

Opacity in European Portuguese: an OT-CC account

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Purposes of this paper:

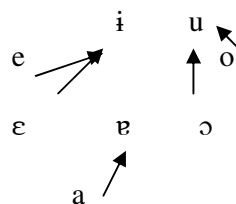
- propose an account of a European Portuguese (EP) opacity effect in the framework of Candidate Chains Theory (McCarthy, 2007);
- show that the Candidate Chains Theory (OT-CC) is able to account for a type of multiple interaction not accounted for by Comparative Markedness (McCarthy, 2003).

1. EP centralization and palatalization

In EP, opacity arises from a counter-feeding interaction between /e/ centralization and /s,z/ palatalization. **Centralization** affects the vowel /e/ when followed by post-alveolar and palatal consonants or by the palatal glide, changing it to [ɐ], a back, mid, un-rounded vowel.

fecho [fɛʃu] ‘zipper’	mosteiro [muʃtɛjru] ‘monastery’
cereja [sɨɾɛʒɐ] ‘cherry’	frei [frɛj] ‘priest’
telha [tɛʎɐ] ‘tile’	azeite [ɛʒɛjtɨ] ‘olive oil’

The Portuguese vowel system contrasts seven vowels: /i,e,ɛ,a,ɔ,o,u/. The vowel [ɐ] is not considered an underlying segment in standard analyses. It is in complementary distribution with [e] before palatals (in stressed positions) and with [a] in unstressed positions ([ˈpartu] “(I) depart” [pɐrtir] “to depart”). Unstressed vowels are generally reduced to less sonorous counterparts, as shown below (from Vigário, 2003, p.68).



Palatalization applies to the fricatives /s,z/ in medial and final codas, yielding the post-alveolar fricatives [ʃ,ʒ]. It is a process of positional neutralization (see contrast in b).

a. pasto	[paʃtu] ‘pasture’	paz	[paʃ] ‘peace’
Lisboa	[liʒboɐ] ‘Lisbon’	Islão	[iʒlɐw̃] ‘Islam’

b. chá	[ʃa] ‘tea’	Sá	[sa] ‘family name’
acha	[aʃɐ] ‘s/he finds’	assa	[asɐ] ‘s/he roasts’
haja	[aʒɐ] ‘there may be’	asa	[azɐ] ‘wing’

2. Counter-feeding

The effects of counter-feeding interaction are shown by forms like

incesto [eʃ]/ *[ɐʃ]	‘incest’	vespa [eʃ]/ *[ɐʃ]	‘wasp’
mesmo [eʒ]/ *[ɐʒ]	‘same’	lesma [eʒ]/ *[ɐʒ]	‘snail’

In the literature on EP, the non-interaction of the two processes is not explained by counter-feeding ordering: for Mateus and d’Andrade (2000), the two processes are placed in the post-lexicon, while Vigário (2003) claims that centralization is lexical and suggests that palatalization may be lexical too (Vigário, 2003, p.80). However, the evidence put forward in Vigário (2003) and Mateus and d’Andrade (2000) indicates, in our opinion, that palatalization has clearly post-lexical character, since it is bleeded by rhotacization across word boundaries: *maus amigos* [máwzəmígu] “bad friends”, *duas almas* [dúəzalmə] “two souls” (Mateus e d’Andrade, 2000) while centralization is lexical.

3. Productivity of the phenomena

This case of opacity cannot be handled by allomorph listing, since both centralization and palatalization are productive processes and interact non-opaquely with other processes within EP grammar. Palatalization is bleeded by consonantal sandhi, thus it could not have been lexicalized. As concerns centralization, it is general and applies also across morpheme-boundaries, as in *deificar* ‘(to)de-ify’, *uropeizar* ‘(to) European-ize’ and *reiterar* ‘(to) re-iterate’ (from Vigário, 2003, p.81), although it does not apply across word boundaries. According to Vigário (p.368, n.106), it does not seem to refer to morphological information.¹ Furthermore, centralization is also fed by a gliding process applying to word final VN sequences (Mateus and d’Andrade, p.133), e.g. *ninguém* [nĩŋvẽ] ‘nobody’, *homem* [ɔmẽ] ‘man’. Fikkert and Freitas (2006, p.97) observed from language acquisition data that Portuguese children distinguish between underlying /e/ and underlying /a/, i.e., they treat differently [ɐ]s derived from /a/ than [ɐ]s derived from /e/, showing that the change operated by centralization has not been incorporated into the lexical representation of words.

4. Classical OT constraints and ranking

The above description of centralization shows that in EP:

- (a) a front mid vowel is prohibited when followed by palatal segments;
- (b) this requirement is enforced by backing the vowel to [ɐ];
- (c) otherwise, the vowel [ɐ] is prohibited.

These generalizations are accounted for by the following constraints and the constraint ranking below.

*eʃ - assign a violation mark to a vowel [e] before a palatal segment²

*ɐ - assign a violation mark to a vowel [ɐ]

Ident[back] - a change in the value for the feature [back] is forbidden

Ranking: *eʃ >> *ɐ >> Ident[back]

¹ There are, however, some lexical exceptions (Vigário, 2003, p.82).

² A similar constraint is proposed in Ito and Mester (1995), a markedness constraint that prohibits palatal or palatalized segments before /e/. Ito and Mester (2006) revise this analysis, claiming that the prohibition results from a systemic markedness constraint.

(4)

/fejo/	*eɟ	*ɸ	Ident _[back]
→ a.[fɸju]		1	1
b.[feju]	W ₁	L	L

The description of palatalization leads to the following generalizations:

- (a) an alveolar fricative is prohibited in syllable coda;
- (b) this requirement is enforced by changing the place of the fricative, from [+ant] to [-ant].

This suggests the following constraints and their respective ranking:

- *[+ant]_σ - an [+anterior] obstruent in the end of the syllable is forbidden (according to Lee, 2002)
- Ident[ant] – a change in value for the feature [anterior] is forbidden

Ranking for EP: ***[+ant]_σ >> Ident[ant]**

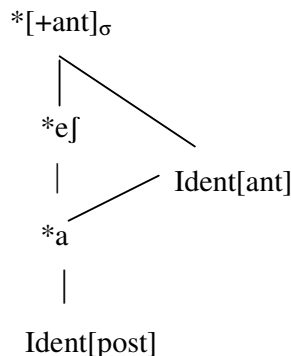
(5)

/pasto/	*[+ant] _σ	Ident _[ant]
→ a.[paɟtu]		1
b.[pastu]	W ₁	L

We know that no coda fricative is prevented from palatalizing when this palatalization creates an offending [eɟ] sequence. Thus, we consider that *[+ant]_σ is ranked above *eɟ. This entails the ranking *[+ant]_σ >> *eɟ >> *ɸ >> Ident[back]. Ident[ant] cannot be fully ranked, but we know that it lies below *[+ant]_σ and that it should not be dominated by *ɸ, because else a word like *fecho* would be fixed to [fesu] and not to [fɸju] .

Thus the constraints are ranked as shown below:

(6)



Classical OT fails to explain the centralization/palatalization interaction

(7)

/vespa /	*[+ant] _σ	*eʃ	Ident _[ant]	*ɐ	Ident _[back]
→ a.[veʃpɐ]		1	1		
b.[vespɐ]	W ₁	L	L		
⊗ c.[vɐʃpɐ]		L	1	W ₁	W ₁

5. The OT-CC analysis

In OT-CC (McCarthy's 2007) candidates are chains of derivational stages from input to output and special constraints on the sequence of faithfulness violations in a chain (PREC(edence) constraints) explain opacity. Chains have to fulfill well-formedness requirements before being submitted to EVAL proper, which are:

- a. the first member of the chain must be fully faithful to the input;
- b. each successive element of a chain must be gradually different from the member before (later members of the chain accumulate all the faithfulness violations of foregoing members);
- c. each member of a chain must be harmonically improving on the member before (this harmonic improvement is evaluated on a language-specific basis, considering the classic OT hierarchy of the language).

Considering the constraints proposed before, valid chains from input /vespa/ are
(8)

- a.< vespa >
- b.< vespa, veʃpa>
- c.<vespa, veʃpa, vɐʃpa>

Each stage is harmonically improving over the preceding candidate, since

- I. [veʃpa] improves over [vespa] because of the constraint *[+ant]_σ, that dominates the constraints *eʃ and Ident_[+ant]; and
- II. [vɐʃpa] improves over [veʃpa] because of the *eʃ that dominates *ɐ.

In a counter-feeding process interaction, process B counter-feeds process A. Thus, in opaque outputs only process B applies. Process A is blocked - since the necessary conditions for its application are not met (but the reason why is no longer valid after process B has applied). In OT -CC, counterfeeding opacity is explained by a special constraint that determines the order of the faithfulness violations in a chain. This PREC constraint says that a violation of **B** has to be preceded by a violation of **A**.

Chains with their respective LumSeqs (*Localized Unfaithful Mapping Sequences*):

(9)

- | | |
|-----------------------|---|
| < vespa > | < > |
| < vespa, veʃpa> | < Ident _[+ant] @3> |
| <vespa, veʃpa, vɐʃpa> | < Ident _[+ant] @3, Ident _[back] @2> |

PREC_(Ident_[back], Ident_[+ant]) states that a violation of the faithfulness constraint against palatalization **has to be preceded, and not followed**, by a violation of the faithfulness against centralization, i.e. it disfavors centralization after palatalization.

In order to rule out the candidate **c**, $\text{PREC}_{(\text{Ident}[\text{back}], \text{Ident}[\text{+ant}])}$ has to be ranked above $*\text{e}\text{f}$. According to McCarthy (2007, p.99), faithfulness constraint B always dominates $\text{Prec}(A,B)$, otherwise, PREC could determine if B was violated or not. This implies the ranking $\text{Ident}[\text{+ant}] \gg \text{Prec}_{(\text{Ident}[\text{back}], \text{Ident}[\text{+ant}])} \gg *\text{e}\text{f}$.

Constraint $\text{Prec}_{(\text{Ident}[\text{back}], \text{Ident}[\text{+ant}])}$ chooses the shorter chain, **a**, over the longer chain **b**.

(10)

/vespa/	*[+ant] _σ	Ident _[+ant]	Prec _(Ident[back], Ident[+ant])	*eɸ	*ɐ	Ident _[back]
a. vespa	W ₁	L	L	L		
→b. vespa, veɸpa {Ident _[+ant] }		1	1	1		
c. vespa, veɸpa, vɐɸpa {Ident _[+ant] , Ident _[back] }		1	W ₂	L	W ₁	W ₁

The evaluation proper does not consider the entire chains but just the output. Non-output forms are not evaluated by EVAL. These are only relevant insofar it comes to determine which chains are the valid ones, and this is done in GEN, before EVAL properly applies.

The box in the *tableau* above shows that PREC is violated by both the opaque and the transparent candidate, but the winner violates it only once.

This analysis accounts for the non-application of centralization to contexts derived by palatalization. McCarthy (2007) remarks that OTCC has troubles to account for opaque interactions where allophony is involved, as in the example [sakatoge] from Tokyo Japanese from Ito and Mester (2003). This, however, applies to cases where the masking process is allophonic. Since in our example the opaque process is allophonic but the masking process is neutralizing, it seems that the Richness of the Base problem is not at issue here.

6. Multiple process interaction

As has been mentioned above, there is another process that creates the context for centralization which, contrary to the palatalization, feeds centralization.

(11)

ninguém [nĩgẽ̃] nobody
 homem [õmẽ̃] man
 porém [purẽ̃] however
 sem [sẽ̃] without

Mateus and d'Andrade (2000, p.133) consider that the glide is inserted into an underlying VN sequence, where N is a floating nasal autosegment. The glide is introduced after the spreading of nasality and it assumes the same V-place as the preceding vowel (e.g. *prendem* *prend* + *e* + [+nasal] → *prẽdẽ̃* → *prẽdẽ̃j* '(they) catch').³

³ This is a provisional analysis. Since there is another process of (postlexical) glide insertion, which counterfeeds centralization, /leeN/ → lejẽ̃ → *lẽjẽ̃ '(they) read' we would not be able to explain both processes with chains (as pointed out in McCarthy, 2007, p. 120-125). This issue will not be discussed here. It suffices to say that the issue of the exact nature of the process is not settled in EP literature. For instance, Vigário (2003, p. 367, n.102) suggests that the underlying nasal is an underspecified non-syllabic segment, which may surface as a nasal glide

The presence of this process leads to a complex, multiple interaction, that can be characterized in the following way: feeding process > opaque process > counterfeeding process.

This is a type of interaction that cannot possibly be accounted for in the framework of Comparative Markedness (CM), the reason being that the two processes - the feeding glide insertion and the counterfeeding palatalization – yield the same markedness violation.

7. Comparative Markedness fails

In the CM view of opacity, markedness violations present in the input (“old” violations) are evaluated differently from markedness violations created through input-output mapping (“new” violations). The constraints of markedness can see if a violation was there already in the input (through the completely faithful candidate, CFC) or if it only appears in the output candidate.

This theory accounts for counterfeeding opacity by the ranking scheme: ${}_O M \gg F \gg {}_N M$. In EP, the markedness constraint $*ej$ is split into two constraints: ${}_O *ej$ and ${}_N *ej$. The mapping $/fejo/ \rightarrow [fɛju]$ is achieved if ${}_O *ej$ dominates the $Ident_{[back]}$ faithfulness constraint. The $vespɛ/ \rightarrow [vɛʃpɛ]$ mapping is achieved if ${}_N *ej$ is dominated by $Ident_{[back]}$. This ranking, ${}_O *ej \gg Ident_{[back]} \gg {}_N *ej$, rules out the hypothetical mapping $/vespɛ/ \rightarrow [vɛʃpɛ]$.

(12)

/vespa/	*[+ant] _σ	${}_O *ej$	$Ident_{[ant]}$	${}_N *ej$	$Ident_{[back]}$	${}_N *ej$
→ a.[vɛʃpa]			1			1
b.[vɛʃpa]			1	W_1	W_1	L
c.[vespa]	W_1		L			L
CFC d.[vespa]	W_1		L			L

The CM ranking scheme $OldMarkedness \gg Faithfulness \gg NewMarkedness$ predicts that no new marked structure, violating the $NewMarkedness$ constraint, will be able to defeat the dominating F constraint. If $Ident_{[back]} \gg {}_N *ej$, then no newly created sequence of [...ej...] should be subjected to centralization. This is, however, exactly what happens with nasal glide insertion.

Further constraints⁴:

$*\tilde{v}]_{\omega}$ - assign a violation mark to a single nasal vowel at the end of the word

DEPV - assign a violation mark to a vowel that has no input correspondent

in word final position, that is, in her interpretation, the glide is not inserted but derived from the underlying nasal segment. This is orthogonal to our argument here, since CM would fail on any of the interpretations of the process.

⁴ No constraints will be provided for nasalization and nasal deletion. There are OT analyzes on these aspects of Portuguese phonology (Bisol, 2007) but the issue has several complexities that cannot be discussed here. We also do not discuss the ranking of the added constraints in relation to the former constraints, therefore a double bar indicates on the *tableau* that the ranking is not determined.

(13)

/ɔmeN/	* \tilde{v}] _ω	DEPV	N* \tilde{e}	Ident _[back]	N*e] _f
→ a.[ɔm \tilde{e}]		1	1	1	
b.[ɔm \tilde{e}]		1	L	L	W ₁
c.[ɔm \tilde{e}]	W ₁	L	L	L	L

The ranking Ident_[back]>> N*e]_f will not let [ɔm \tilde{e}] be the winner over [ɔm \tilde{e}].

If we could understand that this segment is not derived, that is, that the sequence [\tilde{e}] is underlying, this could help us explain away this counterexample to the CM analysis. There would be no new markedness violation of *e]_f feeding centralization. For instance, we could assume an interpretation similar to that suggested in Vigário (2003) according to which the final nasal segment is in fact an underlying nasal glide. This does not help us much, however, because we are still committed to some kind of derivation or we are obliged to postulate different representations for word internal and word final nasal vowels. This is because not every vowel e + [+nasal] surfaces as a diphthong. For example, words like *centro* ‘centre’ and *embarcação* ‘ship’ have [\tilde{e}] and not [\tilde{e}]. There is no support for this in Portuguese phonology.

In sum, there seems to be no way to explain why the change does apply to the environments newly created by the feeding process and at the same time does not apply to the forms created by the counterfeeding process.

8. OT-CC accounts for this issue

What the two processes - the feeding and the counterfeeding one - have in common is the creation of the same markedness violations, i.e. violations of *e]_f.

They, however, do not share the same faithfulness violations.

N → \tilde{j} violation of DEP

s → j violation of Ident_[ant]

Thus, OTCC could be able to account for this interaction of processes.

Consider the two valid chains below:

(13)

<ɔmeN, ɔm \tilde{e} , ɔm \tilde{e} , ɔm \tilde{e} >

<ɔmeN, ɔm \tilde{e} , ɔm \tilde{e} >

Since **PREC**(Ident_[back], Ident_[+ant]) says nothing about the ordering of the faithfulness violations in the chains above, it will not rule out chain **a** in favor of **b**. This is where OT-CC fares better than CM because of its reliance on faithfulness rather than markedness to explain opacity.

(14)

/ɔmeN/	* \tilde{v}] _ω	DEPV	Ident _[+ant]	Prec _(Ident_[back], Ident_[+ant])	*e] _f	N* ɸ	Ident _[back]	N*e] _f
→ a.[ɔmẽ̃]		1				1	1	
b.[ɔmẽ̃]		1			W ₁	L	L	W ₁
c.[ɔmẽ̃]	W ₁	L				L	L	

9. Conclusion

Our analysis accounts for EP counterfeeding opacity by postulating a PREC constraint which militates against centralization applying after palatalization in a chain. In this approach it is possible to explain the multiple interaction of glide insertion > centralization > palatalization because the faithfulness violations are not the same for glide insertion (DEP) and palatalization (IDENT). McCarthy (2007) says that OTCC is not able to handle cases of rule sandwiching; for example, when a rule A is counterfed by B but is fed by another rule P. If process B and process P imply the same faithfulness violation of **B**, then PREC would predict that P cannot feed A. What our analysis above has shown is that OT-CC fares better than the CM **when the two rules P and B do not involve the same faithfulness violations** because of its reliance on faithfulness rather than markedness to explain opacity.

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