

ENGLISH LOANWORD ADAPTATION IN BURMESE*

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0 Abstract

This paper provides a descriptive account of the main patterns found in the adaptation of English loanwords in Burmese. First, English segments missing from the Burmese inventory are replaced by native Burmese segments. Second, coda obstruents are represented by laryngealized tones. Third, consonant clusters are resolved through vowel epenthesis or consonant deletion. Finally, various phonotactic gaps native to Burmese, some with rather idiosyncratic distributional properties, are consistently maintained in loanwords via a number of different strategies. The data suggest overall that Burmese phonology heavily constrains the adaptation of English loanwords, and a brief sketch of an Optimality-Theoretic analysis is presented.

1 Introduction

Lexical borrowing is a common process across languages. Even so, words borrowed into a language are rarely borrowed faithfully; instead, they typically undergo modification vis-à-vis their form in the source language from which they were borrowed. This process of modification may result from the influence of the phonology native to the borrowing language, from general principles of Universal Grammar, or from a combination of the two. Loanword phonology has been of great interest in recent years due to the implications it holds for phonological grammar in general, and the process of loanword adaptation has been modeled in various ways (e.g. Silverman 1992, Kenstowicz 2003, Peperkamp and Dupoux 2003, Broselow 2004, LaCharité and Paradis 2005, *inter alia*) that make different claims about the stages of adaptation and the relative importance of factors such as the borrower's proficiency in the source language and the veridicality of cross-language speech perception. The phonology of Burmese, however, has not been very heavily studied, and the few sources that do comment on it are generally quite old or brief (e.g. Armstrong and Tin 1925, Stewart 1936: 1-17, Cornyn 1944, Jones and Khin 1953, Jones 1960, Burling 1967, Okell 1969: 241). The present study is the first to provide a systematic description of the phonological patterns in English loanwords that have been incorporated into Burmese.

The paper is organized as follows. This section provides some background on aspects of Burmese phonology that are relevant to loanword adaptation, with special attention to phonological differences from English, and summarizes the methods used in

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this study. Section 2 details the substitutions used to fill inventory gaps, and Section 3 illustrates the repairs made to syllable codas and consonant clusters. Section 4 presents loanword data that show certain Burmese phonotactic gaps to be systematic, rather than accidental. Finally, Section 5 briefly sketches an analysis of competing phonological considerations in loanword adaptation using the framework of Optimality Theory, and Section 6 summarizes the main conclusions.

1.1 Background on Burmese phonology

In this section the basics of the Burmese phonological system are laid out in order to highlight patterns and constraints that are reflected in the adaptation of foreign forms.

1.1.1 Inventories

Depending on what one counts, the Burmese language can be said to contain 34 consonants. There is a three-way laryngeal contrast among voiced, voiceless unaspirated, and voiceless aspirated obstruents, as well as a typologically rare voicing contrast in sonorants. A glottal stop and several fricatives round out the inventory (cf. Figure 1). Notable gaps in comparison to English are the lack of labial fricatives, the alveolar approximant /r/, and the voiced palatal fricative /ʒ/.

	labial	dental	alveolar	palatal	velar	glottal
plosive	p p ^h b		t t ^h d		k k ^h g	ʔ
affricate				tʃ tʃ ^h dʒ		
fricative		(t)θ (d)ð	s s ^h z	ʃ		h
nasal	m̥ m		n̥ n	ɲ̥ ɲ	ŋ̥ ɳ	
lateral			l̥ l			
tap/flap			(r)			
approximant	w̥ w			j		

Figure 1: Burmese consonant inventory¹

The Burmese vowel inventory consists of five oral vowels, with nasal counterparts to the “corner” vowels /i a u/, and four oral diphthongs, each of which has a corresponding nasal diphthong. Schwa, which occurs as an allophone of [ɪ, ɛ, a, ʊ], rounds out the inventory (cf. Figure 2).² Here there is a notable gap at the mid height, where nasal vowels do not occur. Burmese also lacks the low front vowel /æ/ and the diphthong /ɔi/ of English. Other English vowels missing from Burmese, such as the lax vowels /ɪ, ɛ, ʊ/, have close correspondents in Burmese vowel allophones not included in the chart below.

¹ The interdental fricatives are accurately described by Win (1998) as sounding “more like weak plosives than fricatives”; thus, they are often transcribed in conjunction with a dental stop. The flap is placed in parentheses because it is not a phoneme, but an allophone of /d/ that otherwise appears only in loanwords (Cornyn 1944).

² The vowels [ɪ, ɛ, ʊ] are not included in the vowel chart because they appear to be allophones of their tense counterparts that appear in closed syllables. Though Win (1998) considers schwa to have phonemic status, the fact that it alternates with several full vowels and cannot stand on its own suggests otherwise. Therefore, in this study schwa will be considered an allophone of [ɪ, ɛ, a, ʊ], as noted above.

		FRONT	CENTRAL	BACK
MONOPHTHONGS	HIGH	i ĭ		u ũ
	MID	e	(ə)	ɔ
	LOW		a ã	
DIPHTHONGS		ei ěĩ	ai ãĩ	au ãũ ou õũ

Figure 2: *Burmese vowel inventory*

Burmese is a tone language, where differences between tones have to do not only with pitch, but also duration, intensity, phonation, and vowel quality (Green 2005). By most accounts (e.g. Cornyn 1944, Khin 1976, Wheatley 1987, Green 1995), there are four distinct tones: low, high, creaky, and a so-called “checked” or glottal tone with the general features of creaky tone followed by glottal stop (cf. Figure 3). The tone that falls on schwa is neutral.

tone	transcription	characteristics
low	à	medium duration, low intensity, low/rising pitch
high	á	long duration, high intensity, high/falling pitch, can be breathy
creaky	ǎ	short duration, high intensity, high/falling pitch, creaky
glottal	aʔ	very short duration, high pitch, sharp glottal closure

Figure 3: *Burmese tone inventory*

Though it is possible to analyze the glottal tone as an allotone of creaky tone occurring before glottal stop, this study will follow previous ones in adopting a system of four phonemic tones; however, this decision affects little about the analyses presented below.

1.1.2 Syllable structure and phonotactics

The basic Burmese syllable structure is C₁(C₂)V(V)(C₃) (cf. Figure 4). An onset C₁ is obligatory and may be optionally followed by an approximant C₂. The rhyme minimally contains a monophthongal nucleus, and may also contain a diphthong. A coda C₃ is optional, but is limited to the glottal stop occurring with glottal tone.³

³ Green (1995) includes a “placeless” nasal as a possible filler of the coda position C₃. Under this analysis, nasal vowels are the surface manifestation of oral vowels followed by placeless nasal codas. Indeed, final nasals are represented in orthography and pronounced incidentally as nasals homorganic with the following consonant in rapid speech, but in normal speech these nasals are realized only as nasalization, making it unclear that synchronically there is still a nasal coda underlying what on the surface are just nasal vowels. Here nasal vowels are assumed to be underlying, and glottal stop is taken to be the only permissible coda.

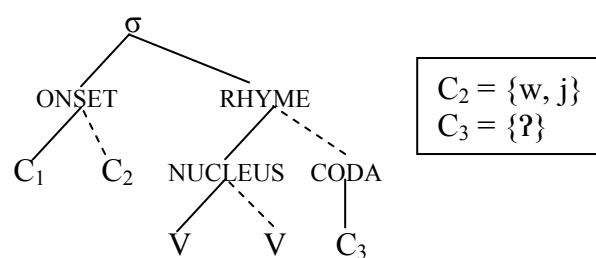


Figure 4: *Burmese syllable canon*

Several phonotactic restrictions apply to this basic structure. First, the glide /j/ only occurs after labials; clusters such as */tj, kj/ are ill-formed (Green 1995). Second, the diphthongs /ai, au/ only occur before coda glottal stop (i.e. not in open syllables). Third, /ɔ/ does not occur with a glottal coda (Cornyn 1944), while the lax vowels [ɪ, ɛ, ʊ, ʌ] only occur with a glottal coda, or else nasalized (except [ɛ]). Finally, the configuration of a nasalized vowel followed by a coda glottal is disallowed (Cornyn 1944).¹

Two different syllable types occur in Burmese, distinguished by Green (1995) as major and minor. Major syllables are heavy, containing any vowel except schwa and bearing tone, while minor syllables are light, contain schwa and no other vowel, do not bear tone, and are not word-final. While most Burmese vowels can be found in monosyllabic words, a syllable with a schwa cannot stand on its own and is always bound to a following major syllable (Cornyn 1944). Most Burmese words are either monosyllabic or consist of a minor syllable followed by a major syllable. Words longer than two syllables are mostly compounds or loanwords (Green 1995).

1.2 Methods

All data presented below are drawn from a corpus of 280 adaptations comprising 193 established loanword adaptations and 46 non-word adaptations gathered from one main Burmese-English bilingual consultant, as well as 41 additional adaptations from Win (1998) and Green (2005). Non-word adaptations were made online based upon aural input. Examples that come from the data of Win or Green are marked as ‘W’ or ‘G’, respectively.

¹ If nasal vowels are assumed to arise from underlying nasal codas as in Green (1995), then the restriction against nasal vowels co-occurring with glottal stop can be attributed to the presence of only one coda slot in the syllable canon. Here it is simply stipulated that they do not occur with glottal tone, since doing so sacrifices nothing in terms of empirical coverage and does not force us to assume underlying nasal codas. Again, however, the analyses presented below are amenable to either set of assumptions.

Two additional generalizations made by Green (2005) are contradicted by data from native Burmese words and so are not considered further here. First, the diphthongs /ei, ou/ are said to pattern with the diphthongs /ai, au/ by not occurring in open syllables (cf. Cornyn 1944, Win 1998 as well); however, several forms contradict this claim (e.g. /jèi/ ‘water’, /pwéi/ ‘gathering’, /pòu/ ‘to have extra’, /póu/ ‘insect’, /pou/ ‘to send’). Second, the lax vowel /ɛ/ is included in the vowel inventory alongside tense /e/ and is said to occur in open syllables as well as syllables closed by glottal stop; however, /ɛ/ is actually never found to contrast with /e/ in open syllables in either native Burmese or the loanword data examined in this study. This vowel clearly appears to be an allophone of /e/ that occurs in closed syllables.

2 Segmental mapping in loanword adaptation

Where an English word contains a segment absent from the Burmese inventory, the segment in question is generally replaced by the closest correspondent from the Burmese inventory. With regard to consonants, the voiceless labiodental fricative /f/ is almost invariably substituted for by the voiceless aspirated bilabial stop /p^h/ (cf. 1). This pattern of substitution applies regardless of whether /f/ is initial (cf. 1a-b, 1e-f) or medial (cf. 1c-d), holds for either orthographic representation (cf. 1a-d vs. 1e-g), and is the substitution of choice in online adaptation of non-words (cf. 1h).²

- (1) Substitution of Burmese /p^h/ for English /f/ in loanword adaptations
- | | | | | | | | |
|----|-------------|---|---------------------------|----|--------|---|------------------------|
| a. | feeling | > | [p ^h i.lĩ] | b. | film | > | [p ^h ə.lĩ] |
| c. | coffee | > | [kə.p ^h i] | d. | rifle | > | [rài.p ^h è] |
| e. | Philippines | > | [p ^h ilɪ?pàĩ] | f. | phone | > | [p ^h óũ] |
| g. | Sphinx | > | [sə.p ^h ɪ̃] | h. | ‘fote’ | > | [p ^h oũ? |

The voiced labiodental fricative /v/ is usually replaced by a voiced bilabial stop /b/ (cf. 2c-f), which sometimes occurs in a cluster with the labial velar glide /w/ preceding /i/ (cf. 2a-b). Note that there is no similarly restricted distribution of /bw/ in native Burmese. Instead, the complex onset substitution strikes a sort of phonological compromise, essentially “breaking” the fricative into segments lying on either side of it on the sonority hierarchy: /b/ is less sonorous and reflects the obstruency of the fricative, while /w/ is more sonorous and reflects the continuancy of the fricative. In older borrowings, /v/ is replaced by /w/ alone (cf. 2g-h).³

- (2) Substitution of Burmese /b, w/ for English /v/ in loanword adaptations
- | | | | | | | | |
|----|----------|---|----------------|----|------------|---|------------------|
| a. | video | > | [b(w)ì.dì.jə] | b. | T.V. | > | [tìb(w)ì] |
| c. | Harvard | > | [há.bʌʔ] | d. | Chevy | > | [tʰèbì] |
| e. | David | > | [déi.brʔ] | f. | university | > | [jù.nì.bà.sì.tì] |
| g. | Victoria | > | [wì.tòu.rì.jà] | h. | November | > | [nòu.wì̃.bà] |

The voiced palato-alveolar fricative /ʒ/ is consistently devoiced to /ʃ/ (cf. 3a-d).

² The only apparent exception is the word *conference*, which comes out as [kù̃.pə.rì̃] according to Win (1998). This isolated instance of /p/-substitution may be related to the fact that /f/ here is surrounded by consonants, albeit sonorants, on either side (cf. /kɒnfrəns/), which might have the effect of masking or shortening the duration of the lower-frequency noise typical of /f/.

³ A couple of different facts suggest that (2g-h) are older borrowings: the anomalous final creaky tones in (2g), and the class of words to which (2h) belongs – namely, words for months of the year, which generally show different patterns of segmental substitution than the majority of words in the corpus (Chang 2003).

As for tones in loanword adaptations, Wheatley (1987: 836) observes that “the assignment of tones in the process is unpredictable”. This statement is not really true of the laryngealized tones (whose occurrence is largely predictable, as detailed below), but is true of the low and high tones (whose occurrence is not neatly correlated with, e.g., stress – see Chang 2003 for further discussion).

(3) Substitution of Burmese /ʃ/ for English /z/ in loanword adaptations

- | | | | | | |
|--------------|---|-----------------|---------------|---|--------------------|
| a. Indonesia | > | [ʔĩ̃.dòù.ní.ʃá] | b. Malaysia | > | [mə.léí.ʃá] |
| c. Asia | > | [ʔà.ʃá] | d. television | > | [tè.lì.bè.ʃĩ̃] (W) |

Finally, the English rhotic /r/ (typically realized as an alveolar approximant [ɹ]) is either mapped to the palatal glide /j/ (cf. 4a-f) in older adaptations, or mapped to the alveolar flap /r/ (cf. 4g-l) in newer adaptations. There is no apparent conditioning environment for these particular variants, and several words can occur with either.

(4) Substitution of Burmese /j, r/ for English /r/ in loanword adaptations

- | | | | | | |
|-------------|---|-----------------|-------------|---|-------------------------|
| a. radio | > | [jèì.dì.jòù] | b. rum | > | [jà̃] |
| c. Russia | > | [jy.ʃá] | d. crown | > | [kə.jáú̃] (W) |
| e. April | > | [ʔèì.pjì] | f. Andrew | > | [ʔĩ̃.də.jú] |
| g. rubber | > | [rà̃.bà] | h. rifle | > | [rà̃̃.p ^h è] |
| i. steering | > | [sə.tì.jà.rà̃̃] | j. director | > | [dà.raiʔ.tà] |
| k. drum | > | [də.rà̃̃] | l. brake | > | [bə.reiʔ] |

With regard to vowels, the low front vowel /æ/ is replaced by /ɛʔ/ (i.e. /e/ with glottal tone, cf. 5a-b), while the diphthong /ɔi/ is replaced by the sequence /wãĩ/, which always comes out nasalized even in the absence of a nasal in the input (cf. 5c-d).

(5) Substitution of Burmese vowels for English vowels: /æ/ > /ɛʔ/; /ɔi/ > /wãĩ/

- | | | | | | |
|---------|---|---------|------------|---|---------------|
| a. Jack | > | [dʒɛʔ] | b. captain | > | [kɛʔ.pə.tèĩ̃] |
| c. boy | > | [bwãĩ̃] | d. Joy | > | [dʒwãĩ̃] |

The substitutions exemplified in (1)-(5) are the major areas where an English segment is mapped to a significantly different Burmese segment. The rest of the English-to-Burmese segment mappings are fairly straightforward. English voiceless plosives generally correspond to Burmese voiceless unaspirated plosives (cf. 6a,c,e), while English voiceless affricates go to Burmese voiceless aspirated affricates (cf. 6g). English voiceless fricatives are mapped to Burmese voiceless fricatives (cf. 6l,n), with English /s/ going to Burmese aspirated /s^h/ before most unreduced vowels (cf. 6k). English voiced obstruents generally correspond to Burmese voiced obstruents (cf. 6b,d,f,h,j,m). Nasals (cf. 7a-b), laterals (cf. 7c), and glides (cf. 7d-f) remain essentially unchanged.

(6) Mapping of English obstruents to Burmese obstruents

a. Poland	>	[pòù.là̃]	b. bomb	>	[bóú̃]
c. tire	>	[tà.jà]	d. dollar	>	[dò.là]
e. king	>	[kí̃]	f. guitar	>	[gì.tà]
g. chocolate	>	[tʰó.kə.léʔ]	h. Germany	>	[dʒà.mə.nì]
i. Ethiopia	>	[ʔì.tθì.jó.pí.já]	j. Netherlands	>	[nè.ðà.là̃]
k. size	>	[sʰaiʔ]	l. stage show	>	[sə.teiʔ.ʃóú]
m. Mazda	>	[mà.zə.dà]	n. hamburger	>	[hà̃.bà.gà]

(7) Mapping of English sonorants to Burmese sonorants

a. May	>	[mèi]	b. national	>	[nèi.ʃí.nè]
c. liberty	>	[li.bà.tì]/[lè.bà.tì]	d. wine	>	[wàĩ]
e. queen	>	[kwí̃]	f. Toyota	>	[tòù.jòù.tà]

As for the rest of the vowels, English tense vowels generally correspond to phonetically non-short Burmese vowels – that is, vowels with non-short tones (cf. §1.1.1, Fig. 3). These may be tense monophthongs (cf. 8a-b) or tense diphthongs (cf. 8c-d).

(8) Mapping of English tense vowels to non-short Burmese vowels

a. CD	>	[sì.dì]	b. university	>	[jù.nì.bà.sì.tì]
c. B.A.	>	[bì.ʔèi]	d. Coca-Cola	>	[kòù.kà.kòù.là]

On the other hand, English lax vowels are represented either by phonetically short or phonetically non-short Burmese vowels. Lax vowels followed by a nasal coda are mapped to phonetically non-short vowels (cf. 9b,h), as are the longer lax vowels /ɑ, ɔ/ (cf. 9i-j). When not followed by a nasal coda, the lax vowels /ɪ, ε, æ, ʌ, ʊ/ are sometimes mapped to phonetically non-short vowels (cf. 9a,c), but more often they are mapped to phonetically short vowels – typically those with glottal tone, which has the effect of laxing/centralizing the host vowel (cf. 9b,d,e,f,g).

(9) Mapping of English lax vowels to short or non-short Burmese vowels

a. cigarette	>	[sí.kə.réʔ]	b. Living Color	>	[lɪʔ.bí̃.kà.là]
c. sweater	>	[sʰwè.tà]	d. B.Sc.	>	[bì.ʔéʔ.sì]
e. jacket	>	[dʒéʔ.kéʔ]	f. ‘vood’ (/ʊ/)	>	[bʊʔ]
g. bus + car	>	[bʌʔ.sə.ká]	h. number	>	[nà̃.bʌʔ]
i. car	>	[ká]	j. Johnny	>	[dʒò.nì]

The low diphthongs /ai, au/ retain essentially the same quality (cf. 4d, 6k, 7d), while final schwa is always turned into a full vowel, whether in an open syllable (e.g. 2g, 3a-c, 6i,m, 7f, 8d) or a closed syllable (e.g. 2c, 6a,j).

3 The treatment of marked structures

3.1 Coda consonants

In the previous section, several patterns of English-to-Burmese segment mappings were laid out. The vowel mappings apply quite generally, but the consonant mappings are mostly restricted to onset position; the treatment of coda consonants differs greatly from the treatment of onset consonants shown above. Coda obstruents, for example, are consistently debuccalized to the glottal stop occurring with glottal tone (cf. 10); they are almost never salvaged via vowel epenthesis.

(10) Adaptation of English coda obstruents with Burmese glottal tone

a. make-up	>	[meiʔ.kʌʔ]	b. September	>	[sɛʔ.tĩ̃.bà]
c. Tibet	>	[t̃i.bɛʔ]	d. cigarette	>	[sí.kə.rɛʔ]
e. cake	>	[keiʔ]	f. Jack	>	[dʒɛʔ]
g. club	>	[kə.lʌʔ]	h. card	>	[kaʔ]
i. plague	>	[pə.leiʔ]	j. March	>	[maʔ]
k. clutch	>	[kə.lʌʔ]	l. college	>	[kɔ́.leiʔ]
m. police	>	[pə.leiʔ]	n. gas	>	[gɛʔ]
o. size	>	[s ^h aiʔ]	p. English	>	[ʔĩ̃.gə.leiʔ]
q. Joseph	>	[dʒóú.s ^h ɛʔ]	r. Elizabeth	>	[ʔì.lɪʔ.zə.bɛʔ]

This debuccalization occurs regardless of voicing, with both voiced and voiceless segments being debuccalized (cf. 10a-f vs. 10g-i); regardless of place of articulation, with bilabials (cf. 10a-b), alveolars (cf. 10c-d), post-alveolars (cf. 10k,l,p), and velars (cf. 10e-f) all being debuccalized; and regardless of manner of articulation, with plosives (cf. 10a-i), affricates (cf. 10j-l), and fricatives (cf. 10m-r) all being debuccalized as well. This last result is especially noteworthy because the fricatives in (10m-p) belong to the perceptually salient class of sibilants, often exempt from neutralization or deletion processes that apply to other types of foreign segments in loanword adaptation (e.g. /s/ is given special treatment in Cantonese loanword adaptation, cf. Silverman 1992).

Coda sonorants are also treated differently from onset sonorants. Coda nasals at all places of articulation are realized as nasalization on the preceding vowel, both word-medially (cf. 11a,c,e) and word-finally (cf. 11b,d,f). Coda laterals, on the other hand, are simply deleted (cf. 12).⁴

⁴ As for coda rhotics, the history of British colonial rule in Burma/Myanmar suggests that the variety of English in closest contact with Burmese was a dialect of British English, in which case coda rhotics were most likely absent in the input to loanword adaptation.

(11) Adaptation of English coda nasals with Burmese nasal vowels

- | | | | | | |
|--------------|---|-------------|------------|---|-------------------------|
| a. champagne | > | [ʃã̃.péĩ] | b. rum | > | [jã̃] |
| c. auntie | > | [ʔã̃.tĩ] | d. Spain | > | [sə.pèĩ] |
| e. Singapore | > | [sĩ.gà.pù] | f. feeling | > | [p ^h ĩ.lĩ] |

(12) Deletion of English coda laterals

- | | | | | | |
|-----------|---|-----------|------------|---|--------------|
| a. April | > | [ʔèi.pjì] | b. e-mail | > | [ʔí.méi] |
| c. Nicole | > | [nĩ.kóú] | d. bicycle | > | [bàĩ.sə.kè] |

3.2 Consonant clusters

The differential treatment of codas and onsets illustrated in the previous section is reflected in a similar dichotomy between coda cluster resolution and onset cluster resolution. Consonant clusters in onset position are broken up via schwa epenthesis (cf. 13), while consonant clusters in coda position are simplified, like singleton codas, by debuccalization and deletion (cf. 14).

(13) Resolution of onset clusters via vowel epenthesis

- | | | | | | |
|-----------|---|------------------|------------|---|--------------|
| a. glider | > | [gə.laiʔ.dà] (G) | b. England | > | [ʔĩ.gə.lã̃] |
| c. Sprite | > | [sə.pə.jaiʔ] | d. disco | > | [dɪʔ.sə.kòù] |

(14) Resolution of coda clusters via debuccalization and deletion

- | | | | | | |
|-------------|---|-----------|----------------|---|--------------------|
| a. August | > | [ʔð.gouʔ] | b. Quaker Oats | > | [kwèi.kà.ʔouʔ] |
| c. golf | > | [gauʔ] | d. Egypt | > | [ʔĩ.dʒɪʔ] |
| e. 'lasked' | > | [laʔ] | f. Charles | > | [t ^h á] |

Onset clusters that are permitted in Burmese (i.e. certain stop-glide clusters) are adapted faithfully with no epenthesis into the cluster (cf. 7e, 9c, 14b).

4 Clarifying the status of distributional gaps

In §1.1.2, several phonotactic gaps in Burmese were identified that seemed like they could simply be accidental. For instance, only three of the five Burmese monophthongs have nasal counterparts; /e, ɔ/ do not occur nasalized. Why should this be? It is not possible to conclude on the basis of this static pattern that there is a constraint against nasal mid vowels since there is no way to tell whether this distribution is the result of a systematic ban or a historical accident. On the other hand, loanword data help adjudicate between these two possibilities. As seen in (15), English words containing sequences of /ɛ/ or /ɔ/ and a coda nasal are altered in a variety of ways instead of being mapped to /ẽ/ or /õ/, indicating that a constraint against nasal mid vowels is active in the grammar. The gap is systematic and causes the vowel to be raised (cf. 15a-c) or diphthongized (cf. 15d).

(15) Avoidance of nasal mid vowels in loanword adaptations

- | | | | | | |
|-------------|---|---------------|-------------|---|--------------|
| a. November | > | [nòù.wĩ̀.̀bà] | b. December | > | [dì.zĩ̀.̀bà] |
| c. John | > | [dʒũ̀] | d. form | > | [pʰàũ̀] |

The low diphthongs provide another example of this sort of distributional gap. While the mid diphthongs /ei, ou/ are allowed in open syllables, the low diphthongs /ai, au/ only occur with coda glottal stop. There is no clear phonetic reason for this kind of distribution, so it could simply be the accidental result of layers of historical change (its origins are in fact historical, cf. Wheatley 1987). Again, however, this gap turns out to be systematic and the result of constraints whose effects can be plainly seen in loanword adaptations. In order to avoid a low oral diphthong in an open syllable, either a coda glottal stop is inserted (cf. 16a-c) or the diphthong is nasalized (cf. 16d-j).

(16) Avoidance of low oral diphthongs in open syllables in loanword adaptations

- | | | | | | |
|------------|---|------------------|---------------|---|---------------------|
| a. glider | > | [gə.laiʔ.dà] (G) | b. typhoon | > | [taiʔ.pʰũ̀] (G) |
| c. Michael | > | [maiʔ.kè] | d. cyclone | > | [sʰàĩ.kə.lóú̃] (G) |
| e. bicycle | > | [bàĩ.sə.kè] | f. Diana | > | [dàĩ.jà.nà] |
| g. diary | > | [dàĩ.jà.jì] | h. Thai(land) | > | [tʰáĩ] |
| i. style | > | [sə.tàĩ] | j. powder | > | [pàũ̀.dà] |

Glottal stop codas are yet another example. They have an asymmetrical distribution, co-occurring with high vowels, low vowels, and the mid front vowel /e/, but never with the mid back vowel /ɔ/. Given this negative evidence, we might hypothesize that there is a constraint in the language against mid back vowels before tautosyllabic glottal stops, and this hypothesis is confirmed by positive evidence from loanword data. English words containing sequences of /ɔ/ and a coda obstruent are altered in a variety of ways rather than being mapped to ɔʔ]₆, indicating that a constraint against mid back vowels before coda glottal stop is active in the grammar. In (17a), the vowel is raised; in (17b), it is diphthongized; and in (17c-e), creaky tone is used instead of glottal tone as the strategy for adapting the coda obstruent.

(17) Avoidance of mid back vowels before coda glottal stop in loanword adaptations

- | | | | | | |
|------------|---|-----------|-------------|---|--------------|
| a. Ford | > | [pʰʊʔ] | b. New York | > | [nə.jú.jauʔ] |
| c. George | > | [dʒɔ̣] | d. Scott | > | [sə.kɔ̣] |
| e. hot dog | > | [hɔ̣.dɔ̣] | | | |

Finally, nasal vowels are associated with a distributional gap as well. Though they occur with low, high, and creaky tones, they never occur with glottal tone, and this phonotactic restriction is reflected in the adaptation of English words with coda clusters comprising a coda nasal and a (voiceless) coda obstruent. Since the coda nasal must be rendered with a nasal vowel, creaky tone is used instead of glottal tone to represent the coda obstruent (cf. 18), in similar fashion to the alternate adaptation strategy used to

represent coda obstruents following mid back vowels (cf. 17c-e). On the other hand, in ND(Z)]_σ clusters the voiced obstruents are simply deleted (e.g. 1e, 6a,j, 13b).

(18) Avoidance of glottal tone with nasal vowels in loanword adaptations

- a. Sphinx > [sə.p^hĩ] b. count > [kãũ]

5 An Optimality-Theoretic analysis of loanword adaptation in Burmese

The phonological restrictions of Burmese that apply to the adaptation of English borrowings are simple to formalize and analyze in the constraint-based framework of Optimality Theory (henceforth, OT: Prince and Smolensky 1993/2004). The central tenet of OT is that surface outputs result from the interaction of markedness constraints against disfavored structures and faithfulness constraints against departures from the input, with the form of the ultimate output depending on how well it satisfies the most important (i.e. highest ranking) constraints in the phonology. From the loanword data presented above, we can deduce that there are several constraints against illicit structures. These markedness constraints are summarized in (19). For details on the formalisms, see Kager (1999).

(19) Markedness constraints active in loanword adaptation

- a. *NOONSET: ‘Syllables are not onset-less.’
- b. *CODA[place]: ‘Coda consonants do not have an oral place of articulation.’
- c. *COMPLEXONSET: ‘Onsets are not complex.’
- d. *COMPLEXCODA: ‘Codas are not complex.’
- e. *Õ: ‘Mid vowels are not nasal.’
- f. *ai/au]_σ: ‘Low oral diphthongs do not occur in open syllables.’
- g. *O?]_σ: ‘Mid back vowels do not occur with glottal tone.’
- h. *Ã?]_σ: ‘Nasal vowels do not occur with glottal tone.’
- i. *ə(C)]_{PrWa}: ‘Minor syllables do not occur word-finally.’

These markedness constraints are counterbalanced by a set of faithfulness constraints penalizing alterations to the input. These faithfulness constraints are summarized in (20) and fall into three main families of constraints: DEP(ENDING), militating against additions to the input; MAX(MIMIZE), militating against subtractions from the input; and IDENT(ITY), militating against featural changes to the input.

- (20) Faithfulness constraints active in loanword adaptation
- DEP**: ‘Output segments have input correspondents (i.e. no epenthesis).’
 - MAX-ONSET**: ‘Input onsets have output correspondents.’
 - MAX-CODA**: ‘Input codas have output correspondents.’
 - MAX[nasal]**: ‘An input [+nasal] feature corresponds to some output [+nasal] feature (i.e. no denasalization).’
 - IDENT[tense]**: ‘Tense vowels stay tense; lax vowels stay lax.’
 - IDENT[place]**: ‘Input segments keep the same specification for [place] in the output (i.e. no debuccalization, no changing of place).’

In general, the markedness constraints dominate the faithfulness constraints (M » F), resulting in changes to the marked structure in the input. For example, it is worse to have a syllable without an onset (cf. 19a) than it is to insert a new segment into the output (cf. 20a), which leads to the winning output candidate having a glottal stop onset in (21).

(21)	/bi.ɛs.si/ ‘B.Sc.’	*NOONSET	DEP
a.	bì.ɛʔ.sì	*!	
☞ b.	bì.ʔɛʔ.sì		*

Furthermore, it is worse for coda consonants to have an oral place of articulation (cf. 19b) than it is to delete the place specification of an input segment (cf. 20f), which leads to another possible output for /bi.ɛs.si/ ‘B.Sc.’ losing in (22).

(22)	/bi.ɛs.si/ ‘B.Sc.’	*CODA[place]	IDENT[place]
a.	bì.ʔɛs.sì	*!	
☞ b.	bì.ʔɛʔ.sì		*

Consonant clusters are always repaired, suggesting that constraints (19c-d) are undominated.⁵ Onset clusters in particular are repaired by epenthesis rather than deletion. In other words, it is worse to delete onset segments to resolve a cluster (cf. 20b) than it is to insert vowels to save onset segments, which leads to the ranking seen in (23).

⁵ This is not exactly right, as certain stop-glide clusters are in fact allowed (cf. §1.1.2). The ban in (19c) is analyzed as more general here only to simplify the OT formalization.

(23)	/glai.də/ 'glider'	*COMPLEXONSET	MAX-ONSET	DEP
a.	glaiʔ.dà	*!		*
☞ b.	gə.laiʔ.dà			**
c.	laiʔ.dà		*!	*
d.	gaiʔ.dà		*!	*

On the other hand, coda clusters are resolved by deletion rather than epenthesis. It is worse to insert vowels to save coda segments than it is to delete coda segments (cf. 20c). This ranking is shown in (24).

(24)	/i.dʒɪpt/ 'Egypt'	*COMPLEXCODA	DEP	MAX-CODA
a.	ʔi.dʒɪʔʔ	*	*!	
b.	ʔi.dʒɪ.pə.tə		**!*	
c.	ʔi.dʒɪ.pə		**!	*
☞ d.	ʔi.dʒɪʔ		*	*
e.	ʔi.dʒɪ		*	**!

Returning to the case of *glider* in (23), the constraint $*[ai/au]_{\sigma}$ and the constraint $*\emptyset(C)_{PrWd}$ prevent other possible outputs from surfacing. It is worse to have a low oral diphthong in an open syllable or a minor syllable at the end of a word than it is to insert (coda) segments or to change the place of a vowel (cf. 25-26).

(25)	/glai.də/ 'glider'	*[ai/au] _σ	DEP
a.	gə.lai.dà	*!	
☞ b.	gə.laiʔ.dà		*

(26)	/glai.də/ 'glider'	*∅(C) _{PrWd}	IDENT[place]
a.	gə.laiʔ.də	*!	
☞ b.	gə.laiʔ.dà		*

Constraint (19h) against nasal vowels with glottal tone appears to be undominated as well. It is worse for this structure to appear in the output than it is to delete the input coda obstruent ($*\tilde{A}ʔ_{\sigma} \gg \text{MAX-CODA}$), and deletion of the coda obstruent is preferred as the repair to this structure over denasalization ($\text{MAX}[\text{nasal}] \gg \text{MAX-CODA}$), cf. (27).

(27)	/kaunt/ 'count'	* $\tilde{A}?$] _{σ}	MAX[nasal]	MAX-CODA
a.	kãũ?	*!		*
b.	kau?		*!	*
☞ c.	kãũ			**

However, given that the correspondent of the coda obstruent is deleted, there is actually a choice among three tones for the vowel. In this case, creaky tone is usually chosen over high or low tone, since the perceptual distance between an English ANT] _{σ} sequence (where the sonorant portion is likely to be significantly laryngealized in anticipation of the final voiceless closure) and a Burmese nasal vowel with creaky tone is smaller than that between the same sequence and a Burmese nasal vowel with high or low tone. In OT these relationships of perceptual similarity are encoded in terms of intrinsically ranked correspondence constraints pairing segments or structures that are perceptually more vs. less similar to each other (cf. Steriade 2001). A subset of the correspondence constraints that are relevant in the above case is shown in (28).

- (28) Subset of correspondence constraints responsible for adaptation of English ANT] _{σ}
- *CORR(ANT] _{σ} ~ \tilde{A}): 'A vowel + nasal + voiceless obstruent sequence in the input does not correspond to a nasal vowel with creaky tone in the output.'
 - *CORR(ANT] _{σ} ~ \tilde{A}): 'A vowel + nasal + voiceless obstruent sequence in the input does not correspond to a nasal vowel with high tone in the output.'
 - *CORR(ANT] _{σ} ~ \tilde{A}): 'A vowel + nasal + voiceless obstruent sequence in the input does not correspond to a nasal vowel with low tone in the output.'

Of these three constraints, *CORR(ANT] _{σ} ~ \tilde{A}) is ranked lowest, since the substitution of a creaky nasal vowel for ANT] _{σ} represents the smallest departure from the input (cf. 29).

(29)	/kaunt/ 'count'	*CORR(ANT] _{σ} ~ \tilde{A})	*CORR(ANT] _{σ} ~ \tilde{A})	*CORR(ANT] _{σ} ~ \tilde{A})
☞ a.	kãũ			*
b.	káú~	*!		
c.	kàù~		*!	

As for the treatment of mid vowels, formalized in (19e) and (19g) are constraints against nasal mid vowels and mid back vowels before coda glottal stop, structures which are both illicit in Burmese. Loanword data reveal that preserving either of these structures is worse than altering the place of the input vowel (cf. 30-31).

(30)	/dʒɔn/ ‘John’	* \tilde{O}	IDENT[place]
	a.	dʒɔ̃	*
	b.	dʒɔ̄	*

(31)	/fɔ:d/ ‘Ford’	* $O?$ _σ	IDENT[place]
	a.	p ^h ɔʔ	*
	b.	p ^h uʔ	*

However, changing the quality of the vowel is not the only possible repair for the configuration of a mid back vowel before coda glottal stop; deletion of the coda is also attested. Thus, fixing this structure also appears to be more important than preserving coda segments (* $O?$ _σ » MAX-CODA). In the present analysis, this variation in repair strategies is modeled by keeping MAX-CODA and IDENT[place] unranked with respect to each other. As shown in (32), this allows both the candidate with coda deletion and the candidate with vowel quality changes to emerge as possible winners.

(32)	/skɔt/ ‘Scott’	* $O?$ _σ	MAX-CODA	IDENT[place]
	a.	sə.kɔʔ	*	*
	b.	sə.kɔ	*	*
	c.	sə.kuʔ	*	*

What determines which of these candidates ultimately wins, then, is the ranking of perceptually based correspondence constraints similar to those in (28). In the case of *Ford*, [uʔ] is apparently a closer match for the rhyme than [ɔ] (*CORR([ɔ:d]~[ɔ]) » *CORR([ɔ:d]~[uʔ])). On the other hand, in the case of *Scott*, [ɔ] is a closer match for the rhyme than [uʔ] (*CORR([ɔt]~[uʔ]) » *CORR([ɔt]~[ɔ])).

Vowel quality is quite faithfully adapted otherwise. Lax vowel quality is maintained, even though doing so often requires inserting new segments not present in the input (i.e. IDENT[tense] » DEP, cf. 33).

(33)	/li.vɪŋ.kə.lə/ ‘Living Color’	IDENT[tense]	DEP
	a.	lí.bí̃.kà.là	*
	b.	líʔ.bí̃.kà.là	*

In addition, tense vowel quality is maintained in obstruent-final syllables, though it is lax in nasal-final syllables. In other words, maintaining vowel tenseness (cf. 20e) is more important than representing an input (obstruent) coda, but less important than representing input nasality (cf. 20d): MAX[nasal] » IDENT[tense] » MAX-CODA, cf. (34)-(35).

through vowel epenthesis, while consonant clusters in syllable codas are repaired through consonant deletion. Finally, phonotactic gaps native to Burmese are maintained in loanwords via a number of different strategies even when they do not have clear phonetic motivations. Thus, the data in the present study indicate that the adaptation of English loanwords in Burmese is severely restricted by the constraints of Burmese phonology.

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