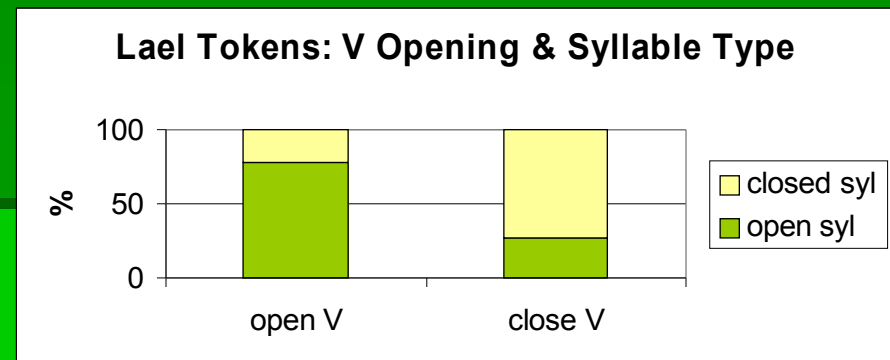
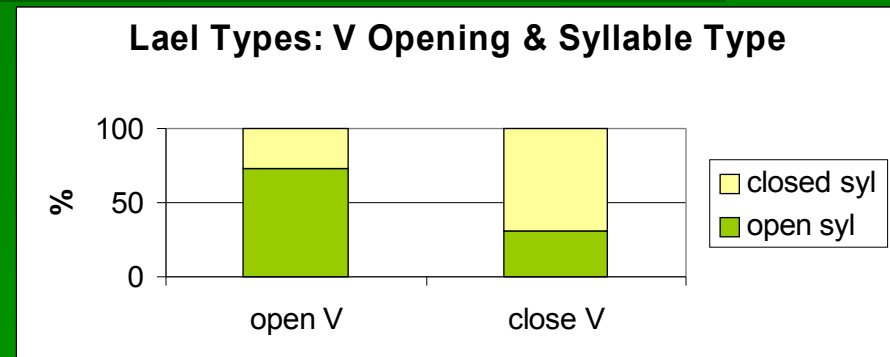
- ❑ **Stressed mid V's** are **massively open** in **non-latinate** vocabulary! (Source: online Houaiss dictionary)
- ❑ **Phi** (= Cramer's V, for 2x2 tables) is very **high** (**=.63**).
- ❑ Thus, the **relationship** between **stress** and **opening** must have been active in **mid V's** for **centuries**.

A Pre-stressed Mid V Harmony Bias?

- ❑ In *both corpora*, *pre-stressed V's*:
 - ❑ If *high* or *low*, prefer *disharmonic openings*, i.e., H-L or LM & L-H;
 - ❑ If *mid*, prefer *harmonic*, i.e., the *same* or *lesser openings*, M-M or M-H (as in above).
- ❑ These *biases* are *significant*, overall and cell by cell.
- ❑ However, they are extremely *weak*: *Cramer's $V \approx .10$!*
- ❑ Thus:
 - ❑ *Harmony* is *weak lexically*;
 - ❑ So, *much room* is left for it in *allophony* and *allomorphy*.
- ❑ Can *dynamics* explain such a *layer interaction*?

Open Stressed V Bias: Stress Position or Syllable Type?

- ❑ Is there such a rule as “**dactylic lowering**” (Wetzels 1992)?
- ❑ **Maybe:** in LAEL, the **association** between mid V **opening** and **stress position** is moderate in word **types**: **Cramer's $V = .22$** ;
- ❑ However, it is nearly **negligible** in word **tokens**: **$V = .10$** ;
- ❑ On the other hand, in the same corpus, the association between mid V **opening** and **syllable type** is much **stronger** in word **types**: **$V = .39$** ;
- ❑ And gets **strengthened** in word **tokens**: **$V = .48$** .



NB: Overall proportions remain even **if nasals** are **discounted**.

Mid V Opening, Stress Position and Syllable Type in Oral Mid V's

- As just seen, **opening** is associated to both **stress** position and **syllable** type.
- Recall that the **contrast** is neutralized by **nasalization**.
- For Lael **oral mid V's**, a **log linear model** fitted to an **opening x stress position x syllable type** contingency table yields **significance** for all **3 factors** and their **interactions**.
- Note the **strength** of the 3 **interactions**.

Best Log Linear Model: Lael Types			
	Degrs.of	Prt.Ass.	p Prt.Ass.
Stress	2	12922.89	0.00
Stress-SylType	2	1393.59	0.00
Opening-Stress	2	1148.86	0.00
Opening-Syltype	1	1128.16	0.00
Opening	1	146.56	0.00
Syl Type	1	112.21	0.00

Best Log Linear Model: Lael Tokens			
	Degrs.of	Prt.Ass.	Prt.Ass.
Stress	2	316599.1	0.00
Opening-Syltype	1	214359.0	0.00
Stress-SylType	2	85319.0	0.00
Opening-Stress	2	70479.4	0.00
Syl Type	1	24287.7	0.00
Opening	1	7386.9	0.00

The Default Opening for Mid Vowels

- Under *penultimate* or *final* stress, *Mid V's* tend to:

- Open* in *open* syllables;
- Close* in *closed* syllables.

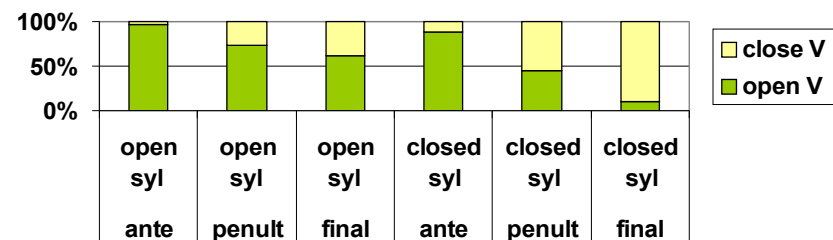
- The majority of *stressed syllables* is *open*.

- Open* is thus the *default* value for *stressed mid V's*.

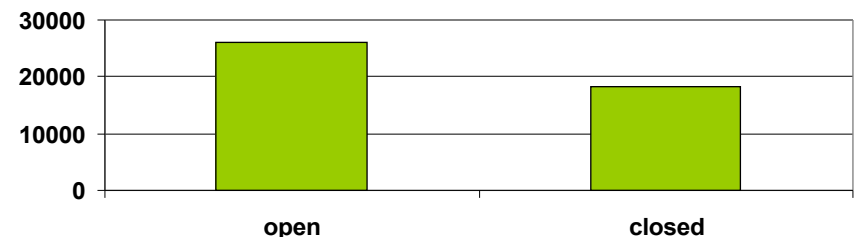
- Therefore, under *antepenultimate* stress, as in other “*elsewhere*” contexts, *oral mid V's* just tend to *default*.

- Research agenda:* Why prefer *open* in *open* syllables?

Stress x Syl Type x Opening: Lael Types



Open and Closed Stressed Syllables: Lael Types



Conclusions

- ❑ All **4 layers** of BP opening/closing phenomena seem to have a **life of their own**;
- ❑ Yet, they are **similar** in:
 - ❑ Popping up at **different scales**;
 - ❑ Evolving by **bursts and spurts**;
 - ❑ Weakly **constraining one another**.
- ❑ This looks like the behavior of **dynamical systems**;
- ❑ So please, dynamics experts, help find **order** in this **chaos**!

References

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