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Vowel epenthesis in loanword adaptation: Representational and phonetic considerations

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Abstract

The phenomenon of loanword incorporation has long proved an intriguing object of study. Recent developments at the phonetics/phonology interface have generated renewed interest in the mechanisms of loanword adaptation, raising questions about the possible representational versus phonetic underpinnings of this process. This paper examines aspects of English and Afrikaans loanword incorporation into the southern Bantu language Sesotho, focusing specifically on the process of vowel epenthesis. It finds that the place features of the epenthetic vowel, as well as the direction from which these features are copied, is completely predictable, but only if contrastive feature specification is assumed. It also shows that phonetic/perceptual effects, where present, are confined to a limited domain. The paper concludes that, although representational and phonetic factors may both play a role in loanword adaptation, it is the language-specific phonological phenomena that are central to this process.

Keywords: Phonology; Loanword adaptation; Segmental representation; Feature specification

1. Introduction

In recent years, a long-standing debate in the field of loanword phonology has re-emerged regarding phonological versus phonetic approaches to loanword adaptation. The phonological account, under which loanwords are adapted according to the rules and/or constraints of the borrowing language targeting aspects of phonological representation, receives support from Hyman (1970), Kaye and Nykiel (1979), Singh (1987), Lebel (1994), Rose (1995), Paradis and

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LaCharité (1997, 2001), Ulrich (1997), Uffmann (2001, 2004), among others. In contrast, other scholars propose that loanword adaptation is largely driven by perceptual factors. For example, Shinohara (1997), Steriade (2001), Fleischhacker (2001), and Kenstowicz (2003a,b, 2004) argue that while loanword adaptation is processed by the phonological component of the grammar, the constraints regulating loanword adaptation are motivated on perceptual, rather than representational, grounds. Peperkamp and colleagues, on the other hand, adopt a more radical perspective (e.g. Peperkamp and Dupoux, 2003; Peperkamp, in press; Vendelin and Peperkamp, in press). They propose that loanword adaptation actually takes place outside of the phonological component of the grammar, at the level of perception, independent of the rules and/or constraints of the borrowing language. Finally, Silverman (1992), Yip (1993, 2004), and Rose (1999a,b) give credit to both the perceptual and the phonological components of the grammar. According to these authors, while the phonology of the borrowing language plays a determining role in the adaptation process, perceptual factors must also be taken into consideration. Such an approach is favored in this paper. We suggest that one of the factors contributing to this debate is related to the different methodological approaches used by the researchers. For example, while Paradis and colleagues base their work primarily on loanwords elicited with consultants who are bilingual native speakers of the borrowing languages, Peperkamp and colleagues base their conclusions on results from experimental tasks conducted primarily on monolingual speakers.

The purpose of the present paper is to shed light on this debate through a consideration of both representational and phonetic factors in explaining the incorporation of English and Afrikaans loanwords into the southern African language Sesotho. We argue that phonological representations play a central role in predicting patterns of vowel epenthesis, and show that asymmetries found in these adaptation patterns reflect independently motivated properties of segmental representations using a contrastive approach to feature specification. Critically, we show that epenthetic vowels generally match the input vowel on the left of the epenthetic site (1a), but not when that vowel is /ɑ/, as in (1b). (In these examples and all that follow, the first form is the source word, and the second the adapted loanword.)

(1)	a.	suitcase	[suːtkejs]	[sut^{h}ukeisi]	‘suitcase’
	b.	patroon	[pɑtʀuwn]	[pɑtɪronɪ]	‘pattern/cartridge’

We appeal to language-specific segmental representations in order to account for this contrast: /ɑ/ is phonologically placeless, being the only low vowel in Sesotho, and this prevents it from being favored as a featural source for vowel copy.

However, the generalization that epenthetic vowels in Sesotho loanwords generally match the input vowel on the left of the epenthetic site does not hold when the intervening consonant is /s/. In (2a), the epenthetic vowel has the same specifications as the vowel to its left. In contrast, in (2b), where /s/ appears between the epenthetic site and the vowel to its left, the coronal vowel /ɪ/ is epenthesized, instead of the expected labial vowel.

(2)	a.	football	[fʊtbɔl]	[futubɔlɔ]	‘football’
	b.	mosterd	[mɔstɛʀt]	[mosɪtrɪdɑ]	‘mustard’

In order to account for this asymmetry, we propose that the phonetics of /s/ creates a perceptual illusion which leads borrowers to posit a non-low coronal epenthetic vowel after this consonant. This is consistent with the fact that /s/ behaves asymmetrically in many other languages, from either a segmental or prosodic/phonotactic perspective.

The paper is organized as follows. Section 2 details the phonological structure of Sesotho and outlines the nature of the database used. The data are presented in section 3, followed by phonological analysis in sections 4 and 5. Section 6 outlines the special behavior of /s/. Section 7 discusses the language-specific nature of loanword adaptation, and is followed by the conclusion in section 8.

2. Background

In this section, we introduce the relevant background concerning the phonological system of Sesotho as well as the methodological aspects of our study.

2.1. Sesotho

Sesotho is a Bantu language spoken by approximately 5 million people in the countries of Lesotho and South Africa. During the 18th and 19th centuries, Sesotho-speaking peoples came increasingly into contact with Afrikaans speakers coming inland from the Cape and English speakers moving inland from Durban. Since that time there has been extensive contact with both Afrikaans- and English-speaking employers, news media, government officials and so on, resulting in a large number of well-incorporated lexical items which are found in any dictionary of Sesotho. Although loanword incorporation from these languages continues today, our study is based primarily on forms that were already incorporated by the middle of the 19th century (Paroz, 1974).[2]

In the next two subsections, we introduce the phonological system of Sesotho highlighting the aspects which will be the most relevant to our analysis.

2.1.1. Segmental inventory

The Sesotho vowel system is balanced for front–back (coronal–labial) distinctions, but is generally analyzed as containing nine vowels, with mid and high vowels further distinguished by relative aperture (Doke and Mofokeng, 1985:1–8; see also Harris, 1987; Khabanyane, 1991; Clements, 1991). This is shown in (3).

(3) Vowel phonemes (Doke and Mofokeng, 1985)

High close	i								u
High			ɪ						ʊ
Mid close				e				o	
Mid					ɛ		ɔ		
Low						ɑ			

[2] In this and other respects, our study follows a methodology which is much more comparable to studies documented by Rose (1995, 1999a,b), Paradis and LaCharité (1997, 2001), Ulrich (1997), Uffmann (2001, 2004), than studies based on experimental evidence such as those by Peperkamp and colleagues. It is interesting to note that our results are also much more compatible with the former studies than the latter, providing further evidence that methodological issues may play a crucial role in explaining some of the controversy regarding the factors affecting loanword adaptation.

Note that Sesotho has only one low vowel, /ɑ/, with no coronal–labial contrast in the low dimension.

Like many other Bantu languages, Sesotho exhibits word minimality effects, where all open class words must be composed of at least a binary foot. Since all syllables are monomoraic (see next subsection), this means that binary feet are disyllabic. In the case of monosyllabic verb stems, the vowel /ɪ/ is epenthesized to ensure word minimality when there is no preverbal material available to prosodify with the verb, as in imperatives, or in sentences with no preverbal object pronominal (e.g. /dʒɑ/ 'eat', [ɪdʒɑ] 'eat!'; /jɑ/ 'go', [ɪjɑ], 'go!'; [kɪ-ne kɪ-ɪjɑ] 'I was going') (Doke and Mofokeng, 1985:36–37).

As we will show below, while [ɪ] is the epenthetic vowel in Sesotho, it does not act as a default vowel in loanwords. Rather, phonological material coming from surrounding vowels or consonants serves to fill the epenthetic site. We attribute this to a requirement of the borrowing language that gratuitous insertion of phonological features (e.g. violations of DEP(VPlace); see further in section 4) be avoided as much as possible such that feature copy from surrounding vowels is the preferred strategy.

The consonantal inventory of Sesotho is listed in (4). Sesotho displays a place contrast for all manners of articulation, except for the liquid consonants /r, l/. All other consonants (e.g. obstruents, nasals) contrast on the place dimension.

(4) Consonant phonemes (Doke and Mofokeng, 1985)[3]

b					
p, p^h		t, t^h		k, k^h	
	(v)				
	f	s	ʃ	(x)	h
b	fʃ		d		
pʃ, $pʃ^h$		ts, ts^h	tʃ, $tʃ^h$	kx^h	
		$tɬ$, $tɬ^h$			
		ɬ			
m		n	ɲ	ŋ	
		l			
		r			
w			j		
			ǂ (click)		

[3] Segments in parentheses are found in loanwords only.

Building on this observation, we will propose, in section 4, that liquids in Sesotho can be represented without place features (see Rose, 1995 for a similar approach in his analysis of French loanwords in Kinyarwanda; cf. Walsh Dickey, 1997 who proposes that liquids are universally specified for place features).

In the native phonology of Sesotho, the epenthetic consonant is /k/. It appears in vowel-initial stem contexts where there is a latent (underlying, hidden) nasal, as in the reflexive (/etsɑ/ 'do, make' → [iketsɑ] 'do/make for oneself' and in nominalization processes ([hɷ-ɑrabɑ] 'to-answer', [kɑrɑbɔ] 'answer') (Doke and Mofokeng, 1985:24–27).

As we will see below, input velar consonants in loanwords never seem to contribute place features to epenthetic vowels, as opposed to labial and coronal consonants. This finding is in line with observations previously made by, e.g. Rose (1995) and Uffmann (2001, 2004).

2.1.2. Syllabic properties

As it is the case in many other Bantu languages, most Sesotho syllables exhibit basic CV structure. The complete inventory of syllable shapes is provided in (5).

(5) Possible Sesotho syllable structures: (C)(G)V, C̩

Vowel-initial syllables and words are allowed, though not common, most consisting of English or Afrikaans loanwords. In addition, the language allows for syllabic /l/ (e.g. [mɑmɛl̩ɔ] 'patience') and syllabic nasals, which can be found word-initially (e.g. [n̩tjɑ] 'dog'), word-medially (e.g. [bɑn̩nɑ] 'men'), and word finally (e.g. [rɑtɑŋ̩] 'love! pl.') (Doke and Mofokeng, 1985:15–18).

Due to the basic CV shape of the language, all of the consonant clusters found in English and Afrikaans words introduced in Sesotho are illicit and must be adapted to obey the basic syllable structure of the language. While non-final nasals that are part of coda-onset clusters are incorporated as syllabic consonants followed by an onset consonant (e.g. *pink* [pɪŋk] → [piŋ̩ki]), all other consonantal sequences must be adapted. Following the Preservation Principle, stated in (6), vowel epenthesis is the primary strategy for breaking up consonant clusters in Sesotho loanwords.

(6) Preservation Principle (adapted from Paradis and LaCharité, 1997)[4]
Segmental information is maximally preserved in loanwords.

Based on this generalization, the challenge is how to predict the quality of epenthetic vowels. In section 4, we show that representational factors, specifically the presence or absence of phonological place features in the environment of the epenthetic site, provide the most natural explanation of the data.[5]

[4] Following Rose (1999a,b), we reject the Threshold Principle, also proposed by Paradis and LaCharité, as a limit to the Preservation Principle.

[5] In this paper, we focus on the place specification of the epenthetic vowel. Vowel height is variable and more difficult to predict. Some of the variation may be due to vowel harmony effects (Doke and Mofokeng, 1985; Riggle, 1999); our data transcription methodology may also have affected some of our results. Finally, effects due to dialectal variation in both the source languages and in Sesotho should also be considered. Because all of these factors lie outside the scope of this paper, we leave this issue for further research.

2.2. The database

The initial set of data for our loanword corpus came from 1100 loanwords extracted from a Sesotho dictionary (Paroz, 1974). This was supplemented with 58 items drawn from the on-line Demuth Sesotho Corpus (98 hours of spoken Sesotho collected in Lesotho between 1980 and 1982, available through the *CHILDES* database at http://childes.psy.cmu.edu/). Each of these loanwords was then verified at Brown University in 2001. Two consultants who are native speakers of Sesotho were presented with a list containing all forms collected from the sources listed above and were asked to provide a goodness grammaticality rating of 1–3 for each entry, where 1 was given to forms recognized as Sesotho words, and 3 was given to those that were not. Forms that received an average score greater than 2 were discarded (Tonks and Demuth, 2002). The resulting list of 949 loanwords (mostly nouns) was then elicited to verify the pronunciation, and was transcribed by a native speaker of English with training in linguistics and phonetic transcription.

Based on this corpus, this study will be concerned primarily with the place of articulation of the epenthetic vowels found in word-initial and word-medial consonant clusters. Word-final vowel realization is influenced by additional factors beyond the scope of this paper. For example, the morphology of both the source and the borrowing languages seems to have played a role in some adaptations. Furthermore, while final vowels are obligatory in Sesotho, these vowels often tend to be reduced and/or devoiced, which may have an effect on the preservation of their quality over time. In order to focus on the more stable and straightforward cases, we leave the issue of final vowels for further research.

2.3. Approach to loanword phonology

The approach to loanword phonology we entertain is relatively standard and follows the orientation proposed by, e.g. Paradis and LaCharité (1997). The loanwords found in our corpus are assumed to originate from adaptations performed by native speakers of Sesotho who were bilingual speakers of English and/or Afrikaans. It is these speakers who dynamically performed the nativization process of the source English and Afrikaans loanwords, the outcomes of which were subsequently lexicalized and integrated into the Sesotho vocabulary. Taking this as a starting point, our study focuses primarily on the patterns found in the outcome of the nativization process.

3. The data

In this section, we describe the general adaptation patterns that English and Afrikaans consonant clusters undergo when incorporated into Sesotho loanwords. As mentioned above, we will be concerned primarily with the place of articulation of the epenthetic vowels, without making any refined height distinction between non-low vowels. Focusing first on non-low vowels, we introduce the patterns of vowel epenthesis operating on consonant clusters in word-initial position in section 3.1. We then compare these patterns with the vowel epenthesis patterns found with word-medial clusters in section 3.2. This section includes word-final source clusters, as the epenthetic vowel breaking up these clusters occurs in word-medial position. Section 3.3 contrasts these patterns with those in which the low vowel /ɑ/ is involved.

3.1. Word-initial consonant clusters

In word-initial position, the general pattern is straightforward: the epenthetic vowel place of articulation is predictable from the cluster's initial consonant, unless this initial consonant is velar. Representative examples with initial labials and coronals are listed in (7a) and (7b), respectively. However, when the initial consonant is velar, the consonant does not contribute a place feature. In such cases, right-to-left vowel copy takes place, as exemplified in (7c) and (7d). Anticipating the behavior of the low vowel /ɑ/, it must also be noted that this vowel can also be copied in the velar-initial context, across both liquid (7c) and nasal (7d) consonants.

(7) Word-initial branching onsets: Copy from consonant on left if possible

a.	Lab + Liq	blik	[blɪk]	[bɷleke]	'tin can/dish'
		blouse	[blɑʊs]	[bɷlɑɷsɪ]	'blouse'
		prys	[pʀejs]	[pɷreisi]	'price/quotation'
b.	Cor + Liq	tronk	[tʀɔŋk]	[tɪrɔn̩kɔ]	'prison'
		troon	[tʀuwn]	[tɪronɪ]	'throne'
		driver	[drɑɪvɐ]	[terɑefɑ]	'driver'
c.	Dor + Liq	graaf	[xʀɑːf]	[k^{h}ɑrɑfu]	'spade'
		kroon	[kʀuwn]	[kɷronɪ]	'crown'
		krip	[kʀɪp]	[kɪrɪpɪ]	'crib/manger'
d.	Dor + Cor	knoop	[knuwp]	[kɷnɷpɔ]	'button'
		knoffel	[knɔffəl]	[kɔnɔfɔlɔ]	'leek/garlic'
		knip	[knɪp]	[kinipi]	'pocket knife'
		knapsak	[knɑpsɑk]	[kɑnɑpɑsɑkɑ]	'knapsack'

3.2. Word-medial consonant clusters

In word-medial context, where there exists a vowel to the left of the epenthetic site, we observe the general pattern of left-to-right copy of the vowel preceding the cluster in the input. This pattern, exemplified in (8), is found with all consonants except /s/ (see section 6 on the latter).

(8) Word-medial and word-final clusters: Copy from vowel on left

a.	Labial-C	hops	[hɔps]	[hɔpɔsɛ]	'drink made with hops'
		skepsel	[skɛpsɛl]	[sɪkɛpɛsɛlɛ]	'helpless person'
		Hebrew	[hibruw]	[heberu]	'hebrew'
b.	Coronal-C	football	[fʊtbɔl]	[futubɔlɔ]	'football'
		fine shawl	[fɑɪnʃɔl]	[fɑɪnɪʃɔlɔ]	'fine shawl'
		suitcase	[suːtkejs]	[sut^{h}ukeisi]	'suitcase'
c.	Dorsal-C	box	[bɔks]	[bɔkɔsɛ]	'box/case'
		bokwa	[bɔkvə]	[bɔkɔbɑjɑ]	'buck-wagon'
		pegs	[pɛgz]	[p^{h}ekese]	'pegs'

3.3. Asymmetrical behavior of /ɑ/

In this subsection, we discuss the special behavior of the vowel /ɑ/. Although copying this vowel into an epenthetic site is possible, it appears to be used only as a last resort. First, recall from (7) that in word-initial clusters, /ɑ/ can copy into the epenthetic site only when the initial consonant is velar, that is, only when this consonant cannot contribute a place feature to the epenthetic site. Additional examples of this pattern are presented in (9).

(9) Word-initial Dor + Liq clusters: Copy /ɑ/ from right

glas	[xlɑs]	[kʰalɑsɪ]	'glass'
glas	[xlɑs]	[xɑlɑsɪ]	'glass'
graweel	[xʀɑveːl]	[kɑrɑbœlɛ]	'gravel'
graaf	[xʀɑːf]	[kʰɑrɑfu]	'spade'
gramaphone	[græməfəʊn]	[kɑrɑmɑfonɪ]	'gramaphone'

Second, when /ɑ/ appears before a word-medial cluster, the place of articulation of the epenthetic vowel is copied from the first consonant of the cluster, if this consonant is labial or coronal. In other words, the copy of consonantal place features into the epenthetic site takes precedence over the copy of /ɑ/, as exemplified in (10).

(10) Cor + C and Lab + C clusters preceded by /ɑ/: Copy from consonant on left

sambreel	[sɑmbʀeːl]	[sɑm̩pœrelɪ]	'umbrella'
address	[ædrɛs]	[ɑtɪrɛsɛ]	'address'
patroon	[pɑtʀuwn]	[pɑtɪronɪ]	'pattern/cartridge'
handkous	[hɑn(t)kɔws]	[hɑnɪkɑusi]	'glove'

Third, if the first consonant of the word-medial cluster is a liquid, the epenthetic site receives place features from the vowel to the right of the consonant cluster. This pattern is exemplified in (11).

(11) Liq + C clusters followed by vowels with Place features: Copy from vowel on right

kartjie	[kɑʀtʃi]	[kɑrikɪ][6]	'cart'
naartjies	[nɑːʀtʃis]	[nɑrikisi]	'tangerine'
Sparletta	[spɑrlɛtə]	[sɪpɑreletɑ]	'soda'

Finally, if no vowel is available on the right hand side of the epenthetic site, that is, in sequences in which neither consonants or vowels can contribute a place, /ɑ/ can now be copied, as can be seen in the examples in (12).

(12) Word-final Liq + Dor clusters preceded by /ɑ/: Copy /ɑ/ from left

balk	[bɑlk]	[bɑlɑkɑ]	'beam/rafter'
kalk	[kɑlk]	[kɑlɑkɑ]	'lime'
hark	[hɑʀk]	[hɑrɑkɑ]	'rake'
mark	[mɑʀk]	[mɑrɑkɑ]	'mark'

[6] The adaptation of [-anterior] /tʃ/ into /k/ reflects the fact that /tʃ/ is rare in the Sesotho native vocabulary (Paroz, 1974).

Any analysis of these patterns of adaptation thus faces the challenge of explaining the directionality effects found across these different contexts, the inertness of velar and liquid consonants with regard to providing place features to epenthetic sites, as well as the peculiar behavior of /ɑ/. In the next section, we introduce the theoretical framework we adopt in our analysis of these various patterns.

4. Theoretical framework

In order to account for the data described in the preceding section, we adopt a framework combining segmental representations with constraints making reference to formal aspects of these representations. While representations themselves are inert and do not trigger the processes found in loanword adaptation, representational properties, predicted through a contrastive approach to feature specification, manifest themselves in the adaptation processes.

4.1. Segmental representations

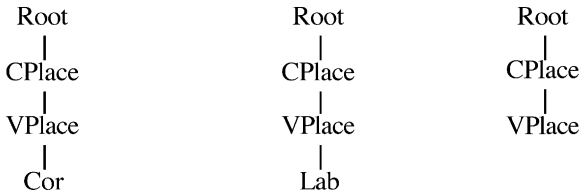
Our analysis relies on the theory of Contrastive Specification proposed by, e.g. Rice and Avery (1993, 2004). According to Rice and Avery, features must be incorporated into segmental representations only if they serve to mark a contrast in the language. In cases where multiple systems of underspecification might be available to the language learner, phonological or morpho-phonemic alternations will provide the evidence needed to posit the correct representations for the target language. This theory of feature specification allows for a constrained set of language-specific representations, since the representations are all motivated from language-specific segmental contrasts and behaviors (see, also, Morén, 2004 on the importance of considering phonological systems as wholes to explain the sound patterns they generate). It is also compatible with approaches to language acquisition based on either distributional learning (e.g. Elman et al., 1996) or inborn learning mechanisms relying on positive evidence (e.g. Chomsky, 1981), in the sense that both support the view that the learner has access to the type of evidence on which contrastive specification is based.

Starting with the representation of vowels, and focusing on the place dimension, we propose that all but one vowel have a place feature specified in their representation. The exception is the low vowel /ɑ/, the only low vowel in the Sesotho phonemic inventory. Assuming the unified feature specification system proposed by Clements and Hume (1995), we specify front vowels for the feature Coronal, as represented in (13a)[7] and back rounded vowels for the feature Labial, as represented in (13b). However, as can be seen in (13c), the low vowel /ɑ/ does not participate in a front/back contrast. It can thus be represented without a place feature, i.e. with a bare VPlace node; a height feature such as [low] or [open], depending on the feature set assumed, suffices to uniquely identify this vowel.

[7] According to Clements and Hume (1995), all coronal (front) vowels are specified for the feature [-anterior]. Given that this feature is not contrastive for vowels in Sesotho, we assume, consistent with the contrastive approach to feature specification, that front vowels in Sesotho need not be specified for [-anterior]. This issue raises the question as to whether [-anterior] needs to be specified at all for vowels across languages, as it is not clear what segmental contrast this feature would encode amongst vowels across languages.

(13) Vowel representations (Place structure only)

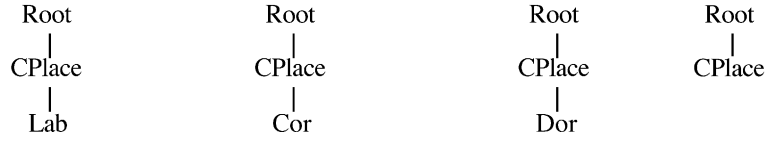
a. Front vowels b. Back rounded vowels c. /ɑ/



Turning now to consonant place specification, we follow the same logic of contrastive specification: because Sesotho obstruents and nasals are contrastive for place features, they must be represented with the Labial, Coronal and Dorsal place features, in (14a), (14b) and (14c), respectively. Finally, the class of liquid consonants, in (14d), is predictably coronal and, as such, need not be specified for place features. These consonants are represented with a bare CPlace node and contrast with other consonants on their sonority dimension.[8]

(14) Consonant representations (Place structure only)

a. Labials b. Coronals (except liquids) c. Velars d. Liquids



4.2. *Predictions from segmental representations*

The representations in (13) and (14) make clear predictions with regard to how each segmental class should behave in loanword adaptations. First of all, only labial and coronal (non-liquid) consonants can contribute place features to epenthetic vowels. Velar consonants are predicted to be inert, in the sense that they cannot contribute place features because the Dorsal place feature is irrelevant to the Sesotho system of vocalic contrasts. First, under the assumption that all vowels are specified for Dorsal, which acts as a mother node for backness and height features (e.g. Sagey, 1986; Halle, 1992), velar consonants would not be in a position to contribute distinctive place specification to epenthetic vowels. Second, within the model of segmental representation developed by Clements and Hume (1995), vowels do not necessarily have a Dorsal specification. For example, in the Sesotho vocalic system, front unrounded vowels can be specified for Coronal, back rounded vowels for Labial, which leaves only the low central vowel as a potential Dorsal-specified vowel. However, as we will see below, while coronal and labial consonants do display a relationship with epenthetic front and back rounded vowels, respectively, no direct relationship can be found between velar consonants and /ɑ/. Based on this observation, we argue that /ɑ/ is best analyzed as placeless, rather than as Dorsal-specified, consistent with the approach based on

[8] While there exists controversy on the featural difference between these two segments (e.g. Walsh Dickey, 1997), they can be distinguished by the presence/absence of the feature [lateral] (e.g. Rice and Avery, 1993).

contrastive specification adopted in this paper.[9] As a result, all velar consonants are predicted not to contribute place features to the vowel epenthesis site.[10]

Similarly, the liquid consonants /l/ and /r/, despite their phonetic coronality, are predicted not to contribute place features because of their phonological placelessness. Finally, the low vowel /ɑ/ is also predicted to display asymmetrical behavior because of its placelessness. This analysis formally captures the observation made in the data that this vowel can only be copied as a last resort, when no surrounding segment can contribute a place feature to the epenthetic site.

Finally, following Clements and Hume (1995), we support the hypothesis that consonant (CPlace) and vowel (VPlace) place features are represented on different tiers, such that copying a VPlace over a CPlace is not ruled out by representational considerations.

In the next section, we introduce the constraints that will govern the interaction of the segments described above during the loanword adaptation process.

4.3. Constraints and constraint ranking

The general framework of our analysis is that of Optimality Theory (OT; Prince and Smolensky, 1993). In order to account for the formal relations that exist between the source and adapted forms, we adopt the framework of Correspondence Theory (CT; McCarthy and Prince, 1995), in which the input form is assumed to be the foreign, unadapted form, while the output is the outcome of the adaptation process, i.e. the form incorporated into the Sesotho vocabulary.

We begin with faithfulness constraints from CT. While both the MAX(Seg) and DEP(Seg) constraints in (15a) and (15b) focus on the segment, the DEP(VPl) constraint in (15c) has the vocalic place (VPlace) feature as its argument.

(15) Faithfulness constraints (after McCarthy and Prince, 1995)
- a. MAX(Seg): Every input segment has an output correspondent.
- b. DEP(Seg): Every output segment has an input correspondent.
- c. DEP(VPl): Every output VPlace specification has an input correspondent.

Following Rose (1999a) and Uffmann (2001, 2004), we propose that loanword adaptation of the type discussed in this paper is generally subject to a ranking in which MAX(Seg) dominates DEP(Seg), a grammar in conformity with the Preservation Principle in (6).[11] As shown in the data presented in section 3, the adaptation strategies show a general preference for feature copy, rather than insertion (epenthesis) of VPlace into the epenthetic site. That is, the input material imposes a limit to the shape of the epenthetic segment. This effect is captured through the high ranking of DEP(VPl), which will prevent the insertion of new vocalic features in the adapted form. The ranking of faithfulness constraints is presented in (16).

[9] As pointed out by an anonymous reviewer, one could also argue that Dorsal can be underspecified because dorsality implies labiality in Sesotho vowels.

[10] Our approach to velar inertness also differs from Uffmann's (2004, this issue) proposal. According to Uffmann, velar do not contribute VPlace because of their relative markedness. Under our approach, velar simply do not have any place features to contribute to vowels. The cross-linguistic observation made by Uffmann that velars almost never contribute place feature to epenthetic vowels in loanwords should however not be taken lightly. No matter which approach (e.g. feature specification incompatibility between velar consonants and vowels; relative markedness of velars) is taken, this relationship is an important one which deserves further attention.

[11] As argued for by Rose (1999b), some deletion processes can in fact be caused by perceptual factors or by properties inherent to the grammar of the borrowing language.

(16) Constraint ranking: MAX(Seg) ≫ DEP(VPl) ≫ DEP(Seg)[12]
  a. Opt for vowel epenthesis in all cases of illicit consonant clusters in the input.
  b. Copy vocalic material from surrounding segment (do not insert new features).

As was shown in the data in section 3, the adapted loanwords generally obey the basic syllable structure of Sesotho. While a full account of this observation would require a set of highly ranked markedness constraints such as *CODA and *COMPLEX (e.g. Prince and Smolensky, 1993), we adopt here the simpler OK(σ) portemanteau constraint in (17), for simplicity and space concerns.

(17) OK(σ) (Yip, 1993)
Portemanteau constraint ensuring syllable well-formedness in output (adapted) forms.

The data in section 3 show that the adaptation of Sesotho loanwords involves featural relations between the epenthetic vowel and a vowel or consonant surrounding it; whenever a feature is present in the representation it will be copied into the epenthetic site. In order to regulate these relations, we appeal to the AGREE family of constraints proposed by Lombardi (1999). In (18), we identify two types of AGREE constraints, namely those that focus on a VPlace dimension and those that have CPlace as their argument.

(18) AGREE (after Lombardi, 1999)
  a. AGREEL/R(VPl): The place feature of the epenthetic vowel must agree with the place feature of the vowel immediately to its left/right.
  b. AGREEL/R(CPl): The place feature of the epenthetic vowel must agree with the place feature of the consonant immediately to its left/right.

In order to implement the AGREE constraints in the context of loanword adaptation, it is necessary to state that these constraints are in effect only during the initial, on-line adaptation process, before the adapted form is lexicalized by the borrower, since these constraints obviously do not apply in already-lexicalized (including native) forms.

Across the example sets discussed, we observed a series of asymmetries. For example, a VPlace feature is copied from the left if available in the input form (e.g. examples in (8)). Otherwise, features will be copied from a non-velar consonant to the left or a vowel to the right (e.g. Labial- and Coronal-initial versus Dorsal-initial word-initial clusters in (7)). These directionality effects can be accounted for by a decomposition and ranking of constraints from the AGREE family above: AGRL(VPl) ≫ AGRL(CPl) ≫ AGRR(VPl).[13]

In order for a relation between two segments to satisfy AGREE constraints, it will be necessary that (a) both segments have the relevant CPlace or VPlace node in their representation (placeless segments basically violate AGREE constraints), and (b), the featural value dominated by the relevant node is realized by both segments. These two conditions for satisfaction of the AGREE constraints are formally stated in (19).

[12] Due to space constraints, highly ranked MAX(Seg) and lowly ranked DEP(Seg) will not be represented in the tableaux in section 5. Any segmental deletion from the input (source) form would incur a fatal violation of the MAX(Seg) constraint, and failure to insert a segment in order to break up an illicit cluster (DEP(Seg)) would violate syllable well-formedness (see below). Therefore, only DEP(VPl) will be further discussed.

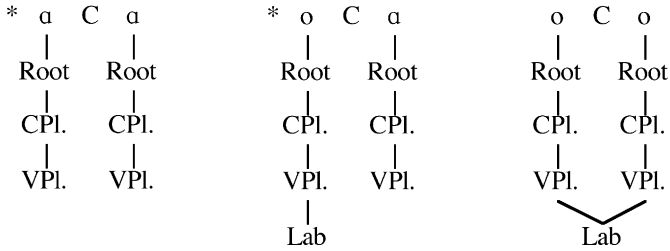
[13] While the domination of AGREEL over AGREER is descriptively adequate, it cannot be motivated independently. It is plausible that government relations acting on the segmental representations are involved (e.g. Kaye et al., 1990). This question is left for further research.

(19) Assessment of AGREE relations: conditions for constraint satisfaction
  a. Both segments involved in the agreement relation have the required node.
  b. The relevant featural value is shared by these segments.

For example, a sequence of two placeless vowels, as in (20a), or a sequence that contains a placeless vowel and a place-specified vowel, as in (20b), both violate AGREE(VPlace). This constraint is satisfied only when a sequence of two vowels actually share a VPlace specification, as in (20c).

(20) AGREE(VPl) relations

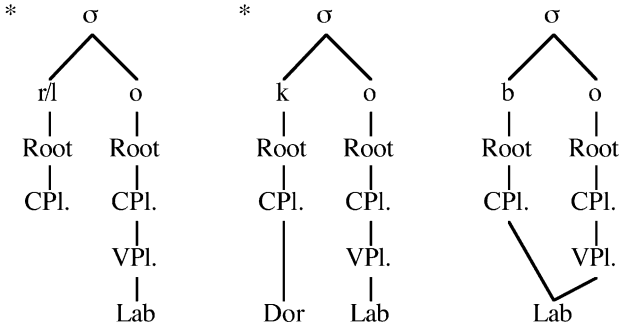
a. Ill-formed b. Ill-formed c. Well-formed



Similarly, AGREE(CPlace) can only be satisfied in cases where the epenthetic vowel shares the place feature of a surrounding consonant, as illustrated in (21).

(21) AGREE(CPl) relations

a. Ill-formed b. Ill-formed c. Well-formed



Critically, consonant-to-vowel place sharing must take place within the same syllable. Thus, a consonant to the right of the epenthetic vowel can never contribute place features. This contrasts with vowel-to-vowel place sharing, which can operate both from left to right and from right to left. While the origin of this asymmetry is difficult to explain, we attribute it to a locality effect, namely that consonant-to-vowel interactions in Sesotho can only apply within the same syllabic domain, as illustrated in (22a). Given Sesotho's CV syllable structure (discussed in section 2.1.2), AGREER(CPl) would imply an interaction between consonants and vowels that belong to two different syllables, as illustrated in (22b).

(22) C-V interactions

a. Licit (within σ) b. Illicit (across syllable boundary)

The impossibility of the relation in (22b) is formalized using Itô and Mester's (1994) CrispEdge constraint in (23), which militates against feature-sharing processes across prosodic domains. The constraint used here is parameterized to encode solely consonant-to-vowel feature sharing.

(23) CrispEdge(CV, σ) (after Itô and Mester, 1994)
Consonant–vowel feature sharing cannot occur across syllables.

This parameterized constraint receives support from the head-dependency relationships that exist between consonants and vowels at the syllabic level: while vowels are syllable heads and, as such, can participate in non-local relations across syllables (such as vowel harmony), consonants do not enjoy this status and generally only participate in local relations (see, however, Hansson, 2001 and Rose and Walker, 2004 as well as references therein for consonant harmony processes in adult languages). Note as well that this grammatically encoded observation may have an articulatory or a perceptual source, as suggested by Gafos (1996) and Hall (2003). For example, while vowel place features are generally encoded phonetically during the entire length of the vowel, the strongest cues to consonant place features are expressed at the release of the consonant, i.e. just before the realization of epenthetic vowels. While this possibility may suggest a central role for phonetics in the explanation of loanword adaptation, a phonetic-only approach to the data would however meet a number of challenges. First, such an approach would have to explain all of the directionality relationships detected in the dataset. Second, it would need to explain why /ɑ/ patterns asymmetrically with respect to the non-low vowels. Third, it would have to account for the inertness of both velar and (phonetically coronal) liquid consonants. Although some of these issues may warrant further research, our grammar-based explanation enables a straightforward explanation of the facts. It also has the advantage of being independently motivated by the system of phonological contrasts of Sesotho, which relates clearly to grammatical properties of the language. Finally, as already noted, we do not completely reject a role for phonetics in loanword adaptation; as we will see in section 6, we contend that perceptual factors do play some role in loanword adaptation.

In the next section, we present the evaluation tableaux that demonstrate how the analysis we propose captures the patterns observed in the data in section 3.

5. Evaluation tableaux

The tableaux presented in this section cover each of the vowel epenthesis contexts identified in section 3. This systematic analysis demonstrates that the constraints and rankings we propose to account for the phonological adaptations of English and Afrikaans loanwords capture all of the observations within a single grammar. While the attention in this section is devoted mostly to constraint interaction, several aspects of the analysis are based on properties of the segmental representations proposed in section 4. The featural relations that exist between the segments

involved in the various contexts from the source forms described in section 3 and related epenthetic sites will be evaluated against the ranking in (24).

(24) Constraint ranking:
OK(σ), CRISPEDGE(CV, σ) ≫ DEP(VPl) ≫ AGRL(VPl) ≫ AGRL(CPl) ≫ AGRR(VPl)

In order to keep the analysis as concise and clear as possible, this ranking includes only the higher-ranked constraints, that is, the ones that have an effect on the selection of the optimal candidate. For the same reasons, only the relevant segments and representations are included in the evaluation tableaux. Finally, syllable structure will be represented in the first tableau only. Subsequent tableaux follow the same logic.

5.1. Word-initial clusters

Recall that the general strategy for determining the place features of the epenthetic vowel given a word-initial cluster consists of copying the CPlace of the initial consonant, as long as this consonant is not velar. This is captured by the domination of AGREEL(CPlace) over AGREER(VPlace), which yields selection of the candidate in (25b). This within-syllable C-to-V feature sharing is preferred over the form in (25c), which fails to display such a relation. The other two candidates fail to satisfy higher-ranked constraints: the candidate in (25a) violates the basic CV structure of Sesotho, while the candidate in (25d) violates highly ranked DEP(VPlace).

(25) Labial + liquid cluster

	blouse [blɑʊs]	OK(σ)	CRISP	DEP(VPl)	AGRL(VPl)	AGRL(CPl)	AGRR(VPl)
a.	σ / b l ɑ / Lab — [blɑ]	*!					
b. ☞	σ σ / b ω l ɑ / Lab — [bωlɑ]						*
c.	σ σ / b ɑ l ɑ / Lab — [bɑlɑ]					*!	*
d.	σ σ / b i l ɑ / Lab, Cor — [bilɑ]			*!		*	*

Note, finally, that the constraint AGREEL(VPl) is vacuously satisfied by all of the candidates because no vowel appears on the left to meet the structural description targeted by the constraint. The same will apply throughout all examples of word-initial clusters.

The tableau in (26) follows the same general reasoning as that in (25), differing in two respects. First, the initial consonant is coronal, rather than labial. However, the same consonant-to-vowel place sharing applies. This parallel behavior is predicted by the fact that both labial and coronal consonants have a place feature that can be contributed to the epenthetic site. The second difference comes from the fact that the vowel to the right of the epenthetic site also has a place feature. Satisfaction of AGREER(VPlace) is thus possible, as can be seen with candidate (26b). However, because of the higher ranking of AGREEL(CPlace), place sharing between the initial consonant and the epenthetic site is favored, as shown in (26c).

(26) Coronal + liquid cluster

	tronk [trɔŋk]	OK(σ)	CRISP	DEP(VPl)	AGRL(VPl)	AGRL(CPl)	AGRR(VPl)
a.	t r o Cor Lab [tro]	*!					
b.	t o r o Cor Lab [toro]					*!	
c. ☞	t i r o Cor Lab [tiro]						*
d.	t i r o Cor Lab Cor [tiro]			*!		*	*
e.	t ɑ r o Cor Lab [tɑro]					*!	*

The analysis of velar-liquid sequences deserves some additional attention. Because velar consonants cannot contribute a place feature to the epenthetic site, copy of the vowel from the right is required. The competition in this case takes place between the right-harmonized candidate in (27b) and the candidate with placeless /ɑ/ insertion in (27c). While both candidates violate AGREEL(CPlace), the harmonized candidate in (27b) wins as it satisfies the lower-ranked AGREER(VPlace) constraint.

(27) Dorsal + liquid cluster

	kroon [kruwn]	OK(σ)	CRISP	DEP(VPl)	AGRL(VPl)	AGRL(CPl)	AGRR(VPl)
a.	k r o Dor Lab [kro]	*!					
b. ☞	k o r o Dor Lab [koro]					*	
c.	k ɑ r o Dor Lab [kɑro]					*	*!
d.	k i r o Dor Lab Cor [kiro]			*!		*	*

In cases involving placeless /ɑ/, we can see, in (28), that copy of only the vocalic and height features[14] of /ɑ/ into the epenthetic site is the favored strategy, even if it violates all AGREE constraints, because of the lack of place specification for this vowel. Indeed, violation of these constraints by the optimal candidate in (28c) is preferred over a violation of higher-ranked DEP(VPlace), which is incurred in all cases of ad hoc VPlace feature insertion.

(28) Dorsal + Liquid + /ɑ/ sequence

	grass [xrɑːs]	OK(σ)	CRISP	DEP(VPl)	AGRL(VPl)	AGRL(CPl)	AGRR(VPl)
a.	x r ɑ Dor [xrɑ]	*!					
b.	x o r ɑ Dor | Lab [xorɑ]			*!		*	*
c. ☞	x ɑ r ɑ Dor [xɑrɑ]					*	*
d.	x i r ɑ Dor | Cor [xirɑ]			*!		*	*

The tableau in (29) exemplifies a comparable situation, except that the second consonant of the cluster, /n/, is specified for Coronal. Cases such as this exemplify the role of the undominated CRISPEDGE(CV, σ) constraint, which prevents consonant-to-vowel place sharing relations across syllable as in (29d). Like in (28) above, copy of placeless /ɑ/ into the epenthetic site in (29b) is preferred over VPlace insertion in (29c) and (29e).

(29) Dorsal + Coronal + /ɑ/ sequence

	knap [knap]	OK(σ)	CRISP	DEP(VPl)	AGRL(VPl)	AGRL(CPl)	AGRR(VPl)
a.	k n ɑ Dor Cor [knɑ]	*!					
b. ☞	k ɑ n ɑ Dor Cor [kɑnɑ]					*	*
c.	k i n ɑ Dor | Cor Cor [kinɑ]			*!		*	*
d.	k i n ɑ Dor Cor [kinɑ]		*!			*	*
e.	k o n ɑ Dor | Cor Lab [konɑ]			*!		*	*

[14] Recall that vocalic and height features are not represented in the evaluation tableaux.

This last example completes the analysis of word-initial consonant clusters. As can be seen from this demonstration, the seemingly complex patterns of vowel epenthesis observed in the data can be captured in a uniform fashion through reference to the segmental properties of the segments surrounding the epenthetic contexts in conjunction with constraints regulating the featural agreement relations taking place between these segments.

5.2. Word-medial clusters

As described in section 3, the general epenthesis strategy for word-medial clusters consists of copying the VPlace specification from the input vowel located on the left of the epenthetic site. This is exemplified in (30) with a Labial + liquid cluster preceded by a front vowel. Focusing on candidates (30b) through (30d), we can see that the domination of AGREEL(VPlace) over AGREEL(CPlace) makes the right prediction. While the insertion of a vowel that shares its place of articulation with the preceding consonant (in (30b)), or of a placeless vowel (in (30c)), both yield a violation of AGREEL(VPlace), this constraint is satisfied by the harmonized candidate in (30d), which displays left-to-right vowel copy.

(30) Labial + liquid cluster

	Hebrew [hibruw]	OK(σ)	CRISP	DEP(VPl)	AGRL(VPl)	AGRL(CPl)	AGRR(VPl)
a.	e b r u | | | |Lab Lab Cor [ebru]	*!					
b.	e b o r u | ⌄ | | Lab Lab Cor [eboru]				*!		
c.	e b ɑ r u | | Lab Lab Cor [ebɑru]				*!	*	*
d. ☞	e b e r u | | | |Lab| Lab ⌄ Cor [eberu]					*	*
e.	e b e r u | | | |Lab| Lab Cor Cor [eberu]			*!		*	*

However, the same pattern cannot apply when /ɑ/ precedes the cluster. Due to the placelessness of this vowel, no candidates can satisfy AGREEL(VPlace), as shown in (31b) through (31d). This cluster therefore patterns like word-initial clusters, where the precedence of AGREEL(CPlace) over AGREER(VPlace) predicts that the epenthetic site will acquire its place of articulation from the consonant that immediately precedes it.

(31) /ɑ/ + Coronal + liquid sequence

	patroon [patʀuwn]	OK(σ)	CRISP	DEP(VPl)	AGRL(VPl)	AGRL(CPl)	AGRR(VPl)
a.	ɑ t r u Cor Lab [atru]	*!					
b. ☞	ɑ t i r u Cor Lab [atiru]				*		*
c.	ɑ t u r u Cor Lab [aturu]				*	*!	
d.	ɑ t ɑ r u Cor Lab [ataru]				*	*!	*
e.	ɑ t u r u Cor Lab Lab [aturu]			*!	*	*	*

In cases where the consonant to the left of the epenthetic site is placeless, as in (32), the vowel receives its place of articulation from the vowel to the right of the epenthetic site, if such a vowel is available. Because of the placelessness of both the /ɑ/ and the liquid preceding the epenthetic site, both AGREEL constraints are violated by all candidates. The optimal candidate is thus determined by the lower-ranked AGREER(VPlace), in (32c).

(32) /ɑ/ + liquid sequence followed by a place-specified vowel

	Sparletta [sparlɛtə]	OK(σ)	CRISP	DEP(VPl)	AGRL(VPl)	AGRL(CPl)	AGRR(VPl)
a.	ɑ r l e Cor [arle]	*!					
b.	ɑ r ɑ l e Cor [arale]				*	*	*!
c. ☞	ɑ r e l e Cor [arele]				*	*	
d.	ɑ r u l e Lab Cor [arule]			*!	*	*	*

Finally, if no vowel is present on the right, thereby preventing right-to-left harmony, then the vocalic and height features of /ɑ/ are copied into the epenthetic site, despite the fact that /ɑ/ has no place feature to contribute to the epenthetic site. This is predicted by the high ranking of DEP(VPlace), as exemplified in (33): the candidates with place feature insertion in (33c) and (33d) violate this constraint, as opposed to the optimal candidate with /ɑ/ copy, in (33b).

(33) /ɑ/ + liquid sequence with no vowel following it

	hark [hɑʀk]	OK(σ)	CRISP	DEP(VPl)	AGRL(VPl)	AGRL(CPl)	AGRR(VPl)
a.	ɑ r k | Dor [ɑrk]	*!					
b. ☞	ɑ r ɑ k | Dor [ɑrɑk]				*	*	*
c.	ɑ r i k | | Dor Cor [ɑrik]			*!	*	*	*
d.	ɑ r u k | | Dor Lab [ɑruk]			*!	*	*	*

5.3. Summary

The constraint-based analysis presented in the last section captures all of the regular patterns of vowel epenthesis found in the corpus of English and Afrikaans loanwords under investigation. In order to attain a complete coverage of the facts, however, additional contexts remain to be analyzed, all of which involve the consonant /s/ to the left of the epenthetic site. These contexts are discussed in the next section.

6. The problem of /s/ opacity

In this section, we discuss the special status of the consonant /s/ in the Sesotho loanword adaptation process. Based on the patterns observed, as well as on the behavior of the epenthetic vowel that appears after /s/ in the adapted forms, we argue that phonetic factors, rather than phonological ones involving segmental representations, offer the best solution to this problem.

6.1. The data

In (34), we show that word-initial sC clusters display insertion of the coronal vowel /ɪ/, as expected based on the word-initial consonant cluster data discussed in section 3, in which C-to-V place feature sharing is also observed.

(34) Word-initial sC clusters: Insert /ɪ/

smous	[smɔws]	[sɪmousu]	'hawker'
sloop	[sluwp]	[sɪlopo]	'pillowcase'
spons	[spɔns]	[sɪpon̩sɪ]	'sponge'
skol	[skɔl]	[sɪkolo]	'school'

We now consider the epenthetic processes involving word-medial sC clusters. Recall from section 3 that we expect the vowel to the left to contribute place features, if available. However, as shown in the word-initial context introduced above, it would appear that /s/ is opaque to vowel feature spreading.

(35) /s/ opacity to vowel feature spreading: Insert coronal vowel

		Predicted	Attested[15]	
borsspeld	[bɔʀspɛlt]	*[(bo)rosopɛlɛ]	[(bo)rosepɛlɛ]	'brooch'
saucepan	[sɔspæn]	*[sosopɑne]	[sosepɑne]	'saucepan'
bosluis	[bɔslœɪs]	*[bɷsɷleisɪ]	[bɷsɪleisɪ]	'tick'
mosterd	[mɔstɛʀt]	*[mosotɑrɪdɑ]	[mosɪtɑrɪdɑ]	'mustard'

The tableau in (36) illustrates the expected optimal output (36b). However, it is the form in (36c) that is attested. It therefore appears that there is something special about the consonant /s/.

(36) Wrong prediction for vowel epenthesis after word-medial /s/

	saucepan [sɔspæn]	OK(σ)	CRISP	DEP(VPl)	AGRL(VPl)	AGRL(CPl)	AGRR(VPl)
a.	o s p ɑ | | | Cor Lab Lab [sospɑne]	*!					
b. ✖	o s o p ɑ | | | | Cor Lab Lab [sosopɑne]					*	*
c. (☞)	o s e p ɑ | ∨ | Cor Lab Lab [sosepɑne]				*!	*	*
d.	o s ɑ p ɑ | | | Cor Lab Lab [sosɑpɑne]				*!	*	*

Now consider the word-initial sCL cluster examples in (37), where two epenthetic sites are required. As expected, an /ɪ/ is inserted between word-initial /s/ and the following consonant. But what is the prediction in the case of the second epenthetic vowel? Given a constraint-based approach to this issue, we should expect the second epenthetic vowel to take its place features from the consonant to its left, if available. If not, place features are expected to come from the vowel to the right. The data, however, show variable effects.

[15] As noted in section 3, the epenthetic vowels sometimes show variable height effects—some of the epenthetic vowels inserted after /s/ appear to be realized as [e]; the central observation here is that the vowel inserted after /s/ is invariably coronal.

(37) sCL clusters: Copy from consonant on left if possible

a.[16]	splash	[splæʃ]	[sɪpolɑʃe]	‘splash’
	sprite	[spraɪt]	[sɪporɑete]	‘Sprite’
b.	straw	[strɔː]	[sɪtɷroi]	‘straw’
	strop	[stʀɔp]	[sɪtɷrɔpɔ]	‘strap/halter’
c.[17]	strike	[strɑɪk]	[sɪtɪrɑɪkɪ]	‘strike’
	straat	[stʀɑːt]	[sɪtɪrɑtɑ]	‘street’
d.	skrop	[skʀɔp]	[sɪkɔrɔpɔ]	‘paid work’
	skroef	[skʀuf]	[sɪkurufu]	‘screw’

As expected, the forms in (37a) share place features with the preceding consonant, and place features arise from the vowel to the right when the consonant to the left is velar (37d). However, in (37b) and (37c), we observe two different behaviors for input /str/ clusters. If the vowel that follows the cluster is place-specified, it provides its place of articulation to the epenthetic site, as exemplified in (37b). However, if this post-cluster vowel is placeless /ɑ/, then an /ɪ/ appears in the second epenthetic site. We presume that this /ɪ/ originates from the place of articulation of input /t/ since this is consistent with the data in (37a).

6.2. Hypothesis

In order to explain the conundrum posed by /s/-initial medial clusters as well as the almost-invariable identity of the epenthetic vowel that is found after /s/ in the data, we propose that the adaptation of these clusters is influenced by phonetic, rather than representational, factors. Implicit to this proposal is the idea that epenthetic /ɪ/ after /s/ is not dynamically added by the grammar of the language, but rather comes as part of the representation of the input to be adapted.

This proposal receives support from research by Fleischhacker (2001), who provides experimental evidence regarding how the high frequency noise spectrum and the coronality of /s/ influence speech perception. In a nutshell, Fleischhacker proposes that the presence of /s/ in a consonant cluster can provide misleading acoustic cues yielding the perception of a front vowel immediately following this /s/, an effect which matches directly the observations made in the Sesotho loanwords.[18]

Additional support for this proposal relates to the interface between phonetics and phonology in Sesotho. The fact that the epenthetic vowel found after /s/ is generally /ɪ/ may not be trivial: its emergence can be facilitated by the fact that this vowel is the epenthetic vowel in the language, as already discussed in section 2 and, as such, has a special status in the grammar. It is indeed plausible that the /s/ creates an opacity effect that yields insertion of a default vowel in its environment.[19]

[16] These two examples were provided to us by our Sesotho consultants, since there were no examples of these word-initial /s+labial+liquid/ sequences in our corpus.

[17] While the epenthetic /ɪ/ found after /t/ in these examples could presumably be copied from the /ɪ/ epenthesized after /s/, we argue that this is not the case, since it is not a source vowel (see following discussion).

[18] As suggested by an anonymous reviewer, one could also posit a special AGREE(CPl) targeting /s/ in the Sesotho grammar to account for the epenthesis pattern after this consonant on phonological grounds, rather than proposing a phonetically based hypothesis. Either way, /s/ requires a special treatment; where the burden of explanation should really be, remains a topic for further research.

[19] How the interface between phonetics and phonology should interact in a grammar, that is, whether the two components should be separate or not within the grammar, is outside the scope of this paper.

In the broader context, our hypothesis suggests that both representational and phonetic factors may contribute to patterns of loanword adaptation. In addition, the facts covered in this paper strongly suggest that a close look at the phonology of the borrowing language is required to understand the processes observed in loanword adaptation. In the next section, we support this claim by looking at patterns of vowel epenthesis observed in other borrowing languages.

7. Discussion: language-specific effects on loanword adaptation

In this paper we have outlined a phonological approach to vowel epenthesis in Sesotho loanword adaptation. By assuming a model of contrastive feature specification (e.g. Rice and Avery, 1993, 2004) we have shown that the low vowel /ɑ/, similar to the liquids /l, r/, is phonologically placeless and, as such, has no place features to contribute to the epenthetic site. Only when no other place features are available from other sources is /ɑ/ able to copy. Given that /ɑ/ is the most sonorous vowel (Clements, 1990), and therefore the most phonetically or perceptually salient, it is not clear how a phonetic approach would account for the various behaviors of /ɑ/. First, if the phonetics of /ɑ/ were preventing it from being copied into an epenthetic site, as phonetically salient vowels are universally disfavored as epenthetic vowel (e.g. Steriade, 2001), we should expect it to never copy. However, as shown in sections 3 and 5, this is not the case: /ɑ/ copies when place features cannot be contributed from other surrounding segments. As discussed in section 5, an analysis based on contrastive specification and the placelessness of /ɑ/ can easily capture the directionality from which epenthetic vowel features are contributed. Finally, as stressed by Uffmann (2004), cross-linguistic evidence must also be considered in the analysis of epenthetic vowels in loanwords. For example, in Selayarese, all vowels, including /a/, can copy across consonants in adapted loanwords, including /s/. Representative examples of Bahasa Indonesian loanwords adapted in Selayarese (Broselow, 1999) are provided in (38).

(38) Selayarese loanwords: Vowel copy (including /a/) across all consonant types (including /s/) (Broselow, 1999)

Bahasa Indonesian	Selayarese	Gloss
[kíkir]	[kíkiri]	‘metal file’
[árus]	[árusu]	‘current’
[kártu]	[karátu]	‘card’
[bákri]	[bakári]	proper name
[kípas]	[kípasa]	‘fan’
[rámli]	[ramáli]	proper name
[sólder]	[solodére]	‘weld’

Similar to what is observed in Sesotho, there exists a language-specific motivation for this generalization: Selayarese displays a process of vowel copy across consonants (including /s/) to satisfy syllable well-formedness. In this language, word-final consonants are restricted to glottal stops and placeless nasal consonants. In order to satisfy these phonotactic requirements, underlying native forms with other final consonants are realized on the surface with a copy of the vowel that precedes the underlying final consonants (e.g. Mithun and Basri, 1986; see also Broselow, 1999). Examples of this process are provided in (39).

(39) Selayarese native phonology: Vowel copy (including /a/) across all consonant types (including /s/) (Mithun and Basri, 1986)

Underlying form	Surface realization	Gloss
/sambal/	[sambɑlɑ]	'vegetable dish'
/kasissil/	[kasissili]	'mosquito'
/mintar/	[mintɑrɑ]	'tomorrow'
/lamber/	[lambere]	'long'
/paʔris/	[paʔrisi]	'painful'
/beras/	[berɑsɑ]	'rice'
/noʔnos/	[noʔnoso]	'shake liquid'

Thus, the process of vowel epenthesis in loanwords builds directly on this aspect of the Selayarese native phonological system.

French loanwords incorporated into Kinyarwanda exhibit a different adaptation process, where the epenthetic vowel generally acquires its place feature specification from the consonant to the left of the epenthetic site, as illustrated in (40a). However, in contexts where there is a liquid in the foreign consonant cluster, the epenthetic vowel acquires its place of articulation from the source vowel on the other side of the liquid. All vowels participate in this process, as illustrated in (40b) (Rose, 1995; see also Uffmann, 2004).

(40) Vowel epenthesis in French loanwords in Kinyarwanda (Rose, 1995)

a. Between non-liquids: copy of first consonant's place of articulation

[ɛ̃dɛmnite]	[i^{n}damunite]	'indemnity'
[paspɔʁ]	[paːsipoːro]	'passport'
[pɔʁtmɔnɛ]	[porotemoːne]	'wallet'

b. In clusters involving a liquid consonant: vowel copy across the liquid

[akɔʁdeɔ̃]	[ak^{w}orudewo]	'accordeon'
[plafɔ̃]	[pɑrɑfo]	'ceiling'
[sitʁɔ̃]	[sitoro]	'lemon'

As proposed in Rose (1995), the transparent behavior of liquids in Kinyarwanda loanwords can be explained by the fact that this language has no phonological contrast among liquids; [r] and [l] are free variants of the phoneme /r/ (Kimenyi, 1979). Liquids in Kinyarwanda, by virtue of not being contrastive for place, similar to liquids in Sesotho, are therefore featurally impoverished, permitting unconstrained vowel copy. All other consonants in Kinyarwanda must be specified for place features. The transparency effects in Kinyarwanda are thus restricted to the one phoneme showing no place features. This makes the prediction that, across languages, we should see similar phonological effects in loanword adaptation processes, depending on the contrastive feature specifications of the consonants in a given borrowing language. While the behavior of liquids observed in Sesotho and Kinyarwanda could be attributed to an articulatory effect, as argued for in Hall's (2003) analysis of intrusive vowels (which are analyzed as by-products of gestural overlaps between adjacent consonants), we maintain that a representational approach to vowel epenthesis in loanwords is more desirable, because feature copy across consonants in loanwords is not restricted to contexts in which there is a liquid, as seen above in the Sesotho corpus as well as in the Selayarese data.

Finally, in Japanese, the strategy for vowel epenthesis in loanwords is much different from those found in Sesotho, Kinyarwanda, or Selayarese. In Japanese, the epenthetic vowel is almost always /u/, even after the consonant /s/. This is fully compatible with the fact that synchronic vowel epenthesis processes in Sino-Japanese generally involve the vowel /u/ (Itô and Mester, 1996; Shinohara, 1997; see also Kubozono, 2002 for a fine-grained characterization of the properties of epenthetic vowels in loanwords adapted in Japanese). Representative examples are provided in (41), which further illustrate how specific aspects of a language's phonology affect the course of loanword adaptation.[20]

(41) Vowel epenthesis in loanwords in Japanese (Shinohara, 1997)

a. French loanwords

[myskl]	[mjusukuru]	'muscle'
[kle]	[kure]	'key'
[magma]	[maguma]	'wallet'

b. English loanwords

[bæskɛt]	[basuketto]
[t͡ʃæptɚ]	[tjaputa]
[ɛstæblɪʃmənt]	[isutaburissjumeŋto]

The examples drawn from the languages discussed above provide additional evidence that the choice of epenthetic vowel is determined by language-specific phonological factors, many having to do with language-specific feature underspecification of consonants and vowels. This is not to say that there are not also language-specific phonetic or perceptual processes involved in loanword adaptation (e.g. Silverman, 1992). However, we suggest that these phonetic/perceptual processes, such as the opacity of Sesotho /s/, may be much more restricted than has generally been proposed.

8. Conclusion

In this paper we discussed the adaptation of English and Afrikaans loanwords in Sesotho, focusing on processes of vowel epenthesis. We showed that the place features of the epenthetic vowel were largely predictable, agreeing with the coronal or labial features of surrounding consonants or vowels. We also showed that the directionality of feature copy can be captured by a ranking of constraints, providing a unified phonological explanation for these processes. Both analyses follow naturally from a model of contrastive feature specification (Rice and Avery, 1993, 2004) where segments that are underspecified for place features play no role in determining the place of epenthetic vowels. While the majority of the data and analyses could be handled by appealing to representational factors motivated independently by the phonological system of Sesotho, exceptional patterns found in the context of /s/ were explained through phonetic effects. This implies that both phonetic and representational factors are important for understanding processes of loanword adaptation.

As mentioned in the introduction, we suggest that some of the controversy as to the relative importance of phonetic/perceptual versus phonological/grammatical factors in loanword adaptation may be due to the methodological differences used in various studies of loanword

[20] As noted by Shinohara, except for relatively recent loanwords, it is the vowel /o/ that is epenthesized after the coronal consonants /t, d/. This behavior also reflects the phonotactics of the language.

adaptation. The term 'loanword adaptation' is often used to describe a large array of phenomena arising from many different situations, not all of which can be directly compared (e.g. differing status of the phonological systems of the source and borrowing languages, different sociolinguistic factors such as degree of bilingualism of the bilingual community in which loanwords are studied and/or degree of bilingualism of the consultants involved in the research, the degree to which orthographic factors may have influenced the results, the influence of other task effects relating to data elicitation techniques, etc.). Methodological factors must then be taken into consideration before any comparison across loanword studies can be made. Nonetheless, the approach we entertain in this paper, which considers several aspects of the phonology of the borrowing language, enables strong language-specific predictions about the course of loanword adaptation that should apply to loanwords emerging from comparable situations of languages in contact.

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