Constraint Interaction and Brazilian Portuguese Glide Distribution

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0. Introduction

Glide distribution is a traditional problem for syllable, prosodic, metrical, and feature geometry theory. Brazilian Portuguese [BP] presents a particularly complex set of facts in these areas. The apparent unpredictability of glides suggests that [y] and [w] must be phonemes (e.g. Barbosa 1965, Leite 1974, Mateus 1975). A phonemic analysis is based on the surface co-occurrence of [iw], [yu], and [i.u], as well as [uy], [wi], and [u.i]. However, BP glides are indeed predictable once one considers certain prosodic, metrical, and morphological tendencies to be found across languages.

Optimality Theory (Prince & Smolensky 1993) maintains that the grammar is constructed of a set of ranked and violable constraints, rather than derivational or generative rules. Since BP glide distribution can be explained solely in terms of general, cross-linguistically motivated constraints, an OT approach is relatively cost-free. In contrast, a traditional rule-based analysis must stipulate desyllabification rules which explicitly target high and mid vowels at various derivational levels.

In this paper, I show that the sequence VG (vowel plus offglide) is distributionally less restricted than GV (onglide plus vowel) or V.V (vowels in hiatus). The more restricted forms, GV and V.V, obtain in prosodic, metrical, and morphological environments in which VG is disallowed. In an OT framework, the analysis takes on the following form: When input /VV/ corresponds to output VG, there are no constraint violations, while outputs GV and V.V violate the constraints MAX-μ and ONSET, respectively. However, GV and V.V are optimal in those environments in which VG violates certain constraints ranked more highly than MAX-μ and ONSET.

The organization of this paper proceeds along the following course. The data are presented in Section 1. In Section 2, I provide relevant background on the syllable and meter in BP. In Section 3, I propose an OT analysis. Finally in Section 4, I review the more salient theoretical points that emerge from the analysis.

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1.0 Distributional facts

The data are divided into three groups: vowel-glide alternation, consonant-glide alternation, and glide epenthesis. These data reflect the Baiano dialect, as spoken by residents of Salvador, Bahia.

1.1 Vowel-glide alternation

As shown in (1)-(2), non-morphemic high vowels are predictably realized as offglides immediately following a stressed vowel.

(1)	ai	[ay]	*[á.i]	'woe'
	aí	[a.í]		'there'
(2)	sarau	[saráw]	*[...rá.u]	'evening party', 'soirée'
	baú	[ba.ú]		'trunk', 'chest'

VG diphthongs may occur tonically (i.e. in stressed syllables), as in (3)-(4), or pretonically, as in (5)-(6).

(3)	eu	[ew]	'I'
(4)	pai	[pay]	'father'
(5)	euforia	[ew.fo.rí. ʌ]	'euphoria'
(6)	paixão	[pay.ʃãw̃]	'passion'

Since the distribution of offglides is less restricted than that of onglides or of hiatus, offglides can be considered the unmarked case.

The controversy regarding the underlying status of glides centers on minimal (or nearly minimal) pairs in which word-final unstressed [ɪ] or [ʊ] alternates with the corresponding offglide. These cases are exemplified in (7)-(11).

(7a)	tio	[tʃí.ʊ]	'uncle'
(7b)	til	[tʃiw]	'tilde'
(8a)	vôo	[vó.u]	'flight.m.sg', 'fly.1SG PRES INDIC'
(8b)	vou	[vow]	'go.1SG PRES INDIC'
(9a)	rio	[hí.ʊ]	'river', 'laugh.1SG PRES INDIC'
(9b)	riu	[hiw]	'laugh.3SG PRET'
(10)	arrue	[a.hú.ɪ]	'provide with streets.1/3SG PRES SUBJV'
(10a)	a Rui	[a.húy]	'to Ruy [a man's name]'
(11a)	atue	[a.tú.ɪ]	'act.1/3SG PRES SUBJV'
(11b)	intui	[i.túy]	'intend.3SG PRES INDIC'[1]

The (a) forms evidence word-final high vowel in hiatus, while the (b) forms evidence the corresponding offglide.[2] In section 3, I argue that the hiatus forms (a) involve a single vowel suffix, while the offglide forms (b) do not.

Morphological boundaries are also relevant to the verbs in (12)-(13), in which different prefixes combine with same vowel-initial stem.

(12)	pro.ibir	'to prohibit'	co.ibir	'to restrict'
(13)	i.ni.bir	'to inhibit'	e.xibir	'to exhibit'

When the prefix ends in a vowel (12), then the morpheme and syllable boundaries

[1] Other 3SG PRES IND -IR verbs like (11b): *diminui* diminish, *distingui* distinguish, *evolui* evolve, *con-/di-/in-flui* flow together/dilute/influence, *con-/de-strói* con-/de-struct, *con-/in-/sub-stitui* con-/in-/sub-stitute, *a-/dis-/re-tribui* at-/dis-/re-tribute, *instrui* instruct, *polui* pollute, *possui* possess; in -ER verbs: *dói* hurt, *mói* grind.

[2] Hiatus in (7a)-(11a) characterize more careful speech; colloquially, the offglide prevails.

coincide. When the prefix ends in a consonant (13), then the morpheme and and syllable boundaries are misaligned, presumably to achieve core (CV) syllabification.

Many BP dialects favor hiatus where other dialects of BP (e.g. Paulista) and all the other Romance languages exhibit an onglide (Stavrou 1947). Unstressed [i] and [u] precede a tonic vowel in (14)-(18) and precede a pre-tonic vowel in (19)-(20).

(14)	ciúme	[si.ũ´.mɪ]	'jealousy'
(15)	miúdo	[mi.ú.dʊ]	'very small', 'minute'
(16)	juiz	[ʒu.ís]	'judge'
(17)	suingue	[su.ĩ´.gɪ]	'[rhythmic] swing' (< English)
(18)	patuá	[pa.tu.á]	'kind of amulet' (< French *patois*)
(19)	Piatã	[pi.a.tã´]	'place name'
(20)	iabá	[i.a.bá]	'female Afro-Brazilian spirit-saint'

Examples (17) and (18) are loanwords. The glide pronunciations of English and French are realized as distinct vowels in BP.

Suffixed forms preserve the hiatus of the base form, despite the stress shift onto the suffix. Examples (21)-(23) correspond to (14)-(16), above.

(21)	ciumento	[si.u.mẽ´.tʊ]	'jealous'
(22)	miudinho	[mi.u.dĩ´.ɲʊ]	diminutive of (15) *miúdo*
(23)	juizado	[ʒu.i.zá.dʊ]	'judgeship'

Here, the absence of offglides may suggest a cyclic derivation or level-ordered phonology, although this will prove unnecessary in the proposed analysis.

Intervocalic glides are conventionally syllabified as codas, i.e. VG.V. However, Stavrou (1947) and Tadday (1971) analyze them as ambisyllabic. Stress placement falls on the penult in (24)-(25), and on the final syllable in (26)-(27).

(24)	idéia	[i.déy.ʸʌ]	'idea'
(25)	gandaia	[gã.dáy.ʸʌ]	'drunken partying spree'
(26)	coió	[kɔy.ʸɔ́]	'foppish admirer'
(27)	auê	[aw.ʷé]	'commotion', 'ruckus'

The glide is phonologically a coda, while the onset is phonetically transitional. The coda analysis of the intervocalic glide is required in light of the well-known Latinate pattern of quantity-sensitive stress placement: if the penult is heavy, stress cannot fall on the antepenult, as in (24), *idéia*, **ídeia*. I will refer to this as the Quantity-Sensitive Stress constraint (QSS).

Furthermore, the coda analysis is corroborated by a language game known as *língua do pê* ('language of the [letter] P'). In one version of the game, the rime is copied, with [p] as the copy's onset; e.g. (24) *idéia* becomes *ipì-de*[y]*pè*[y]-*apá*.

Onglides are generally restricted to post-tonic position, as in (28)-(34). The alternations in (33)-(34) are significant in that mid vowels surface as onglides.

(28)	lábio	[ɫá.byʊ]	'lip'
	labial	[ɫa.bi.áw]	'labial'
(29)	tábua	[tá.bwʌ]	'board'
	tabuada	[ta.bu.á.dʌ]	'multipliation table'
(30)	mútuo	[mú.twʊ]	'mutual'
(31)	tênue	[tẽ´.nwɪ]	'tenuous'
(32)	série	[sé.ryɪ]	'series'

(33)	mágoa	[má.gwʌ]	'heartbreak'
	magoa	[ma.gó.ʌ]	'break someone's heart.3SG PRES INDIC'
(34)	térreo	[tɛ́.hyʊ]	'ground floor'
	terreiro	[te.hɛ́y.rʊ]	'yard', 'Afro-Br. cult (*candomblé*) center'

In such cases, a morpheme boundary typically intervenes between the onglide and vowel, e.g. *lá.b*[y]-[ʊ]. In contrast, recall from examples (7)-(12) that offglides do not follow morpheme boundaries, e.g. (7a) *ti.o* [tí.ʊ], *[tiw], 'uncle'.

Parenthetically, there are two 'exceptions' to the observation that onglides obtain only post-tonically. First, [kw] can occur in any stress environment, as in (35), yet it is generally accepted that /k^{w}/ is phonemic in Portuguese, cf. (36). Second, we find [gw], *[gu], pre-vocalically, as in (37)-(38), presumably due to a constraint obliging adjacent voiced dorsal segment to share features or fuse in atonic positions.

(35)	quatro	/k^{w}atRo/	[kwá.trʊ]	'four'
(36)	cueca	/kuɛka/	[ku.ɛ́.kʌ]	'men's briefs'
(37)	guarda	/guaRda/	[gwáh.dʌ]	'guard'
(38)	guaxinim	/guaʃiniN/	[gwa.ʃi.ñ̃ ỹ]	'raccoon'

These two 'exceptional' cases merit no further attention in this work.

1.2 Consonant-glide distribution

Above, it was noted that /i/ and /u/ do not surface as offglides post-tonically, e.g. (28) *lábio* [łá.byʊ], *[łá.bɪw], 'lip'. Nevertheless, post-tonic offglides are common in BP. Consider the examples in (39)-(40), which illustrate the alternation of coda [w] in post-tonic syllables with onset [ł] (i.e. velarized or dark *l*).

(39)	fácil	[fá.siw]	'easy'
	facílimo	[fa.sí.łi.mʊ]	'easy.SUPERLATIVE'
(40)	possível	[pu.sí.vɛw]	'possible'
	possibilidade	[po.si.bi.łi.dá.dʒɪ]	'possibility'

Based on this correspondence between coda [w] and onset [ł], I argue below that the source of the post-tonic offglide is archiphonemic /L/.

1.3 Glide epenthesis

In many Brazilian dialects, [y] is epenthesized between a stressed vowel and word-final /Z/, as in (41)-(49).

	Epenthesis		No epenthesis		
(41)	luz	[łuys]	luzes	[łúzɪs]	'light.SG ~ PL'
(42)	gás	[gays]	gasolina	[gazuñ́nʌ]	'gas' ~ 'gasoline'
(43)	dez	[dɛys]	dezena	[dezẽ́nʌ]	'ten' ~ 'group of ten'
(44)	faz	[fays]	fazer	[fazéh]	'make.3SG PRES IND ~ INF'
(45)	arroz	[ahóys]	arrozal	[ahozáw]	'rice' ~ 'rice paddy'
(46)	rapaz	[hapáys]	rapaziada	[hapaziádʌ]	'guy' ~ 'group of guys'
(47)	Jesus	[ʒezúys]	Jesus Cristo	[ʒezuʃ.krí[ʃtʊ]	'Jesus' ~ 'Jesus Christ'
(48)	xampus	[ʃ̃ãpúys]	xampu	[ʃ̃ãpú]	'shampoo.PL ~ SG'
(49)	orixás	[oriʃáys]	orixá	[oriʃá]	'Afro-Br. spirit-saint.PL ~ SG'

The epenthesizing environment must be word-final, e.g. (45) **arro*[y]*zal*, and under stress, e.g. (47) **Jesu*[y]s *Cr*[í]*sto*.

1.4 Synopsis of glide distribution

Form	Example	Environment
VG	*pai*	tonic
	paixão	pre-tonic
	fácil	post-tonic only if /L/
V.-V, *V-G	*atu.e*	hiatus, no offglide following morpheme boundary
V.V, *GV	*ci.úme*	hiatus, no onglide before tonic V...
	Pi.atã	...or before pre-tonic V
	ci.umento	suffixed forms preserve hiatus of base
VG.ᴸV	*aué*	intervocalic glides ambisyllabic
GV	*lábio*	post-tonic only, OK preceding morpheme boundary
V□Z#	*arroz*	epenthetic [y] between stressed vowel and word-final /Z/.

2.0 Background

2.1 Onset-coda alternations

BP favors core (CV) syllabification, but certain sonorant consonants and /Z/ can be syllabified in the coda. Onset-coda alternations are outlined below.

Onset	Coda	Example alternation	Gloss
[ɫ]	[w]	so.[l]ar ~ so[w]	'solar' ~ 'sun'
[r]	[h], [x], or none	co.[r]es ~ co[h]	'colors' ~ 'color'
[n]	none, nasal V	i.[n]édito ~ [i].capaz	'unedited' ~ 'unable'
[z]	[s], [z], [ʃ], [ʒ]	lu.[z]es ~ lu[s], lu[ʃ].tre	'lights' ~ 'light', 'lamp'

The underpinning of the analysis of the sonorant onset-coda alternation is Grammar Optimization (Kiparsky 1993). The optimal grammar is the most transparent one; that is, the one that is maximally structure-filling. In the case of predictable alternations such as these, a structure-filling analysis can be achieved by means of Archiphonemic Underspecification (Inkelas 1995), within OT. Specifically, archiphonemes are underspecified in the input for some feature F and are subject to the constraint ranking MAX F » DEP MARKED F » DEP F. The interaction of these constraints effectively fills underspecified segments with the default feature.

To account for the sonorant onset-coda alternations, I posit the archiphonemes /N/, /R/, and /L/, which lack a primary consonantal place of articulation (C_1-Pl) underlyingly as well as in their coda realizations. Syllabified as onsets, however, they are coronal as a result of the structure-filling ranking ONSET PARSES PLACE » DEP MARKED PLACE » DEP PLACE. In effect, onsets must parse a C_1-Pl, coronal by default. In Section 3, I will elaborate on the alternation involving [ɫ] and [w]. Until then, I use 'L'.

Syllabification of coda consonants can be captured by ranking DEP ('no epenthesis') over NO CODA ('no coda consonants'), as shown in Tableau (A).

(A) *sol* /sɔL/ 'sun'

		DEP	NO CODA
☺	a. sɔL		*
	b. sɔ.L□	*!	

2.2 Epenthesis

Except for realizations of /Z/, obstruents are prohibited from the coda and 'trigger' the epenthesis of [ɪ], as in *subsolo* [su.bɪ.sɔ́.ɫu] 'basement'. The constraint responsible for

epenthesis is *[-SON]μ ('moras do not parse obstruents), formulated in Goodman (1995) by way of Waksler (1990) and Zec (1988). Tableau (B) depicts epenthesis as the result of the ranking *[-SON] μ » DEP.

(B) *subsolo* /subsɔLo/ 'basement'

		*[-SON]μ	DEP
☺	a. su.b□.so.lo		*
	b. sub.so.lo	*!	

2.3 Moraic /Z/

As demonstrated in (50)-(51), realizations of /Z/ ([s], [z], [ʃ], [ʒ]), hereafter [Z], exhibit a restrictive effect on stress placement.

(50)	fantasma	[fɐ̃.tá3.mʌ]	*[fɐ̃´.ta3.mʌ]	'ghost'
(51)	moleza	[mo.ɫé.zʌ]	*[mɔ́.ɫe.zʌ]	'languid feeling'

Whether coda or onset, [Z] must be moraic, via QSS (above). It can be inferred in (51), for example, that antepenult stress is impossible since the penult is heavy, parsing moras of both [e] and onset-syllabified [Z]. Syllabified intervocalically, [Z] must be a geminate.

In order for /Z/ to associate with a mora despite the fact that it is an obstruent, MAX-μ must outrank *[-SON]μ. Tableau (C) illustrates this scenario.

(C) *fantasma* /faNtaZma/ 'ghost'

		MAX-μ	*[-SON]μ	DEP
☺	a. fan.taZ.ma		*	
	b. fan.ta.Z□.ma	*!		*

That is, it is a worse offense for a mora to go unparsed than for a mora to be associated with an obstruent.

2.4 Onsetless syllables

Onsets are distributionally optional, e.g. *lu.a* [ɫú.ʌ] 'moon'. This results from the ranking of DEP over the requirement that all syllables have onsets, ONSET, in (D).

(D) *lu.a* /Lu-a/ 'moon'

		DEP	ONSET
☺	a. lu.a		*
	b. lu.□a	*!	

Now, by association of the rankings in Tableaux (B), (C), and (D), it can be established that MAX-μ dominates ONS; i.e., failure to parse a mora is worse than a syllable without an onset. This ranking is crucial to the analysis of hiatus in words like (14) *ci.úme*, as well as to the analysis of ambisyllabic intervocalic glides, e.g. (24) *idéia.*

2.5 Stress & Meter

I analyze the BP foot as right-headed and bounded[3]. Primary stress most often falls on the final syllable, provided that its nucleus is not a basic person/gender/number

[3] Thanks to James Harris for pointing out boundedness to me at the NELS conference.

suffix or an epenthetic vowel, which are extrametrical. In (52)-(55), '1' indicates primary stress, '2' secondary, etc.; parentheses indicate feet.

(52)	umbu	'kind of fruit'	(2 1)
(53)	demorão	'a habitual delayer'	(2)(3 1)
(54)	maracujá	'passion fruit'	(3 2)(3 1)
(55)	Itapemirim	'name of a bus company'	(2)(3 2)(3 1)

For convenience, I will subsume these metrical properties under the constraint FT-FORM.

The metrical pattern that will relate to the analysis of onglides (e.g. *lábio* 'lip') is the proparoxytonic (i.e. antepenult) stress pattern. This pattern is confined to a small but stable group of nouns and adjectives, as exemplified in (56)-(58).

(56)	sábado	'Saturday'	(1) 0 0
(57)	libélula	'dragonfly'	(2 1) 0 0
(58)	paralelepípedo	'cobblestone'	(2)(3 2)(3 1) 0 0

Since proparoxytonic stress occurs unpredictably, I propose that primary stress is marked in the input on the third to the last vowel. The remaining metrical structure of the word conforms to inviolable FT-FORM, as evident in (56)-(58).

3.0. Optimality Analysis of Glide Distribution

Given the three possible outputs VG, GV, and V.V from input /VV/, the distributionally least restricted sequence is VG .

Tableau (E) reveals the optimality of VG when the source of the offglide is a vowel.

(E) *pai* 'father'

	DEP	ONSET
☺ a. pai		
b. pa.i		*!
c. pa.□i	*!	

Preference for VG over V.V follows from the same ranking that results in syllables without onsets (Tableau B), DEP » ONSET.

The contrastive pairs in (7)-(11) reappear below. Hyphens indicate morpheme boundaries. The (a) forms end in the noun/verb suffixes [ɪ]/[ʊ], while the corresponding (b) forms end in non-morphemic [y]/[w]. Suffixes are identified in the rightmost column.

(7a)	tio	[tʃí.-ʊ]	'uncle'	[ʊ], MASC SG
(7b)	til	[tʃiw]	'tilde'	none
(8a)	vôo	[vó.-u]	'flight', 'fly'	[ʊ], MASC SG or 1SG PRES INDIC
(8b)	vou	[v-ow]	'go.1SG PRES INDIC'	[ow], irregular 1SG PRES INDIC
(9a)	rio	[hí.-ʊ]	'river', 'I laugh'	MASC SG & 1SG PRES IND
(9b)	riu	[h-iw]	'laughed'	[iw], 3SG PRET
(10a)	arrue	[a.hú.-ɪ]	'provide with streets'	[ɪ], 1/3SG PRES SUBJV
(10b)	a Rui	[a.húy]	'to Ruy'	none
(11a)	atue	[a.tú.-ɪ]	'act'	[ɪ], 1/3SG PRES SUBJV
(11b)	intui	[i.túy]	'intend.3SG PRES INDIC'	none

The absence of offglides immediately following a morpheme boundary can be

straightforwardly explained in the context of Alignment Theory (McCarthy & Prince 1993). As illustrated in (F), the left edge of the subjunctive suffix of *atu.e* and the stem of *pro.ibir* are each aligned with the left edge of a syllable, at the expense of the lower ranking ONSET violation.

(F) *atue* /atu-e/ 'act.1/3SG PRES SUBJV'
proibir /pro-ibiR/ 'prohibit.INF'

		L-ALIGN (MORPH, σ)	ONSET
☺	a. atu.-[i], pro-[i]bir		*
	b. atu-[y], pro-[y].bir	*!	

In contrast, it is generally agreed that 3SG PRES IND verbs end in a Theme Vowel (TV), not in a person/number suffix. In the -IR class, 3SG PRES IND verbs (e.g. *intu*[y]) end in TV /e/, considered an allomorph of /i/ in Sacconi (1986). Lacking a true suffix, verbs like *intu*[y] violate neither constraint in (F). This follows from the well-known cross-linguistic fact that categories such as third person, singular, present, and indicative tend to lack overt marking. Lack of suffixation in these categories is thought to reflect their conceptual basicness (Jakobson 1939, Bybee 1985, et al.).

Morpheme-syllable misalignment is rampant in BP, a result of the relatively low ranking of the alignment constraint. For example, misalignment in (12d) *i.n-i.bir* reflects the ranking NO CODA » L-ALIGN (MORPH, σ). There is also misalignment of the plural morpheme *-s*, e.g. *fa.to-s* 'facts'. Epenthesis in **fa.to-.s*□ would satisfy the alignment constraint, but its ill-formedness can be attributed to the ranking PARSE-σ » L-ALIGN (MORPH, σ), since **fa.to-.s*□ has two extrametrical syllables in contrast to only one in *fa.to-s*. The dominance of PARSE-σ will again figure in Tableaux (J) and (P).

The proposed alignment analysis can be contrasted with previous generative endeavors, the details of which are given in Lopez (1980):

(1) The *atu*[ɪ] ~ *intu*[y] type contrast is taken as evidence for the phonemic status of glides, hence /intuy/ (e.g. Barbosa 1965, Leite 1974, Mateus 1975). This analysis runs afoul of the noun *int*[u.i]*ção* and 1PL PRES INDIC *int*[u.ĩ]*mos*, which evidence [i], not [y].

(2) It has been suggested that the vowel of subjunctive verbs like *atue* [a.tú.ɪ] cannot be realized as a glide because they end in a mid vowel underlyingly, /atu-e/. In contrast, *intu*[y] is analyzed as /intu-i/. In support of these underlying representations, consider 1PL SUBJV *at*[u.ẽ]*mos* vs. 1PL PRES INDIC *int*[u.ĩ]*mos*. Orthography provides external support for this claim (*atuemos vs. intuimos*).

Unfortunately, the *atu*[ɪ]~*intu*[y] contrast cannot be attributed to word-final /e/ vs. /i/, respectively. The analysis wrongly requires that present indicative verbs of the -ER conjugation class end in /i/, e.g. *mói* [mɔy] 'grind.3SG PRES IND', which runs afoul of the infinitive *moer* [mo.eh] as well 1PL PRESENT INDIC *moemos* [mo.ẽ.mʊs]. The glide in [mɔy] must be /e/, not /i/. Mid vowels commonly alternate with glides, as exemplified above in (33)-(34).

(3) A generative account for the *atu*[ɪ]~*intu*[y] contrast holds that there is an underlying theme vowel (TV) interrupting the root and suffix in nouns like *tio*, 1SG PRES INDIC verbs like *rio*, and in 1/3SG PRES SUBJV verbs like *atue*. This TV purportedly blocks glide formation, then is deleted. López (1980), however, argues that the deletion of TVs generally precedes stress placement, which in turn precedes glide formation. This ordering

yields *[a.túy] on this account.

(4) López (1980) rejects all previous analyses and stipulates a restriction on word-final glide formation in noun, 1SG PRES INDIC, and 1/3SG PRES SUBJV forms.

The proposed alignment constraint accounts for V.V vs. VG in nouns and verbs alike by exploiting the different morphological structures of these patterns, i.e. the presence or absence of a morpheme boundary.

To account for cases of hiatus instead of onglides, e.g. (14) *ciúme* [si.ũ´.mɪ], *[syũ´.mɪ], 'jealousy', recall the ranking MAX-μ » ONSET established in Section 2.4. This, in conjunction with *ONSET-μ » ONSET, means that the requirement for onsets is less important than the requirements that moras be parsed and that onsets not be moraic, as shown in (G).

(G) *ciúme* /sium-e/ 'jealousy'

		MAX-μ	*ONSET-μ	ONSET
☺	a. si.ũ´.mɪ			*
	b. s y_{μ} ũ´.mɪ		*!	
	c. s $y_{\langle\mu\rangle}$ũ´.mɪ	*!		

The proposed analysis has implications for moraic theory. In the proposed analysis, the explanation for the general avoidance of onglides (GV) depends upon MAX-μ. This constraint in turn depends upon the view that short vowels are represented by one mora underlyingly (Hyman 1985, Hayes 1989). This view contrasts with that of McCarthy & Prince (1986, 1988), in which only long vowels and geminates are moraic underlyingly, while short vowels and certain consonants receive their moraic structure derivationally. If, however, short vowels were not moraic underlyingly, then MAX-μ would be irrelevant to the tableau, and one would expect *[syũ´.mɪ] to be optimal.

Preservation of hiatus in suffixed forms like *ci.u.mén.to*, 'jealous', despite the stress shift that accompanies suffixation, can be explained in terms of Correspondence Theory (McCarthy & Prince 1995), within OT. Output-to-output correspondence constraints require prosodic identity between base and suffixed forms. To account for suffixed forms like *ci.u.mén.to*, I posit L-ANCHOR-σ, based on foot-anchoring constraints. L-ANCHOR-σ holds that every correspondent of a syllable-initial segment is also syllable-initial. In effect, the suffixed forms preserve the syllabification of the base. The anchoring constraint outranks the onset requirement, as in Tableau (H).

(H) *ci.umento* /sium-eNt-o/ 'jealousy'

		L-ANCHOR-σ	ONSET
☺	a. ci.u.men.to	OK, ≈ | ci. | ú. | me	*
	b. ci[w].men.to	*!	

The offglide in suboptimal candidate (b) fails to correspond with the full vowel of the base, *ci.ú.me*, even though it satisfies ONSET.

The constraints named thus far are sufficient to account for the ambisyllabicity of intervocalic glides, exemplified in (24)-(27). As shown in Tableau (I), ambisyllabic glides satisfy the three constraints that participate in Tableau (G), above.

(I) *auê* /aue/ 'commotion'

		MAX-μ	ONSET-μ	ONSET
☺	a. aw.^{w}é			
	b. aw.é			*!
	c. a.u.é			*!*
	d. a.w$_{\mu}$é		*!	
	e. a.w$_{\langle\mu\rangle}$é	*!		

Ambisyllabicity is the resolution of conflict among constraints: on one hand, the grammar requires onsets; on the other hand, the available onset bears a mora. Geminate structure allows the mora to be associated with the first syllable in order to satisfy ONSET and simultaneously allows the melody to be associated with the second syllable in order to satisfy MAX-μ and *ONSET-μ.

This same family of constraints accounts for the seemingly exceptional properties of the palatal sonorants [ʎ] and [ɲ] (colloquially [ỹ]), as in *bau.ni.<u>lh</u>a* 'vanilla' and *a.ra.<u>nh</u>a* 'spider', respectively. As shown in Giangola (1995), the idiosyncrasies of the palatal sonorants are: (1) they rarely occur word-initially; (2) they never follow a diphthong or any closed syllable; (3) as the onsets of word-final syllables, they block antepenultimate stress; (4) without exception, [ɲ] or [ỹ] is always preceded by a nasal vowel. Once the palatal sonorants are analyzed as geminates (or moraic), their unique behavior can be explained in terms of independently needed principles of BP phonology (Giangola 1995). Crucially, MAX-μ and *ONSET-μ must dominate ONSET to ensure that the mora of the palatal sonorant receives a parse from the preceding syllable, just as in the case of ambisyllabic glides.

The OT treatment of intervocalic glides and palatal sonorants is an example of the power and elegance of the theory. These forms are predicted at no additional cost to the grammar. That is, the constraint hierarchy which yields ambisyllabic intervocalic glides and palatal sonorants has been established independently of these phenomena. Furthermore, it is not necessary to stipulate the features of the segments involved.

Turning now to the case of onglides (which are always post-tonic), the proposed OT analysis is based on the metrical analysis of words like *lábio* [ɫá.byʊ] as underlyingly marked for stress on the third to the last vowel (/Lábi-o/), like proparoxytones, e.g. (56) *sábado* /sábad-o/. In contrast, (59)-(62) are *un*marked for stress in the input.

(59)	vadio	[va.dʒí.ʊ]	/vadi-o/	'given to vagrancy, loafing'
(60)	alegria	[a.ɫe.grí.ʌ]	/aLegRi-a/	'joy'
(61)	rodopio	[ho.do.pí.ʊ]	/Rodopi-o/	'spinning' (e.g. in dance)
(62)	ironia	[i.ro.n^{y}í.ʌ]	/iRoNi-a/	'irony'

Tableau (J) shows the optimality of post-tonic onglides over vowels in hiatus.

(J) *lábio* /Lábi-o/ 'lip'

		FT-FORM	PARSE-σ	MAX-μ	L-ALIGN (MORPH, σ)
☺	a. (lá).by$_{\text{ɹ}}$-ʊ		σ	*	*
	b. (lá).bɪ.ʊ		σσ!		
	c. (lá).(bi).ʊ	*!			
	d. (lá.bi).ʊ	*!			

Candidates (c) and (d) are eliminated on FT-FORM. The runner-up in (b) has two unparsed (or extrametrical) syllables, while the winner in (a) has only one. Violations of MAX-μ and the alignment constraint are irrelevant to the victory of the onglide over hiatus.

Tableau (K) depicts the victory of onglides over offglides post-tonically as a result of the ranking of the Weight-to-Stress Principle (WSP) over MAX-μ. WSP holds that 'weak nodes do not branch', in effect, obliging heavy syllables to be stressed (Prince & Smolensky 1993, Prince 1990, Hayes 1980).

(K) *lábio* /Lábi-o/ 'lip'

		WSP	MAX-μ
☺	a. lá.b y$_{\text{ɹ}}$ʊ		*
	b. lá.bɪw	*!	

Candidate (b) violates WSP since its unstressed syllable is bimoraic.

Recall, however, unstressed post-tonic [iw] in (39)-(40), e.g. *fácil* [fá.sɪw] 'easy', where [w] is underlyingly /L/. First, to account for the alternation of [w] and [ɫ], I propose that underlying /L/ is specified as secondarily dorsal, yielding [w] in the coda. The onset's primary place of articulation is filled with the default [coronal], the result of ONSET PARSES PLACE » DEP MARKED PLACE » DEP PLACE. The onset is thus simultaneously coronal and dorsal, i.e. [ɫ]. (See Sproat & Fujimura 1993 on dark *l* in English.)

While post-tonic offglides appear to violate WSP (cf. *[ɫá.bɪw]), they nonetheless satisfy the higher ranked H-NUC constraint, as shown in (L).

(L) *fácil* /fásiL/ 'easy'

		H-NUC	WSP	DEP PLACE
☺	a. fásɪw$_{[cons]}$		*	
	b. fásil		*	*!
	c. fásyʊ$_{[cons]}$	*!		

H-NUC (P&S 1993) holds that the most harmonic nucleus is the most sonorous segment available. Ill-formed *[fásyʊ] violates H-NUC since the sonority peak corresponds with a segment that is specified as consonantal in the input.

The post-tonic offglide pattern must be attributed to the specification of the glide as consonantal. This analysis thus implies that BP makes an abstract, non-phonetic distinction between consonantal and vocalic glides.

Finally, to account for the epenthesis of [y] between a stressed vowel and word-final [Z] in (41)-(49), e.g. *arroz* [ahóys] 'rice', I posit the constraint *[-SON]μ# ('moras do not parse word-final obstruents'), which is inviolable in BP. This constraint can be motivated cross-linguistically, as it prevents consonant suffixes from increasing a word's mora count.

This motivation for *[-SON]μ# is reminiscent of complex, word-final codas in English, as in *kinds, sixths,* and *pinched.* Halle & Vergnaud (1980) house these exceptional codas in a phonological appendix adjoined to the previous syllable, while Booij & Rubach (1984) adjoin the appendix to a higher order Phonological Word. Kenstowicz (1994) explains these exceptional codas in terms of morphophonology: '...inflectional suffixes are composed of segments drawn from the set of coronal obstruents.' In the absence of a phonological appendix hosting coronal codas, 'many English stems would have defective paradigms'. This holds true for Portuguese [Z], which marks the plural of nouns and adjectives as well as the nearly obsolete second person singular form of most verb tenses. If [Z] were moraic word-finally, there would result a host of exceptionally trimoraic plurals, as in (63)-(64).

(63)	réu ~ réus	$h\varepsilon_{\mu}w_{\mu}$ ~ $h\varepsilon_{\mu}w_{\mu}s$	'defendant.MASC.SG ~ PL'
(64)	lei ~ leis	$le_{\mu}y_{\mu}$ ~ $le_{\mu}y_{\mu}s$	'law.SG ~ PL'

Returning now to the analysis of the epenthetic glide, Tableau (M) reveals that a low-cost violation of DEP buys satisfaction of higher ranked *[-SON]μ# and MAX-μ.

(M) *arroz* /arroZ/ 'rice'

		*[-SON]μ#	MAX-μ	DEP
☺	a. a.ho_{μ}□$_{\mu}$s			*
	b. a.ho_{μ} $s_{<\mu>}$		*!	
	c. a.ho_{μ} s_{μ}	*!		

Tableau (N) makes it clear why there is no epenthesis when [Z] is not word-final. Recall from (51) *moleza* that intervocalic [z] is a geminate. Its structure satisfies MAX-μ, without the need to incur a violation of DEP.

(N) *arrozal* /arroZaL/ 'rice paddy'

		MAX-μ	DEP
☺	a. $aho_{\mu\mu}$.záw	OK, geminate Z	
	b. aho_{μ}□$_{\mu}$.záw		*!

Tableau (O) shows that epenthesis only obtains in stressed syllables. In *un*stressed syllables, epenthesis would give rise to a heavy syllable, in violation of WSP.

(O) *fatos* /fat-o-Z/ 'facts'

		WSP	MAX-μ	DEP
☺	a. fá.$tU_{\mu}s_{<\mu>}$		*	
	b. fá.tU_{μ}□$_{\mu}$s	*!		*

Another example of the power and elegance of an OT analysis, this is the same

constraint ranking that decided the victory of onglides over offglides post-tonically, in words like *lá.b*[y]*o* vs. **lá.bi*[w], in Tableau (K).

Tableau (P) portrays the failure of word-final [Z] to 'trigger' epenthesis when preceded by a diphthong as the result of a preference for parsing syllables over moras. This devolves from the ranking established in Tableau (J), where the onglide in *láb*[y]*o* bests hiatus (**láb.i.*[u]).

(P) *réu-s* /rɛu-Z/ 'defendants'

	PARSE-σ	MAX-μ
☺ a. $h\varepsilon_{\mu}w_{\mu}s_{<\mu>}$		*
b. $(h\varepsilon_{\mu}w_{\mu})_{Ft}.\text{-}s\square_{\mu}$	*!	
c. $(h\varepsilon_{\mu}w_{\mu})_{Ft}.\text{-}\square_{\mu}s$	*!	

Note that this ranking also figures in Tableau (J), where the onglide in *láb*[y]*o* bests hiatus in trisyllabic **láb.i.*[u].

4.0 Conclusion

The analysis of the complex distribution of onglides, offglides, and hiatus supports the concept of well-formedness as the relative optimality among competing outputs evaluated against a hierarchy of general cross-linguistically motivated constraints. In contrast, a rule-based approach would be undesirable since stipulative rules target unstressed high and mid vowels for desyllabification at various derivational levels.

Furthermore, the proposed OT analysis facilitates the explanation of a number of apparently distinct data sets without the need to develop novel analyses for each.

- The ranking of DEP over ONSET accounts for the optimality of syllables without onsets (Tableau D). Offglides in words like *pai* and *eu* violate neither of these constraints (Tableau E).
- In Section 2, it was established by association that MAX-μ must dominate ONSET (Tableaux B, C, D). This ranking is responsible for hiatus in words like *ci.úme* (Tableau G), for the ambisyllabicity of intervocalic glides (Tableau I), and for the geminate status of palatal sonorants (Giangola 1995).
- The constraint ranking which accounts for the optimality of *láb*[y]*o* over **lábi*[w] (Tableau K) also explains the lack of epenthesis between an unstressed syllable and word-final [Z] (Tableau O).
- The constraint interaction that results in *lá.b*[y]*o* vs. tri-syllabic **lá.bi.o* (Tableau J) correctly blocks epenthesis following an already heavy syllable (Tableau P).

The following is as summary of the more salient theoretical points that have emerged from this analysis.

- I have accounted for the controversial V.V ~ VG contrast in pairs such as subjunctive *atu.*[ɪ] ~ indicative *intu*[y] simply in terms of morpheme-syllable alignment, ranked below NO CODA and DEP. This analysis contributes further evidence that categories such as third person, singular, present, and indicative are unmarked, presumably reflecting their conceptual basicness, in the tradition of functional linguistics.
- The proposed OT analysis relies heavily on MAX-μ (e.g. Tableaux C, G, I, and M), in support of the underlying mora hypothesis (Hyman 1985, Hayes 1989), *contra*

McCarthy & Prince (1988, 1986). If vowels were not moraic in the input, then this constraint would be irrelevant in determining optimality.

- Prosodic identity between base and 'derived' forms (e.g. *ci.u.men.to*) can be captured by means of the output-to-output correspondence constraint L-ANCHOR-σ, after McCarthy & Prince (1995). As Benua (1995) rightly observes, by enforcing identity among morphologically related output forms, Correspondence Theory, couched within OT, obviates the need for cyclic rule application, level-ordered phonologies, co-phonologies, and so-called 'mini-grammars'. While Correspondence Theory has been succesfully applied to problems in reduplication (McCarthy 1995) and truncation (Benua 1995), the BP data suggest that anchoring also applies between base forms and their suffixed correspondents.
- The alternation of dark *l* and [w], in the context of sonorant onset-coda alternations in general, corroborates the theory of Archiphonemic Underspecification (Inkelas 1995) within OT as a viable strategy to achieve Grammar Optimization (Kiparsky 1993).
- In addition, the analysis of post-tonic offglides (e.g. *fácil*), obliges an abstract, non-phonetic distinction between glides specified as consonantal versus those specified as vocalic in BP.
- The case of glide epenthesis suggests that obstruents do not receive moraic parses in word-final position. This constraint may be 'universal', in the sense of cross-linguistically valid, to the extent that it prevents suffixation from augmenting a word's mora-count or from yielding super-heavy syllables. In BP, however, the constraint applies even in tautomorphemic contexts, e.g. *arro*[y]z 'rice'. While the constraint may be universally motivated, the epenthesis that results in order to satisfy MAX-μ is a product of constraint interaction unique to BP.

References

Barbosa, J. M. 1965. Études de phonologie portugaise. Lisbon: Junta de Investigações do Ultramar.

Benua, L. 1995. Identity effects in morphological truncation. In J. Beckman, S. Urbanczyk & L. Walsh, eds., *Univ. of Mass. Occasional Papers in Linguistics 18: Papaers in Optimality Theory*. Amherst, MA: GLSA.

Booij, Geert, and Jerzy Rubach. 1984. Morphological and prosodic domains in lexical phohonology. Phonology Yearbook 1:1-27.

Bybee, Joan L. 1985. Morphology: a study of the relation between meaning and form. Amsterdam: John Benjamins.

Giangola, James P. 1995. Complex palatal geminates in Brazilian Portuguese. The Proceedings of the Thirteenth West Coast Conference in Formal Linguistics. Stanford: Center for the Study of Language and Information.

Goodman, Beverley. 1995. Features in Ponapean phonology. PhD dissertation, Cornell Univ.

Halle, Morris, and Jean-Roger Vergnaud. 1980. Three dimensional phonology. Journal of Linguistic Research 1:83-105.

Harris, James W. 1983. Syllable structure and stress in Spanish: a non-linear analysis. LI Monographs 8. Cambridge, MA: MIT Press.

Hayes, Bruce. 1980. A metrical theory of stress rules. PhD dissertation, MIT, Cambridge, Mass.

Hayes, Bruce. 1989. Compensatory lengthening in moraic phonology. LI 20:253-307.

Hyman, Larry. 1985. A theory of phonological weight. Dordrecht: Foris.

Inkelas, S. 1995. The consequences of optimization for underspecification. In J. Beckman, S. Urbanczyk, & L. Walsh, eds. Univ of Mass. *Occasional Papers in Linguistics* 18: Papers in Optimality Theory. Amherst, MA: Graduate Linguistic Student Association.

Jakobson, Roman. 1939. Signe zéro. Reprinted in *Roman Jakobson, Selected Writings, III*. The Hague: Mouton.

Kiparsky, Paul. 1993. Blocking in non-derived environments. In S. Hargus & E. and Kaisse (eds.), Phonetics and Phonology 4: Studies in Lexical Phonology. San Diego: Academic Press.

Kenstowicz, Michael. 1994. Phonology in generative grammar. Cambridge, Mass.: Blackwell.

Leite, Yvonne. 1975. Portuguese stress and related rules. PhD dissertation, University of Texas, Austin.

López, Barbara Strodt. 1980. The sound pattern of Brazilian Portuguese (Cariocan [sic] dialect). PhD dissertation, UCLA.

Major, R. C. 1985. Stress and rhythm in Brazilian Portuguese. Language 61(2):259-282.

Mateus, M. E. M. 1975. Aspectos da fonologia portuguesa. Lisbon: Centro de Estudos Filológicos.

McCarthy, John. 1995. Extensions of faithfulness: Rotuman revisited. Ms. Univ. of Mass., Amherst.

McCarthy, John and Alan Prince. 1986. Prosodic morphology. Ms., Univ. of Mass., Amherst, and Brandeis Univ., Waltham, Mass.

McCarthy, John and Alan Prince. 1988. Quantitative transfer in reduplicative and templatic morphology. In *Linguistics in the morning calm* 2:3-35, ed. The Linguistic Society of Korea, Seoul: Hanshin.

McCarthy, John and Alan Prince. 1993. Generalized alignment. Ms., Univ. of Mass., Amherst, and Rutgers Univ.

McCarthy, John & Alan Prince. 1995. Faithfulness & reduplicative identity. In J. Beckman, S. Urbanczyk, & L. Walsh, eds. Univ of Mass. *Occasional Papers in Linguistics* 18: Papers in Optimality Theory. Amherst, MA: Graduate Linguistic Student Association.

Prince, Alan. 1980. A metrical theory for Estonian quantity. LI 11:511-562.

Prince, Alan & Paul Smolensky. 1993. Optimality: constraint interaction in generative grammar, ms., Rutgers Univ, New Brunswick, and Univ. of Colorado, Boulder.

Sacconi, Luiz Antônio. 1986. Nossa gramática: teoria e prática. São Paulo: Editora Atual.

Sproat, Richard and Osamu Fujimura. 1993. Allophonic variation in English */l/* and its implications for phonetic implementation. Journal of phonetics 21(3):291-311.

Stavrou, Christopher. 1947. Brazilian Portuguese pronunciation. Philadelphia: David McKay Co.

Tadday, Regina. 1971. Padrão silábico no português. Estudos Leopoldenses 19:353-377. São Leopoldo, RS, Brazil: UNISINOS (Universidade do Vale do Rio dos Sinos).

Waksler, Rachelle. 1990. A formal account of glide-vowel alternation in prosodic theory. PhD dissertation, Harvard Univ.

Williams, Edwin B. 1986. Do latim ao português. Rio de Janeiro: Edições Tempo Brasileiro. (Trans. by A. Houaiss, From Latin to Portuguese, 1938, Oxford: Oxford Univ. Press.)

Zec, Draga. 1988. Sonority constraints on prosodic structure. PhD dissertation, Stanford Univ.