Vowel epenthesis in loanword adaptation: phonological and phonetic considerations*

Yvan Rose
Memorial University
yrose@mun.ca

Katherine Demuth
Brown University
Katherine_Demuth@Brown.edu

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 perceptual versus phonological 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 phonological and perceptual

* Many thanks to those who provided assistance and expertise for this research, including Jonathan Barnes, Carrie Dyck, Matt Goldrick, Cecilia Kirk, ‘Malillo Machobane, Francina Moloi, Katherine White and Alan Yu. A previous version of this paper was presented at the 12th Manchester Phonology Meeting. We thank that audience, and especially the following for discussion and comments: Peter Avery, Wyn Johnson, Michael Kenstowicz, Haruo Kubozono, Chloe Marshall, Bruce Morën, Mits Ota, Carole Paradis, Sharon Peperkamp, Keren Rice, Daniel Silverman, Christian Uffman, and Moira Yip. We also owe special thanks to Patrick Tonks for empirical work on the dataset.
factors may both play a role in loanword adaptation, it is the language-specific phonological phenomena that are central to this process.

**Introduction**

In recent years, a long-standing debate in the field of loanword phonology has re-emerged regarding phonological versus perceptual approaches to loanword adaptation. The phonological account, under which loanwords are adapted according to the rules and/or constraints of the borrowing language, receives support from Hyman (1970), Kaye and Nykiel (1979), Singh (1987), Lebel (1994), Rose (1995), Paradis and LaCharité (1997, 2001), Ulrich (1997), Uffmann (2001, 2004), among others. In contrast, proposals by Shinohara (1997), Steriade (2001), Kenstowicz (2003a,b, 2004), Peperkamp and Dupoux (2003), Peperkamp (2004), and Vendelin and Peperkamp (2004) propose that loanword adaptation involves the perceptual component of the grammar only, independent of the rules and/or constraints of the borrowing language. Finally, a third, less radical, position can also be found in the literature, under which credit is given to both the perceptual and the phonological components of the grammar, as proposed by, e.g., Silverman (1992), Yip (1993, 2004) and Rose (1999a,b). 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.

We suspect that one of the factors contributing to this debate is the different methodological and theoretical approaches used. 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 with monolingual speakers. The purpose of the present paper is to shed light on this debate through an in depth consideration of both perceptual and phonological 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 /a/, as in (1b). (In these examples and all that follow,
the first form is the source word, and the second the adapted loanword.)

(1)  
\[ a. \text{suitcase} \quad [\text{s}u\text{t}\text{ke}j]\quad [\text{s}u\text{t}\text{h}\text{ke}j\text{e}si]\quad \text{‘suitcase’} \]
\[ b. \text{patroon} \quad [\text{pat}\text{ruwn}] \quad [\text{pat}\text{ru}\text{r}o\text{n}] \quad \text{‘pattern/cartridge’} \]

We appeal to language-specific segmental representations in order to account for this contrast: /a/ is
phonologically placeless, being the only low vowel in Sesotho, and this prevents it from being
favored as a base for vowel copy. Indeed, /a/ can only be copied when no place feature is available
from vowels and consonants adjacent to the epenthetic site.

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

(2)  
\[ a. \text{football} \quad [\text{f}\text{u}\text{t}\text{b}\text{o}l]\quad [\text{f}\text{u}\text{t}\text{b}\text{o}l\text{e}] \quad \text{‘football’} \]
\[ b. \text{mosterd} \quad [\text{m}\text{o}\text{s}\text{t}\text{e}\text{r}\text{t}] \quad [\text{m}\text{o}\text{s}\text{t}\text{a}\text{n}\text{d}a] \quad \text{‘mustard’} \]

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. In addition to the empirical difference exemplified
in (2), we will argue that the epenthetic /i/ found in this context has no phonological specification. As we will show, the epenthetic vowel inserted, even if phonetically coronal, cannot be copied to other epenthetic sites, in contrast to other epenthetic vowels. Thus, we show that both phonological/grammatical and phonetic/perceptual factors are important for understanding the nature of Sesotho loanword adaptation, but that the latter play a much more limited role in determining the vocalic content of epenthetic sites.

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 status 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 item which are found in any dictionary of Sesotho. Although loanword incorporation from these languages continues today, our study is based
primarily on forms which were already well incorporated by the middle of the 19th century (Paroz 1974).\textsuperscript{1}

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

\subsection{Segmental inventory (Doke and Mofokeng 1985)}

Many Bantu languages have five or seven vowel system. Like these, 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) or height (Khabanyane 1991, Clements 1991). This is show in (3).

\begin{align*}
\text{(3) Vowel phonemes} \\
\text{High close} & \quad \text{i} \quad \text{u} \\
\text{High} & \quad \text{ì} \quad \text{ò} \\
\text{Mid close} & \quad \text{e} \quad \text{o} \\
\text{Mid} & \quad \text{ε} \quad \text{ɔ} \\
\text{Low} & \quad \text{a}
\end{align*}

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

The vowel /a/ can thus be represented without a place feature; a height feature such as [low] or [open], depending on the feature geometry assumed, suffices to uniquely identify this vowel.

\textsuperscript{1} 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 Dupoux (2003), Peperkamp (2004), and Vendelin and Peperkamp (2004). It is interesting to note that our results are much more compatible with the
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, /ι/ is epenthesized to ensure word minimality when there are no preverbal material available to prosodify with the verb, as in imperatives, or in sentences with no preverbal object pronominal (e.g. [dʒa] ‘eat’, [ιdʒa] ‘eat!’; [ja] ‘go’, [ιja], ‘go!’; [kt-ne ιt-ιya] ‘I was going’) (Doke and Mofokeng 1985: 36-37). The Sesotho epenthetic vowel is /ι/, described as being midway between Cardinal vowels [i] and [e] (Doke and Mofokeng 1985), or as [+high, -ATR] by Harris (1987) (see also Khabanyane 1991 and Clements 1991 for further discussion of the Sesotho vowel system).

As we will show below, while [ι] is the epenthetic vowel in Sesotho, it does not act as a default epenthetic vowel in loanwords. Rather, phonological material coming from surrounding vowels or consonants serves to fill the epenthetic site.

We argue in section 4 that the fewer the features a segment has in its representation, the less likely it is to be a source vowel for specifying the epenthetic site. As we will show, both epenthetic /ι/ and low /a/ will be underspecified in the representations we propose for Sesotho vowels. While /ι/, by virtue of being the epenthetic vowel in the language, is not specified for place or height features, /a/ will be represented as placeless, but with a height feature specification.

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.
The consonantal inventory of Sesotho is listed in (4).

(4) Consonant phonemes (Doke and Mofokeng 1985)

<table>
<thead>
<tr>
<th>Consonant Phonemes</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>b</td>
<td></td>
</tr>
<tr>
<td>p, pʰ</td>
<td>t, tʰ</td>
</tr>
<tr>
<td>k, kʰ</td>
<td></td>
</tr>
<tr>
<td>(v)</td>
<td>3</td>
</tr>
<tr>
<td>f</td>
<td>s</td>
</tr>
<tr>
<td>j</td>
<td>(x)</td>
</tr>
<tr>
<td>h</td>
<td></td>
</tr>
<tr>
<td>b̃</td>
<td>f̃</td>
</tr>
<tr>
<td>d̃</td>
<td></td>
</tr>
<tr>
<td>p̄f, p̄fʰ</td>
<td>ts, tsʰ</td>
</tr>
<tr>
<td>t̄j, t̄jʰ</td>
<td>t̄f, t̄jʰ</td>
</tr>
<tr>
<td>kxʰ</td>
<td></td>
</tr>
<tr>
<td>tl, tʰ</td>
<td></td>
</tr>
<tr>
<td>ɬ</td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>n</td>
</tr>
<tr>
<td>j</td>
<td>η</td>
</tr>
<tr>
<td>ɭ</td>
<td></td>
</tr>
<tr>
<td>r</td>
<td></td>
</tr>
<tr>
<td>w</td>
<td>j</td>
</tr>
<tr>
<td>‡ (click)</td>
<td></td>
</tr>
</tbody>
</table>

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. 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 to the analysis of French loanwords in Kinyarwanda; cf. Walsh Dickey 1997, who proposes that liquids are universally specified for place features).

Segments in parentheses are found in loanwords only.
In the phonology of native Sesotho words, the epenthetic consonant is /k/. It appears in vowel-initial stem contexts where there is a latent (underlying, hidden) nasal, as in the reflexive (/etsa/ ‘do, make’ → [iketsa] ‘do/make for oneself’ and in nominalization processes ([ho-araba] ‘to-answer’, [karabo] ‘answer’) (Doke and Mofokeng 1985: 24-27). There is no voiced counterpart to /k/, and even the velar affricate /kx/ has been found to be uvular in some speakers (Clements 2000: 285). Thus, /k/ may be the only true velar in Sesotho, making it a prime candidate for underspecification of place features. As we will Corpus below, input velar consonants in loanwords never contribute place features to epenthetic vowels, as opposed to labial and coronal consonants. We will account for this behavior using a feature specification model that builds on Rice and Avery’s (1993, 2004) model of contrastive feature specification.

2.1.2 Syllabic properties

As 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, C

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. [mamelɔ] ‘patience’) and syllabic nasals, which can be found word-initially (e.g. [ntja] ‘dog’), word-medially (e.g. [banna] ‘men’), and word finally (e.g. [rataŋ] ‘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 which are part of coda-onset clusters are incorporated as syllabic consonants followed by an onset consonant (e.g. pink [piŋk] → [piŋki]), all
other consonantal sequence 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)³

Segmental information is maximally preserved in loanwords.

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

2.2 The database

The data 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 online Demuth Sesotho Corpus (98 hours of spoken Sesotho collected in Lesotho between 1980 and 1982, available through the CHILDES database (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 which received an average score below 2 were discarded (Tonks and Demuth 2002). The resulting list of

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³ Following Rose (1999a,b), we reject the Threshold Principle, also proposed by Paradis and LaCharité as a limit to the Preservation Principle.

⁴ 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 will leave this issue for further research.
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 General 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 /a/ 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 /a/, it must also be noted that this vowel can also be copied in the velar-initial context, both across liquid ((7c)) and nasal ((7d)) consonants.

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

<table>
<thead>
<tr>
<th>Initial Consonant Clusters</th>
<th>Word</th>
<th>[Front]</th>
<th>[Back]</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab + Liq</td>
<td>blik</td>
<td>[blik]</td>
<td>[bɔleke]</td>
<td>‘tin can/dish’</td>
</tr>
<tr>
<td></td>
<td>blouse</td>
<td>[blaʊs]</td>
<td>[bɔlaʊs]</td>
<td>‘blouse’</td>
</tr>
<tr>
<td></td>
<td>prys</td>
<td>[prejs]</td>
<td>[pɔreisi]</td>
<td>‘price/quotation’</td>
</tr>
<tr>
<td>Cor + Liq</td>
<td>tronk</td>
<td>[trɔŋk]</td>
<td>[tɔɾŋkɔ]</td>
<td>‘prison’</td>
</tr>
<tr>
<td></td>
<td>troon</td>
<td>[τɾuwn]</td>
<td>[tɾorni]</td>
<td>‘throne’</td>
</tr>
<tr>
<td></td>
<td>driver</td>
<td>[dɾuˈvɐɾ]</td>
<td>[ɾɐɾeʃa]</td>
<td>‘driver’</td>
</tr>
</tbody>
</table>
Thus, there is a difference in the behavior of word-initial labial and coronal consonants on one hand, and velar consonants on the other: the former trigger left-to-right consonant-vowel feature sharing when vowel eпenthesis occurs, whereas the latter do not. In contrast, vowel eпenthesis with word-initial velar consonants is determined by the vowel on the right of the cluster. We will show in section 4 that this difference can be captured in terms of phonological representations, where velar consonants are underspecified for place features. Place features for the epenthetic vowel must therefore be derived from the only other available source, that of the vowel on the left.

### 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 is found with all consonants (except /s/), as expected.\(^5\) This is exemplified in (8).

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\(^5\) As we will discuss more in depth in section 6, clusters whose first consonant is /s/ contradict this general pattern.
Thus, when a vowel is available to the left of the epenthetic site, vowel copy takes precedence over consonant-vowel feature sharing. This applies across the board, regardless of the place of the intervening consonant. However, this process only applies to non-low vowels. In the next subsection, we show that these patterns differ from that of the low vowel /a/.

3.3 Asymmetrical behavior of /a/

In this subsection, we discuss the special behavior of the vowel /a/. 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, /a/ 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).
Word-initial Dor + Liq clusters: Copy /a/ from right

<table>
<thead>
<tr>
<th>Word</th>
<th>[IPA]</th>
<th>[IPA]</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>glas</td>
<td>[kʰɬaɡs]</td>
<td>[kʰɬaɡs]</td>
<td>‘glass’</td>
</tr>
<tr>
<td>graweel</td>
<td>[kɑrəboʊl]</td>
<td>‘gravel’</td>
<td></td>
</tr>
<tr>
<td>graaf</td>
<td>[kʰɔrəfu]</td>
<td>‘spade’</td>
<td></td>
</tr>
<tr>
<td>gramaphone</td>
<td>[kʰrəməfoʊn]</td>
<td>‘gramaphone’</td>
<td></td>
</tr>
</tbody>
</table>

Second, when /a/ 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 /a/, as exemplified in (10).

Cor + C and Lab + C clusters preceded by /a/: Copy from consonant on left

<table>
<thead>
<tr>
<th>Word</th>
<th>[IPA]</th>
<th>[IPA]</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>sambreel</td>
<td>[sæmbrəl]</td>
<td>[səmpɔrəl]</td>
<td>‘umbrella’</td>
</tr>
<tr>
<td>address</td>
<td>[ədres]</td>
<td>[ətʊrəs]</td>
<td>‘address’</td>
</tr>
<tr>
<td>patroon</td>
<td>[patruwn]</td>
<td>[pətɾuʊn]</td>
<td>‘pattern/cartridge’</td>
</tr>
<tr>
<td>handkous</td>
<td>[hæn(t)kɔws]</td>
<td>[hænˈkɔusi]</td>
<td>‘glove’</td>
</tr>
</tbody>
</table>

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

\[
\begin{align*}
\text{kartjie} & \quad [kərtʃi] \quad [kərki] \quad \text{‘cart’} \\
\text{naartjies} & \quad [nərtʃis] \quad [narikisi] \quad \text{‘tangerine’} \\
\text{Sparletta} & \quad [sparəltə] \quad [sparəltə] \quad \text{‘soda’}
\end{align*}
\]

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, /a/ can now be copied, as can be seen in the examples in (12).

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

\[
\begin{align*}
\text{balk} & \quad [bəlk] \quad [bələkə] \quad \text{‘beam/rafter’} \\
\text{kalk} & \quad [kəlk] \quad [kələkə] \quad \text{‘lime’} \\
\text{hark} & \quad [hərk] \quad [hərəkə] \quad \text{‘rake’} \\
\text{mark} & \quad [mərk] \quad [mərəkə] \quad \text{‘mark’}
\end{align*}
\]

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 /a/. In the next section, we introduce the theoretical framework we adopt in our analysis of these various patterns.

\[\text{The adaptation of [-anterior] /tʃ/ into /k/ reflects the fact that /tʃ/ is rare in the Sesotho native vocabulary (Paroz 1974).}\]
4. Theoretical framework

In order to account for the various patterns 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. In order to account for these adaptation processes, we will encode the relations between the different consonants and vowels and the epenthetic site through specific rankings of constraints making reference to formal aspects of phonological representations.

4.1 Segmental representations

Our analysis will rely crucially on the theory of Contrastive Specification initially proposed by 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 can be conceived and, as such, are available to the learner of the language, phonological or morpho-phonemic alternations provide the learner with the required evidence to attain an understanding of, and the correct representations for, the target language. In cases where the language-specific evidence suggests that a segment or a segmental class patterns as default, it will be underspecified for the relevant featural dimension. This theory of feature specification allows for language-specific representations in a constrained way, as the representations are all motivated from language-specific segmental contrasts and behaviors (see, also, Morén 2004 on the importance to consider phonological systems as wholes to explain the sound patterns they generate). It is also compatible with approaches to language acquisition that are based on either distributional learning (e.g. Elman, Bates, Johnson, Karmiloff-Smith, Parisi and Plunkett 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 if based.
Our characterization of the Sesotho phonological system will refer to both segmental contrasts and default segment behaviors. As will be shown, the predictions made by this approach to feature specification will match closely the behavior of the Sesotho loanword vowels and consonants described above.

Starting with the representation of vowels, and focusing on the place dimension, we propose that all but two vowels have a place feature specified in their representation. The two exceptions are the low vowel /a/, the only low vowel in the Sesotho phonemic inventory, and the high front vowel /i/, which acts as the epenthetic vowel in the native phonology of Sesotho, as reported in section 2. Assuming the unified feature specification system proposed by Clements and Hume (1995), we specify front vowels (except /i/) 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 /a/, which does not participate in a front/back contrast, is represented as placeless. This vowel contrasts with the other vowels on the height dimension only. Finally, in line with Rice and Avery (2004), we propose that the vowel /i/, by virtue of being the epenthetic vowel in Sesotho, must be represented as featureless, as shown in (13d).

\(^7\) 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 we are assuming, 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 features only)

<table>
<thead>
<tr>
<th>Vowel</th>
<th>Place Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. /i, e, ε/</td>
<td>Root</td>
</tr>
<tr>
<td>b. /u, o, ə/</td>
<td>Root</td>
</tr>
<tr>
<td>c. /ɔ/</td>
<td>Root</td>
</tr>
<tr>
<td>d. /ι/</td>
<td>Root</td>
</tr>
</tbody>
</table>

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. One obstruent, however, differs from this: the velar consonant /k/. We argue, following Rice and Avery (2004), that because it is the default (epenthetic) consonant in Sesotho (see section 2), /k/ must be represented as placeless, in (14d). Finally, the class of liquid consonants, i.e. /l/ and /ɾ/, in (14e), are predictably coronal and, as such, need not be specified for place features. These consonants contrast with other consonants on their sonority dimension, and the two are distinguished by the presence/absence of the feature [lateral] (Rice and Avery 1993).

(14)  Consonant representations

<table>
<thead>
<tr>
<th>Consonant</th>
<th>Place Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. /p, f, m, …/</td>
<td>Root</td>
</tr>
<tr>
<td>b. /t, s, n, …/</td>
<td>Root</td>
</tr>
<tr>
<td>c. /x, ɾ, …/</td>
<td>Root</td>
</tr>
<tr>
<td>d. /k/</td>
<td>Root</td>
</tr>
<tr>
<td>e. /ɾ, l/</td>
<td>Root</td>
</tr>
</tbody>
</table>

---

8 This node does not exist in Clements and Hume’s (1995) model, which does not address the feature [lateral].
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. Indeed, the Dorsal place feature is irrelevant to the Sesotho system of vocalic contrasts. (This claim assumes that vowels are not specified for Dorsal, which challenges the proposals by, e.g., Sagey (1986) and Halle (1992).) As a result, all velar consonants including placeless /k/ (and its voiced foreign counterpart /g/, which is generally adapted into /k/), are predicted not to contribute place features to the vowel epenthesis site. 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 /a/ 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, as opposed to some standard feature-geometric approaches, we claim that these representations do not directly predict segmental transparency or opacity effects. 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.

---

9 This approach to velar inertness also differs from Uffman’s (2001) proposal. According to Uffman, velars do not contribute VPlace because of their relative markedness. Under our approach, velar simply do not have any place features to contribute to vowels.
4.3 Constraints and constraint ranking

The general framework we adopt to evaluate the well-formedness of adapted forms with regard to the constraints of the borrowing language 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 also 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 (i.e. the timing position and the melodic content it dominates),\(^\text{10}\) the DEP(VPl) constraint in (15c) has the vocalic place (VPlace) feature as its argument.

\begin{equation*}
(15) \quad \text{Faithfulness constraints (after McCarthy and Prince 1995)}
\end{equation*}

\begin{itemize}
  \item a. \quad \text{MAX(Seg): Every input segment has an output correspondent.}
  \item b. \quad \text{DEP(Seg): Every output segment has an input correspondent.}
  \item c. \quad \text{DEP(VPl): Every output VPlace specification has an input correspondent.}
\end{itemize}

Following Rose (1999a) and Uffmann (2001), 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) which generally predicts the preservation of input consonant clusters through vowel epenthesis or other non-destructive strategies.\(^\text{11}\) 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

\(^{10}\) That the timing position has the form of a mora or a skeletal unit has no impact on our analysis.

\(^{11}\) 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.
captured through the high ranking of \textit{DEP(VPl)}. The ranking of faithfulness constraints is presented in (16).

\begin{equation}
\text{(16) Constraint ranking: } \text{MAX} (\text{Seg}) \gg \text{DEP} (\text{VPl}) \gg \text{DEP} (\text{Seg})^{12}
\end{equation}

a. Opt for vowel epenthesis in all cases of illicit consonant clusters in the input.

b. Copy vocalic material from surrounding segments (rather than VPlace feature epenthesis).

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 *\textit{CODA} and *\textit{COMPLEX} (e.g. Prince and Smolensky 1993), we adopt here the simpler \textit{OK}(\sigma) portemanteau constraint in (17), for simplicity and space concerns.

\begin{equation}
\text{(17) } \text{OK}(\sigma) \text{ (Yip 1993)}
\end{equation}

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 \textit{AGREE} family of constraints proposed by Lombardi (1999). In (18), we identify two types of \textit{AGREE} constraints, namely those that focus on a VPlace dimension and those that have CPlace as their argument.

\begin{footnotesize}

\begin{enumerate}
\item 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.
\end{enumerate}
\end{footnotesize}
(18) AGREE (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.

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).

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

For example, a sequence of two placeless vowels, as in (20a), or a sequence that contains both 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 contains the same place features, as in (20c).

(20) \text{AGREE(VPl) relations}

\begin{center}
\begin{tabular}{ccc}
\text{a. Ill-formed} & \text{b. Ill-formed} & \text{c. Well-formed} \\
* \alpha & C & \alpha & * \alpha & C & \alpha & \alpha & C & \alpha \\
\text{Root} & \text{Root} & \text{Root} & \text{Root} & \text{Root} & \text{Root} & \text{Root} & \text{Root} & \text{Root} \\
\text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} \\
\text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} \\
\text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} \\
\end{tabular}
\end{center}

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

(21) \text{AGREE(CPl) relations}

\begin{center}
\begin{tabular}{ccc}
\text{a. Ill-formed} & \text{b. Ill-formed} & \text{c. Well-formed} \\
* \sigma & \text{r/l} & \alpha & \text{o} & \text{i} & \text{b} & \text{b} & \text{o} \\
\text{Root} & \text{Root} & \text{Root} & \text{Root} & \text{Root} & \text{Root} & \text{Root} & \text{Root} \\
\text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} & \text{CPl.} \\
\text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} & \text{VPl.} \\
\text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} & \text{Lab} \\
\end{tabular}
\end{center}

\footnote{While the domination of AGREE\text{L} over AGREE\text{R} is descriptively adequate, it cannot be motivated independently. It is plausible that government relations acting on the segmental representations are involved (e.g. Kaye, Lowenstamm and Vergnaud 1990). This question is left for further research.}
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), AGREE(CPI) 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 \(\sigma\))
- b. Illicit (across syllable boundary)

\[
\sigma \quad \text{C/V} \\
F
\]

F

\[
* \sigma \quad \text{C/V} \\
F
\]

The impossibility of the relation in (22b) is formalized in our proposed constraint on LOCALITY in (23), which prevents feature-sharing processes across syllables.

\[(23)\] LOCALITY(\(\sigma\))

Consonant-vowel feature-sharing must occur within the prosodic domain of the syllable.

This hypothesis is supported through the head-dependency relationship that exists 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 can only participate in local relations, within the syllable. Note as well that this grammatically-encoded observation may have a phonetic source, as suggested by Gafos (1996). 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 meet several 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 /a/ 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
contrast of Sesotho, which relates clearly to grammatical, rather than to phonetic, properties of the
language.

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:

\[ \text{OK(σ), LOCALITY}(σ) \gg \text{DEP(VPl)} \gg \text{AGRL(VPl)} \gg \text{AGRL(CPl)} \gg \text{AGRR(VPl)} \]
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 from initial consonant, as long as this consonant is not velar. This is captured by the domination of $\text{AGREEL(CPlace)}$ over $\text{AGREER(VPlace)}$, 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 $\text{DEP(VPlace)}$. 
(25) Labial + liquid cluster

Note that the constraint AGR(E)R(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 are represented with 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 AGRER(VPlace) is thus possible, as can be seen with candidate
(26b). However, because of the higher ranking of AGREE\textsc{L}(CPlace), place sharing between the initial consonant and the epenthetic site is favored, as shown in (26c).

(26) Coronal + liquid cluster

<table>
<thead>
<tr>
<th>tronk [\textipa{\texttt{tro}}\textipa{\texttt{k}}]</th>
<th>OK(\sigma)</th>
<th>LOC(\sigma)</th>
<th>DEP(VPI)</th>
<th>AGRL(VPI)</th>
<th>AGRL(CPl)</th>
<th>AGRE\textsc{R}(VPI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. t r o \hline Cor Lab \hline [tro]</td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. t o r o \hline Cor Lab \hline [toko]</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. t i r o \hline Cor Lab \hline [tiro]</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. t i r o \hline Cor \hline Lab \hline [tiro]</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>e. t o r o \hline Cor \hline Lab \hline [taro]</td>
<td></td>
<td></td>
<td>*!</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

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 /a/ insertion in (27c). While both candidates violate AGREE\textsc{L}(CPlace), as is the case with all candidates imaginable because of the placelessness of velar consonants, the harmonized candidate in (27b) wins as it satisfies the lower-ranked AGRE\textsc{R}(VPlace) constraint.
In more complex cases involving both placeless velars and placeless /ɑ/, we can see, in (28), that /ɑ/ copy into the epenthetic site is the favored strategy, even if it violates all AGREE constraints. 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 + /a/ sequence

<table>
<thead>
<tr>
<th></th>
<th>grass [xr̥ːs]</th>
<th>grass [xr̥ːs]</th>
<th>OK(σ) LOC(σ)</th>
<th>DEP(VPl)</th>
<th>AGRL(VPl)</th>
<th>AGRL(CPl)</th>
<th>AGRR(VPl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>x r a</td>
<td>x r a</td>
<td>!</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dor</td>
<td>[xr̥ː]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>x o r a</td>
<td>x o r a</td>
<td>* !</td>
<td>!</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Dor</td>
<td>[xɔː]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c</td>
<td>x a r a</td>
<td>x a r a</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Dor</td>
<td>[xɑː]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>x i r a</td>
<td>x i r a</td>
<td>* !</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td></td>
<td>Dor</td>
<td>[xiɾa]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The tableau in (28) contains only placeless segments in the input. The tableau in (29) exemplifies a comparable situation, except that the second consonant of the cluster, /n/, is specified for CPlace. Cases such as this exemplify the role of the undominated LOCALITY(σ) constraint, which prevents consonant-to-vowel place sharing relations across syllable as in (29d). Like (28) above, copy of placeless /a/ into the epenthetic site in (29b) is preferred over VPlace epenthesison (29c) and (29e).
This last example completes the analysis of word-initial consonant clusters. As can be seen from this demonstration, all of 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. Focussing on candidates (30b) through (30d), we can see that the domination of AGREEV (VPlace) over AGREEV(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 AGREE(APlace), this constraint is satisfied by the harmonized candidate in (30d), which displays left-to-right vowel harmony.

(30)  Labial + liquid cluster

<table>
<thead>
<tr>
<th>Hebrew [hibruw]</th>
<th>OK(σ),LOC(σ)</th>
<th>DEP(VPl)</th>
<th>AGRL(VPl)</th>
<th>AGRL(CPl)</th>
<th>AGRR(VPl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. e b r u</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lab Lab</td>
<td>Cor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ebru]</td>
<td>![]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. e b o r u</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lab Lab</td>
<td>Cor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[eboru]</td>
<td>![]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. e b a r u</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lab Lab</td>
<td>Cor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[ebaru]</td>
<td>![]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. e b e r u</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>Lab Lab</td>
<td>Cor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[eberu]</td>
<td>![]</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. e b e r u</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lab Lab</td>
<td>Cor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[eberu]</td>
<td>![]</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

However, the same pattern cannot apply when placeless /a/ preceded the cluster. Due to the placelessness of /a/, no candidates can satisfy AGREE(APlace), as shown in (31b) through (31d). This cluster therefore patterns like word-initial clusters, where the precedence of AGREE(APlace) over AGREE(APlace) predicts that the epenthetic site will acquire its place of articulation from the consonant that immediately precedes it.
(31) /a/ + Coronal + liquid sequence

<table>
<thead>
<tr>
<th>patroon [patruwn]</th>
<th>OK(σ)</th>
<th>LOC(σ)</th>
<th>DEP(VPl)</th>
<th>AGRL(VPl)</th>
<th>AGRL(CPl)</th>
<th>AGR(VPI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. a t r u</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cor Lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[atru]</td>
<td>!</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. a t i r u</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cor Lab</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[atiru]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. a t u r u</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Cor Lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[aturu]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. a t a r u</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Cor Lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[ataru]</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>e. a t u r u</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cor Lab</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>[aturu]</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

In cases where the consonant to the left of the epenthetic site is placeless, as in (32), the vowel gets 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 /a/ and the liquid preceding the epenthetic site, both AGREEEL constraints are violated by all candidates. The optimal candidate is thus determined by the lower-ranked AGREEER(VPlace), in (32c).
(32) /a/ + liquid sequence followed by a place-specified vowel

<table>
<thead>
<tr>
<th>Sparletta [sparle]</th>
<th>OK(σ) LOC(σ)</th>
<th>DEP(VPl)</th>
<th>AGRL(VPl)</th>
<th>AGRL(CPl)</th>
<th>AGRR(VPl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. α r l e</td>
<td>![arle]</td>
<td>* !</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. α r a l e</td>
<td>![arale]</td>
<td></td>
<td>*</td>
<td>*</td>
<td>* !</td>
</tr>
<tr>
<td>c. α r e l e</td>
<td>![arele]</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. α r u l e</td>
<td>![arule]</td>
<td>* !</td>
<td></td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

However, if no vowel is present on the right, thereby preventing right-to-left harmony, then /a/ gets copied into 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 /a/ copy, in (33b).
(33) /a/ + liquid sequence with no vowel following it

<table>
<thead>
<tr>
<th>$hark$ [hark]</th>
<th>OK(σ) LOC(σ)</th>
<th>DEP(VPl)</th>
<th>AGRL(VPl)</th>
<th>AGRL(CPI)</th>
<th>AGRR(VPl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. α r k</td>
<td>Dor</td>
<td>[ark] *!</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. α r α k</td>
<td>Dor</td>
<td>[arak] *</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c. α r i k</td>
<td></td>
<td>Cor</td>
<td>[arik] *!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>d. α r u k</td>
<td></td>
<td>Lab</td>
<td>[aruk] *!</td>
<td>*</td>
<td>*</td>
</tr>
</tbody>
</table>

A brief summary, presented in the next section, recapitulates the analysis proposed thus far.

### 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. To summarize, the epenthetic site generally acquires its place feature from a surrounding segment, from the left whenever a feature is available, otherwise from the right (so long as feature sharing does not violate the LOCALITY(σ) requirement banning consonant-to-vowel place sharing across a syllable boundary). Apparent exceptional patterns can all be explained by appealing to the phonological representations of the segments involved. First, the placeless of /a/ makes it a weak candidate for vowel copy; place-specified, non-low vowels have more featural material to contribute to the epenthetic site. Second, /k/ cannot contribute a place feature. This is explained by the fact that this consonant can be analyzed as placeless in Sesotho due to its behavior as the epenthetic consonant.
of the language. Its placelessness, and associated behavior in loanword adaptation, is comparable to that of the liquid consonants /l/ and /r/. Neither of these consonants is able to contribute a place feature to the epenthetic site, because their representation is devoid of a place feature, as predicted by the theory of contrast-based feature specification we are assuming. Finally, the respective behaviors of place-specified vowels and consonants that surround the epenthetic site have been handled through constraints making reference to place structure. As shown in the preceding section, a unique ranking of these phonological constraints can capture all of the contexts of vowel epenthesis discussed thus far. However, a few additional contexts remain, all of which involve the consonant /s/ to the left of the epenthetic site.

6. The problem of /s/ opacity

In this section, we discussed 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 the problem.

6.1 The data

In (34), we show that word-initial sC clusters display insertion of the coronal vowel /ı/, as expected based on the word-initial consonant cluster data discussed in section 3.

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

\[
\begin{align*}
\text{smous} & \quad [\text{sm\textipa{owment}}] & [\text{sm\textipa{owment}}] & \text{‘hawker’} \\
\text{sloop} & \quad [\text{sl\textipa{owp}}] & [\text{sl\textipa{owp}}] & \text{‘pillowcase’} \\
\text{spons} & \quad [\text{sp\textipa{ons}}] & [\text{sp\textipa{ons}}] & \text{‘sponge’} \\
\text{skol} & \quad [\text{sk\textipa{ol}}] & [\text{sk\textipa{ol}}] & \text{‘school’}
\end{align*}
\]
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 spread.

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

<table>
<thead>
<tr>
<th>Predicted</th>
<th>Attested</th>
</tr>
</thead>
<tbody>
<tr>
<td>*[(bo)rooseple]</td>
<td>[bo'rospele]</td>
</tr>
<tr>
<td>*[sosopane]</td>
<td>[sosepane]</td>
</tr>
<tr>
<td>*[bósopleist]</td>
<td>[bósuleist]</td>
</tr>
<tr>
<td>*[mosotanda]</td>
<td>[mostanda]</td>
</tr>
</tbody>
</table>

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/

<table>
<thead>
<tr>
<th></th>
<th>OK(σ)</th>
<th>LOC(σ)</th>
<th>Dep(VPl)</th>
<th>AgrL(VPl)</th>
<th>AgrL(CPl)</th>
<th>AgrR(VPl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>!</td>
<td></td>
</tr>
<tr>
<td>b.</td>
<td></td>
<td></td>
<td></td>
<td>!</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>c.</td>
<td></td>
<td></td>
<td>!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d.</td>
<td></td>
<td></td>
<td>!</td>
<td>*</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Now consider the word-initial sCL cluster examples in (37), where two epenthetic sites are required. As expected, an /i/ 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. Vowel features should not be expected to come from /i/, since /i/ is not a source vowel, and is therefore not available for feature sharing. The data, however, show variable effects.
(37) sCL clusters: Copy from consonant on left if possible

a.\textsuperscript{14} splash [splæʃ] [splaʃ] ‘splash’

\textit{Sprite} [spraɪt] [spraɪt] ‘Sprite’

b. straw [strɔː] [strɔː] ‘straw’

\textit{strop} [strɔp] [strɔp] ‘strap/halter’

c.\textsuperscript{15} strike [strɪk] [strɪk] ‘strike’

\textit{straat} [strɔ:t] [strɔ:t] ‘street’

d. skrop [skrɔp] [skrɔp] ‘paid work’

\textit{skroef} [skrɔf] [skrɔf] ‘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 placeless (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 /a/, 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). What is not clear is why there should be variable solutions to vowel epenthesis with word-initial /str/ clusters only.

Since variability appears only in triconsonantal word-initial s-clusters that contain a coronal consonant, it is possible that some of the perceptual features for /t/ are masked, being embedded between /s/ and /r/. This would render /t/ less likely to consistently contribute its coronality to the epenthetic site (37c). Alternatively, the fact that the vowel place of articulation is not copied from the

\textsuperscript{14} 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.
/t/ in the examples in (37b) may be due to a dissimilation effect: whenever possible, this epenthetic vowel must differ phonetically from the /h/ appearing after an /s/. The high ranking of DEP(VPlace) discussed in the preceding section however limits alternative strategies; only vowel place of articulation copied from the right of the cluster is possible in this case, as long as this vowel is not placeless /a/. In either case, there may be lexical or dialectal considerations, in either the source language, or in the borrowing language, that may have further affected the choice of epenthetic vowel in this context. We leave this issue for further research, which would require an extension of our corpus to incorporate additional loanwords containing these clusters, in order to determine the range of variation and the dominant adaptation pattern, if any.

In this section we have shown that Sesotho /s/-medial clusters behave differently from others, always selecting the epenthetic vowel /ɪ/, regardless of context. Any theory of loanword adaptation (phonological or phonetically-based) would need to account for this exceptional phenomenon. We turn to this issue in the following section.

6.2 Hypothesis

In order to explain the conundrum posed by /s/-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 perceptual, 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.

---

13 While the epenthetic /ɪ/ found after /t/ in these examples could presumably be copied from the /ɪ/ epenthized after /s/, we argue that this is not the case, since it is not a source vowel (see following discussion).
immediately following this /s/, an effect which matches directly the observations made in the Sesotho loanwords.

Additional support for this proposal relates to the interface between phonetics and phonology in Sesotho. First, the fact that the epenthetic vowel found after /s/ matches the identity of the epenthetic vowel /ì/ in the language is not trivial: its emergence can be facilitated by the fact that this vowel is arguably featureless from a phonological perspective, as already discussed in section 2. Therefore, no grammatical requirements can influence the appearance of this vowel in the adapted forms. Second, because of its featureless nature in the Sesotho grammar, /ì/ can hardly provide any featural material to adjacent epenthetic sites. This phonological property of /ì/ can explain why it does not act as a source vowel in the way that place-specified input vowels do.

In the broader context, our proposal implies that phonology-only or phonetics-only approaches to loanword adaptation may both be too strong. Rather, we argue that both phonological representations and perceptual factors may contribute to patterns of loanword adaptation. In the case of Sesotho, it appears that phonetic effects do not provide a natural explanation for the majority of the adaptation patterns. Furthermore, the phonetics of /s/ constitutes only a portion of the explanation for /ì/ epenthesis. The fact that /ì/ is also the epenthetic vowel in the language cannot be ignored. Thus, it is the interaction between the perceptual phonetics of /s/ and the underspecified phonological representation of /ì/ that conspire to produce the exceptional behavior of this epenthetic process. This suggests that phonetic factors alone do not enable us to make strong cross-linguistic predictions with regard to general processes of loanword adaptation. In the next section, we argue that consideration of language-specific phonological considerations offer a more powerful means of making predictions about the course of loanword adaptation in other 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 (Rice and Avery
we have shown that Sesotho /l/, /r/, and /k/ are underspecified for place features. This means that, unlike other Sesotho phonemes, they cannot contribute place features to the epenthetic vowel. Likewise, we showed that Sesotho /a/, the only low vowel, behaves much like /l/, /r/, and /k/ in also being placeless and having no place features to contribute to the epenthetic site. Only when no other place features are available from other sources is /a/ able to copy. A preliminary consideration of vowel epenthesis in loanwords in Shona (Uffmann 2004) reveals patterns generally similar to those found in the Sesotho data.

Given that /a/ is the most sonorous vowel (Clements 1990), and therefore the most phonetically or perceptually salient, it is not clear how a perception-based approach would account for the relative inertness of /a/. On the other hand, if the phonetics of /a/ were preventing vowel copy, we should expect it to never copy. However, as shown in sections 3 and 5, this is not the case: /a/ copies when Place features cannot be contributed from other surrounding segments. In contrast to high and mid vowels, which show coronal/labial oppositions, /a/ is featurally impoverished, having less material to contribute to epenthetic sites, and is thus dispreferred as a source for vowel copy. As discussed in section 5, an analysis based on the placelessness of /a/ can easily capture the directionality from which epenthetic vowel features are contributed. It is not clear how these asymmetries would be accounted for from a perceptual perspective, especially since the effects seen with Sesotho /a/ are not necessarily shared by other borrowing languages.

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).
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 preceded the underlying final consonants (e.g. Mithun and Basri 1986; see also Broselow 1999). Examples of this process are provided in (39).
Selayarese native phonology: Vowel copy (including /a/) across all consonant types (including /s/) (Mithun and Basri 1986)

<table>
<thead>
<tr>
<th>Underlying form</th>
<th>Surface realization</th>
<th>Gloss</th>
</tr>
</thead>
<tbody>
<tr>
<td>/katal/</td>
<td>[katala]</td>
<td>‘itch’</td>
</tr>
<tr>
<td>/sambal/</td>
<td>[sambahla]</td>
<td>‘vegetable dish’</td>
</tr>
<tr>
<td>/kasissil/</td>
<td>[kasissili]</td>
<td>‘mosquito’</td>
</tr>
<tr>
<td>/mintar/</td>
<td>[mintara]</td>
<td>‘tomorrow’</td>
</tr>
<tr>
<td>/lamber/</td>
<td>[lambere]</td>
<td>‘long’</td>
</tr>
<tr>
<td>/pa?ris/</td>
<td>[pari?si]</td>
<td>‘painful’</td>
</tr>
<tr>
<td>[beras/</td>
<td>[berasa]</td>
<td>‘rice’</td>
</tr>
<tr>
<td>/no?nos/</td>
<td>[no?noso]</td>
<td>‘shake liquid’</td>
</tr>
<tr>
<td>/tulus/</td>
<td>[tulusu]</td>
<td>‘go straight’</td>
</tr>
</tbody>
</table>

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 nearest source vowel. All vowels participate in this process, irrespective of their height specification, as illustrated in (40b) (Rose 1995).
(40) Vowel epenthesis in French loanwords in Kinyarwanda (Rose 1995)

a) Between non-liquids: copy of 1st C’s place of articulation

<table>
<thead>
<tr>
<th>French Word</th>
<th>MERV</th>
<th>SERR</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>indemmité</td>
<td>[ëdëmmitê]</td>
<td>[ï^damunite]</td>
<td>‘indemnity’</td>
</tr>
<tr>
<td>passeport</td>
<td>[pasœpɔ]</td>
<td>[pa:sipo:ro]</td>
<td>‘passport’</td>
</tr>
<tr>
<td>porte-monnaie</td>
<td>[porotmɔnɛ]</td>
<td>[porotemɔnê]</td>
<td>‘wallet’</td>
</tr>
</tbody>
</table>

b) In clusters involving a liquid C: vowel copy across the liquid

<table>
<thead>
<tr>
<th>French Word</th>
<th>MERV</th>
<th>SERR</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>accordéon</td>
<td>[akɔgde5]</td>
<td>[ak“orudewɔ]</td>
<td>‘acordeon’</td>
</tr>
<tr>
<td>plafond</td>
<td>[plafɔ]</td>
<td>[parafo]</td>
<td>‘ceiling’</td>
</tr>
<tr>
<td>citron</td>
<td>[siτe5]</td>
<td>[sitoro]</td>
<td>‘lemon’</td>
</tr>
</tbody>
</table>

As proposed in Rose (1995), the transparent behavior of liquids in Kinyarwanda loanwords can again 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, like Sesotho, are therefore featurally impoverished, permitting unconstrained vowel copy. All other consonants in Kinyarwanda must be specified for place and manner 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.

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.\textsuperscript{16}

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

\begin{itemize}
\item[a)] French loanwords
\begin{itemize}
\item \textit{muscle} \quad [myskl] \quad [mjus\textsubscript{u}kur\textsubscript{u}] \quad ‘muscle’
\item \textit{clé} \quad [kle] \quad [kure] \quad ‘key’
\item \textit{magma} \quad [magma] \quad [mag\textsubscript{u}ma] \quad ‘wallet’
\end{itemize}
\item[b)] English loanwords
\begin{itemize}
\item \textit{basket} \quad [bæsk\textsubscript{e}t] \quad [bas\textsubscript{u}k\textsubscript{e}t\textsubscript{o}]
\item \textit{chapter} \quad [t\textsubscript{ʃ}\textsubscript{æ}\textsubscript{pt\textsubscript{æ}]} \quad [tj\textsubscript{ap\textsubscript{u}ta}]
\item \textit{establishment} \quad [estabh\textsubscript{u}lm\textsubscript{a}nt] \quad [is\textsubscript{u}tabur\textsubscript{i}ssj\textsubscript{u}m\textsubscript{e}\textsubscript{nt\textsubscript{o}}]
\end{itemize}
\end{itemize}

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). However, we suggest that these phonetic/perceptual processes, such as the opacity of Sesotho /s/ and the special status of /h/, may be much more restricted than has generally been proposed.

\textsuperscript{16} As noted by Shinohara, except for relatively recent loanwords, it is the vowel /o/ that is epenthesized after the coronal consonants /t, d/. This behaviour also reflects the phonotactics of the language.
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 could 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) where segments that play no role in determining the place of the epenthetic vowel are in fact underspecified for place features. While the majority of the data and analysis 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/perceptual and phonological/representational factors are important for understanding processes of loanword adaptation, raising questions about approaches that only appeal to only one.

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 adaptation. The term ‘loanword adaptation’ is often used to describe a large array of phenomena arising from an may 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 influence 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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