MDPI

Article

Interactions of Nasal Harmony and Word-Internal Language Mixing in Paraguayan Guaraní

Katherine Ruth Russell [ID]

Department of Linguistics, University of California, Berkeley, 1203 Dwinelle Hall, Berkeley, CA 94720, USA; katherine.russell@berkeley.edu

Abstract: Words containing morphemes from multiple languages offer a unique look into the grammatical systems that constrain word formation. In this paper, I introduce novel data from nasal harmony patterns in contexts involving word-internal language mixing between Paraguayan Guaraní and Spanish, collected with native speakers of Guaraní. I provide the first full formal constraint-based analysis of nasal harmony in Paraguayan Guaraní, then show that nasal consonants within Spanish roots trigger nasal harmony in Guaraní affixal morphology, providing evidence for an emergent case of long-distance nasal harmony in the language. I demonstrate that this data supports an analysis in which a single phonological system has access to two different strata based on language of origin, countering predictions made by some previous approaches to the phonology of language mixing. My analysis combines Cophonology Theory and Agreement by Correspondence with phase faithfulness: a root is first evaluated according to the phonological grammar associated with its lexical stratum, and is then subject to faithfulness to that output.

Keywords: phonology-morphology interface; language mixing; nasal harmony; Paraguayan Guaraní; Tupi-Guaraní

1. Introduction

Paraguayan Guaraní [gug, Tupi-Guaraní, Paraguay] is situated in a unique sociolinguistic context in which language mixing, particularly word internally, is extremely frequent. In this paper, I show that looking into the interactions of Guaraní morphophonology with lexical borrowings from Spanish presents a challenge for traditional stratal analyses, and directly bears on issues within language mixing. Although Guaraní nasal harmony has been the subject of extensive description and analysis in the theoretical literature (e.g., Goldsmith 1976; Piggott 1992; Walker 1999, 2000), prior accounts lack any discussion of its interactions with word-internal language mixing. In this paper, I propose the first formal constraint-based analysis of nasal harmony in Paraguayan Guaraní, and present novel data bearing on its interactions with roots loaned from Spanish. I show that native roots and lexical borrowings from Spanish pattern differently with respect to nasalization: native roots undergo and trigger harmony (1a), while loaned roots can trigger harmony but never undergo it themselves (1b)—a rare case of innovated long-distance nasal harmony.

(1)   a. ñamaña   pe   ógare
           [ñã-mãˈɲã   pe   ˈoɰa=ɾe]
           1PL.INCL.A-look DEM house=at
           'We looked at that house.'

         b. ñakosina
           [ñã-*kosi*ˈ*na*]
           1PL.INCL.A-cook
           'We cooked.' (cf. Spanish *cocinar*)

I demonstrate that when a loaned root takes native morphology, the root patterns as part of the loanword stratum, while the native prefixes pattern as native roots do. This data directly bears on issues within language mixing: according to the PF Interface Condition (PFIC) (MacSwan and Colina 2014), Phonetic Form (PF), the level of representation at which structure undergoes phonological evaluation, takes the syntactic word as the unit of analysis, and therefore requires the entire word to be subject to the same phonological constraints. However, the pattern I describe in which nasal consonants within Spanish roots trigger nasal harmony in Guaraní prefixes challenges this view of word formation. Instead, I propose an alternative analysis which incorporates phase faithfulness (McPherson and Heath 2016) and Agreement by Correspondence (Rose and Walker 2004).

All original examples in Guaraní are represented using a four-line gloss method. First, the word or sentence is spelled in the Guaraní orthography, followed by the phonetic representation in the International Phonetic Alphabet (IPA). Spanish morphemes are italicized. These graphic representations are then followed by morphemic glossing and English translations.

This paper is structured as follows: in Section 2, I provide an overview of word-internal language mixing and predictions within prior literature, then describe the patterns of Spanish-Guaraní word-internal language mixing. I then proceed to detail the system of regressive nasal harmony in Guaraní and propose a constraint-based analysis in Section 3. I present data on the interactions of nasal harmony and word-internal language mixing in Section 4. I follow with my analysis of these interactions in Section 5, and discuss the implications of this work on formal models of word formation as well as assumptions about harmony systems in Section 6.

Methods

The data provided in this paper comes from my original work with two native speakers of Paraguayan Guaraní, unless cited otherwise. Data was collected through elicitation via Zoom. Elicitation took place biweekly over the course of nine months. The two speakers are middle-aged women who were born and raised in Paraguay, and report having spoken both Guaraní and Spanish since childhood. They were both educated to the secondary level in Paraguay, and are fully literate in Guaraní, Spanish and English. Both consultants have resided in the United States for several decades, but continue to use Guaraní and Spanish on a daily basis to communicate with friends and family members. One speaker regularly travels back and forth between the United States and Paraguay, and was physically located in Paraguay for much of the nine months during which time data collection took place. Most of the data presented in this paper comes from structured elicitation in which the researcher asked the consultants to translate a sentence or phrase from English or Spanish into Guaraní. Occasionally, the researcher would produce a Guaraní sentence or phrase and ask for the consultants' judgments and any comments on its grammaticality and usage. The same phrases and sentences were elicited separately with each speaker, and were re-elicited multiple times over the course of several months. The examples represented in this paper are those which consultants produced or deemed to be totally acceptable across multiple elicitation sessions. Several examples were collected from news articles written in Paraguayan Guaraní: all such examples were read aloud and confirmed by the consultants. 475 tokens, defined as a word consisting of a Spanish loan containing a nasal consonant accompanied by native Guaraní morphology, were analyzed. The data were transcribed and coded for nasalization primarily by ear. The nasality of consonants were checked by hand in Praat (Boersma and Weenink 2022): however, as there are no acoustic correlates that uniquely identify nasalized vowels (Chen 1997), vowel nasalization was coded by ear. Due to the constraints of collecting data remotely during the pandemic, it has not been possible to make use of tools to do detailed phonetic analysis, like measuring nasal airflow, at this time: future research will aim to tackle such questions. All materials collected are publicly available online through the California Language Archive (Gomez et al. 2020) and are accessible at http://dx.doi.org/doi:10.7297/X2PR7TNF (accessed on

21 January 2022). As Guaraní is widely spoken and its form varies substantially by social, economic and geographic factors, all original data presented in this paper should be taken as representative of the speech of these two individual speakers.

2. Word-Internal Language Mixing

2.1. Theoretical Background

Much of the prior literature on the phonology of word-internal language mixing centers on the question of whether word-internal mixing of phonological grammars is possible. MacSwan and Colina (2014), for instance, assume that bilinguals have access to two phonological systems, and that each phonological system is associated with its own phonological grammar—a distinct ranking of phonological constraints. They introduce their PF Interface Condition (PFIC) to argue that it is impossible for both phonological systems to simultaneously apply to a single item comprised of morphemes from both languages, since the phonological grammars would conflict and a ranking paradox would thereby ensue. They therefore take the boundary between words to represent the minimal possible opportunity for code switching.

In their study of German-Spanish language mixing contexts, González-Vilbazo and López (2011) find that word-internal switches are possible, but the entire word conforms to the phonology of one language. In particular, phonological evaluation makes use of the phonology of the language of the affixal morphology, since a derivational affix is the morphological head, which then projects its features to the whole word. These findings support MacSwan and Colina (2014)'s view that word-internal mixing of phonological systems is impossible. Following this study, Stefanich and Cabrelli Amaro (2018) explore the possibilities of word-internal language mixing for Spanish-English bilinguals, and report that preliminary evidence suggests that these bilinguals may employ Spanish phonology when producing words with English roots and Spanish affixes.

However, other prior literature claims that word-internal switches between phonological systems are indeed attested. For example, Schindler et al. (2008) present a compelling case of language mixing contexts in which a vowel within a French root triggers vowel harmony in an Urban Wolof suffix: after a French root (italicized) containing a +ATR vowel, the vowel of the suffix is realized as +ATR (2a). However, following a French root ending in a −ATR vowel, the same suffix is realized as −ATR (2b).

(2)   a. faire-leen
          [*fɛr*-lɛːn]
          make-IMP

          'Make!'

    b. peser-leen
          [*pəse*-leːn]
          weigh-IMP

          'Weigh!' (Schindler et al. 2008, p. 9)

This situation is predicted to be impossible by the PFIC. The authors posit an approach to code switching whereby violable constraints make reference to syntactic properties as well as source language identity. In a similar vein, Flores and Williams (2019) survey the speech of Japanese-Spanish bilinguals and report that word-internal switches of phonological systems are allowed if individual morphemes are interpreted as stand-alone units, following Azuma (1996)'s Stand-Alone Principle – any segment that can meaningfully stand alone in the speaker's mind can be a target for code-switching. In this paper, I present a previously unreported case of word-internal mixing of phonological grammars in Spanish-Paraguayan Guaraní bilinguals.

2.2. Spanish-Guaraní Language Mixing

Paraguayan Guaraní and Spanish have long been in contact: Paraguay is the only American nation where an indigenous language has survived as a majority language spo-

ken by the non-indigenous population (Estigarribia 2015). According to the 2012 census, 77 percent of Paraguayans speak Guaraní, and about 69 percent of the population is bilingual with Guaraní and Spanish (DGEEC 2012). The term 'Jopará', which means 'mixture' in Guaraní, refers to the colloquial variant which involves frequent language mixing[1] between Guaraní and Spanish (Estigarribia 2015; Lustig 2010). The intricacies of Jopará have been documented and described in many publications, including Bakker et al. (2008); Boidin (2006); Boyer (2010); Dietrich (2010); Fernández Guizzetti (1966); Lustig (2010); Melià (1974); Morínigo (1959); Palacios Alcaine (2008), among others. In particular, sociolinguistic work has focused on the comparative uses of Guaraní and Spanish in different spheres (Choi 2004, 2005; Gynan 1998; Zajícová 2009, etc.). In this paper, however, I focus specifically on the use of roots of Spanish origin in combination with Guaraní morphology.

2.2.1. Lexical Strata

Individual lexical items display various repairs of violations of Guaraní phonotactics. Pinta and Smith (2017) propose five lexical strata in Guaraní, based on phonological repairs of loanwords from Spanish, as reproduced in Table 1. They identify four different properties: the presence of a nasal coda (N CODAS), any coda consonant (CODAS), non-final stress (NON-FINAL STRESS), and complex onsets (#CC). The five different strata are identified based on which properties are repaired and which are tolerated: the more properties that are repaired, the more native-like a stratum is, and conversely, the more properties that are tolerated, the more foreign-like a stratum is. Pinta and Smith do not consider nasal harmony behavior in their analysis of lexical strata.

Table 1. Lexical strata in Guaraní (Pinta and Smith 2017, p. 306).

	N CODAS	**CODAS**	**NON-FINAL STRESS**	**#CC**
1. Native	Repaired	Repaired	Repaired	Repaired
2. Mostly nativized	Repaired	Repaired	Repaired	Tolerated
3. Partially nativized	Repaired	Repaired	Tolerated	Tolerated
4. Barely nativized	Repaired	Tolerated	Tolerated	Tolerated
5. Unadapted	Tolerated	Tolerated	Tolerated	Tolerated

I provide an example of a lexical item from each stratum below, in (3). In (3a), all syllables are open, primary stress is pronounced on the final syllable, and there are no complex onsets present: therefore, none of the four properties identified by Pinta and Smith are violated. In (3b), the onset cluster *skr* violates the phonotactic constraint in Guaraní on complex onsets. This is, however, the only property violated: stress is final and all syllables are open. Next, in (3c), we see that non-final stress is tolerated. With *colectivo* in (3d), we see that two properties are violated: stress is not final, and there is one syllable with a coda consonant. Finally, in (3e), the nasal coda consonant of the word *maletín* is tolerated without repair.

(3)　a.　Native

　　　che　añe'ẽ
　　　[ʃe　ã-ɲẽˈʔẽ]
　　　1SG　1SG.A-speak

　　　'I speak.'

　　b.　Mostly nativized

　　　che askrivi
　　　[ʃe　　　a-*skɾi*ˈ*vi*]
　　　1SG　　　1SG.A-write

　　　'I write.' (cf. Spanish *escribir*)

c. Partially nativized

Julia ohendu música
[ˈhulja õ-h-ẽˈndu ˈmusika]
Julia 3.A-H-listen music

'Julia listens to music.' (cf. Spanish *música*)

d. Barely nativized

ha'ekuéra oguahẽ mokõi colectivo-pe ha peteĩ moto-pe
[haʔe-ˈkʷeɾa õ-ŋʷãˈhẽ mõˈkõj *kolekˈtivo*=pe ha pẽtẽˈĩ ˈmoto*=pe]
3-COLL 3-arrive two bus=LOC and one motorcycle=LOC

'They arrived on two buses and one motorcycle.' (cf. Spanish *colectivo* and *moto*)

e. Unadapted

che amoĩ kuatia maletín-pe
[ʃe ã-mõˈĩ kʷatiˈa *maleˈtin*=pe]
1SG 1SG.A-put paper briefcase=LOC

'I put the paper in the briefcase.' (cf. Spanish *maletín*)

Loanwords from Spanish into Guaraní can be classified based on phonological properties related to repairs and violations of Guaraní phonotactics. I return to and build on this conception of lexical strata in Guaraní in Section 5.

2.2.2. Word-Internal Language Mixing Contexts

Guaraní is an agglutinative language. Word-internal language mixing typically involves the affixation of Guaraní agglutinative morphology onto Spanish lexical borrowings (4a). At the same time, several Guaraní grammatical morphemes are also in common use in Paraguayan Spanish (Estigarribia 2020), as in (4b). In cases like (4a), which are the main focus of this work, a Spanish lexical item is analyzed as a root in Guaraní, thus enabling it to combine with Guaraní affixal morphology. As such, Guaraní serves as the matrix language (Myers-Scotton 1993).

(4) a. che-*ayuda*-mí-na
1SG.B-help-PLEAD-REQ

'Help me, please.' (Estigarribia 2020, p. 17)

b. *e* *rancho*-kue *de mi* *papá*
be.3SG.PRS rancho-N.PST of 1SG.POSS dad

'It's my dad's old ranch.' (Lustig 2010, p. 12)

Both verbs and nouns may act as predicates in Guaraní: the two categories are differentiated by their use of two distinct sets of person marking, though a single lexical root can often be used in both classes (Dietrich 2017). Spanish lexical items can be used analogously with Guaraní morphology: for instance, the morpheme *koras*õ, from Spanish *corazón*, can take both nominal and verbal morphology (5).

(5) a. che añandu chekorasõme
[ʃe ã-ñãˈndu ʃẽ-*kõɾ̃ãˈsõ*=mẽ]
1SG 1SG.B-feel 1SG.B-heart=LOC

'I feel it in my heart.' (cf. Spanish *corazón*)

b. che amokorasõ chemuñeca
[ʃe ã-mõ-*kõɾ̃ãˈsõ* ʃẽ-*muˈñeka*]
1SG 1SG.A-CAUS-heart 1SG.B-doll

'I put a heart on my doll.' (cf. Spanish *corazón* and *muñeca*)[2]

The examples below in (6) demonstrate Spanish adjectives used predicatively with Guaraní agglutinative morphology.

(6)　a.　ijagraciádo
　　　　　　[i-ɟ-aɣraˈsjaðo]
　　　　　　3.B-J-funny
　　　　　　'He is funny.' (cf. Spanish *agraciado*)

　　　b.　ha'e　omoanaranjádo　　　imuñéca
　　　　　　[haʔe　õ-mõ-ʔanaɾanˈhaðo　ĩ-muˈñeka]
　　　　　　3　　　3.A-CAUS-orange　　3.B-doll
　　　　　　'She made her doll orange.' (cf. Spanish *anaranjado* and *muñeca*)

The set of prefixes in Guaraní includes person marking and valency-changing morphemes, all of which can attach to Spanish roots (7).

(7)　a.　amalicia　　　okýta
　　　　　　[a-maliˈsja　　o-ˈki-ta]
　　　　　　1SG.A-think　3.A-rain-FUT
　　　　　　'I think it will rain.' (cf. Spanish *maliciar*)

　　　b.　ha'e　cheavergonzapaite　　　　chéve
　　　　　　[haʔe　ʃe-ʔaβeɾɣonsa-pa-ɟˈte　　ˈʃeve]
　　　　　　3　　　1SG.B-shame-TOTAL-INTENS　1SG.ACC
　　　　　　'He totally embarrassed me.' (cf. Spanish *avergonzar*)

　　　c.　nde　chembodíspara
　　　　　　[nde　ʃẽ-mbo-ˈðispaɾa]
　　　　　　2SG　1SG.B-CAUS-run
　　　　　　'You made me run.' (cf. Spanish *disparar*)

　　　d.　ojeavri
　　　　　　[o-ɟe-ʔaˈvɾi]
　　　　　　3.A-AGD-open
　　　　　　'It opened (by itself).' (cf. Spanish *abrir*)

A wide variety of grammatical meanings are expressed through suffixes and enclitics, including aspect and nominal tense, as well as postpositions (Estigarribia 2020; Tonhauser 2007). Examples of suffixes and enclitics attaching to Spanish roots are provided below in (8).

(8)　a.　ndajumo'ãi　　　　　　　　rekosinambapota jave
　　　　　　[nd-a-ɟu-mõʔˈã-ɟ̃　　　　ɾe-*kosina*-mba-poˈta=ɟave]
　　　　　　NEG-1SG.A-come-FRUS-NEG　2SG.A-cook-TOTAL-INCIP=during
　　　　　　'I won't come until you're about to finish cooking.' (cf. Spanish *cocinar*)

　　　b.　ha'e　campesinokue
　　　　　　[haʔe　*kampesino*-ˈkʷe]
　　　　　　3　　　countryman-N.PST
　　　　　　'He is a former *campesino*.' (cf. Spanish *campesino*)

　　　c.　che ndaikatúi　　　　　　aha　　afirma-peve　　pe　kuatia
　　　　　　[ʃe　nd-a-jkaˈtu-ɟ　　　　a-ˈha　a-*fiɾ*ˈma=peʋe　　pe　kʷatiˈa]
　　　　　　1SG　NEG-1SG.A-be.able-NEG　1SG.A-go　1SG.A-sign=until　DEM　paper
　　　　　　'I couldn't leave until I signed the paper.' (cf. Spanish *firmar*)

Spanish roots as they appear in Guaraní are based off of their Spanish infinitive forms (9). Although the vowels of these verbs undergo predictable changes based on conjugation within Spanish (e.g., *entender* is conjugated as *entiendo* in the first person singular present), they are consistently pronounced in Guaraní with the vowels of the infinitive form in Spanish.

(9) a. che ahendúrõ antendéta
[ʃe ã-h-ẽˈndũ=ɾ̃õ ã-*nte*ˈ*nde*-ta]
1SG 1SG.A-H-listen=COND 1SG.A-understand-FUT

'If I listen, I will understand.' (cf. Spanish *entender*)

b. chesy opensa cherasyha ha ojavy
[ʃe-ˈsɨ o-*pe*ˈ*nsa* ʃe-ɾ-asɨ-ˈha ha o-ɟaˈʋɨ]
1SG.B-mother 3.A-think 1SG.B-R-sick-NMLZ and 3.A-wrong

'My mother thinks that I'm sick, and she's wrong.' (cf. Spanish *pensar*)

c. mitãkuña'i ojuga okápe sapatu'ỹre
[mĩtã-kũñã-ˈʔi o-*hu*ˈɣa oˈka=pe *sapatu*-ˈʔ ɨ̃=ɾ̃ẽ]
child-female-DIM 3.A-play outside=LOC shoe-PRIV=at

'The little girl was playing outside with no shoes on.' (cf. Spanish *jugar* and *zapato*)

Spanish lexical items participate in phonological processes present in Guaraní, such as /j/-epenthesis (10a) and reduplication (10b,c). The application of such processes to words involving loans shows that loaned roots can differ from their counterparts in Spanish in terms of pronunciation and syllabification. The pattern of reduplication is particularly revealing, as the reduplicant in Guaraní is a disyllabic suffix, and therefore highlights the location of syllable boundaries (Hamidzadeh 2013). The example in (10c) demonstrates that the /nd/ cluster of the Spanish verb *vender* is treated as a single complex segment in Guaraní, as it appears as the onset of the reduplicant.

(10) a. amoñatende chupe
[ã-mõ-ɲ-*ate*ˈ*nde* ʃuˈpe]
1SG.A-CAUS-J-pay.attention DOM

'I made him pay attention.' (cf. Spanish *atender*)

b. ijagraciadociádo
[i-ɟ-*aɣɾasɟaðo*~ˈ*sjaðo*]
3.B-J-funny~RED

'He is very funny.' (cf. Spanish *agraciado*)

c. avendekandeka chupe yva
[a-*ʋende*-ka~*nde*ˈka ʃuˈpe ɨˈʋa]
1SG.A-sell-CAUS~RED DOM fruit

'I make him continue selling fruit.' (cf. Spanish *vender*)

3. Nasalization in Guaraní

Languages of the Tupi-Guaraní family, including Paraguayan Guaraní, are well known for exhibiting long-distance regressive nasal harmony (Lapierre and Michael 2018). The harmony system has been a topic of thorough investigation in the theoretical literature for decades (Beckman 1998; Goldsmith 1976; Gregores and Suárez 1967; Kaiser 2008; Piggott 1992; Rivas 1974; Steriade 1993; Walker 1999, 2000).

There are two triggers of nasal harmony in Guaraní: phonemic nasal vowels and nasal consonants. Nasality is contrastive on stressed vowels, and spreads leftwards from a phonemic nasal vowel, resulting in the nasalization of all consonants and vowels to its left within the phonological word (11a–c); compare to oral counterparts in (11d–f). Only a stressed vowel is specified phonologically for nasality: in the vast majority of cases, the stressed vowel is the root-final vowel (Cabral and Rodrigues 2011).

(11) a. morotĩ
[mõɾ̃õˈtĩ]
white

'white'

b. iñakã
[ĩ-ɲ-ãˈkã]
3.B-J-head

'her head'

   c. ñañomoñe'ẽ
     [ɲã-ɲõ-mõ-ɲẽˈʔẽ]
     1PL.INCL.A-RECIP-CAUS-speak
     'We made each other speak.'

   d. sa'yju
     [saʔɨˈɟu]
     yellow
     'yellow'

   e. ijapysa
     [i-ɟ-apɨˈsa]
     3.B-J-ear
     'her ear'

   f. ambojeroky   chupe
     [ã-mbo-jeɾoˈkɨ   ʃuˈpe]
     1SG.A-CAUS-dance DOM
     'I make him dance.'

Voiceless obstruents are transparent to regressive nasal harmony (12): for example, the nasality originating from the stressed vowel in 'cut' spreads leftwards through two voiceless stops. Although the voiceless stops do not themselves nasalize, they do not block the spread of nasality to segments to their left. There are no consonants in Guaraní that block nasality from spreading altogether.

(12) a. aikytĩ   yvyra kysépe
       [ãĩ-kɨ̃ˈtĩ   ɨʋɨˈɾa kɨˈse=pe]
       1SG.A-cut wood knife=LOC
       'I cut the wood with a knife.'

     b. oñenupã
      [õ-ɲẽ-nũˈpã]
      3.A-AGD-hit
      'He was hit.'

I present the attested consonant alternations in regressive nasal harmony contexts in Table 2, below. The consonants are presented in IPA: in cases in which the IPA symbols do not correspond with their equivalents in the Guaraní orthography, the orthographic forms are presented in parentheses. The first group—the voiced stops—are underlyingly nasal, and surface as post-oralized before oral vowels. The status of the segments of mixed nasal and oral articulation has long been debated in the Tupi-Guaraní literature. While it is generally understood that these constitute single segments, as opposed to consonant clusters, analyses vary between positing that they result from the pre-nasalization of oral stops (Daviet 2016; Gregores and Suárez 1967; Rose 2008) and arguing that they result from the post-oralization of nasal consonants (Cardoso 2009; Lapierre and Michael 2017; Piggott 1992). Yet other analyses posit that sets of both fully nasal consonants and partially nasal consonants are phonemic (Kaiser 2008; Robboy 1987). I follow Gregores and Suárez (1967), Lapierre and Michael (2018), and Estigarribia (2021) in taking the stance that underlying nasal stops surface as partially oralized allophones before oral vowels. This analysis is most appropriate since nasal stops and post-oralized nasals are in complementary distribution. The same phoneme—for instance, the negative prefix /n/—is pronounced as fully nasal before a nasal vowel, and as a post-oralized nasal before an oral vowel. I assume that post-oralization occurs before an oral vowel as the result of shielding (Stanton 2017). The second group in Table 2—the approximants—consists of phones which are underlyingly oral, and surface as nasalized before nasal vowels.

Table 2. Consonant alternations in regressive nasal harmony, with orthographic representations in parentheses.

ORAL	NASAL
mb	m
nd	n
ŋg (ng)	ŋ (g̃)
ŋgʷ (ngu)	ŋʷ (g̃u)
r	r̃
v	ṽ
j	ñ
ɰ (g)	ɰ̃ (g̃)

The presence of a phonemic nasal consonant triggers the nasalization of segments to its left. The effects of this nasalization process are visible in the example in (13a): though the stressed vowel in the verb 'listen' is oral, the presence of a phonemic nasal consonant results in nasalization of segments to its left. In (13b), the consonant of the causative morpheme is a phonemic bilabial nasal, which nasalizes the 1PL.INCL.A prefix to its left.

(13)　a.　rohendu
　　　　　[r̃õ-h-ē'ndu]
　　　　　1>2-H-listen
　　　　　'I am listening to you.'

　　　b.　ñambojeroky　　　　　chupe
　　　　　[ɲã-mbo-jeɾo'kɨ　　　　ʃu'pe]
　　　　　1PL.INCL.A-CAUS-dance DOM
　　　　　'We made him dance.'

The domain of regressive nasal harmony in Guaraní is the root and its prefixes (Lapierre and Michael 2018). All prefixes show effects of regressive nasal harmony. A nasal consonant within a prefix, like the initial segment of CAUS, nasalizes vowels and consonants to its left (14a). However, a nasal vowel or consonant within a suffix does not trigger regressive nasal harmony (14b).[3]

(14)　a.　ha'e　oñembovy'akuaa　　　　　ichupe
　　　　　[ha'ʔe õ-ɲẽ-mbo-ʋiʔa-kʷa'a　　i-ʃu'pe]
　　　　　3　　3.A-AGD-CAUS-happy-know 3.B-DOM
　　　　　'He knows how to make himself happy.'

　　　b.　che　avy'amo'ã
　　　　　[ʃe　a-ʋiʔa-mõ'ʔã]
　　　　　1SG 1SG.A-happy-FRUS
　　　　　'I was almost happy.'

In summary, nasality spreads from a phonemic nasal vowel or consonant within the domain of a root and its prefixes in Guaraní. This nasal harmony process takes place from right to left, as it affects segments to the left of the trigger. Regressive nasal harmony targets all segments except voiceless obstruents, which are transparent to harmony.

3.1. Analysis of Guaraní Nasal Harmony

I now provide a constraint-based analysis of Guaraní nasal harmony couched in Optimality Theory (OT) (Prince and Smolensky 1993). Although various aspects of the nasal harmony in Paraguayan Guaraní have previously been described and analyzed in the literature (Kaiser 2008; Lunt 1973; Robboy 1987; Walker 1999, 2000, 2003, among others), I provide the first full formal constraint-based analysis here. This account builds upon prior implementations of nasal harmony in OT, particularly Thomas' split analysis of a

similar nasal harmony system in Mbyá (Thomas 2014). Following Thomas, I propose that nasal harmony in Guaraní is most appropriately analyzed as two coexisting systems: vowel-to-vowel harmony as well as coarticulation of adjacent segment edges. In addition to its benefit as a novel contribution to the literature, this OT-based analysis helps to provide context for the interactions of nasal harmony and language mixing, upon which I expand in Section 4.

I assume here that each segment is comprised of two subsegments (Garvin et al. 2018). For instance, a post-oralized nasal consonant, like [mb], is represented with one [m] subsegment and one [b] subsegment.[4] Ample evidence for subsegmental representations comes from a multitude of phonological phenomena, including complex nasal segments and duration (Garvin et al. 2018) as well as tone (Shih and Inkelas 2013).

An analysis of nasal harmony in Guaraní must be able to account for the distribution of the three patterns found in the nasal harmony domain of the root and its prefixes. A nasal harmony domain may be entirely oral, entirely nasal, or split into exactly one nasal span and oral span, in which the nasal span occurs to the left of the oral span (Lapierre and Michael 2018). I provide an example of each type of span below in (15).

(15)   a. Oral

        ahecha
        [a-h-eˈʃa]
        1SG.A-H-see

        'I see.'

   b. Nasal

        ahetũ
        [ã-h-ẽˈtũ]
        1SG.A-H-smell

        'I smell.'

   c. Split nasal-oral

        ahendu
        [ã-h-ẽˈndu]
        1SG.A-H-listen

        'I listen.'

3.1.1. Nasal Spans

I focus first on accounting for nasal spans, as in (15b). An entirely nasal span results from a phonemic nasal at the right edge of a root, from which nasality spreads leftwards across adjacent syllable nuclei. In an OT analysis, this can be accounted for with a markedness constraint referencing agreement of syllable nuclei (Thomas 2014) (16). Nasal harmony is triggered by a phonemic nasal vowel and targets all vowels to its left.

(16)   AGREE-σ[NAS]: Assign a violation for each instance in which adjacent syllable nuclei do not agree in their values for the feature [nasal].

Descriptively, edges of adjacent segments in Guaraní tend to share a single articulation, either oral or nasal. I propose that this coarticulation arises from the combination of markedness constraints which penalize sequences of segment edges for failing to match in terms of nasality (17). The constraint *NV assigns a violation for any edge of a segment which is adjacent to a segment edge with the opposite coarticulation. Reflecting the observation that approximant consonants undergo nasalization, the markedness constraint *JṼ specifically penalizes transparency of approximants to nasal harmony. These constraints, combined, help account for the two triggers of nasal harmony in Guaraní: nasal consonants and nasal vowels, respectively.

(17)　a.　*NV: Assign a violation for a nasal consonant subsegment adjacent to an oral vowel subsegment across a segment boundary.

　　　b.　*JṼ: Assign a violation for an oral approximant subsegment adjacent to a nasal vowel subsegment across a segment boundary.

Since these constraints reference segment edges rather than a particular direction, they apply both within and across syllables in both directions. Additionally, referencing segment edges captures the generalization that subsegments within a single segment may not necessarily share a single articulation—like the *m* portion and the *b* portion of a post-oralized nasal—but each subsegment does share the same articulation as the segment edge next to it.

Finally, faithfulness to nasality on stressed vowels dominates faithfulness to nasality in general (18). This constraint ranking reflects the observation that nasality is contrastive only on a stressed vowel. Since stress in Guaraní is systematically assigned to the final syllable, this constraint typically references a root-final vowel.[5]

(18)　a.　ID-V́[NAS]: Assign a violation for an instance in which the output value for the feature [nasal] does not match the input value for a stressed vowel.

　　　b.　ID-IO[NAS]: Assign a violation for each time a subsegment's output value for the feature [nasal] does not match its input value.

To demonstrate the predictions made so far by this combination of constraints, I present the example in (19) in the tableau in Figure 1. Given the properties of nasal harmony that I have described for Paraguayan Guaraní, I assume that the underlying representation is the material given in between slashes in (19). Nasality originates from the phonemic stressed root-final vowel.

(19)　/ja-jo-ajuá̃/

　　　ñañoañuã
　　　[ɲã-ɲõ-ãɲũˈã]
　　　1PL.INCL.A-RECIP-hug

　　　'We hug each other.'

/jajoajuˈã/	*JṼ	ID-V́[NAS]	AGREE-σ[NAS]	ID-IO[NAS]
a.　jajoajuˈã			*!	
b.　jajoajuˈa		*!		**
c.　jãjõãjũˈã	***!			*******
☞ d.　ɲãɲõãɲũˈã				**************

Figure 1. Constraint-based analysis of /ja-jo-ajuˈã/.

Candidate (a), in which nasality does not spread leftwards from a stressed nasal vowel to adjacent syllable nuclei, is eliminated by the markedness constraint AGREE-σ[NAS]. Candidate (b), which changes the value of the feature [nasal] for the stressed vowel, fatally violates the faithfulness constraint ID-V́[NAS]. Candidate (c), in which an approximant consonant remains oral when adjacent to a nasal vowel, violates the highly ranked markedness constraint *JṼ. Finally, the faithfulness constraint ID-IO[NAS] is ranked low in Guaraní, allowing the nasalization of all subsegments to the left of a stressed nasal vowel, as exemplified by the winning candidate (d). The markedness constraint *NV does not come into play in this particular tableau, as none of the candidates shown include a sequence of a nasal consonant adjacent to an oral vowel.

3.1.2. Split Nasal-Oral Spans

Split nasal and oral spans result from the presence of a phonemic nasal consonant directly to the left of a phonemic oral vowel. The nasal consonant surfaces as post-oralized, and nasality spreads leftwards. Subsegmental representations are crucial in order to account for these split nasal and oral spans: a post-oralized consonant can be represented as a single segment with two subsegments, a nasal one followed by an oral one. The nasal left edge of a post-oralized nasal consonant shares a nasal articulation with the segment to its left, while the oral right edge shares an oral articulation with the segment to its right. In this way, the requirement that adjacent segment edges share a single articulation is maintained.

In order to account for why underlying nasal consonants surface as post-oralized, I propose that the faithfulness constraint MAX[NAS], which ensures that the nasality of a phonemic nasal consonant is maintained on the surface, is highly ranked (20). In other words, a segment cannot have nasal subsegments in the input but none in the output.

(20)　MAX[NAS]: Assign a violation for a segment with feature [nasal] in the input that is not present in the output.

The attested output, in which a nasal span is followed by an oral span, is correctly predicted from this constraint ranking, as demonstrated by the example in (21) and Figure 2.

(21)　/ro-h-enu/

　　rohendu
　　[r̃õ-h-ẽˈndu]
　　1>2-H-listen

　　'I listen to you.'

/roheˈnu/	*NV	ID-V́[NAS]	MAX[NAS]	AGREE-σ[NAS]	ID-IO[NAS]
a.　roheˈnu	**!				
b.　r̃õhẽˈnũ		*!			********
c.　rohendú	*!				*
☞ d.　r̃õhẽˈndu				*	*******
e.　roheˈtu			*!		**

Figure 2. Constraint-based analysis of /ro-h-eˈnu/.

Candidates (a) and (c), in which a nasal segment edge surfaces directly adjacent to an oral segment edge, are ruled out by the markedness constraint *NV. Candidate (b), involving nasality spreading rightwards from a phonemic nasal consonant, is ruled out by the faithfulness constraint ID-V́[NAS], which ensures that the surface value of the feature [nasal] for a stressed vowel remains identical to its input value. Candidate (e), which results in the complete denasalization of a phonemic nasal consonant, is eliminated by the constraint MAX[NAS]. The winning candidate (d), in which a phonemic nasal consonant surfaces as post-oralized before an oral vowel and spreads its nasality to the left, is correctly chosen.

We are now in a position to construct a constraint ranking for nasal harmony in Paraguayan Guaraní (Figure 3).

*NV, *JṼ, ID-V́[NAS], MAX[NAS]

》

AGREE-σ[nas]

》

ID-IO[NAS]

Figure 3. Proposed constraint ranking for Paraguayan Guaraní.

The combination of vowel-to-vowel harmony, enforced by the constraint AGREE-σ[NAS], and adjacent segment edge coarticulation, enforced by the constraints *NV and *JṼ, results in the transparency of obstruents to nasal harmony, like the /h/ in /rohe'nu/. Since vowel-to-vowel harmony takes place at the level of the syllable nucleus, no consonant can block the spread of nasality. This is consistent with the attested pattern in Guaraní.

An alternative constraint-based analysis of nasal harmony comes from Walker (2003), who examines crosslinguistic variation in nasal harmony. She establishes a typologically grounded hierarchy of markedness constraints: *NASALOBSTRUENTSTOP >> *NASALFRICATIVE >> *NASALLIQUID >> *NASALGLIDE >> *NASALVOWEL. Within the typology of possible languages which are predicted by this hierarchy, Walker classifies Guaraní as a language in which all segments are targets of nasal harmony. This includes voiceless obstruents, which are typically assumed to be transparent to harmony. In her proposed model, which invokes Harmonic Sympathy (McCarthy 1997), all segments within a harmony domain are phonologically nasal. However, because of phonetic constraints on the production of nasal obstruent stops, they cannot be realized on the surface, and the sympathetic candidate—a candidate with a faithfulness relationship to the phonetically impossible candidate—is selected instead. The sympathetic candidate is identical to the phonetically impossible candidate, with the exception that the problematic segment is transparent to nasal harmony on the surface. Walker argues that obstruent stops cannot be realized as nasal because it is physically impossible to produce nasalization with a burst: while this is undoubtedly true, there are other contexts in Guaraní in which voiceless stops alternate with nasal stops (e.g., the locative enclitic *pe* can surface as *mẽ* after a nasal). It is unclear why, under Walker's account, voiceless obstruents must surface as transparent rather than becoming fully nasal. In this analysis, however, I have followed Thomas (2014) in splitting nasal harmony into two coexisting systems: vowel-to-vowel harmony and consonant-vowel coarticulation. The identity of a consonant does not enter into vowel-to-vowel harmony whatsoever, thereby resulting in nasalization of adjacent syllable nuclei regardless of the intervening consonant. The constraints *NV and *JṼ penalize specific sequences of adjacent segments, but have no effect on obstruents, resulting in surface transparency. The constraint *NV, which in this analysis is relevant for consonant-vowel coarticulation, is independently motivated, as I have shown that it is also needed to account for the distribution of nasality in Guaraní outside of nasal harmony. For instance, this constraint helps to enforce shielding of a nasal consonant before an oral vowel, which is not straightforwardly accounted for in Walker's analysis.

In this constraint-based analysis of regressive nasal harmony in Guaraní, I have accounted for the distribution of entirely nasal spans as well as split nasal-oral spans. Entirely nasal spans result from a phonemic nasal vowel at the right edge of a root spreading nasality leftwards across adjacent syllable nuclei. Within and across those syllables, adjacent segments share a nasal articulation. Due to the effect of highly-ranked faithfulness constraints which are phonetically grounded and make reference to specific manners of articulation, voiceless obstruents are transparent to nasal harmony. Split nasal-oral spans result from a sequence of a phonemic nasal consonant and an oral vowel. A ranking in which the faithfulness constraint MAX[NAS] dominates ID-IO[NAS] results in the attested output, in which a nasal consonant is post-oralized before an oral vowel.

4. Interactions of Nasalization and Language Mixing

Spanish has three phonemic nasal consonants—/m/, /n/, and /ɲ/—but no phonemic nasal vowels (Harris 1984).[6] As such, Spanish loanwords contain surface phonological environments that never occur natively in Guaraní, since phonemic nasal consonants in Guaraní always surface as their partially oralized allophones before oral vowels. For instance, the sequence [no] is entirely possible in Spanish, but impossible within native Guaraní words: underlying /no/ would surface as either [ndo] or [nõ] in Guaraní, depending on stress and surrounding context.

Some sequences of a vowel and coda nasal in Spanish lexical items have been reinterpreted in Guaraní as phonemic nasal vowels, and exhibit native nasal harmony patterns within the root (22).

(22) a. che añandu   chekorasõme
          [ʃe ã-ɲãˈndu ʃẽ-*kõɾ̃ãˈsõ*=mẽ]
          1SG 1SG.A-feel 1SG.B-heart=LOC

          'I feel it in my heart.' (cf. Spanish *corazón*)

      b. chekasõ   ikuára
          [ʃẽ-*kãˈsõ*   i-ˈkʷaɾa]
          1SG.B-pants 3.B-hole

          'My pants have a hole.' (cf. Spanish *calzón*)

      c. pe havõre   oĩ   peteĩ   ñati'ũ
          [pe *hãˈʋõ*=ɾ̃ẽ   õ-ˈĩ   petẽˈĩ   ɲãtĩˈʔũ]
          DEM soap=LOC 3.A-be.LOC one mosquito

          'There is a mosquito on the soap.' (cf. Spanish *jabón*)

However, not all VN sequences in Spanish are borrowed into Guaraní as nasal vowels: rather, they more closely approximate the pronunciation of the lexical item as it is in Spanish. This appears to particularly be true for items that were likely borrowed relatively recently (23).

(23) a. che amoĩ   kuatia che<u>maletín</u>-pe
          [ʃe ã-mõˈĩ   kʷatiˈa ʃẽ-*maleˈtin*=pe]
          1SG 1SG.A-put paper   1SG.B-briefcase=LOC

          'I put the paper in my briefcase.' (cf. Spanish *maletín*)

      b. che akosina   <u>sartén</u>-pe
          [ʃe a-kosiˈna   saɾˈten=pe]
          1SG 1SG.A-cook frying.pan=LOC

          'I am cooking with a frying pan.' (cf. Spanish *sartén*)

      c. <u>kamisa</u> ojejapo   <u>algodón</u>-gui
          [*kamiˈsa* o-ɟe-ɟ-aˈpo   *alɣoˈðon*=wi]
          shirt   3.A-AGD-J-make cotton=from

          'The shirt was made from cotton.' (cf. Spanish *algodón*)

Most loaned roots containing nasal consonants are pronounced approximately as they are in Spanish. This may be somewhat surprising, as it is generally assumed that the output of word formation needs to adhere to the phonotactics of the matrix language; yet these items clearly violate Guaraní phonotactics, in that nasal consonants appear directly adjacent to oral vowels. The difference in strategy between adaptations to morpheme-internal nasal harmony (22) and apparent non-adaptations (23) is likely related to the diachronic expansion of Guaraní-Spanish bilingualism in Paraguay. Spanish influence on Guaraní appears to have taken place slowly and gradually over a long period of time, until quite recently, when urbanization has accelerated the rate of Guaraní speakers acquiring and using Spanish (Fernández Barrera 2015; Zajícová 2009). Since the majority of users of Guaraní today are bilingual with Spanish, they appear to be more tolerant of violations of Guaraní phonotactics by Spanish items (Pinta and Smith 2017).

The presence of a nasal consonant in a Spanish root triggers nasalization in morphemes further to the left, an observation first made by Thun (2005) in his study of Spanish-Guaraní code switching in texts. Even when oral vowels intervene, prefixes nasalize due to the influence of the root-internal nasal consonant (24).

(24) a. ñañotraicionáta
          [ɲã-ɲõ-tɾaisjoˈna-ta]
          1PL.INCL.A-RECIP-betray-FUT

          'We are going to betray each other.' (cf. Spanish *traicionar*)

b. oñemaquilla-meve   che narekonoséi   chupe
[õ-ɲẽ-*makiˈʎa*=mẽʋe   ʃe   n-ã-ɾekonoˈse*-j   ʃuˈpe]
3.A-AGD-makeup=until 1SG NEG-1SG.A-recognize-NEG DOM
'Until she put on makeup, I didn't recognize her.' (cf. Spanish *reconocer*)

c. nañañecomunicambái   guaraníme
[nã-ɲã-ɲẽ-*komunika*-ˈmba-j   w̃ãɾ̃ãˈnĩ=mẽ]
NEG-1PL.INCL.A-AGD-communicate-TOTAL-NEG Guaraní=LOC
'We don't all communicate in Guaraní.' (cf. Spanish *comunicar*)

This lies in contrast to all other attested examples of nasal harmony within Guaraní, which are all local: nasality spreads from one syllable (or segment) to the syllable (or segment) directly adjacent to it. As such, this data constitutes a novel case of long-distance nasal harmony, a typologically rare phenomenon (Rose and Walker 2011). The harmonization of prefixes to the root additionally serves as evidence against the PFIC, which requires the entire word to be subject to the same phonological constraints. The situation in Guaraní indicates that a single phonological system must have simultaneous access to phonological information about morphemes from two different languages. Alternatively, speakers are recruiting two distinct phonological systems within a singular phonological word—regardless, both situations are predicted to be impossible by the PFIC (Schindler et al. 2008).

Nasalization triggered by a nasal consonant within a Spanish root is sensitive to the phonological shape of the prefix. Prefixes in Guaraní may be of the shape V or CV. If the prefix is purely vocalic, as in (25a,b), it does not nasalize, unless it is directly adjacent to a nasal consonant (25c).

(25)   a.   okosina
         [o-*kosiˈna*]
         3SG.A-cook

         'She cooked.' (cf. Spanish *cocinar*)

     b.   *õ-*kosiˈna*
         3SG.A-cook

         intended: 'She cooked.' (cf. Spanish *cocinar*)

     c.   antende
         [ã-*nteˈnde*]
         1SG.A-understand

         'I understand.' (cf. Spanish *entender*)

Consonants in Guaraní fall into two categories: sonorants, which undergo nasalization, and obstruents, which are transparent to nasal harmony. Of the CV prefixes, a sonorant-initial prefix nasalizes (26a,b). However, a prefix containing an obstruent does not nasalize (26c,d).[7] Therefore, we can revise the generalization to state that prefixes of the shape JV, in which J represents an approximant, nasalize before loaned roots containing nasal consonants.

(26)   a.   ñakosina
         [ɲã-*kosiˈna*]
         1PL.INCL.A-cook

         'We cooked.' (cf. Spanish *cocinar*)

     b.   remondyryry   nekamisa
         [ɾ̃ẽ-mõ-ndɨɾɨˈɾɨ   nẽ-*kamiˈsa*]
         2SG.A-CAUS-drag 2SG.B-shirt

         'You ripped your shirt.' (cf. Spanish *camisa*)

     c.   amondyryry   chekamisa
         [ã-mõ-ndɨɾɨˈɾɨ   ʃe-*kamiˈsa*]
         1SG.A-CAUS-drag 1SG.B-shirt

         'I ripped my shirt.' (cf. Spanish *camisa*)

    d. *ã-mõ-ndɨɾɨˈɾɨ   ʃ**ẽ**-kamiˈsa
    1SG.A-CAUS-drag 1SG.B-shirt

    intended: 'I ripped my shirt.' (cf. Spanish *camisa*)

No consonants within loanwords block the nasalization of prefixes preceding a nasal consonant. This includes segments like /j/ which are typically undergoers of nasal harmony in Guaraní (27a), as well as segments like voiced stops (27b,c) which are not present in the Guaraní phonemic inventory.[8]

(27)   a. neyérno
        [nẽ-ˈʝerno]
        2SG.B-son.in.law

        'your son-in-law' (cf. Spanish *yerno*)

     b. naganái
        [n-ã-ɣaˈna-j]
        NEG-1SG.A-win-NEG

        'I didn't win.' (cf. Spanish *ganar*)

     c. nadonái   la   pirapire
        [n-ã-ðoˈna-j   la   piɾa-piˈɾe]
        NEG-1SG.A-donate-NEG DEF fish-skin

        'I didn't donate money.' (cf. Spanish *donar*)

5. Analysis

The combination of loaned roots and Guaraní morphology appears to pose a problem for the constraint-based analysis of nasal harmony I have proposed. Simply applying the same constraint ranking for regressive nasal harmony to words with loaned roots leads to unattested outputs, as demonstrated by the tableau in Figure 4 for (28).

(28)   /ja-jo-komuniˈka/

      ñañocomunica
      [ɲã-ɲõ-*komuniˈka*]
      1PL.INCL.A-RECIP-communicate

      'We communicate with each other.' (cf. Spanish *comunicar*)

/jaɟokomuniˈka/	*NV	ID-V́[NAS]	AGREE-σ[NAS]	ID-IO[NAS]
a. jaɟokomuniˈka	****!			
☛ b. ɲãɲõkõmũndiˈka			*	*************
c. ɲãɲõkõmũnĩˈkã		*!		***************
☹ d. ɲãɲõkomuniˈka	****!		*	********

Figure 4. Constraint-based analysis of /ja-jo-komuniˈka/ with native constraint ranking.

In this tableau, candidates (a) and (d) are ruled out by the constraint *NV, which incurs a violation for each instance of a nasal consonant edge adjacent to an oral vowel edge. Since that sequence occurs four times in each candidate ($o - m$, $m - u$, $u - n$, $n - i$), both candidates are eliminated. Candidate (c), in which nasality spreads rightwards onto the root-final vowel, fatally violates the faithfulness constraint ID-V́[NAS], which ensures that the output value of nasality on a stressed vowel is identical to its input value. This ranking therefore predicts that post-oralization of the nasal consonant within the loanword should occur, and nasality should spread leftwards from that nasal consonant throughout the root and prefixes. However, clearly, that prediction does not reflect the attested surface form, in which prefixes nasalize but the root includes nasal consonants adjacent to oral vowels.

An alternate constraint ranking, in which the faithfulness constraint ID-IO[NAS] dominates all other constraints, also predicts an unattested surface form, in which prefixes

show no effect of nasalization (Figure 5). When evaluating the entire word at once, it does not seem to be possible to distinguish between the phonological grammar associated with the lexical stratum of the root and that of the morphology.

/jajokomuniˈka/	ID-IO[NAS]	*NV	ID-V́[NAS]	AGREE-σ[NAS]
☙ a. jajokomuniˈka		****		
b. ɲãɲõkõmũndiˈka	*************!			*
c. ɲãɲõkõmũnĩˈkã	***************!		*	
☺ d. ɲãɲõkomuniˈka	********!	****		*

Figure 5. Constraint-based analysis of /ja-jo-komuniˈka/ with alternative constraint ranking.

Instead, I assume that different lexical strata—classes of morphemes distinguished by etymological origin—have distinct constraint rankings at the root level. As per Cophonology Theory, a lexical stratum may be associated with its own phonological grammar, or cophonology (Inkelas 1998; Inkelas and Zoll 2007; Orgun 1996). I now expand upon the five lexical strata proposed by Pinta and Smith (2017) in order to extend their analysis to incorporate behavior with respect to nasal harmony. In the native stratum, the faithfulness constraint ID-IO[NAS] is ranked low, while in loanword strata that same constraint is undominated. As a result, native roots show the effects of nasal harmony.[9] Segments within loanwords, on the other hand, have the same value for nasality in the output as in the input. Non-native strata, which can be distinguished by other phonotactic characteristics like the reduction of consonant clusters and placement of stress, share a cophonology in which the faithfulness constraint ID-IO[NAS] is undominated. Therefore, loanwords are not subject to the effects of nasal harmony and coarticulation at the root level, unlike native items.

I assume that the root constitutes the syntactic spell-out domain of a phase (López et al. 2017; Marantz 2007), and that phonological evaluation takes place cyclically, first at the root level and then at the stem level. Because the root has already undergone phonological evaluation, it is subject to faithfulness to the output of the previous phase (McPherson and Heath 2016). I make use of the faithfulness constraint ID-PHASE to indicate that the phonological content of the root must be frozen after root-level evaluation, but before stem-level evaluation. I assume that, in the event of the affixation of native Guaraní morphology to a Spanish loaned root, the root first undergoes phonological evaluation per the phonological grammar associated with the loanword strata. At the stem level, the root and prefixes are evaluated together. At this point, there is no distinction whatsoever in the evaluation of loanword roots as opposed to native roots. Due to the high ranking of the faithfulness constraint ID-PHASE, though, any candidate in which the phonological form of the root is altered is ruled out. Without such assumptions, all morphemes in the input are phonologically evaluated at once, resulting in the derivation of unattested surface forms.

In order to evaluate the harmony component of the interaction of a loanword with native Guaraní morphology, I make use of the Agreement by Correspondence (ABC) framework (Rose and Walker 2004), an account of harmony within Optimality Theory, which treats harmony processes as a form of featural agreement between segments. In an ABC analysis, correspondences between similar segments are established by a hierarchy of CORR constraints. In Guaraní, the relevant constraints are presented in (29): correspondence relations exist between nasal consonants, as well as between nasal consonants and approximants, the undergoers of nasal harmony. The fact that obstruents are transparent to nasal harmony is attributable to the low ranking of the constraint invoking a correspondence relation between nasal consonants and obstruents. The use of the ABC framework is appropriate for this data, as it reflects the observation that triggers of nasalization within loanwords are necessarily consonantal, and targets of nasalization within prefixes are always approximant consonants.

(29)   a.   CORRN-N: There is a correspondence relation between two nasal consonants.

　　　b.   CORRN-J: There is a correspondence relation between a nasal consonant and an approximant.

Agreement between corresponding segments with respect to a feature (here, nasality), is enforced by a faithfulness constraint (30), thus ensuring that an approximant in a correspondence relation with a nasal consonant will also surface as nasal.

(30) IDENT-CC: Let C1 and C2 be consonants in the output, and let there be a correspondence relation from C1 to C2. If C1 is nasal, so is C2.[10]

In addition to the phase faithfulness and ABC constraints, the coarticulation constraint *NV, which ensures that nasal consonants agree in terms of nasality with the vowels to which they are adjacent, is relevant here (Figure 6).

/jajokomuniˈka/	ID-PH	ID-CC	CORRN-J	*NV	ID[NAS]
a. ɟ$_x$aɟ$_x$okom$_x$un$_x$iˈka		**!		****	
b. ɟ$_x$aɟ$_x$okom$_y$un$_y$iˈka			**!	****	
c. ɲ$_x$ãɲ$_x$õkõm$_x$ũn$_x$ĩˈkã	****!				***************
d. ɲ$_x$ãɲ$_x$õkõmb$_x$ũnd$_x$iˈka	****!				**************
e. ɲ$_x$aɲ$_x$okom$_x$un$_x$iˈka				*******!	****
☞ f. ɲ$_x$ãɲ$_x$õkom$_x$un$_x$iˈka				****	********

Figure 6. Constraint-based analysis of /ja-jo-komuniˈka/ with ABC analysis.

In the above tableau, we see that candidates (a) and (b) are ruled out by the architecture of ABC. Candidates (c) and (d) are ruled out: any candidate in which the phonological form of the root is altered is eliminated by the highly-ranked phase faithfulness constraint.[11] Candidate (e), in which all consonants harmonize but the vowels in between do not, is eliminated due to violating *NV more times than the winner, candidate (f).

This combination and ranking of constraints result in the correct output, in which prefixes surface as nasal before a loanword with a nasal consonant, despite the non-local relationship between the trigger and target. The correspondence and identity constraints within the ABC framework ensure that the consonants in the prefixes nasalize, and the coarticulation constraint *NV results in nasalization of the adjacent vowels as well. This coarticulation constraint has no effect on the nasality of vowels within the root, as per the highly-ranked ID-PHASE constraint. This interaction reflects the surface form, in which consonants and vowels in prefixes share a single articulation, while identical sequences within loanword roots do not.

Alternative Analyses

An alternative analysis of the data could involve positing that all prefixes have oral and nasal allomorphs, and that the presence of a specified nasal segment within a root triggers the choice of the nasal allomorph of a prefix. However, such an analysis cannot easily account for the fact that only prefixes including approximant consonants nasalize in the presence of a loaned root containing a nasal consonant. Instead, the analysis I have proposed involving consonant harmony is better equipped to account for the data.

Another alternative analysis could consider loaned roots as having more underlying specifications than native roots. For instance, every segment within a loaned root could be underlyingly specified as nasal or oral, while all segments within native morphology are underspecified for nasality. Under this analysis, words simply undergo phonological evaluation once, by a single phonological grammar. Application of the highly ranked faithfulness constraint MAX[NAS] would result in the derivation of surface forms in which prefixes nasalize but segments within loaned roots do not. This analysis would assume that, in a root like *kosina* 'cook', the nasal consonant [n] would be specified as nasal, and all other segments within the root would be specified as oral. However, such an analysis still fails: we have seen that, elsewhere in Guaraní, the sequence of a specified nasal consonant and specified oral vowel results in post-oralization of the nasal consonant (cf. Figure 2). In this

kosina example, the nasal consonant lies between two specified oral vowels. Under this analysis, we would then predict to see shielding occur in both directions, resulting in an unattested surface output like *[kosindná]. This alternative analysis, in which all segments within loaned roots are underlyingly specified for nasality or orality, makes incorrect predictions about surface forms.

Yet another alternative analysis could involve Stratal Optimality Theory, in which phonological evaluation applies iteratively at different levels (Bermúdez-Otero 2011; Kiparsky 2000). Under a Stratal OT approach, the output of one phonological evaluation serves as the input to the next phonological evaluation. Under such an analysis, phonological evaluation would apply first to the root, e.g., *kosina*. Similarly to the analysis I have proposed, the root would be evaluated by a phonological grammar associated with its lexical stratum, here the loanword stratum. Phonological evaluation would next apply at the stem level, at which point native morphology attaches to the root. However, a Stratal OT analysis fails at this point, as the entire word would now be subject to the same phonological grammar, therefore predicting that a loanword root would behave exactly like a native root (cf. Figure 4).

Finally, a different potential approach to the data I have presented here would be to invoke indexed constraints, in which distinct faithfulness constraints make reference to lexical strata (McCarthy and Prince 1995; Ito and Mester 1995, 1999; Alderete 2001). For instance, ID-IO[NAS][LOAN] would outrank ID-IO[NAS][NATIVE]. The stem would be phonologically evaluated at once, with all morphemes indexed as either loaned or native. The indexed faithfulness constraints would therefore incur violations based on the stratum to which a morpheme belongs: for example, the outcome *ñãñõkosiná* would incur zero violations for the constraint ID-IO[NAS][LOAN] and four violations for the constraint ID-IO[NAS][NATIVE]. An analysis involving indexing constraints to lexical strata is able to correctly derive the observed surface forms. However, such an analysis also involves making assumptions about the mechanisms involved in phonological evaluation, particularly in that the phonology must be able to have access to information about the specific lexical stratum to which each morpheme belongs. My analysis instead assumes that the differential behavior of morphemes by stratum is attributable to the association of each lexical stratum with its own cophonology: faithfulness constraints are reranked within the phonological grammar associated with each stratum, rather than specifically indexed to each stratum.

6. Discussion and Conclusions

I have provided data from a novel case of nasal harmony within word-internal language mixing contexts. The data suggests that phonological grammars (in this model, constraint rankings), must involve phonological evaluation at both the root and stem level, and be sensitive to loan versus native strata. A root is first evaluated according to the cophonology associated with its lexical stratum. Then, at the stem level, the phonological form of the root is subject to faithfulness to the output of prior evaluation. At the same time, a nasal segment within a root is able to trigger harmony, affecting the surface form of prefixes. This work, which directly addresses word-internal mixing of distinct lexical strata, fills an important gap in our understanding of the interface between phonology and morphology.

The constraint-based analysis I have proposed within the ABC framework for the interactions of lexical borrowings with regressive nasal harmony predicts that this process crucially differs from the same system when only native words are involved in terms of triggers. My account of regressive nasal harmony in Guaraní involves constraints ensuring that both adjacent syllable nuclei and linearly adjacent segments agree in nasality, reflecting the two possible triggers of nasal harmony: phonemic nasal vowels and consonants. Triggers of nasal harmony within lexical borrowings from Spanish, on the other hand, may only be nasal consonants, given that Spanish lacks phonemic nasal vowels. I have shown that long-distance nasal harmony triggered by nasal consonants within Spanish loaned roots only targets prefixes which include approximant consonants. The ABC analysis

involving correspondence relations between similar consonants reflects that this process is most appropriately considered to be consonant harmony, with nasal coarticulation between adjacent segments within prefixes. I have shown evidence for the existence of a novel nasal consonant harmony system in Guaraní within the domain of loanword roots and their prefixes, which has developed out of the productive nasal harmony system of Guaraní. Prototypical nasal harmony in Guaraní involves vowel-to-vowel harmony as well as consonant-vowel coarticulation, as I have described: this new system of long-distance consonant harmony is therefore truly exceptional.

The data I have presented reveals that the interactions of nasal harmony and word-internal language mixing in Guaraní provides a substantial contribution to our understanding of formal models of word formation. This data contributes to the literature relating to the novel analytical approach taken by López et al. (2017), in deploying phase theory to account for where and how language mixing may occur. The Guaraní nasal harmony facts also, however, challenge several assumptions about the outputs of word-internal language mixing. According to the PFIC (MacSwan and Colina 2014), PF takes the syntactic word as the unit of analysis, and therefore requires the entire word to be subject to the same phonological constraints. In this paper, I have presented data which challenges the PFIC-based account, as I have shown that evaluation of the entire word by a single phonological grammar fails to correctly predict the surface form when that word involves the affixation of Guaraní morphology to a Spanish root. It is not, in fact, the case that all morphemes within such cases of word-internal language mixing are all subject to the same phonological constraints. As such, the proposal I have put forth here echoes previous findings by Schindler et al. (2008) and Flores and Williams (2019), who have argued that word-internal switches between phonological systems are indeed possible and attested in the world's languages.

In conclusion, patterns of nasal harmony in contexts involving word-internal language mixing challenge assumptions made by the PFIC, in that distinct constraint rankings associated with lexical strata must apply at the root level in order to correctly predict the attested output. An analysis which involves phases is able to capture this generalization. Finally, phonology needs to apply at both the root and stem level, and be sensitive to lexical stratum at each level.

Abbreviations

The following abbreviations are used in this manuscript:

1	first person
2	second person
3	third person
A	set A agreement prefix
B	set B agreement prefix
ACC	accusative
AGD	agent demoter
CAUS	causative
COLL	collective
COND	conditional
DEF	definite
DEM	demonstrative
DIM	diminutive
DOM	differential object marking
FRUS	frustrative
FUT	future
H	relational /h/
IMP	imperative
INCIP	incipient
INCL	inclusive
INTENS	intensifier
J	epenthetic /j/
LOC	locative
NAS	nasal
NEG	negative
NMLZ	nominalizer
N.PST	nominal past
PL	plural
PLEAD	plea
POSS	possessive
PRIV	privative
PRS	present
R	relational /r/
RECIP	reciprocal
RED	reduplication
REQ	request
SG	singular
TOTAL	totalitive
Q	question

Notes

[1] I take the term 'language mixing' to refer to the combination of morphemes from two (or more) languages that appear together (Alexiadou and Lohndal 2018; Muysken 2000).

[2] This example was elicited in the following context: I have a sticker in the shape of a heart and I want to find a place to put it. I decide to put it on my doll. How would I describe what I did to the doll?

[3] There is one exception to this generalization: the presence of a suffix with an initial alveolar flap and following nasal vowel results in the spreading of nasality one segment to the left—for instance, /ʃe-ɾoɰa-ɾã/ 'my future house' is pronounced as [ʃeɾoɰãɾ̃ã́], in which the final vowel of the root surfaces as nasal but does not nasalize segments further to the left. However, this surface form is likely phonetically, rather than phonologically, driven.

[4] At this time, I leave the investigation of acoustic and airflow data of post-oralized consonants for future research.

[5] This constraint could alternatively be formulated as invoking positional faithfulness (Beckman 1998): for instance, faithfulness to nasality on a vowel at the right edge of a root, as stress in Guaraní is systematically assigned to the final syllable. In the few cases of exceptional non-final stress, however, a constraint which specifically makes reference to the property of stress is necessary.

[6]   This is not to say that vowels are never pronounced with phonetic nasalization in Spanish: however, nasalization is not a target of speech production in Spanish vowels and nasalization is not a phonologically active feature of vowels in the language (Solé 1992).

[7]   I leave concrete conclusions about the nasalization of rhotics and fricatives at the left edge of words for future work involving more fine-grained phonetic data.

[8]   In Spanish, these voiced stops are spirantized in intervocalic position, and are often pronounced as such when present in Guaraní: voiced fricatives also do not occur in the Guaraní phonemic inventory, and similarly would be predicted to block nasal harmony.

[9]   Fully nativized loanwords, like *kõrãsõ* 'heart', fall within the native stratum (Pinta and Smith 2017).

[10]   The notations C1 and C2 simply refer to any two consonants in the output: this constraint does not assume any specific direction of harmony.

[11]   This phase faithfulness requirement holds true for native roots, as well: it is not exclusive to loanword roots, although the effects are more clearly visible with loanwords. Additionally, it may be relevant in accounting for other phenomena related to nasal harmony in Guaraní. For instance, the failure of a nasal vowel or consonant within a suffix to trigger regressive nasal harmony (e.g., 14b) could be analyzed as due to the high ranking of the phase faithfulness constraint. Other analyses of nasal harmony, like Walker (2003)'s sympathy account, often fail to capture these interactions of morphology and phonology, but they fall out straightforwardly from an analysis referencing phase faithfulness.

References

Alexiadou, Artemis, and Terje Lohndal. 2018. Units of Language Mixing: A Cross-Linguistic Perspective. *Frontiers in Psychology* 9: 1719. [CrossRef] [PubMed]

Alderete, John D. 2001. Dominance effects as transderivational anti-faithfulness. *Phonology* 18: 201–53. [CrossRef]

Azuma, Shoji. 1996. Free morpheme constraint revisited. *World Englishes* 15: 361–67. [CrossRef]

Bakker, Dik, Jorge A. Gómez Rendón, and Ewald Hekking. Spanish meets Guaraní, Otomí, and Quechua: A multilingual confrontation. In *Aspects of Language Contact: New Theoretical, Methodological and Empirical Findings with Special Focus on Romancisation Processes*. Edited by Thomas Stolz, Dik Bakker and Rosa Salas Palomo. Berlin: Mouton de Gruyter, pp. 165–238.

Beckman, Jill. 1998. *Positional Faithfulness*. London: Routledge.

Bermúdez-Otero, Ricardo. Cyclicity. In *The Blackwell Companion to Phonology*. Edited by Marc van Oostendorp, Colin J. Ewen, Elizabeth Hume and Keren Rice. Malden: Wiley-Blackwell.

Boersma, Paul, and David Weenink. Praat: Doing Phonetics by Computer [Computer Program]. Version 6.2.06. Available online: http://www.praat.org/ (accessed on 21 January 2022).

Boidin, Capucine. Jopara: Una vertiente sol y sombra del mestizaje. In *Tupí y Guaraní. Estructuras, Contactos y Desarrollos*. Edited by Wolf Dietrich and Haralambos Symeonidis. Munster: Lateinamerika Zentrum/Centro Latinoamericano de l'Université de Münster.

Boyer, Henri. 2010. *Hybrides Linguistiques: Genèses, Statuts, Fonctionnements*. Paris: L'Harmattan.

Cabral, Ana Suely Arruda Câmara, and Aryon Dall'Igna Rodrigues. 2011. The Interface of Stress and Nasality in Tupí-Guaraní Languages in a Historical Perspective. *Rivista di Linguistica* 7: 1–15.

Cardoso, Valéria Faria. 2009. Sistematização da Fonologia Kaiowá: Nazalição e/ou Oralização. *Sínteses* 14: 31–72.

Chen, Marilyn Y. 1997. Acoustic correlates of English and French nasalized vowels. *The Journal of the Acoustical Society of America* 102: 2360–70. [CrossRef]

Choi, Jinny K. 2004. Language planning and language spread of Guarani in Paraguay: Comparison, evaluation, and implication. *Language Problems and Language Planning* 28: 241–59. [CrossRef]

Choi, Jinny K. 2005. The linguistic situation in urban Paraguay: A tendency toward Spanish-Guarani bilingualism? *Spanish Context* 2: 175–201. [CrossRef]

Daviet, Windy. 2016. Observations Sociolinguistiques et Analyse de la Phonologie du Dialecte ava du Guaraní Bolivien, Langue Tupi-Guaraní de Bolivie. Master's thesis, Université Lumière Lyon, Lyon, France.

Dietrich, Wolf. 2010. Lexical evidence for a redefinition of Paraguayan 'Jopara.' *Language Typology Universals* 63: 39–51. [CrossRef]

Dietrich, Wolf. Word Classes and Word Class Switching in Guaraní Syntax. In *Guarani Linguistics in the 21st Century*. Edited by Bruno Estigarribia and Justin Pinta. Leiden: Brill, pp. 158–93.

Dirección General de Estadística, Encuestas y Censos (DGEEC): National Population and Housing Census of 2012. Available online: https://www.ine.gov.py/publication-single.php?codec=MzY= (accessed on 30 August 2021).

Estigarribia, Bruno. 2015. Guaraní-Spanish Jopara Mixing in a Paraguayan Novel. *Journal of Language Contact* 8: 183–222. [CrossRef]

Estigarribia, Bruno. 2020. *A Grammar of Paraguayan Guaraní*. Edited by Lily Kahn and Riitta-Liisa Valijärvi. London: UCL Press.

Estigarribia, Bruno. 2021. A Diachronic Account of Exceptional Progressive Nasalization Patterns in Guaraní Causatives. *IJAL* 87: 203–41. [CrossRef]

Fernández Barrera, Meritxell. Paraguayan Guarani: Some Considerations about Language Mixing and an Acoustic Study of Urban and Rural Vowels. Master's thesis, Leiden University, Leiden, The Netherlands, 2015.

Fernández Guizzetti, Germán. 1966. *Los Determinadores y la Cuantificación en el Pensar Real de los Hablantes del Guaraní Yopará*. Rosario, Argentina: Instituto de Antropología, Facultad de Filosofía, Universidad Nacional del Litoral.

Flores, Tanya L., and Aja Williams. 2019. Japoñol: Spanish-Japanese Code-Switching. *IULC Working Papers* 19: 1–21.

Garvin, Karee, Myriam Lapierre, and Sharon Inkelas. 2018. A Q-theoretic approach to distinctive subsegmental timing. Paper presented at the Linguistic Society of America, Salt Lake City, UT, USA, January 4–7.

Goldsmith, John A. 1976. Autosegmental Phonology. Ph.D. thesis, Massachusetts Institute of Technology, Cambridge, MA, USA.

Gómez, Mary, Irma Easty Ovelar, Madeline Bossi, Maksymilian Dabkowski, Emily Drummond, Emily Grabowski, Rebecca Jarvis, Phuong Khuu, Lev Michael, and Katherine Russell. 2020. *Berkeley Field Methods: Paraguayan Guaraní*. Survey of California and Other Indian Languages. Berkeley: University of California. http://dx.doi.org/doi:10.7297/X2PR7TNF. [CrossRef]

González-Vilbazo, Kay, and Luis López. 2011. Some properties of light verbs in code switching. *Lingua* 121: 832–50. [CrossRef]

Gregores, Emma, and Jorge A. Suárez. 1967. *Suárez. A Description of Colloquial Guaraní*. The Hague: Mouton.

Gynan, Shaw N. 1998. Attitudinal Dimensions of Guaraní-Spanish Bilingualism in Paraguay. *Modern & Classical Languages* 61: 35–59.

Hamidzadeh, Khashayar. 2013. Reduplication in Paraguayan Guaraní: A Descriptive Account. Master's thesis, University of Manitoba, Winnipeg, MB, Canada.

Harris, James W. 1984. Autosegmental Phonology, Lexical Phonology, and Spanish Nasals. In *Language Sound Structure*. Edited by Mark Aronoff and Richard T. Oehrle. Cambridge: MIT Press, pp. 67–82.

Inkelas, Sharon. 1998. The theoretical status of morphologically conditioned phonology: A case study from dominance. In *Yearbook of Morphology*. Edited by Geert E. Booij and Jaap van Marle. Amsterdam: Springer, pp. 121–55.

Inkelas, Sharon, and Cheryl Zoll. 2007. Is Grammar Dependence Real? A comparison between cophonological and indexed constraint approaches to morphologically conditioned phonology *Linguistics* 45: 133–71.

Itô, Junko, and Armin Mester. 1995. Japanese phonology. In *Handbook of Phonological Theory*. Edited by John A. Goldsmith. Cambridge: Blackwell, pp. 817–38.

Itô, Junko, and Armin Mester. 1999. The phonological lexicon. In *The Handbook of Japanese Linguistics*. Edited by Natsuko Tsujimura. Malden: Blackwell, pp. 62–100.

Kaiser, E. 2008. Nasal Spreading in Paraguayan Guarani: Introducing Long-distance Continuous Spreading. *Amerindia* 32: 283–300.

Kiparsky, Paul. 2000. Opacity and cyclicity. *The Linguistic Review* 17: 351–67. [CrossRef]

Lapierre, Myriam, and Lev Michael. 2017. Nasal segments in Tupi-Guaraní: A comparative synthesis. Paper presented at the 8th Conference on Indigenous Languages of Latin America (CILLA VIII), Austin, TX, USA, October 26–28.

Lapierre, Myriam, and Lev Michael. 2018. Nasal harmony in Tupi-Guaraní: A comparative synthesis. Paper presented at SSLA III, Amherst, MA, USA, October 19–21.

López, Luis, Artemis Alexiadou, and Tonjes Veenstra. 2017. Code-Switching by Phase. *Languages* 2: 9. [CrossRef]

Lunt, Horace G. 1973. Remarks on nasality: The case of Guaraní. In *A Festschrift for Morris Halle*. Edited by Stephen R. Anderson. Austin: Holt, Rinehart and Winston, pp. 131–39.

Lustig, Wolf. 2010. Mba'éichapa oiko la guarani? Guaraní y jopara en el Paraguay. *PAPIA-Revista Brasileira de Estudos do Contato Linguístico* 4: 19–43.

MacSwan, Jeff, and Sonia Colina. 2014. Some consequences of language design: Code switching and the PF Interface. In *Grammatical Theory and Bilingual Codeswitching*. Edited by Jeff MacSwan. Cambridge: MIT Press, pp. 185–200.

Marantz, Alec. 2007. Phase and words. In *Phases in the Theory of Grammar*. Edited by Sook-Hee Choe. Seoul: Dong-In Publishing Co., pp. 191–222.

McCarthy, Paul, and Alan Prince. 1995. Faithfulness and reduplicative identity. In *University of Massachusetts Occasional Papers in Linguistics 18: Papers in Optimality Theory*. Edited by Jill Beckman, Laura Walsh Dickey and Suzanne Urbanczyk. Amherst: GLSA, pp. 249–384.

McCarthy, Paul. 1997. Sympathy and phonological opacity. Paper presented at the Hopkins Optimality Theory Workshop, Baltimore, MD, USA, May 9–12.

McPherson, Laura, and Jeffrey Heath. 2016. Phrasal grammatical tone in the Dogon languages: The role of constraint interaction. *NLLT* 34: 593–639. [CrossRef]

Melià, Bartomeu. 1974. Hacia una 'tercera lengua' en el Paraguay. *Estudios Paraguayos* 2: 31–71.

Morínigo, Marcos A. 1959. Influencia del español en la estructura lingüística del guaraní. *Filología* 5: 235–47.

Muysken, Pieter. 2000. *Bilingual Speech: A Typology of Code-Mixing*. Cambridge: Cambridge University Press.

Myers-Scotton, Carol. 1993. *Dueling Languages: Grammatical Structure in Code Switching*. Oxford: Oxford University Press.

Orgun, C. Orhan. 1996. Sign-Based Morphology and Phonology: With Special Attention to Optimality Theory. Ph.D. thesis, University of California, Berkeley, CA, USA.

Palacios Alcaine, Azucena. 2008. Paraguay. In *El Español en América: Contactos Lingüísticos en Hispanoamérica*. Edited by Azucena Palacios Alcaine. Barcelona: Ariel, pp. 279–300.

Piggott, Glyne. 1992. Variability in feature dependency: The case of nasality. *NLLT* 10: 33–78. [CrossRef]

Pinta, Justin, and Jennifer L. Smith. 2017. Spanish Loans and Evidence for Stratification in the Guarani Lexicon. In *Guarani Linguistics in the 21st Century*. Edited by Bruno Estigarribia and Justin Pinta. Leiden: Brill, pp. 285–314.

Prince, Alan, and Paul Smolensky. 1993. *Optimality Theory: Constraint Interaction in Generative Grammar*. Technical Report CU-CS-696-93. Boulder: Department of Computer Science, University of Colorado.

Rivas, A. 1974. Nasalization in Guaraní. Master's thesis, Massachusetts Institute of Technology, Cambridge, MA, USA.

Robboy, W. 1987. Rule-specific transparency and P-bearingness: Evidence from Guaraní nasality processes. Paper presented at the West Coast Conference on Formal Linguistics, Tucson, AZ, USA, March 20–22.

Rose, Françoise. 2008. *Grammaire de Emérillon Teko, une Langue Tupi-Guarani de Guyane Française*. Leuven: Peeters.

Rose, Sharon, and Rachel Walker. 2004. A typology of consonant agreement as correspondence. *Language* 80: 475–531. [CrossRef]

Rose, Sharon, and Rachel Walker. 2011. Harmony systems. In *The Handbook of Phonological Theory*. Edited by John Goldsmith, Jason Riggle and Alan C.L. Yu. Oxford: Blackwell Publishing, pp. 240–90.

Schindler, Molly, Géraldine Legendre, and Abdoulaye Mbaye. 2008. Violations of the PF Interface Condition in Urban Wolof. Paper presented at the Annual Meeting of the Chicago Linguistic Society, Chicago, IL, USA, January 3–6.

Shih, Stephanie, and Sharon Inkelas. 2013. A subsegmental correspondence approach to contour tone (dis)harmony patterns. Paper presented at the Annual Meeting on Phonology, Linguistic Society of America, Washington, DC, USA, January 3–6.

Solé, Maria-Josep. 1992. Phonetic and Phonological Processes: The Case of Nasalization. *Language Speech* 35: 29–43. [CrossRef]

Stanton, Juliet. 2017. Constraints on the Distribution of Nasal-Stop Sequences: An Argument for Contrast. Ph.D. thesis, Massachusetts Institute of Technology, Cambridge, MA, USA.

Stefanich, Sara, and Jennifer Cabrelli Amaro. 2018. Phonological factors of Spanish/English word internal code switching. In *Code-Switching—Experimental Answers to Theoretical Questions: In Honor of Kay González-Vilbazo*. Edited by Luis López. Amsterdam: John Benjamins Publishing Co., pp. 195–203.

Steriade, Donca. 1993. Closure, release and nasal contours. In *Phonetics and Phonology 5: Nasals, Nasalization and the Velum*. Edited by Marie K. Huffman and Rena A. Krakow. San Diego: Academic Press, pp. 401–70.

Thomas, Guillaume. 2014. A split analysis of nasal harmony in Mbyá. *Rivista di Linguistica* 10: 75–104.

Thun, Harald. 2005. 'Code switching', 'code mixing', 'reproduction traditionnelle' et phénomènes apparentés dans le guarani paraguayen et dans le castillan du Paraguay. *Rivista di Linguistica* 17: 311–46.

Tonhauser, Judith. 2007. Nominal Tense? The Meaning of Guaraní Nominal Temporal Markers. *Language* 83: 831–69. [CrossRef]

Walker, Rachel. 1999. Guarani voiceless stops in oral versus nasal contexts: An acoustical study. *JIPA* 29: 63–94. [CrossRef]

Walker, Rachel. 2000. Long-distance consonantal identity effects. Paper presented at the WCCFL 19, Los Angeles, CA, USA, February 4–6. Edited by Roger Billerey and Brook Lillehaugen. Somerville: Cascadilla Press.

Walker, Rachel. 1999. Reinterpreting Transparency in Nasal Harmony. Paper presented at the 4th HIL Phonology Conference, Leiden, The Netherlands, January 28–30.

Zajiícová, Lenka. 2009. El bilingüismo paraguayo: Usos y actitudes hacia el guaraní y el castellano. In *Lengua y Sociedad en el Mundo Hispánico*. Madrid: Vervuert Verlagsgesellschaft.