

Portuguese Vowel Harmony: A Comparative Analysis and the Superiority of Autosegmental Representations

Both major branches of Portuguese, European and Brazilian (EP and BP henceforth), exhibit what is often called root vowel (RV) alternation in certain verb stems with certain inflectional affixes. Various authors have described the phenomenon within varying frameworks.

In 1974, Harris asserts that the phenomenon should be thought of as evidence for Kiparsky's (1973) 'elsewhere condition' – a specific definition of disjunctively ordered processes in phonology (he is favoring this approach to such phenomena over an alternative proposed by Chomsky and Halle in 1968's SPE).

In Maria Galvão's 1993 master's thesis, she provides a review of the linear analyses of this phenomenon as given by Harris (1974), Redenbarger (1981) and Mateus (1982). Galvão then goes on to reanalyze the problem using feature geometry.

In Wetzels' 1995 article in *Phonology*, he asserts that the detailed knowledge we possess in this area of BP phonology characterizes the phenomenon as an excellent test case for evaluating theoretical innovations. (281) The innovation which he proposes to put to the test is specifically the adequacy of describing vowel height in terms of an independent aperture node, linked to the vocalic tier (283) which does away with height and ATR features, replacing them with a system of [+/- open] tiers (as proposed by Clements (1991)). By the publication of Mateus and D'Andrade (2000) description of the Phonology of Portuguese, a feature geometry approach to the issue – specifically utilizing the stability of autosegments to motivate the linking of the two processes at question – seems to have become accepted.

After presenting relevant data, this squib will review the linear analyses proposed by Harris (1976) and Redenbarger (1981), then compare those of Galvão (1993) and Wetzels (1995) with an aim to show how

the autosegmental representations of the latter two provide superior explanatory power within the general theory of descriptive phonology.

Background

Portuguese verbs can be placed into three classes (referred to as conjugations) which are characterized by their theme vowel (TV). Each of these conjugations defines an inflectional paradigm.

Portuguese contrasts seven oral vowels [i e ε a o ɔ u] in stressed position – this contrast is reduced to five in pre-stressed environments at the cost of the lower mid-vowels (which neutralize with [e o]), and is further reduced to three [i a u] word-finally.

As stress can affect the surface qualities of vowels, it is important to keep in mind that a lexical stress assignment rule of Portuguese will apply to the penultimate vowel of a word being derived. Words with ante penultimate stress can be found in Portuguese – these are assumed to be cases of unpredictable lexical stress marking.

The Data

The underlying morphemic structure of the Portuguese verb is given in (1)¹. The verb is formed from a root morpheme, to which a theme vowel (TV) is added to form a stem. A tense/mood/aspect morpheme (which may be null) follows the TV, and a person/number morpheme is added finally. An inflectional rule of truncation will delete the first of two vowels in a series within the verb, and we note that the vowel in the root morpheme may harmonize in height to the theme vowel.

$$1) \text{ Moremos} \leftarrow [_{\text{Verb}} [_{\text{Stem}} [_{\text{Root}} \text{mor}] + [_{\text{TV}} \text{a}]] + [_{\text{Tense/Mood/Aspect}} \text{e}] + [_{\text{Person/Number}} \text{mos}]]$$

Below (table 1) some verbal paradigms are given to illustrate the alternation under discussion. The acute accent over a vowel represents stress. Note the root vowel (RV) alternation within the verb stem.

1 Reproduced from Harris (1974).

	1 st conjugation (<i>a</i> -themes) <i>morar</i> 'reside'		2 nd conjugation (<i>e</i> -themes) <i>mover</i> 'move'		3 rd conjugation (<i>i</i> -themes) <i>servir</i> 'serve'	
	Present Indicative					
	Sing.	Plural	Sing.	Plural	Sing.	Plural
1 st per.	m[ó]ro	m[o]rámos	m[ó]vo	m[o]vémos	s[í]rvo	s[e]rvímos
2 nd per.	m[ó]ras	m[o]ráis	m[ó]ves	m[o]véis	s[é]rves	s[e]rvís
3 rd per.	m[ó]ra	m[ó]ram	m[ó]ve	m[ó]vem	s[é]rve	s[é]rvem
	Present Subjunctive					
1 st per.	m[ó]re	m[o]rémos	m[ó]va	m[o]vámos	s[í]rva	s[i]rvámos
2 nd per.	m[ó]res	m[o]réis	m[ó]vas	m[o]váis	s[í]rvas	s[i]rváis
3 rd per.	m[ó]re	m[ó]rem	m[ó]va	m[o]vam	s[í]rva	s[í]rvam
	Imperative					
	m[ó]ra	m[o]rái	m[ó]ve	m[o]véis	s[é]rve	s[e]rví

Table 1: Root Vowel qualities in alternating stems, from Harris (1974:62) and reproduced in Wetzels (1995)

fugir 'to flee'					
Present Indicative		Present Subjunctive		Imperative	
f[ú]jo	f[u]gímos	f[ú]ja	f[u]jámos		
f[ó]ges	f[u]gís	f[ú]jas	f[u]jáis	f[ó]ge	f[u]gís
f[ó]ge	f[ó]gem	f[ú]ja	f[ú]jam		

Table 2: RV data for fugir 'to flee,' from Harris (1974)

The descriptive goal is to give an account of the the processes at work here (RV harmony to the TV, neutralization in unstressed syllables, vowel deletion and possibly a lowering rule) such that descriptive and explanatory adequacy conditions are fulfilled.

Analysis

This portion of the paper will briefly review the linear analyses proposed by Harris (1976) and Redenbarger (1981), then highlight the superiority of the autosegmental representations given by Galvão (1993), and Wetzels (1995).

Overview

Harris' early analysis failed to make adequate and motivated choices as to the input to his rules – his analysis suffers as a result. Because he takes the UR of each RV to be equivalent in quality to the surface realization of some related noun, he ends up with rules that employ angled brackets and lexical exception features. While he is able to describe the data using such a scheme, later analyses provided explanatory adequacy which his framework lacked.

Redenbarger improved upon Harris by collapsing the rules of Truncation and Harmony, which are indeed linked, but failed to note the causality – perhaps due to the lack of theoretical apparatus at the time.

Galvão and Wetzels both noted the fact that key to providing an illuminating account of this problem is to recognize the co-occurrence and co-dependence of the processes of Harmony and Truncation. While Redenbarger noted the overlap of the structural descriptions of the rules, Galvão and Wetzels motivated the causal relation using the stability of autosegments.

Harris (1976) and Redenbarger (1981)

Harris is chiefly concerned with demonstrating that these alternations conform to the formal definition given by Kiparsky (1973) for his 'elsewhere condition – an analysis of phonological rules that must be disjunctively ordered. Harris intends to link Harmony and a rule of Vowel Lowering in such a way that Lowering can only apply if Harmony does not (despite the fact that the structural description given for Lowering is a subset of the one given for Harmony – Harris will employ the use of an exception feature to block Harmony and allow Lowering). We will see in later sections of this paper that such complication is unnecessary given more motivated choices about URs.

Harris depends on related nouns to provide him with information regarding URs – a decision which requires him to posit considerable complexity in his rule scheme. Because some RVs may start out as higher (closed) mid vowels Harris must use his rule of Lowering to insure correct outputs in non-harmonizing forms. He attempts several orderings of this rule with respect to other processes, and finally arrives at a rather complex description of the process which relies on angled brackets and

disjunctive ordering (the 'elsewhere condition') to generate correct outputs. Harris is forced into his complex analysis because he must use Lowering to affect some verbs (those which he has decided to have underlying closed mid-vowels /e/ /o/ based on related nouns) and he must order this rule in order for it not to spoil the outputs of Harmony.

Harris posits five rules to describe the alternation at issue: Harmony, Stress, Neutralization, Truncation and Lowering.

We should note that his rule of stress assignment and his rule of neutralization are uncontroversial and effect that which is mentioned above (cf. Background), that stress is assigned to the penultimate vowel, and that unstressed open mid-vowels /ɛ/, /ɔ/ neutralize to their closed counterparts /e/, /o/.

Harris' rule of Truncation simply deletes the first of a series of two vowels within a verb such that $[[\text{pass} + \text{a}]_{\text{st}} + \text{o}]_{\text{vb}^2}$ may surface as *passo* [pásu]. This formulation of Truncation must apply before stress assignment (stress assigned to the penultimate vowel), in order for stress to be assigned correctly.

Harris' Harmony and Lowering are given in (2).

2) a. Harmony

V	→	[-low]	/	___ C ₀	V] _{Stem}
[α round]		[<+high>]			[-low]
[α back]					[<+high>]

b. Lowering

V	→	[+low]	/	___ C ₀]Root
[+stress]					
[{-high/+E}]					

These rules employ angled brackets and a lexical feature [E], which Harris describes as a mnemonic for 'Exceptional' that is assigned to the minority class of third conjugation roots with underlying high vowels which are unexpectedly lowered in certain forms. Harris is forced to propose this exceptional class in order to properly deal with the *fugir* class, which Harris analyses as

unexpectedly undergoing lowering, despite their [+high] condition. Later analyses disagree with Harris as to the UR of the RV in this class.

Harris' final descriptions of the rules at play do provide descriptive adequacy in deriving the correct forms – nonetheless, we may consider his analysis somewhat unilluminating in that he employs alpha notation, angled brackets and must posit an exceptional class to account for all the data.

Redenbarger, however, recognizes a key fact about Portuguese, that there are essentially five underlying vowel qualities available for the RV of the Portuguese verb. He posits a rule of Verbal Stem Laxing, which causes all root vowels to be [-tense]. This applies early in the inflectional derivation.

Redenbarger also recognizes the overlap of the structural descriptions of Harmony and Truncation, and so collapses them into one rule, given in (3) ([-constr ph] prevents the rule from applying to /a/). This crucial difference allows him to account for all three conjugations with a single rule. Nonetheless, Redenbarger failed to recognize the alternations in verbs like *fugir* (table 2, above) as a case of harmony. He assumes an underlying high vowel as the RV, and must derive the lowered forms exhibited as due to the phonetic effect of a redundant feature rule, that all [-tense] vowels must be output as [-high]. This rule applies late in the derivation.

3) Vowel Harmony/Truncation

... V	C ₀ +	V	+ V ...] _{Verb}
[-high]		[α high]	
[-constr ph]		[β tense]	
↓		↓	
[α high]		∅	
[β tense]			

In one sense, Redenbarger has improved the description of Portuguese over that given by Harris, in that he is able to account for all of three conjugational classes by one set of rules. However, he receives criticism from Wetzels (1995) in that his collapsed rule of Harmony/Truncation does not properly

delimit the causal relation of such an overlap – this criticism should perhaps be tempered by the fact that autosegmental representations of features had not yet been posited in phonological theory.

Galvão (1993) and Wetzels (1995)

Galvão and Wetzels both propose an autosegmental approach to these alternations. The chief difference between the two approaches lies in their formulation of URs. While both authors admit only five oral vowel qualities as URs for RVs in Portuguese, they differ as to their specifics.

Galvão utilizes the vowel feature geometry described in Odden (1991). She proposes that the Height node remains unspecified for mid vowels at the beginning of the inflectional derivation (her inventory is then /i E a O u/). This allows the Height node of the truncated TV to be associated with that of the RV (effecting harmony). In the case that the RV is not a mid vowel, height features are already specified so no reassociation occurs and the floating autosegments are cleaned up by the Stray Erasure principle.

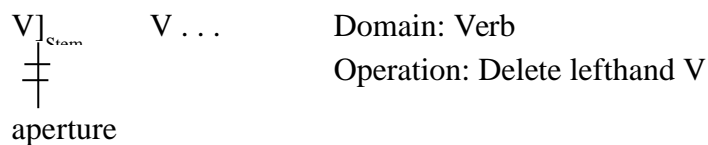
Wetzels inventory is essentially /i ε a ɔ u/. Regarding table 3 below, Wetzels notes that tonic oral vowels exhibit a seven-way contrast in nouns, while those in the corresponding verbs are predictably lower in the non harmonizing forms. He thusly assumes that the lower mid-vowels are URs for the mid RVs. He later formulates Vowel Lowering (VL) as a neutralization rule which applies at an early stratum of the lexical phonology of BP, namely that of deriving denominal verbs from a nominal root to which a TV is adjoined. VL will effect that any stressed mid-vowel in the verbal stem is passed to the inflectional rules as lower /ε/, /ɔ/.

Wetzels approach to Harmony and Truncation is quite similar to that of Galvão, invoking the delinking of the node which dominates height specification (in the geometry Wetzels uses, this is an aperture node that dominates [open] tiers). Wetzels delinks the aperture node of the TV at deletion and reassociates this with the RV. The Branch Pruning Convention is invoked to delink whatever association was present on the TV at the time that the Harmony rule applies. Wetzels Truncation and Harmony rules are reproduced below as (4) and (5).

Noun		Verb	
dem[ɔ̃]ra	'delay'	dem[ɔ̃]ra	'delays'
esn[ɔ̃]be	'snob'	esn[ɔ̃]ba	'is snobbish'
f[ɔ̃]rca	'force'	f[ɔ̃]rca	'forces'
esc[ɔ̃]va	'brush'	esc[ɔ̃]va	'brushes'
conv[ɛ̃]rsa	'conversation'	conv[ɛ̃]rsa	'talks'
s[ɛ̃]rvo	'servant'	s[ɛ̃]rve	'serves'
ap[ɛ̃]lo	'appeal'	ap[ɛ̃]la	'appeals'
inter[ɛ̃]sse	'interest'	inter[ɛ̃]ssa	'interests'

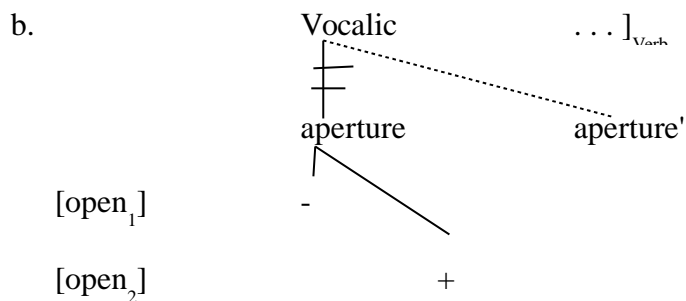
Table 3: Contrastive Mid vowels appear in Nouns, RVs are predictably lower in non harmonizing forms.

4) Truncation (vowel deletion with aperture stability)³



5) Vowel Harmony⁴

- a. Operation: Associate aperture'
- Direction: Right to left
- Target: [-open₁, +open₂]
- Branch pruning: Yes
- Domain: Verb



³ From Wetzels (1995).

⁴ Ibid.

Wetzels considers that this version of the rule in (5) is redundant, that the majority of these specifications may be omitted as they are predictable by the principles of autosegmental theory or phonological theory in general.

Nonetheless, we can see that the approach to Truncation and Harmony described in Wetzels and Galvão is improved over that of Harris and Redenbarger in that the co-occurrence and co-dependence of the two processes is explained by means of the stability of autosegments, a phenomenon first observed in studies of tone. Autosegmental theory is falsifiable in that only features dominated by a particular node of the geometry may be set free at deletion. We note that these alternations are indeed predicted by the theory in so far as all the various feature geometries that have been proposed do group vowel height features under a particular node.

Conclusion: Feature Geometries and Explanatory Power

Insofar as two rules or processes can be shown to be dependent on one another, a simplification of the description has been achieved. Furthermore, insofar as the varying phonological processes of all natural languages can be shown to be dependent upon a smaller set of rules, or insofar as we may justify a greater number of processes as variations of a smaller number of principles, a simplification (or increase in explanatory) power can be said to have been achieved.

Autosegmental tiers were first proposed in studies of tone, when it was observed that tones could exhibit assimilatory influence on neighboring segments, even when their segment had been deleted.

As further studies applied these sorts of models to other processes, it was found that autosegmental models were more adequate for all types of assimilatory processes.

These alternations provide evidence for accepting an extension of autosegmental representations to create feature geometries that determine the dependencies of vowel height features and by theoretical extension, all phonological features.

The analyses of Galvão and Wetzels describe these assimilations in a more illuminating way by demonstrating that the premise of autosegmental theory (the stability of autosegments) provides

explanatory elegance that cannot be captured by linear analyses. Redenbarger's analysis in particular provides an excellent test case, in that he makes motivated choices about URs which reflect the realities of the Portuguese phonological system but he lacks the theoretical framework to show how a deleted segment may be predicted to influence an adjacent segment.

In this sense, the use of feature geometries unifies and simplifies the theory of phonology that framework within which we build our descriptive statements.

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