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PARADIGMATIC CORRESPONDENCES IN THE BRAZILIAN PORTUGUESE VERBAL VOWEL SYSTEM*

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Abstract: In this paper, we reanalyse the alternation in the Brazilian Portuguese verbal system called verbal vowel harmony (VH), which applies to verb stems in the second and third conjugations (e.g., *bebér* ‘to drink’ > *bébo* ‘I drink’; *segír* ‘to follow’ > *sígo* ‘I follow’). We pose the following questions concerning VH: (i) Is it a synchronic process? (ii) Does it exhibit paradigmatic effects? and (iii) How can it be described in Optimality Theory? To answer question (i), we present a corpus of BP dictionarized verbs in the third person and results from empirical tests that evaluate acceptability/productivity in the conjugation of pseudo-verbs. Concerning question (ii), we show that a paradigmatic correspondence between verbal forms in BP accounts for misapplication patterns. Answering question (iii), we offer a description of the process in line with Transderivational Correspondence Theory (Benua 1997).

Keywords: vowel harmony, allomorphy, paradigms, morphophonology, Optimality Theory

1. Introduction

The main goal of this paper is to present a reanalysis of the Brazilian Portuguese (BP) verbal vowel system, particularly the alternations in second and third conjugation verbal roots.

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Brazilian Portuguese verbs may be grouped into three paradigms, depending on the theme vowel, that is, the stressed vowel which precedes the infinitive morpheme /r/. These vowels are *-a*, in verbs like *falár* ‘to speak’, *-e*, in verbs like *bebér* ‘to drink’, and *-i*, in verbs like *segír* ‘to follow’.¹ These theme vowels characterize the first, second and third verbal conjugations, respectively.

The alternation described here concerns only the second and third conjugations. In order to describe this alternation, some essential information about Brazilian Portuguese must be offered. First, in (1), the Brazilian Portuguese vowel system is presented.

(1) The BP vowel system

stressed position 7 contrasting vowels	pre-stressed position 5 contrasting vowels	post-stressed position 3 contrasting vowels
s/i/lo ‘silo’	m/i/rár ‘to look at’	júr/i/ ‘jury’
s/é/lo ‘seal’	m/u/rár ‘to enclose’	júr/o/ ‘I swear’
s/é/lo ‘I stamp’	m/o/rár ‘to live’	júr/a/ ‘s/he swears’
s/ú/co ‘juice’	p/e/gár ‘to take’	
s/ó/co ‘punch’	p/a/gár ‘to pay’	
s/ó/co ‘I punch’		
s/á/co ‘sack’		

Brazilian Portuguese has a seven-vowel system in stressed positions, reduced to five in pre-stressed and to three in post-stressed positions. Stress preferably falls on the penultimate syllable, though it may also be assigned to the antepenultimate or ultimate syllable, under special conditions.

Stress assignment in Portuguese verbs seems to follow morphological principles as well. As it can be seen in (2), stress generally falls on the root in the three persons of the singular and in the third person plural of the present indicative (e.g., *bébo*, *bébes*, *bébe*, *bébem*); in the other persons, it falls on the theme vowel (e.g., *bebémos*, *bebéis*). The present subjunctive follows the same pattern. The root allomorphy here described is interrelated with this stress assignment scheme.

The theme vowels *-e* and *-i* do not contribute to the formation of new verbs in BP. Nevertheless, the allomorphy in (2) is present in most verbs used in this language. For this reason, this phenomenon has been

¹ Verbs like *pór* ‘to put’ constitute a special category in Portuguese, being generally inflected as second conjugation verbs.

(2) Allomorphic roots in the Brazilian Portuguese verbal system²

	beb + e + r 'to drink'		mov + e + r 'to move'		seg + i + r 'to follow'		cobr + i + r 'to cover'	
	Indic.	Subj.	Indic.	Subj.	Indic.	Subj.	Indic.	Subj.
1sg	bébo	béba	móvo	móva	sígo	síga	cúbro	cúbra
2sg	bébes	bébas	móves	móvas	séges	sígas	cóbres	cúbras
3sg	bébe	béba	móve	móva	sége	síga	cóbrec	cúbra
1pl	bebémos	bebámos	movémos	movámos	segímos	sigámos	cobrímos	cubrámos
2pl	bebéis	bebáis	movéis	mováis	segís	sigáis	cobris	cubráis
3pl	bébem	bébam	móvem	móvam	ségem	sígam	cóbrem	cúbram

approached in several derivational analyses, such as Harris (1974); Mateus (1975); Lopez (1979); Redenbarger (1981); Quicoli (1990), and Wetzels (1991; 1992; 1995).

These analyses, with diverse theoretical particularities, work with three rules: vowel harmony (VH), vowel lowering (VL) and truncation of the theme vowel (VT).

The vowel harmony rule is characterized as a process of regressive assimilation that makes the final vowel of the verb root agree in height with the theme vowel. In the harmonized forms, the theme vowel fails to surface, as can be seen in (2), both in the first person singular indicative and in all forms of the subjunctive.

Lowering is the most general rule, as it applies to cases that do not undergo harmony. For this reason, it is ordered after harmony, as an effect of the Elsewhere Condition. It can be observed in (2) in the second and third person singular and in the third person plural of the indicative.

The problematic nature of VH feeds our main discussion while the processes of lowering and truncation, which derive from it, are also dealt with here.

In order to account for the restrictive traits of VH, the derivational studies had to limit the rule to an overly sophisticated morphophonological context: it is only applied when the trigger—the theme vowel—is in a hiatus position, with the first person indicative verbal suffix *-o*, or present subjunctive *-a*. Another condition is that the target of the rule, the last vowel in the root, is stressed.

Besides the complexity of this rule, another problem in the derivational analysis is related to the fact that it does not cover all the facts

² The verb structure in BP is as follows: root + theme vowel + mood/tense/aspect suffix + number/person suffix.

of the language: in (2), for instance, the subjunctive forms such as *sigá-mos*, *sigáis* undergo harmony, even though the roots of these forms are not stressed.

Considering the problems raised in this introduction, this study aims to find answers to the following nuclear questions:

- (3) Nuclear questions:
- (a) Is vowel harmony a synchronic process?
 - (b) Does this process exhibit paradigmatic effects?
 - (c) How can this verbal allomorphy be described within an optimality theoretic framework?

To answer question (a), a corpus search of BP dictionarized verbs as well as results from tests administered to informants with a schooling level from high school onwards, evaluating acceptability/productivity in pseudo-verbs, are presented. Concerning question (b), the existence of a paradigmatic correspondence between verbal forms in BP to account for misapplication patterns of VH is discussed. Trying to answer question (c), a description of the verbal system allomorphy in terms of Optimality Theory (OT), proposed by McCarthy–Prince (1993) and Prince–Smolensky (1993), as well as Transderivational Correspondence Theory (TCT), proposed by Benua (1997), is set forth.

Next, each one of these three aspects will be examined in more detail.

2. The synchronicity of the vowel harmony process in Brazilian Portuguese

Our first question concerns the status of the synchronicity of the vowel harmony process. Although we know that new verbs are not formed in the second and third conjugations, we aim to know if VH, as a process, is identified by native speakers.

In order to answer this question, we started by searching all the verb patterns in *Houaiss Electronic Dictionary*, version 1.0. We found 829 verbs, subdivided into several categories, which are summarized in Figure 1.

Figure 1 shows VH as a current process in BP in almost 90% of the dictionarized verbs. Moreover, more than half of the verbs to which VH does not apply are defective verbs. According to traditional grammars,

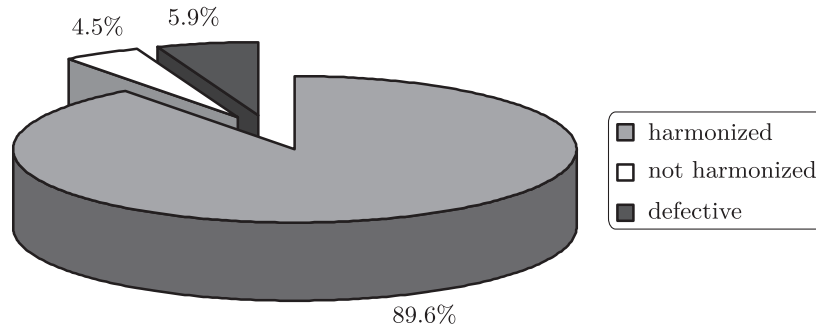


Fig. 1

VH in dictionarized verbs—1sg indicative

for some obscure reason, these verbs are not inflected in the first person singular of the present indicative.

Based on these data, we decided to verify if native speakers would follow the same pattern with new verbs. In order to see this, we designed two tests to be administered to informants with a schooling level from high school onwards.

(4) Tests

- (a) Test 1: 210 informants. 3 sets of exercises comprising 24 sentences each, in order to be filled in with 4 pseudo-verbs in 6 different categories of mood/tense/aspect, with 3 options of root mid vowel realization for each sentence.
- (b) Test 2: 60 informants. 12 sentences with inflected pseudo-verbs for the informants to decide the quality of the theme vowel, whether it is *-e* or *-i*.

All the pseudo-verbs proposed in the tests were created in view of the phonotactic environments of the real verbs in BP. Moreover, concerning the alternatives of Test 1, lower mid vowels were present only when the root vowel was not followed by a nasal consonant, since this sequence is prohibited in BP (e.g., **néndo*).

In Figure 2, we present the data of VH in the first person singular of the present indicative, in which the forms that surfaced with /e/ or /o/ in case of the theme vowel *-e*, and with /i/ or /u/, in case of the theme vowel *-i*, were considered harmonized.

These data show that, from a synchronic point of view, vowel harmony seems to be a barely productive process in BP, since its frequency is much lower than the frequency of the forms in which vowels do not harmonize.

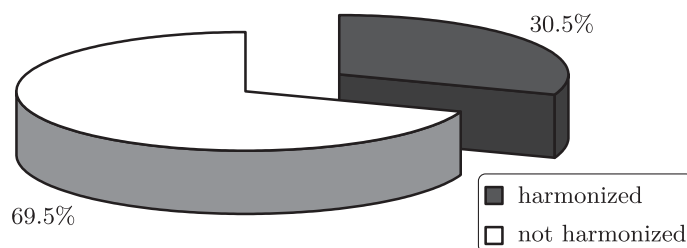


Fig. 2

VH in pseudo-verbs—1sg indicative

That being so, which were the vowels selected by the informants to realize these verbs?

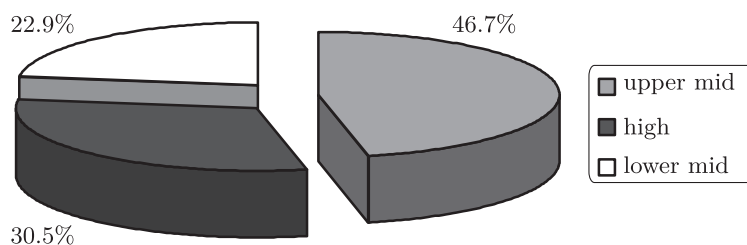


Fig. 3

Selected vowels—general frequency

As can be seen in Figure 3, considering the general frequency of occurrence in the indicative, the selection of vowels by the informants exhibits the following order of preference: upper mid vowels, high vowels, and lower mid vowels, regardless of the theme vowel (i.e., whether it is *-e* or *-i*).

This indistinct option for upper mid vowels leads us to question the hypothesis proposed in the literature that VH really exists in the second conjugation. We hypothesize, then, that these are not cases of harmony, but cases of input preservation instead. This input is, in principle, equal to the infinitive. Assuming this hypothesis, VH would be restricted to the verbs with *i*-theme. In this case, the harmony frequency found in our survey falls from 30.5% to 24%, reinforcing the idea of low productivity of the process.

On the other hand, even being slightly productive, harmony in the third conjugation was shown to be transparent by the results of the second test. Faced with inflected pseudo-verbs, the informants related the

vowels /i, u/, present in the root, to the theme vowel *-i* in almost 80% of the cases, both in the present indicative and in the present subjunctive. This suggests that VH, despite its low productivity in the language, is a transparent process for BP speakers.

3. Paradigmatic effects

The second question presented in the introduction concerns the paradigmatic status of the vowel harmony process.

Derivational analyses propose that the harmony rule, in this case, affects the verb forms of the present indicative and present subjunctive, without mentioning paradigms. They admit, however, a morphophonological motivation. In other words, they consider the suffixes of number/person and mood/tense/aspect, *-o* and *-a*, respectively, as part of the rule's trigger. Moreover, they argue that the theme vowel is deleted in order to avoid the hiatus that is formed when this vowel comes to be adjacent to such verbal suffixes.

However, it seems that stating that harmony only applies when one of these two suffixes follows the theme vowel (which might even have different functions) is stipulative and unnecessary. We believe that it is possible to make a larger generalization for the motivation of the phenomenon. Thus, we intend to maximally generalize vowel harmony, considering it to be a process of height agreement between the root vowel and the theme vowel. Peculiarities apart, this process is also found in the nominal system in BP, in which a high vowel variably spreads its height to the pre-tonic mid vowel (for instance, in words such as *menino* ~ *minino* 'boy', *corúja* ~ *curúja* 'owl'). For the verbs, however, according to Wetzels (1992; 1995), the unstressed vowel of the suffix is the trigger of height spreading, and the stressed vowel of the root is the target. For the author, the stress requirement prevents VH from taking the left-to-right direction, as it seems to be possible in similar assimilatory processes in other languages.

However, what interests us in the relation between harmony and stress is the fact that this may explain why vowel harmony does not apply to forms that apparently could undergo the process but do not.

Cases that are worthy of discussion are illustrated next in (5).

- (5) Application patterns of BP VH
- (a) Normal application
- seg + i + o → *sígo* —present indicative 1sg
 seg + i + a → *síga* —present subjunctive 1sg
- (b) Underapplication (not considering target stress)
- seg + i + (i)a → *segía* —past imperfect indicative 1sg
 seg + i + u → *segíu* —past perfect indicative 3sg
- (c) Overapplication (considering target stress)
- seg + i + a + mos → *sigámos* —present subjunctive 1pl
 seg + i + a + is → *sigáis* —present subjunctive 2pl

In (5a), the normal application of the process, which affects both present indicative and present subjunctive, is exemplified. In (5b), however, we illustrate our first problem, which consists of the fact that the process does not apply in an environment analogous to the environment found in normal application—past imperfect indicative. As was shown, if we assume Wetzels' proposal, characterizing the target as stressed, this problem does not exist, since these forms are cases in which the stress is not in the root. However, this solution, which avoids an underapplication pattern, leads to the second problem, illustrated in (5c): we cannot explain, through this analysis, why the process applies to forms in which the stress is not in the root, as in the first and second persons singular of the present subjunctive (e.g., *sigámos*, *sigáis*), now producing an overapplication pattern.

The low productivity of this process and these misapplication patterns make us grow suspect of the categorical status of the rules proposed in the derivational analyses and think about the possibility that a paradigm is taking charge of the phenomenon.

In our test of transparency, we observed that the informants recognized VH, with very similar frequencies—around 80%—both in the present indicative and in the present subjunctive.

In addition, the results of our test of productivity showed, in spite of the variability found in the use of the root vowel, that the speakers followed a pattern in the use of the vowels that was more or less regular. In a large part of the cases, they chose the same vowel in both the indicative and the subjunctive verb forms (in 43% of the data).³

³ We believe that this percentage is not higher because of the considerable quantity of defective verbs in the first person singular present indicative of this language,

We assume, thus, the hypothesis of a paradigmatic relation in the BP verb system, specifically between the root of the first person present indicative and the present subjunctive. All the other verb tenses take the infinitive as the basic form, which, in our opinion, does not characterize a paradigmatic relation, once we assume through the theoretical model we have chosen that the infinitive is an ideal input form.⁴

More importantly, once we assume this paradigmatic relation, we are able to explain the vowel harmony process in a simpler way, without the necessity of arbitrary morphophonological expedients.⁵

Let us now examine this analysis in the framework of Optimality Theory, henceforth OT.

4. An optimality theoretic analysis

We assume *a priori*, without elaborating on the discussion at this moment, that OT is an adequate theory to treat phenomena of a phonological and/or morphophonological nature, considering aspects like descriptive economy, universality and uniformity of analysis.

In (6), the set of constraints used in our analysis is presented.

(6) Constraints used

- | | |
|---------------------|--|
| (a) Agree | The vowel in the verb root agrees in height with the theme vowel. |
| (b) Ident-IO | Every element in the input has a corresponding element in the output. (root) |
| (c) *ε, ɔ [-stress] | Lower mid vowels are not permitted in unstressed position. |
| (d) Lowering | The last vowel of a verb root is [+low]. ⁶ |

which causes some hesitation for the informants when they have to decide for the form of the pseudo-verbs. If we assume this argument, we can also explain why harmony in the third person is more significant in the subjunctive than in the indicative.

⁴ Even if we admit the Richness of the Base, concerning I/O relations.

⁵ Apart from similarities to the traditional grammar (in the sense of Priscianic verb formation), this approach is more restrictive, considering that it applies only between two forms of the present. Besides, several other cases of allomorphy in verb roots (e.g., *cáibo/cáiba* 'I fit'/'that I fit'; *odéio/odéie* 'I hate'/'that I hate') seem to confirm our hypothesis.

⁶ This constraint, in this formulation, does not create obstacles to the verbs with the vowel /a/ in the root, which are not allomorphic.

- (e) Truncation Theme vowels are truncated.
- (f) Stress-Root Verb roots are stressed.
- (g) Lowering&Trunc]_{theme} The last vowel of a verb root is [+low] and theme vowels are truncated, within the verb theme domain.
- (h) Stress-Root&Ident-IO]_{stem} Verb roots are stressed and every element in the input has a corresponding element in the output, within the verb stem domain.
- (i) Ident-OO The root in the derived verb has an identical correspondent in the base.

In this analysis, we are not concerned with a rigorous formulation of the constraints presented in (6), we simply tried to gather the ones which actually reflect the facts of the language.

Let us first analyse some exemplary cases, in order to understand the functioning of the grammar we propose here.

As we have stated, the first person singular present indicative selects the allomorph with a high vowel in the third conjugation and with an upper mid vowel in the second conjugation. In optimality theoretic terms, the Agree constraint competes with Ident-IO⁷ and causes the selection of the harmonized form, instead of the faithful candidate and the candidate with the lower mid vowel. This can be seen in (7) and (8).

- (7) Present indicative 1sg/*i*-theme verb

/seg + i + o/	Agree	Ident-IO
ségo	*!	
ségo	*!	*
↳ sígo		*

- (8) Present indicative 1sg/*e*-theme verb

/beb + e + o/	Agree	Ident-IO
↳ bébo		
bébo	*!	*
bíbo	*!	*

The Agree constraint, supported by Clements (2001), is used here to account for the similarity between a feature of the theme vowel, present in the input, and a feature of the root vowel, present in the output. We

⁷ Root identity in this case.

must observe, too, that our formulation of Agree does not refer to stress or any morphological peculiarity in the trigger of the process.

This constraint, however, is shown to be inoperative in the second conjugation verbs, since the harmonized vowel is also identical to the input vowel, Ident-IO alone being able to resolve the conflict. This is consistent with our previous claim that there seems to be no real harmony in the second conjugation.

The requirement, described in the literature, that the last vowel of Portuguese verb roots be [+low] is expressed by the Lowering constraint. This constraint has to be low ranked in Portuguese, or it would exclude the harmonized forms of the verb.⁸

However, a common property of the harmonized and the lowered forms is, as we stated before, theme vowel truncation. What accounts for this fact is the Truncation constraint, also very low ranked in the language, considering that all the other verb forms surface with the theme vowel.⁹

Hence, the outputs with lower mid vowel surface when two constraints are simultaneously violated by all the other candidates: Lowering and Truncation. This restrictiveness may be satisfied if we use the mechanism of local conjunction. In this approach, two constraints are combined into a higher ranked constraint which will be violated only if the candidate violates both of the constraints that compose it. We propose, therefore, in (9), the local conjunction of Lowering and Truncation within the verb theme domain.

(9) Present indicative 2sg

/beb + e + s/	Low&Trunc] _{theme}	Agree	Ident-IO	Low	Trunc
bébes	*!			*	*
bébes		*	*		*
bíbes	*!	*	*	*	*

In the derivational analysis proposed by Harris (1974), truncation is ordered before the stress rule, in order to guarantee that the stress falls on the penultimate syllable. But this ordering does not explain forms like *bebí*, with stress on the last syllable.

⁸ This constraint is similar to that used by Archangeli–Suzuki (1997).

⁹ This constraint is very likely to be in conflict with RealMorph, a constraint which requires that every morpheme present in the input has an output realization.

Therefore, unlike Harris, we argue that stress assignment in Portuguese verbs is not purely phonological, but has strong morphological conditioning. This is made evident by the fact that the stress falls on the last vowel of the verb root when the theme vowel is truncated, or on the theme vowel, when it surfaces.

In an OT approach, we can say that the Stress-Root constraint, which requires the stress to fall on the root, competes with another constraint which demands that the stress fall on the penultimate syllable of the word—the general pattern in Portuguese.¹⁰

So, in order to guarantee that the unstressed verb forms do not undergo vowel harmony, the Stress-Root constraint combines, through local conjunction, with IO-ID, within the stem domain, ensuring an upper mid vowel output.¹¹ This can be seen in (10).

(10) Present indicative 1pl

/seg + i + mos/	*ε, ɔ [-stress]	Stress-Root & Ident-IO] _{stem}	Agree	Ident-IO	Stress-Root
segímos			*		*
segímos	*!		*	*	
sigímos		*!		*	*

The tableau in (10) shows this complex constraint and also another constraint, high ranked in BP, which prohibits lower mid vowels in unstressed positions.

The last case we want to illustrate can be described as an overapplication of vowel harmony. Let us observe (11).

In this case, the chosen form does not correspond to the real output of the language, since here VH applies even in an unstressed root.

The solution to this impasse, in a parallel OT analysis, can be found in a paradigmatic approach, as in Transderivational Correspondence Theory, proposed by Benua (1997).

¹⁰ The Stress-Root constraint could be converted into AlignStem/PWord-L (Peperkamp 1997, 70), since prosodic words have to be stressed. But, considering that we are working with two-level well-formedness constraints, we prefer not to use Correspondence Theory in this work.

¹¹ We are at this moment establishing a distinction between *root* and *stem*, the first being the domain of the constraint, and the second, the domain of the local conjunction. This distinction considers that this local conjunction could also affect prefixed verbs, with no loss to the analysis.

(11) Present subjunctive 1pl—preliminary version

/seg + i + a + mos/	*ε, ɔ [- stress]	Stress-Root& Ident-IO] _{stem}	Agree	Ident-IO	Stress-Root
⊖ segámos			*		*
segámos	*!	*	*	*	*
sigámos		*!		*	*

In Benua’s proposal, the outputs are linked by their individual I/O mappings. The related words are simultaneously evaluated, in parallel, against a ranking of constraints. By means of this ranking, the correspondence relations produce “cyclic effects” with no need for “cyclic derivation”.

The problem of this theory seems to be its asymmetric and base-prioritizing character. The base-priority is applicable to derivation but not necessarily to inflection, since inflectional paradigms may show symmetrical behavior. In this analysis, however, we consider a morphosyntactic argument, defending the priority of the indicative present first person singular over the subjunctive present, in an asymmetrical way.

Thus, according to this paradigmatic approach, the impasse presented in (11) ceases to exist, since a high ranked paradigmatic constraint, Ident-OO, will require correspondence between the output of the subjunctive present and the output of the indicative present first person singular. This is demonstrated in (12).

(12) Present subjunctive 1pl—final version

/seg + i + a + mos/	Ident-OO	*ε, ɔ [- stress]	Stress-Root& Ident-IO] _{stem}	Agree	Ident-IO	Stress-Root
segámos	*!			*		*
segámos	*!	*	*	*	*	*
⊖ sigámos			*		*	*

The paradigm seems to be dispensable for *e*-theme verbs, considering that here the pattern of overapplication also does not hold, since their harmonized forms coincide with complete faithfulness to the input.¹²

¹² A problem that is directly linked to this characteristic of input preservation is the fact that, in our analysis, it is not possible to adopt Richness of the Base, since the vowel alternation in BP verbs is predictable from the input form. An alternative to solve this problem would be to propose positive and negative constraints for each vowel feature and combine them with constraints of stress and truncation.

The final ranking is presented in (13).

(13) Final ranking

Ident-OO \gg * ϵ , ɔ [-stress] \gg Low&Trunc]_{theme}, Stress-Root&Ident-IO]_{stem} \gg
 Agree \gg Ident-IO, Stress-Root, Low, Trunc

5. Concluding remarks

In this section, some findings of our work are enumerated.

First, our empirical analysis allowed us to verify that the process of vowel harmony has low productivity in BP, despite being fully transparent. In this sense, the speakers' preference for the vowel /e/, independently of the quality of the theme vowel, motivated the hypothesis that, in fact, there is no vowel harmony in the verbs of the second conjugation.

Secondly, faced with cases of overapplication of vowel harmony, we considered the hypothesis of paradigmatic correspondence between the first person singular present indicative and all the present subjunctive forms. Several examples in the language, beyond the phenomenon of vowel harmony, confirm this hypothesis, such as pairs like *odéio/odéie* 'I hate'/'that I hate', *cáibo/cáiba* 'I fit'/'that I fit'. We also found support for this hypothesis in our empirical analysis, since a major part of the informants decided for the same vowel in the indicative and in the subjunctive in the applied test.

Finally, we proposed an OT analysis, in which we used local conjunction to explain the processes of harmony, lowering and truncation. Also, we made use of output-output correspondence to explain the overapplication of harmony.

The analysis of this phenomenon in a constraint-based approach shows advantages over the derivational analyses, since it is able to show the conspiracy of several processes which work separately in BP, in phenomena other than the allomorphy here described—instead of rules with extremely complex contexts and questionable motivation. The use of conjoined constraints, in our analysis, accounts for the situations in which two of these processes combine. Moreover, an output-output approach, as in Transderivational Correspondence Theory, accounts for the paradigmatic relation between indicative and subjunctive forms.

Although this is a possible alternative within the OT principles, it does not seem satisfactory for us because of the loss of information about the phonological and morphological conditioning of the allomorphy which we describe.

Concerning the design of our constraints, we regard them as preliminary. We consider them, however, well motivated for the linguistic phenomena described.

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