Loanword Adaptation:

A study of some

Australian Aboriginal Languages

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Abstract

This thesis is a case study of some aspects of the adaptation of English words in several Australian Aboriginal languages, including Martu Wangka, Gamilaraay and Warlpiri. I frame my analysis within Smith's (to appear) source-similarity model of loanword adaptation. This model exploits loanword-specific faithfulness constraints that impose maximal similarity between the perceived source form and its corresponding loan. Using this model, I show that the conflict of the relevant prosodic markedness constraints and loanword-specific faithfulness constraints drives adaptation. Vowel epenthesis, the most frequent adaptation strategy, allows the recoverability of a maximal amount of information about the source form and ensures that the loan conforms to the constraints of language-internal phonological grammar. Less frequent strategies including deletion and substitution occur in a restricted environment. The essence of the present analysis is minimal violation, a principle that governs loanword adaptation as well as other areas of phonology.

Contents

List of Abbreviations

Abbreviation	**Meaning**
Ls	source language
Lb	borrowing language
OT	Optimality Theory
IO	Input-Output
FAITH	faithfulness
CORR	correspondence
PLS	Posited representation of the source-language form
MAX	Maximality
DEP	Dependence
IDENT	Identity
ALIGN	Alignment constraint
±SON	±sonorant
±CONT	±continuant
±RND	±round
±LW	±low
LAB	labial
DOR	dorsal
COR	coronal
AUG	augmentive suffix
V	Verb
T	voiceless obstruent
D	voiced obstruent
S	voiceless sibilant (usually *s*)
N	Nasal
R	Sonorant
O	Obstruent

1 Introduction

Borrowing of words is a pervasive phenomenon of languages in contact. From a phonological viewpoint, borrowing is interesting when the borrower and the borrowee languages have distinct phonological structures. In such cases, words are typically adapted to the phonology of the borrowing language. However, such adaptation is not unconstrained. Crucially, there seems to be a requirement that the borrowed word remain as similar as possible to the source form. Recently, there has been considerable work in phonology arguing for different positions on the issue of borrowing. Adaptation has been attributed to the misperception of unfamiliar speech sounds (Silverman 1992; Peperkamp and Dupoux 2003; Peperkamp 2004), the mispronunciation of non-native forms (Paradis and LaCharité 1997), a combination of perceptual and phonological influences (Yip 2002, 2006; Smith 2006) and the borrower's attempt to maximise perceptual similarity between perceived source form and the loan (Kang 2003; Adler 2006; Kenstowicz 2003).

In this thesis, I present an analysis of some aspects of adaptation in several Australian Aboriginal languages which show that both perceptual and phonological factors must be included in the account. I frame my analysis in Jennifer Smith's (ms: 28th September 2007) model of loanword adaptation formalised within Optimality Theory (henceforth OT).[1] This model exploits loanword-specific faithfulness constraints that demand identity between the perceived source form and the corresponding spoken loan.

1.1 General Introduction

Loanword adaptation refers to the process in which a lexical form is adopted from a source language and incorporated into the lexicon of the target borrowing language, performed by a borrower. The examples in (1) illustrate various adaptation strategies using an example of a Martu Wangka borrowing from the English word 'if':

[1] To appear in Steve Parker, ed., *Phonological Argumentation: Essays on Evidence and Motivation.* London: Equinox.

(1) English source word and its corresponding Martu Wangka loan:

a. English [ɪf] 'if'

b. Martu Wangka [jiːpi] yiipi < English 'if'

In the Martu Wangka loan (1b), the English voiceless labiodental fricative [f] is realised as the labial stop [p]. We also observe the additional material in the Martu Wangka loan. A glide [j] occurs as the onset and a vowel [i] has also been inserted after the final consonant. In this thesis, I put forward an explanation for adaptation strategies like vowel insertion and deletion, which are due to differences in syllabic constraints of the source and borrowing languages.

1.2 Overview

The phonologies of Australian Aboriginal languages show extensive similarity.[2] Hamilton (1996: 29) characterises this similarity as a common *family resemblance* in which attested synchronic variation is a property of highly regularised and restricted phonological change. Common properties of the languages under investigation include the composition of the phonemic inventories, distributional restrictions on phonotactic positions and syllable structure.

Some of these phonological properties in languages like Martu Wangka and Gamilaraay are distinct from those in English. The restrictions shown by the borrowing language phonology are the driving force behind adaptation strategies. Many kinds of adaptation strategies occur. For instance, phonemic substitution occurs when a speaker borrows an English word containing a phoneme without a correspondent in the native phonemic inventory. Consider borrowings in Martu Wangka and Gamilaraay. Each language lacks

[2] For more detailed discussions of phonologies Australian Aboriginal languages, see Dixon (1980), Hamilton (1996), and for more general discussions about their genetic classification, see Dixon (1980, 2002), Blake and Dixon (1991).

fricatives in the native inventory. Thus English fricatives [ʃ] and [s] must be realised with a different segment, as shown in (2):

(2) Fricative substitution in Martu Wangka and Gamilaraay loans:

a. [ʃ]> [c]: Martu Wangka **j**iipu < English sheep

b. [s] > [t̪]: Gamilaraay **dh**al < English 'salt'

Given the syllable structure of these languages is also distinct from that of English, a number of syllable-related adaptation strategies occur as well. One type of adaptation strategy used to resolve ill-formed syllable structure is vowel insertion or epenthesis. Vowel epenthesis occurs in Martu Wangka, Pitjantjatjara and Warlpiri. In these languages, words are obligatorily vowel final.[3] Thus, when borrowing an English word with a final consonant, a vowel is inserted after the final consonant:

(3) Final vowel insertion in Martu Wankga, Warlpiri and Pitjanjatjara loans

a. Martu Wangka jaaj**i** < English 'church'

b. Warlpiri jaat**i** < English 'shirt'

c. Pitjantjatjara paatj**a** < English 'bus'

An alternative adaptation strategy is to delete some of the offending material during adaptation. Gamilaraay, which disallows coda clusters, shows deletion when borrowing

[3] Earlier sources for Martu Wangka (Mantjiltjara (Marsh 1960)) and Pitjantjatjara (Yankunytjatjara (Goddard (1983)) show that some consonants word-finally (shown in Appendix 7.2.3). More recent sources for Martu Wangka (Marmion 2004) and Pitjantjatjara (Langlois 2004:43) indicate that words must end in a vowel.

words with final clusters. The second consonant is deleted, thus simplifying the cluster, as below:

(4) Gamilaraay dhal**_** < English 'salt'

These adaptation strategies are straightforwardly explained within the constraint-based optimality-theoretic framework, within the model of loanword adaptation proposed by Smith (to appear). The model exploits the normal markedness-faithfulness tension of OT by utilising a set of markedness constraints and a set of Input-Output faithfulness constraints. In addition to these constraints, this model includes a set of loanword-specific faithfulness constraints along a source-borrowing correspondence relation. The motivation to distinguish Source-Borrowing faithfulness constraints from Input-Output faithfulness constraints directly follows from the observation that loanword adaptation is distinct from, while informed by, processes occurring in the native grammar.

The essence of the optimality-theoretic analysis presented here is minimal violation. Minimal violation governs strategies occurring borrowing as well as in all other areas of phonology. This means that adaptation strategies are the most minimal response to higher-ranked constraints on syllable structure well-formedness within the borrowing language's hierarchy.

In addition we sometimes see variable outcomes of the same adaptation strategy due to other phonological factors about the borrowing language. So, for example, in Martu Wangka adaptation, the inserted vowel has different quality (either *i* or *u*) depending on the environment:[4]

(5) Variation in the quality of epenthetic vowels Martu Wangka loans:

a. jiip**u** < English 'sheep'

[4] The variation in the quality of the epenthetic vowel in Martu Wangka loans will be discussed in section 4.2..

b. kuut**u** < English ‘coat’

c. ‘jaaj**i** **<** English ‘church’

Language-internal patterns like this emerge in my analysis as predicted by the optimality-theoretic explanation. This is The Emergence of the Unmarked (McCarthy and Prince 1994). This means that unmarked syllable structures surface when loans are subject to adaptation strategies.

The adaptation strategies shown in (1-5) result from differences between the phonetic and phonological organisation of the source language and borrowing language. The borrower must attempt to faithfully maintain information about the source form *he perceives*. This information is filtered through the phonetic and phonological organisation of his own language. Thus he produces a loan conforming to constraints on the phonemic inventory, phonotactic constraints and syllable structures of his own language, while maintaining as much information about the source word as possible.

1.3 Thesis structure

The structure of this thesis is as follows:

In the present section, I introduced the aspects of borrowing I focus on throughout my thesis.

In the following chapter, I describe the OT framework. In particular, I describe Smith's correspondence model of source-similarity faithfulness which I use to frame my analyses. I also define the primary (S)ource-(B)orrowing faithfulness constraints MAX-SB, DEP-SB and IDENT-SB and show how different rankings of these constraints account for different loanword adaptation strategies, focusing on deletion and epenthesis-based repair.

The next chapter begins with a comparative description of the relevant aspects of the phonologies of English and two borrowing languages: Martu Wangka and Gamilaraay. Here I focus on the differences between the consonant and vowel inventories of the source and borrowing languages and the effect this has on the structure of borrowed words. This provides a background to the rest of the thesis, which is concerned with adaptation repairs at the level of syllable and word structure. This chapter concludes with an introduction to the main constraints on syllable structure that are necessary in order to explain as the motivation behind adaptation. I show how prosodic markedness constraints interact with SB-faithfulness constraints.

The fourth chapter considers the adoption of English words with final consonants in Martu Wangka and Gamilaraay adaptation. I discuss Martu Wangka and Gamilaraay because each of these languages shows different constraints on whether they allow final consonants, and if so, which consonants they allow word-finally. I put forward an optimality-theoretic explanation for the observed strategies in each of these languages.

In the fifth chapter, I continue with a discussion about adaptation strategies due to syllabic constraints, focusing on those with onset and coda consonant clusters. Using examples of Martu Wangka loans, I put forward an explanation for the split pattern of epenthesis-based and deletion strategies that occur in coda cluster adaptation. Then I propose an explanation for the split pattern of deletion and epenthesis in onset clusters observed in Warlpiri loans. Here I draw from aspects of Fleischhacker's (2000) explanation for languages showing a similar pattern of internal-edge epenthesis when adapting onset clusters.

2 Theoretical Framework, Data and Methodology

2.1 Source-similarity correspondence in Optimality-Theory

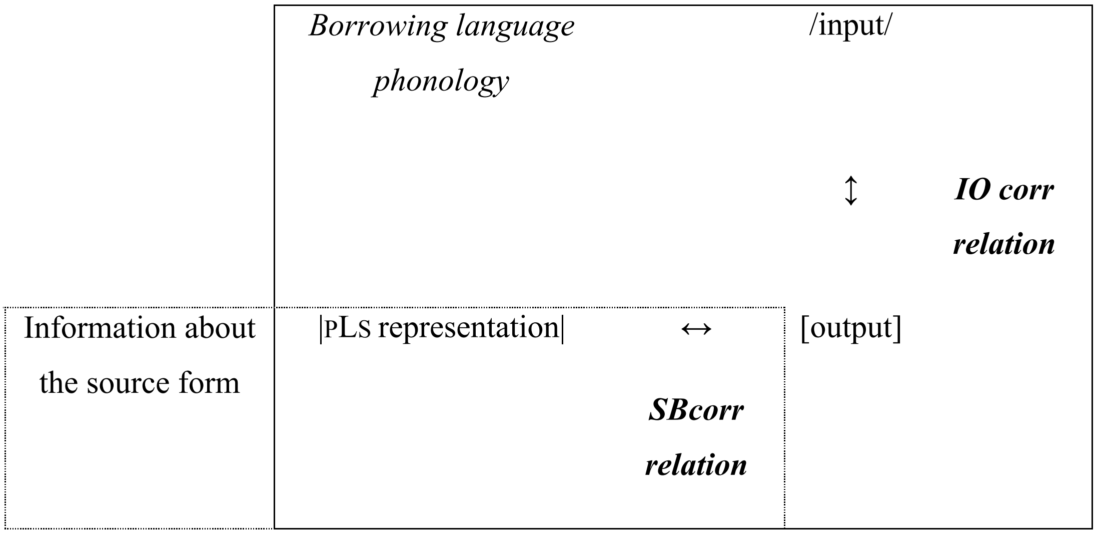
This section introduces Smith's (to appear) model of loanword adaptation that I use to frame my analysis.

Smith proposes a source-similarity correspondence model formalised within OT. In previous derivational explanations, a surface loanword form is derived from an underlying representation through phonological processes active in the native phonology. In contrast, optimality-theoretic explanations assume a set of ranked but violable constraints governing the well-formedness of possible candidate surface forms. The central idea of this theory is that the optimal surface form candidate incurs fewest violations of the highest ranked constraints within the language's constraint hierarchy. In adaptation, the optimal loan form incurs the fewest violations against the source-borrowing faithfulness constraints, which demand that the source word and loan word are identical, as well as obeying the relevant markedness constraints of the borrowing language.

The correspondence theory of faithfulness as developed by McCarthy and Prince (1993a,b) was extended beyond correspondence between Input-Output pairs to other pairs of forms that correspond including the Base Reduplication relationship (McCarthy 1995) and the Base-Truncation relationship (Benua 1997). Smith and others extend this correspondence to include the relationship between the perceived source word and its borrowed form.

Several recent explanations about loanword adaptation proposed by Kang (2003), Rose and Demuth (2006), Kenstowicz (2003) and Adler (2006) exploit a similar correspondence relation known as the *Source-similarity* correspondence relation which holds between the output source form, spoken by the source language speaker and the output spoken loan spoken by the borrower. Smith (to appear) develops a formal model of loanword adaptation using the source-similarity relation. In her model, a correspondence pair occurs between the loan form and what she calls the *posited source-language representation* (PLS). The PLS is based on perceptual and/ or orthographic information and additional factors like the borrower's knowledge of the source language phonological grammar. To account for the observation that many loanword processes are driven by constraints pervading the internal borrowing-language phonological grammar, the PLS is considered the input. The model is shown in (1):

(1) Smith's source-similarity correspondence model of loanword adaptation:



In the regular phonology of a language, there is a correspondence between the underlying form and the spoken form. This correspondence is governed by the IO correspondence relation. In the borrowing situation, the input is the pLs. This is not the underlying form of the source language nor an underlying form of the borrowing language- it is a *perceived* form. The SB correspondence relation ensures that the spoken form of the loan is as faithful as possible to the perceived loan form.

This model was proposed in answer to problems that arose in other optimality-theoretic explanations that proposed to account for loanword adaptation using the internal phonological grammar of the borrowing language (see, for example Yip 1993). In these approaches, candidate loan outputs are assessed using the constraint hierarchy of the language-internal grammar. To demonstrate the basic problem with these accounts, I will discuss some examples of native and loanwords in Japanese (Smith 2006:64) and Maori (Yip 2002:5). Examples are provided in (2). Both of these languages prohibit consonant clusters and some codas. In native morphological alternations, unsyllabifiable consonants are deleted, as shown in (2ai, 2bi). In loanword adaptation, however, unsyllabifiable consonants are retained through epenthesis-based repair, as shown in (2aii, 2bii):

(2) Language-internal variation between deletion in native morphophonemic alternations and retention through epenthesis repair in loans in Japanese and Maori:

Language		*Repair*			*Gloss*
a. Japanese	i. Native morphophonemics	deletion	/kak + rɯ/	[ka.k_ɯ]	'write'-NON PAST
	ii. borrowing	epenthesis		kɯ.ɾiː.mɯ	< English 'cream'
				*_ ɾiː_	
b. Maori	i. native morphophonemics	deletion	/inum/	[inu_]	'drink' (unsuffixed)
	ii. borrowing	epenthesis		wu:ru	< English 'wool'
				*wu:_	

Within these languages, syllable structure constraints like *COMPLEX^ONSET and NOCODA govern syllable well-formedness. These constraints conflict with IO-faithfulness constraints. We observe deletion rather than epenthesis-based repair for ill-formed syllable structures in native morphological alternations. This shows that DEP-IO, the IO-faithfulness constraint that prohibits epenthesis must dominate MAX-IO, the constraint that prohibits deletion. The tableau in (3) confirms this ranking:

(3) Japanese / kak + rɯ/ 'write-NONPAST'

/kak + rɯ/	*SYLLABLE STRUCTURE	DEP-IO	MAX-IO
a. kak.rɯ	*! (CODACONDITION)		
b. ka.kɯ.rɯ		*!	
→ c. ka.k_ɯ			*

In contrast, consider what happens when Japanese borrows the English word 'cream'. The constraint ranking as above, DEP-IO >> MAX-IO, incorrectly predicts the deletion form *_ɾiː_* (4c) rather than the attested epenthetic-form *kɯ.ɾiː.mɯ* (4b):

(4) Japanese kɯ.ɾiː.mɯ < English 'cream'

kɹiːm	*SYLLABLE STRUCTURE	DEP-IO	MAX-IO
a. kɾiːm	*! (*COMPLEX ONSET)		
b. kɯ.ɾiː.mɯ		**!	
→c. _ɾiː_			**

Using the language-internal ranking is clearly undesirable, since *kɯ.ɾiː.mɯ* (4b) is the attested form. For this reason, Smith proposes that loanword-specific faithfulness constraints are necessary in the grammar. This requirement is motivated by the observation that different factors govern native morphological alternations and loans. In morphological alternations, information is retrievable in other ways from the grammar. In loanword adaptation however, information is not retrievable from the internal grammar. Thus the borrower must retain a maximal amount of information about the PLS.

In the following tableaux in (5-6), we see how these loanword-specific constraint rankings interact with IO-faithfulness constraints. The same constraint ranking DEP-IO >> MAX-IO shown in (3) allows deletion repairs for ill-formed syllable structures in native morphological alternations. Included in these tableaux are additional loanword-specific faithfulness constraints governing faithfulness in PLS-output mapping. These constraints are MAX-S(ource)B(orrowing), which prohibits deletion in adaptation, and DEP-SB, which prohibits epenthesis. The constraint ranking MAX-SB>> DEP-SB allows epenthesis rather than deletion to occur in adaptation. Let us again consider the Japanese examples. In tableau in (5), the form to be evaluated shows a native morphological alternation. Thus SB-faithfulness is irrelevant, as indicated by the grey shading:

(5) Japanese /kak+rɯ / ‘write-NONPAST’

kak+rɯ	SYLLABLE STRUCTURE	MAX-SB	DEP-SB	DEP-IO	MAX-IO
a. kakrɯ	*!(CODA CONDITION)	*			
b. kakɯrɯ				**!	
→c. kak_ɯ					*

The next form to be re-evaluated is the Japanese borrowing from English ‘cream’. IO-faithfulness is irrelevant in assessing loan inputs, so IO-faithfulness constraints are vacuously satisfied. The ranking MAX-SB >> DEP-SB correctly predicts the attested epenthetic loanword form *kɯ.ɾiː.mɯ.*

(6) Japanese kɯ.ɾiː.mɯ < English ‘cream’

|pLs| kɾiː.m	SYLLABLE STRUCTURE	MAX-SB	DEP-SB	DEP-IO	MAX-IO
a. kɾi:m	**! (*COMPLEX ONSET) (NOCODA)				
→b. kɯ.ɾiː.mɯ			**		
c. _ɾiː_		**!			

The winner is the epenthetic form *kɯ.ɾiː.mɯ* (6b), which satisfies the higher-ranked source-similarity constraint MAX-SB. The other well-formed candidate *_ɾiː* _ (9c) has deleted segments from the source form, violating higher-ranked MAX-SB.

Smith's model straightforwardly captures the distinction between modelling internal processes and modelling loanword adaptation in initial language contact. In the latter process, the borrower perceives a form and actively ensures that a maximal amount of information is utilised to produce a form that is most similar to the source form. Therefore, this model asserts that loanword adaptation potentially shows differences from morphophonemic alternations and allows for the cross-linguistic epenthesis-preference observed in loanword adaptation (Paradis and LaCharité 1997).

Another appealing aspect of this model is that it relates the nature of the source form directly to the selection of the adaptation strategy. Werker and Tees (1984) show that language acquisition involves the loss of some phonemic contrasts absent in the native inventory. For example, English speakers perceive unaspirated voiceless stops like [p] in Spanish as something akin to English voiced stops [b]. This means that the representation of the source form, that is the 'posited loan form', may be distinct from the source form. This model also allows perceptual similarity in the selection of adaptation strategy (Yip 2002, Kang 2003) and accommodates the deletion of non-salient segments at the perceptual level (i.e. pre-phonologically) (Peperkamp and Dupoux 2003, Yip 2002, Shinohara 2006). Consequently, this model allows variations between adaptation strategies related to phonological mappings and misperceptions of the borrower. I chose this model because it makes an explicit representation of the correspondence between the perceive source loan form and allows flexibility of adaptation strategies.[5]

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[5] c.f. Paradis and LaCharité's (1997) model of loanword adaptation proposed within their broader framework called the Theory of Constraints and Repairs. This model predicts that the number of adaptation repairs occurs within a limited defined parameter, stipulated by the Threshold Hypothesis given below:

> *Preservation Principle:* "Segmental information is maximally preserved within the limits of the Threshold Principle…
>
> *Threshold Principle:*
>
> > a. "All languages have a tolerance threshold to the amount of repair needed to enforce segment preservation. This threshold is the same for *all languages*: two steps (or two repairs) within a given constraint domain' (my emphasis, Ibid:384)

Thus, the Threshold principle encodes an epenthesis-preference into this model and incorrectly predicts all languages show epenthesis as the default process in loanword adaptation.

Source similarity faithfulness constraints

In the following section, I provide a formal definition for the primary Source-Borrowing faithfulness constraints MAX-SB, DEP-SB, IDENT-SB which I employ in my analysis (7). Notice that for each IO Correspondence constraint, there is, in principle, a parallel SB faithfulness constraint.

(7) Input-Output and Source-Borrowing Correspondence constraints:

Constraint	*Definition*	*Phonological realisation*
MAX-IO	An element in the input must also be in the output.	Prohibits deletion (between underlying and surface forms
MAX-SB	An element in the perceived source has a corresponding element in the loan.	Prohibits deletion between source form and loan form
DEP-IO	An element in the output has a corresponding element in the input.	Prohibits epenthesis between underlying and surface forms.
DEP-SB	An element in the loan has a corresponding element in the perceived source.	Prohibits epenthesis between the posited source and loan forms.
IDENT-IO [F]	Let α be a segment in the input segment S1 and β be a correspondent of α in the output segment S2. If α is [γF], then β is [γF].	Prohibits changing the value for features associated with a segment between input and output.
IDENT-SB [F]	Let α be a segment in the source segment S and β be a correspondent of α in the borrowing segment B. If α is [γF], then β is [γF].	Prohibits changing the value for the feature associated with a segment between the posited source and loan

In loanword adaptation, constraint violation frequently occurs when these faithfulness constraints, which demand that the perceived source form and loan are identical, conflict with other constraints. In particular, we will see that these SB-faithfulness constraints conflict with the syllable structure constraints of the borrowing language. Adaptation repairs, having been established as unfaithful source-borrowing mappings (rather than experience-related misperceptions by the borrower (as argued by Peperkamp and Dupoux 2003)[6] involve violations of SB- faithfulness constraints.

2.1.1 Typology of rankings for different adaptation repairs

In this section, I show how different rankings of SB-faithfulness constraints generate different adaptation repairs.

Importation

In *importation*, the borrower can conceivably produce a form which is exactly like the source form. This form may include segments that are absent in the native inventory or

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[6] Peperkamp and Dupoux (2003) argue that loanword adaptation derives from experience-related misperceptions of the borrower. In their model, acoustic or auditory information about the source output form is mapped onto the borrower's native categories or structures at the extra-grammatical speech-perceptual level. The model is shown below:

Adaptation at the speech-perceptual level (Ibid:368-9).

Ls acoustic signal

↓ "Phonetic decoding module"

Speaker's Language specific phonetic categories

↓ "Phonological decoding module"

Underlying Representation

Empirical evidence to support this claim is that Russian and English native speakers (Davidson 2006) and native Japanese speakers (Dupoux et. al.1999) show perceptual epenthesis between non-native consonant sequences. For example, native Japanese speaker frequently classify [VC_1C_2V] sequences (*ebzo*) as [$VC_1ɯC_2V$] sequences (*ebɯzo*), whereas French speakers distinguished the two sequences (Ibid:1568).

syllable structures unattested in native forms. Consider how some English speakers pronounce 'Bach' as [bɑːx] rather than the more nativised [bɑːk]. In the former pronunciation, the English speaker recognises the form as a non-native word and actively pronounces a segment [x] absent in the English consonant inventory. Presumably, this is in order to be maximally faithful to the source form. In an optimality-theoretic explanation, the speaker's pronunciation of the loan derives from the conflict of a language-internal markedness constraint **x*, which prohibits velar fricatives in English, and the source-similarity faithfulness constraint, IDENT-SB [X] which ensures that a source form with the segment *x* has a correspondent loan with *x*. Source-similarity faithfulness constraints must dominate the markedness constraints for non-native segments to be preserved, as illustrated in the tableau in (8):

(8) Importation: English [bɑːx] < German [bɑːx] 'Bach'

PLS |bɑːx|	IDENT-SB [X]	**x*
→a. bɑːx		*
b. bɑːk	*!	

The suboptimal *bɑːk* (8b) candidate satisfies the lower ranked constraint on **x* by substituting the *x* with a native segment *k,* but fatally violates the source-similarity faithfulness constraint IDENT-SB [X]. The optimal candidate *bɑːx* (8a) is maximally faithful to the source form by producing a non-native segment. This incurs a violation against the lower-ranked **x*. Importation forms are not nativised and hence beyond the scope of this thesis. We are interested rather in how words are nativised.

Let us instead consider the alternate nativised pronunciation [bɑː**k**]. In this case, the English speaker has selected a segment [k] from the English inventory similar to the correspondent segment in the source word. The segment is velar and voiceless but not a fricative. This shows that it is more important to pronounce a loan which is well-formed in the native grammar than to be faithful to the non-native segment [x] in the source. This means that the borrowing language's markedness constraints must dominate SB-faithfulness constraints for adaptation to occur. In this case, the constraint **x* must dominate the source-borrowing faithfulness constraints for substitution repair, as shown in (9):

(9) English [bɑː**k**]< German [bɑː**x**] 'Bach'

PLS: |bɑː**x**|	**x*	IDENT-SB [X]
a. bɑː**x**	*!	
→b. bɑː**k**		*

This time, the maximally faithful candidate *bɑː**x*** (9a) violates the higher-ranked **x* constraint. In the winning candidate, *bɑːk* (9b), *x* has been replaced by an alternate phoneme *k*. This form violates the lower-ranked IDENT-SB [X], and satisfies the higher ranked constraint against **x*. We will see that this type of ranking, that is, MARKEDNESS >> SB-FAITH is necessary for adaptation to occur.

Not only are adaptations observed at the segmental level, but also many adaptation repairs occur when the borrower adapts source forms with ill-formed syllable structure. When languages with simpler syllable structure borrow from languages with complex syllable structure, there are theoretically a number of possible repair strategies. Segments comprising the ill-formed structure could be retained though the use of epenthesis; some offending segments can be deleted resulting in simpler syllable structure; segments could be changed into segments that satisfy the language's phonotactic constraints. In the following section, I show how different constraint rankings of SB-faithfulness constraints generate different adaptation strategies at the level of syllable structure, focusing on the typology of SB-faithfulness constraints rankings that generate epenthesis and deletion.

Epenthesis

Cross-linguistically, loanword adaptation exhibits a strong epenthesis-preference and, a strong deletion and metathesis dispreference (Paradis and LaCharité 1997; Gouskova 2001:283). The languages under investigation are no exception. For example, Martu Wangka, a language allowing only vowels word-finally, shows final vowel epenthesis when borrowing English words with final consonants (jiip**u** < English 'sheep'). Thus, it follows that Martu Wangka's word-structure constraint VOWEL FINAL, which ensures that words are vowel final, must dominate DEP-SB so that epenthesis-based repair occurs:

(10) Martu Wangka jiip**u** < English 'sheep'

jiip	VOWEL FINAL	DEP-SB
a. jiip[7]	*!	
→b. jiip**u**		*

The candidate *jiip* (10a) is the more faithful candidate of the forms evaluated but violates this language's word structure requirements. Contrastingly, the optimal candidate *jiip**u*** (10b) has inserted a vowel after the final consonant. The epenthetic form incurs a violation against lower-ranked DEP-SB to satisfy the higher-ranked constraint VOWEL FINAL.

[7] The most faithful form ʃiːp never surfaces because of a high ranked constraint on the phoneme *ʃ, which prevents the segment [ʃ] from surfacing. This and other substitutions will be discussed in section 3.2.3.

Languages showing epenthesis-based repair demonstrate that it is more important to maintain information about the source form than to delete segments to satisfy the language's syllable structure requirements. Therefore, Max-SB must dominate DEP-SB for vowel epenthesis rather than deletion to occur. The tableau in (11) shows that the attested epenthesis-based repair strategy is due to the constraint ranking MAX-SB>> DEP-SB:[8]

(11) Martu Wangka jiipu < English 'sheep'

jiip	VOWEL FINAL	MAX-SB	DEP-SB
a. jiip	*!		
b. jii_[9]		*!	
→c. jiip**u**[10]			*

Again we see that the most faithful form *jiip* (11a) cannot surface because it violates VOWEL FINAL. The other two candidates exhibit different repair strategies, which resolve the constraint on VOWEL FINAL. The candidate *jii_* (11b) has deleted the disallowed final consonant, thus incurring a fatal violation against the higher ranked SB-faithfulness constraint MAX-SB. Contrastingly, the optimal candidate *jiip**u*** (11c) has inserted a final vowel, violating lower-ranked constraint DEP-SB while higher-ranked MAX-SB is satisfied.

Deletion

[8] VOWEL FINAL and MAX-SB are not ranked with respect to each other because they don't conflict.

[9] The minimal word in Martu Wangka is minimally bimoraic, and most frequently bisyllabic (Geytenbeek 2008, discussed by Deak 2008). This minimal word requirement is typical of many Australian Aboriginal languages (Dixon 1980:127). A few monosyllabic loans occur in the data (e.g. puu < English 'four'). Martu Wangka's preference for bisyllabic words may be an additional reason for why we observe epenthetic forms rather than deletion forms, which would be monosyllabic.

[10] The epenthetic vowel is round *u* and not non-round *i* following labials. I propose an explanation for the conditioning environments for epenthetic vowels in section 3.2.2.

OT also permits the typologically possible deletion-based repair to occur.[11] Specifically, it predicts that it is possible for a language to show the reverse constraint ranking DEP-SB >> MAX-SB, allowing deletion rather than epenthesis. The tableau in (12) illustrates how the reverse constraint ranking predicts deletion rather than epenthesis-based repair to occur:

(12) Hypothetical repair for English 'sheep'

jiip	VOWEL FINAL	DEP-SB	MAX-SB
a. jiip	*!		
b. jiipu		*!	
→c. jii_			*

The constraint on word structure well-formedness is still undominated and drives some adaptation strategy. This time however, the epenthetic form *jiipu* (12b) incurs a fatal violation against the higher ranked DEP-SB constraint, whereas the deletion form *jii_* (12c) incurs a less serious violation of the lower-ranked constraint Dep-SB.

The different rankings in the previous two tableaux (11-2) demonstrate how OT accounts for typologically possible repair strategies. In the analysis presented, we will see how OT also permits language-internal variation between adaptation repair strategies. This variation occurs in other languages including Cantonese (Yip 2002), Hawaiian (Adler 2006), (Shinohara 2006) and Japanese (Smith 2006). Various arguments have been put forth for the epenthesis-preference in loanword adaptation. I follow Smith (to appear: 16), who gives two explanations for the epenthesis-preference:

a. sociolinguistic: a borrower judges a loan more similar to its source form when it has all the information perceived in the source (deletion-dispreferred), and

[11] This is rare, but attested nonetheless. For example, Hmong shows deletion as the default adaptation process (Golston and Yang 2001: 50).

b. access to orthographic information: a borrower sees all the information in the source form (c.f. simplification through deletion in pidgeons and creoles (Alber and Plag 2001) and first language acquisition (Fleischhacker 2000)).

We will see that the borrowing languages under investigation typically exhibit epenthesis-based repair as the preferred phonological process, with alternative repairs sometimes occurring in a restricted context.

2.2 Loanword data

The borrowing languages under investigation, their Ethnologue abbreviation, classification and sources are provided in (13):

(13) Language, and its Ethnologue abbreviation, classification and sources:

Name	*Eth*	*Classification*	*Source(s)*
Gamilaraay	kld	Pama-Nyungan, Riverine region, Wiradhuric	(Austin 1992; Ash, Giacon, and Lissarrague 2003)
Jiwarli	mem	Pama-Nyungan, South-West, Mangala	(Burgman 2005, based on materials from Austin 1995)
Martu Wangka	mpj	Pama-Nyungan South-West, Wati	(Deak 2008, based on materials from Marion 2004)
Nhanda	-	Pama-Nyungan, Western, South-West	(Blevins 2001)
Pitjantjatjara	pjt	Pama-Nyungan South-West, Wati	(Langlois 2001)
Putijarra	mpj	Pama-Nyungan, Western South-West, Wati	(Webb 2004)
Warlpiri	wpb	Pama-Nyungan, South-West, Ngarga	(Nash 1983, 1986), Simpson (2008) personal communication)
Yindjibarndi	yij	Pama-Nyungan, South-West, Coastal Ngayarda	(von Brandenstein and Wordick 2002)

Source and loan forms are presented in the standard orthographic script used for each language.

The selection of languages is not intended as comprehensive representation of loanword adaptation in Australian Aboriginal languages. It is appropriate for a comparative analysis of certain aspects of loanword adaptation. Throughout the analysis we will see that many borrowing languages exhibit extensive similarity in terms of similar inventories and syllable structure constraints. This often means that similar loanword adaptation strategies occur, but I do not extrapolate this to a typical pattern exemplified by Australian Aboriginal languages.

2.3 Method

To assess the adaptation strategies observed, I assembled a corpus of loanwords from several Australian Aboriginal languages and their correspondent English source words. This method served four important functions:

i. isolating specific structural differences between source forms and corresponding loans,

ii. extrapolating language-specific adaptation strategies,

iii. establishing interlinguistic variation of loanword adaptation, and

iv. relating explanations of these patterns to a broader theoretical perspective.

I hypothesised about what aspects of loanword adaptation might be interesting in these languages by surveying a descriptive phonological grammar of each borrowing language. For example, the observation that languages like Martu Wangka, Warlpiri and Pitjantjatjara disallow final consonants provides an interesting contrast with Gamilaraay, a language allowing some consonants within the native consonant inventory to occur word-finally. Given that English is less constrained in its forms than either of these groups, I expected there to be some interesting and distinctive strategies employed in the nativisation of English words.

2.3.1 Empirical issues

General issues in discussions about loanword adaptation

A significant issue in modelling loanword adaptation was the fact that I was unable to examine the degree of borrower variation. Loanword adaptation repair strategies are frequently highly variable between individual speakers (Haugen 1950), as well as across contexts. A borrower may encounter many surface variants of the same underlying form, produced by different speakers during initial language contact. The distinctive articulatory or gestural patterns of these speakers potentially result in multiple source forms perceived by borrowers. Different borrowers obtain different information about the spoken source form according to exposure to the source language. The borrower is required to select an adaptation strategy that may be context independent and lacking a precedent (Kenstowicz and Suchato 2006: 923) or arbitrary (i.e. the same phonological processes exploited in the internal grammar) (Smith to appear:16), until the establishment of highly conventionalised adaptation strategies within the language community (Haugen 1950). Complicating these processes are additional influences including explicit knowledge of the source language phonological grammar obtained by bilingual speakers (Paradis and LaCharité 1997). For example, variation in loanword adaptation occurs in some multilingual speaking communities, analogous to the acrolectal-basilectal cline of creoles. One such case occurs in the Pitjantjatjara speaking community. Speakers of Traditional Pitjantjatjara pronounce English loans more like native Pitjantjatjara words. In contrast, Areyonga teenage Pitjantjatjara speakers pronounce English loans more similarly to English, presumably due to their greater exposure to, and facility with English. An example of this variation is given below:

(14) Pitjantjatjara Variation

a. Traditional: puluwʌnʌ < English 'blue'-PREDICATIVE

b. Teenage Areyonga: bluewʌn[12]

We observe that the Teenage Areyonga loan (14b) is more faithful to the English source form by maintaining voicing and cluster onset [bl] of its source. In contrast, the more nativised form (14a) shows epenthesis and devoicing of the initial [b] > [p]. This form represents a greater deviation from the source form. Thus we see how exposure to English can influence a borrower's similarity to the source form.

What we must also recognise is that individual speakers can consciously vary their pronunciation according to the socio-cultural context. Langlois (2004: 47) reports that Areyonga teenage Pitjanjatjara speakers vary the pronunciation of some loanwords across a continuum according to the sociolinguistic context:

[12] 'Blue-one' is a widespread creole construction.

(15) Areyonga Teenage Pitajantjatjara variation

a. pulu(-wʌnʌ) < English 'blue'-PREDICATIVE

b. plu(-wʌnʌ)

c. bulu(-wʌnʌ)

d. blu(-wʌnʌ)

The four forms in (15a-d) show variation between the pronunciation cluster onset [bl] and voicing. The loan most similar to English source *bluwʌnʌ* (15d) maintains the source cluster and voicing, whereas the most nativised form *puluwʌnʌ* (15a) shows devoicing and breaks up the consonant cluster by inserting a vowel. The intermediate loans *pluwʌnʌ* (15b) and *buluwʌnʌ* (15c) show variations between voicing and the status of the consonant cluster. Thus we observe how variation may occur across socio-linguistic contexts.

Issues specific to my thesis

The most significant issue I faced was the representation and the reliability of the loanword data. Most of the data were obtained from linguistic grammars and dictionaries which generally use the standard orthographic script for describing the language. Orthographic representations often fail to adequately capture many aspects of the borrower's pronunciation of the loanword form. Therefore discussions about loanwords required me to infer aspects of the loanword form on the basis of language-internal phonological properties and the generally accepted grapheme-phoneme correspondences. Also, I assume that most of the loanword examples were from spoken sources. I have also kept in mind that some entries in the dictionaries like some of those in the Gamilaraay dictionary (Ash, Giacon, and Lissarrague 2003: 12) are from some written sources.

Throughout the analysis, I assume that auditory forms served as the input. This is potentially problematic when we consider that the nature of the source input, whether auditory or orthographic, or a combination of these forms, influences the selection of an adaptation strategy (Smith 2006; Vendelin and Peperkamp 2006).[13] Smith (2006:68) uses Japanese loanword 'doublet' forms to illustrate how the selection of the strategy varies according to auditory and orthographic source forms:

(16) Japanese loanword doublets < English 'glycerine'

e. deletion loan [_ ɾisɯɾiɴ]

f. epenthetic loan [gɯɾisɯɾiɴ]

Smith attributes deletion forms (a) to the perceptual deletion of non-salient segments in auditory borrowings. If a borrower does not perceive a segment, he cannot represent a correspondent segment in the PLS and cannot produce a form with this segment. Smith argues that the epenthetic forms (b) are from orthographic sources. The borrower exploited a maximal amount of information about the source form in adaptation because all the information is represented orthographically represented. In the present analysis, it is unlikely that most of the loans were borrowed off orthographic forms. However, the sociolinguistic situation in initial language contact requires further investigation.

I have also assumed that the loanwords were borrowed directly from English. This is highly problematic when we consider that many borrowers also speak Kriol (Sandefur 1970) and Aboriginal English (Butcher 2007), languages exhibiting intermediate phonological properties of both English and Australian Aboriginal languages. This means that the loan has already been nativised before the language borrows the loan. Many borrowers also speak more than one Australian Aboriginal language. For example, Warlpiri speakers also frequently speak Pitjantjatjara (Nash 1983:8). This means that it is likely that loans showing highly similar or identical forms may have been borrowed as a nativised loan from one language into the other Australian Aboriginal language. However,

[13] Yip (2002: 10) suggests that even visual information influences adaptation.

we must recognise that the strategies employed in a creolisation situation may be similar to those when a speaker borrows from a source language.[14] The potential for borrowing of nativised loans was taken into consideration. However we will see that considerable variation occurs between languages and this must be accounted for.

Finally, some examples of borrowings with phonotactic forms disallowed by the native phonological grammar occur in the data:

(17) partially nativised borrowings in Nhanda and Gamilaraay:

a. disallowed word-initial coronal in Nhanda **d**ampa < English 'damper'

b. disallowed word-final velar stop in Gamilaraay **b**aadig < English 'paddock'

Unassiminated borrowings like these are interesting because they reveal what constraints in the borrowing language can be violated. Non-native aspects of these loans are noted, but they do not impact significantly on the following analyses.

Having highlighted theoretical and methodological issues relevant to my thesis, we can proceed with explanations about specific aspects of adaptation. In the following chapter, I discuss some differences between the phonological properties of the English and two borrowing languages, Martu Wangka and Gamilaraay.

[14] Alber and Plag (2001:820) propose an output-output correspondence relation for source-similarity effects in the creole Sranan under the assumption that similar phonological and perceptual factors influence creole lexification and loanword adaptation.

3 Source and borrowing language segment inventories and syllable structures

3.1 Introduction

In this chapter, I briefly compare and contrast properties of English phonology, including segment inventories and phonotactic patterns, to those in two examples of borrowing languages, Martu Wangka and Gamilaraay. This is necessary in order to explain the driving force behind the segmental adaptations. This discussion forms a background to those adaptation repairs discussed throughout the thesis. I introduce prosodic markedness constraints which are employed to explain the adaptation strategies and show how these constraints conflict with SB-faithfulness constraints.

3.2 Segmental inventories of the source and borrowing languages

In the following section, I compare and contrast the consonant and vowel inventories of English with two borrowing languages, Martu Wangka and Gamilaraay. This comparison provides a view to explaining the way English segments are realised in borrowing.

3.2.1 Consonant inventories

Martu Wangka

The consonant inventory of Martu Wangka distinguishes five places of articulation, comprising two peripheral series (labial *p, m* and velar *g, ng),* two apical series (alveolar *t, n* and post-alveolar *rd, rn*) and one laminal series (palatal *j*): [15]

[15] The composition of consonant inventory is similar (but not identical) to the consonant inventories of other languages in my study like Warlpiri and Pitjantjatjara. For example, Warlpiri's consonant inventory includes a retroflex flap [ɽ].

(1) Consonant inventory of Martu Wangka:

	bilabial	lamino-dental	apico-alveolar	apico-post-alveolar	lamino-palatal	velar
stop	p [p]		t [t]	rt [ʈ]	j [c]	k [k]
nasal	m [m]		n [n]	rn [ɳ]	ny [ɲ]	ng [ŋ]
fricative						
trill			rr [r]			
lateral			l [l]	rl [ɭ]	ly [ʎ]	
approximant	w [w]			r [ɻ]	y [j]	

Firstly, the consonant inventory of English has a voiced and voiceless contrast for stops whereas Martu Wangka's consonant inventory lacks a phonemic voicing contrast. In Martu Wangka, the phonetic instantiation of the single stop series is typically a voiceless stop (Marsh 1969:131). Accordingly, English voiceless and voiced stops become non-contrastive in adaptation:[16]

(2) Neutralisation of English voiceless and voiced oral stops in Martu Wangka:

Ls	*Source*	*Segment*	*Realisation*	*Lb*	*loan*
English	Pentecost	p	p	Martu Wangka	**P**intikaj(-pa)
	bottle	b			**p**aatul(-pa)
	coat	k	k		**k**uutu
	go	g			**k**uu
	table	t	t		**t**iipul(-pa)
	dollar	d			**t**ala

[16] As in any language without a voicing contrast, there is context-dependent allophonic variation between the articulation of voiced and voiceless stops. For example, stops are typically voiced after nasal segments (Hamilton 1996:54).

The second major distinction between the consonant inventories of English and Martu Wangka is that the latter lacks fricatives. Thus English [h], labiodental fricatives (f, v) and sibilants (s, z, ʃ) and non-sibilant theta [θ] and thorn [ð] fricatives lack correspondent phonemes in Martu Wangka. As a result, English words with initial [h] are not distinguished from English words with initial vowels.[17] Both are realised with initial epenthetic glides, driven by the constraint on onsetless syllables:[18]

(3) Neutralisation of English source words with initial [h] and initial vowels: [19]

Source Language (Ls)	*Source*	*Environment*	*Realisation*	*Borrowing Language (Lb)*	*Loan*
English	half	#h	#y	Martu Wangka	***yaapu***
	arrow	#_a			***yarawu***
	all together	#_a	#w		***wulkaja***

English labiodental fricatives (*f, v*) are invariably realised as the labial stop *p*. Consequently, the voicing neutralisation observed for stops also occurs for fricatives:

[17] Jane Simpson points out that #[h]-deletion frequently occurs in non-standard English and creole anyway. This means that the PLS has no #[h], so source-borrowing deletion of [s] doesn't occur.

[18] I propose that this constraint is ONSET, defined in section 3.3.

[19] Yindjibarndi also exhibits neutralisation of initial [h] and initial vowels. No glide insertion occurs because this language allows onsetless syllables, as shown in the examples below:

(1) [h]-initial and vowel-initial neautralisation in Yinjibarndi, a language allowing onsetless syllables:

Ls	*source*	*Environment*		*Lb*	*loan*
English	Harold	#h	#v	Yindjibarndi	*_Arrarli*
	Algie	#v			*Alyi*

(4) English labiodental fricatives:

Ls	*source*	*Segment*	*Realisation*	*Lb*	*loan*
English	farm	f		Martu Wangka	**p**aam(-pa)
	knife		p		*nayi**p**u*
	never	v			*naa**p**a*

In Martu Wangka, English sibilants (s, ʃ, z) and the non-sibilants [θ,ð) are realised as the palatal stop *j*.[20]

(5) English sibilants and non-sibilants:

Ls	*source word*	*segment*	*segment*	*Lb*	*loan*
English	leprosy	s		Martu Wangka	*lipuriji*
	shirt	ʃ			*jaarta*
	lazy bugger	z	j		*liijipaka*
	all together	ð			*wulikaja*
	Thursday	θ,			*jayaji*

Gamilaraay

The consonant inventory of Gamilaraay distinguishes five places of articulation, comprising two peripheral (labial *b, m* and velar *g, ng),* one apical series (alveolar *d, n*), two laminal series (dental *dh* and palatal *dj*) (25):

[20] This is frequent in loanword adaptation in other languages like Warlpiri, discussed in section 3.4, as well in Areyonga Teenage Pitjantjatjara (Langlois 2001).

(6) Consonant inventory of Gamilaraay:

	bilabial	lamino-dental	apico-alveolar	apico-post-alveolar	lamino-palatal	velar
stop	b [b]	dh [d̪]	d [d]		dj [j]	g [g]
nasal	m [m]	nh [n̪]	n [n]		ny [ɲ]	ng [ŋ]
fricative						
trill			rr [r]			
lateral			l [l]			
approximant	w [w]			r [ɹ]	y [j]	

Like in Martu Wangka, in Gamilaraay voice is not contrastive for stops. The phonetic realisation of English voiced and voiceless stops is also neutralised in Gamilaraay:

(7) Neutralisation of English voiceless and voiced oral stops in Gamilaraay:

Ls	*source*	*Segment*	*Realisation*	*Lb*	*loan*
English	pistol	p	b	Gamilaraay	**b**irridul
	barrel	b			**b**aril
	cabbage	k	g		**g**abirr
	grass	g			**g**ararr
	tea	#t	dh		**dh**ii
	damper	#d			**dh**aamba
	comforter	t	d		gamba**d**a
	paddock	d			ba**d**ig

Word-initial alveolar stops (t, d) are realised as the dental *dh* rather than the closest correspondent phoneme alveolar *d*. Word-initial alveolar *d* is unattested in native

Gamilaraay words. Thus dental *dh* is the closest correspondent phoneme to alveolar stops attested word-initially. Intervocalic alveolar stops are attested in Gamilaraay, hence alveolar stops show regular mapping in this environment.

As in Martu Wangka, the Gamilaraay consonant inventory lacks phonemic fricatives. English words with initial [h] are realised as glide initial:[21]

(8) English source words with initial [h]:

Ls	*source*	*Environment*	*Realisation*	*Lb*	*loan*
English	handkerchief	#h	#y	Gamilaraay	*yanggiidjaa*

English labiodental fricatives (*f, v*) are invariably realised as the labial stop *b*:

(9) Realisation of English labiodental fricatives as labial stop *b*:

Ls	*source*	*segment*	*Realisation*	*Lb*	*loan*
English	foul	f	b	Gamilaraay	**b**aawul
	verandah	v			**b**araanda

We observed that in Martu English sibilants are invariably realised as palatal *j*. In contrast, in Gamilaraay, English sibilants (s, ʃ) are realised as the dental *dh* word-initially, palatal *dj* and less frequently *d* in the intervocalic position and alveolar *rr* in the coda position: [22]

[21] Only a few examples of English vowel initial loans occur in the Gamilaraay loanword data (nhayamban < English 'iron pan'; Gamilaraay barrangal < English 'ankle'). I am uncertain about the word-initial consonant in these loans.

[22] There were no examples of Gamilaraay borrowing from English words with [z, ð]. I predict that these would exhibit similar pattern to those segments in (10).

(10) Realisation of English sibilants (s) in different phonotactic positions:

Ls	*source*	*Environment*	*Segment*	*Realisation*	*Lb*	*Loan*
English	saddle	onset	s		> Gamilaraay	**dh**aadal
	shirt		ʃ	dh		**dh**uwadi
	thousand		θ			**dh**awadha
	pussy cat	intervocalic	s	dj		bu**dj**igarr
	missus			d		mi**d**i
	grass	coda	s	rr		garaa**rr**

Similarly to the realisation of stops, in Gamilaraay, English sibilants are variably realised according to distributional constraints on its phonotactic position. Word-initial sibilants are realised by dental *dh,* due to the constraint on word-initial alveolar and lamino-palatal consonants. Intervocalic sibilants become lamino-palatal. This environment shows mapping similar to Martu Wangka. I discuss the realisation of English sibilants in the coda position further in the following chapter.

Discussion

English consonants that have a correspondent phoneme in the borrowing language's inventory show regular mapping. In contrast, English consonants that lack a correspondent in Martu Wangka's inventory (2-5) or Gamilaraay's inventory (7-10) require the borrower to establish similarities between the source phoneme and a correspondent native phoneme. The similar composition of the consonant inventories of Martu Wangka and Gamilaraay means that highly similar or identical patterns of substitution occur.

I assume that consonant adaptations conform to the least articulatory and least auditorily salient deviation from the source segment within the assumptions of Steriade's (2001)

Perceptibility-map (P-map) model. The P-map model provides information about absolute and context-dependent phonemic contrasts. Steriade proposed this model to explain how a borrower selects a correspondent phoneme according to "the least distinctive contrast whose modification resolves the violation" (Ibid 2004:14). [23]

In both Martu Wangka and Gamilaraay, English voiced and voiceless stops are realised as a corresponding native segment at the same place of articulation. A consequence of this is that a voiced segment may be devoiced in adaptation. Under the assumptions of the P-map, devoicing, observed in source-borrowing phoneme pair *d* > *t* [-voice] (**d* > *n* [+nasal], **d* > *l* [+approximant]) allows the least minimal perceptual deviation from the source segment. In Gamilaraay, the prohibition against word-initial alveolar *d* prevented the least distinctive absolute contrast d> [-voice] t (orthographic d). In this environment we observe the presumably closest auditory modification *d*> *dh* allowed in this position.

The main source of variation is the realisation of English sibilants as palatal *j* [c] in Martu Wangka and variously as dental *dh* (IPA [d̪]) palatal dj, trilled rr [r] in Gamilaraay. What is interesting is that the consonant inventory of both Martu Wangka and Gamilaraay includes the alveolar stop *t*, which we might assume to be the closest candidate phoneme to English alveolar *s,* which has the same place of articulation value as *t*. Why is it not therefore selected? Presumably, the borrower is exploiting a different articulatory similarity between the sibilant and its correspondent phoneme. For example, the articulation of dental stops [dh] is frequently characterised as having a slightly affricated release (Hamilton 1994:51). Therefore, when adapting sibilants, the borrower selects a phoneme within the native inventory which bears some similarity in terms of continuancy (i.e. manner of articulation) to an English sibilant. The consonant inventory of Martu Wangka has only one laminal series, and therefore the only potential candidate is palatal *j*. The consonant inventory of Gamilaraay has two laminal series *j* and *dh*. Here, variation occurs according to distributional constraints on each phonotactic position. Word-initially, English sibilants are realised lamino-dental *dh*, the only potential candidate attested word-initially. Intervocalically, English sibilants are realised as a lamino-palatal *dj*. This environment here is similar to Martu Wangka's adaptation of sibilants.

[23] Information about the perceptibility of phonemic contrasts comes from attested cross-linguistic responses to phonotactic violations (e.g. devoicing (*nasalisation, *approximation) is the only attested response to constraints on voiced stops) as well as several confusion studies (for example, van den Broecke (1976)).

I suggest that when English [COR] stops are mapped onto the closest correspondent phoneme, this phoneme is assigned the function of a stop. Once this phoneme is assigned the function of a stop, the speaker selects an alternative phoneme which is assigned an alternative function of a fricative. This process prevents English sibilants and stops with the same place of articulation being realised as the same native phoneme (e.g. in Martu Wangka alveolar stop *d* > *t*, alveolar fricative *s* > palatal *j, *t*). The borrower selects a sufficiently similar alternative phoneme in the native inventory which has the same major articulator – that is, [COR]. When an alternative phoneme with the same major articulator is not available, we observe a neutralisation of English stops and fricatives. For example, labiodental fricatives and labial stops are both realised as labial stops because an alternative LAB phoneme is not available to be assigned the function of a fricative.

Finally, in each borrowing language, different English sibilants like [s] and [ʃ] are mapped onto a single phoneme. I assume that the most significant aspect is the major articulator of the source segment rather than its place of articulation. In both languages, English labiodental fricatives become labial stops, thus being faithful to [LAB] feature of the source segment. English distinguishes a whole range of coronal sibilants. Since the consonant inventory of the borrowing language lacks a sufficiently similar correspondent phoneme at each place of articulation, we observe neutralisation of a whole range of English sibilants.

3.2.2 Vowel inventories

Both Martu Wangka and Gamilaraay exhibit a maximally distinct vowel inventory with contrastive length. In contrast, English distinguishes many more vowels. The assumed specifications of each vowel system are given in (11):

(11) Vowel chart for Martu Wangka and Gamilaraay, and partial vowel chart of English

		[-back] [-round] ([-rnd]				[+back] round ([+rnd]	
		short	long	short	long	short	long
Lb Martu Wangka, Gamilaraay	-low ([-lw])	i	iː			u	uː
	+low ([+lw])			a	aː		
Ls English		front		central		back	
		unround		unround		round	
	high	i				u ʊ	
	mid	e		ə ʌ		o ɔ	
	low	æ		a			

Martu Wangka and Gamilaraay adaptation involves the neutralisation of many English vowels. The borrower selects a vowel from the vowel inventory of the borrowing language which is phonetically closest to the source vowel.[24] Language-internal variation occurs for adaptation of English unstressed schwa vowels, which lack clear phonetic qualities.

[24] c.f. In Nhanda, which also has a maximally distinct three vowel system, expansion of the vowel inventory occurs in adaptation. Specifically, we observe two new vowel phonemes are *o* in coopu < English 'soap' and *e* in Wagaweyi < English 'Walkaway' (place name).

Martu Wangka

English vowels are realised as the phonetically closest Martu Wangka vowel, as shown in (12):

(12) Realisation of English vowels in Martu Wangka loan:

Ls	*source*	*Vowel*	*Realisation*	*Lb*	*loan*
English	missus	ɪ		Martu Wangka	m**i**jiji
	sweater	e			juw**i**ter
			i, ii		
	pretty flower	i			purt**i**pulawu
	tin of meat	iː			tinam**i**ti
	year	ɪə			y**ii**ya
	shoot-VERB	ʉː			j**uu**t(-amu)
	football-AUG	ʊ	u, uu		p**uu**tpul(-pa)
	shotgun	ɔ			j**u**rrkana
	four	oː			p**uu**
	daddy	æ			t**a**ti
	can't-AUG	ɑː			k**a**n(-pa)
	dance	æ (possibly ɑː)	a, aa		t**aa**nji
	you've gotta	ɔ			yik**a**rra
	donkey	ɒ			t**a**ngki

In Martu Wangka, English mid and high front vowels become front *i,* English mid and high back vowels become back round *u* and English low front [æ], and mid central vowels become *a*. English low back [ɔ] is variably realised as back *u* or low *a*.

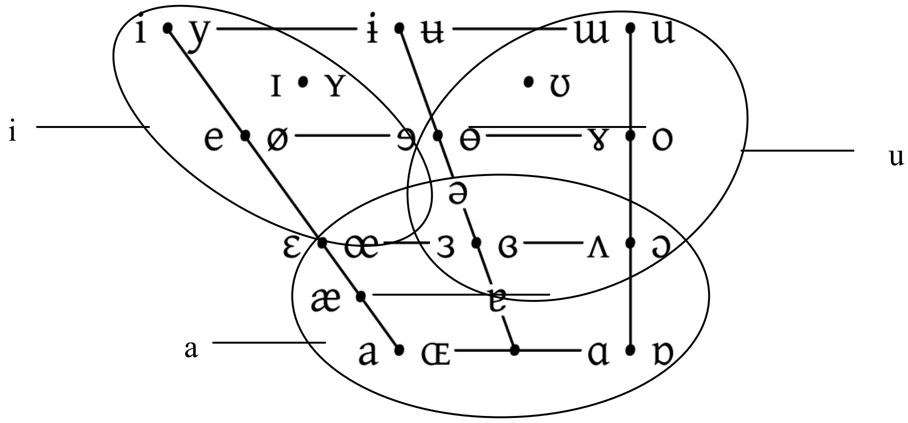
Martu Wangka loans show variation in the realisation of unstressed [ə]. Most frequently, [ə] is realised as the phonetically closest Martu Wangka vowel, low *a*. [ə]. Less frequently, [ə] shows local assimilation to the immediately preceding consonant. It is realised as high *i*, when the immediately preceding consonant is palatal, and round [*u*], when an immediately preceding consonant is labial. Least frequently, [ə] has no correspondent vowel in the loan. This only occurs for source forms with word-initial unstressed [ə]:

(13) Realisation of English [ə] adaptations according to environment:

Ls	*source*	*Segment*	*Environment*	*Vowel*	*Lb*	*loan*
English	prisoner	[ə]	none	> a	Martu Wangka	pirijin**a**
	missionary		C[palatal]_	> front *i*		mij**in***(-pa)*
	pannikin					panik**in**(-pa)
	pretty flower		C[LAB]_	> round *u*		purtipulaw**u**
	again		#unstressedV	> ∅		_kinpa

The diagram (14) demarcates English vowels according to their realisation. The circled vowels correspond to a single vowel in Martu Wangka's vowel system.

(14) English vowels in Martu Wangka: (The diagram is based on the IPA vowel chart.)



There are no diphthongs in Martu Wangka. English dipthongs are generally realised as long vowels. The first vowel assimilates to the second vowel, becoming a long vowel:

(15) English diphthongs in Martu Wangka:

Ls	*source*	*Diphthong*	*Realisation*	*Lb*	*loan*
English	gate-AUG	eɪ	> ii	Martu Wangka	k**ii**t(-pa)
	load	əʉ	> uu		l**uu**t

English diphthongs that differ along the front-back dimension (for example [oɪ] in boy and [ɑe] in bite) show an alternative adaptation. Both vowels are mapped regularly (as shown in (12)) and a glide is inserted into the diphthong. The epenthetic glide *y* is homorganic with the second vowel of the English diphthong.

(16) English diphthongs with vowels of different front-back values:

Ls	*source*	*Environment*	*Realisation*	*Lb*	*loan*
English	might be	ɑ_e̯	> ayi	Martu Wangka	ma**y**iti
	poison-AUG	o_ɪ	> ayi		pa**y**ijin(-pa)

Gamilaraay

English vowels are realised with the closest phoneme in Gamilaraay as shown in (44). The pattern observed is similar to Martu Wangka's (32):

(17) English vowels in Gamilaraay:

Ls	*source*	*Vowel*	*Realisation*	*Lb*	*loan*
English	bits of rag	ɪ	i	Gamilaraay	b**i**djaraay
	musket	e			marrg**i**n
	canoe	ʉː			gan**uu**
	pudding	a	u, uu		b**u**dhun
	road	oː			yurrun
	bottle	ɔ			b**a**dhaal
	bicycle	ɑe			b**a**djigal
	damper	æ	a, aa		dh**aa**mba
	motor car	a			marrig**a**

Like in Martu Wangka, English mid and high front vowels become front *i,* English mid and high back vowels become back round *u* and English low front [æ], low back [ɔ] and mid central vowels become *a*.

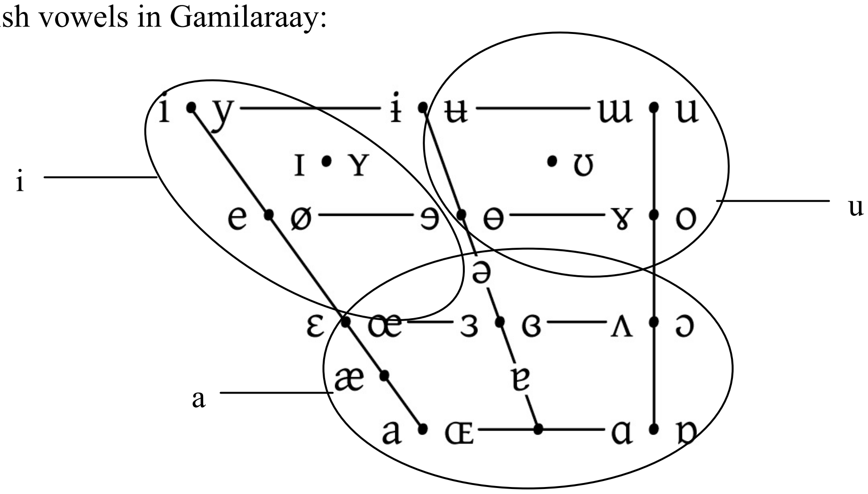
Also like in Martu Wangka, Gamilaraay loans show variation in the realisation of English central [ə]. [ə] is realised as high *i* when the immediately preceding consonant is palatal. Otherwise [ə] is realised as the closest Gamilaraay vowel, low *a*.

(18) English [ə] in Gamilaraay according to environment:

Ls	*source*		*Environment*	*Vowel*	*Lb*	*loan*
English	flour	[ə]		a	Gamilaraay	bulaaw**a**
	constable		> C[palatal]_	front high i		gandj**i**bal

The diagram in (19) shows the patterns for English vowels realisations. Vowels within each circle are realised by a single vowel within Gamilaraay's vowel system:

(19) English vowels in Gamilaraay:



Gamilaraay shows an alternative strategy to Martu Wangka when adapting diphthongs. When the second vowel of an English diphthong is high, the vowel is realised as a homorganic glide y:

(20) English source words with diphthongs:

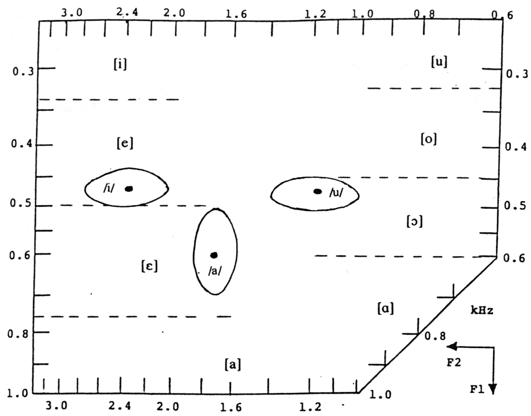
Ls	*source*	*Diphthong*		*Lb*	*loan*
English	boil-V-TRANSITIVE	oɪ	> aay	Gamilaraay	baayl(-irrama-li)
	wire	ɑe̯	> aay		waaya

Discussion

Martu Wangka and Gamilaraay exhibit extensive similarity when realising English vowels, as indicated by overlapping circled vowels in the diagram in (20). Both languages show variation in the realisation of English low back [ɔ] as low *a* and back *u.* [25]

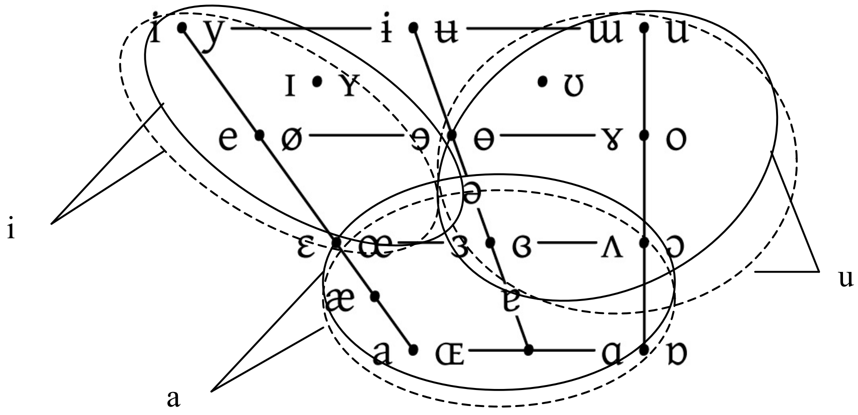
[25] Orthographic forms cannot adequately indicate the diversity of realisations of vowels in Martu Wangka and Gamilaraay loans. It is uncertain whether the vowel space expands significantly under new inputs or English vowels are mapped onto a much smaller vowel space which is typical of the language's inventory, as illustrated below:

(2) Formant frequency data of short stressed vowels from a Warlpiri speaker (Butcher 1994:29):



However, Areyonga Teenage Pitjantjatjara speakers pronounce vowels with a wide range of phonetic contrasts, presumably due to contact with English. For example, English [æ] and [ɒ] are realised as such ([kæmulʌ] < English 'camel', [sɒkʌ] < English (Langlois 200:45). (c.f. Neutralisation of these vowels occurs in the corresponding Traditional Pitjantjatjara loans [kɑmulʌ] and [sɑkʌ].)

(21) A comparison of English vowels adaptations in Martu Wangka (demarcated by the unbroken line) and Gamilaraay (--):



Having established typical English consonant and vowel substitution patterns in Martu Wangka and Gamilaraay, we can concentrate on adaptations resolving constraints on syllable and word structure. In the following sections, I compare the syllable structure of English to that in Martu Wangka and Gamilaraay and introduce prosodic markedness constraints required in the following optimality-theoretic explanations.

3.3 Syllable and word structure constraints in adaptation

Martu Wangka and Gamilaraay exhibit different restrictions on phonotactic and syllable structure than English. In the following section, I compare these restrictions. Then I define prosodic markedness constraints employed throughout the analyses and show how these constraints conflict with a language's source-borrowing faithfulness constraints, according to Smith's optimality-theoretic explanation.

3.3.1 Syllable structure and Phonotactic patterns

Syllable types for English, Martu Wangka and Gamilaraay are given in (22):

(22) Syllable types in English, Martu Wangka and Gamilaraay (- indicates attested type, x indicates unattested):

	Ls	*Lb*	
	English	Martu Wangka	Gamilaraay
CV	-	-	-
CV:	-	-	-
CVC	-	-	-
CV:C	-	-	-
VC	-	x	- (rare)
CCVC	-	x	x
CVCC	-	x	x

The table in (42) shows that English allows more syllable structure types than each borrowing language. Specifically, English allows onsetless syllables, and onset and coda clusters. In contrast, Martu Wangka and Gamilaraay are considerably more restrictive, prohibiting all tautosyllabic clusters and onsetless syllables.[26]

English is also less restrictive than each borrowing language in terms of distributional constraints on phonotactic positions. The phonotactic position relevant to the following analyses is the coda. English allows a whole range of consonants to occupy the coda position. In Martu Wangka, morpheme internal codas must not be obstruents.[27] Gamilaraay exhibits similar restrictions on codas, allowing sonorants, as well as *j* in some heterorganic clusters.

[26] Both languages allow some heterosyllabic clusters, as shown in Appendix 7.1.

[27] I assume Warlpiri exhibits a similar restriction against obstruents as codas. We will return to Warlpiri's coda condition in section 4.4.

Finally, English is also less restrictive than each borrowing language at the level of word structure. English allows a range of consonants word-finally. In contrast, Martu Wangka only allows vowels at the end of words. Consonant-final nominal stems in the native lexicon take the (AUG)mentive suffix *–pa* (e.g. jaaly-**pa** 'a whisper-AUG'). In contrast, Gamilaraay allows only [+sonorant] coronals- *n, l, rr, y* in the native inventory.

3.3.2 Prosodic markedness constraints

Syllable constraints employed in the thesis, their definition and phonological realisation are given in (23):

(23) Markedness constraints used throughout the analysis

Constraint	**Definition**	**Phonological realisation**
ONSET	Syllables must have onsets	prohibits syllables without onsets
NOCODA	Syllables must not have codas.	prohibits syllables with codas
*COMPLEX$^{ONSET, CODA}$	Syllables must not have complex onsets or codas.	prohibits sequences of consonants as onsets and codas
VOWEL FINAL[28]	The right edge of a grammatical word coincides with vowel.	prohibits consonant final words

Constraint violation occurs when inputs contain syllable structures that violate one of these constraints. IO Faithfulness constraints must dominate constraints governing syllable structure well-formedness to allow surface forms with ill-formed syllable structure. In English, input 'tree' /tri:/ is faithfully mapped to an output [**tr**i:], preserving the complex onset. The onset cluster can surface due to English's partial constraint ranking IO-FAITHFULNESS >> *COMPLEX^{ONSET}, as shown in (22):

[28] VOWEL FINAL is also the constraint known as Align-R-V. I use VOWEL FINAL for the rest of the thesis because the name is easier to understand.

(24) English ‘tree’

triː	FAITH-IO	*COMPLEX^ONSET
a. tiriː	*! DEP-IO	
b, _riː	*! MAX-IO	
→b. triː		*

We observe similar constraint rankings in a borrowing language like Martu Wangka. For instance, Martu Wangka native input forms with a coda are faithfully mapped to an output, preserving the coda. Codas are permitted to surface due to IO-FAITH >>NOCODA:

(25) Martu Wangka jaaly-pa ‘a whisper’-AUG

jaaly-pa	FAITH-IO	NOCODA
a. jaa_pa	*! MAX-IO	
c. jaa.lyi.pa	*! DEP-IO	
→b. jaalypa		*

Before I continue with a discussion of constraint rankings in loanword adaptation, the loan input representations must be clarified. I assume that adaptation strategies under investigation are at least in part phonologically unfaithful mappings rather than entire misperceptions by the borrower, as proposed by Peperkamp and Dupoux (2003). Peperkamp and Dupoux’s explanation predicts that word final epenthesis in Martu Wangka results from experience-related misperceptions in initial language contact. That is, the borrower perceives a final vowel because the borrowing language internal phonology never allows surface forms with word-final consonants.

In native Martu Wangka alternations, the AUG suffix–*pa* resolves consonant-final stems.[29] This shows that the borrower must store consonant-final morphemes in the native lexicon. Martu Wangka borrowings from English sometimes take the AUG –pa, as shown in (26).

(26) Martu Wangka loans with –pa suffix:

Lb	*Loan*	*Ls*	*source*
Martu Wangka	kiit(-pa)	<English	gate
	niil(-pa)		nail

These loans show that the borrower veridically perceived a final consonant in these examples and must store the perceived source form with a final consonant. Thus the perceived source form violates Martu Wangka's word constraint, VOWEL FINAL.

(27) Martu Wangka loans with final vowels:

Lb	*Loan*	*Ls*	*source*
Martu Wangka	jiipu	<English	sheep
	jaaji		church

The examples in (26) include source words with word-final released consonants. In this environment, it is possible that final vowel epenthesis may create an intervocalic context that is a phonetic approximation of the consonant release (as argued by Kang 2003 for Korean loanwords). This impacts on my analysis because the input, that is, the perceived source form, has a final vowel, thus satisfying Martu Wangka's word constraint, VOWEL FINAL. Phonological mapping /jiipu/ → [jiipu] is maximally faithful to the perceived

[29] We know that –pa is a suffix and not part of the nominal stem because a nominal stem can take other nominal suffixes instead of –pa, like the ERGATIVE SUFFIX –rtu.

source form, incurring no SB-faithfulness violations. However, in my analysis, the constraint ranking selects the correct output for perceived loan inputs with final vowels anyway, as shown in the tableau in (28):

(28) Martu Wangka jiipu < English 'sheep'

PLS |jiipu|	VOWEL FINAL	FAITH-SB
a. jiip		*!
→b. jiipu		

Before each analysis, I explain why I assume the aspect of loanword adaptation under investigation must involve phonologically unfaithful mapping.[30]

In loanword adaptation, violation of markedness constraints frequently occurs when a language borrows a word with ill-formed structure. These constraints must dominate a language's source-borrowing correspondence for adaptation strategies to occur. For example, Martu Wangka shows final vowel epenthesis when an English word with a disallowed final consonant as shown in (29). Loan inputs with final consonants demonstrate that VOWEL FINAL dominates FAITH-SB:

(29) jiip**u** < English 'sheep'

jiip	VOWEL FINAL	FAITH-SB
a. jiip	*!	
→b. jiipu		*

[30] However, we must acknowledge that at least part of loanword adaptation is due to perception, as allowed by Smith's source-similarity model.

The more faithful *jiip* is not well-formed in terms of Martu Wangka's word-structure. This is illustrated with the higher ranked syllable structure constraint VOWEL FINAL being fatally violated with the lower ranked SB-faithfulness satisfied. The optimal candidate *jiip**u*** violates source-similarity faithfulness by inserting a vowel after the final consonant, while the higher ranked VOWEL FINAL is satisfied.

In the second chapter, we saw that OT allows vowel epenthesis as well as other typologically possible adaptation strategies like deletion. In Martu Wangka, DEP-SB must rank below MAX-SB, for epenthesis-repair rather than deletion to occur:

(30) jiip**u** < English 'sheep'

jiip	MAX-SB	DEP-SB
a. jii_	*!	
→b. jiipu		*

I assume the same ranking holds in Warlpiri and Pitjantjatjara, other vowel final languages which show epenthesis in adaptation. In section 3.2, I discuss epenthesis-repair in Martu Wangka loans. I put forward an optimality-theory explanation for variable outcomes of epenthesis-based repair in Martu Wangka driven by VOWEL FINAL, and compare to these outcomes to those observed in Warlpiri and Pitjantjatjara loans showing epenthesis-repairs.

Similar interactions of source-borrowing faithfulness and syllable structure constraints emerge when we look at other borrowing languages. For example, Gamilaraay words, whether native or loaned, must have final codas that are [+sonorant, COR]. This constraint is formalised in (30):

(31) Gamilaraay CODA CONDITION [(+son)orant, (COR)oronal]]$_\sigma$: Codas must +sonorant and coronal.

English allows many consonants word finally, so this constraint is quite restrictive in Gamilaraay adaptation. Loan inputs with disallowed final consonants show that Gamilaraay's Coda Condition dominates FAITH-SB for adaptation strategies to occur:

(32) Gamilaraay baaybuu < English 'pipe'

baayb	[+son,COR]]$_{\sigma}$	FAITH-SB
a. baayb	*! ([-son, LAB]]$_{\sigma}$ *b*)	
→b. baay.b**uu**		**

The more faithful candidate *baayb* (a) cannot surface because it has a final [-son, LAB] coda which violates Gamilaraay's CODA CONDITION. In the optimal candidate *baaybuu*, a vowel is inserted and the LAB consonant is the onset of the following syllable, satisfying the constraint on codas. In section 3.3, I put forward an explanation for various strategies in Gamilaraay adaptation due to CODA CONDITION >> SB-FAITH.

Similar conflicts of prosodic markedness constraints and SB-FAITH occur in other aspects of adaptation. For example, Martu Wangka shows cluster-dependent variation between vowel epenthesis and deletion when adapting a final coda cluster. This is due to the constraint ranking $*\text{COMPLEX}^{\text{CODA}}$ >> SB-FAITH:

(33) Martu Wangka milki < English 'milk'

milk	$*\text{COMPLEX}^{\text{CODA}}$	SB-FAITH
a. milk	*!	
→b. mil.ki		*

In section 4.2, I discuss adaptation strategies due to *COMPLEX CODA. I put forward an optimality-theoretic explanation for cluster-dependent variation between epenthesis and deletion repair strategies in Martu Wangka loans.

Finally, languages including Warlpiri show adaptation strategies when adapting onset clusters. This is due to the constraint ranking *COMPLEX^{ONSET}>> FAITH-SB:

(34) Warlpiri turaki < English ‘truck’

trak	*COMPLEX^{ONSET}	FAITH-SB
a. trak	*!	
→b. turaki		*

In section 4.4, I put forward an optimality-theoretic explanation for adaptation strategies due to *COMPLEX^{ONSET}, focusing on Warlpiri borrowings from English.[31]

3.4 Conclusion

From the preceding discussion, we can recognise the general interaction of source-borrowing faithfulness and syllable structure constraints, as given in (34):

[31] I assume the same ranking holds for Martu Wangka (turaka < English ‘truck’) and Gamilaraay (bulanggiin < English ‘blanket’), languages disallowing tautosyllabic consonant clusters that show epenthesis repairs.

(35) General schema for conflict of markedness constraints and SB-faithfulness:

Lb	*:*	*Syllable and word structure*	*>>*	*SB-faithfulness*
Martu Wangka	:	VOWEL FINAL	>>	MAX-SB>> DEP-SB
Gamilaraay	:	CODA CONDITION [+son,COR]]$_\sigma$	>>	SB-FAITH
Martu Wangka	:	*COMPLEX $^{\text{CODA}}$	>>	SB-FAITH
Warlpiri	:	*COMPLEX $^{\text{ONSET}}$	>>	SB-FAITH

By framing my analysis in Smith's model of loanword adaptation, I showed how the relevant markedness constraints drive adaptation strategies. In the next two chapters, I put forward optimality-theory explanations for more adaptation strategies due to the conflict of prosodic markedness constraints and source-similarity correspondence. In chapter 3, I discuss adaptation driven by Martu Wangka's word-structure constraint VOWEL FINAL and Gamilaraay's CODA CONDITION. In chapter 4, I continue with adaptations driven by *COMPLEX$^{\text{CODA, ONSET}}$. Loanword data comes from a few languages to demonstrate common patterns. In my optimality-theoretic explanations, I focus on adaptation strategies in Martu Wangka due to *COMPLEX$^{\text{CODA}}$ and those in Warlpiri due to *COMPLEX$^{\text{ONSET}}$.

4 Adaptation strategies in Martu Wangka and Gamilaraay

4.1 Introduction

In this chapter I present an optimality-theoretic analysis of the adaptation strategies due to syllabic constraints, observed in Martu Wangka and Gamilaraay borrowings from English. These languages show different adaptation strategies when borrowing English words that have consonant and consonant clusters that cannot be incorporated into their native structures. Most frequently, final vowel epenthesis occurs. However Gamilaraay also shows consonant substitution in a restricted context. I also account for the quality of the epenthetic vowels in Martu Wangka, and compare this to the quality of epenthetic vowels in Warlpiri and Pitjantjatjara loans. I begin with a discussion of Martu Wangka and continue with Gamilaraay.

4.2 Martu Wangka

As mentioned in section 3.3, Martu Wangka words must end in a vowel. Given that many English words are consonant final, some strategy must be employed when such words are borrowed into Martu Wangka. We saw that in this situation, a vowel is inserted after the final consonant or consonant clusters. This process has the effect of making a word vowel-final and breaking up final consonant clusters into a heterosyllabic sequence (CC# → C.CV#). Some examples are shown in (1):

(1) Martu Wangka loans showing epenthesis

a. jiip**u** < English ‘sheep’

b. kuut**u** < English ‘milk’

c. mil.k**i** < English ‘milk’

In section 3.3, we observed that Martu Wangka’s word structure constraint VOWEL FINAL must dominate SB-faithfulness constraints to allow adaptation strategies. Epenthesis is due to the constraint ranking VOWEL FINAL, MAX-SB[32] >> DEP-SB. The tableau in (54) illustrates this ranking:

(2) Martu Wangka jaaji < English ‘church’

jaaj	VOWEL FINAL	MAX-SB	DEP-SB
a. jaaj	*!		
b. jaa_		*!	
c. jaaj**i**			*

The examples in (1) show that the quality of the final epenthetic vowel varies between [+rnd] *u* and [-rnd] *i*. In the following section, we will see that the quality is not random.

4.2.1 Frequencies of Epenthetic vowels

A preliminary analysis of epenthetic Martu Wangka loans revealed that some context-independent variation occurs between the epenthetic vowels.[33] In this section, I use Uffmann’s (2006) method for determining the conditioning environments for the epenthetic vowel. This method involves calculating the epenthetic vowel frequencies both context-independently and according to different environments. The table in (58) provides context-independent frequencies of each word-final epenthetic vowel in Martu Wangka loans.

[32] VOWEL FINAL and MAX-SB cannot be ranked relative to each other. Having established the general schema Markedness >> SB-faithfulness, I predict that VOWEL FINAL would dominate MAX-SB.

[33] All examples are provided in Appendix 7.2.1.

(3) Frequencies of word-final epenthetic vowels in Martu Wangka loanwords:

Epenthetic Vowel	**Number**	**Percentage (%)**
u	28	47.5
i	23	39.0
a	8	13.6
Total	59	100

The most frequent epenthetic vowel is round *u*. Cross-linguistic investigation of epenthetic vowels has demonstrated that the [+rnd] feature associated with *u* vowels is marked (Lombardi 2002). In the following table (4), we will see that round *u* occurs in restricted environments, and that the high frequency of these conditioning environments accounts for the high frequency of epenthetic *u.* Therefore, it is unlikely that default insertion of the marked vowel *u* occurs. I hypothesise that the next most frequent vowel [-rnd, -lw] *i* is the least marked in this language's vowel system and is the default epenthetic vowel, and conditioning environments account for the occurrence of *u*. The table in (4) presents the frequencies of the epenthetic vowels according to two main environments, the vowel in the immediately preceding syllable and place of the immediately preceding consonant:

(4) Context-dependent frequencies of final epenthetic vowels in Martu Wangka loans:

Environment		**Frequency of the epenthetic vowel (%)**		
		u	*i*	*a*
Vowel in the preceding syllable	*u*	**58.8**	23.5	17.6
	i	37.5	56.3	6.3
	a	42.3	15.4	42.3
Immediately preceding consonant	LAB	**82.4**	0	17.6

The table in (4) indicates that when the epenthetic vowels are divided according to the immediately preceding [LAB] consonant, the most frequent epenthetic vowel is round *u*. Round vowels and labials share the value for the place feature [LAB]. Therefore I propose that the [+rnd] value of the epenthetic vowel is dependent on the immediately preceding [LAB], in the process of local labial assimilation. In the following section, we observe that the high frequency of source words with final LAB consonants accounts for the most frequent *u* vowel independent of the context, as found in (3).

The table in (4) also indicates that when the epenthetic vowels are divided according to the vowel in the immediately preceding syllable, the most frequent epenthetic vowel is predicted by the vowel in the preceding syllable. Specifically, when non-epenthetic vowel is round *u*, the epenthetic vowel is most frequently round *u*; and when the underlying vowel is non-round *i* the most frequent epenthetic vowel is non-round *i*. I propose that the epenthetic round *u* vowel exhibits [+rnd] harmony with the [+rnd] *u* vowel in the immediately preceding syllable. I assume that *i* is inserted in the other environments. In conclusion, Martu Wangka shows three environments that condition the quality of the epenthetic vowel, as given in (5):

(5) Conditioning environments for final epenthetic vowels in Martu Wangka loans:

a. [+rnd] vowels immediately following labials show labial assimilation
b. [+rnd] vowels show [+rnd] harmony with vowels in the immediately preceding syllable
c. default insertion of *i* in other environments

In the following section, I provide some examples that demonstrate variation in the quality of the epenthetic according to these environments.

4.2.2 Conditioning Environments in epenthetic Martu Wangka loans:

This section provides some examples of Martu Wangka loans which demonstrate that the quality of the epenthetic vowel varies according to the environments identified in the previous section. The epenthetic vowel [+rnd] following a labial:

(6) inputs with final [LAB] consonants:

Lb	*Loan*	*Ls*	*Source*
Martu Wangka	nayip**u**	< English	knife
	jiip**u**		sheep
	kaap**u**		cup
	maap**u**		mob
	pilamap**u**		fill em up
	naw**u**		now
	jaalp**u**		self
	yaap**u**		half
	laamp**u**		lamp
	juup**u**		soap

In following examples (7), the epenthetic vowel harmonises with the [+rnd] vowel in the immediately preceding syllable:

(7) inputs with a [+rnd] vowel:

Lb	*Loan*	*Ls*	*Source*
Martu Wangka	kuut**u**	<English	coat
	luut**u**		load
	juut**u**		shorts
	puluk**u**		bullock
	pukuj**u**		box

When a loan has both conditioning environments for round vowels, the epenthetic vowel is [+rnd], as expected:

(8) words with both a [+rnd] vowel and word-final labial consonants:

Lb	*Loan*	*Ls*	*Source*
Martu Wangka	luw**u**	< English	law
	yaruw**u**		arrow
	juup**u**		soap
	ruum**u(-**parni)		room-PRIVATIVE without

In examples that do not contain either conditioning environment, the epenthetic vowel is [-rnd]. That is, we observe epenthetic *i* in the examples which don't have final LAB consonants, and the vowel in the preceding syllable is either [-rnd] *i* (9) or [+lw] *a* (10):

(9) loans with [-round, -back] *i* vowel: [34]

Lb	*Loan*	*Ls*	*Source*
Martu Wangka	parralayij**i**	<English	paralysed
	Yingkilij**i**		English
	tiij**i**		dish
	piinyj**i**		fence
	wiijij**i**		wages
	marrit**i**		married
	pakit**i**		pocket
	tinamit**i**		tin of meat

[34] It is also possible that the occurrence of epenthetic *i* is conditioned by the underlying *i* in the immediately preceding syllable.

jikijiy**i**	sixty
milk**i**	milk

(10) loans with [+lw] vowels:[35]

Lb	*Loan*	*Ls*	*source*
Martu Wangka	jumaj**i**	< English	too much
	paajay**i**		birthday
	jikaj**i**		six
	jaaj**i**		church
	taanj**i**		dance

4.2.3 Phonological evidence for the quality of the epenthetic vowel

In the following analysis, I make the assumption that the quality of the epenthetic vowel is predicted by Martu Wangka's phonological grammar. An alternative hypothesis is that the borrower perceives the release of the final consonant as a vowel. If the borrower perceives the consonant release as a vowel, we would expect that the quality of the epenthetic vowel exhibits more variation according to the preceding consonant. In the examples in (59), we observed that epenthetic *i* occurs after coronals (palatal *j* in *tiiji*, alveolar *t* in *tinamiti*) and dorsals (velar k in *milki*). Therefore it is unlikely that the quality of the epenthetic vowel is solely perceptual.

4.2.4 An OT analysis of final epenthetic vowels in Martu Wangka loans

Epenthesis-based repair in Martu Wangka loanword adaptation results from the conflict of the VOWEL FINAL and faithfulness constraints along the SB correspondence relation, as shown in (2). The quality of the epenthetic vowel derives, in my analysis, from the conflict

[35] Again, it is also arguable that the epenthetic *i* is conditioned by the immediately preceding palatal.

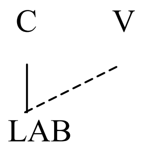
of a sequence constraint on the sequence *LAB*i*, the harmony constraint AGREE [+RND] and general markedness constraints for this language's vowel system.[36]

I propose that the loans exhibiting labial assimilation are driven by the sequence constraint *Lab*i* which prohibits sequences of LAB consonants followed by the [-rnd] *i*.

(11) *LAB*i*: Labial segments must be not followed by non-round *i*.[37]

This constraint distinguishes labial assimilation, which is local spreading of the LAB feature, from another process active in Martu Wangka loanword phonology, [+rnd] harmony, which is the extension of [+rnd] features of input vowels to the epenthetic vowel. Contrast the representations in (12-3). In the LAB*u* sequence shown in (12), I assume that [+rnd] feature of the epenthetic vowel is dependent on the [LAB] feature of the immediately preceding consonant:

(12) Structure of LAB*u* sequence

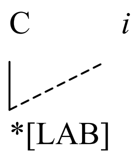


Martu Wangka's dispreference for Lab*i* sequences is illustrated by the distinct [LAB]/[+rnd] features associated with the LAB consonant and [-rnd] *i*:

[36] I independently came up with the analysis for the quality of the Martu Wangka loans. We will see that some aspects of the analysis are similar to Harvey and Baker's (2005:1460-1465) analysis of the epenthetic vowel in Warlpiri loans, as indicated at relevant points in the discussion.

[37] This sequence constraint is similar to Harvey and Baker's (2005: 1461) sequence constraint *[+RD][-RD] for Warlpiri which prohibits sequences of [-rnd] vowels after [+rnd] vowels except that *LAB*i* is specific to consonant-vowel sequences, specifically sequences of [LAB]/[+rnd] and [-rnd] vowels. *LAB*i* is similar to 'LABATT: Return every i that is immediately preceded by a labial consonant (p, m, w)' (McCarthy 2003: 12), except that the latter constraint was proposed in the context of comparative markedness, and cannot be imported into the present analysis.

(13) Structure of LAB*i* sequence



*LAB*i* does not prevent Lab*i* sequences from surfacing in native words because this constraint ranks below this language's input-output faithfulness. Native words with underlying Lab*i* sequences illustrate how FAITH-IO constraints must dominate the *LAB*i* for this sequence to surface:

(14) Martu Wangka native stem - jaapi 'hot meat'

jaapi	FAITH-IO	*LAB*i*
a. jaap**u**	*! (IDENT-IO [-RND])	
→b. jaap**i**		*

The next constraint we need to account for the epenthetic vowel quality is the harmony constraint AGREE [+RND], given in (15):

(15) AGREE [+RND]: The [+RND] value for vowels in neighbouring syllables must be identical (based on the AGREE constraint proposed by Lombardi 1996)

AGREE [+RND] is the constraint that ensures that the [+rnd] value for input vowels extends (rightwards) to the epenthetic vowel. Vowel harmony is not active in Martu Wangka's internal phonology (Deak 2008 personal communication).[38][39] It emerges only in the

[38] Suffixes do not alternative in their value for [±round] in accordance with the vowel in the preceding syllable, as shown in /yaku+ rri/→ [yakurri] *[yakurru] 'dance'+ INCOHATIVE SUFFIX.

[39] However Marsh (1969:138) notes that context-dependent allophonic variation occurs (e.g. round *u* vowels assimilate to front *i* across word boundaries, when the immediately following consonant is the front glide *y*: kalatju yanu > kaladj**i** yanu 'and we PLURAL EXCUSIVE went'.).

context of these epenthetic vowels. Native forms with [+rnd] and [-rnd] vowels in neighbouring syllables show that FAITH-IO constraints demanding faithfulness to input vowels, dominates AGREE [+RND], as shown in the tableu in (71).

(16) Martu Wangka native stem - jupi 'wet'

jupi	FAITH-IO	AGREE [+RND]
a. jupu	*! (IDENT [-RND])	
→b. jupi		*

The form *jupu* (a) satisfies the constraints for AGREE [+RND] through sacrificing the value for the [+rnd] *u* vowel in the input, thus fatally violating FAITH-IO. The optimal form *jupi* (b) is faithful input but has input vowels with disharmonic [+rnd][-rnd] vowels in neighbouring syllables. Thus we see how the ranking FAITH-IO >> AGREE [+RND] does not allow harmony in Martu Wangka's native phonology.

The final set of constraints we need to fully account for the quality of the epenthetic vowel comprise markedness constraints for the features associated with each vowel in Martu Wangka's vowel system. Lombardi (2002) establishes the universal constraint rankings of these markedness features using a cross-linguistic typology of context-independent epenthetic vowels. The relative markedness of height and roundness features required for this analysis are given in (17):

(17) Relative markedness of vowel features (Ibid:5):

a. round vowels are more marked than non-round vowels: *[+RND] >> *[-RND]
b. the markedness of [+lw] and [-lw] vowels varies between languages:
    i. In languages where the default vowel is low [a], non-low vowels are more marked than low vowels: *[-LW]>> *[+LW].
    ii. In languages where the default vowel is the least marked vowel in the system. For example, low vowels are more marked than non-low vowels: *[+LW]>> *[-LW].

I am using the constraint ranking proposed by Lombardi (2002:6) *[+LW]>> * [-LW], *[+RND] >> *[-RND].[40] This means that I am assuming that round and low vowels are more marked than non-low and non-round vowels within Martu Wangka's vowel system. Thus, *i* is the least marked vowel. The tableau in (70) illustrates how this constraint ranking accounts for the insertion of the least marked vowel *i:*

(18) Relative markedness of vowels in Martu Wangka's vowel system:

	*[+LW]	*[-LW]	*[+RND]	*[-RND]
a. *a*	*!			
b. *u*		*	*!	
→c. *i*		*		*

When the other context-specific constraints *LAB*i* and AGREE [+RND] are irrelevant, the least marked epenthetic vowel is [-lw, -rnd] *i* which is the 'default' inserted vowel. The quality of the epenthetic vowel can be straightforwardly explained as an outcome of the optimality-theoretic principle called The Emergence of the Unmarked. Since epenthetic vowels are not subject to input faithfulness, the ranking of markedness features exclusively determines the quality of the epenthetic vowel. In contrast, input vowels are saved by higher ranked FAITH-IO constraints that permit marked vowels to surface, thus preserving contrasts:

(19) Martu Wangka native stem- jupi 'wet'

jupi	FAITH-IO	*[+LW]	*[-LW]	*[+RND]	*[-RND]
a. jipi	*!	**			**
→b. jupi		**		*	*

[40] Height constraints do not conflict with roundness constraints, so these constraints aren't ranked with respect to each other.

The candidate *jiiji* (a) sacrifices the [+lw] values for the input vowel in order to be less marked within the vowel system, thus fatally violating FAITH-IO. The dominance of FAITH-IO allows marked [+lw] vowels to surface as is, thus preserving vowel contrasts.

In Martu Wangka loans, [+rnd] vowel harmony occurs due to the ranking AGREE [+RND] >> *[+RND]. Loan inputs with [+rnd] vowels shows how the constraint ranking AGREE [+RND] >> *[+RND] allows marked [+RND] epenthetic vowels to surface, as in (20):

(20) Martu Wangka kuutu < English 'coat'

kuut	AGREE [+RND]	*[+RND]
a. kuuti	*!	
→b. kuutu		*

AGREE [+RND] is irrelevant when evaluating loan inputs with [-rnd] vowels,. The markedness ranking for roundness *[+RND]>> *[-RND], *[+LW]>> *[-LW] allows least marked [-rnd, -lw] vowels to surface:

(21) Martu Wangka milki < English 'milk'

milk	AGREE [+RND]	*[+RND]	*[-RND]	*[+LW]	*[-LW]
a. milku		*!			
b. milka			*	*!	
→c. milki			*		

In the following two tableaux (22-3) we see how *LAB*i* interacts with AGREE [+RND]. When evaluating loan inputs with final LAB consonants and [-rnd] vowels, AGREE [+RD] is irrelevant and *LAB*i* ensures that the epenthetic vowel is [+rnd]:

(22) Martu Wangka jiipu < English sheep

jiip	*LAB*i*	AGREE [+RD]
a. jiipi	*	
→b. jiipu		

When evaluating loan inputs with [+rnd] vowels and COR or DOR final consonants, *LAB*i* is irrelevant and AGREE [+RND] ensures that the epenthetic vowel is [+rnd]:

(23) Martu Wangka kuutu < English 'coat'

kuut	*LAB*i*	AGREE [+RND]
a. kuuti		*!
→b. kuutu		

Finally, inputs with final LAB consonants show how *LAB*i* interacts with height constraints in order for the epenthetic vowel to be [+rnd] and not [+lw] after LAB:

(24) Martu Wangka jiipu < English 'sheep'

jiip	*LAB*i*	*[+LW]	*[-LW]
a. jiipi	*!		*
b. jiipa		*!	
→c. jiipu			*!

From the preceding discussion, I propose the constraint ranking for word-final epenthesis-based repair in Martu Wangka loanword adaptation, as given in (25):

(25) FAITH-IO>>VOWEL FINAL, MAX-SB >> DEP-SB>> *LAB*i* >> AGREE [+RND], *[+LW] >> *[-LW], *[+RND] >> *[-RND].

In the following tableaux (26-8), we observe how the hierarchy interacts as a whole. I have not included violations against markedness constraints of the input vowels. This would make the tableaux too difficult to read. The reader should remember that any input vowels are saved by the higher ranked FAITH-IO constraints that permit these vowels to faithfully surface, as shown in (19). I evaluate three different loan forms that show different environments identified in (4).

The first form to be evaluated is an input with a low vowel *a* and final coronal, so *LAB*i* and AGREE [+RND] are irrelevant:

(26) Martu Wangka jaaj < English 'church'

jaaj	FINAL VOWEL	MAX-SB	DEP -SB	*LAB*i*	*[+LW]	AGREE [+RND]	*[-LW]	*[+RND]	*[-RND]
a.jaaj	*!								
b.jaa_		*!							
c.jaa.j**a**			*		*!				
d.jaa.j**u**			*				*	*!	
→e.jaa.j**i**			*				*		*

The candidate *jaaj* (a) is most faithful to the source form but incurs the most serious violation against the dominant markedness constraint VOWEL FINAL. The next candidate *jaa_* (b) is the deleted form, which is well-formed prosodically but violates the higher-ranked source-similarity constraint MAX-SB. The next three potential candidates are epenthetic forms which violate DEP-SB and therefore the lower-ranked constraints determine the optimal form. All epenthetic candidates vacuously satisfy the sequence constraint *LAB*i* and AGREE [+RND], allowing the effects of the relative markedness of vowels within this language's vowel system to emerge. The candidates *jaaja* (c) contains the most marked vowel [+lw] and *jaaju* (d) contains the other more marked [+rnd] vowel. The optimal candidate *jaaji* contains the least epenthetic marked vowel- [-rnd] *i*.

In the following two tableaux (27-8), I omit MAX-SB, since we can now see that deletion forms like (26b) will always be knocked out by this constraint. The second form to be evaluated is an input with [+rnd] *u* and a coronal, so *LAB*i* is irrelevant:

(27) Martu Wangka kuutu < English 'coat'

kuut	FINAL V	DEP -SB	*LAB*i*	*[+LW]	AGREE [+RND]	*[-LW]	*[+RND]	*[-RND]
a. kuut	*!							
b. kuu.ta		*		*!				
c. kuu.ti		*			*!	*		*
→d. kuu.tu		*				*	*	

All epenthetic candidates vacuously satisfy the constraint on *LAB*i*, allowing the effects of AGREE [+RND] to appear. The epenthetic *a* in the candidate *kuuta* (a88b) violates the highest ranked markedness constraint on *[+Lw] vowels. The non-low epenthetic vowels in the other epenthetic candidates *kuuti* and *kuutu* both incur a violation against *[-lw]. The winning candidate is *kuutu* because it is more important for vowels in neighbouring syllables to have the same value for [+rnd] even though this means that the epenthetic vowel is the relatively more marked [+rnd] vowel.

The final form to be evaluated is a source word with a final LAB consonant.

(28) Martu Wangka jiipu < English 'sheep'

jiip	FINAL VOWEL	DEP -SB	*LAB*i*	*[+LW]	AGREE [+RND]	*[-LW]	*[+RND]	*[-RND]
a. jiip	*!							
b. jii.p**i**		*	*!			*		*
c. jii.p**a**		*		*!				
→d. jii.p**u**		*				*	*	

The candidate *jiipi* contains the least marked epenthetic vowel but violates the constraint against the marked sequence *LAB*i*. The other epenthetic candidate *jiipa* has the marked low vowel *a*, violating the highest ranked markedness constraint *[+lw]. In the optimal candidate *jiipu* (d), the [+rnd] *u* after the labial satisfies the sequence constraint on *LAB*i*.

In this analysis, I showed that the interaction of conditioning environments such as inputs with [+rnd] vowels and general markedness constraints for a language's vowel system are significant factors determining the quality of the epenthetic vowel in Martu Wangka loans.

4.2.5 Other vowel final languages, Warlpiri and Pitjantjatjara

In the following section, I discuss two other languages, Warlpiri and Pitjantjatjara. Like Martu Wangka, each language allows words to end in vowels only. Each language shows vowel epenthesis when adapting English words with final consonants. In section 3.3, I showed that this is due to the constraint ranking VOWEL FINAL, MAX-SB>> DEP-SB. In the following section, I compare the quality of epenthetic vowels in Martu Wangka loans to those in Warlpiri and Pitjantjatjara loans.

Warlpiri

Warlpiri provides an interesting contrast to Martu Wangka because vowel harmony is active in loans as well as native morphological alternations. Native morphological categories except verb stems exhibit rightwards [-rnd] vowel harmony (Nash 1986). This basic pattern of vowel harmony behaviour is shown in (29):

(29) rightwards [-rnd] harmony Warlpiri morphophonemic alternations (Ibid 1986:86):

	Lb Warlpiri			*Gloss*
a.	/kurd**u**-kurl**u**-rl**u**=lk**u**=j**u**=l**u**/	→	[kurd**u**-kurl**u**-rl**u**=lk**u**=j**u**=l**u]**	'child-PROP-ERG. then-me-they'
b.	/ malik**i** -kurl**u**-rl**u**=lk**u**=j**u**=l**u**/	→	[malik**i**-kirl**i**-rl**i**=lk**i**=j**i**=l**i**]	'dog-PROP-ERG.then-me-they'
			*[malik**i**-kirl**u**-rl**u**=lk**u**=j**u**=l**u**]	

In (29b), the [-rnd] value of the final stem vowel extends rightwards to the suffix vowel. Thus underlying suffix and clitic [+rnd] vowels are assimilated to [-rnd] *i* when the vowel in the stem is [-rnd]. The other property of Warlpiri [+rnd] vowel harmony is that labials block the extension of the [-rnd] value of the stem, as shown in (30). Thus, Warlpiri native forms appear to exhibit the same preference for LAB*u* over LAB*i* sequences as Martu Wangka loans.

(30) labial opacity in rightward [-rnd] harmony in Warlpiri native morphophonemics (Ibid 1986:87)

	Lb Warlpiri			*Gloss*
a.	/milpirri-puru/	→	[milpirripuru]	'cloud-during'
			*[milpirripiri]	
b.	/ngali-wurru/	→	[ngaliwurru]	'you and I'
			*[ngaliwirri]	

The other pattern relevant to the present discussion is that, in addition to [-rnd] harmony, at least one Warlpiri dialect also shows [+rnd] harmony in native morphophonemic alternation:

(31) [+rnd] harmony in Warlpiri dialect (Harvey and Baker 2005: 1462):

yanu-rni-rli	→	[yanu-rnu-rlu]	go-past=this.way=we2INCL
		*[yanu-rni-rli]	

The example in (31) shows that the [+rnd] value of the stem is extended rightwards to the suffix vowel. Warlpiri loans with final epenthetic vowels show an analogous pattern of [+rnd] harmony. The loanword examples in (32) show that value for the [+rnd] input is extended rightwards to a segment which has no correspondent input. In contrast to Warlpiri native alternations, which show assimilation of input [-rnd] to output [+rnd] vowels in suffixes, loans show the extension of the [+rnd] value to an epenthetic vowel, which has no correspondent in the underlying representation. Thus, Warlpiri loans exhibit [+rnd] harmony like Martu Wangka loans:

(32) source words with a word-final consonant:

Lb	*loan*	*Ls*	*source*
Warlpiri	tayipul**u**	< English	table
	kanjurl**u**		council
	nanigut**u**		nanny goat
	kamul**u**		camel
	puluk**u**		bullock

When the input vowel in the preceding syllable is [– rnd] (33) or [+lw] (34), the epenthetic vowel is [-rnd]. Thus, in the absence of conditioning environments, both Warlpiri loans and Martu Wangka loans insert *i* in non-conditioning environments:

(33) loans with input [-rnd] vowels

Lb	*Loan*	*Ls*	*Source*
Warlpiri	yirripurlayini**i**	< English	aeroplane
	majini		machine
	kantini		canteen
	rapij**i**		rubbish
	karrijin**i**		kerosene
	nyujik**i**		music

(34) source words with [+lw] *a*:

Lb	*Loan*	*Ls*	*Source*
Warlpiri	jaaj**i**	<English	church
	rapurant**i**		wrap-around
	turak**i**		truck

We observe a significant difference between the quality of the epenthetic vowels in Warlpiri and Martu Wangka loans after labial consonants. In Martu Wangka loans, the sequence constraint *LAB*i* preferred [+rnd] *u* epenthetic vowels after labials. In Warlpiri loans, the epenthetic vowel is [-rnd] *i* after labials, as in (35):[41]

[41] I found no examples of Warlpiri loans with an underlying [+rnd] *u* and final labial in Nash (1983). Following Harvey and Baker's (2005) explanation, I predict that in these loans, the epenthetic vowel would [-rnd] *u*. I base this on the fact that in [+rnd] harmony, labials can be associated with [+rnd], thus satisfying their constraint *[LAB, -RND] (Ibid: 1461) which disallows labials associated with the feature [-rnd]. We return to this constraint in the following discussion. Jane Simpson has since informed me that *jup**u**, sup**u*** (< English soap) have been recorded, as predicted by H&B's explanation.

(35) inputs with final labials:

Lb	*loan*	*Ls*	*source*
Warlpiri	nyujiyimi**i**	< English	museum
	tapi		tap

In the following section, I review the optimality-theory analysis proposed by Harvey and Baker (henceforth H&B) (2005). We saw that Martu Wangka vowel harmony emerged only in the context of epenthetic vowels. This is due to the constraint ranking FAITH-IO >> AGREE [+RND]. In contrast, Warlpiri native morphology stems exhibit rightwards [-rnd] harmony and, in at least one dialect, [+rnd] harmony as well. H&B distinguish root (RT) faithfulness from general constraints governing faithfulness to vowel features. The ranking RT-IO FAITH>> IDENT-IO [-RND], the constraint militating against changes in [–rnd] input vowels, allows alternations of [-rnd] vowels in suffixes and clitics, but not those in roots. The authors also propose two sequence constraints militating against output vowels with different values for [±rnd] in neighbouring syllables (similar to AGREE [+RND] used in Martu Wangka, and its correspondent constraint for [-rnd] harmony, AGREE [-RND]). The tableau in (93) illustrates H&B's proposed constraint hierarchy, using a native alternation showing [+rnd] harmony:

(36) Warlpiri [+rnd] harmony (not all dialects): Warlpiri yanu-rni-rli 'go-past=this.way=we2INCL':

yanu-rni-rli	RT-IO [±RND]	AGREE [-RND]	AGREE [+RND]	IDENT-IO [-RND]
a. yani-rni-rli	*!			
b. yanu-rni-rli		*!		
c. yanu-rni-rlu		*!	*	*
d. yanu-rnu-rli			*!	
→e. yanu-rnu-rlu				**

The optimal candidate *yanu-rnu-rlu* (e) sacrifices [-rnd] values of the vowel in each suffix, thus incurring two violations against the lowest ranked IDENT-IO [-RND], in order for adjacent vowels to have the same [± rnd] value, thus satisfying AGREE [+RND] and AGREE [-RND].

As noted in the discussion of Martu Wangka loans, epenthetic vowels are not subject to faithfulness since they have no correspondent inputs. H&B account for [+rnd] harmony similarly to native alternations. They use the same constraint hierarchy generating Warlpiri's native harmony patterns, as well as feature markedness constraints for vowels in Warlpiri's vowel system. The constraint hierarchy *[+LW]>> *[- LW], *[+RND]>> *[-RND] generates the default insertion of *i,* the least marked vowel in the system.[42]

In the following tableaux in (37-8), I incorporate SB-faithfulness constraints into the constraint hierarchy proposed by H&B. The first form to be evaluated is a loan with a [+rnd] vowel:

(37) Warlpiri kamul**u** < English 'camel'

kamul	VOWEL FINAL	MAX-SB	DEP -SB	AGREE [-RND]	AGREE [+RND]	*[+LW]	*[-LW]	[+RND]	*[-RND]
a. kamul	*!								
b. kamu_		*!							
c. kamula			*			*!			
d. kamuli			*		*!		*		
→e. kamulu			*				*	*	

Warlpiri's VOWEL FINAL constraint prevents the most faithful form *kamul* (a) from surfacing, and the higher-ranked SB-faithfulness constraint MAX-SB ensures that the deletion form *kamu _* (b) cannot surface. The next three candidates are epenthetic forms

[42] I used the same constraint ranking proposed by Lombardi (2002: 6) to account for the quality of final epenthetic vowels in Martu Wangka loans.

that violate the lower-ranked SB-faithfulness constraint DEP-SB. The epenthetic *a* in the candidate *kamula* (c) violates the highest ranked markedness *[+LW]. The non-low epenthetic vowels in the other epenthetic candidates *kamuli* (d) and *kamulu* (e) incur a violation against the lower-ranked height markedness constraint *[-LW]. The winning candidate is *kamulu* because it is more important for vowels in neighbouring syllables to have the same value for [+rnd] and satisfy AGREE [+RND] than to be the least marked vowel (i.e. [-rnd] as in *kamuli*) in Warlpiri's vowel system.

In Warlpiri native alternation, labials block the extension of [-rnd] vowels. H&B propose a constraint *[LAB, -RND] which prevents the association of labials with [-rnd] feature of the immediately preceding vowel. Thus, their constraint has the effect of blocking the extension of the [-rnd] value for the root vowel to the suffix. This constraint also prevents the extension of [-rnd] value of loan inputs to the epenthetic vowel. The tableau in (38) shows how the effects of vowel markedness constraints emerge in Warlpiri loan inputs with final labials:

(38) Warlpiri nyujiyimi[43] < English [mjuziːəm] 'museum'

museum	VOWEL FINAL	DEP-SB	*[LAB, -RND]	AGREE [-RND]	*[+LW]	*[-LW]	[+RND]	*[-RND]
a. nyujiyimi |/| *[-rnd]		*	*!			*	*	
→b. nyujiyimi		*				*	*	

The form in (a) shows the extension of the [-rnd] feature of the input vowel to the labial and the immediately following the epenthetic vowel. This form has a [-rnd] value associated with a labial, which violates *[LAB, -RND]. The optimal form maintains the [+rnd] value of the labial consonant, thus blocking the extension of the [-rnd] vowel. Here we see the effects of The Emergence of the Unmarked. The epenthetic vowel is least

[43] An interesting coalescence strategy occurs when the onset cluster [mj] in the English word becomes lamino-palatal *ny*. *ny* which shares the same place of articulation as the j and the nasal value of m.

marked vowel is [-rnd], the least marked in Warlpiri's system. Thus Warlpiri loans do no exhibit the same dispreference for LAB*u* sequences occurring in Martu Wangka loans.

I conclude that the distinction between Warlpiri and Martu Wangka is the occurrence and nature of vowel harmony in loans and native morphological alternations. Both Warlpiri and Martu Wangka loans show [+rnd] harmony. Martu Wangka native words show neither [-rnd] harmony nor [+rnd] harmony. In contrast, Warlpiri native morphophonemic alternations shows [-rnd] harmony. H&B account for harmony in epenthetic loans using the same constraint rankings for a broader pattern of [+rnd] and [-rnd] harmony in Warlpiri's native phonology.[44] The authors show that RT-faith must be distinguished from general constraints governing faithfulness to vowel features for either harmony pattern to occur. In Martu Wangka however, distinguishing RT faith is unnecessary because harmony is not active in the native phonology.

Martu Wangka loans show an additional conditioning environment for [+rnd] vowels, which is a final labial consonant followed by round *u*. I explained this as Martu Wangka's preference for sequences of labials immediately followed by round vowels. That is, round vowels are dependent on the LAB value of the immediately preceding consonant. H&B show that in Warlpiri loans, LAB consonants do not exhibit this preference for LAB*u* sequences. On the contrary, Warlpiri shows a dispreference for sequences of LAB*u* due to constraint on *[LAB, -RND] which prevents labials being associated with [-rnd]. H&B's constraint predicts that loans with [+rnd] inputs would have [+rnd] *u* epenthetic vowels after labials, given that labials can be associated with [+rnd] values in [+rnd] harmony and thus satisfy *[LAB, -RND].

Finally Martu Wangka and Warlpiri have the same hierarchy for the markedness of vowel features- *[+LW]>> *[-LW], *[+RND]>> *[-RND]. In each language, this hierarchy allows

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[44] Using H&B's constraint ranking AGREE [-RND] >> AGREE [+RND], it is possible to show why [+rnd] harmony occurs in both Warlpiri and Martu Wangka loans and [-rnd] harmony is not active in Martu Wangka's native phonology. If an IO-faithfulness constraint was ranked between AGREE [-RND] and AGREE [-RND], for example AGREE [-RND] >> IDENT-IO [+RND] >> AGREE [+RND], it would be more important to be faithful to the [+rnd] value of an input vowel than to share the same [-rnd] value of the preceding vowel. Thus the effects of [-rnd] harmony can never surface. AGREE [+RND] ranks below this IO-faithfulness constraint, thus allowing the emergence of [+rnd] harmony in special contexts, like in epenthetic vowels, which have no input vowels to be faithful to, and some Warlpiri dialects.

the least marked epenthetic vowel *i*. These languages provide an interesting contrast to the following language, Pitjantjatjara, which shows a different epenthetic vowel *a* in loans.

Pitjantjatjara

Like Martu Wangka and Warlpiri, Pitjantjatjara shows final vowel epenthesis when borrowing English words with final consonants. The epenthetic vowel is [+lw] *a* when the vowel in the preceding syllable is [+lw] *a* (39) and [-lw, -rnd] *i* (40):

(39) words with [+lw] vowel:

Lb	*loan*	*Ls*	*source*
Pitjantjatjara	kaanta(-mila)	< English	count
	paatja		bus

(40) words with [-rnd] vowels:

Lb	*loan*	*Ls*	*source*
Pitjantjatjara	griina(-wana)		green
	ping.ka(-wana)		pink
	ritja		race
	wiita		wet
	pulangkita		blanket

On the basis of these data, I assume that default epenthetic vowel here is [+lw] *a* because [-lw] vowels are more marked than [+lw] in Pitjantjatjara's vowel system, hence:

(41) *[-LW]>> [+LW], *[+RND]>>*[-RND]

This ranking followings directly from the system proposed by Lombardi (2002:6). The tableau in (42) confirms this ranking:

(42) Pitjantjatjara wiita < English ‘wet’

wiit	VOWEL FINAL	MAX-SB	DEP-SB	*[-LW]	*[+LW]	*[+RND]	*[-RND]
a. wiit	*!						
b. wii_		*!					
c. wiitu			*	*!			*
d. wiiti			*	*!	*	*	
→e. wiita			*		*		

The most faithful form *wiit* (a) cannot surface because it violates VOWEL FINAL. The deletion form *wii_* (b) cannot surface either because it violates the higher-ranked SB-faithfulness constraint MAX-SB. The candidates *wiitu* (c) and *wiiti* (d) contain epenthetic [-lw] vowels, violating the higher-ranked height markedness constraint *[-LW]. The winning candidate *wiita* (e) has epenthetic [+lw] *a*, the least marked vowel in Pitjantjatjara’s system.

Thus, the distinction between Pitjantjatjara and both Martu Wangka and Warlpiri is the ranking of height markedness constraints. In Pitjantjatjara loans, the constraint ranking *[-LW]>> *[+LW] allows [+lw] *a* epenthetic vowels, whereas in Martu Wangka and Warlpiri loans, the reverse ranking *[+LW]>> *[-LW] allows *i* epenthetic vowels. This shows that some small language-specific constraint rankings for vowel features generate epenthetic vowels of different qualities. In both languages, the default epenthetic vowel is the least marked within the system, as predicted by the optimality-theoretic explanation, the Emergence of the Unmarked.

4.2.6 Interim Conclusion

I conclude this analysis with a discussion of the phonetic features of epenthetic vowels in Warlpiri and Martu Wangka's loans. Under the assumption that loanword adaptation involves the least perceptual or auditory deviation from the source form, we find that the context-independent epenthetic vowel is the least perceptually salient vowel - *i* - within each vowel system.[45] In a perceptually-oriented account, this means that the Martu Wangka loans exhibit a minimal auditory deviation from the source word to resolve the VOWEL FINAL constraint. In the following discussion about Gamilaraay adaptation, we observe highly audible deviations from source segments involving changes to sonority value source occur.[46] This is a problem when addressing adaptation strategies as minimal auditory deviations from the input, as in exclusively perceptually-oriented accounts.

4.3 Gamilaraay

In the previous section, I discussed adaptation strategies in Martu Wangka, Warlpiri and Pitjantjatjara. In each language VOWEL FINAL allowed only words with final vowels to surface. In the following section, I discuss loanword adaptation in Gamilaraay, a language which, unlike all of the languages above, allows some final consonants. In Gamilaraay, consonants that are [+son, COR] (i.e. *n, y, l, rr*) may occur in the word-final position. It follows that at least some consonant final English words are permitted to surface with final consonants in this language. In section 3.3.3, we established that Gamilaraay's CODA CONDITION [+son, COR)]]$_\sigma$ must dominate source-borrowing faithfulness so that unfaithful loan outputs can surface:

[45] See Kenstowicz for a similar discussion.

[46] c.f. Adler (2006) shows that Hawaiian consonant adaptation typically proceeds via minimalist auditory deviation from the input, disallowing changes to sonority (b > p, *l *n).

(43) Gamilaraay baaybuu < English 'pipe'

baayb	[+son, COR)]]$_\sigma$	FAITH-SB
a. baayb	*! [LAB]]$_\sigma$	
→ b. baaybuu		**

In the following section, we observe that Gamilaraay loans show both vowel epenthesis and substitution when resolving forms disallowed by Gamilaraay's CODA CONDITION. I explain these adaptation strategies using the conflict of CODA CONDITION and a set of context-sensitive FAITH-SB constraints.

4.3.1 The split pattern of epenthesis-based repair and substitution in Gamilaraay loans

This section describes adaptation strategies employed in Gamilaraay borrowings from English. When Gamilaraay borrows English words with permissible word-final consonants, final consonants faithfully surface. This includes the COR sonorants *l* and *n*:

(44) source words with word-final consonants allowed in Gamilaraay:

Lb language	*Loan*	*Ls*	*loan*
Gamilaraay	bari**l**	< English	barrel
	baadji**n**		poison

However this constraint is quite limited because English allows many other word final consonants. If one of these is borrowed, Gamilaraay requires some strategy so that the loan conforms to the CODA CONDITION. We observe vowel epenthesis, as in Martu Wangka, after final labials and dorsals (45):[47]

[47] Labials and dorsals comprise a natural 'peripheral' class in Australian Aboriginal languages (Dixon 1980:139). This may be an alternative explanation for why peripheral consonants show the same adaptation strategy, vowel epenthesis. Further investigation about the quality of the epenthetic vowel is required.

(45) Source words with final with word-final [LAB]:

Lb language	*Loan*	*Ls*	*loan*
Gamilaraay	nhaayb**a**	< English	knife
	baayb**uu**		pipe
	dhuub**uu**		soap
	yurraam**u**		rum

(46) Source words with word-final [DOR] consonants:

Lb language	*Loan*	*Ls*	*loan*
Gamilaraay	milg**in**	< English	milk
	yurrug**u**		rope (possible)

When Gamilaraay borrows English words with final COR consonants other than *l* and *n* we find a different strategy. In these forms, substitution rather than epenthesis takes place. Final COR obstruents become sonorants. Specifically, coronal stops become nasal, as shown in (47):

(47) Source words with word-final COR stops: [48]

Lb	*Loan*	*Ls*	*Source*
Gamilaraay	bulaang.gii**n** ~ bulang.gii**n**	< English	blanket
	burrgiya**n**		pussy cat
	marrgi**n**		musket
	yuruu**n**		road
	yurruu**n**		road
	dhalbi**n**		tablet

Sibilants and the affricate [ʤ] become the alveolar trill *rr,* as shown in (48):[49]

(48) Source words with word-final sibilants and affricate [ʤ]: [50]

Lb	*Loan*	*Ls*	*Source*
Gamilaraay	garaa**rr**	< English	grass (possible)
	nhiigilii**rr**		necklace
	yuluu**rr(-**inma-li)		lose-VERB INTRANS
	dhindi**rr**		tin dish
	maadj**irr**		matches
	yarra**rr**		rice
	babuligaa**rr**		public house
	gabi**rr**		cabbage

[48] Appendix 2.2 contains examples that show that coda *t* is less frequently realised as alveolar rr (e.g. Gamilaraay nhaniguu**rr** < English 'nanny goat'). Ash, Giacon, and Lissarrague (2003:7) characterise the flap sound as something similar to a flapped [d] by an English speaker, indicating auditory and articulatory source-similarity to the source segments [t, d]. These examples are not included in my analysis.

[49] Giacon (personal communication) indicates that the phonetic instantiation of this phoneme is trilled in careful speech, therefore I assume that the underlying representation is trilled rr and the flap rr is a reduced form which bears similarity to [t]. The assumption that the underlying representation of the rr as trilled fits into the definition for the CODA CONDITION ((31) in section 3.3), which allows only [+sonorant] segments including trilled rr and and prohibits [-sonorant] flap *rr*.

[50] This substitution pattern is not restricted to final consonants, but also occurs for word-internal coda consonants as well (e.g. Gamilaraay ma**rr**gin< English 'mu**s**ket').

4.3.2 Input representations of final COR consonants

In the present analysis, I assume that the borrower exploits source-similarity judgements when selecting an adaptation strategy. The s>rr-substitution examples in (48) cannot be considered misperceptions by the borrower because of the high perceptual salience of fricatives (Wright 2004).[51] The stop>nasal-substitution repairs also involve changes of sonority, which results in a significant auditory deviation from the source segment.[52] Finally, the distinct realisations of coronal stops and sibilants according to distributional restrictions on phonotactic positions (final s < rr substitution in garaa**rr** < English 'rice'; initial word-initial s< dh substitution in dhindirr < English salt, as discussed in section 3.3.1) confirm that the borrower has accurately perceived some aspects of these phonemes. Therefore I propose that substitutions discussed here are at least partly driven by Gamilaraay's phonotactic restrictions on codas. This means source-borrowing mapping involves faithfulness violations against the features of the source segment. For example the [-sonorant] [s] segment in English 'rice' becomes [+sonorant] *rr* in the corresponding Gamilaraay loan. This counts as a faithfulness violation against the identity of the value associated with the [±sonorant] feature of the source segment.

4.3.3 Constraints and Rankings for Gamilaraay loans

I propose that the split pattern of epenthesis-based repair and coronal substitution derives from the conflict of Gamilaraay's CODA CONDITION [+son, COR)]]$_\sigma$ and three source-similarity faithfulness constraint types- MAX-SB and DEP-SB, used in the previous analyses, and an additional SB-faithfulness constraint family IDENT-SB [F], defined in (49):

(49) IDENT-SB [F]: Let α be a segment in the source segment S and β be a correspondent of α in the borrowing segment B. If α is [γF], then β is [γF].

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[51] See Smith (to appear) for a similar argument.

[52] c.f. In context-independent segmental adaptation, the borrower will always maintain the identity of [±sonorant] value associated with a segment where possible (Adler 2006).

Constraint violation occurs when correspondent source and borrowing segments have a different value associated with the feature [F]. In contrast to MAX-SB and DEP-SB, which are constraints on segments, IDENT-SB [F] governs the identity of features. To account for the split pattern of epenthesis-based for LAB and DOR consonants and substitution repairs for COR consonants, we must incorporate the universal markedness hierarchy for place (de Lacy 2002; Paradis and Prunet 1991, Prince and Smolensky 1993):

(50) LABIAL, DORS[53] >> CORONAL

This implicational hierarchy indicates that coronals are universally less marked than labials and dorsals. The optimality-theoretic instantiation of the markedness hierarchy employed in this analysis is given in (51):

(51) IDENT-SB [LAB, DOR] >> IDENT-SB [COR]

These constraints militate against changing the place values of segments during adaptation. The ranking predicts that violations of IDENT-SB [LAB, DOR] are more serious than violations of IDENT-SB [COR]. In fact, Gamilaraay coronals do not alternate in place values. However, this ranking distinguishes the adaptation strategies for labials and dorsal from those for coronals. Having divided the constraints in this way, it is possible for other constraints to occur between them, and still maintain the overall ranking.

Loan inputs with final LAB consonants demonstrate that IDENT-SB [LAB, DOR] must dominate DEP -SB for epenthesis-based repair to occur:

[53] LAB, DORS are left unranked with respect to each other because there is conflicting evidence cross-linguistically. See Hamilton (1996:109-10) for a further discussion about place markedness in Australian Aboriginal languages. Gamilaraay loans exhibit the same pattern of epenthesis-based repair for disallowed word-final LAB and DORS consonants, so ranking their corresponding constraints is not crucial. I collapse both IDENT-SB [LAB] and IDENT-SB [DOR] to make the following tableaux easier to read.

(52) Gamilaraay baaybuu < English ‘pipe

baayb	IDENT-SB [LAB, DOR]	DEP-SB
a. baayn	*!	
→b. baaybuu		*

The candidate *baayn* (a) contains a licit coda, but fatally violates IDENT-SB [LAB] by sacrificing the LAB value of the input consonant. In contrast, the epenthetic candidate *baaybuu* (b) is faithful to the LAB value of the source consonant, and incurs a less serious violation against DEP-SB.

COR consonants may alternate in changes in [±sonority] in accordance with the CODA CONDITION. In the tableau in (53), we see how DEP-SB interacts with IDENT-SB [COR]. This ranking alone cannot predict that substitution repair rather than epenthesis-based repair occurs.

(53) Gamilaraay yuruu**n** < English ‘road’

ruud	DEP-SB	IDENT-SB [COR]
a. yuruu**du**	*!	
b. yuruu**n**		

COR stops (47) and sibilants (48) alternate in the value for [±sonorant] but not their value for [±continuant] to satisfy the CODA CONDITION [+son, COR]]$_{\sigma}$ (as formulated in section 3.3.1):

(54) English d > Gamilaraay **n**

$d]_\sigma$	→	$n]_\sigma$
|		|
[COR, -cont]		[+son]

The [+continuant, +sonorant] feature of the trill *rr* is attested by Chomsky and Halle (1968: 318).

(55) English 'grass' > Gamilaraay gararr

$s]_\sigma$	→	$rr]_\sigma$	*	$n]_\sigma$
|		|		|
[COR, +cont]		[+son]		[+son, -cont]

The split pattern of coda *t* > *n* substitution and s > *rr* substitution derives, in my analysis, from two additional IDENT-SB constraints militating against changes to the sonority and continuancy values of source segments. Each constraint is defined in (56-7):

(56) IDENT-SB [-(SON)ORANT]: Let α be a segment in the source segment S and β be a correspondent of α in the borrowing segment B. If α is [-sonorant], then β is [-sonorant].

(57) IDENT-SB [± (CONT)INUANT]: Let α be a segment in the source segment S and β be a correspondent of α in the borrowing segment B. If α is [γ continuant], then β is [γ continuant].

Inputs with prohibited [-sonorant] coronals show that DEP-SB must dominate IDENT-SB [-SON], the constraint that prohibits changes in the [-son] value of source segments. This allows substitution repairs and ensures that epenthesis does not occur for non-sonorant coronals:

(58) Gamilaraay yuruu**n**[54] < English 'road'

ruud	DEP-SB	IDENT-SB [-SON]
b. yuruud**u**	*!	
c. yuruu**n**		*

In the following two tableaux (58-9), we see how IDENT [±CONT] interacts with IDENT [-SON]. Source inputs with final coronal stops show that the [-cont] value of the source stop must be preserved in adaptation:

(59) Gamilaraay yuruu**n** < English 'road'[55]

ruud	IDENT-SB [±CONT]	IDENT-SB [-SON]
a. yuruurr	*!	*
→b. yuruun		*

[54] I do not include DEP-SB violations for the epenthetic glide and vowel inserted at the left edge of the initial *r* (**yu**ruun). This illustrates an alternative strategy that occurs in response to Gamilaraay's constraint on word-initial COR.

[55] Since final COR stops and sibilants show non-alternation in values for COR and [±cont], IDENT-SB [COR] and IDENT-SB [±CONT] cannot be ranked with respect to each other:

(1) Gamilaraay yuruun < English 'road'

ruud	IDENT-SB [COR]	IDENT-SB [±CONT]
a. yuruu**rr**		*!
→b. yuruu**n**		

In each candidate, the [+son] value for the codas incurs a violation against IDENT-SB [-SON]. Therefore we cannot rank IDENT-SB [±CONT] and IDENT [-SON] with respect to each other. The optimal candidate is *yuruun* because its [-cont] feature for the *n* is faithful to the [-cont] feature of the value of the correspondent source segment [-cont] *d*, satisfying IDENT-SB [±CONT].

In the next tableau (60), a source form with [+cont] *s* is evaluated. In section 3.2.1, we saw that Gamilaraay's consonant inventory lacks fricatives. Therefore, when discussing substitution repairs for source forms with final sibilants, we must also recognise constraints on Gamilaraay's consonant inventory like **s* which prohibits [s] from surfacing:

(60) Gamilaraay garaa**rr** < English 'grass'

graas	*s	[+SON, COR]]$_\sigma$	IDENT-SB [-SON]
a. garaas	*!	*([-son]]$_\sigma$ *s*)	
b. garaadh		*!([-son]]$_\sigma$ *dh*)	
→c. garaa**rr**			*

The most faithful candidate *garaas* (a) cannot surface because the [s] is not in the Gamilaraay consonant inventory, thus incurring a violation against **s*. Even if this segment were in the inventory, the [-sonorant] feature of [s] violates Gamilaraay's CODA CONDITION. In the next candidate *garaadh* (b), the source [s] is realised as a phoneme in Gamilaraay's consonant inventory *dh* that is attested word-initially, satisfying **s*. This form cannot surface either because the [-sonorant] value of the *dh* violates the CODA CONDITION. The final consonant in the optimal candidate *garaa**rr*** violates source-similarity faithfulness by sacrificing [-son] value of the source consonant. This violates lower-ranked IDENT-SB [-SON] constraint, and satisfies the CODA CONDITION.[56]

From the preceding discussion, I propose the constraint hierarchy for the split pattern of epenthesis and substitution repairs in Gamilaraay adaptation, as given in (61):

(61) *ʂ, CODA CONDITION [+SON, COR]]$_\sigma$, MAX-SB

IDENT-SB [LAB, DOR]>> DEP-SB>>

IDENT-SB [COR], IDENT-SB [±CONT]>> IDENT-SB [-SON].

Let us consider how this hierarchy works in the following tableaux (62-4). The first form to be evaluated is an English source word with a final labial, so IDENT-SB [COR] is irrelevant.

(62) Gamilaraay baaybuu < English ‘pipe’

baayb	*S	[+SON, COR]]$_\sigma$	MAX-SB	IDENT-SB [LAB, DOR]	DEP-SB	IDENT–SB [COR]	IDENT-SB [±CONT]	IDENT-SB [-SON]
a. baayb		*!						
b. baay_			*!					
c. baayn				*!				*
→d. baaybuu					*			

[56] I have not included candidates that have other final consonants allowed in native morphemes in Gamilaraay (l, y) because these substitutions are unattested in loanword adaptation. When evaluating source words with [-cont, COR] stops, we can see that [+cont] l, y in unattested forms like *yurruu**l** and *yuruu**y** would fatally violate IDENT-SB[±CONT]. Evaluations for source forms with final [-cont, COR] s, additional constraints like IDENT-SB[±LATERAL], IDENT-SB[±CONSONANTAL] for knocking out **garaal* and **garaay* respectively.

The candidate *baayb* (a) is most faithful to the source form but the final LAB incurs the most serious violation against the CODA CONDITION [+SON, COR]]$_\sigma$. The next candidate *baay_* (b) is the deleted form that fatally violates the highest-ranked SB faithfulness constraint MAX-SB. The candidate *baayn* (c) has with licit [+son, COR] coda through sacrificing the source segment's place value, incurring a violation against IDENT-SB [LAB]. The optimal candidate *baaybuu* satisfies the higher ranked constraint IDENT-SB [LAB] by inserting a vowel after final LAB, with the lower ranked DEP-SB candidate incurring the most minimal violation.

The next form to be evaluated is an input form with a final COR stop. IDENT-SB [LAB, DOR] is irrelevant, so lower-ranked source-similarity constraints determine the optimal form.

(63) Gamilaraay yuruun < Ls English 'road'

ruud	*S	[+SON, COR]]$_\sigma$	Max-SB	IDENT [LAB, DOR]	DEP-SB	IDENT-SB [COR]	IDENT [±CONT]	IDENT [-SON]
a. yuruud		*!						
b. yuruu_			*!					
c. yuruudu					*!			
d. yuruurr							*!	*
→e. yuruun								*

The most faithful candidate *yuruud* (a) has a [-sonorant] coda which violates CODA CONDITION. The deleted candidate *yuruu_* (b)violates the highest ranked SB-faith constraint MAX-SB and the epenthetic form *yuruudu* (d) violates the next highest source-similarity constraint DEP-SB. The next two candidates *yuruurr* (e) and *yuruun* (e) are substitution forms with licit [+son, COR] codas. Both candidates satisfy higher ranked source-similarity constraints MAX-SB and DEP-SB while violating lower-ranked IDENT-SB [-SON]. In the optimal candidate *yuruun,* the [-cont] value of the n is faithful to the [-cont] value of the source segment *d*, and satisfies the higher ranked constraint IDENT [±CONT]. In the other substitution candidate *yuruurr,* the [+cont] value of the *rr* incurs a violation against IDENT-SB [±CONT].

The final form to be evaluated is an input form with a final sibilant:

(64) Gamilaraay garaarr < English 'grass'[57]

graas	*S	[+SON, COR]]$_\sigma$	Max-SB	IDENT-SB [LAB, DOR]	DEP-SB	IDENT [COR]	IDENT [±CONT]	IDENT [-SON]
a. garaas	*!	*						
b. garaadh		*!					*	
c. garaadj		*!					*	
b. garaa_			*!					
c. garraadi					*!		*	
d. garaan							*!	*
→e. garaarr								*

The most faithful candidate *garaas* (a) contains a non-native segment *s*, which violates the **s* constraint on Gamilaraay's consonant inventory. The next substitution candidates *garaadh* (b) and *garaadj* (c) show attested [s]-substitutions occurring in the onset and intervocalic positions respectively. In each of these forms, the substituted coda is [-sonorant] which incurs a violation against the CODA CONDITION. The deleted candidate *garaa_* (d) violates the highest ranked SB-faithfulness constraint MAX-SB and the epenthetic form *garaadu* (e) violates Dep-SB. The next two candidates *garaan* and *garaarr* are substitution forms with licit [+son, COR]. In the optimal candidate *gararr,* the [+cont] value of the *rr* is faithful to [+cont] value of the source segment *s*, thus satisfying the higher ranked constraint IDENT [±CONT]. In the other substitution candidate *garaan* the [+cont] value of the rr violates against IDENT [±CONT].

[57] We are only concerned with adaptation strategies due to [+SON, COR]]$_\sigma$ so I exclude DEP-SB violations for the vowel inserted into the initial onset [gr] cluster. All candidates would violate this ranking.

I conclude that in Gamilaraay adaptation, the borrower must exploit source-similarity judgements to distinguish between adaptation repairs. However, if loanword adaptation involves the most minimal perceptual deviations from the source form, we would not expect substitutions involving highly perceptual changes to the sonority value of the source segments to occur. We observed changes to sonority in a restricted environment, specifically coronal obstruents become [+sonorant] in accordance with Gamilaraay's CODA CONDITION. In most other environments, it was more important to be maximally faithful to aspects of the source segment, especially its marked LAB/ DOR place value.

4.4 Conclusion

I have provided a description and optimality-theory analysis of adaptation due to syllabic constraints in Martu Wangka and Gamilaraay borrowings from English. What I have shown using Smith's correspondence model of source-similarity faithfulness is that violations of prosodic markedness constraints drive adaptation strategies. In Martu Wangka, violations of VOWEL FINAL drive epenthesis-based repair and in Gamilaraay, violations of the CODA CONDITION [+SON, COR]]$_\sigma$ drives both epenthesis-based repair for LAB and DOR consonants and substitution for [–sonorant] COR consonants. The conflict between the relevant markedness constraint of each language and SB-faithfulness as presented in my analysis is given in (65):

(65) OT schema for Martu Wangka and Gamilaraay borrowings from English

Lb	*Well-formedness*	*>>*	*SB-Faithfulness*	
Martu Wangka	VOWEL FINAL	,	MAX-SB	>> DEP-SB
Gamilaraay	CODA CONDITION	,	MAX-SB>>	IDENT [LAB, DOR] >> DEP-SB >> IDENT-SB [-SON], IDENT-SB [-SON], IDENT [+CONT]

Both Martu Wangka and Gamilaraay employ epenthesis-based repair rather than deletion. Therefore, the adaptation strategies considered here conform to the cross-linguistic epenthesis-preference of loanword adaptation (Paradis and LaCharité 1997) and other second language acquisition situations (Smolensky et. al. 2001). In this analysis, unless lower-ranked source-similarity faithfulness constraints intervene, like the IDENT-SB [COR] in Gamilaraay's proposed constraint hierarchy, DEP-SB is the lowest-ranked source similarity constraint. This allows vowel epenthesis in most environments. Thus vowel epenthesis results in a decrease in structural markedness because it resolves the relevant markedness constraint. Violations of DEP-SB represent the most minimal constraint violation within each language's constraint hierarchy.

We must recognise that violations of DEP-SB are formally analogous to violations of other constraints, specifically MAX-SB and IDENT-SB constraints. The epenthesis-preference occurs in response to the borrower's demand to maintain a maximal amount of information about the source form.

Gamilaraay shows an additional adaptation strategy- substitution. Substitution occurs in a restricted environment, specifically for [-sonorant] coronals. In my analysis, coronal substitution is due to the interaction of lower-ranked IDENT-SB [COR] and IDENT-SB [-SON]. Minimal violation limits this substitution strategy to a highly restricted environment, that is, segments which have the least marked place value [COR]. The higher-ranked segment-specific source-borrowing faithfulness constraint IDENT-SB [LAB, DOR] mitigates against substitution in non-coronals. Here, we observe the more frequent adaptation strategy, vowel epenthesis.

In the following chapter, I continue with an investigation of adaptation strategies that occur in response to other syllable structure constraints. Specifically, I discuss adaptation repairs due to *COMPLEX ^{CODA} and *COMPLEX ^{ONSET}.

5 Adaptation strategies due to *Complex ^{coda} and *Complex ^{onset}

5.1 Introduction

In this chapter I discuss onset and coda clusters. We will observe that the languages under investigation show cluster-dependent variation between deletion and epenthesis-based repair for both coda and onset clusters. I begin with discussion about adaptation strategies for word-final coda clusters then continue with word-initial onset clusters.[58]

5.2 Deletion and epenthesis in final homorganic coronal clusters

5.2.1 Introduction

In the previous chapter, we saw that when a language borrows an English word with a final consonant, a vowel is inserted after the consonant. If the final consonant is the second consonant in a heterorganic coda cluster, final vowel insertion also breaks the cluster up into a heterosyllabic sequence (CC#→ C.CV#):

(1) Martu Wangka mil.ki < English milk

In the present section, I investigate adaptation strategies for final homorganic clusters. Homorganic LAB and DOR clusters show epenthesis like heterorganic clusters:

(2) Final LAB and DOR clusters:

a. Martu Wangka lamp**u** < English 'lamp'

b. Yindjibarndi thurrang.g**u** < English 'drunk'

[58] I have included loanword examples from many languages because of the unavailability of loanword data from one language showing adaptation repairs in all environments.

Final homorganic COR clusters show a split pattern of epenthesis and deletion repair. When the second consonant is a sibilant, the cluster shows epenthesis-based repair. The sibilant is realised as the palatal *j*, as discussed in section 3.2.1:

(3) Martu Wangka piny.ji < English 'fence'

However, when the second consonant is a stop, the stop is deleted (CC#→ C_#), thus simplifying the cluster. We also observe final vowel epenthesis or addition of the AUG –pa suffix due to the constraint VOWEL FINAL:

(4) Martu Wangka jawun_(-pa) < English 'thousand'

In section 3.3.2 we saw that the adaptation strategies in (1-4) are due to the constraint ranking *COMPLEX ^{CODA} , VOWEL FINAL >> SB-FAITH, as shown in the tableau below:

(5) Martu Wangka piny.ji < English 'fence'

fens	VOWEL FINAL	*COMPLEX^{CODA}	SB-FAITH
a. piinyj	*!	*	
→b. piiny.ji			*

In the present chapter, I put forward an optimality explanation for the split pattern of epenthesis and deletion in COR homorganic clusters. This explanation exploits context-sensitive MAX-SB constraints militating deletion against different segments. In the following section, we will look at more examples showing repairs for coda clusters.

5.2.2 Epenthesis and deletion patterns in final coda clusters

The split pattern of deletion and epenthesis-based repair is pervasive throughout languages in my corpus. In heterorganic clusters, a vowel is invariably inserted after the consonant cluster and the second consonant becomes the onset of the following syllable:

(6) word-final heterorganic consonant clusters:

Lb	*Loan*	*Ls*	*source*
Martu Wangka	jaal.p**u**	< English	self
	milki		milk
Gamilaraay	milki**n**		milk

The same strategy occurs in most homorganic consonant clusters. Specifically, in final homorganic labial (7) and dorsal (8) coda clusters, a vowel is inserted after the second consonant, and the second consonant becomes the onset of the following syllable:

(7) word-final homorganic LAB Nasal-Voiceless Stop (NT) clusters:

Environment	*Lb*	*Loan*	*Ls*	*source*
NT#	Martu Wangka	laam.p**a**[59]	<English	lamp
		laam.p**u**		lamp

(8) word-final homorganic DOR clusters

Environment	*Lb*	*Loan*	*Ls*	*source*
NT#	Jiwarli	thurang.ka	< English	drunk
	Yindjibarndi	thurang.gu		drunk

[59] This form is also analysable as laam_+ AUG -pa or laamp+pa < English lamp + -pa.

Warlpiri	tirangki	drunk

Final homorganic COR coda clusters show a split pattern of epenthesis and deletion. In COR clusters with a final sibilant, both consonants are retained through epenthesis-based repair, and the sibilant is realised as palatal *j*. The alveolar nasal *n* becomes lamino-palatal *ny* which is homorganic with the immediately following lamino-palatal *j*:[60]

(9) Word-final homorganic COR clusters with a second sibilant consonant:

Environment	*Lb*	*loan*	*Ls*	*source*
Ns#	Martu Wangka	piiny.j**i**	< English	fence
	Putijarra	piiny.j**i**		fence
	Warlpiri	pin.j**i**		fence

In [COR] clusters with a final stop, however, the stop is deleted (CC#→C_#), thus simplifying the cluster. The examples in (10) include lateral-voiceless stop (RT) and nasal-voiced and voiceless (ND, NT respectively) clusters.[61]

(10) Word-final homorganic COR clusters with second stop:

Environment		*Lb*	*Loan*	*Ls*	*source*
a.	RT#	Gamilaraay	dhal_		salt
		Putijarra	ayikaan_		I can't
b.	ND#	Jiwarli	ngayirlan_		island
	NT#	Putijarra	tiin_tiin_		tent

[60] Thus the cluster maintains its homorganic status.

[61] Warlpiri does not follow this pattern. NT# and ND# clusters are typically repaired through epenthesis-based repair (jiminti**i** < English cement, tin**t**i< English 'tent', rapuranti**i** < English wrap-around).

In languages that are obligatorily vowel final we also observe addition of the AUG –pa suffix or final vowel insertion (C1C2#→ C1_V#) in addition to cluster simplification:

(11) word-final homorganic COR clusters in languages that must be vowel final:

Environment		*Lb*	*Loan*	*Ls*	*source*
a.	ST#	Martu Wangka	niij_(-pa)	<English	nest
			parralaj_i		paralysed
			~ parralayiji		
			Pintikaj_(-pa)		Pentacost
		Warlpiri	pirnpaj_i		breakfast
b.	NT#	Martu Wangka	jawujun_(-pa)		thousand
			kan_(-pa)[62]		can't
		Martu Wangka	kaman_(-pa)		government
c.	RT#	Martu Wangka	waly_taki		wild doggy

5.2.3 Clarification of input forms

Before I put forward an optimality-theory analysis, I will clarify the input representations for the examples with COR clusters (10-1) which show variation between epenthesis and deletion repairs. In the loans in (10), both the relatively non-salient post-sonorant voiced stops (jawujun_(-pa) < English thousan**d**) and relatively more salient post-sonorant voiceless stop (kan**_** < English 'can't') are deleted. Therefore variation for COR cluster adaptation cannot be entirely related to the relative perceptual salience of consonants in

[62] Kriol *kaan* 'can't' is widespread, so *kan-pa* may have come from Kriol (Jane Simpson, pers. comm.). The PLS is *kaan_ *kaant*, so deletion occurs before Kriol> Martu Wangka adaptation. We can hypothesise that a similar process of simplification of NT# clusters through T#-deletion occurred in creolisation.

these contexts (as argued by Shinohara 2006). However, we will see that my analysis reflects this observation.

An alternative explanation is that the source speaker omitted COR stops. Previous investigations (Guy 1980, 1991, 1997) have found that the occurrence of final COR stops is dependent on the phonological context. Specifically, COR stop deletion occurs more frequently after stops and sibilants than liquids and nonsibilant fricatives. This means that when auditory forms serve as the source input, it is likely that the final COR stop has been deleted in some contexts. This means that *COMPLEX^{CODA} is irrelevant here because the perceived source form does not have a complex coda (Martu Wangka niij_(-pa) < English *nes*_ **nest* 'nest'). Thus PLS-loan mapping /nes_-pa/→[nes_-pa] incurs no MAX-SB violations because deletion occurs at the pre-phonological level of source production. However, in the examples in (9-10), we observe coronal stop deletion in environments most likely to show deletion in English, like after sibilants (Martu Wangka niij_(-pa) < English 'ne**s**t') as well as environments dispreferring coronal stop deletion, like after liquids (Gamilaraay *dhal*_ < English 'salt'). I conclude that at least some coronal stop deletion is phonologically unfaithful source-loan mapping. We will see that my explanation also reflects the fact that coronal stops show deletion in borrowing languages as in English.

5.2.4 Constraint Rankings

In all languages in (6-11), [63] the adaptation strategies are driven by the language-internal markedness constraint on coda clusters *COMPLEX ^{CODA} as shown in the tableau in (5). To distinguish COR clusters from LAB/ DOR clusters, I incorporate the universal markedness hierarchy of place features, given in (12):[64]

(12) LAB, DORS>> COR

[63] In the following analysis, I will use examples from Martu Wangka to show how adaptation occurs in one language. I assume that similar explanations could be put forward for other languages in (130-4).

[64] In the previous chapter, the same markedness hierarchy was incorporated as an IDENT-SB heirachy to explain the split pattern of epenthesis and substitution when Gamilaraay.

In my analysis, the place markedness hierarchy is instantiated as a constraint hierarchy of MAX constraints militating against deletion of consonants with different place values:

(13) MAX-SB [LAB, DOR] >> MAX-SB [COR]

This hierarchy predicts that deleting a LAB or DOR consonant incurs a more serious violation than deleting a COR consonant. Having separated MAX-SB constraints in this way, it is possible for other constraints to be indispersed between while maintaining the ranking of this hierarchy. In examples in (8-9), we observe that LAB/ DOR clusters show epenthesis rather than deletion. Inputs with final LAB clusters show that MAX-SB [LAB, DOR] must dominate DEP-SB for epenthesis-based repair to occur:

(14) Martu Wangka 'laampu' < English 'lamp'

lamp	MAX-SB [LAB, DOR]	DEP-SB
a. laa_	**!	
→b. laampu		*

In COR clusters, we observed that a final sibilant (9) is retained through epenthesis-based repair, whereas COR stops (10-1) are deleted. These examples demonstrate that it is more important to retain a [+continuant] sibilant, which has robust internal cues, than a [-continuant] stop, which has less robust internal cues. Given the high perceptibility of sibilants (as mentioned in the previous chapter, Wright (2004)), I hypothesise that sibilant deletion conforms to a greater auditory deviation from the source form than stop deletion in the correspondent context. The borrower perceives the presence of sibilants and the pLs form contains a corresponding segment. Therefore he must produce a form with a correspondent segment, even though his native consonant inventory lacks fricatives. I propose that this pattern derives from the conflict of segment-sensitive MAX-SB constraints:

(15) Max-SB [+continuant] >> Max-SB [-continuant]

The constraint hierarchy in (15) predicts that deleting continuants is a more serious violation than deleting stops. We will see that the interaction of MAX-SB [-CONT], which mitigates against deletion of non-continuants, and the MAX-SB [COR] constrains deletion to coronal stops. This interaction reflects Guy's (1980, 1983) observation that coronal stop deletion occurs in English. The split pattern of deletion and retention through epenthesis-repairs in coronal clusters is due to the relative ranking of each constraint with respect to other SB-faithfulness constraints. Inputs with final sibilants show that MAX-SB [+CONT] must dominate DEP-SB for epenthesis-based repair rather than deletion to occur:

(16) Martu Wangka 'piinyji < English 'fence'

fens	MAX-SB[+CONT]	DEP-SB
a. piny_	*!	
→b. piinyji		*

Inputs with final COR stops show that DEP-SB must dominate MAX [-CONT] for deletion rather than epenthesis-based repair for stops to occur:[65]

[65] Since deletion only occurs in clusters with final [-cont, COR] consonants, MAX-SB [-CONT] and MAX [COR] cannot be ranked with respect to each other, as shown in (1). However these constraints don't conflict, so they don't have to be ranked.

(1) Martu Wangka 'kan_' < English 'can't'

kan	DEP-SB	MAX-SB [-CONT]	MAX-SB [COR]
a. kanti(pa)	*!		
→b. kan(-pa)		*	*

(17) Martu Wangka ‘niij_(pa) < English ‘nest’

nest	DEP-SB	MAX-SB [-CONT]
a. niij.ti-(pa)	*!	
→b. niij_(pa)		*

An alternative explanation for the deletion in COR clusters is that stop deletion occurs in response to Martu Wangka’s CODA CONDITION, which disprefers obstruents as codas, as discussed in section 3.3. The formal definition for this constraint is given in (18):

(18) Martu Wangka CODA CONDITION $[+\text{SON}]]_\sigma$: codas must be [+sonorant]

Inputs with obstruent-obstruent sequences show that Martu Wangka’s CODA CONDITION prevents surface forms with codas as obstruents:[66]

(19) Martu Wangka parralaj_i < English ‘paralysed’[67]

[66] Martu Wangka’s CODA CONDITION is also the constraint which ensures that stops rather than [+son] consonants are deleted in word-internal sequences (assuming that the borrowee pronounced the stop):

(2) Martu Wangka wiiny_maya < English ‘wind mill’

windmill	$[+\text{SON}]]_\sigma$	MAX-SB [+CONT]	MAX-SB[-CONT]
a. wi_dmaya	*! ($[-\text{sonorant}]]_\sigma$ *d*)		*
→b. winy_maya			*

[67] An alternative hypothesis is that the coda cluster [zd]# is coaleseced to *j*, as in maa**j**a < English ‘master’ and yawu**j**ayiti< English ‘outside’. This still counts as a MAX-SB violation because one of the segments is deleted in adaptation.

paralysed	[+SON]]$_\sigma$	DEP-SB	MAX-SB [-CONT]
a. parralajti	*! ([-sonorant]]$_\sigma$ *j*)	*	
b. parralajiti		**!	*
→b. parralaj_i		*	*

The form *parralajti* (a) cannot surface because it has an unattested [-son] coda, thus violating Martu Wangka's CODA CONDITION. [68] The form *parralajiti* (b) has also inserted a vowel into the cluster, satisfying the CODA CONDITION. Minimal violation limits the insertion of more than one epenthetic vowel to resolve the CODA CONDITION, thus deletion occurs, as shown in the optimal candidate *parralaj_i* (c).

Finally, in the coronal stop deletion examples in (9-10), we observed that the second consonant rather than the first consonant in a COR cluster was deleted (CC# →C_#, *_C#). I propose the constraint preferring deletion at the right edge is CONTIGUITY-SB:[69]

(20) CONTIGUITY-SB: Elements that are adjacent in the source must be adjacent in the loan.

Inputs with coronal clusters, where the second segment is a stop, show that CONTIGUITY correctly predicts that deletion at the edge occurs, as shown in the tableau below:

(21) Martu Wangka niij_(-pa) < English 'nest'

[68] All morpheme internal obstruent-obstruent are unattested, as shown in Appendix 7.3.1.

[69] The obstruent rather than the more salient nasal segment or fricative is deleted (kan_ *ka_t < English can't; niij_, *nii_t < English nest). Therefore a constraint penalising deletion of the more salient segment like the one proposed by Yip (2002:11) called MIMIC-PARSE SALIENT- parse salient segments, could also account for this pattern.

nest	MAX-SB [COR]	CONTIGUITY
a. nii_t(-pa)	*	*!
→b. niij_(-pa)	*	

The candidate *nii_t(-pa)* (a) has simplified the coda cluster by deleting the first coronal thus violating CONTIGUITY, whereas the winning candidate *niij_(-pa)* (b) has deleted the coronal at the edge, thus satisfying CONTIGUITY.

Finally, CONTIGUITY is also the constraint that prefers edge epenthesis. In the following tableau (22), we see how CONTIGUITY interacts with DEP-SB:

(22) Martu Wangka lampu < English 'lamp'

lamp	DEP-SB	CONTIGUITY
a. lamup	*	*!
→b. lampu	*	

From the preceding discussion, I propose the constraint ranking for adaptation repairs for coda clusters in Martu Wangka:

(23) *COMPLEX $^{\text{CODA}}$, VOWEL FINAL, CODA CONDITION [+SON]]$_\sigma$ >> MAX-[LAB, DOR], MAX-[-CONT] >> DEP-SB >> MAX-[+CONT], MAX-[COR], CONTIGUITY

Let us examine how the constraint hierarchy interacts as a whole. The first form to be evaluated using the hierarchy in (23) is an English source with a final homorganic LAB NT# cluster, so MAX-SB [+CONT] and MAX-SB [COR] are irrelevant:

(24) Martu Wangka lampu < English 'lamp'

lamp	*COMPLEX^{CODA}	VOWEL FINAL	MAX-SB [LAB, DOR]	MAX [+CONT]	DEP-SB	MAX-SB [COR]	MAX [-CONT]	CONTIGUITY
a. lamp	*!	*						
b. la_			**!				**	
c. lam_u			*!		*		*	
d. la_pu			*!				*	*
e. lamup		*!			*			*
f. lamupu					**!			*
→g. lam.pu					*			

The candidate *lamp* (a) is most faithful to the coda cluster in source form but this incurs the most serious violations against the *COMPLEX and VOWEL FINAL. The first deletion candidate *mi__* (b) has deleted the homorganic cluster all together, incurring two violations against Max-SB [LAB]. The next two are candidates that have deleted one of the consonants in the cluster. In *lam_u* (c), the second LAB consonant has been deleted, incurring a violation against MAX-SB [LAB] and in the other deletion candidate *la_pu* (c), the first consonant has been deleted, also incurring a violation against MAX-SB [LAB]. The candidate *lamup* has broken up the consonant cluster by inserting a vowel into the cluster, satisfying *COMPLEX^{CODA} but violates VOWEL FINAL.[70] The other epenthetic candidate

[70] From the tableau in (24), we can also see why vowel epenthesis not at an edge is dispreferred in languages allow final consonants:

(3) Hypothetical repair for language allowing final consonants: English milk

milk	*COMPLEX	MAX-SB [LAB, DOR]	DEP	MAX-[COR]	CONTIGUITY
a. milig			*		*!
→b. milgi			*		

lamupu (f) has inserted a vowel into the cluster as well as a vowel after the cluster. This candidate incurs two DEP-SB violations. In the optimal candidate *lampu* (g), the consonant cluster has been broken up into a heterorganic sequence by inserting a vowel, incurring only one DEP-SB violation. The vowel occurs at the right edge, thus satisfying VOWEL FINAL.[71]

The next form to be evaluated has COR cluster with final sibilant. In the following tableaux I include constraints from this language's consonant inventory **s, *f*:

(25) Martu Wangka piinyji < English 'fence'

fens	*s, *f	*COMPLEX CODA	FINAL VOWEL	MAX-SB [LAB, DOR]	MAX-SB [+CONT]	DEP-SB	MAX-SB [-CONT]	MAX-SB [COR]	CONTIGUITY
a. fens	**!	*	*						
b. pii__					*!		*	**	
c. piiny_i					*!	*		*	
d. pii_ji						*	*!		*
→e. piinyji						*			

The candidate *fens* (a) is faithful to the COR cluster, but this incurs a violation against **s* as well as *COMPLEX^CODA^. In the next three deletion candidates, *pii__* (b), *piiny_i* (c*),* *pii_ji* (d), either one or both COR consonants in the cluster are deleted, violating MAX-SB [COR]. Both *piiny_i* and *pi__* have deleted the sibilant which comprises the second consonant of the coda cluster, thus violating MAX-SB[+CONT]. The optimal form *piiinyji* (e) has inserted a vowel after the cluster. The cluster is broken up into two syllables,

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[71]From the tableau in (24) , we can recognise why deletion is less frequent in forms with heterorganic clusters. Deletion results in the loss of information about the place of articulation of one of the consonants which cannot be recovered from the loan form. In contrast, when deletion occurs in homorganic clusters, a segment in the loan has a correspondent value for the place feature of the deleted segment- the consonant in the cluster that is retained in adaptation.

satisfying *COMPLEX, and incurs the fewest violations in the hierarchy, with only one DEP-SB violation.

The final form to be evaluated has a final COR cluster where the second consonant is a stop. I include Martu Wangka's CODA CONDITION, which prevents obstruents as codas:[72]

(26) Martu Wangka kaman_(-pa) < English 'government'[73]

kamant(-pa)	*COMPLEX CODA	[+SON]]$_\sigma$	MAX-[LAB], [DOR]	MAX-[+CONT]	DEP	MAX-[-CONT]	MAX-[COR]	CONTIGUITY
a. kamant(-pa)	*!							
b. kamanti(-pa)					*!			
c. kama_t(-pa)		*!				*	*	*
→d. kaman_(-pa)						*	*	

The candidate *kamant(-pa)* (a) is faithful to the COR cluster, but this incurs a violation against *s as well as *COMPLEX. The epenthetic form *kamanti(-pa)* has broken up the consonant cluster into a heterosyllabic sequence thus satisfying *COMPLEX. However this form cannot surface because the [-sonorant] *t* is disallowed by Martu Wangka's CODA CONDITION. The optimal candidate *gaman*_(-pa) has deleted the second COR consonant, thus satisfying contiguity.

5.2.5 Conclusion

This section proposed an optimality theory analysis for Martu Wangka's variation between deletion and epenthesis-based repairs due to *COMPLEX^{CODA}. My analysis accounts for the

[72] I left VOWEL FINAL to make the tableau easier to read. All forms evaluated satisfy VOWEL FINAL because they have the AUG -pa suffix.

[73] MAX-SB violations segments other than those comprising the final cluster are not included. This is not crucial because all forms to be evaluated only show the relevant alternations in the final cluster.

fact that the preferred adaptation strategy for resolving coda clusters is epenthesis-based repair. Higher-ranked MAX-SB [LAB, DOR] constraints mitigates against deletion of non-coronals, so in all clusters except homorganic coronal clusters deletion cannot occur. Minimal violation ensures that deletion occurs in a restricted environment, specifically for COR stops. This environment coincides with the same environment for stop deletion in English, as reflected in my analysis. In the following section, I continue with an analysis of consonant clusters, focusing on adaptation strategies due to *COMPLEX^{ONSET}.

5.3 Onset Clusters

5.3.1 Introduction

In this section, I discuss onset clusters. We observe that onset clusters are repaired either by epenthesis or deletion. I put forward an explanation of the different adaptation strategies for word-initial onset clusters. In most clusters, a vowel is inserted into the cluster (anaptyxis). This includes initial voiceless obstuent-sonorant (abbreviated to TR) clusters:

(27) Warlpiri t**u**raki < English 'truck'

This pattern includes [s]-nasal clusters (SN), with the initial [s] realised as the closest native phoneme – the palatal *j*:

(28) Warlpiri j**i**nayiki < English 'snake'

In #s-voiceless obstruent (ST) onsets however, the #[s] is deleted, thus simplifying the cluster:

(29) Warlpiri **_**puunu < English 'spoon'

Nash (1983) attributes #[s]-deletion in Warlpiri adaptation to the relative articulatory difficulty of the non-native segment [s]. That is, many borrowers find ST sequences difficult to pronounce and therefore omit the [s] during production. I will appeal to the phonetic differences between clusters and discuss how these differences govern the selection of the adaptation strategy.

In section 3.2.2, I showed that the prosodic markedness constraint *COMPLEX$^{\text{ONSET}}$ must dominate the language's source-borrowing correspondence for repairs to occur:

(30) Warlpiri t**u**raki < English ‘truck’

trak	*COMPLEX ONSET	FAITH-SB
a. trak	*!	
→b. turaki		*

Following Fleischhacker (2000), I propose that the borrower’s selection of internal vowel epenthesis (1-2) results from the demand for maximal perceptual similarity between the source cluster and the corresponding loan output. I discuss the similarities between the source onset cluster and the epenthetic output (voicless obstruent-sonorant (TR) and voiceless obstruent- vowel- sonorant (TVR)). Then I contrast the phonetic properties of ST clusters and explain why vowel epenthesis cannot occur. Focusing on Warlpiri loans, I show that an alternative epenthesis at the edge (vowel-sibilant-voiceless obstruent (VST)) cannot occur because this violates ONSET, which disallows onsetless syllables (*__ij__.puunu*) and Warlpiri’s CODA CONDITION [+SON]$]_{\sigma}$[74] which prohibits obstruents as codas (*__ij__.puunu, *yi__jp__uunu*). I begin with a description of general patterns of onset cluster adaptation and continue with an optimality-theoretic analysis.

5.3.2 Adaptation strategies for onset clusters

Below I show the basic patterns observed in onset clusters. In most onset clusters, a vowel is inserted into the cluster (#CC →#CV.C) (30-1). Specifically, epenthesis occurs between the two segments in TR clusters, as shown in (31):[75]

[74] Warlpiri also disallows glides (w, y, r) as codas. This isn’t relevant to the present discussion, which is about Warlpiri’s prohibition against obstruents as codas, so I leave the CODA CONDITION unspecified.

[75] Further investigation of the quality of the epenthetic vowel is required. Contrast the epenthetic high *i* in pilayi < English ‘play’ and epenthetic round *u* in p**u**lakani < English ‘flagon’ in the same context. As we saw in the third chapter, Warlpiri vowel harmony occurs in the rightwards direction. We cannot assume that harmony occurs in the opposite direction.

(31) source words with (O)bstruent-sonorant (#OR) onsets:

Cluster Type		*Repair*	*Lb*	*loan*	*Ls*	*source*
a.	OR	#OR>OiR	Warlpiri	p**i**layi	< English	play
				j**i**riyi		three
				p**i**langkiti		blanket
		#CC>CuC		t**u**raki		truck
				p**u**lakani		flagon
				p**u**ratiyi		Friday
				pirdi-p**u**lawa		pretty-flower

Internal vowel epenthesis also occurs in #S-Nasal (SN) and S-approximant #SW clusters, with the initial [s] realised as the palatal stop *j*:[76]

(32) source words #sC[+sonorant] clusters:

Cluster		*Lb*	*loan*	*Ls*	*source*
a.	#sn	Warlpiri	j**i**nayiki	< English	snake
b.	#sn		j**u**muku		smoke
c.	#sw	Martu Wangka	j**u**wita		sweater

[76] Unfortunately I have not found any examples with #[s]-lateral but I predict that these clusters would show epenthesis as well, as predicted by Fleischhacker's (2000) explanation in the following section.

However in ST clusters, there is no insertion. Instead, the #[s] is deleted:[77]

(33) source words #ST clusters:

Lb	*loan*	*Ls*	*Loan*
Warlpiri	_kuurlu	< English	school
	_puunu		spoon
Martu Wangka	_kiinanu		skin
	_kiin(-pa)		skin

5.3.3 Clarification of input forms

Contrast the examples in (32-3). In the epenthetic loans in (32), the source segment [s] has a correspondent segment *j* in the loan form. These examples demonstrate that the borrower has perceived the presence of the #[s]. We must assume that to be the case in the #[s]-deletion forms in (33) as well. Therefore all input representations must include [s] and the grammar must generate the variation between the [s]-deletion and retention though epenthesis-based repair.

5.3.4 OT analysis of epenthesis and deletion repairs for complex onsets

The adaptation strategies observed in the examples in (31-3) are driven by the markedness constraint on onset clusters *COMPLEX$^{\text{ONSET}}$. Internal epenthesis resolves the onset clusters (30-1), unless the cluster is #ST (32), then the cluster is simplified by deleting the #[s]. As we established in section 3.2., the constraint ranking MAX-SB >> DEP-SB allows epenthesis-based repairs rather than deletion to occur in most consonant clusters:

[77] c.f. Warlpiri TS# clusters show [s]-deletion at the edge in final clusters as well (e.g. yajilitik_i < English'athletics'), but a vowel is also inserted at the right edge so the word satisfies VOWEL FINAL.

(34) Warlpiri ‘jinayiki’ < English ‘snake’

snake	MAX-SB	DEP-SB
a. _nayiki	*!	**
→b. jinayiki		***

This ranking incorrectly predicts that the epenthetic forms like *jupuunu* (35a) rather than the attested deleted forms like *_puunu* (35b) will occur for ST clusters:

(35) Warlpiri _puunu < English ‘spoon’

spuun	MAX-SB	DEP-SB
✷a. jipuu.nu		*
→b. _puu.nu	*!	*

To explain this cluster-dependent split pattern of epenthesis-based repair and deletion, I incorporate a set of cluster-sensitive DEP constraints as proposed by Fleischhacker (2000). Fleischhacker investigates the differential occurrence of anaptyxis and vowel insertion at the left edge (or prosthesis, #CC → #VC.C) in loanword adaptation. She proposes that the source of variation between adaptation strategies is directly related to the borrower’s attempt to maximise the auditory similarity of the form to the source cluster. In illustration of her proposal, I present her analysis of the prototypical anaptyxis-prosthesis asymmetry in Arabic loanword adaptation below:

In Arabic, most clusters including sibilant-sonorant (SR) clusters show vowel insertion into the cluster, but sibilant voiceless obstruent (ST) clusters show vowel insertion at the cluster’s left edge. Sibilant-voiceless obstruent-sonorant (STR) clusters show both vowel insertion at the left edge of ST, and vowel insertion between the TR sequence, as expected:

(36) Split internal-edge vowel insertion in Arabic (Broselow 1987, 1992, 1983, quoted in Fleischhacker 2000:2):

a. TR: b**i**lastik< English ‘plastic;

b. SR: s**i**lad < English ‘slide’

c. ST: ʔ**i**skii < English ‘ski’

d. **STR: ʔi**st**i**riit< English 'street'

The central claim of Fleischhacker’s analysis is that the borrower selects the site of vowel insertion to maximise the auditory similarity between the source and the loan. To support this claim, she distinguishes the phonetic properties of these clusters. I present her argument, focusing on only TR and ST clusters since these represent the most phonetically distinct clusters. TR clusters are characterised by the initial silence of the T followed by the release into the strong formant structure of the R. This sharp increase in amplitude in the T-R transition is similar to the sharp increase in amplitude of C-V transitions. Fleischhacker suggests that the borrower perceives the strong formant structure as a *perceptual break* that facilitates vowel insertion into the cluster. Contrastingly, sT clusters are characterised by aperiodic noise followed by a break with no formant structure associated with the either S or T. Thus ST sequences lack the sharp increase in amplitude characterising the C-V transition. Therefore Fleischhacker argues these clusters lack a sufficiently large perceptual break to facilitate internal vowel insertion and instead the vowel is inserted before the ST clusters.[78]

[78] To provide empirical evidence to support her claim, she conducted a source-similarity judgement experiment where listeners were asked to compare TR and ST sequences with corresponding anaptyctic and prosthetic outputs. Her results are summarised below:

i. Listeners judged TR sequences as more similar to corresponding anaptyctic TVR outputs than prosthetic VTR outputs. The reverse result occurs for sT sequences.
ii. Listeners judge sT sequences as more similar to prosthetic VsT outputs than anaptyctic sVT outputs.

Fleischhacker (2001:10) uses a typology of languages exhibiting anaptyxsis-prosthesis assymetries to propose the implicational hierarchy, given in (37):

(37) Epenthesis patterns according to cluster type:

ST >> Sn >> Sm >> Sl >> Sr >> Sy >> TR

← →

Prosthesis Anaptyxis

Clusters towards the right of the continuum are better candidates for internal vowel epenthesis than those towards the left of the continuum. In an optimality-theoretic analysis, she incorporates this a hierarchy as a set of DEP constraints militating against vowel insertion into each cluster. The general definition of this constraint is given in (38):

(38) DEP-V/ X_Y: A vowel present in the output context X_Y has a correspondent the input context X_Y

Constraint violation occurs when a vowel is inserted in the environment X_Y. The DEP-V/ X_Y constraints relevant to my analysis are given in (39):

(39) DEP-V/S_T >> DEP-V/S_N >>…>>DEP-V/T_R

(where S= sibilant, T=voiceless stop, N=nasal, R= sonorant)

Once the DEP constraints are subdivided this way, other constraints can be interspersed between them while maintaining the overall ranking of the hierarchy, permitting different repair types to occur. Fleischhacker proposes the ranking given in (40) for Arabic's pattern of prosthesis in #ST clusters (#ST → **V**S.T) and anaptyxsis in other onset clusters:

(40) Partial constraint hierarchy for Arabic anaptyxsis-prosthesis asymmetry:

C//V,[79] ONSET, DEP-V/ S_T >> DEP-[ʔ] >> DEP-V/ S_N >> …>> DEP-V/T_R

[79] C//V is the constraint that ensures that a consonant is adjacent to a vowel. Both this constraint and the constraint I use *COMPLEX^{ONSET} prevent complex onsets from surfacing.

This system in demonstrated in the following two tableaux (41-2):

(41) Arabic silad < English ‘slide’

slid	C//V	ONSET	DEP-V/S_T	DEP-[ʔ]	DEP-V/S_R
a. slid	*!				
b. islid		*!			
c. ʔislad				*!	
→d. silad					*

In the first candidate *slid* (a), the SR onset cluster violates the highest ranked constraint C//V because S is not adjacent to a vowel. The next two candidates show vowel insertion at the edge. In *islad* (b), the epenthetic vowel is adjacent to #S, satisfying C//V, but this form violates the constraint on onsetless syllables - ONSET. The next candidate shows initial glottal insertion, thus satisfying ONSET, but this constraint violates the higher-ranked DEP-[ʔ] constraint. The optimal form has inserted a vowel into the SR cluster, incurring the most minimal violation within the hierarchy, against DEP-V/S_R.

(42) Arabic ʔiskii < English ‘ski’

skii	C//V	ONSET	DEP-V/S_T	DEP-[ʔ]	DEP-V/S_N
a. skii	*				
b. iskii		*!			
c. sikii			*		
→d. ʔiskii				*	

Again we see that the most faithful candidate *skii* (a), the ST onset violates the highest ranked constraint C//V because S is not next to a vowel. The next two candidates show vowel insertion at different sites. In *iskii* (b), the vowel precedes the S, satisfying C//V, but this form violates ONSET. In *sikii* (c), the vowel is inserted into the cluster, violating the higher ranked DEP-V_/S_T which prevents vowel insertion into an ST cluster. The optimal candidate *ʔiskii* (d) has inserted a vowel before the SR cluster, thus satisfying DEP-V_/S_T and ONSET. It incurs the least serious violation against the lowest ranked DEP-V/S_R.

Returning to the Warlpiri loans in the present investigation, we observe an anaptyxis-deletion asymmetry rather than an anaptyxis-prothesis asymmetry as in the above Arabic borrowings. In the following tableau I adopt Fleischhacker's DEP hierarchy in (39). Vowel epenthesis in #SN clusters is due to Max-SB>> DEP-V/S_N:

(43) Warlpiri j**i**nayiki < English 'snake'

snake	MAX-SB	Dep-V-/S_N
a. _nayiki	*!	
→b. j**i**nayiki		*

Max >> Dep-V-/S_N allows epenthesis in all clusters towards the right of Fleischhacker's hierarchy in (160). That is MAX>> DEP-SB-V/ S_R >>DEP-SB-T_R. Dep-V/S_T must dominate Max-SB for deletion to occur in ST:[80]

[80] Unfortunately I found no examples of borrowings from English words with #STR clusters. However, I predict that this cluster would show both #[s]-deletion and internal vowel insertion. This prediction is based on the fact that in languages like Arabic, #STR clusters show a split pattern of edge insetion **V**ST and vowel insertion between TR (as shown in Arabic *ʔistiriit* < English 'street' (36d)). One example- Warlpiri Yaliji_piringi < English 'Alice Springs'- shows this pattern. However, we cannot be certain whether the speaker has stored the PLS |ælɪ**s**prɪŋs| rather than |ælɪs sprɪŋs|. The former PLS shows no deletion.

(44) Warlpiri _puunu< English 'spoon'

spuun	DEP-V/S_T	MAX
a. jipuunu	*!	
→b. _puunu		*

I assume that deletion rather than prosthesis occurs in Warlpiri loans because this language disprefers onsetless syllables (*ijnayiki*) and disallows obstruents as codas even when onsetless syllables are resolved by epenthetic glides (**yij.na.yiki*).[81] This is due to the constraint ranking ONSET, Warlpiri's CODACONDITION [+SON]]$_\sigma$ [82]which disallows obstruents as codas >> DEP-SB, Max-SB, Dep-*y*, which disallows glide epenthesis:

(45) Warlpiri _puunu < English 'spoon'

spuun	ONSET	[+SON]]$_\sigma$	DEP-*y*	DEP-V	MAX
a. ij.puunu	*!			*	
b. yij.puunu		*![+OBS]]$_\sigma$*j*	*	*	
→c. _puunu					*

[81] As attested in Yaliji_p**i**ringi < English 'Alice Springs'. Epenthetic glides resolved onsetless syllables in Martu Wangka, as discussed in section 2.3.2.

c.f. Internal vowel epenthesis occurs in word-internal heterosyllabic ST sequences (VSTV) (e.g. wij**i**pirtirli < English ho**sp**ital.)

c.f. Coda t> ly substitution (e.g. wa**ly**_pali < English 'white fellow') also occurs in accordance with Warlpiri's Coda Condition.

[82] The formulation of Warlpiri's CODA CONDITION is sufficient for the present analysis, but the reader should note that [+son] glides (w, y, r) as well as *r* are unattested as codas as well.

Finally, I propose that the constraint preferring deletion at the edge, rather than the T in ST clusters (*_puunu, *j_uunu*) is CONTIGUITY: Inputs with ST show how MAX interacts with CONTIGUITY:

(46) Warlpiri _puunu < English 'spoon'

spuun	MAX	CONTIGUITY
a. j_uunu	*	*!
→b. _puunu	*	

Internal vowel insertion in SN clusters violates CONTIGUITY-SB:

(47) Warlpiri jinayiki < English 'snake'

snake	MAX	DEP-V/S_N	CONTIGUITY
a. _nayiki	*!		
→b. jinayiki		*	*

From the preceding discussion, I propose the constraint hierarchy for the split pattern of deletion and internal epenthesis in Warlpiri given in (15):

(48) *COMPLEX^{ONSET}, CODA CONDITION [+SON]]$_{\sigma}$ >> DEP-V-S_T >> MAX-C >> DEP-V-S_N, CONTIGUITY

5.3.5 Conclusion

I proposed an optimality-theoretic explanation for the cluster-dependent variation between epenthesis and deletion Warlpiri's adaptation of onset clusters. I adopted aspects of Fleischhacker's (2000) explanation, which proposes that internal vowel insertion in most consonant clusters results from the borrower's demand to be faithful to the onset cluster.

According to the present analysis, #[s]-deletion in ST clusters is the most minimal violation. Forms with prosthetic vowels violate ONSET (***i**j.puunu*) and forms which resolve the constraint on onsetless syllables by glide epenthesis, violate Warlpiri's CODA CONDITION $[+\text{SON}]]_{\sigma}$ ($*[+\text{SON}]]_{\sigma}$ *yij.puunu)*. Thus, forms with prosthetic vowels show an increase in structural markedness. CONTIGUITY ensures that deletion occurs at the left edge of the ST onset cluster.

5.4 Conclusion

In this chapter, I discussed adaptation strategies due to the syllabic constraints $*\text{COMPLEX}^{\text{CODA}}$ and $*\text{COMPLEX}^{\text{CODA ONSET}}$. Under the assumptions of Smith's source-similarity correspondence model, violations of these constraints drives adaptation repairs. Specific rankings within the proposed analysis are shown in (49):

(49) OT schema for onset and codas clusters:

Lb	*Well-formedness*	>>	*Faithfulness*
Martu Wangka	$*\text{COMPLEX}^{\text{CODA}}$	>>	MAX-SB [LAB, DOR]>> DEP-SB >> MAX [-CONT], MAX-SB [COR]
Warlpiri	$*\text{COMPLEX}^{\text{ONSET}}$	>>	**DEP-V/S_T** >> MAX-SB>> DEP/ S_N>>…>> DEP

My analysis accounts for the fact that both epenthesis and deletion repairs occur when each language incorporates onset and coda clusters in the native structure. The most frequent repair strategy is epenthesis, as we found for aspects of adaptation discussed in Gamilaraay and Martu Wangka in the previous chapter.

The analysis proposed for Martu Wangka clearly captures the basic patterns for final coda cluster adaptation. It allows a variation between adaptation strategies through the instantiation context-specific MAX-SB constraints. According to my analysis, the selection of the epenthetic site is governed by structure markedness. Vowel insertion at the right edge of the cluster satisfies VOWEL FINAL. We never observe a vowel inserted only into the cluster (CC#→ CV**C**#) because this violates VOWEL FINAL, which causes an increase in markedness. Minimal violation places a limit on the amount of epenthesis that can occur.

The latter explanation predicts that inserting a vowel at the right edge of the cluster, which allows the cluster to be vowel final, as well as vowel insertion into the cluster cannot occur.[83] Deletion also occurs in a restricted environment, but it must be minimal. Deletion of both consonants in the cluster is rare, and the deletion occurs at the edge.

My optimality-theoretic explanation for Warlpiri's onset cluster adaptation predicts that both epenthesis and deletion occur. I adopted Fleischhacker's (2001) explanation, which argues that internal epenthesis occurs in most onset clusters, as permitted by their phonetic qualities. Following Fleischhacker, I assume that the site of vowel epenthesis- into most clusters- results from the speaker's mandate that the output is as auditorily similar to the source cluster while resolving the constraint on *COMPLEX. Deletion occurs in ST clusters because it is the most minimal violation within the language's constraint hierarchy. Edge vowel insertion is not attested in attested in #ST clusters because this violates ONSET and Warlpiri's CODA CONDITION. CONTIGUITY ensures that deletion occurs at the left edge. What we must recognise is that deletion of a highly salient segment [s] occurs as predicted by the optimality-theoretic explanation. I conclude that loanword adaptation cannot be entirely addressed as a minimal perceptual deviation from the source form.[84]

[83] Appendix 7.2 gives some examples which have anaptyxic and final vowels (Martu Wangka jik**a**j**i** < English). Further investigation of these forms is required.

[84] Smith (to appear), Kenstowicz and Suchato (2006), Yip (2006) all reach similar conclusions.

6 Conclusion

This thesis is a case study of loanword adaptation in some Australian Aboriginal languages framed within Smith's (to appear) correspondence model of source-similarity faithfulness. This model exploits source-similarity faithfulness to explain how the prosodic markedness constraints of a borrowing language interact with the independent Source-Borrowing faithfulness constraints. According to Smith's proposal, the model predicts that adaptation strategies occur in response to violations of syllable structure constraints.

The adaptation strategies discussed in this thesis do not require distinct and specific explanations. The proposed analysis shows that all strategies can be straightforwardly explained under the assumptions of minimal violation within the constraints-based framework of Optimality Theory. Repairs are the most minimal modification resolving the violation against the higher-ranked constraints on syllable and word well-formedness. This predicts that minimal constraint violation limits the nature and the amount of repairs.

The analysis presented here provides further evidence for The Emergence of the Unmarked (McCarthy and Prince 1995). We observed that a repair strategy never results in an increase in structural markedness. Under the assumptions of The Emergence of the Unmarked, we could straightforwardly explain factors such as the site of the epenthetic vowel. For example, the adaptation of onset clusters never showed vowel insertion at the left edge because this results in onsetless syllables or syllables with codas which have more marked structures. In addition to this, we saw how variable outcomes of the same strategy were predicted by the optimality-theoretic explanation. For example, I explained that epenthetic vowels, which are not subject to the source-similarity faithfulness, are the least marked within a language's vowel system in the absence of other conditioning environments.

Typically, the most frequent repair strategy is vowel epenthesis. Minimal violation limited less frequent strategies including deletion and substitution to a restricted environment. This indicates that loanword adaptation is highly constrained. The borrower must exploit a maximal amount of information perceived in the source form. Vowel epenthesis is the only adaptation strategy that allows the recoverability of the information about the source form. I conclude that framing my analysis within Smith's correspondence model of source-similarity faithfulness adequately captures the diversity and complexity of loanword adaptation in the aspects of the languages discussed here.

7 Appendices

7.1 Appendix 1: Consonant and Vowel Inventories, Phonotactic positions and Syllable Types

7.1.1 Consonant Inventories

(1) International Phonetic Association Symbols

	bilabial	lamino-dental	apico-alveolar	apico-post-alveolar	lamino-palatal	velar	Glottal
stop	p b	t̪ d̪	t d		c ɟ	k g	ʔ
nasal	m	n̪	n		ɲ	ng	
fricative	f v	θ ð	s z	ʃ ʒ			
approximant			ɹ		j		
lateral			l				
approximant	w			ɻ	j		

(2) English consonant inventory (orthographic symbols)

	bilabial	lamino-dental	apico-alveolar	apico-post-alveolar	lamino-palatal	velar	glottal
stop	p b		t d			k g	(ʔ)
nasal	m		n			ng	
fricative	f v	th th	s z	sh			
lateral			l				
approximant	w			r		y	

(3) Martu Wangka

	bilabial	lamino-dental	apico-alveolar	apico-post-alveolar	lamino-palatal	velar
stop	p [p]		t [t]	rt [ʈ]	j [c]	k [k]
nasal	m [m]		n [n]	rn [ɳ]	ny [ɲ]	ng [ŋ]
fricative						
trill			rr [r]			
lateral			l [l]	rl [ɭ]	ly [ʎ]	
approximant	w [w]			r [ɻ]	y [j]	

(4) Gamilaraay

	bilabial	lamino-dental	apico-alveolar	apico-post-alveolar	lamino-palatal	velar
stop	b [b]	dh [d̪]	d [d]		j [ɟ]	g [g]
nasal	m [m]	nh [n̪]	n [n]		ny [ɲ]	ng [ŋ]
fricative						
trill			rr [r]			
lateral			l [l]			
approximant	w [w]			r [ɻ]	y [j]	

7.1.2 Vowel Charts

(5) English

English		front		central		back	
		unround		unround		round	
	high	i				u ʊ	
	mid	e		ə ʌ		o ɔ	
	low	æ		a			

(6) Vowel charts of Martu Wangka and Gamilaraay:

		[-back] [-rnd]				[+back] [+rnd]	
		short	long	short	long	short	long
Martu Wangka	-low	i	i:			u	u:
	+low			a	aa		
Gamilaraay	-low	i	ii			u	uu
	+low			aa	aa		

7.1.3 Phonotatic positions: Attested consonants

(7) Phonotactic positions: Martu Wangka (Mantijiltjarra Hamilton 1996: 275) Warlpiri (Ibid: 306); Pitjantjatjara (Yankunytjatjarra Ibid:312) and Gamilaraay (based on closely-related dialect Yuwalaraay, Ibid: 318-19).

Class	*Word initial*	*Word final*	*Heterorganic morpheme internal clusters*
Martu Wangka	p, t, c, k m, n, ny, ng l, r, y	j, n, rn, ny, l, l, ly, rr	np, nyp, nm, lp, rlp, lw rp, rm nk, nyk, n.ng, lk, rlk, rk, rng, ngj lyj rc, nyp ny, lyp, nyk, lyk nyp, lyp nyk, lyp
Warlpiri	p, rt, c, k p, rn, ny, ng l, rr, w, l, y	none	np, nyp, nm, rtp, lw, lyw, rp, rm nk, nyk, nnkg, lk, rlk, rk, rng, rj, nyp, lyp nyk, lyp
Pitjantjatjaara	p, rt, j, k, m, rn, ny, ng w, l, r	j, rn, ny, ly, rl, y	
Gamilaraay	b, dh, k m, nh, ng w, j	n, l, y, rr	np, nm, lp, rp, rm, n.g, n.ng, lg, rk, rng, lt, jp, jm, jk jp, jm, jg

(8) Syllable structure of source language, English, and borrowing languages, Martu Wangka and Gamilaraay (- indicates attested, x= unattested):

	Ls	Lb	
	English	Martu Wangka	Gamilaraay
CV	-	-	-
CV:	-	-	-
CVC	-	-	-
CV:C	-	-	-
VC	-	x	rare
CCVC	-	x	x
CVCC	-	x	x

7.2 Appendix 2: Loanword Data

7.2.1 Martu Wangka loans

(9) epenthetic [+rnd] vowel:

Environment	*Ls*	*Loan*	*Lb*	*Source*
a. following [+rnd]	Martu Wangka	kuut**u**	<English	coat
		luut**u**		load
		juut**u**		shorts
		puluk**u**		bullock
		pukuj**u**		box
b. [+rnd], LAB#		luw**u**		law
		yaruw**u**		arrow
		juup**u**		soap
		ruum**u**parni		room
c. following *ng*#,		lang**u(-**pala)	< English	long
		miiting**u**		meeting
		puting**u**		pudding
		wiiting**u**		wedding
		raang**u**		wrong
d. following [-rnd]		wayin**u**		wine
		kiit**u**		gate
		pujikat**u**		Pussycat

(10) epenthetic [-rnd] *i* vowel:

Environment	*Lb*	*Loan*	*Ls*	*source*
a. [-rnd]	Martu Wangka	parralayiji**i**	<English	paralysed
		Yingkiliji**i**		English
		tiiji**i**		dish
		taanj**i**rringu		dance
		piinyj**i**		fence
		wiijij**i**		wages
		marrit**i**		married
		pakit**i**		pocket
		tinamit**i**		tin of meat
		yawujayit**i**		outside
		jikijiy**i**		sixty
		milk**i**		milk
		payik**i**		bag
		pikipik**i**		pig
		parrik**i**		fence
		wiik**i**		week
b. following [+lw]		jumaj**i**		too much
		paajay**i**		birthday
		jikaj**i**		six
c. following [+rnd]		pukuj**i**		box

(11) epenthetic [+low] a vowel:

Environment	*Lb*	*Loan*	*Ls*	*Source*
a. following [+lw]	Martu Wangka	turak**a**	< English	truck
		laamp**a**(variant)		lamp
		jaart**a**		shirt

7.2.2 Pitjantjatjara loans

(12) epenthetic [+lw] vowel

Vowel in preceding syllable	*Lb*	*loan*	*Ls*	*source*
a. [+lw]	Pitjantjatjara	kaanta(-mila)	< English	count
		paatja		bus
b. [-rnd]		griina(-wana)		green
		ping.ka(-wana)		pink
		ritja		race
		wiita		wet
		pulangkita		blanket
c. [+rnd]		ruuma		room
		ruupa		rope

(13) epenthetic [-rnd] *i*

Vowel in preceding syllable	*Lb*	*loan*	*Ls*	*source*
a. [-rnd]	Pitjantjatjara	paiki	< English	bag
		taipula		table

(14) epenthetic [+rnd] *u*

Vowel in preceding syllable	*Lb*	*loan*	*Ls*	*source*
a. [+rnd]	Pitjantjatjara	uputju	< English	office
		ukutu		awkward

7.2.3 Warlpiri loans

(15) epenthetic [+rnd] vowels

Vowel in preceding syllable	*Lb*	*loan*	*Ls*	*source*
a. [+rnd]	Warlpiri	taypipul**u**	< English	table
		kanjurl**u**		council
		nanigut**u**		nanny goat
		kamul**u**		camel
		puluk**u**		bullock
		jupu~supu		soap

(16) epenthetic [-rnd] vowels

Vowel in preceding syllable	*Lb*	*Loan*	*Ls*	*Source*
a. [-rnd]	Warlpiri	yirripurlayin**i**	< English	aeroplane
		majini		machine
		kantini		canteen
		rapij**i**		rubbish
		karrijin**i**		kerosene
		nyujik**i**		music
b. [+lw]		jaaj**i**		church
		rapurant**i**		wrap-around
		turak**i**		truck

7.2.4 Gamilaraay loans

(17) Source words with final with word-final [LAB]:

Lb language	*Loan*	*Ls*	*loan*
Gamilaraay	nhaayb**a**	< English	knife
	baayb**uu**		pipe
	dhuub**uu**		soap
	yurraam**u**		rum

(18) Source words with word-final [DOR] consonants:

Repair	*Lb language*	*Loan*	*Ls*	*loan*
a. epenthesis	Gamilaraay	milg**i(n)**	< English	milk
		yurrug**u**		rope
b. deletion		bidjaraay_		bits of rag
		dhamiyaa_		tommy hawk
c. no repair		badi**g**		paddock

(19) Source words with word-final [-son] COR stops:

Repair	*Lb*	*Loan*	*Ls*	*loan*
a. t > nasal	Gamilaraay	bulaang.gii**n**	< English	blanket
		bulang.gii**n**		blanket
		burrgiya**n**		pussy cat
		marrgi**n**		musket
		yuruu**n**		road
		yurruu**n**		road
		dhalbi**n**		tablet
b. t> rr		yurab**irr**		rabbit
		bulanggii**rr**		blanket
		nhaniguu**rr**		nanny goat
		bidjiirr		biscuit
		buwaa**rr**		board
b. deletion		bulaang.gi_	< English	blanket
		dhuwadi_		shirt

(20) Source words with word-final sibilants and affricate:

Substitution	*Lb*	*Loan*	*Ls*	*loan*
a. S >> rr	Gamilaraay	garaa**rr**	< English	grass (possibly)
		nhiigilii**rr**		necklace
		yuluu**rr(-**inma-li)		lose-VERB INTRANS
		dhindi**rr**		tin dish
		maadj**irr**		matches
		yarra**rr**		rice
b.	ʤ >rr	gabi**rr**		cabbage

7.2.5 Source words with Complex Codas and Onsets

(21) Source words with final heterorganic clusters:

Environment		*Lb*	*Loan*	*Ls*	*source*
a. RT#	> RTV	Martu Wangka	jaal.pu	< English	self
			milki		milk
		Gamilaraay	milki(n)		milk
b. [ks]	> kVjV	Martu Wangka	puk**u**ju		box
			jik**a**ki		six
			jik**i**jiyi		sixty
		Warlpiri	pak**u**ju		box
c. [ks]	> k_V#		yajilitik_i		athletics
d. NS	> N_V#		Yalijipiring_i		Alice Springs

(22) word-final homorganic LAB clusters:

Environment	*Lb*	*Loan*	*Ls*	*source*
a. NTvoiceless#	Martu Wangka	laam.p**a**	<English	lamp
		laam**(-pa)**		
		laam.p**u**		lamp

(23) word-final homorganic DOR clusters

Environment	*Lb*	*Loan*	*Ls*	*source*
a. NTvoiceless#	Jiwarli	thurang.ka	< English	drunk
	Yindjibarndi	thurang.gu		drunk
	Gamilaraay	dharraan.g-(ilaay)		drunk-no gloss
	Warlpiri	tirangki		drunk

(24) Word-final homorganic COR clusters with a second sibilant consonant:

Environment		*Lb*	*loan*	*Ls*	*source*
a. NS#	> N*j*V#	Martu Wangka	piiny.j**i**	< English	fence
		Putijarra	piiny.j**i**		fence
		Warlpiri	pin.ji		fence
b. NS#>	> N_	Gamilaraay	dhagin_		stockings

(25) Word-final homorganic COR clusters with second stop:

Environment		*Lb*	*Loan*	*Ls*	*source*
a. RT	>R_#	Gamilaraay	dhal_	< English	salt
		Putijarra	ayikaan_		I can't
b. NT	>N_ #	Jiwarli	ngayirlan_		island
		Putijarra	tiin_tiin_		tent
	> __#	Gamilaraay	gabaa__		government
c. NT	> N.TV	Warlpiri	tinti		tent

(26) In languages like Martu Wangka, that must end in a vowel, word-final homorganic consonant clusters show AUG (-pa) suffix or final vowel epenthesis:

Environment		*Lb*	*Loan*	*Ls*	*source*
a. ST#	> S_(-pa)	Martu Wangka	niij_(-pa)	<English	nest
			pintikaj_(-pa)		Pentacost
	> S_**V**#		parralayij_i		paralysed
		Warlpiri	Pirnpaj_i		breakfast
			yapukaj_i		half-caste
b. ND#	> N_(-pa)	Martu Wangka	jawujun_(-pa)		thousand
c. NT#	> N_(-pa)		kan_(-pa)		can't
		Martu Wangka	kaman_(-pa)		government
d. NT	> N_		wiiny_maya		windmill
e. RT	> R_		waly_taki		wild doggy
f. ND#	> NDV#	Warlpiri	rapurant**i**		wrap around
g. NT#	> NT#		jimint**i**		cement

(27) source words with a #TR onsets: a vowel is inserted into the cluster (a) or the cluster is simplified through deleting the second R consonant (b).

Cluster Type		*Repair*	*Lb*	*loan*	*Ls*	*source*
a.	#TR	> TVR	Warlpiri	p**i**layi	< English	play
				j**i**riyi		three
				p**i**langkiti		blanket
			Martu Wangka	kilin(-pala)		clean(V-IMPERATIVE)
				turaka		truck
				kaarlapu		clubs suit
				t**u**raki		truck
				p**u**lakani		flagon
				p**u**ratiyi		Friday
b.	TR	> T_	Warlpiri	p_irdi-pulawa		pretty flower
			Martu Wangka	p_urtipulawu		pretty flower
				pit_ul(-pa)		petrol-AUG

(28) source words #sC[+sonorant] clusters:

Environment			Lb	loan	Ls	source
a.	#SN	>#SVN	Warlpiri	j**i**nayiki	< English	snake
				j**u**muku		smoke
b.	#SN	> #_N	Jiwarli	_muuka		smoke
c.	#SW	#SVW	Martu Wangka	j**u**wita		sweater

The example in (24b) shows initial [s]-deletion in SN cluster. In Fleishacker's hierarchy (Chapter 5, (37)), SN is the next cluster type after ST cluster types which is less likely to undergo analysis. So in my analysis, SN clusters are the next most likely to show #[s]-deletion. Thus in Jiwarli, the constraint ranking DEP-V/ S_T>> DEP-V/S_N >> MAX-SB to allow #[s]-deletion in ST as well as SN clusters.

(29) source words #sT clusters:

Environment	*Lb*	*loan*	*Ls*	*Loan*
a. #ST > _T	Warlpiri	_kuurlu	< English	school
		_puunu		spoon
	Martu Wangka	_kiinanu		skin
		_kiin(-pa)		skin
		_tuuwa		store
		_tuuri		story
	Putijarra	_tayijun		station
		_tiijinja		station
		_tuuwa		store
c. #ST > S_	(or coalescence)	j_ak**u**manu		stockman

If we assume that the speaker stored the form as a source word #STR, the cluster shows #[s]-deletion, and anaptyxsis into TR, as expected.

(30) source word with #STR cluster:

Environment	*Lb*	*loan*	*Ls*	*Loan*
a. #ST > _TVR	Warlpiri	Yalijipiringi	< English	Alice Springs

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